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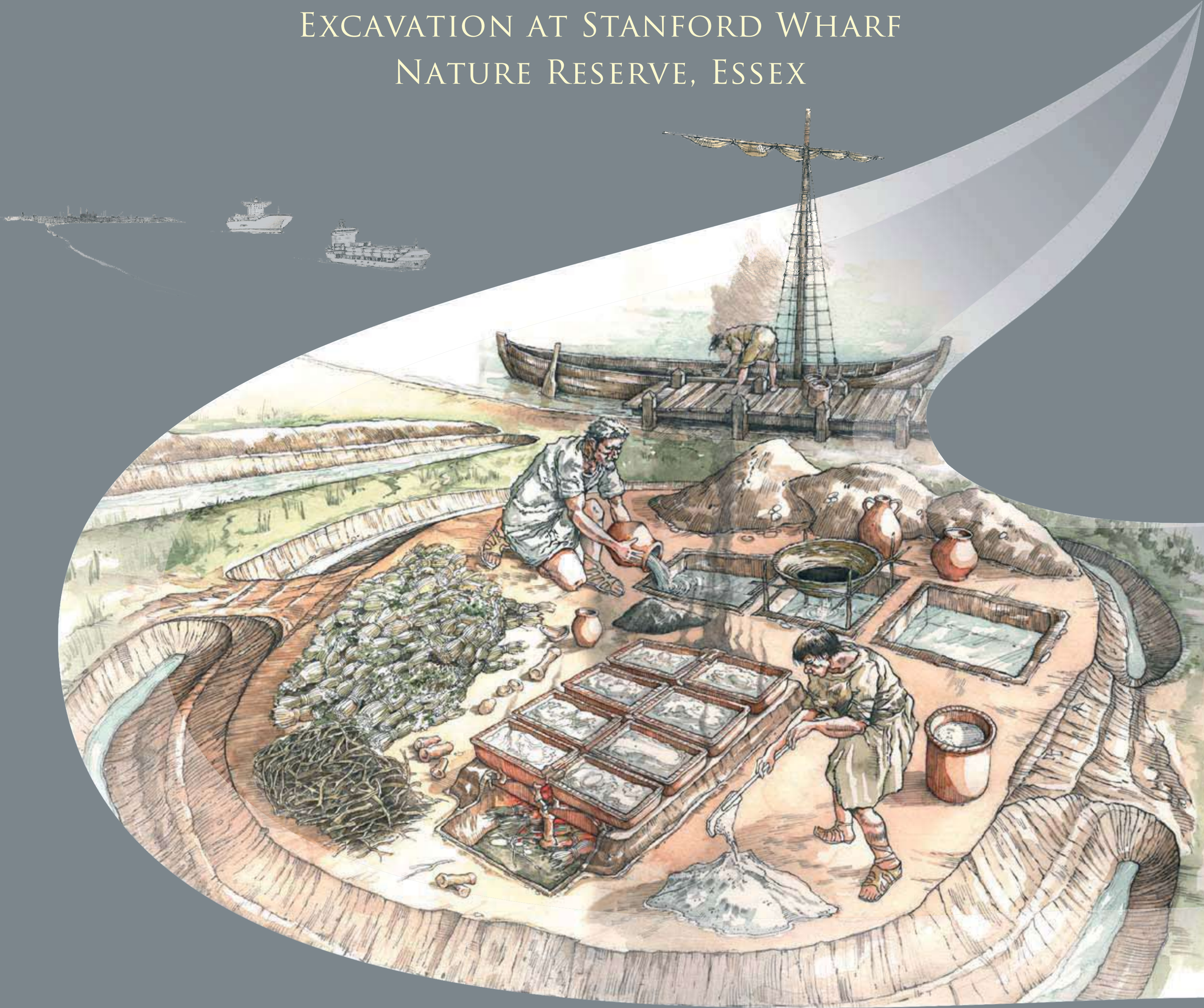
Iron Age and Roman Salt Making in the Thames Estuary

Excavation at Stanford Wharf Nature Reserve, Essex



Specialist Report 24

SOIL MICROMORPHOLOGY AND MICROCHEMISTRY[1], CHEMISTRY AND MAGNETIC SUSCEPTIBILITY[2], AND FTIR[3]

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STANFORD WHARF, ESSEX (LONDON GATEWAY COMPENSATION SITES A AND B; COMPA 09): SOIL MICROMORPHOLOGY AND MICROCHEMISTRY[1], CHEMISTRY AND MAGNETIC SUSCEPTIBILITY[2], AND FTIR[3]

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EXTENDED SUMMARY

49 thin sections were studied employing soil micromorphology and associated SEM/EDS (Energy Dispersive X-Ray Spectrometry), X-Ray microprobe and FTIR (Fourier Transform Infrared Spectrometry). 24 carefully correlated bulk samples from the same monolith sequences also provided complementary chemical and magnetic susceptibility data, including information on organic matter (LOI), phosphate, salinity (specific conductance) and heavy metals (Cu, Pb and Zn). *Sequence 1* records the effects of marine inundation on the Neolithic and Bronze Age palaeosols formed in brickearth. Salt water sodium ions (Na^{++}) led to soil dispersion and structural collapse. This did not affect large charcoal and flint flakes within the soil, but finer charcoal and surface charcoal were probably liberated and floated locally. The uppermost soil was truncated, and this charcoal-rich material formed basal laminae in the marine alluvium. Truncated and marine inundation-transformed Holocene palaeosols were found elsewhere for example under redhill sequence 16. *Anthropogenic reference materials* associated with salt making were analysed ahead of studying the anthrosols and redhill deposits. ‘White nodules’ are vesicular siliceous glass bodies, occurring as either hollow circular nodules that are partially pseudomorphic of monocotyledonous plant stems and leaves, or as more strongly melted aggregates. These develop from plant silica (opal) usually in the form of phytoliths, and partially melted and fused phytoliths are ubiquitous at Stanford Wharf. Plant opal has a much lower melting point compared to quartz. These white nodules are thus a form of fuel ash formed by the combustion of monocotyledonous plants, and differ from siliceous fuel ash formed from wood, for example. Examples of ‘green glaze’ on briquetaage were also analysed. The briquetage is ‘manufactured’ from estuarine sediments with a mica-smectite clay component. Sections through the green glaze briquetage record the increasing effects of heat upwards causing, 1) ‘rubefication’ (400°C - <700°C), with the

upper blackened part being more strongly heated (>700 °C). The green glaze itself is a strongly heated silicate glass (minimum 700-800°C to around/below 1000°C). The dominantly siliceous glaze contains statistically significant greater quantities of Na (sodium), P (phosphorus) and Fe (iron) compared to the briquetage. Fe possibly gives it a greenish colour, and P is probably concentrated from burned fuel. It is possible that Zn (zinc) may also have a similar origin (marine plants and sediment may have concentrated Zn from sea water). Amounts of Na are anomalously high but diminish away from the glaze surface; this can be viewed as supporting a salt (NaCl) making origin for this green-glazed bricqutage. The distribution of Cl (chlorine) shows a similar pattern, but as the resin embedding the briquetage include Cl, such findings must be viewed with much more caution. *Anthrosol sequence 6* is largely composed of briquetage debris and fused phytolith-rich fuel ash waste, which also contains many 'white nodules'. This is reflected in their high phosphate and magnetic susceptibility values; notably high Zn values may again possibly be associated with marine wetland plant fuel concentrating Zn for sea water. These anthrosols form exterior space-trampled and mesofauna-worked accumulating spreads. They also include interdigitated marine alluvium showing that they are still located in the intertidal zone; they display the highest specific conductance ('salinity') values at Stanford Wharf. Conceptually, these anthrosols can be regarded as a special form of Roman 'dark earth'. *Romano-British round house sequences 14-17*, show that the outer ditch was cut into marine clay, where waterlain fills developed; a basal layer included laminated byre waste, indicating animal management, and debris of burned hearth and kitchen (e.g. fish bone) origin. Here, and in the inner ditch where natural alluviation predominates, human cess and coprolitic waste again indicate domestic occupation. The settling tanks were cut into brickearth and lined with marine alluvial clay. Lower, microlaminated waterlain fills, which also include cess traces, confirm that these settling tanks held water. The upper fills, however, are dominated by phytolith and fused phytolith-rich monocotyledonous fuel ash waste; burned byre floor waste was also found suggesting that this material could also have been employed as a slow-burning fuel, as well as confirming the local stabling of stock. The very high phosphate levels in these deposits also results from the presence of latrine waste; such installations often have a secondary 'cess pit' use. The round house hearth was constructed employing brickearth 'clay', supported by a layer of possible sea rush leaves (*Juncus maritimus*; see Turner, this vol); a cob- or lime plastered-brickearth may have lined the hearth. The loose fill of the hearth was mainly composed of monocotyledonous fuel ash waste (siliceous vesicular white nodules, fused phytoliths, charred monocotyledonous remains) and burned hearth remains (strongly burned brickearth and sands). Again, notably high phosphate concentrations in part reflects inputs of cess dumped into the hearth. Lastly, very small lead enrichment of the charred sea rush liner may infer the possibility of use of lead vessels, but very much more convincing evidence was found at Sequence 21. *Redhill sequence 19* examined a profile and lateral examples of deposits dominantly composed of red burned mineral material that have the highest magnetic susceptibility values at Standofrd Wharf. Sometimes this was in the form of briquetage employing marine clay and or brickearth, but mainly redhill is predominantly made up of burned salt marsh sediment which had been incidentally gathered alongside marine wetland plant fuel. Fragments often show relict root channels that formed in this vegetated ripening sediment; rare examples may preserve algal stained laminae typical of modern salt marsh sedimentation. Thus redhills probably formed rapidly due to the dumping of minerogenic fuel ash waste, a formation process similar to farm mound accumulations where minerogenic peat was used as a fuel. Redhills also include more fragile phytolith-fuel plant ash waste, and this has been burrowed by mesofauna. General fragmentation occurred because the spreads formed ephemeral trampled 'occupation surfaces'; marine clay inwash also occurred at times. *Floors in Late Roman building Sequence 21* found on-site estuarine sediments to be strongly influenced by occupation deposits including latrine waste, and a series of beaten floor deposits formed in the structure under generally moist conditions. The latter also record alternating: 1) hearth and kitchen waste from internal trampling, and 2) incorporation of alluvial clay from outside. More importantly very high lead enrichment (3580 $\mu g\ g^{-1}$ Pb) was found to be associated with 'iron' staining of the floors (EDS maximum 54.1% Pb), clearly indicating use of lead vessels, as suggested for late Roman salt making. Small amounts of Sn (tin) imply other metal vessels may have been used here. *Sequence 22, Late Roman deposition near Late Roman buildings*, is composed of layered deposits that include sands, brickearth and domestic hearth, kitchen and latrine waste. It can be suggested that these are trampled floor sweepings. *Sequence 23, the brickearth quarry pit* was possibly a wood-lined well or salt water sump, used after the extraction of brickearth for constructional and manufacturing purposes formed a pit. Pyrite at the base testifies to its waterlogged nature. The yellow colour of the fill around bark-covered wood is due to the formation of jarosite (iron potassium sulphate), which forms in marine acid sulphate soils, developing as a reaction product of weathering pyrite and K-bearing deposits. Ash dumping in the pit, as indicated by a large 'white nodule', may have provided this potassium. The report is supported by 7 tables, 136 figures and a DVD archive of thin section scans, photomicrographs and instrumental data.

INTRODUCTION

During 2009-2010, auger boring, trench excavation, and post-excavation assessment of Stanford Wharf, Thames Estuary, Essex (COMPA 09) took place. This included field visits by Macphail (2009), and geoarchaeological, environmental and archaeological investigations and assessment by Oxford Archaeology South (e.g., Edward Biddulph, Chris Carey, Stuart Foreman, and Rebecca Nicholson) and specialists. Following an assessment meeting in January 2011 and a pilot study of three monoliths (4 thin sections), the soil micromorphological and associated investigations focused upon:

1) The Bronze Age coastal landscape and the effects of mid-Holocene marine inundation (Geoarchaeology Sequence 1), and,
2) Romano-British salt production, in relationship to:
    a. Anthrosols, and Roundhouse features (outer ditch, inner ditch, settling tanks and hearth)(Geoarchaeological Sequences 6, 14-17, respectively), and
    b. Redhill deposits (Geoarchaeology Sequence 19),
3) Late Roman structures and deposits (Late Roman building floors, deposits and 'cess' pit)(Geoarchaeology Sequences 21-23, respectively).

In addition to the study of these 10 geoarchaeological sequences (No's 1, 6, 14, 15, 16, 17, 19, 21, 22 and 23), a reference series of four examples of 'white nodules' (glassy slags) from four Roman-Mid Roman hearth installations were included in the study (including SEM/EDS), alongside 'green glaze' examples from a Late Roman ditch (4226). The 'green glaze' came under special scrutiny (SEM/EDS, microprobe and FTIR)(see Methods).

METHODS

In total, 20 monolith cores were selected for study and subsampling, from which 41 thin sections were manufactured, and 24 bulk samples were taken that exactly correlate to contexts being studied in thin section. In addition, 4 thin sections of 'white nodules' and 4 thin sections of 'green glaze' were made (2 specific subsample duplicates being employed for FTIR). Thus 49 thin sections were made in all. The 24 bulk subsamples were sent to John Crowther at Trinity St Davids, Lampeter and 2 thin sections of 'green glaze' were forwarded to Francesco Berna to Boston University.

Chemistry and magnetic susceptibility (bulk samples)

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 (i.e. phosphate-P_i:P and phosphate-P_o:P, respectively). LOI (loss-on-ignition) was determined by ignition at 375^{o}C 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. Unfortunately, the samples were too small to enable specific conductance to be determined on saturation extracts. Instead, conductance was determined on a 1:10 (soil:water) solution, which provides a broad indication of salinity (i.e. concentration of soluble salt).

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).

FT-IR Microspectroscopy (μFTIR)

Thin sections GAT-4240/A2 and /B2 were lapped with 6μm lapping film and analyzed by FTIR microspectroscopy using a Thermo-Nicolet Continuum IR microscope attached to a Nexus 470 IR spectrometer. Spectra of particles and areas with diameter of about 150 μm were collected with ATR diamond objective, and with a Reflectocromat 15x objective in Transmission and Total Reflectance mode.

Soil micromorphology (with EM/EDS and Microprobe)

The 20+ monolith were assessed and 20 of these were subsampled (Tables 3 and 7) and impregnated with a clear polyester resin-acetone mixture (e.g. Figs 86-87, 109); 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)(e.g. Figs 31, 36, 48). The 49 thin sections were further polished with 1,000 grit papers, scanned with a flatbed scanner, and 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. Specific inclusions from 7 selected thin sections were analysed for microchemistry employing SEM/EDS (Energy Dispersive X-Ray Spectrometry)(Table 4, e.g. Figs 227-28, 121-122). In addition, thin section sample 4240A1 was analysed in detail employing microprobe (element mapping at two scales; two quantitative line analyses)(parallel study to FTIR investigation of 4240A2 and 4240B2).

Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs)(see Tables 3 and 7), and counted according to established methods (Bullock et al., 1985; Courty, 2001; Courty et al., 1989; Macphail and Cruise, 2001; Stoops, 2003). Previous investigations of inundated coastal site, and experimental studies at Wallasea Island (Crouch River, Essex), along with current catalogues of anthropogenic materials found in thin section, were also utilised (Macphail, 1994b, 2009; Macphail et al., 2010; Macphail and Goldberg, 2010; Wilkinson and Murphy, 1995; Wilkinson et al., 2012).

RESULTS

Chemistry and magnetic susceptibility (bulk samples)

Results are first presented as overviews. Individual results different sequences/contexts are then evaluated.

Loss-on-ignition (LOI)

There is quite marked variability in LOI (range, 1.20–16.7%). 13 of the 24 samples have a very low LOI (< 3.00%). Samples with higher LOI values (highlighted in Table 1) reflect greater inputs of organic matter (including charcoal) and/or slower rates of organic decomposition, the latter being typically associated with poorly drained conditions.

Specific conductance

Specific conductance (1:10, soil:water) ranges from 129-2080 µS. Three samples (highlighted in Table 1) stand out as being notably more saline than the others. Such accumulation of soluble salts is likely attributable either to a greater marine influence during sedimentary accretion or accumulations associated with salt-making (which is known to have taken place at the site). It should be noted that soluble salts are vulnerable to leaching and reprecipitation within sedimentary sequences. The specific conductance data therefore need to be interpreted with some degree of caution.

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

The phosphate-P concentrations recorded display very wide variability (range, 0.820–18.9 mg g^{-1}). 11 of the 24 samples would appear to show some degree of phosphate enrichment, ranging from 'enriched' to 'very strong enriched' (as detailed in Table 1). Some of the enrichment might be associated with organic phosphate sources. Indeed, 10 of the 11 enriched samples also have notably higher LOI values. However, phosphate-P concentrations of ≥ 10.0 mg g^{-1} are exceptionally high and in these cases it seems likely that bone-derived phosphate is also present (since bone is a very rich phosphate source). As is typically the case in phosphate-enriched archaeological contexts, the majority of the phosphate is present in inorganic forms (phosphate-P_i:P range, 73.0–95.8%; Table 2). This reflects the fact that even in cases where organic phosphate sources are dominant, much of the organic phosphate will have now been mineralised as a result of post-depositional organic decomposition process.

Heavy metals: Pb, Zn and Cu

On the basis of the range of values recorded, levels of enrichment have been categorised as follows:

	'Slightly enriched'	*'Enriched'*	*'Strongly enriched'*
Pb (μg g^{-1})	25.0–99.9	100–499	≥ 500
Zn (μg g^{-1})	100–299	300–499	
Cu (μg g^{-1})	50.0–99.9		

With two exceptions, the Pb concentrations recorded are very low (≤ 20.9 μg g^{-1}). Sample 21/6144 stands out as having an exceptionally high concentration of 3580 μg g^{-1}, which seems likely to reflect the presence of a small Pb particle(s)/globule(s). There is evidence of Cu and, especially Zn, enrichment in several of the samples. While none of the values are particularly high, there appears to be some degree of consistency between the patterns in the Zn and Cu data.

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 heating/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 (Table 1). What is somewhat surprising is that, with one exception, all of the samples show some degree of enhancement and in most cases χ_{conv} value is ≥ 10.0%. This could possibly be a reflection of the sheer intensity of heating/burning activity across the site, with perhaps a combination of *in situ* heating and the deliberate dumping and general dispersion of burnt material. However, it should be noted that some of the sediments will inevitably have been subject to some degree of post-depositional gleying as a result watertable fluctuations. As a consequence, the magnetic susceptibility of the sediments may have been affected by Fe (iron) mobilisation, leaching (which may account for some of the lower χ_{max} values) and reprecipitation. Some degree of caution is therefore needed in interpreting the results.

Evaluation of each sequence of deposits

Sequence 1: Early Holocene to Romano-British sediment units

The various contexts investigated all have a low organic matter content (LOI range, 2.04–2.87%). The peak in LOI in context 1136 may indicate a hiatus in sediment accumulation, with the higher organic matter content possibly reflecting a period of surface exposure/soil development. This interpretation is consistent with the elevated phosphate-P concentration (3.68 mg g^{-1}), which could in part reflect enrichment through manuring, and with the strongly enhanced magnetic susceptibility (χ_{conv}, 15.3%), which could reflect the presence of burnt material, or even *in situ* burning. Otherwise, the anthropogenic signature in this sequence is weak, with no heavy metal enrichment and relatively low phosphate-P concentrations and magnetic susceptibility enhancement. The elevated salinity (specific conductance range, 516–550 μS) is likely attributable to a somewhat stronger marine influence at the time of sediment accretion.

Sequence 6: Three sequential anthrosols

All three contexts sampled have a high salinity (specific conductance range, 1770–2080 χS). Otherwise, there appears to be a clear difference between context 1793 and contexts 1747 and 1794. The former has a low LOI (2.62%) and shows little evidence of anthropogenic activity, apart from the enhanced magnetic susceptibility (χ_{conv}, 14.6%). In contrast, the latter two are more organic rich (LOI, 4.26 and 4.03%, respectively); are strongly enriched in phosphate

(phosphate-P, 8.93 and 6.95 mg g^{-1}), which could well reflect the presence of bone-derived phosphate; have exceptionally high levels of magnetic susceptibility enhancement (χ_{conv}, 66.6 and 48.2%); and are slightly enriched in Zn, though the source of this is uncertain.

Sequence 16: Roundhouse settling tanks

The two contexts (1362 and 1363) sampled from the fills of the settling tank are both quite organic rich (LOI, 6.90 and 8.00, respectively) and have a somewhat elevated salinity. Of the sequences investigated, the contexts from sequence 16 have the strongest overall anthropogenic signature, with exceptionally high phosphate-P concentrations (17.9 and 18.9 mg g^{-1}), strongly enhanced magnetic susceptibility, the highest Zn concentrations (434 and 418 χg g^{-1}) and indications of some degree of Cu enrichment.

Sequence 17: Roundhouse hearth

The various contexts sampled from the vicinity of the hearth are extremely variable in character. Contexts 1597 and 1594 contain very little organic matter, and have a weak anthropogenic signature: no evidence of phosphate or heavy metal enrichment, though they do show strong signs of magnetic susceptibility enhancement. The remaining four samples, in contrast, have strong anthropogenic signatures. They much are more organic rich, with by far the highest LOI (16.7%) being recorded in context '1593 blackish' – the dark colour presumably a reflection of the presence of organic matter and charcoal; enriched in phosphate (three very strongly enriched, and probably including bone-derived phosphate) and Zn; and have enhanced magnetic susceptibility (two very strongly enhanced). Two of the samples are also enriched in Cu.

Sequence 19: Redhill

The seven contexts sampled from the redhill sequence all have a strongly enhanced magnetic susceptibility (χ_{conv} range, 27.7–53.6%), which is clearly consistent with these deposits being affected by heating/burning. Apart from context 6234 (LOI, 4.05%), the deposits all have a low organic matter content, which is consistent with them being subject to heating/burning. None of the contexts shows signs of phosphate or heavy metal enrichment, which suggests the deposits to be 'clean and sterile'.

Sequence 21: Floor of late Roman building

The single sample (context 6144) analysed from sequence 21 has a somewhat elevated LOI (3.59%) and displays signs of phosphate enrichment and magnetic susceptibility enhancement – i.e. features consistent with a floor surface. The exceptionally high concentration of Pb (3580 µg g^{-1}) is likely attributable to the presence of a particle(s)/globules(s) of Pb (see micromorphology/EDS).

Sequence 22: Later Roman deposit

The single sample analysed from sequence 22 is relatively organic rich (LOI, 6.46%) and displays signs of phosphate and Cu enrichment and magnetic susceptibility enhancement.

Overall, the various contexts sampled from the seven sedimentary sequences investigated display very marked variability in the key properties analysed, and this has provided valuable insight into their character and origins, and in particular into the nature and patterns of anthropogenic activity at the site.

FT-IR Microspectroscopy (µFTIR) analyses of 'green glaze' samples (from Late Roman ditch 4226)

Thin section GAT-4240/A2 (Figure 29)

Sample GAT-4240/A2 is composed of material that shows FTIR patterns compatible with silica glass. The strong IR absorption at ca 465 cm-1 suggests the presence also of metal oxides (possibly spinel: $MgAl_2O_4$; spinel can be synthesised by sintering or fusing MgO and Al_2O_3; Deer et al., 1992, 561. The authigenic acicular crystals growing on the external surface of the glaze do not show a gypsum ($CaSO_4.2H_2O$) IR pattern and at the moment remain unknown.

Thin section GAT-4240/B2 (Figure 30).

In sample GAT-4240/B2 the IR spectra show progressive decreasing of the intensity of the mica-smectite absorption at 3620 cm-1 towards the glaze surface (from left to right). This observation suggests temperature above 400° and below 700° C for the orangey red material. The black material shows no absorption at 3620 cm-1 suggesting that the temperature reached by this part of the daub wall should have been higher than 700° C. The IR pattern of the glaze is compatible with silica glass. Some clay adhering to the fragment (at left) show the IR absorptions of kaolinite at 6395 and 6320 cm-1 suggesting that this material is fresh local soil. The authigenic acicular crystals growing on the external surface of the glaze did not produce gypsum IR pattern nor spectra similar to the one collected from the authigenic crystal growing on the surface of A2 samples. Their identification remains momentarily unknown.

These results are discussed in the context of other analyses of the green glaze samples (see below).

Soil micromorphology

These results are presented in Tables 3-7, illustrated in Figs 1-136, and supported by material on the accompanying CD-Rom. 39 characteristics were identified and counted from the 87 contexts/sub-contexts in the 47 thin sections analysed

White nodules and green glaze reference samples

White nodules

White nodules collected from four contexts were examined in thin section samples: M1593 (Context 1330), M1597 (Context 1329), M1617 (Context 1321) and M5565 (Context 1216); M5565 was also examined employing SEM/EDS.

M1593 (Context 1330): Essentially, numerous (7+), 2-7mm-size colourless, dark greyish to opaque, isotropic nodules, which are whitish to greyish under OIL, and which occur as two main types (Fig 1). Type 1 is hollow and round, with a thin 400µm-wide vesicular rim. One example is characterised by ~5 µm wide pale yellowish 'glass'/clay 'lining', with iron-replaced organic matter partial fill. Type 2 are larger subrounded/lozenge-shaped aggregates, with no central hollow, but a variety of fine and large vesicles. Iron staining of the matrix occurs, including void hypocoatings, but no amorphous iron-replaced organic matter fill is evident.

M1597 (Context 1329): Similar to M5565 and M1593, but with 'blackish'/opaque nodules with fine (embedded) granular or fine prismatic (coatings and void formations) gypsum. Silt-size quartz and mica are present in some nodules. An example of fine plant-tempered sediment daub, with some strongly burned parts where fine fabric has become isotropic, occurs. These materials are similar to those in M5565 and M1593, but with incorporation of fine sediment that is sometimes gypsum-rich. Secondary gypsum also formed in this (estuarine) depositional environment, and sometimes gypsum has formed within nodules.

M1617 (Context 1321): As M1597, fine gypsum crystal formation affecting parts of the nodules, sometimes followed by iron staining. A 6mm size burned clay fragment is a piece of plant rich and once-rooted intertidal silty clay sediment, probably burned/rubefied at ~300-400ºC (Dammers and Joergensen, 1996).

M5565 (Context 1216): White nodules here are similar to those in M1593, with same size and types of nodules (Figs 2-4). In addition, rare to occasional very thin clay/sediment coatings are present. There is abundant iron staining of Type 2 examples. Possible colourless vesicular, unstained, Type 3, are present (silica glass?). SEM/EDS studies (Figs 5-6) show that overall these nodules are very strongly siliceous (mean 26.9% Si; max 34.7% Si - 74.2%SiO2), rich in cations (mean 3.00% Na, 2.62% Mg, 4.46% K, 4.94% Ca, *n*=13), generally moderately rich in P (mean ~1.23%P for those with P; full range 0-1.89%P), and that Fe always present (mean 4.83%; some with strong iron-staining/replacement eg. 44.4% Fe).

It is suspected that these white nodules/glassy slags are fuel ash residues (R. Nicholson, pers. comm.), where fuel is often monocotyledonous plant material (see below). This is because these nodules are often semi-pseudomorphic of plant stem sections (as also seen as charred remains in the geoarchaeological sequences); in some examples studied elsewhere such nodules are simply original silicified 'straw' stems (Macphail, 2005; Shelley, 2005; Marco Madella, Barcelona, pers. comm.). As the silica in phytoliths is in the form of plant opal ($SiO_2.nH_2O$) which becomes unstable above 573°C (Deer *et al*., 1992, 469) (without any flux being present) and barley straw can disappear above 400°C (Dammers and Joergensen, 1996), it is not surprising that hearth debris contain both partially altered vesicular stem pseudomorphs (Type 1) and strongly transformed vesicular glass (Type 2). Within the redhill deposits and hearth debris examples (where white nodules also occur), siliceous aggregates of partially melted and fused phytoliths are often ubiquitous (SMT 1b1), and these also embed charred monocotyledonous plant fragments. This again testifies to the use of this type of plant material as fuel. It can also be noted that wood includes siliceous aggregates and when burned at high temperature vesicular fuel ash glassy slags also develop (Weiner, 2010, 170-172), but not as semi-pseudomorphs of plant stems.

Green glaze (samples 4240A and 4240B from ditch Context 4226)

4240A2 and 4240B2 (Discussion of FTIR results)(Francesco Berna, Boston University, Figs 29-30)
FTIR mineralogical analyses have been used to reconstruct pyrotechnological processes, for example by identifying what happens to sediments when heated at increasing temperatures, showing how minerals are altered and what new minerals can be formed (Berna et al., 2007). Both samples 4240A2 and 4240B2 are composed of material that shows FTIR spectra compatible with some kind of silica glass ('green glaze' surface). The strong IR absorption at ca 465 cm-1 also suggests the presence of iron oxides (Spinel, $MgAl_2O_4$?). In terms of temperature, a minimum of 750-800°C was attained, but as crystobalite is not present a temperature below 1200°C is assumed; the presence of Na and K can act as fluxes and definitely induce formation of glass at temperatures around or below a 1000°C. The IR patterns of the glaze is thus compatible with high temperature glass/vitrified silica material.

In the underlying plant tempered briquetage the IR spectra show progressive diminishing of the 3620 cm absorption of mica-smectite towards the glaze surface in sample 4240B2. This phenomenon indicates temperatures above 400° and below 700°C for the orangey red material. The black material show no absorption at 3620 suggesting that the temperature reached by this part of the daub wall should have been higher than 700°C. While it can be noted that the aluminium-silicates (clays) making up the briquetage are mica-smectites, the inwash clays show IR absorptions of kaolinite at 6395 and 6320; the latter is of likely alluvial origin.

Statistical analysis of microprobe line analyses (A and B) on M4240A1 (John Crowther, Lampeter; Table 6; Fig 7)

Unfortunately, data for the glaze are available for only 6 points along the two transects investigated, compared with 194 for the briquetage. Thus, statistical comparisons of the glaze and briquetage data sets, using Mann-Whitney U tests, must therefore be interpreted with some degree of caution. The results indicate that compared with the briquetage, the glaze contains significantly ($p < 0.05$) higher concentrations of Fe, P, Na and S and lower concentrations of Si, Ca and Mg.
4240A

Large fragment in ditch fill 4226; 17mm thick burned clay, comprises three layers (Fig 7):

1 (lower briquetage): ~15mm thick laminated silty clay, with 0.3-0.5mm thick laminae with ferruginised fine detrital organic matter in generally iron poor/depleted (1-2% Fe) matrix (Figs 8-10). Both relict estuarine plant and 1mm-thick plant tempering plant channel pseudomorphs are present (Figs 8-13). Original roots were pyritised then ferruginised.

2: 0.5-2mm thick reddened/rubified layer, where now clay is mainly isotropic. Again, relict pyritised roots etc., are both ferruginised and reddened/rubefied.

3: uppermost 200-350 µm-thick vesicular 'green glass' surface. This is characterised by fine and medium-size vesicles, and composed of darkish grey siliceous (40-60% SiO_2) glass which becomes becomes colourless upwards, with patchy iron-stained needle form minerals in places (Figs 13-15). Instrumental analyses (SEM/EDS, microprobe, FTIR) indicate: Al-Si dominated briquetage composed of mica-smectite clays, with iron staining picking out sedimentary layering and relict ferruginised plant material (void coatings and hypocoatings), with green glaze formed of silicate glass (minimum 700-800°C to around/below 1000°C) that is enriched in Fe, Na, P and S and probably K, in comparison to the briquetage (Figs 16-20, 29; Tables 3-7).

This is a moderately strongly burned straw(?)-tempered, once-rooted iron poor estuarine silty clay-based 'mud-plastered' hearth/briquetage surface. The burning of fuel containing Si (eg. monocotyledonous, phytolith-rich fuel, see below) which at times attained high temperatures (minimum 700-800°C to around/below 1000°C), led to the development of a vesicular silicate glass layer, stained by iron, and presumably hence the pale green colour. This fuel would also be a source of P. The concentrated presence of Na (sodium), which is most intense at the surface of the glaze, is strongly indicative of the glaze resulting from salt making. It is possible that the associated concentration of Cl here is also related, but as Cl is in the resin, this finding has to be viewed with caution. In addition, burning led to pyritised (FeS_2) *in situ* root remains becoming oxidised into FeO. Inwash of estuarine clay (kaolinite) into the ditch and into voids within the briquetage was also noted.

4640B

Small fragment in ditch fill 4226; 14 mm-thick burned clay, comprising three layers (Figs 21-24):

1 (base): ~12mm thick mainly strongly rubefied laminated silty clay, which is much more iron-rich (6% Fe) compared to 4640A, and dispays very diffuse fine laminae with (Fig 24). There plant tempering/original rooting plant channel pseudomorphs (max 3.5mm-thick), with abundant partial dusty yellow ('alluvial') clay infillings;

2: 2-8mm thick very strongly reddened/rubified/blackened (opaque) layer (Figs 21-24), clay is mainly isotropic, and includes a trace of relict plant ferruginisation;

3: uppermost 250 µm-thick vesicular 'green glass' surface, with fine vesicles, and composed of colourless silica glass becoming blackish upwards (Figs 21-26), with patchy unidentified needle form minerals in this surface. Instrumental analyses indicate: relatively iron-rich (~6.00% Fe) Al-Si dominated briquetage composed of rubefied (400°C - <700°C) mica-smectite clays, with blackened clay (>700°C) below a thin green glaze layer formed of silicate glass (minimum 700-800°C to around/below 1000°C)(Figs 27-28, 30). Na diminishes, for example, from 10.1% Na (outer glaze) to 4.50% Na (inner glaze).

This is another example of moderately strongly burned straw(?)-tempered, but mainly once-rooted 'raw' estuarine silty clay-based 'mud-plastered' hearth/briquetage surface. But here, the original sediment is relatively iron-rich. Again, original pyritised root remains were oxidised and appear as ferruginised (FeO) material. Inwash of estuarine clay (kaolinite) was also noted, as in 4640A. The Na content of the glaze again implies that the burned briquetage is associated with salt making.

Georchaeological sequences

Sequence 1 (Landform development)

1145 (1077 in root channels)(1007B2): This is a moderately poorly sorted fine sandy silt loam, with very few small flint gravel (Fig 31). Two burned flint grains (rubefied, max 650µm) and rare wood charcoal (max 1.5mm) are present (Figs 32-33). The palaeosol is generally iron-depleted and characterised by many textural intercalations associated with matrix void infills and thin pale clay void coatings (Figs 32-33). Relict iron-stained, once-humic broad burrows occur in the matrix (Figs 34-35). Occasional iron stained root traces (and void hypocoatings) and other burrows also occur.

Context 1145 is a probable lower topsoil of an early Holocene palaeosol developed in brickearth, with (Neolithic-Bronze Age) occupation traces in the form of flint gravel, burned flint and wood charcoal. Relict once-humic earthworm(?) burrows also occur. In the main, the soil lost structure when it was slaked by inundation, hence textural intercalations and associated pedofeatures, and current massive structure (cf The Stumble, and other River Crouch and Blackwater sites in Essex; Macphail, 1994b, 2009; Macphail et al., 2008a, 2010; Wilkinson and Murphy, 1995; Wilkinson et al., 2012).

1077 (G4a)(M1007B1): Here, there are both large areas of 1) very fine charcoal-rich weakly humic fine sandy silt loam and patches of poorly humic soil (burrow mixed), and 2) homogeneous fine sandy silt loam as massive non-porous soil with sloping matrix pans as part of the intercalatory fabric (Figs 36-39). Rare flint gravel and wood charcoal (max 1.5mm) occur in the former (1). Vertical fissures are characterised by microlaminated coatings of brown clays and dusty clay rich in very fine charred and detrital organic matter.

This Context is the partially slaked and partially intact Neolithic-Bronze occupation topsoil (Ah)(see M1007B2). It is the remnants of the paleosol, with locally slaked topsoil forming a massive soil with muddy pans (slurries). Later (alluvial) clay inwash is recorded. This seems to be recording developing saline conditions (COMPA 09 Assessment).

1144 (M1007B1): This is a brown, moderately humic loamy clay, with a total intercalatory microfabric and embedded grains (Figs 36-39).

Context 1114 is a muddy mixture of clayey alluvium and slaked prehistoric topsoil formed in brickearth.

1143 (M1007B1): 1143 records a sediment sequence commencing with very charcoal-rich silty-fine sandy laminae (Figs 37-39). This is followed by humic clay laminae which include clasts of humic and charcoal-rich fine SZL sediment ('rip up' clasts). The sandy laminated sediment surface includes fine root channels; 'brown clay', as found in this Context 1143, is also found as thick void coatings in fissures down-profile (Figs 40-41).

Here, alluvial silt and fine sand deposition including local fine charcoal concentrations, is followed by humic clay alluviation with some local erosion ripping up the underlying charcoal-rich silty sands. Alluvial clay is rich in very fine detrital organic matter and charcoal, and this 'brown clay' washed down fissures and channels formed in the underlying slaked and inundated prehistoric palaeosol. This infers fluctuating base levels, and a short period of drying out between original inundation (by saline water?) and clayey alluviation. Presumably as this developed into an intertidal mud flat, this drying out and fissuring could be a single intertidal drying out episode, but it was also briefly vegetated suggesting a slightly longer episode of non-sedimentation. Nevertheless, rising saline water first apparently affected the palaeosol, before marine clay alluviation occurred.

8506/1142 (1007A): These contexts are composed of broad and very broad burrow mixed dark brownish silty clay sediment, with relict laminae, and anthropogenic deposits. The latter are dominated by fused siliceous material rich in phytoliths, charred and rubefied monocotyledonous plant fragments (Figs 42-43); diatoms are also present. In addition, very abundant charcoal (mainly monocotyledonous plant material, max 4mm), many white nodules (as in reference studies eg. 5565) of melted siliceous material/'straw'. Many briquetage fragments are present (max 13mm). Anthropogenic materials occur within broad excrements and burrows. Voids are often characterised by reddish brown or brown clay inwash up to 4mm thick. Pyrite has weathered/is weathering into ferrihydrite.

These contexts record a major spread of probable salt making fuel ash waste, onto alluvium, with biota coarsely mixing this into the sediment. Strongly burned vesicular siliceous waste occurs alongside briquetage and partially fused phytolith-rich monocotyledonous charred plant remains (Figs 42-43). The presence of diatoms also indicate that this is dominantly estuarine wetland plant fuel; pyrite formed in this deposit, but became altered due to changing base levels/exposure. Ensuing alluviation led to inwashed brown clays; possibly of burned waste origin produced reddish clays as evidence of burning.

8506 (mixed 1135-1136)(M1004B2): This is a coarsely and finely burrowed silty clay containing fine charcoal, and small amounts of phytoliths and rubefied silt, mixed with common amounts of anthropogenic 1135-1136 material, which includes many charcoal (including monocotyledonous material; max 2.5mm), many small (5-6mm) size reddish and blackish briquetage and fuel ash waste ('white nodules') are present. The sediment also includes traces of fine (1mm) roots/rooting. Broad burrowing is also associated with some relict broad organo-mineral excrements. 8506 is characterised by very abundant textural intercalations and associated closed vughs and vesicles with brown dusty clay/impure clay infills up to 1mm thick (Figs 44-45). Many patches (in 1135 material) of reddish brown clayey infills occur between relict peds and voids (1.5mm), including matrix intercalations of reddish 1135-1136 material. Iron (Fe-Mn?) hypocoatings and organic matter impregnations also characterise this fabric. It can be noted that Contexts 1135 and 1136 have notably high specific conductance ('salinity') and enhanced and strongly enhanced magnetic susceptibility (9.01-15.3% χ_{conv}) values.

As in M1007A, the original silty clay alluvium, was deposited as a muddy sediment, which upwards underwent weak sediment ripening. Alluvium included likely very local anthropogenic fine charcoal and rubefied silt (from underlying anthropogenic spread in M1007A). Subsequent biological activity and weathering affecting overlying, and or, earlier more terrestrial anthropogenic activity (local red hill formation and salt workings) led to coarse mixing of briquetage, monocotyledonous charcoal and fused fuel ash waste. Reddish (rubefied) clayey sediment from this activity became slaked and washed down-profile, indicating inundation and slaking events which led to partial collapse of the ripened palaeosoil. This marks, with M1007A, a major spread of salt making fuel ash waste (Early Romano-British or Late Bronze Age in date?)

1136 (M1004B1): This is a dark brown, very fine charcoal-rich silty clay, which includes occasional charcoal, such as wood charcoal (max 2.5mm). Abundant rubefied and blackened briquetage, and fused sediment material, and an example of leached (coprolitic?) bone fragment (750µm) are also present. Organic staining, plant fragments and fungal material all occur, alongside rare traces of loamy sand fragments. Original burrowed soil with subangular blocky structures is partially slaked into a massive/prismatic soil. This phenomenon is associated with very abundant textural intercalations, collapsed voids, and down-profile, microlaminated matrix pans (1.5mm thick) have formed. *In situ* root traces also occur together with rare brown clay void coatings. Weak iron staining is present throughout. Included, burned fragments are also recorded by strongly enhanced % χ_{conv}) values (Table 1).

Context 1136 is a ripened alluvial soil that underwent biological homogenisation and was probably vegetated, hence organic matter/plant fragments present. Occupation, presumably peripheral to salt making led to the inclusion of small fragments of burned briquetage; the presence of a bone fragment and fungal bodies may hint at middening. (Fuel waste seems to be rare here, although some material has been worked down-profile). Ensuing inundation, led to structural collapse and slaking, with water draining down-profile.

Subsequently, the soil became revegetated and clay alluviation is recorded in the root channels.

1136 (M1004A): This layer is essentially the same as below, but with fewer anthropogenic inclusions overall. These, however, include 3 coprolitic bone fragments (max 600µm) and rare rubefied (burned) peaty clay, with relict humic content and many diatoms ('peat ash')

1135 (1132)(M1004A): These contexts are composed of complex layering; from the top:

1. Massive structured, broadly burrowed, fine charcoal rich silty clay loam, with occasional briquetage, orange brown amorphous organic matter fragments and a fine-size example of coprolitic bone (Fig 46), over;

2. massive structured with remains of 1-1.5mm laminated silty clay and coarse-silt fine sand layers (Fig 47; Context 1132 has a high specific conductance), over,

3. remains of subangular blocky peds with very thick microlaminated ped coatings and void infills (innermost: 1.5+mm thick matrix material or silty clay, with 50µm brown clay, overlain by 400 µm-thick outermost layer of dusty brown clay).

Anthropogenic soil 1136 had developed a subangular blocky ripened surface, but inundation and natural mud flat sedimentation (silty clay and silt-fine sands; typical laminated mudflat/saltmarsh sediments) buried this soil. Thus it was slaked and saline alluviation also caused the downprofile inwash of brown alluvial clays (latterly from 1132 clay sedimentation). Ensuing sedimentation was very anthropogenic in character (1135), with fine charcoal and possible sewage being components. On-site anthropogenic activity recommenced as the soil dried out and was burrowed. Lastly, 1132 sedimentation (not studied) led to brown clay downwash, as noted above as final void clay coatings in microlaminated sequences.

Sequence 6 (Three sequential anthrosols, 1380 over 1381, and 1262 by boathouse)

1837 (M1381A): A very heterogeneous and burrow mixed dark brown soil-sediment, characterised by fine root channels (as in 1007A, 1143), and moderate amounts of phytolith-rich burned fuel debris, monocotyledonous charcoal and briquetage (see 1794 below); and soil-sediment inclusions (Figs 48-50). It is very strongly burrowed but shows relict layering, including one 3cm-thick ripened alluvium. Rare void infills of brown clay include microfossil concentrations.

This is a dried out and biota-worked spread/wash of fuel-ash debris, with a possible ripened alluvial clay layer. Very coarse burrowing and trampling may also be responsible for this very mixed junction.

1794 (M1381A): These are a very strongly mixed/burrowed anthropogenic deposit very rich in monocotyledonous charcoal (max 4mm), with charred stem sections, consistent with type 1a1 fuel ash (vitrified stem sections)(one 7mm aggregate is also present). Large amounts of moderately to strongly burned phytolith remains occur (Fig 51) alongside abundant briquetage. This material is also semi-layered, includes fragmented soil-sediments and characterised by both thin, broad and very broad burrows. This layer also shows organic matter (LOI) and zinc (Zn) enrichment, strong phosphate enrichment and very strong marked specific conductance (2080 µS) and $\%\chi_{conv}$ (Table 1)

This records a sequence of fuel ash and briquetage-debris rich spreads, where again wetland plants are probably the main fuel source. These deposits were exposed and became bioworked, but part of their layered character is probably due to trampling. Fuel ash debris and ash remains have led to strong phosphate enrichment and increased LOI, whilst the high proportion of burned debris is reflected by very strongly enhanced magnetic susceptibility. The exact origin of Zn enrichment is not clear, but the specific conductance shows that this deposit is currently very saline.

1794 (M1380B2): This layer continues to be heterogeneous with mixed fuel ash waste, varying from very strongly melted vesicular white nodules to weakly fused phytolith-rich sediments. Briquetage includes variants of microfossil-containing material, and relict crumb/soil aggregates (topsoil) as rubefied structural (?) components (accidental inclusions). Burned sediment fragments also occur. Partially biologically worked fine charcoal rich clayey sediments also occur as sediment infill. The boundary to overlying 1793 is marked by a horizontally oriented 25mm long briquetage fragment, on clayey sediment fills (Fig 52).

Upper Context 1794 records a heterogeneous anthropogenic deposit formed as a loose trampled spread, with a ‘surface’ marked by a horizontally oriented briquetage fragment. This was mainly dry ground/trampled occupation surface. Increasingly, however, alluviation led to clayey sediment infills (see 1793, below), and spreads of coarse material over muddy mudflat ground.

1793 (M1382B2): his is a massive coarsely laminated (5-6mm) clay containing very fine detrital organic matter and charcoal (Figs 52-54). Minor amounts of rounded 'clay' clasts and anthropogenic inclusions occur also as thin laminae (briquetage fragments; max 5mm). Occasional thin and broad burrow fills include anthropic material; minor thin burrowing of anthropic laminae. Occasional pyrite have become oxidised (ferruginised). As 1794 below, it has a very high specific conductance and strongly enhanced magnetic susceptibility.

Here, massive alluviation episodes are interdigitated with wash of anthropogenic material (terrestrial wash?/rainwash?). Short-lived minor burrowing of anthropogenic laminae indicate brief drying out (intertidal episodes?).

1793 (M1380B1) This context continues upwards as relict patches of laminated dusty brown, fine charcoal rich clay; it is homogeneous when characterised by very abundant thin burrows. Secondary microlaminated dusty brown and brown clay void coatings occur throughout. Again, it displays very high specific conductance values (Table 1).

This is partially weathered and burrowed charcoal-rich alluvium, marking a ripening episode and exposure. Even so, further alluvial flooding led to microlaminated brown clay deposition in voids.

1747 (M1380B1): This is a rather compact fine charcoal-rich clayey soil-sediment, with a large area of pale phytolith-rich sediment, and with very abundant generally small (2-4mm) clasts of raw sediment, weakly burned sediment and briquetage, charcoal including monocotyledonous material and stem sections (Figs 55-58). Rare thin dusty brown clay coats most voids. It also has a very high specific conductance ('salinity'), relatively high amounts of organic matter (LOI), zinc (Zn), and is very enriched in phosphate, all consistent with an anthropogenic spread rich in burned material in an intertidal environment.

This context seems to record a probable exterior occupation surface deposit formed by trampling (Gé et al., 1993), producing moderately well sorted and fragmented anthropogenic materials (briquetage etc) and raw sediment fragments (employed for briquetage, constructions, etc). The phytolith-rich fabric is unfused wetland plant fuel ash residues, with included wetland clay containing diatoms for example, presumably accidentally collected with plant fuel. Ash residues are one likely source of phosphate, and it may be that burned marine(?) wetland plant concentrate small amounts of Zn.

1746 (1380A):

Very heterogeneous with clayey sediment soils, with varying concentrations of very fine charcoal etc, very abundant coarse clasts of raw ripened soil (8-15mm in size), with abundant briquetage (max 8mm), many fine charcoal, fuel ash nodules (eg aggregate = 4mm), examples of fused sandy soil and trace of roots (Figs 59-61). The soil is overall characterised by very abundant thin, broad to very broad (13mm) burrows and associated excrements, including mammilated ones. The whole fabric is lastly affected by very thin void clay coatings, with chambers and coarser porosity with microlaminated clay fills up to 1mm thick.

Context 1746 is composed of coarsely dumped spreads of dug up local ripened alluvial soil (without charcoal – clean natural deposits), and mixed contemporary anthropogenic alluvium (charcoal rich), which also include large amounts of fine charcoal, fuel ash waste and briquetage. The 'raw' sediment can include rooted surface material (Figs 59-61) and may have been accidentally collected when wetland plants were gathered for salt making fuel. Often this sediment is burned and makes up much of the redhill deposits (see below). These have undergone a period of strong biological working (as a topsoil)(cf immature 'dark earth'; Cowan, 2003; Macphail, 1994a, 2010a), before being affected by renewed alluviation/rising sea levels/base levels. Possibly this was ground raising deposit.

Boat house anthrosol sequence 1262

5727 (M1262B): This is a massive and laminated silty clay loam with silty-very fine sandy laminae, with very fine charcoal, and trace amounts of very fine coprolitic bone material; occasional charcoal (max 750 µm), fine briquetage and rare fused phytolith clasts also occur. Abundant textural intercalations and associated panning and closed vughs/vesicles, were noted. Pyrite spheroids in 'root' channels have been oxidised/ferruginised.

This is a moderately anthropogenic alluvium, deposited as laminated intertidal muds.

5731 (lower)(M1262B): This lowermost part of 5731 is made up of a 2-4cm-thick layer of concentrated burned phytoliths, some partially fused, with occasional fine (max 3mm) monocotyledonous charcoal and small briquetage (max 4mm) fragments, which occurs over a partially welded 3.5mm thick layer of sand-size loamy sediment aggregates (alluvium as below) and angular alluvial clay clasts (2-3mm). This lower layer junction with 5727 is also characterised by textural intercalations and micropanning.

It can be suggested that a channel cut(?) into the underlying alluvium (5727), led to initial muddy fill of eroded loamy and clayey fragments of alluvium. A thin layer of anthropogenic deposits dominated by burned monocotyledonous plant debris was then deposited by inwash from local activities.

5731 (upper)(M1262B): This is a massive and weakly microlaminated fine charcoal-rich silty clay loam sediment, with matrix intercalations and micropanning and void infills (including relict planar voids). Occasional fine charcoal, and rare fine-size white nodules and briquetage, are present.

This is a massive and once-microlaminated muddy alluvium, containing only very small amounts of fine-size anthropogenic inclusions. This appears to be the result of 'natural' anthropogenic alluviation infilling the channel.

5731 (M1262A2): This context continues upwards as a massive and weakly microlaminated fine charcoal-rich silty clay loam sediment, with matrix intercalations, micropanning and void infills (including relict planar voids). Occasional generally fine briquetage, with patches of many semi-fused phytoliths and fused phytolith fine fabrics, occur alongside with occasional fine charcoal, including 750 µm size monocotyledonous sections. Rare pyrite spheroids are ferruginised/oxidised.

Here, massive and once-microlaminated muddy alluviation continues, withonly very small amounts of fine-size anthropogenic inclusions. This is 'natural' anthropogenic alluvium infilling channel.

5732 (M1262A1): This context is extremely heterogeneous with clayey sediment soils (possibly/likely burrowed remains of soil-sediment formed *in situ*). It contains varying concentrations of very fine charcoal etc, very abundant coarse clasts of raw ripened soil (4-16mm in size), abundant briquetage (max 7mm), many fine charcoal (2.5mm - size monocotyledonous material), rare fuel ash nodules (eg aggregate = 2mm), and traces of roots (in original soil-sediment material) (Figs 62-64). The soil is overall characterised by very abundant thin, broad and very broad (~14mm) burrows and associated excrements, including mammillated ones. The whole fabric is lastly affected by rare very thin void clay coatings.

5732 is composed of coarsely dumped spreads of dug up local ripened alluvial soil (without charcoal – clean natural deposits), and mixed contemporary anthropogenic alluvium (charcoal rich), which also include large amounts of fine charcoal, fuel ash waste and briquetage. Some soil-sediment material may be of local *in situ*-formed origin?). These have undergone a period of strong biological working (as a topsoil)(again similar to immature 'dark earth'), before being affected by renewed alluviation/rising sea levels/base levels. Possibly this was ground raising deposit, with local/possible some *in situ* soil sediment being used.

Sequence 14 (Romano-British roundhouse outer ditch)

5433 (M1203B2): This is a massive, compact iron depleted fine sandy silt loam, with closed vughs and textural intercalations; the fine fabric includes very fine charcoal.

This is the truncated and slaked early Holocene terrestrial lower topsoil formed in brickearth (exposed by ditch cutting)(see Sequence 1).

5428 (M1203 B2): Context 5428 is a pebble- (20mm) rich fill, with alternating 1) clayey alluvium, 2) laminated silty clay with long (~5mm) horizontally oriented humified and sometimes charred monocotyledonous plant fragments (and charred probable dung), and 3) fine sandy loam (brickearth) layers. Rubefied (burned) bone examples, including fish bone (1mm) occur (Figs 65-69). Charcoal increases upwards from occasional to many (max 3mm wood charcoal); one white nodule (vesicular fuel ash waste) and burned flint were noted.

Here, the base of the ditch became infilled with alluvial clay, followed by microlaminated silts full of waterlain probable byre waste; this was followed by silting of the brickearth ditch sides, and small pebbles were also deposited. This sequence of microlaminated fine material is repeated 3 times upwards, implying cyclical formation processes. Burned bone, including fish bone, burned flint and wood charcoal also testify to background domestic use of the area/round house. Stabling and domestic use of the roundhouse and environs are thus recorded.

5428 (M1203B1): This context continues upwards as a similar fill: microlaminated with very fine charcoal, phytoliths and articulated phytoliths, and a patch of more obvious dung residues.

This appears to be semi-waterlain byre waste.

5429 lower (M1203B1): This is a dark, microlaminated fill, with very abundant monocotyledonous (max 8mm) and woody/shrubby (max 6mm) charcoal, with the sediment becoming fragmented into subangular blocky upwards. Very abundant phytoliths and articulated phytoliths, an example of burned bone, with possible organic faecal material and weakly FeP stained charcoal ('night soil') are all present. Rare fuel ash waste nodules, also occur. Occasional secondary inwash infills are recorded alongside the formation of probable diatom death assemblages (see Fig 72).

5429 is a waterlain, mixed clayey brickearth and alluvium, with domestic/constructional debris (plant/crop processing, thatch, hearth waste), and food and sewage(?) waste too. It became dried out and cracked upwards; with some ensuing flooding leading the inwash of diatoms which died presumably when trapped in this ditch.

5429 upper (M1203B1): Upwards, this context becomes very loose, open concentration of rubefied/moderately to low temperature burned mud plastered, plant tempered daub/briquetage fragments (from brickearth mainly)(30mm max)(Figs 70-71). Daub also composed of clayey and anthropogenic sediments, sometimes rich in fine charcoal and phytoliths, was also noted.

This is a dump of destruction/dismantling debris of burned floors/low temperature hearths-briquetage. This was followed by inwash of (very local?) brickearth-sourced alluvium/silting.

5430 (M1203A): This is a massive silty clay with prismatic fissuring, and coarse anthropic inclusions of an angular flint (18mm)(Fig 73), sand and gravel size brickearth clasts, burned brickearth, strongly and moderately burned briquetage, and a 3mms-size example of a human? coprolite/cess embedding charred monocotyledonous waste, phytoliths, and has iron-stained closed vughs/vesicles (Figs 74-77).

Context 5430 is a post-occupation alluvial ditch fill, with small amounts of washed in and dumped anthropic materials, including a human coprolite/cess fragment which embeds charred monocotyledonous fuel/cereal processing? waste.

Sequence 15 (Roundhouse inner ditch)

5332 (M1202): These are mainly massive silty clays with small amounts of fine charcoal. The layer has the beginnings of a subangular blocky structure and marked broad burrowing. Burrows are filled with anthropogenic soil, very rich in charcoal, red and blackened burned sediment and briquetage (Figs 78-80). There are also examples of articulated phytoliths and fine sand size amorphous cess nodules/human coprolite fragments.

This inner ditch at the roundhouse became rapidly infilled with local alluvium containing small amounts of charcoal (this also affected the upper outer ditch fills). Moderate drying out and structural formation and broad burrowing from the overlying red hill deposits, took place. This included both salt making debris and domestic latrine waste, as also recognised in the outer ditch fill.

5328 (M1202): This upper context is composed of iron-depleted fine and medium sands (loamy sands), many void infills of brown silty clay and very broad burrow fills of anthropogenic charcoal and burned clay rich soil.

Here, again, the roundhouse ditch was cut into top of Holocene sandy soils, and these collapsed into the ditch at times. Continued clayey alluviation also affected this fill, alongside burrowing of anthropogenic soils, from local 'redhill' type deposits.

Sequence 16 (Round house settling tanks)

1364 (1224B): This is a poorly mixed fill composed of: 1) moderately coarse fragments of weakly ripened alluvial clayey soil containing small amounts of charcoal, and 2) microlaminated coarse silty and fine sandy fills rich in charcoal and containing small amounts of black burned sediment/soil, phytoliths and trace amounts fine (coprolitic?) bone and organic matter (Fig 81). Abundant finely microlaminated dusty clay void coatings and pans up to 0.5mm thick, were noted.

It seems likely that this records the base of a clay-lined tank cut into brickearth. The 'clay' is composed of moderately coarse fragments of weakly ripened alluvial clayey soil, of presumed local origin. Use of tank led to inwash of local brickearth alongside charred and burned organic matter, some of which is monocotyledonous, and small amounts of black burned sediment of 'fire installation'(hearth?) origin. Small inputs of possible human latrine waste also occurred. Water in the tank(s) gently eroded the brickearth tank sides, and this sediment settled as microlaminated deposits in the lowermost fill. Later pale dusty clay inwash, appears to be a post-depositional feature associated with later fills(?).

1363 *(1224B)*: This context is composed of monocotyledonous ash residue-dominated fills, with fused phytoliths, coarse phytoliths (1mm in length), weakly rubefied burned local alluvial soil clay and brickearth (Fig 81). Lowermost fill of 1363 is very charcoal rich with monocotyledonous charcoal, including stem sections ('straw sections'); here also voids are commonly infilled with brownish microlaminated finely dusty clay. (These are absent in very broadly burrowed 'ash' above.) The context has a marked LOI, Zn enrichment and %χ_{conv}, and very strongly enriched P (highest amounts recorded at Stanford Wharf), as well as notable specific conductance, χ_{max} and Cu enrichment. SEM/EDS analyses indicate that vesicular fuel ash and fused phytoliths may contain up to 4.41% P.

Context 1363 is a dump/fill of moderately sorted ashed wetland(?) plant and/or 'straw' and sand to fine gravel size weakly burned alluvial clay and brickearth soil. These are very phosphate-rich fuel ash debris and weakly burned clay from fire installation(s), presumably associated with use of settling tanks. The very high P may also reflect inputs of cess, as more clearly visible in 1362 and in the roundhouse hearth deposits (below). Inwash of fine dusty clay (with brown colours reflecting local fire installations – burned iron inputs) records continued wash/water settling into the tank. The upper fills dried out at times allowing some bioworking.

1362 (1224A): 1362 has a diffuse boundary to 1363 below. It is also very ashy, with fused phytolith monocotyledonous burned plant residues, white fuel ash nodules, burned plant tempered briquetage/daub constructed from brickearth clay. Many rubefied and blackened dung fragments (max 10mm) occur, with both layered and bioworked examples of amorphous dung; here some fused articulated phytolith remains are stained and were probably originally of dung origin (e.g. from a byre floor)(Figs 82-83). Very high amounts of monocotyledonous charcoal, including stem sections, are present. An example of calcined bone was also visible. Iron staining is very abundant, and likely includes yellowish Fe-P impregnations (Figs 84-85). Overall, the fill is characterised by very abundant broad and very broad burrows. Bulk analyses (Table 1) found marked LOI, Zn and %χ_{conv}, and very strongly enriched P (highest amounts recorded), and notable specific conductance, χ_{max} and Cu.

This fill is also composed of fuel ash residues, associated with moderately burned alluvial clay and brickearth soil (probably accidentally gathered along with wetland monocotyledonous plant fuel, as in the redhill sequences – see below). Clearly, also herbivore dung/byre waste (Macphail et al., 2004) has been incorporated and burned here, possibly as an extra slow burning fuel source. Calcined bone is probably an accidental ashed inclusion of kitchen waste origin. Iron and likely Fe-P stain the ashed fill and clay clasts, and although P is in part derived from weathered plant ash and dung, the higher amounts may also again be due to cess dumping (Macphail and Goldberg, 2010). Concentrations of Zn appear to be possibly of fuel ash/marine clay origin (as discussed above); Zn in seawater could have been concentrated in marine wetland plants.

Sequence 17 (round house hearth)

Both vertical and horizontally oriented monoliths were employed to sample this feature (Figs 86-89)

Horizontal monolith 1152:

1593 (Greyish)(M1152B): Context 1593 has a lower 'greyish' part, which is a broadly horizontally layered (10-20mm) reddish brown/rubefied brickearth loam (inside edge)(Fig 89). It is characterised by monocotyledonous charcoal remains (clayey plastering), and fine and medium brickearth sands, as well as fused ash/melted phytoliths. Ca-P cess staining and infills, include probable nematode eggs, and ferruginised dietary remains(?)(Figs 90-91). These components show various levels of heating, with loss of fine fabric birefringence and partial melting of sand grains (Fgs 92-93). Burned vesicular bone/human coprolitic waste were also noted. Clasts of more strongly burned brickearth and sand (max 14mm), and white nodules (vesicular fuel ash waste and 'straw' pseudomorphs), are present throughout. This greyish 1593 has a very high P, marked LOI and Zn content, and very high χ_{conv}. SEM/EDS analyses of cess found 9.72-14.3% P and 22.5-28.8% Ca (1.99-2.01% F, was also recorded).

These roundhouse hearth deposits are composed of inside layering of rubefied, clayey plastered brickearth loam (with fine monocotyledonous charcoal), and relict hearth debris of more strongly burned brickearth loams and sands. These include clasts of previously burned sand, and fused fuel ash, fused phytoliths/ash waste fragments. Clasts also include cess stained brickearth plaster and cess-staining and infills in general, which have a typical calcium phosphate chemistry and included probable nematode eggs, testifying to the casual disposal of human waste (Macphail and Goldberg, 2010). These are fills against 1593 blackish (see below). Inwash of marine clays have raised specific conductance as a post-depositional effect.

1593 (Blackish; cf 1485 M1151) (M1152B): This blackish part of 1593 has thin to broad (vertical) layers (2.5-10 mm) of monocotyledonous charcoal and charred layered monocotyledonous plants, lined with patchy dark grey, possible 'lime' plastered brickearth of 'cob' (Ca-enriched; 4.33-5.39% Ca, mean 4.95% Ca, n=3), brown brickearth loam. Also present are patchy fused phytoliths, burned brickearth, and partially burned monocotyledonous plant remains/stem/leaf sections (strongly Ca-Fe-P enriched, Table 4); packing of more strongly burned plant ash/fused phytoliths. Bulk analyses also recorded a very high LOI, and high specific conductance, P, Zn and Cu enrichment.

The blackish 1593 context records hearth construction layers composed of vertically oriented monocotyledonous plant material (now charred), possible lime(?) plastered with brickearth (or cob?), and with raw brickearth loam. The now-charred plant lining hearth layer can be compared to both charred 'straw' lining/tempering of an early Roman brickearth floor at No 1, Poultry, London, and an experimental straw lined oven ashed at West Heslerton, North Yorkshire; in each case the straw was charred (Macphail, 2003; Macphail and Goldberg, 2010; Macphail and Linderholm, 2011)figs 5-6.

1594 (M1152B): This context is very similar to 1594 described in M1152A (see below). In brief it is composed of vertically fissured dark grey burned brickearth. It is a heated brickearth loam and sand-plastered hearth wall construction.

1594 (M1152A): This is a homogeneous, moderately burned/heated fine sandy silt loam (brickearth), which is vertically fissured with 250µm – 1mm wide fissures (Figs 86, 88).

This is a heated plastered brickearth loam and sands constructed hearth wall. Heating and drying out caused fissuring.

1595 (M1152A): This is a compact, pure brickearth, with patchy rubefication. There are many brown clayey fills up to 2mm wide.

Context 1595 records an outer brickearth plastered hearth wall construction, with patchy heating effects.

Vertical monolith 1151 (see Fig 87)

1599 (M1151B): This is a discontinuous, homogeneous, essentially compact (although fissured) clay loam, rich in very fine charcoal. It is characterised by very abundant textural intercalations and associated clayey void infills, with rare ferruginous diffuse impregnations. Rare thin burrow fills occur.

This lowermost layer is a local muddy anthropogenic alluvium derived from brickearth. Minor burrowing and rooting, took place prior to likely truncation.

1597 (M1151B): This is a reddish brown to dark reddish brown layered and compact brickearth, with fissures, textural intercalations, closed vughs and voids with iron hypocoatings.

This is a possible waterlain and trampled anthropogenic detritus-rich brickearth immediately pre-dating the hearth.

1598 (M1151B): This is a broadly fissured dark red and dominantly blackened brickearth layered hearth material.

Context 1598 records burned and heated brickearth hearth makeup.

1595 (M1151B): This is composed of broadly fissured, dominantly sandy brickearth that has variously blackened and rubefied layers.

1595 is a variously heated and burned sandy brickearth hearth wall.

1593 lower (M1151A): This is composed of loosely packed, very dominant strongly burned brickearth, white nodules (vesicular fused fuel ash), fused phytoliths and strongly burned sands, with rare traces of briquetage, and rare sections of charred monocotyledonous plants (see M1152).

This is a loose fuel ash and burned hearth debris fill, relict of hearth use (see M1152).

1485 (M1151A): Context 1485 includes a 3mm – 1cm-thick layer of 1mm-size (sections) of charred monocotyledonous plant material (Figs 94-95; leaves of *Juncus maritimus*, Kath Turner pers. comm.). This layer is also with associated(?) concentrations of fused ash/phytoliths, white nodules, etc, as in blackish 1593 (M1152B). Bulk analyses found high LOI and very high P, Zn and Cu enrichment. Pb also showed signs of enrichment, possibly due to the absorption characteristics of charcoal.

This is a charred hearth constructional layer composed of a monocotyledonous plants (sea rush)(Kath Turner, pers. comm.) used to bind the brickearth construction and re-used burned hearth debris. As noted above (in 1152) both archaeological and experimental analogues of oven/hearth construction can be cited. The small Pb concentration may reflect absorption characteristics of charcoal.

1593 (M1151A): This is a very mixed, loose and coarse (30mm) fill of burned brickearth, white nodules, fused phytoliths (fused monocotyledonous plant ash); clasts of vesicular burned sands also occur. Many brown dusty clay void infills were also noted. Here high Zn enrichment and organic matter (LOI), and very high P and very strongly enhanced magnetic susceptibility (%χ_{conv}), were recorded alongside a marked specific conductance.

These deposits composing a loose ash and burned hearth debris layers, are probably representing re-use/reconstruction of hearth (see 1152). Salinity (specific conductance) may be the result of marine clay inwash.

Sequence 19 The Redhill Sequence

6022b (M1371A2): This is a massive, compact iron depleted fine sandy silt loam (Fig 96), with closed vughs and intercalations. The fine fabric includes very fine charcoal, and layer as a whole records very fine root traces.

6022b is the truncated and slaked early Holocene terrestrial lower topsoil formed in brickearth, which was rooted.

6240 (M1371A2): Context 6240 is composed of a very broad (50+mm) infill of microlaminated 'redhill' silts, composed of fine size burned sediment/briquetage (max

4mm), with fine charcoal and phytolith-rich fuel ash waste. The uppermost 10-15mm is made up of microlaminated silts with fine charcoal only.

6240 records very broad burrowing/subsurface channelling, and alluviation picking up, first local redhill material and then second, 'clean' silts. (It also apparently erodes and infills below 6022a).

6022a *(M1371A2)*: This is the junction of uppermost, compact and massive brickearth (soil) and thin (3-7mm) layer/pan of very abundant charcoal and many fine burned sediment/briquetage.

This is the junction between an inundation-truncated and slaked early Holocene soil and locally formed muddy alluvium containing very fine occupation/salt making debris.

6241 *(M1371A2)*: 6241 is made up of a fine charcoal-rich silty clay loam with poorly sorted mixture of fine to moderately course (7mm max) burned anthropogenic inclusions (3a1, 3a2, 4a1,1b1, see Table 7), and includes burned 'diatomite' and burned brickearth (Fig 96). The layer also exhibits rare 50µm thick matrix void coatings and abundant thin to very broad burrows.

Thus Context 6241 records the coarsely mixed and burrowed occupation soil formed in anthropogenic alluvium, with much burrow mixing of redhill deposits from above.

6241 (M1371A1): This is very similar to 6241, described above, but also with remains of clean silt sedimentation (Fig 97), fewer anthropogenic inclusions. It has marked thick (max 0.5mm) reddish brown clay void coatings.

Here the formation of anthropogenic soil formed in charcoal-rich alluvium, is recorded. There is a slaking history, in part likely associated with continued inundation events and deposition of silts. Later burrowing mixed redhill deposits, and clay wash through overlying redhill deposits led to marked deposition of reddish brown clay.

6238 *(M1371A1)*: This is composed of broadly layered rubefied redhill deposits, with burned fragments of diatom-rich silty clay, daub made from silty clay, burned fuel waste rich in very fine charcoal and embedded phytoliths, and burned flint (Fig 98) with possible charred peaty deposits. A very small amount of reddish brown inwash clay was noted.

Context 6238 records likely occupation surfaces/trampled deposits (cf (Gé et al., 1993) and moderately bioworked spreads of salt making debris.

6389 (M1366C): This is a massive, mainly homogeneous medium sandy loam, containing small amounts of fine charcoal and blackened/burned microfossil-rich sediment (red under OIL) and fine red briquetage. The layer is characterised by very abundant textural intercalations and infills. Later channels are mainly infilled either with upward-fining silty clay with very fine charcoal, or later by 'redhill silts' (Figs 99-101). Minor iron staining is recorded.

Local muddy sandy alluvium (channel fill?) developed channels and these were later infilled, first by flood silts/silty clays, and followed, second, by very localised 'redhill silts', eroded from local salt making anthropogenic deposits (colluvium?).

6377 *(M1366C)*: This is also composed of reddish silts and silty clay, and contains very abundant small-size red burned clay/briquetage/sediment, which occur as inwash and poorly laminated fills. Upwards, these develop into massive burrowed and more sandy deposits, containing gravel size clasts of burned sediment and briquetage; again with many monocotyledonous charcoal. A last phase of reddish brown clay is recorded. (This deposit has very strongly enhanced magnetic susceptibility with 32.2% χ_{conv})

Channel fills(?) continue upwards as 'redhill silts', composed of silty clay and coarse silts containing many fine charcoal and very abundant coarse silt-fine sand size red burned sediment and briquetage. This material infills channels in 6389 below and seals this layer, before becoming more coarse and burrowed (i.e., it is no longer waterlain).

6377 (M1366B2): Context 6377 continues upwards into thin section M1366B2 as burrowed waterlain 'redhill silts' with some coarser inclusions.

6379 *(M1366B2)*: This is loose, subangular blocky layer with common areas of silty clay sediment and many coarse (8-10mm) briquetage and very abundant burned sediment. The last include layered and porous 'turf' fragments, 2-3mm thick, with burned ferruginised organic horizons (this appears to be ripened sediment with possible algal crusts (Figs 102-105)(cf Wallasea Island, Essex; Macphail *et al*., 2010). Raw sediment and brickearth soil clasts (7mm), occur alongside abundant monocotyledonous charcoal (3mm max). The context is burrowed and has occasional reddish brown clay void coatings. (Again, a very strongly enhanced magnetic susceptibility, with 27.7% χ_{conv} is recorded.)

This is an episode of a redhill spread/trample made up of coarse anthropogenic inclusions, within period of waterlain silting (colluvium? within redhill feature). Strongly burned sediment and burned surface 'turf' are fuel waste debris, and probably record the use of wetland rooted, ripened surface sediments, where iron-replaced organic matter of possible seaweed origin, occurs (Macphail *et al*., 2010). As a comparison, waste from minerogenic peaty soils (not peat) forms major prehistoric, medieval and historic farm mound deposits in Scotland for example, with some also being employed as arable 'fertilisers' (Adderley *et al*., 2006; Carter, 1998a, b).

6378 *(M1366B2)*: This is a mainly homogeneous dark brown silty clay with very fine and fine charcoal and very fine burned briquetage etc, and small amounts of fine burned anthropogenic material. Voids have partially collapsed and are associated with textural intercalations dusty clay void coatings. Some areas have been burrowed, and minor structures occur as poorly formed prisms.

This layer records renewed alluvial silting from a redhill source, with periodic drying out, structure formation, followed by partial structural collapse on renewed alluviation/wetting .

6378 (M1366B1): This is a mainly homogeneous dark brown silty clay with very fine and fine charcoal, and very fine burned briquetage etc, and small amounts of fine burned anthropogenic material. Voids, which appear to be horizontally aligned, have partially collapsed and are associated with textural intercalations and sorted dusty clay void coatings.

Upper 6378 is a probable trampled muddy alluvial fill.

6374 over 6024 *(M1366B1)*: Here, a loose, mix of coarse, strongly burned marine alluvium/sediment (12mm), brickearth, and sandy brickearth plant tempered daub (25mm), with included microfossils in burned sediment, occurs. It is possible that burned dung/dung-like material is also present. There is very abundant fine pellety-worked ash-waste. The layer includes occasional monocotyledonous charcoal (max 2.5mm). The junction with 6378 below, is formed by pans of fine charcoal and fine burned-debris rich silty clay (max 2mm thick) of redhill origin (6374?). Occasional thin reddish brown clay coatings are recorded.

This is a coarse spread(s) of burned salt working constructional (briquetage) and fuel-ash waste material of local soil, sediment and marine sediment origin. Bioworking of ash residues testifies to subaerial weathering. Pans of 'redhill silts' (6734) suggests renewed alluvial/colluvial activity/intensification of activity, here after a break in operations. (Trampled muddy alluvium below with lower concentrations of fine burned material in 6378)

6373 (M1366A): This is again, a loose, mix of coarse strongly burned marine alluvium/sediment, brickearth, and sandy brickearth plant tempered daub, as below, and coarse clasts of fused phytolith-rich ash waste and monocotyledonous charcoal (Figs 106-108). The last is often associated with a thin excremental microfabric. (Note: no textural pedofeatures recorded here).

Context 6373 records continued accretion of coarse spreads of burned salt working constructional and wetland(?) plant fuel waste material of local soil, sediment and marine sediment origin. Bioworking of ash residues testifies to subaerial weathering, and no flooding was recorded, perhaps due to an accumulating higher elevation.

6373 (M1365B): This is a slightly more compact mix of coarse strongly burned marine alluvium/sediment, brickearth, and sandy brickearth plant tempered daub, compared to 6373 below. It also includes a few coarse clasts of fused phytolith-rich ash waste and rare charcoal (here an example of 2mm wide twigwood section). Only trace amounts of clay coatings, but many thin burrows and very abundant thin excrements were recorded. (Note: this has a very strongly enhanced magnetic susceptibility with 43.1% χ_{conv} , Table 1).

Here, continued accretion of mainly coarse spreads of burned salt working constructional waste material of local soil, sediment and marine sediment origin, took place. Major bioworking of ash residues testifies to subaerial weathering (only trace of clay inwash was found).

6371 *(M1365B)*: This is very similar to 6373, below, but with a higher proportion of more iron-stained burned salt making installation material. The again, even more strongly enhance magnetic susceptibility of 50.1% χ_{conv} appears associated with a layer dominated by more ferruginous, red briquetage and sediment waste.

As 6373, but raw source sediment material was originally more iron-stained, hence slightly higher % χ_{conv}. Modern saltmarsh sediments also show this variation and layering of reddish clayey relatively iron-rich sediments compared to iron poor laminae.

6370 over 6371 (M1365A2): This is a slightly compact, mix of coarse strongly burned marine alluvium/ sediment, brickearth, and sandy brickearth plant tempered daub, as below, and few coarse clasts of fused phytolith-rich ash waste and occasional charcoal (here an example of 1mm wide monocotyledonous section)(Fig 109). Trace amounts of clay coatings increases upwards to 'rare'; many thin burrows and very abundant thin excrements also occur. More burned rubefied (iron –stained) briquetage is present in lower unit (6371?), below 0.5-2mm wide horizontal fissure at 19cm. Another horizontal fissure is located at 15.5cm.

These are trampled, and slightly compacted and fragmented salt making installation waste, with small amounts of included fuel waste of likely monocotyledonous origin.

6375 over 6343 *(M1365A1)*: These contexts are similar to those below, but with the inclusion of coarse (4-5mm) wood charcoal examples, a large brickearth pottery fragment (9mm wide, 11mm long)(Figs 109-110), and frequent phytolith rich fused monocotyledonous ash waste. Many reddish brown clay to dusty brown clay coatings affecting packing voids (50-150 µm thick), are present (Figs 111-112).

These units are moderately compact as below, because of trampling that likely more commonly finely fragmented monocotyledonous ash waste compared to briquetage material; this ash is more delicate. Post-depositional (?) flooding of the site gave rise to increasing numbers of reddish clay coating features, and may mark a rise in sea level.

Examples of lateral variations within the redhill sequences

6240 (M1364A; lateral variation with M1362B): This is a layer of loose, finely fragmented and very dominantly red burned briquetage and sediment clasts. There is one example of a 9mm-long, 250 µm wide monocotyledonous charcoal fragment of note that is vertically oriented (the charcoal is embedded in burned briquetage). (The layer has a very strongly enhanced magnetic susceptibility with 53.6% χ_{conv}; Table 1)

This context is composed of dumped jumble of burned salt making debris. The dominance of red burned material here is consistent with the 2nd highest $\%\chi_{conv}$ at site. The fine fragmentation could argue for trampling. Episodes of clayey alluvial sedimentation is recorded.

6241 (M1364A; lateral variation with M1362B): This layer is composed of very coarse inclusions/makeup materials. At the base of the context, there is a brickearth pottery fragment (50x30mm), in the middle a partially burned brickearth soil fragment 45x20mm), and at the top a moderately strongly burned (fused) iron-depleted piece of brickearth-based sediment (25x10mm).

These materials may imply deliberate surfacing (cobbling) of redhill deposits.

6238 (M1364A; lateral variation with M1362B): Here, there is layer of coarse void fills of finely fragmented sand to gravel size burned briquetage and sediment, and fused ash clasts; the last often as thin excrements. Abundant microlaminated yellowish brown clay coatings and infills (non-rubefied)(100-300 µm thick). Very few fine sand grains are present.

This appears to be a layer formed by the downward burrow mixing of finely fragmented (trampled and burrowed) salt making debris (with rare quartz sand of possible aeolian origin). This was succeeded by marine alluviation and clayey inwash.

M1362B (6238/6241/6240 lateral variation with M1364A)

6240 (M1362B): This is composed of mainly fine to medium anthropogenic components, with very abundant microlaminated yellowish brown void clay coatings and pan-like infillings.

6240 records trampled redhill deposits with major alluvial flooding effects and deposition of alluvial clay. (Slightly greater alluvial clay deposition compared to 1365 sequence, was noted)

6241 (M1362B): Here 6241 is mainly made up of fine, medium and moderately coarse anthropogenic components (one includes a gastropod in burned sediment; Figs 113-114), and fewer (abundant) yellowish brown void clay coatings, were noted.

6241 is perhaps a less trampled(?) spread, and shows diminishing effects of clay alluviation. No very coarse clasts/surfacing(?) evidence was found here, compared to M1364.

6238 (M1362B): Similarly, this context is formed of mainly fine, with some medium-size anthropogenic inclusions, with occasional to many thin clay void coatings. These coatings post-date the formation of very abundant thin excrements and thin to broad burrows.

6238 records bioworked trampled spreads of redhill deposits, with much less flooding/alluvial effects compared to contexts below. This perhaps demonstrates a period of stasis(?). It is possible that this context here was less wet/prone to alluviation compared to the nearby 1364 sequence; just a few cm difference in elevation could make a marked difference in these gently inundated estuarine sites.

6236 (M1362A2): This is a layer of compact, fine to medium size anthropogenic inclusions (as 6238 below), with many monocotyledonous charcoal fragments (max 3mm), with very abundant fine excrements and burrows, but only rare yellowish brown clay void coatings. A 15mm long, 2.5mm thick example of burned/fused stabling floor crust from a byre was recognised. This is compact, and comprises microlaminated long (3mm) lengths of articulated phytoliths and monocotyledonous plant remains.

Here, Context 6236 is a compacted (trampled) subaerailly weathered and bioworked occupation surface(s) on rehill deposits, which include horizontally charred byre stabling floor crust material (burned fuel waste; Figs 115-116). Byre waste was also found in hearth deposits at the roundhouse (see above)

6235 (M1362A2): This context is essentially similar to 6236, below, but slightly less compact.

This context records another series of occupation surfaces within redhill deposits.

6234 (M1362A2): This is a moderately compact, extremely heterogeneous mix of anthropogenic materials, with strongly burned phytolith-rich monocotyledonous fuel waste, with burned sediment and bricketage, brickearth pottery and many monocotyledonous charcoal including sections (2-3mm wide). A 30mm size burned flint pebble is present alongside brickearth alluvium occupation soil, rich in very fine charcoal. The latter and some fine charcoal have been mixed along very broad burrows (25mm). Only a rare trace of yellowish brown clay coating is present. (This layer has a marked LOI, χ_{max} and very strongly enhanced magnetic susceptibility - $\%\chi_{conv}$)

Occupation surface deposits in these redhill sequence are becoming more strongly influenced upwards by occupation soils formed in brickearth alluvium, and burrowing by small animals. Mixing-in of unburned humic alluvial occupation soil (and many charcoal residues) are consistent with slightly marked organic matter content (LOI) and χ_{max}.

Sequence 21 Floors in Late Roman building

6144 lowermost (M1328): The lowermost part of Context 6144 is a compact weakly humic silty clay loam containing many charcoal, phytoliths and occasional coarse sand-size briquetage variants, and example of 1.5mm long dung fragment. The layer is also poorly laminated with thin horizontal fissures, a poorly developed horizontal unistriated b-fabric, occasional textural intercalations and associated matrix void infills, and occasional amorphous 'iron' staining (Figs 117-119). In fact, EDS shows this 'iron-staining' to be made up of: 9.11-9.58% Ca, mean 9.31% Ca, *n*=3; 2.30-4.14% Fe, mean 3.27% Fe; 7.80-8.11% P, mean 7.95% P; 2.40-13.5% Sn (tin), 7.01% Sn; 46.5-54.1% Pb (lead), mean 49.1% Pb)(Figs 120-121). Thus lead (Pb) enrichment is dominant, alongside very strong concentrations of Ca, P and Sn (tin).

This lower part of 6144 is trampled/beaten 'clay floor' make up composed of varying thin spreads of mudflat 'clays', with many fine anthropogenic inclusions relating to local salt working and animal husbandry(?). The floor was muddy at times, and markedly contaminated with lead, and to a lesser extent, tin, alongside major calcium phosphate and iron staining. This indicates use of lead- and tin-based vessels for heating brine(?), and leaching of calcium phosphate fuel ash waste (see below).

6144 upper (M1328): Here, the layer is coarsely fragmented and often a burrow mixed, once layered microlaminated deposit. There are: a) ~1mm thick laminae of stained clay and fine burned material (e.g. charcoal, fine briquetage and bone, including coprolitic bone with 1.58% F (Fluorine), 16.1% P, 35.9% Ca, 5.46% Pb (lead), 0.71% S)(Fig 123), b) charcoal-rich layers (trampled fragments max 5mm thick) and c) coarse floor make up of raw clayey sediments (15mm max), brickearth and briquetage variants. Also present are coarse wood charcoal (roundwood, eg oak?; max 16mm). Trample laminae are *in situ* at the base developing above 'clay floor make up'(6144 lowermost). Major Fe-Ca-P-Pb (staining of laminated clayey floor layers and materials such as monocotyledonous charcoal (29.0% Pb) were found. Minor clay inwash features were also noted. Bulk analyses found notable levels of organic matter (LOI) and P, with very strongly enriched Pb (3580 µg g^{-1} Pb, and marked $\%_{\chi max}$ and strongly enhanced magnetic susceptibility ($\% \chi_{conv}$).

Despite sediment fragmentation, the following can be recognised: domestic trampling within, and in and out of the structure (humic clayey into structure; burned debris within). Iron staining of clayey laminae is probably associated with poor drainage, and major contamination with calcium phosphates and lead (tin also recorded below). This implies major industrial processes took place, employing tin- and lead-based vessels, the most likely for heating brine.

5752 (M1324A): This is essentially a homogeneous prismatic structured iron-depleted silty clay, with a very fine charcoal content. Sediment includes very abundant fine gravel size clasts of clayey brickearth soil-sediment, which is weakly iron stained. Intrapedal voids (channels and vughs) are partially collapsed and associated with very abundant textural intercalations; clay clasts occur as embedded grains. Rare coarse charcoal and briquetage are present at the top of the deposit.

Context 5752 is a muddy alluvium with eroded clasts of brickearth subsoil. The sediment experienced a period of ripening and structure/void formation, before flooding and renewed alluviation led to partial soil-sediment collapse.

5753 (M1324A): Similarly, 5753 is a massive, diffusely laminated fine charcoal-rich poorly sorted fine sandy silt loam. Many coarse charcoal, burned sediment and briquetage, with patches of many yellow leached fine bone (<2mm) and organic matter (human coprolitic waste), occur. Very abundant textural intercalations and partially collapsed vughs, with minor iron and manganese staining, were noted throughout.

This records muddy anthropogenic alluviation associated with on-site occupation and middening/spreads and trample(?), including disposal of human waste.

Sequence 22 Late Roman deposition (near Late Roman buildings)

1006 (M1332A2): Here, there is a massive dark brown silty clay with possible prismatic structures; relict silty laminae are also present. Many sand size burned sediment/briquetage, charcoal (max 0.5mm), with many fine yellowish coprolitic bone (max 1.5mm; Figs 124-125) occur alongside rare burned flint. Very abundant textural intercalations, associated closed vughs and embedded grains, and 200 μm thick matrix coatings on some channels/planar voids were noted, alongside possible relict sedimentary silt laminae. Very abundant Fe(P?) impregnative staining, with possible rare traces of CaP infills seem to be present.

This is a mixed soil-sediment formed through generally fine alluviation and inputs of fine anthropogenic material including both salt making briquetage and large quantities of cess. This implies very local human occupation and waste disposal.

1007b (M1332A2): Context 1007b is an unsorted coarse layer of dominantly small stones (pebbles) of flint and gravel size angular flint (often burned, mixed with medium sands. Humic, fine charcoal-rich silty clay loam soil occurs, often as burrow fills between gravel and sand. Fine material includes many fine wood charcoal often embedded in reddish iron-stained ash residues(?). Rare cess/coprolitic bone occur alongside likely FeP staining. This layer has a markedly high LOI, and is enriched in P and Cu, with strongly enhanced magnetic susceptibility - $\%\chi_{conv}$.

The layer is formed of spread/dumps of hearth and coarse hearth instalation debris, which is mixed with human waste (Cu may be derived from ashes and use of Cu-based vessels?).

1007b (M1332A1): This unit continues upwards as found in M1332A1, below, but is marked by including coarse strongly burned (calcined) bone (2-5mm; Figs 126-127). It also becomes microlayered with alluvial clay layers, and coarse wood charcoal and reddish fine soil layers.

These are further dumped spreads and occupation surface trample deposits of domestic hearth waste, food residues, and ubiquitous background latrine origin.

1007a (M1332A1): Upwards 1007a includes a very compact sloping 1cm thick layer of fine charcoal and fine bone-rich anthropogenic brickearth soil, with diffuse laminae and textural intercalations.

1007a records the compacted muddy trample of fine occupation soil.

1008 (M1332A1): This is a non-stony, compact, layered (5-7mm) and microlayered (2mm) brickearth and alluvial anthropogenic soil deposit, with very abundant coarse charcoal (max 10mm; including knotwood), which is often aligned to sloping layers. Many to abundant bone occur, including both fine orange burned and yellowish coprolitic bone. The last includes a 9mm example with poorly preserved birefringence.

Context 1008 is a domestic trampled occupation surface, or trampled sweepings. It may be an interior or protected/roofed(?) but 'disused' space (pathway?), employed for discarding domestic hearth, kitchen and latrine waste. Similar contexts have been reported from Roman London and early medieval Tours (Galinié et al., 2007; Macphail and Crowther, 2009b).

Sequence 23 Brickearth quarry pit

G42 (6462) (M1363C): This is a massive, compact, iron mottled brickearth, which includes coarse sand. Textural intercalations, iron staining and pyrite spheroids are also present (Fig 131).

This is the primary fill of a pit cut into brickearth, and records muddy slumping of the pit sides. Anaerobic water-saturated conditions led to pyrite formation.

6458b *(M1363C)*: This lower unit of 6458 is made up of laminated silts with a wide (30+mm) fill composed of decaying wood (max 10mm size fragments) and associated finely fragmented bark; it is mainly embedded in yellow, opaque and isotropic, probable jarosite/iron sulphate - $KFe_3+3(OH)_6(SO_4)_2$, as determined by SEM/EDS (mean 6.35% S, 2.47% K, 13.8% Fe)(Figs 132-133, 135-136). An example of a 5 mm-size white nodule, possibly pseudomorphic of a monocotyledonous plant stem used as fuel(?)(Fig 134).

According to the field photo (C. Carrey) this appears to be a wood lining to the pit.(Wood lining suggests this may be a 'well'/source of ground water/salt water sump; the presence of pyrite shows it was constantly waterlogged at the base. Upwards, jarosite developed as a reaction product of weathering pyrite and K-bearing deposits (Bullock et al., 1985); K could derive from ash dumps as suggested by inclusion of the white nodule fuel ash residue?). Jarosite is typical of acid sulphate marine soils (Bullock et al., 1985; Jarvis et al., 1983, 1984).

6458a *(M1363C)*: Here there is a mixed deposit of 'jarosite' soil fill and fine burned briquetage and charcoal; it is marked by thin burrowing.

This layer represents a thin anthropogenic fill from local salt making processing.

6457 *(M1363C)*: Context 6457 is a massive brickearth fill, becoming more fine charcoal rich upwards (reflecting local anthropogenic soil development), with brown alluvial clay inwash features and 'carbonate' staining of burrow fills.

Context 6457 shows how the disused pit infilled through silting, with inwash of later brown alluvium over the site, and small amounts of 'carbonate' staining of burrow fills. The last may be a post-depositional feature.

DISCUSSION

Sequence 1 (Landform development) The two monolith series (1004 and 1007) here, record the relict evidence of the early to mid-Holocene/Neolithic-Bronze Age palaeosol formed in Brickearth geology (OSL 3.6Ka, 1120 - 920 cal BC; OA 2010), and ensuing 1) marine flooding and 2) marine alluviation (OSL 2.9Ka; OA 2010). The local dryland soils formed in brickearth (here, aeolian drift over Eocene Clay) are stagnogelyic argillic brown earths (Ratsborough soil series, Ratsborough soil association, Jarvis *et al*., 1983, 1984, 243-244). The Stanford-le-Hope site is mapped as having a cover of clayey, pelo-alluvial gley soils formed in marine alluvium (Wallasea 1 soil series, Wallasea 1 soil association; Jarvis *et al*, 1983, 1984, 281-284). (Wallasea soils described by the Soil Survey of England and Wales, are, however, reclaimed soils protected by sea walls etc.)

Such mid-late Holocene marine clay-inundated terrestrial soils have been investigated, for example, from:

- Fords Park Road, Canning Town, London (Mesolithic to Bronze Age on Brickearth, River Thames; Macphail, 2010b), CTRL route, Essex (eg Neolithic Ferry Lane, River Thames; Macphail *et al.,* 2010)
- The Stumble and other River Couch and Blackwater sites, Essex (Neolithic and Bronze Age on Head; Macphail, 1994; Macphail et al 2010; Wilkinson and Murphy, 1995; Wilkinson *et al*., 2012).
- Mesolithic Goldcliff, Gwent (River Severn; Bell *et al*., 2000; Macphail and Cruise, 2000).

The site formation processes associated with this saline water inundation and subsequent burial by marine alluvium at Stanford Wharf have been reported previously (Goldberg and

Macphail 2006, 160-166; Macphail 1994, Macphail in Wilkinson *et al*., 2012), and summarised in 2010 after interdisciplinary experimental studies on newly flooded areas of Wallasea Island, River Crouch, Essex (Macphail, 2009; Macphail *et al*., 2009, 2010, table 4). In brief, the evidence suggests that at Stanford Wharf, Holocene soils with charcoal and burned flint residues of Neolithic-Bronze Age occupation, were first affected by marine (saline) water flooding. This caused the soils to slake and lose structure because sodium ions (Na^{++}) dispersed the soil, for example as in terrestrial solonetz soils which have structureless/massive topsoils because of this salt content (Duchaufour, 1982, 430-431; Bridges, 1998, 68-69). In the case of the brickearth soils at Stanford Wharf, void spaces collapsed, and whilst some soil lost its fine soil content, other areas became enriched with this dispersed fine silt and clay (forming textural intercalations). Previous features, such as earthworm burrow evidence of terrestrial soil formation also lost their structure and are now only visible as iron-stained fills, relict of once-humic burrowed soil. This dispersed soil moved down-profile, which demonstrates gentle episodic inundation and down-profile drainage (at 'low tide'). In addition, surface soil material became eroded and fragmented, and was locally transported. Equally, charcoal was liberated and also floated in this locally derived muddy 'alluvium'. Subsequent marine alluviation took various forms, including typical laminated silty clay and silts (intertidal mud flat deposits)(Boorman *et al*., 2002; Reineck and Singh, 1986, 447), and clayey alluvium. The latter is probably of local origin because it contains much fine charcoal. This inundation and the presence of marine alluvium are reflected in higher values of specific conductance ('salinity'). Ephemeral muddy 'ripened' soils (Bal, 1982) formed and include anthropogenic fragments, such as burned clay, briquetage and fused fuel ash waste (from burned monocotyledonous plants), and some rare latrine waste.

Anthropogenic materials ('White Nodules' and 'Green Glaze')

White nodules: It is suspected that these white nodules/glassy slags are fuel ash residues (R. Nicholson, pers. comm.), where fuel is often monocotyledonous plant material (see below). This is because these nodules are often semi-pseudomorphic of plant stem sections (as also seen as charred remains in the geoarchaeological sequences); in some examples studied elsewhere such nodules are simply original silicified 'straw' stems (Macphail, 2005; Shelley, 2005)(Marco Madella, Barcelona, pers. comm.). As the silica in phytoliths is in the form of plant opal ($SiO_2.nH_2O$) which becomes unstable above 573°C (Deer *et al*., 1992, 469) (without any flux being present) and barley straw can disappear above 400°C (Dammers and Joergensen, 1996), it is not surprising that hearth debris contain both partially altered vesicular stem pseudomorphs (Type 1) and strongly transformed vesicular glass (Type 2). Within the redhill deposits and hearth debris examples (where white nodules also occur), siliceous aggregates of partially melted and fused phytoliths are often ubiquitous (SMT 1b1), and these also embed charred monocotyledonous plant fragments. This again testifies to the use of this type of plant material as fuel. It can also be noted that wood includes siliceous aggregates and when burned at high temperature vesicular fuel ash glassy slags also develop (Weiner, 2010,170-172), but not as semi-pseudomorphs of plant stems.

Green glaze: The two examples of green glaze (4640A and 4640B) show the use of estuarine/mud flat sediments for salt making. Throughout the redhill deposits both pale-burned and red-burned estuarine sediment fragments occur (see below), and these are replicated by the two briquetage examples analysed; 4640A is pale because it is relatively iron-poor (1-2% Fe) whereas 4640B is rubefied (red) since it is relatively iron-rich (~6% Fe). This difference probably simply reflects the laminated nature of salt flat deposits (Macphail et al., 2010, figs 22-23; Reineck and Singh, 1986, fig 617). It is also worth noting that throughout the redhill deposits (Sequence 19), variations in magnetic susceptibility are in great part apparently related to the proportion of rubefied (Fe-rich) and pale (iron-poor) burned sediments that are present; as described below, much of this material was rooted and is likely relict of estuarine plants for fuel (plants were rooted ripening soils formed in salt marsh sediments).

The combined analyses showed that the mudflat sediments used to make the briquetage include mica-smectitie clays (later inwash alluvium is composed of kaolinite), and that these became heated (rubefied) to 400°C - <700°C, with the upper blackened part being more strongly heated (>700°C)(FTIR data). The green glaze itself is a strongly heated silicate glass (minimum 700-800°C to around/below 1000°C). Statistical Mann-Whitney U tests on microprobe data indicate that the green glaze contains significantly ($p < 0.05$) higher concentrations of Fe, P, Na and S; iron 'staining' of the glaze probably gives it its green colour. P concentrations likely derive from plant-derived fuel ash waste. Furthermore, it can be noted that, these Na (sodium) concentrations diminish from the surface, for example, from 10.1% Na (outer glaze) to 4.50% Na (inner glaze), implying that these are Na-salt (NaCl) making concentrations (EDS observations, Table 4). Microprobe mapping did show some Cl was concentrated in the green glaze, but as the embedding resin contains Cl, this result needs to be treated very cautiously. Lastly, Zn (zinc) was also seen in the analysed microprobe maps to be concentrated in the green glaze (but not in the statistical test – see above), and as argued below, this may be a result of burning marine plant material and sediment.

Sequence 6 (Three sequential anthrosols, 1380 over 1381, and 1262 by boathouse)

The 1380-1381 monoliths record a sequence of fuel ash and briquetage-debris rich spreads, where again wetland plants are probably the main fuel source (for salt making). These deposits were exposed and became bioworked, but part of their layered character is probably due to trampling. Fuel ash debris and ash remains have led to strong phosphate enrichment and increased LOI, whilst the high proportion of burned debris is reflected by very strongly enhanced magnetic susceptibility (Table 1). The exact origin of Zn enrichment in these anthrosols is not clear, but probably results from wetland fuel ash concentrations; such ash is likely also responsible for some phosphate enrichment (see EDS data, Table 4). It can also be noted that Zn is a microconstituent of organisms (<0.05%), and is also found in sea water (0.01 mg/l), inferring that ashed residues from marine wetland plants could contribute to Zn enrichment in these anthrosols and redhill deposits in general (in contrast seawater only contains 0.003 mg/l Cu, 0.008 mg/l Sn and 0.00003 mg/l Pb). The common occurrence of interdigitated marine clays within these anthrosol sequences is also consistent with very high specific conductance values, which also show that this deposit (1747, 1793, 1794) is currently very saline (intertidal).

The anthrosols can also be seen as accumulating in an outside area characterised by trampled spreads and occupation surfaces, where bioactivity, mainly evidenced by burrowing by soil mesofauna, can be common (Gé et al., 1993; Goldberg and Macphail, 2006, 211-224). These anthrosols can also be broadly grouped with Roman dark earth, where one major mechanism of formation is the dumping of refuse and its reworking by natural subaerial processes; examples of dark earth intercalated with alluvium are also recorded in the Po valley, Italy, for example (Macphail, 1994a, 2010a; Nicosia *et al*., 2012).

The upper sequence of 1262 (near boat house) has a similar origin as that of 1380-1381. The lower deposits, however, record the cutting of a channel into weakly anthropogenic alluvium, with 1) immediate infilling with disturbed clasts of alluvium and 2) inwash of presumably locally derived phytolith-rich fuel ash waste, followed by 3) renewed alluviation, prior to anthropogenic dumping.

Sequence 14 (Romano-British roundhouse outer ditch)

This outer ditch was cut into the upper part of the local Holocene brickearth soil (see Sequence 1), and the first fills record possibly three episodes of alternating: 1) clayey alluvium, 2) laminated silty clay with long (~5mm) horizontally oriented humified and sometimes charred monocotyledonous plant fragments (and charred probable dung), and 3) fine sandy loam (brickearth) layers. These occur alongside anomalous pebbles, implying local use of stones. Layer '2' material may also include burned bone, including fish bone, fine briquetage fragments, wood charcoal and fused monocotyledonous fuel ash waste. Clearly, this outer ditch was affected by marine clay alluviation, local brickearth silting, and waterlain anthropogenic material sedimentation; the last, records local disposal of byre (animal stabling) and small amounts of domestic (hearth and kitchen) waste. The layered byre refuse can be compared to experimental stabling deposits (Butser Ancient Farm, Hampshire) and its disposal in Roman, Saxon and medieval contexts (Macphail, 2011; Macphail *et al*., 2009; Macphail *et al*., 2004). It is possible that this outer area was employed as an animal enclosure. The small amounts of domestic waste found in the lower fills also occur upwards, together with additional indicators of plant processing(?)/plant use and burned constructional/fire installation debris, together perhaps recording later dismantling of the roundhouse structure. Human occupation is also evidenced by the occurrence of the later waterlain fills including the presence of mineralised probable human coprolitic material/cess (Macphail and Goldberg, 2010) in clayey alluvial fills. As shown later, *in situ* dumped human waste is present in the roundhouse hearth deposits (Sequence 17).

Sequence 15 (Roundhouse inner ditch) Here, the fills are essentially 'clean', in that they record typically fine charcoal-rich clayey alluvium (flooding), followed by sandy deposits that presumably originate from the ditch-cut substrate. On the other hand, the fills underwent some drying-out and minor soil structure formation, which probably coincided with burrowing down of anthropogenic, redhill-like deposits. In addition, burrows include coarse wood charcoal and probable human coprolitic material. This suggests that domestic occupation is penecontemporaneous with salt making, as also recorded in the outer roundhouse ditch.

Sequence 16 (Round house settling tanks) These settling tanks were cut into the brickearth substrate, and lined with lumps of local alluvial clay. During use, water in the tank(s) gently eroded the brickearth tank sides, and this sediment (1364) settled as microlaminated deposits in the lowermost fill along with fragments of the clay liner. Overlying deposits (1363, 1362) more likely represent disuse fills, and for example there is both micromorphological and bulk evidence of latrine waste dumping. In addition, most of the fills demonstrate fuel-ash waste disposal. Again, this is very dominantly of a monocotyledonous plant origin (phytolith-rich with charred leaves/stems). In addition, it is worth noting that burned dung and likely byre floor deposits are present. The latter corroborates the identification of animal management in the environs of the round house as found in the outer ditch; dung would also have provided another source of slow burning fuel in addition to supposed wetland plants. Lastly, Zn enrichment may again reflect inputs of marine plant ashes and the burned marine clays themselves. Disuse also led to latrine waste disposal into the settling tanks, producing the highest phosphate concentrations at the site (Table 1); this is a very common use of disused pits, grubenhäusser, etc. including disused industrial installations. For instance, one example of deep basins associated with presumed water heating to extract dye from murex shells in Roman Beirut, has a secondary (Byzantine?) infilling of cess with similar and even high phosphate concentrations as found in these settling tanks (18.4-47.6 mg g^{-1} Phosphate-P)(Macphail and Crowther, 2009a).

Sequence 17 (round house hearth) The two monoliths (one vertical, the other horizontal) show construction of the hearth over a slightly weathered, possibly truncated muddy, ripened brickearth alluvial loam. The hearth construction was composed of a series of layers. The outer parts are made up of raw compact brickearth, which during the lifetime of the hearth became patchily rubefied and fissured, because of heating. This is clearly associated with the various strongly enhanced magnetic susceptibility values for this feature. The inner hearth, however, includes a thin plant-tempered brickearth layer. Instead of employing ‘straw’ as in 1st C brickearth floor at No 1, Poultry, London, or as an experimental ‘Roman’ oven at West Heslerton, North Yorkshire (Macphail, 2003; Macphail and Goldberg, 2010, figs 5-6; Macphail and Linderholm, 2011), marine wetland *Juncus* leaves, seem to have been employed (‘Sea Rush’, Kath Turner, pers. comm.). These became charred during the use of the hearth. It can also be noted that this thin layer shows the only sign of Pb enrichment here. This both reflects the absorption properties of charcoal and possible use of lead vessels here (for much more convincing evidence of lead use see Sequence 21). Additionally, lime/cob-plastered brickearth may have been used in this inner layer, but because of heating the lime/cob the calcium carbonate ($CaCO_3$) is no longer birefringent, but is typically whitish under OIL. Moreover, EDS found it to be higher in Ca compared to brickearth in general (Table 4). This lime/cob construction identification should be still viewed with some caution, however. Some of the makeup also included ashed plant remains from previous fires (fused phytoliths) and strongly burned sands and brickearth. Compared to the constructional layers, the 'central' fill of the hearth is a loose mixture. Again, the ashed residues of monocotyledonous plants occur as fused phytoliths, but more strongly heated white nodules (vesicular siliceous glass; see above) and melted sands and fused brickearth occur. Although quartz types on its own require some 1600-1700° C to melt (Deer *et al*., 1992, 458), the fluxing effects of ashes here may probably indicate temperatures of >700-800, but probably <1000 (see green glaze FTIR). Plant opal of phytoliths melts at relatively low temperatures (see above). Latrine/human waste was also dumped into the hearth, and shows moderate heating; it has a calcium phosphate chemistry, embedded possible nematode eggs and ferruginised likely remains of food, as typical of human coprolites (Courty *et al*., 1989; Macphail and Goldberg, 2010). The values for phosphate-P are the highest at Stanford Wharf. As noted above, ashed fuel residues and latrine waste were also thrown into the settling tanks, as a disuse feature. It is possible that this practice was a major secondary use of the settling tanks. Lastly, inundation effects have resulted in very strongly marked specific conductance values, as found in newly created salt marsh today (Boorman *et al*., 2002; Macphail *et al*., 2010).

Romano-British roundhouse

In summary, this feature was studied employing monoliths through the inner and outer ditches of this structure, together with its hearth and settling tanks. Individual features were cut into a variety of local substrates, for example, the outer ditch was cut into alluvial clay, whereas the settling tanks were excavated into brickearth, and alluvial clay was employed as a liner. The hearth was constructed employing brickearth 'clay', supported by a layer of possible sea rush leaves (see Turner, this vol); a cob- or lime plastered-brickearth may have lined the hearth. The loose fill of the hearth was mainly composed of monocotyledonous fuel ash waste (siliceous vesicular white nodules, fused phytoliths, charred monocotyledonous remains) and burned hearth remains (strongly burned brickearth and sands). Very small lead enrichment of the charred sea rush liner may infer the possibility of use of lead vessels, but very much more convincing evidence was found at Late Roman Sequence 21. The settling tanks, first show the effect of holding water (microlaminated silty clay sediments gently eroded from the tank sides), and then disuse, i.e., the upper fill of monocotyledonous fuel ash waste. Here again, the enrichment in Zn may be the result of ashing marine wetland plants. In addition to salt making activity employing fire installations (hearth) and tanks, the site also records *in situ* or very nearby animal management, with waterlain byre waste being found in the lower outer ditch fills for example. Dung was seemingly also employed as another, presumably slow burning fuel, in addition to wetland plants. Domestic occupation was recorded by small instances of wood charcoal, burned bone, including fish bone, and human coprolitic waste. Some human faecal material was washed into the ditch fills, whereas small to moderate (settling tanks) and very large amounts (hearth) were also disposed of. While latrine waste discard was evidently contemporary at the settling tank, some of the infill material here and at the hearth appears to be slightly later. It is possible that this practice was a major secondary use of the features. Lastly, inundation effects have resulted in very strongly marked specific conductance values, as found in newly created salt marsh today.

Redhill sequences (Sequence 19) 25 thin sections and 7 bulk samples were analysed from redhill deposits including both vertical sequences and some lateral comparisons. This appears to be the first systematic microstartigraphic study of redhill deposits/salterns even though the phenomenon of redhills has been a focus of archaeological interests since the first decade of the 20th century (Wilkinson and Murphy, 1995, 168-195). At the sampled locations at Stanford Wharf, redhill deposits occur over the truncated and inundation-transformed Holocene soil (as found elsewhere in Essex for example, Wilkinson and Murphy, 1995). Initial redhill depositional effects, however, are characterised by waterlain fine redhill sediments, presumably washed from other developing redhill accumulations. Typical redhill deposits are fine to coarse in character, and all have a strongly enhanced magnetic susceptibility (χ_{conv} range, 27.7–53.6%), which is clearly consistent with these deposits being affected by heating/burning. Apart from context 6234 (LOI, 4.05%), the deposits are poorly humic. This is consistent with them being almost dominantly composed of burned (mainly minerogenic) phytolith-rich fuel ash waste, and rubefied ripened salt marsh sediment which, hypothetically, was collected alongside wetland monocotyledonous plant fuel. In addition, pieces of briquetage and pottery manufactured from estuarine sediments and brickearth occur.

Some examples of burned salt marsh intertidal sediment clearly show original laminae that are probably relict of ferruginised algal layers, as found in the modern Wallasea Island analogue (Macphail, 2009; Macphail *et al*., 2008a). In addition, this and many other examples show surface rooting channels, and imply that when wetland plants were gathered, sediment fragments were still attached. Thus, when used as fuel in salt making, this produced a very large quantity of minerogenic 'ash' waste, hence the likely rapid accumulation of the redhill deposits. A clear analogy can be made with the use of minerogenic peats and soil peat as a prehistoric fuel in Scotland and its islands, where 'farm mounds' are typical features (Carter, 1998a, b). In addition, these wetland plant fuels and attached sediment, can be perhaps viewed as slow burning fuel; it is therefore not surprising to find the occasional inclusion of burned byre waste (Macphail *et al*., 2004), as also found at the roundhouse site. It can be suggested that the redhills accumulated as spreads, and that these were trampled forming ephemeral occupation surfaces (Gé *et al*., 1993). Trampling seems to have led to the finer fragmentation of the more fragile plant-derived phytolith-rich fuel ash waste, compared to the more indurated burned sediment and briquetage. It is possible that larger fragments became horizontally oriented by trampling, and that some surfaces may have been 'cobbled' with larger fragments, but the analysis of lateral 'control' samples do not suggest that this as not just simply accidental or was widespread. It can also be noted that burrowing by small mesofauna took place as a form of sub-aerial weathering process on these essentially 'sterile' deposits (see Chemistry, above). As these are very dominantly deposits of burned material, the very strongly enhanced magnetic susceptibility values are not unexpected (Tite and Mullins, 1971). Some differences in values, however, can be perhaps related visually to a preponderance of the more strongly reddened burned sediment fragments (Crowther, 2003; Crowther and Barker, 1995).

During the formation of the redhill deposits, these were variously affected by inwash of clay. Some of course may be associated with dispersed clay translocation, but most probably result from flooding events. Certainly, the uppermost parts are influenced by alluvial clay sealing the redhill at this location.

Sequence 21 Floors in Late Roman building Two monolith samples here found floor deposits (6144) and *in situ* estuarine sediments (5752-5753); the latter were strongly influenced by occupation deposits including latrine waste. Floor deposits are typical sub-laminated 'domestic' beaten floor accumulations (Macphail *et al*., 2004), and document:

- a mudflat clay floor make up, and
- muddy laminated floor deposits that record:
    - interior trampling (fine burned mineral material, charcoal, burned bone), and
    - traffic from outside (more clay-rich laminae).

Such cyclical beaten floor accumulations have been reported from Roman and medieval London for example (Goldberg and Macphail, 2006, fig 11.15; Macphail and Crowther, 2009b). Bulk analyses found 6144 to be very strongly enriched in lead (3580 $\mu g\ g^{-1}$ Pb, Table 1), the highest amounts by far found at Stanford Wharf, but no lead metal fragments were found in thin section. Instead, very high amounts of lead (max. 54.1% Pb; Table 4) were associated with visually apparent 'iron' staining in the floor deposits. This occurred alongside high concentrations of P, Ca and Sn (tin; not included in bulk analyses). This staining therefore, records localised waterlogging and the mobilisation of tin and lead (presumably from vessels used to heat brine), and P and Ca associated with fuel ash and latrine waste weathering (cf. London Guildhall dark earth below early medieval deposits; Macphail *et al*., 2007, 2008b). The dominance of lead suggests that perhaps lead vats were employed here for Late Roman salt making (E. Biddulph etc., pers. comm.).

Sequence 22 Late Roman deposition (near Late Roman buildings) This depositional sequence is clearly of domestic and probably associated, salt making origin, and presumably derives from the late Roman buildings. The lowermost fills are semi-waterlain with marine alluvium, but upwards the deposits are drier and increasingly anthropogenic material-rich. Burned bone and wood charcoal are of kitchen hearth origin probably, whereas coprolitic bone, amorphous cess and amorphous FeP(?) indicate inputs of latrine waste. Layered and microlaminated deposits argue for the trampling of domestic waste sweepings, possibly in a roofed/protected space at the edge of the buildings. Such deposits are associated with occupation and waste disposal (cf. 7th-8th C Square Prosper Merimée, Tours; Fondrillon, 2007; Galinié *et al*., 2007).

Sequence 23 Brickearth quarry pit Although first interpreted as a cess pit because of the yellow fill towards the base, it appears that the pit is more likely to have been a brickearth quarry pit, for making briquetage and constructing hearths (see above). It also seems to have been lined with bark covered wood over the primary inwashed fill. It is possible that the pit may also have then acted as a well, or sump for salt water. The presence of pyrite spheroids in the primary fill shows that it was waterlogged; other wells with permanent waterlogging have been found to feature pyrite (Viklund *et al*., Forthcoming). The area around the wood is yellow, not because it is cess filled, but because probable jarosite (iron potassium sulphate) has formed (S [6.92%], SO3 [17.3%] and Fe [15.3%], FeO [19.7%], with 2.65% K [3.19% K_2O]). Interestingly, although jarosite can be a feature of acid sulphate marine soils, it develops as a reaction product of weathering pyrite and K-bearing deposits (Bullock *et al*., 1985; *Jarvis et al*., 1983, 1984); potassium could have been derived from the dumping of ash here, as suggested by the presence of a 5mm-size fuel ash nodule.

CONCLUSIONS

49 thin sections were studied employing soil micromorphology and associated SEM/EDS (Energy Dispersive X-Ray Spectrometry), X-Ray microprobe and FTIR (Fourier Transform Infrared Spectrometry). 24 carefully correlated bulk samples from the same monolith sequences also provided complementary chemical and magnetic susceptibility data, including information on organic matter (LOI), phosphate, salinity (specific conductance) and heavy metals (Cu, Pb and Zn). *Sequence 1* records the effects of marine inundation on the Neolithic and Bronze Age palaeosols formed in brickearth. Salt water sodium ions (Na^{++}) led to soil dispersion and structural collapse. This did not affect large charcoal and flint flakes within the soil, but finer charcoal and surface charcoal were probably liberated and floated locally. The uppermost soil was truncated, and this charcoal-rich material formed basal laminae in the marine alluvium. Truncated and marine inundation-transformed Holocene palaeosols were found elsewhere for example under redhill sequence 16. *Anthropogenic reference materials* associated with salt making were analysed ahead of studying the anthrosols and redhill deposits. 'White nodules' are vesicular siliceous glass bodies, occurring as either hollow circular nodules that are partially pseudomorphic of monocotyledonous plant stems and leaves, or as more strongly melted aggregates. These develop from plant silica (opal) usually in the form of phytoliths, and partially melted and fused phytoliths are ubiquitous at Stanford Wharf. Plant opal has a much lower melting point compared to quartz. These white nodules are thus a form of fuel ash formed by the combustion of monocotyledonous plants, and differ from siliceous fuel ash formed from wood, for example. Examples of 'green glaze' on briquetaage were also analysed. The briquetage is 'manufactured' from estuarine sediments with a mica-smectite clay component. Sections through the green glaze briquetage record the increasing effects of heat upwards causing, 1) 'rubefication' (400°C - <700°C), with the

upper blackened part being more strongly heated (>700 °C). The green glaze itself is a strongly heated silicate glass (minimum 700-800°C to around/below 1000°C). The dominantly siliceous glaze contains statistically significant greater quantities of Na (sodium), P (phosphorus) and Fe (iron) compared to the briquetage. Fe possibly gives it a greenish colour, and P is probably concentrated from burned fuel. It is possible that Zn (zinc) may also have a similar origin (marine plants and sediment may have concentrated Zn from sea water). Amounts of Na are anomalously high but diminish away from the glaze surface; this can be viewed as supporting a salt (NaCl) making origin for this green-glazed bricqutage. The distribution of Cl (chlorine) shows a similar pattern, but as the resin embedding the briquetage include Cl, such findings must be viewed with much more caution. *Anthrosol sequence 6* is largely composed of briquetage debris and fused phytolith-rich fuel ash waste, which also contains many 'white nodules'. This is reflected in their high phosphate and magnetic susceptibility values; notably high Zn values may again possibly be associated with marine wetland plant fuel concentrating Zn for sea water. These anthrosols form exterior space-trampled and mesofauna-worked accumulating spreads. They also include interdigitated marine alluvium showing that they are still located in the intertidal zone; they display the highest specific conductance ('salinity') values at Stanford Wharf. Conceptually, these anthrosols can be regarded as a special form of Roman 'dark earth'. *Romano-British round house sequences 14-17*, show that the outer ditch was cut into marine clay, where waterlain fills developed; a basal layer included laminated byre waste, indicating animal management, and debris of burned hearth and kitchen (e.g. fish bone) origin. Here, and in the inner ditch where natural alluviation predominates, human cess and coprolitic waste again indicate domestic occupation. The settling tanks were cut into brickearth and lined with marine alluvial clay. Lower, microlaminated waterlain fills, which also include cess traces, confirm that these settling tanks held water. The upper fills, however, are dominated by phytolith and fused phytolith-rich monocotyledonous fuel ash waste; burned byre floor waste was also found suggesting that this material could also have been employed as a slow-burning fuel, as well as confirming the local stabling of stock. The very high phosphate levels in these deposits also results from the presence of latrine waste; such installations often have a secondary 'cess pit' use. The round house hearth was constructed employing brickearth 'clay', supported by a layer of possible sea rush leaves (*Juncus maritimus*; see Turner, this vol); a cob- or lime plastered-brickearth may have lined the hearth. The loose fill of the hearth was mainly composed of monocotyledonous fuel ash waste (siliceous vesicular white nodules, fused phytoliths, charred monocotyledonous remains) and burned hearth remains (strongly burned brickearth and sands). Again, notably high phosphate concentrations in part reflects inputs of cess dumped into the hearth. Lastly, very small lead enrichment of the charred sea rush liner may infer the possibility of use of lead vessels, but very much more convincing evidence was found at Sequence 21. *Redhill sequence 19* examined a profile and lateral examples of deposits dominantly composed of red burned mineral material that have the highest magnetic susceptibility values at Standofrd Wharf. Sometimes this was in the form of briquetage employing marine clay and or brickearth, but mainly redhill is predominantly made up of burned salt marsh sediment which had been incidentally gathered alongside marine wetland plant fuel. Fragments often show relict root channels that formed in this vegetated ripening sediment; rare examples may preserve algal stained laminae typical of modern salt marsh sedimentation. Thus redhills probably formed rapidly due to the dumping of minerogenic fuel ash waste, a formation process similar to farm mound accumulations where minerogenic peat was used as a fuel. Redhills also include more fragile phytolith-fuel plant ash waste, and this has been burrowed by mesofauna. General fragmentation occurred because the spreads formed ephemeral trampled 'occupation surfaces'; marine clay inwash also occurred at times. *Floors in Late Roman building Sequence 21* found on-site estuarine sediments to be strongly influenced by occupation deposits including latrine waste, and a series of beaten floor deposits formed in the structure under generally moist conditions. The latter also record alternating: 1) hearth and kitchen waste from internal trampling, and 2) incorporation of alluvial clay from outside. More importantly very high lead enrichment (3580 $\mu g\ g^{-1}$ Pb) was found to be associated with 'iron' staining of the floors (EDS maximum 54.1% Pb), clearly indicating use of lead vessels, as suggested for late Roman salt making. Small amounts of Sn (tin) imply other metal vessels may have been used here. *Sequence 22, Late Roman deposition near Late Roman buildings*, is composed of layered deposits that include sands, brickearth and domestic hearth, kitchen and latrine waste. It can be suggested that these are trampled floor sweepings. *Sequence 23, the brickearth quarry pit* was possibly a wood-lined well or salt water sump, used after the extraction of brickearth for constructional and manufacturing purposes formed a pit. Pyrite at the base testifies to its waterlogged nature. The yellow colour of the fill around bark-covered wood is due to the formation of jarosite (iron potassium sulphate), which forms in marine acid sulphate soils, developing as a reaction product of weathering pyrite and K-bearing deposits. Ash dumping in the pit, as indicated by a large 'white nodule', may have provided this potassium.

ACKNOWLEDGEMENTS

The authors thank Edward Biddulph, Chris Carey, Stuart Foreman, and Rebecca Nicholson for samples, information and discussion. Kath Turner kindly suggested a 'sea rush' identification for charred plant remains seen in thin section. Kevin Reeves (IoA, UCL) is thanked for facilitating EDS and Microprobe studies.

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Table 1: London Gateway (COMPA09) thin section-associated bulk samples; analytical data (excludi –which is presented in Table 2)

Sequence/ Context	LOI[a] (%)	Specific cond[b] (µS)	Phosphate-P[c] (mg g^{-1})	Pb[d] (µg g^{-1})	Zn[d] (µg g^{-1})	Cu[d] (µg g^{-1})	χ (10^{-8} m^3 kg^{-1})
1/1132	2.04	**535****	0.821	17.2	31.1	6.5	21.0
1/1135	2.42	**530****	2.49	16.5	49.6	14.3	57.3
1/1136	2.87	**550****	3.68*	14.3	73.1	17.5	84.6
1/8506	2.10	**516****	1.21	15.8	38.4	10.2	34.3
6/1747	**4.26***	**2040*****	**8.93****	18.0	**197***	36.0	347
6/1793	2.62	**1770*****	2.72	16.2	72.4	16.2	20.3
6/1794	**4.03***	**2080*****	**6.95****	20.9	**181***	33.3	226
16/1362	**6.90****	**395***	**17.9*****	14.9	**434****	**78.2***	145
16/1363	**8.00****	**381***	**18.9*****	17.0	**418****	**75.7***	164
17/1593	**3.82***	**310***	**18.7*****	14.9	**203***	37.9	212
17/1485	**6.33****	n.d.[g]	**15.4*****	**43.5***	**231***	**91.6***	279
17/1597	1.30	192	1.53	12.8	41.6	13.9	128
17/1594	1.20	149	0.820	10.8	27.5	7.9	71.9
17/1593 blackish	**16.7*****	**380***	**4.34***	16.4	**102***	**93.5***	152
17/1593 grey/ashy	**5.80****	**346***	**12.6*****	15.1	**163***	46.6	241
19/6234	**4.05***	194	2.85	17.7	49.5	11.8	334
19/6240	2.43	220	1.69	17.0	54.5	13.3	310
19/6371	2.30	132	1.95	16.3	55.8	11.6	342
19/6373	1.83	129	1.18	15.4	49.9	8.3	243
19/6024	1.92	145	1.08	12.1	38.6	7.2	159
19/6378	2.25	155	1.25	15.6	39.0	8.7	77.6
19/6377	1.92	162	1.15	14.2	41.4	10.3	173
21/6144	**3.59***	169	**3.18***	**3580*****	43.3	15.2	177
22/1007	**6.46****	146	**4.97***	20.8	62.4	**67.0***	84.5

[a] **Loss-on-ignition:** Figures highlighted have notably higher values: * = 3.00–4.99%, ** = 5.00–9.99%, *** = 10.0=19.9%

[b] **Specific conductance:** Figures highlighted have notably higher values: * = 200–499 µS, ** = 500–999 µS, *** = >1000 µS

[c] **Phosphate-P:** Figures highlighted show signs of phosphate-P enrichment: * = enriched (2.50–4.99 mg g^{-1}), ** = strongly enriched (5.00–9.9 enriched (≥ 10.0 mg g^{-1}) – phosphate fractionation data are presented in Table 2

[d] **Pb, Zn and Cu:** Figures highlighted show likely enrichment: * = slightly enriched, ** = enriched , *** = strongly enriched (criteria differ fo

[e] χ_{max}: Figures highlighted have notably higher values: * = 750–999 x 10^{-8} m^3 kg^{-1}, ** = >1000 x 10^{-8} m^3 kg^{-1}

[f] χ_{conv}: Figures highlighted in bold show signs of magnetic susceptibility enhancement: * = enhanced (χ_{conv} = 5.00–9.99%), ** = strongly enh very strongly enhanced (χ_{conv} ≥ 20.0%).

[g] **n.d.** = not determined (insufficient sample supplied)

Table 2: London Gateway (COMPA09) thin section-associated bulk samples; Phosphate fractionatio

Sequence/ 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 (%)
1/1132	0.616	0.205	0.821	75.0	25.0
1/1135	2.18	0.314	2.49	87.4	12.6
1/1136	3.33	0.35	3.68	90.5	9.5
1/8506	1.03	0.179	1.21	85.2	14.8
6/1747	8.48	0.452	8.93	94.9	5.1
6/1793	2.48	0.24	2.72	91.2	8.8
6/1794	6.66	0.291	6.95	95.8	4.2
16/1362	16.6	1.31	17.9	92.7	7.3
16/1363	17.6	1.34	18.9	92.9	7.1
17/1593	18.0	0.673	18.7	96.4	3.6
17/1485	14.6	0.769	15.4	95.0	5.0
17/1597	1.43	0.102	1.53	93.3	6.7
17/1594	0.750	0.070	0.820	91.5	8.5
17/1593 blackish	3.67	0.673	4.34	84.5	15.5
17/1593 grey/ashy	11.9	0.713	12.6	94.3	5.7
19/6234	2.30	0.554	2.85	80.6	19.4
19/6240	1.27	0.417	1.69	75.3	24.7
19/6371	1.59	0.364	1.95	81.4	18.6
19/6373	0.891	0.284	1.18	75.8	24.2
19/6024	0.785	0.291	1.08	73.0	27.0
19/6378	1.02	0.232	1.25	81.5	18.5
19/6377	0.872	0.277	1.15	75.9	24.1
21/6144	2.79	0.388	3.18	87.8	12.2
22/1007	4.52	0.447	4.97	91.0	9.0

Table 3: London Gateway (COMPA09); Thin sections and associated bulk samples; soil micromorphology counts

Thin section	Relative Depth	Context	Bulk	MFT	SMT	Voids	Stones	White Nod. Type 1	White Nod. Type 2	White Nod. Type 3
Sequence 1										
M1004A	13-17 cm	1135		D2	6a2	40%				
M1004A	17-21.5 cm	1136	x1135	D1	6a1	30%				
M1004B1	26-33.5 cm	1136	x1136	D1	6a1(5a1,7a1)	40%				
M1004B2	33.5- 42 cm	8506 (1136)	x8506	C2	5a1(6a1,6a2)	35%		(a*)		
M1007A	20-27.5 cm	8506/1142		C1	1b1,1a1-3,6a4	20%, 40%		aaa	aa	aaa
M1007B1	27.5-30.0 cm	1143		E4	Clay Lam	40%				
M1007B1	30-30.5 cm	1077		E3/E 2	7a4/7a1, 7a3	30%				
M1007B2	35.0-42.5	1145		E1	7a1 (7a2)	20%				
Sequence 6										
M1380A	17-25 cm	1746		D3	5a2,6a4,4a2,1a 1-3	40%		a	aaa	a*
M1380B1	25-30 cm	1747	x1747	C2	5a2,1b3	35%				
M1380B1	30-32.5m	1793	x1793	C4	5a2	40%				

M1380B2	35.5-39cm	1793		C3	5a1(1a2,6a4)	30%				
M1380B2	39-42 cm	1794	x1794	C2	1b1/2,1a1-3,6a4,5a	40%		aaa	aaa	a
M1381A	33-36 cm	1794		C2	1b1/2,1a1-3,6a4	40%		aaaa	aaaa	a
M1381A	36-41 cm	1837		C1	6a4(1a-1b)	40%(20%)		aa	aa	a
M1262A1	21.5-28 cm	5732		D3	5a2,6a4,4a2,1a1-3	45%		a	a	a*
M1262A2	28-35.5 cm	5731		C2	6a2,1b1,1b3	30%		a*	a*	
M1262B	35.5-37.5(38.0)	5731		C2	6a2,4a2	30%		a	a*	
M1262B	37.5(38.0)-40(42.0)cm	5731		C1	1b2	45%				
M1262B	40(42.0)-43cm	5727		D4	6a2	30%				
Sequence 14										
M1203A	3.5-11 cm	5430		C2	5a	35%	f			
M1203B1	13.5-21.5 cm	5429 upper		F3	3a3(3a1)	60%				
M1203B1	18-20.5 cm	5429 lower		F2	6a5, 4a	30%		a	a*	
M1203B1	20.5-21.5 cm	5428		F1	6a4	25%				
M1203B2	21.5-27.5 cm	5428		F1	6a4	70%?	fff		a-1	

M1203B2	27.5-28 cm	5433		E1	7a1	20%			
Sequence 15									
M1202B	27-31(34.0) cm	5328		F4	6a1,6a2(5a1)	25%			
M1202B	31(34)-34.5 cm	5332		E2	7a1(6a1,6a2)	30%	*		
Sequence 16									
M1224A	0-8 cm	1362/1363	x1362	C2a	1b1,4a2	35%		a	a
M1224B	13-18 cm	1363	x1363	C1	1b1,4a2	30%		a*	a*
M1224B	18-21 cm	1364		F5	4a2, 5a3	40%(20%)			
Sequence 17									
M1151A	3-7 cm	1593	x1593	G1	1b1,8a2,8a4	40%		aa	a
M1152A	7-8 cm	1485	x1485	G2	1b1,8a1,8a2,8a3	25%		a	a
M115A	8-10.5 cm	1593 lower		G1	1b1,8a2,8a4	35%		aa	a
M1151B	10.5-11.5 cm	1595		G4a	8a1,8a2	35%			
M1151B	11.5-13 cm	1598		G4a	8a1,8a2	35%			
M1151B	13-16.5 cm	1597	x1597	G4	8a1(8a4)	25%			
M1151B	16.5 -18 cm	1599		E3	7a1	30%			

M1152A	16-19.5 cm	1595		G4	8a1(8a4)	25%		
M1152A	16-24 cm	1594	x1594	G3	8a2	35%		
M1152B	24-25(25.5) cm	1594		G3	8a2	35%		
M1152B	25(25.5)-25.5 cm	1593	x1593 blackish	G2	1b1,8a1,8a2,8a3	25%	a	a
M1152B	25.5-32 cm	1593	x1593 greyish/ashy	G1	1b1,8a1,8a2,8a4	35%	aa	a
Sequence 19								
M1362A1	0-7.5 cm	6234	x6234	C2c	1a1, 3a1,3a2, 4a1, 1b1, 5a5	30%		
M1362A2	7.5-10.5 cm	6235		C2	1a1,3a1,3a2, 4a1, 1b1	25%		
M1362A2	10.5-15 cm	6236		C2	3a1,3a2, 4a1, 1b1	25%		
M1362B	31-39 cm	6238/6241/6240 lateral variation		C2	3a1,3a2, 4a1, 1b1	35%		
M1364A	41-42(43.5)	6238		C2	3a1,3a2, 4a1, 1b1	60%		
M1364A	42(43.5)-46(49) cm	6241		C2b	3a1, 8a	35%		
M1364A	46(49)-50 cm	6240	x6240	C2	3a1,3a2,4a1,1b1	30%		

M1365A1	6-13.5 cm	6375/6343		C2	3a1,3a2,4a1,1b1	30%	
M1365A2	13.5-21 cm	6370/6371		C2	3a1,3a2,4a1,1b1	30%	
M1365B	33.5-35.5 cm	6371	x6371	C2	3a1,3a2,4a1,1b1	30%	
M1365B	35.5-41.5 cm	6373	x6373	C2	3a1,3a2,4a1,1b1	30%	
M1366A	21-28 cm	6373		C2	3a1,3a2,1b1	35%	
M1366B1	28-42 cm	6374/6024	x6024	C2	3a1,3a2,5a4etc	30%	
M1366B1	31(33)-33.5cm	6378	x6378	C5	5a4,5a5	40%	
M1366B2	35.5-37 cm	6378		C5	5a4	35%	
M1366B2	37-40 cm	6379		C2	5a5	40%	*
M1366B2	40-42 cm	6377	x6377	C5	5a4	35%	
M1366C	42-42.5(46.0) cm	6377		C5	5a4,5a5	35%	
M1366C	42.5(46.0)-50 cm	6389		D2	6a	20%	*
GAT-1371A1	0-55 mm	6238		C2	3a1,3a2,4a1,4a2,1b1	40%	
GAT-1371A1	55-75 mm	6241		E3(C2)	7a2,7a4,3a,4a,1b	35%	
GAT-1371A2	75-90 mm	6241		E3(C2)	7a2,7a4,3a,4a,1b	35%	

GAT-1371A2	90-110 mm	6022a		E2	7a2/7a1	15%	
GAT-1371A2	110-120(140) mm	6240		C5	5a4,7a2	10%	
GAT-1371A2	120(140)-150 mm	6022b		E1	7a1	20%	
Sequence 21							
M1324A	0-2 cm	5753		C4	5a2	20%	
M1324A	2-8 cm	5752		C3	5a1	30%(15%)	
M1328	14-20 cm	6144 upper	x6144 upper	H2	3a1,3a2,4a1,4a2,9b	40%	
M1328	20-22 cm	6144 lowermost		H1	9a	20%	*
Sequence 22							
M1332A1	14.5-18.5 cm	1008					
M1332A1	18.5-22 cm	1007	x1007	C2	4a1/6a1	20%/50%	ffff
M1332A2	22-27 cm	1007		C2	6a1	50%	fffff
M1332A2	27-29.5 cm	1006		D1	6a1	35%(15%)	
Sequence 23							

GAT-1363C	36-37.5(38) cm	6457		F8	7a1,7a2(7a5)					
GAT-1363C	37.5(38)-43 cm	6458a, 6458b		F7	7a5	35%		a-1		
GAT-1363C	43-43(44) cm	6462 (G42)		F6	7a1	20%				
Miscellaneous										
Green Glaze										
4240A1				B1	2a1,3a1,4a1					
4240A2										
4240B1				B2	2a1,3a1,3a2,4a 1					
4240B2										
White nodules										
1593		1330	x1593	A1	1a1, 1a2			x3	x4	?
1597		1329		A2	1a1, 1a2			x1	x13	
1617		1321		A2	1a1, 1a2			x3	x16	
5565		1216		A1	1a,1a2,1a3			x4	x8	x1

Table 3, cont.

Thin	**Relative**	**Context**	**White**	**Silic**	**Silica**	**Fused**	**Str. burne**	**Red-**	**Burned**	**Charco**

section				a			d	burned		al
	Depth		Nods.	ash?	glass	phytoliths	sed daub	sediment	Brick-earth	
Sequence 1										
M1004A	13-17 cm	1135					aa	a*		aaa
M1004A	17-21.5 cm	1136					aa	aa		aa
M1004B1	26-33.5 cm	1136					aaaa	aa		aa
M1004B2	33.5- 42 cm	8506 (1136)	(aa)			a	(aaa)	(a)		a(aaa)
M1007A	20-27.5 cm	8506/1142				aaaaa	aaa	aa		aaaaa
M1007B1	27.5-30.0 cm	1143					aaa			aa
M1007B1	30-30.5 cm	1077								a*
M1007B2	35.0-42.5	1145								a
Sequence 6										
M1380A	17-25 cm	1746					aaaa			aaa
M1380B1	25-30 cm	1747	aaa				aaaaa			aaaaa
M1380B1	30-32.5m	1793					a			a
M1380B2	35.5-39cm	1793	a				aa			a*
M1380B2	39-42 cm	1794	aa			aaaa	aaaaa	aaa		aaa

M1381A	33-36 cm	1794	aaa	aaaaa	aaaa		aaaaa
M1381A	36-41 cm	1837	aa	aa	aaa		aa
M1262A1	21.5-28 cm	5732		a*	aaa	a	aaa
M1262A2	28-35.5 cm	5731		aaa	aa		aa
M1262B	35.5-37.5(38.0)	5731		a	a		aa
M1262B	37.5(38.0)-40(42.0)cm	5731		(aaaaa)	aa		aa
M1262B	40(42.0)-43cm	5727		a	aa	a	aa
Sequence 14							
M1203A	3.5-11 cm	5430			a	aa	a
M1203B1	13.5-21.5 cm	5429 upper		(a)		aaaaa	aa
M1203B1	18-20.5 cm	5429 lower		(aaaaa)			aaaaa
M1203B1	20.5-21.5 cm	5428					aa-aaa
M1203B2	21.5-27.5 cm	5428					aa-aaa
M1203B2	27.5-28 cm	5433					
Sequence 15							
M1202B	27-31(34.0) cm	5328			aaa	aaa	aa
M1202B	31(34)-34.5 cm	5332		(a)	a	a	

Sequence 16								
M1224A	0-8 cm	1362/1363	a	aaaaa	aa	aaaa		aaaaa
M1224B	13-18 cm	1363		aaaaa	a*	(aaaaa)		aaaaa
M1224B	18-21 cm	1364			aa			aaaa
Sequence 17								
M1151A	3-7 cm	1593	aaa	aaaaa		aa	aaaaa	a
M1152A	7-8 cm	1485		aaa		a	aaaaa	aaaaa
M115A	8-10.5 cm	1593 lower	aa	aaaaa	a-1		aaaaa	a(aaa)
M1151B	10.5-11.5 cm	1595					aaaaa	
M1151B	11.5-13 cm	1598					aaaaa	
M1151B	13-16.5 cm	1597					aa	a*
M1151B	16.5 -18 cm	1599						aaaa
M1152A	16-19.5 cm	1595					aa	
M1152A	16-24 cm	1594					aaaaa	
M1152B	24-25(25.5) cm	1594					aaaaa	
M1152B	25(25.5)-25.5 cm	1593		aaa		a	aaaaa	aaaaa
M1152B	25.5-32 cm	1593	aa	aaaaa	a-1		aaaaa	a(aaa)
Sequence								

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M1362A1	0-7.5 cm	6234	a	aaaa	aaaaa	aaaaa	aa	aa
M1362A2	7.5-10.5 cm	6235	a	a	aaaaa	aaaaa		aaa
M1362A2	10.5-15 cm	6236		aa	aaaaa	aaaaa	a	aaa
M1362B	31-39 cm	6238/6241/6240 lateral variation		a	aaaaa	aaaaa	aa	
M1364A	41-42(43.5)	6238		aa	aaaaa	aaaaa	a	
M1364A	42(43.5)-46(49) cm	6241			aaaaa		aaaaa	
M1364A	46(49)-50 cm	6240		aa	aaaaa	aaaaa	aa	aa
M1365A1	6-13.5 cm	6375/6343		aa	aaaaa	aaaaa	aa	aa
M1365A2	13.5-21 cm	6370/6371		a	aaaaa	aaaaa	aa	aa
M1365B	33.5-35.5 cm	6371		aa	aaaaa	**aaaaa**	aaa	a
M1365B	35.5-41.5 cm	6373		aa	aaaaa	aaaaa	aaa	a
M1366A	21-28 cm	6373		aaaaa	aaaaa	aaaaa	aaaaa	a
M1366B1	28-42 cm	6374/6024	a*	aa	aaaaa	aaaaa	aaaaa	aa
M1366B1	31(33)-33.5cm	6378			a*	a*		aaaa
M1366B2	35.5-37 cm	6378			aa	aa		aaaa
M1366B2	37-40 cm	6379			aaa	aaa		aaaa
M1366B2	40-42 cm	6377	a*		aa(aaaaa)	aa(aaaaa)		aaa

M1366C	42-42.5(46.0) cm	6377	a*		aa(aaaaa)	aa(aaaaa)		aaa
M1366C	42.5(46.0)-50 cm	6389			aa	a		a
GAT-1371A1	0-55 mm	6238		aaaaa	aaaaa	aaaaa		aa
GAT-1371A1	55-75 mm	6241		aa	aaa	aaa		aa
GAT-1371A2	75-90 mm	6241		aaa	aaaaa	aaaaa		aaa
GAT-1371A2	90-110 mm	6022a			aaa	aaa		aaaaa
GAT-1371A2	110-120(140) mm	6240		aa	aaaaa	aaaaa		aaaa
GAT-1371A2	120(140)-150 mm	6022b			a*	a*		
Sequence 21								
M1324A	0-2 cm	5753			aaa	aaa	a	
M1324A	2-8 cm	5752			a			a
M1328	14-20 cm	6144 upper			aaa	aaa	aa	aaaa
M1328	20-22 cm	6144 lowermost			aa	aa	a	aaa
Sequence 22								

M1332A1	14.5-18.5 cm	1008							
M1332A1	18.5-22 cm	1007				a	a	a	aaaaa
M1332A2	22-27 cm	1007				a	a	a	aaa
M1332A2	27-29.5 cm	1006				aaa	aaa		aa
Sequence 23									
GAT-1363C	36-37.5(38) cm	6457				a	a		a
GAT-1363C	37.5(38)-43 cm	6458a, 6458b				(aaa)	(aaa)		(aaaa)
GAT-1363C	43-43(44) cm	6462 (G42)							
Miscellaneous									
Green Glaze									
4240A1				x1		x1			
4240A2									
4240B1				x1		x1	x1		
4240B2									
White nodules									
1593		1330	aaaaa						

1597		1329		aaaaa			x1			
1617		1321		aaaaa				x1		
5565		1216		aaaaa						

Table 3, cont.

Thin section *Sequence 1*	**Wood**	**Burned peat/soil**	**Raw sed clasts**	**Burned dung'**	**Burned flint**	**Leached bone (cop mat.)**	**Burned bone**	**Human? cop**	**Root traces**	**2ndary Fe**
M1004A						a-1				aaaaa
M1004A		a				a-3			a*	aaaaa
M1004B1						a-1			a	aaaa
M1004B2									a*	(aaa)
M1007A										
M1007B1				a*?						aa
M1007B1										a
M1007B2					a-2				a*	aa
Sequence 6										

M1380A									a*	
M1380B1		aaaaa								
M1380B1										
M1380B2										aa
M1380B2										
M1381A				a*						
M1381A									(a)	
M1262A1	a?		a?						a*	
M1262A2										a*
M1262B										
M1262B										
M1262B					(a*)					
Sequence 14										
M1203A		a						a-1		(a)
M1203B1										
M1203B1		aa	aa?			a-1				a*
M1203B1		a	aaa	a-1			a-2(1 fish)		a-1	
M1203B2			aaa	a-1			a-2(1 fish)		a-1	

M1203B2							
Sequence 15							
M1202B							a
M1202B					a-1		aa
Sequence 16							
M1224A	aaa	aaa		a-1			aaaaa
M1224B	aaa	a*?				a*	aaa
M1224B	aaaaa		a-1		(a*?)		aa
Sequence 17							
M1151A							aaa
M1152A							
M115A							
M1151B							
M1151B							
M1151B							a*
M1151B						a*	a
M1152A							

M1152A				
M1152B				
M1152B				
M1152B				
Sequence 19				
M1362A1				a-1(ff)
M1362A2				
M1362A2			a-1	
M1362B				
M1364A				
M1364A		aa		
M1364A		a		
M1365A1		a		
M1365A2		a		
M1365B		a		
M1365B		a		
M1366A	aaa	aa	a?	
M1366B1	aaa		aa?	

M1366B1		a*					
M1366B2		a					
M1366B2	aa	aa	a*			(a)	
M1366B2		a*					
M1366C		a*					
M1366C			a-1				aaa
GAT-1371A1	a?		a-1				
GAT-1371A1							
GAT-1371A2							
GAT-1371A2			a-2				
GAT-1371A2							
GAT-1371A2						a*	a
Sequence 21							
M1324A		(aa)		(aaa)	a?		aa
M1324A		(aaaaa					aaaaa

		)						
M1328		aaaaa						aaaa
M1328		(aaaaa)	(a-1)					aa
Sequence 22								
M1332A1								
M1332A1		aa		aaaa	aa	a	aa	aaaa(FeP?)
M1332A2				aaa	a	a*	a	aaa(FeP?)
M1332A2				a	aaa		aaa	aaaaa(FeP?)
Sequence 23								
GAT-1363C	a							
GAT-1363C	aaaaa							
GAT-1363C								aaaa
Miscellaneo-us								

Green Glaze										
4240A1										aa
4240A2										
4240B1										a*
4240B2										
White nodules										
1593										(aaaa)
1597										(aaa)
1617										(aaa)
5565										(aaaa)

Table 3, cont.

Thin section	**2ndary**	**Gypsum**	**Jaro-site**	**Pyrite**	**Plant**	**Plant**	**Text.**	**Micro-Lam**	**Reddish**	**Brown**
Sequence 1	**Fe--Mn**				**traces**	**temp. trace**	**Inter -cal.**	**pan**	**clay**	**clay**
M1004A										
M1004A					aa		aaaaa	aaa		aa
M1004B1					a*		aaaaa	a		aa
M1004B2					a		aaaaa	aa		a

M1007A				aaaaa		(aa)	
M1007B1	(aaa)	aaaaa	aa			aa	aaaaa
M1007B1		aa			aaaaa		aaaaa
M1007B2		a*		aaaaa	aaa		aa
Sequence 6		a*		aaa	a		
M1380A							
M1380B1		a*			aa		aaa
M1380B1							a
M1380B2		a*			(aaaa)		aaaaa
M1380B2	(aa)				(aaaaa)		
M1381A							
M1381A		aaa					
M1262A1		aa					a
M1262A2		a*		(aaa)	(a)		a
M1262B	(a)			aaaaa	aaaaa		
M1262B				aaaaa	aaaaa		
M1262B				aa	aa		
Sequence 14	(aa)			aaaa	aaa		

M1203A						
M1203B1			aaaaa			a
M1203B1		aaaaa		aaa		
M1203B1				a		
M1203B2	aaaaa		aaa	aaa		
M1203B2	aaaaa		aaa	aaa		
Sequence 15			aaaaa			
M1202B						
M1202B			aaaa	aa		
Sequence 16				aa		
M1224A						
M1224B		a		a	a	
M1224B				aaa	a	
Sequence 17				aaaa		
M1151A						
M1152A			(aaaa a)			aa
M115A						aa

M1151B			aa
M1151B	(aaaaa)		a
M1151B	(aaaaa)		a
M1151B	(aaaaa)		
M1152A	aaaaa	(aaaaa)	
M1152A	(aaaaa)		aaa
M1152B	(aaaaa)		a
M1152B	(aaaaa)		a
M1152B			aa
Sequence 19			aa
M1362A1			
M1362A2			a*
M1362A2			a(aa)
M1362B			a
M1364A		(aaaaa)	aaa(aaaa

				a)
M1364A				aaaaa
M1364A				
M1365A1			aaa	
M1365A2			aaa	
M1365B			a	
M1365B			a*	
M1366A			a*	
M1366B1				
M1366B1		aaaa	aa	
M1366B2	aaaaa	(aaaaa)	aa	
M1366B2	aaaaa		a	
M1366B2		(aaaaa)	aa	
M1366C			aa	
M1366C			aa	
GAT-1371A1	aaaaa			
GAT-1371A1			a	
GAT-	aaaaa	aaaaa	aaa	

1371A2					
GAT-1371A2			(aaa)	(aaa)	
GAT-1371A2			(aaaaa)	aaaaa	
GAT-1371A2				aaaaa	
Sequence 21		a*	aaaaa		
M1324A					
M1324A	aa		aaaaa	aa	
M1328	aaa		aaaaa		
M1328					aa
Sequence 22			aa	aa	
M1332A1					
M1332A1					
M1332A2			(aaaaa)	(aaa)	
M1332A2					
Sequence 23			aaaaa	a	

GAT-1363C							
GAT-1363C			aa				aa
GAT-1363C			aaaaa				aa
Miscellaneous				aaaa			
Green Glaze							
4240A1							
4240A2		a*		aa	aaa	aaa	
4240B1							
4240B2		a			a	aaaaa	
White nodules							
1593							
1597							
1617		(aaa)			a		
5565		(aaa)			a		

Table 3, cont.

Thin section	**Silt/silty**	**Thin-Broad**	**V. broad**	**Thin-Broad**

Sequence 1	**clay**	**burrows**	**burrows**	**excr.**
M1004A				
M1004A		aaa		
M1004B1				
M1004B2		aaaaa	aaaaa	a?
M1007A		aaaa	aaaaa	aa
M1007B1		aaaaa	aaaaa	aaaaa
M1007B1				
M1007B2		aaaa		
Sequence 6		a		
M1380A				
M1380B1		aaaaa	aaaaa	aaaaa
M1380B1		aa(aaaaa)	aaa(aaaa)	(aaa)
M1380B2		(thin aaaaa)		
M1380B2		aaa		
M1381A		aaaaa	aaaa	
M1381A		aaaaa	aaa	

M1262A1	aaaaa	aaa	
M1262A2	aaaaa	aaaaa	aaaaa
M1262B			
M1262B			
M1262B			
Sequence 14			
M1203A			
M1203B1			
M1203B1			
M1203B1			
M1203B2			
M1203B2			
Sequence 15			
M1202B			
M1202B	aaa	aaa	
Sequence 16	aaa	aaa	
M1224A			

M1224B	aaaaa	aaaaa
M1224B	aaaa	aaaa
Sequence 17		
M1151A		
M1152A		
M115A		
M1151B		
M1151B		
M1151B		
M1151B		
M1152A	(a)	
M1152A		
M1152B		
M1152B		
M1152B		
Sequence 19		
M1362A1		
M1362A2	aaaa	aaaa

M1362A2		aaaa
M1362B		aaaa
M1364A		(aaa)
M1364A		
M1364A		
M1365A1		aaa
M1365A2		aaa
M1365B		aaa
M1365B		aaa
M1366A		aaa
M1366B1		a
M1366B1	aaa	
M1366B2	aaaaa	
M1366B2	aaaaa	aa
M1366B2	aaaaa	aaa
M1366C	aaaaa	aaa
M1366C	aaaaa	aaa
GAT-1371A1	aaaaa	aaa

GAT-1371A1		aaa	aaa
GAT-1371A2		aaaaa	aaaaa
GAT-1371A2	(a)	aaaaa	aaaaa
GAT-1371A2			
GAT-1371A2	aaaaa		
Sequence 21		a	
M1324A			
M1324A	a		
M1328			
M1328		aaaa	aaaa
Sequence 22		aa	
M1332A1			
M1332A1			
M1332A2			
M1332A2		aaa	

Sequence 23	a	
GAT-1363C		
GAT-1363C		aa
GAT-1363C		aaaa
Miscellaneous		
Green Glaze		
4240A1		
4240A2		
4240B1		
4240B2		
White nodules		
1593		
1597		
1617		
5565		

* - 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%, very abundant >20% aaaaa

Table 4: London Gateway (COMPA09) thin section studies; SEM/EDS data (selected)

Sample	F	Na	Mg	Al	Si	P	S	K	Ca	Ti	Mn	Fe	Sn	Br	Pb
M1224B (1363)															
Plant (dung?)-tempered daub		0.62	1.52	8.93	29.0	0.41		3.06	0.72	0.64		8.50			
Ditto		0.45	2.01	10.8	25.4	0.54		3.98	1.03	0.44		10.2			
Ditto		0.5	1.95	9.74	28.9	0.38		2.76	1.12	0.78		6.84			
Fused phytolith-ash matrix		1.47	5.45	5.70	20.2	4.41	0.68	1.05	10.2	1.04		4.55			
Ditto		0.80	4.14	7.77	23.4	3.54	0.29	1.71	7.62	0.47		3.95			
Vesicular fuel ash		2.50	2.17	4.56	27.0	4.41		2.10	6.82	0.33	0.19	2.52			
Ditto		1.73	1.83	6.81	29.6(63.3SiO_2)	2.55		1.18	2.22	0.27		2.62			
Ditto		1.27	4.28	6.67	19.0	3.94	0.62	1.15	11.7			5.81			
Fused phytolith detail		0.78	2.20	6.59	21.8	3.46	0.25	2.31	6.90	0.36		10.7			
Ditto		2.95	1.14	9.72	27.1	0.79		2.12	2.00	0.30		7.56			
Ditto		0.52	1.47	8.06	26.2	1.82		2.30	3.05	0.37		10.5			

1152B															
Brickearth hearth plaster?		6.94	1.59	8.44	25.9	1.02			5.39	0.31		2.86			
Ditto		6.62	1.64	8.25	27.2	0.40		0.99	4.33	0.52		2.96			
Ditto		5.01	1.70	10.3	25.9			0.58	5.12	0.48		3.27			
Melted phytoliths		6.79	3.49	10.8	24.3	0.31			0.63	0.23		3.25			
Ditto		4.26	1.20	7.22	35.5			3.60	0.65	0.36		0.79			
Monocot. charcoal layer (Fe stained)		2.34	4.70	8.27	10.1	3.30	1.23	1.22	16.9			12.5			
Ditto		2.27	6.37	4.78	7.23	4.36	1.77		24.9			9.77			
Construction brickearth silts		0.82	1.01	3.69	36.9			3.35	2.26			2.79			
Ditto clay		0.37	1.42	11.2	29.2			3.10	0.91	9.67		5.80			
Burned bone?	2.01	2.17	2.82	2.91	11.9	9.72	0.24	0.51	22.5	0.38		3.02			
Ditto	1.99	1.64	0.99	3.26	4.99	14.3	0.26	0.46	28.8	0.30		1.90			
1328A															
6144 Clay floors 1															
Stained clay floor infill			0.77	1.65	2.77	8.11			9.23			4.14			46.5

Ditto			0.59	0.74	0.80	7.80			9.11			3.36	6.38		46.6
Ditto detail			0.44	0.82	1.36	7.11			7.85			3.21	13.5		40.8
Ditto detail				0.79		7.94			9.58			2.30	2.40		54.1
Fe-stained floor matrix		0.40	1.34	9.44	26.5	0.79		2.31	0.81	0.63		11.4			1.29
Silty trample		0.57	1.56	9.05	29.0	0.65		3.22	1.78	0.45		5.72			2.10
‘Clay floor’			0.57	4.48	38.9			1.15	0.31	0.40		3.71			
Stained floor		0.77	1.40	3.10	6.09	10.5	1.03	0.62	17.2	0.98		5.28			15.8
Ditto trample		0.49	1.39	7.49	22.6	4.96		2.21	10.1			4.97			
6144 Floor 2 trample															
Floor 2 trample (stained)		0.79	0.81	3.24	6.31	9.41		0.78	16.4			4.22			23.7
Ditto Monocot charcoal			5.63		2.54	6.71			17.0			5.08		6.57	29.0
Ditto vughy soil fill		0.40	1.38	9.47	29.4	0.66		3.32	1.02	0.32		6.89			
Ditto cop? bone fragment	1.58	0.66	0.35		0.27	16.1	0.71		35.9			0.89			5.46
M1363 Pit															
Wood				0.72	0.46	0.09	0.92					0.85			

Yellow-stained fill 1		0.13	0.20	1.78	4.51		1.34	0.81				3.57			
Fill				0.76	2.73		0.47	0.34		0.07		1.20			
Yellow-stained 2				13.5	26.0		3.83		2.19			4.91			
Ditto 3		0.17	0.12	0.76	12.3		2.17	0.95				4.93			
Jarosite		0.40		0.73	1.41		6.92	2.65				15.3			
Jarosite		0.53	0.20	1.05	1.96		5.78	2.23				12.4			
5565 *White nodules*															
1.Vesicular t.		5.97	5.92	5.32	23.5	1.32		2.04	6.97	0.40		4.59			
Ditto		6.15	2.56	6.97	24.6(52.6%SiO_2)	1.02		4.16	4.52	0.42		5.66			
Ditto detailed features		2.86		3.53	13.5			20.1	18.1			8.49			
Ditto		6.23	3.40	6.22	25.2	1.31		2.44	4.73	0.65		5.19			
Ditto		1.06	0.95	7.45	32.2(68.8%SiO_2)	1.04		2.82	3.12	0.75		2.10			
'StrawSection'		2.73	1.96	7.26	27.7	1.46		3.88	2.59	0.52		5.95			
Ditto		1.96	0.96	9.17	25.9	1.62		7.48	1.99	0.68		4.97			
Ditto detailed area		2.47	1.33	7.38	28.2	1.89		4.08	3.62	0.35		4.18			

Ditto		1.23	0.78	7.11	34.7 (74.2%SiO_2)	0.46		2.22	2.14			2.08			
Ditto		1.60	3.03	6.19	31.9	1.70		2.07	2.92			1.81			
Ditto (stained)		1.26	6.89	1.93	25.2	0.47		2.23	11.1	0.57	0.32	6.80			
2.Vesicular t.		5.06	2.35	11.1	27.3			1.73	1.39	0.72		3.43			
Ditto		0.44	1.30	10.1	29.3(62.8%SiO_2)			2.68	0.99	0.60		7.60			
Ditto(Fe-stained area)		3.36	1.02	5.12	11.0	1.15				1.27		44.4			
Green glaze 4240A1															
Eg briquetage		4.12	1.36	8.20	31.2			3.05	1.25	0.64		2.14			
Outermost glaze eg		12.1	0.95	8.53	23.9			3.31	0.97	0.44		3.95			
Inner glaze layer eg		5.34		9.94	25.2		0.25	7.09		0.87		4.98			
Green glaze 4240B1															
Briquetage edge		6.15	1.09	9.01	27.4			3.82	0.69			6.70			
Briquetage inner		0.94	1.14	7.61	32.6			2.44	0.69	0.50		6.15			
Outermost		10.1	1.10	7.23	26.2		0.67	3.03	0.57	0.32		5.74			

glaze eg															
Outermost glaze eg		8.58	3.25	4.26	25.4	0.44	0.39	1.97	5.35	0.57		5.54			
Inner glaze eg		4.50	1.05	7.65	30.5(65.2% SiO_2)			3.17	0.61	0.64		5.30			

Table 5: London Gateway (COMPA09) thin section studies; microprobe table

	SiO2	FeO	CaO	Al2O3	TiO2	K2O	MgO	P2O5	CuO	Na2O	MnO	SnO2	SrO	ZnO	SO3	PbO
Green glaze																
Line A																
Mean	41.1	9.02	0.408	12.6	0.697	4.75	0.753	0.180	0.004	9.45	0.008	0.000	0.000	0.016	0.484	0
Standard Deviation	5.00	3.69	0.377	2.27	0.085	1.12	0.253	0.053	0.008	2.88	0.013			0.025	0.082	
Range	11.7	7.79	0.777	5.07	0.172	2.51	0.537	0.129	0.016	6.38	0.027			0.052	0.173	
Minimum	34.4	4.50	0.193	10.7	0.605	3.73	0.528	0.116	0.000	6.96	0.000			0.000	0.391	
Maximum	46.1	12.3	0.970	15.8	0.777	6.24	1.06	0.245	0.016	13.3	0.027			0.052	0.564	
Count	4	4	4	4	4	4	4	4	4	4	4			4	4	
Green glaze																
Line B																
Mean	42.4	3.190	0.404	11.8	0.710	5.17	0.387	0.104	0.001	5.36	0.007	0.005	0.000	0.028	0.267	0.004
Standard Deviation	12.2	0.588	0.210	3.74	0.011	1.61	0.194	0.062	0.001	2.77	0.003	0.007		0.004	0.042	0.006
Range	17.3	0.831	0.297	5.29	0.016	2.27	0.275	0.088	0.001	3.92	0.004	0.010		0.005	0.059	0.008
Minimum	33.8	2.77	0.255	9.13	0.702	4.04	0.249	0.060	0.000	3.39	0.005	0.000		0.025	0.237	0.000
Maximum	51.2	3.60	0.552	14.4	0.718	6.31	0.524	0.148	0.001	7.32	0.009	0.010		0.030	0.296	0.008

Count	2	2	2	2	2	2	2	2	2	2	2	2		2	2	2
Briquetage																
Line A																
Mean	45.6	1.22	0.939	12.4	0.647	4.27	1.30	0.076	0.008	3.49	0.008	0.004	0.000	0.008	0.101	0.006
Standard Deviation	11.78	0.531	0.387	2.73	0.399	1.17	0.795	0.024	0.012	1.01	0.008	0.007	0.000	0.013	0.103	0.008
Range	59.5	2.80	2.79	13.6	3.04	5.97	5.27	0.122	0.051	5.56	0.045	0.041	0.003	0.046	0.603	0.034
Minimum	2.82	0.520	0.117	2.55	0.018	0.181	0.040	0.027	0.000	0.227	0.000	0.000	0.000	0.000	0.017	0.000
Maximum	62.3	3.32	2.90	16.2	3.06	6.15	5.31	0.149	0.051	5.79	0.045	0.041	0.003	0.046	0.620	0.034
Count	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96	96
Briquetage																
Line B																
Mean	47.0	1.31	0.996	12.60	0.618	3.15	1.143	0.079	0.011	4.28	0.006	0.005	0.002	0.010	0.079	0.007
Standard Deviation	13.6	1.084	0.380	3.29	0.278	1.11	0.703	0.033	0.020	1.24	0.007	0.008	0.012	0.014	0.121	0.010
Range	59.7	6.54	2.09	15.5	1.84	5.04	3.36	0.193	0.151	6.15	0.029	0.036	0.096	0.088	0.860	0.040
Minimum	0.931	0.314	0.092	1.11	0.013	0.047	0.000	0.011	0.000	0.140	0.000	0.000	0.000	0.000	0.005	0.000
Maximum	60.6	6.85	2.17	16.6	1.86	5.09	3.36	0.204	0.151	6.29	0.029	0.036	0.096	0.088	0.865	0.040
Count	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98

Table 6: Statistical tests comparing microprobe Line Analysis data for the green glaze compared to briquetage (by John Crowther)

		MANN-WHITNEY U TEST
		Significant difference ($p<0.05$)
BRIQUETAGE	SiO_2	HIGHER
	FeO	LOWER
	CaO	HIGHER
	Al_2O_3	
	TiO_2	
	K_2O	
	MgO	HIGHER
	P_2O_5	LOWER
	CuO	
	Na_2O	LOWER
	MnO	
	SnO_2	
	SrO	
	ZnO	
	SO_3	LOWER

	PbO	
GLAZE	SiO_2	LOWER
	FeO	HIGHER
	CaO	LOWER
	Al_2O_3	
	TiO_2	
	K_2O	
	MgO	LOWER
	P_2O_5	HIGHER
	CuO	
	Na_2O	HIGHER
	MnO	
	SnO_2	
	SrO	
	ZnO	
	SO_3	HIGHER
	PbO	

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of SiO2 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.033	Reject the null hypothesis.
2	The distribution of FeO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
3	The distribution of CaO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.
4	The distribution of Al2O3 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.662	Retain the null hypothesis.
5	The distribution of TiO2 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.105	Retain the null hypothesis.
6	The distribution of K2O is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.051	Retain the null hypothesis.
7	The distribution of MgO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.016	Reject the null hypothesis.
8	The distribution of P2O5 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.009	Reject the null hypothesis.
9	The distribution of CuO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.283	Retain the null hypothesis.
10	The distribution of Na2O is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.
11	The distribution of MnO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.853	Retain the null hypothesis.
12	The distribution of SnO2 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.244	Retain the null hypothesis.
13	The distribution of SrO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.760	Retain the null hypothesis.
14	The distribution of ZnO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.166	Retain the null hypothesis.
15	The distribution of SO3 is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
16	The distribution of PbO is the same across categories of Glaze.	Independent-Samples Mann-Whitney U Test	.119	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Table 7: London Gateway Soil Micromorphology (Descriptions and preliminary interpretations)

Microfacies type (MFT)/Soil microfabric type (SMT)	Sample No.	Depth (relative depth) Soil Micromorphology (SM) SEM/EDS (EDS)	Preliminary Interpretation and Comments
			Area A
			Sequence 1 (Landform development)
MFT D2/SMT 6a2	M1004A	13.0-21.5 cm 13.0-17.0 cm (1135) SM: moderately heterogeneous (SMT 6a2 variants), with junction of 1135 and 1136 over 16.5-18 cm; *Microstructure*: complex with relict subangular blocky at 16.5-18 cm, remains of 1-1.5mm thick laminae of silty clay and coarse silt-fine sand, at 15-16 cm; upwards becomes massive, 40% voids, with planar fissures and large vughs, some partially closed; *Coarse Mineral*: as below, with laminae of silty clay and coarse silt-fine sand; *Coarse Organic and Anthropogenic*: example of fine coprolitic bone, occasional organic fragments, occasional rubefied bricketage fragments; many charcoal (<0.5mm); *Fine Fabric*: SMT 6a2: dusty brown to blackish and dotted brown (PPL), moderately low to low interference colours (open and close porphyric, stipple speckled b-fabric), brownish orange and blackish brown with black and reddish flecks (OIL), weakly humic, but with occasional orange brown amorphous OM fragments,	1135 (1132) Very complex layer of from the top: 1.Massive structured, broadly burrowed, fine charcoal rich silty clay loam, with occasional briquetage, orange brown amorphous organic matter fragments and a fine-size example of coprolitic bone, over; 2. massive structured with remains of 1-1.5mm laminated silty clay and coarse-silt fine sand layers, over 3. remains of subangular blocky peds with very thick microlaminated ped coatings and void infills (innermost: 1.5+mm thick matrix material or silty clay, with 50µm brown clay, overlain by 400 µm-thick outermost layer of dusty brown clay) *Anthropogenic soil 1136 had developed a*

		and abundant very fine charcoal; *Pedofeatures*: *Textural*: very abundant intercalations, with microlaminated 'ped' coatings at 16-18.5 cm, composed of innermost: 1.5+mm thick matrix material or silty clay, with 50µm brown clay, overlain by 400 µm-thick outermost layer of dusty brown clay; *Fabric*: many broad burrows mixing brown and blackish brown SMT 6a2; other pedofeatures as below. 17.0-21.5 cm (1136) SM: very heterogeneous *Microstructure*: *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), *Coarse Organic and Anthropogenic*: 3 coprolitic bone (max 600µm); rare rubefied (burned) peaty clay, with relict humic content and many diatoms ('peat ash'); *Fine Fabric*: as below; *Pedofeatures*: as below; *Amorphous*: very abundant coarse iron impregnation (mottling)(with depleted zones around iron mottles).	*subangular blocky ripened surface, but inundation and natural mud flat sedimentation (silty clay and silt-fine sands; typical laminated mudflat/saltmarsh sediments) buried this soil both slaking it and also causing the inwash downprofile of brown alluvial clays (latterly from 1132 clay sedimentation). Ensuing sedimentation was very anthropogenic in character, with fine charcoal and possible sewage being major components. On-site anthropogenic activity recommenced as the soil dried out and was burrowed. Lastly, 1132 sedimentation (not studied) led to brown clay downwash, as noted above as final void coatings in microlaminated sequences.* 1136 As below, but with fewer anthropogenic inclusions overall, but these include 3 coprolitic bone (max 600µm) and rare rubefied (burned) peaty clay, with relict humic content and many diatoms ('peat ash')

MFT D1/SMT 6a1			
MFT D1/SMT 6a1 (5a1, 8a1)	M1004B1	26-33.5 cm SM: heterogeneous with very dominant SMT 6a1, very few 5a1 and 8a1 (fine sandy silt brickearth fragment); *Microstructure*: massive/prismatic with collapsed medium and coarse subangular blocky, 40% voids, partially collapsed root channels, planar voids, vughs (closed vughs) and fine channels; *Coarse Mineral*: C:F, SMT 6a1: 45:55, well sorted medium and coarse silt with very few very fine and fine sand; *Coarse Organic and Anthropogenic*: many roots *in situ* sometime with associated fine clay infills, root fragments, plant fragments, and trace amounts of charred/blackened? fungal bodies; occasional charcoal, including wood charcoal (max 2.5mm), abundant rubefied and blackened briquetage, and fused sediment material (cf SMT 3a and 4a); leached bone fragment (750µm); trace of patchy fungal bodies; *Fine Fabric*: SMT 6a1: dusty darkish and dusty and dotted very dark brown (PPL), moderately low interference colours (open porphyric, stipple speckled b-fabric, XPL), greyish brown to grey (OIL), weakly humic, with patchy humic staining,	1136 Dark brown, fine charcoal-rich silty clay, which includes occasional charcoal, including wood charcoal (max 2.5mm), abundant rubefied and blackened briquetage, and fused sediment material; an example of leached bone fragment (750µm) is also present. Organic staining, plant fragments and fungal material are also present. Rare traces of loamy sand fragments also present. Original burrowed soil with subangular blocky structure is partially slaked into massive/prismatic soil; associated very abundant textural intercalations, collapsed voids, and down-profile, microlaminated matrix pans (1.5mm thick) have formed. *In situ* root traces also occur alongside rare brown clay void coatings. Weak iron staining is present throughout. Organic content and burned included fragments are also recorded

		abundant to very abundant very fine charred OM, phytoliths present; *Pedofeatures*: very abundant textural intercalations and associated closed vughs and vesicles with blackish brown dotted impure clay infills up to 0.5mm thick (lining channels and relict planar voids); void coatings – pan like microlaminated silty clay 1.5mm thick; rare brown clay coating channels (3-400 µm thick); *Amorphous*: abundant weak traces of iron impregnating relict OM and void hypocoatings, eg around charcoal; *Fabric*: very abundant broad burrows.	by medium LOI and MS. *Ripened alluvial soil underwent biological homogenisation and was probably vegetated, hence organic matter/plant fragments present. Occupation, presumably peripheral to salt making led to the inclusion of small fragments of burned briquetage; the presence of a bone fragment and fungal bodies may hint at middening. (Fuel waste seems to be rare here, although worked down-profile). Ensuing inundation, led to structural collapse and slaking, water draining down-profile. Subsequently, the soil became revegetated and clay alluviation is recorded in the root channels.*
MFT C2/SMT 5a1 (6a1, 6a2)	M1004B2	33.5- 42 cm SM: very heterogeneous with common SMT 5a1 (8506), common SMT 6a1 (see M1004B1; 1136) and frequent SMT 6a2 (see M1004A; 1135); *Microstructure*: massive/coarse prismatic (drying out effect?) with underlying fine to medium subangular blocky (somewhat affected by slaking), 35% voids, with moderately well accommodated planar voids, partially collapsed channels and vughs (closed vughs) and fine vesicles; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), SMT 5a1: 40:60, very well sorted medium and coarse silt, with very few very fine sand-size quartz, quartzite, feldspar, mica (trace amounts of rubefied grains); *Coarse Organic and Anthropogenic*: SMT 5a1(8506) occasional fine charcoal and trace amounts of burned mineral (max 650µm, including monocot); Mixed 1136-1135: many charcoal (monocot	8506 (mixed 1135-1136) Coarsely and finely burrowed silty clay containing fine charcoal, and small amounts of phytoliths and rubefied silt, mixed with common amounts of anthropogenic 1135-1136, which includes many charcoal (including monocotyledonous material; max 2.5mm), many small (5-6mm) size reddish and blackish briquetage and fuel ash waste (‘white nodules’); sediment also includes traces of fine (1mm) roots/rooting. Broad burrowing also associated with some relict broad organo-mineral excrements. 8506 is characterised by very abundant textural intercalations and associated closed vughs and vesicles with brown dusty clay/impure clay infills up to 1mm thick; many patches (in

		max 2.5mm), rubefied clay (bricketage/SMT3a1 and rare blackened SMT3a2 fragments; max 6mm), occasional fuel ash/white nodules, very fine to 5mm (some enclosing charred monocot); occasional burned sediment (now isotropic); trace of root material in partially infilled 1mm wide roots; *Fine Fabric*: SMT 5a1: dusty and dotted brown (PPL), moderate interference colours (open porphyric, stipple speckled b-fabric, XPL), yellowish brown (OIL), occasional fine charred, trace amounts of rubefied grains, rare phytoliths; *Pedofeatures*: *Textural*: very abundant textural intercalations and associated closed vughs and vesicles with brown dusty clay/impure clay infills up to 1mm thick; many patches (in 1135 material) of reddish brown clayey infills between relict peds and voids (1.5mm), matrix intercalations of reddish 1135-1136; *Amorphous*: many (in 1135/1136) blackish void hypocoatings and organic matter impregnations (Fe-Mn??); *Fabric*: very abundant broad (1mm) to very broad (5mm) burrows and other mixing; *Excrements*: possible occasional partially slaked remains of broad organo-mineral excrements.	1135 material) of reddish brown clayey infills between relict peds and voids (1.5mm), matrix intercalations of reddish 1135-1136. Iron (Fe-Mn?) hypocoatings and organic matter impregnations also occur in this fabric. *Original silty clay alluvium, deposited as a muddy sediment, which upwards underwent weak sediment ripening. Alluvium included likely anthropogenic fine charcoal and rubefied silt (from underlying M1007A). Subsequent biological activity and weathering affecting overlying and or earlier more terrestrial anthropogenic activity (local red hill formation and salt workings) led to coarse mixing of briquetage, monocotyledonous charcoal and fused fuel ash waste. Reddish (rubefied) clayey sediment from this activity became slaked and washed down-profile, indicating inundation and slaking events which led to partial collapse of the ripened palaeosoil.*
MFT C2/SMT 1b1, 1a1-1a3, 6a4 (8a1)	M1007A	20-27.5 cm SM: very heterogeneous, with anthropogenic component: common SMT 1b1 (fused phytoliths) and frequent 1a1-1a3 (fused fuel ash), very few sandy SMT 8a1; and natural component : common SMT 6a4 (laminated silts and silty clay); *Microstructure*: weakly prismatic with subangular material, (relict laminated) silty clay (20%) fine channels and fissures, anthropogenic (40%), open vughs, chambers and packing voids; *Coarse Mineral*: as 6a3 and 7a4; *Coarse*	8506/1142 Broad and very broad burrow mixed dark brownish silty clay sediment, with relict laminae, and anthropogenic deposits. The latter are dominated by fused siliceous material rich in phytoliths, charred and rubefied monocotyledonous plant fragments, and diatoms are also present. In addition, very abundant charcoal (mainly monocotyledonous, max 4mm), many white

		Organic and Anthropogenic: dominant: very abundant fused phytolith aggegates (SMT 1b1), with many fused white nodules (especially types 1a3 and 1a3, although reddish stained sometimes), many briquetage (max 13mm); very abundant charcoal (commonly monocot; max 4mm); rare traces possible byre floor/dung waste?; *Fine Fabric*: SMT 1b1: heavily speckled grey (PPL), isotropic or very low interference colours (close porphyric, undifferentiated or stipple speckled b-fabric, XPL), grey with black and reddish inclusions (OIL), very abundant rubefied and charred monocotyledonous plant material, with many phytoliths; diatoms can be present; SMT 6a4: dusty and speckled very dark brown (PPL), moderate interference colours (close porphyric, stipple speckled b-fabric, XPL), dull yellow brown (OIL), weakly humic with many very fine charred and amorphous OM; *Pedofeatures*: *Textural*: abundant brown to reddish brown void coatings and infills up to 4mm thick; *Amorphous*: many weathered/weathering pyrite/iron hydrite; *Fabric*: very abundant broad burrows; *Excrements*: very abundant broad organo-mineral excrements.	nodules (as in reference studies eg. 5565) of melted siliceous material/'straw'. Many briquetage fragments are present (max 13mm). Anthropogenic materials occur within broad excrements and burrows. Voids are often characterised by reddish brown or brown clay inwash up to 4mm thick. Pyrite have aged or are ageing into ferrihydrite. *These contexts record a major spread of probable salt making fuel ash waste, onto alluvium, with biota coarsely mixing this into the sediment. Strongly burned vesicular siliceous waste occurs alongside briquetage and partially fused phytolith-rich monocotyledonous charred plant remains. Presence of diatoms also indicate that this is dominantly estuarine wetland plant fuel; pyrite formed in this deposit. Ensuing alluviation led to inwash brown clays; possibly burned waste contaminated/produced reddish clays as evidence of burning.*
MFT E4/SMT brown clay laminae	M1007B1	27.5-30.0 cm SM: heterogeneous with upwards: very charcoal-rich silty-fine sandy laminae, followed by humic clay laminae which include clasts of humic and charcoal-rich fine SZL sediment ('ripped up'); *Microstructure*: massive, laminated, 40% fissures and channels; clay laminae: grey to brown 0.5mm laminae, with few coarse silt and sand, very abundant humic staining, detrital OM and charred OM. Some weakly iron stained. Clasts (5mm-size) of coarse silt fine sandy	1143 Sediment sequence commencing with : very charcoal-rich silty-fine sandy laminae, followed by humic clay laminae which include clasts of humic and charcoal-rich fine SZL sediment ('rip up' clasts). *Alluvial silt and fine sand deposition including local fine charcoal concentrations, followed by humic clay alluviation, with some*

		sediments, very rich in fine charcoal, are included.	*local erosion ripping up underlying charcoal-rich silty sands. Alluvial clay is rich in very fine detrital organic matter and charcoal; this 'brown clay' washed down fissures and channels formed in the underlying slaked and inundated prehistoric palaeosol . This infers fluctuating base levels, and a short period of drying out between original inundation and clayey alluviation.* 1144 Brown, moderately humic loamy clay, with total intercalations and embedded grains. *Muddy mixture of clayey alluvium and slaked prehistoric topsoil formed in brickearth.*
MFT E3/SMT 7a4		30.0-35.0 cm 1144/1077 As below, but totally massive with SMT 7a4: dusty and finely dotted brown (PPL), moderately low interference colours (close porphyric, stipple speckled b-fabric, XPL), pale brownish orange (OIL), moderately humic with occasional very fine charcoal; *Pedofeatures*: *Textural*: total intercalations with 'embedded' sand and silt grains 32.5.0-35.0 cm (1077) SM: heterogeneous SMT 7a1, with patchy and mixed SMT 7a3; *Microstructure*: massive, 30% voids, planar voids (post-slaking, pre-alluviation cracking); *Coarse Mineral*: as below; *Coarse Organic and Anthropogenic*: rare trace of fine gravel-size flint (?) and charcoal (max	1077 (G4a) Both large areas of 1) very fine charcoal-rich weakly humic fine sandy silt loam and patches of poorly humic soil (burrow mixed), and 2) homogeneous SZloam as massive non-porous soil with sloping matrix pans as part of the intercalatory fabric. Rare flint gravel and wood charcoal (max 1.5mm) occur in the former (1). Vertical fissures are characterised by microlaminated brown clays and dusty clay rich in very fine charred and detrital organic matter. *This is the partially slaked and partially*

MFT E2/SMT 7a1, 7a3		1.5mm); *Fine Fabric*: SMT 7a3: as 7a1, but dotted brown, with abundant very fine charcoal; *Pedofeatures*: *Textural*: partial totally intercalatory and matrix panning fabric; planar voids have occasional 500-900µm thick microlaminated brown clay and dusty clay coatings, rich in detrital and fine charred detrital OM; *Depletion*: as below, but probably totally depleted matrix; *Amorphous*: rare iron staining of brown clay void coatings; *Fabric*: abundant very broad burrows	*intact Neolithic-Bronze occupation topsoil (Ah). This is the remnants of the paleosol, with slaked topsoil forming massive soil with muddy pans (slurries). Later clay inwash is recorded.*(Developing saline conditions?)
MFT E1/SMT 7a1(7a2)	M1007B2	35.0-42.5 cm SM: moderately heterogeneous, with very dominant SMT 7a1 (depleted) and few 7a2 (once-humic?)(rare 1077 material in root channels); *Microstructure*: massive, 20% voids, planar void fissures, original fine channels and fine channels with root remains, some closed vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), moderately poorly sorted with medium and coarse silt-size, and very fine, fine and medium sand-size subrounded to subangular quartz, quartzite, feldspar, with very few coarse sand (quartz and angular flint) and examples of subangular and angular flint (4mm- 15mm); *Coarse Organic and Anthropogenic*: at least two burned flint grains (rubefied, max 650µm); rare wood charcoal (max 1.5mm); *Fine Fabric*: SMT 7a1: speckled very pale grey (PPL), very low interference colours (close porphyric, stipple speckled b-fabric, XPL), very pale grey (OIL), traces of humic staining, very fine organic fragments and charred OM; rare root traces; SMT 7a2: blackish, isotropic (PPL, XPL), pale orange (OIL), relict humic staing (now-ferruginised); *Pedofeatures*: *Textural*: many very dark brownish/blackish textural intercalations, with rare very	1145 (1077 in root channels) Moderately poorly sorted fine sandy silt loam, with very few small flint gravel; two burned flint grains (rubefied, max 650µm) and rare wood charcoal (max 1.5mm) present. Palaeosol is generally iron-depleted and characterised by many textural intercalations associated with matrix void infills and thin pale clay void coatings. Relict iron-stained once-humic broad burrows occur in the matrix. Occasional iron stained root traces (and void hypocoatings) and other burrows also occur. *Probable lower topsoil of brickearth early Holocene palaeosol, with (Neolithic-Bronze Age) occupation traces in the form of flint gravel, burned flint and wood charcoal. Relict once-humic earthworm(?) burrows also occur. In the main, the soil lost structure when slaked by inundation, hence textural intercalations and associated pedofeatures, and current massive structure. (cf Blackwater*

		pale thin void clay coatings and matrix infills; *Depletion*: general fabric iron depletion and iron-stained flints with leached margins; *Amorphous*: occasional ferruginised burrows, iron impregnated once-humic soil (SMT 7a2), root traces and channel hypocoatings; *Fabric*: rare relict 1-2mm broad burrows (SMT 7a2); *Excrements*: rare trace of ferruginised Oribatid extremely thin organic excrements in root traces.	*and other Essex sites; Three Ways Wharf).*
			Sequence 6 (Anthrosol sequences)
MFT C1/SMT 6a4(1a-1b)	M1262A1	21.5-28 cm SM: extremely heterogeneous with SMT 6a4 and 5a2, and large (eg 4mm and 16mm) clasts of phytolith-rich 1b3 and bioworked clayey soil-sediment (SMT 4a2), which may be remains of *in situ* soil formation here; *Microstructure*: massive, with semi-welded subangular blocky and crumbs, 45% voids, open and closed vughs, with coarse chambers and planar voids; *Coarse Mineral*: as 1380A, very few glauconite; *Coarse Organic and Anthropogenic*: very abundant raw clay sediment and soil fragments, abundant briquetage (max 7mm) and burned silty sediment; example of burned microfossil-rich humic sediment (minerogenic peat?/dung residue?), many fine charcoal (monoct max 2.5mm), rare fuel ash nodules (eg 1a2 = 2mm); trace of roots and plant material; *Fine Fabric*: as SMT 4a2: (see 1380A); *Pedofeatures*: *Textural*: rare very thin dusty brown clay void coatings (<50 µm); *Fabric*: very coarse mixing, in part due to abundant very broad (up to 14mm wide) , broad and thin burrows; *Excrements*: very abundant very thin, thin and broad (eg 1mm)	***Near Boathouse*** 5732 Extremely heterogeneous with clayey sediment soils (possibly/likley burrowed remains of soil-sediment formed *in situ*), with varying concentrations of very fine charcoal etc, very abundant coarse clasts of raw ripened soil (4-16mm in size), with abundant briquetage (max 7mm), many fine charcoal (2.5mm - size monocotyledonous material), rare fuel ash nodules (eg aggregate = 2mm), and trace of roots (original soil-sediment). The soil is overall characterised by very abundant thin, broad to very broad (~14mm) burrows and associated excrements, including mammillated ones. The whole fabric is lastly affected by rare very thin void clay coatings. *Coarsely dumped spreads of dug up local ripened alluvial soil (without charcoal – clean natural deposits), and mixed*

		excrements, including possible mammilated ones.	*contemporary anthropogenic alluvium (charcoal rich), which also include large amounts of fine charcoal, fuel ash waste and briquetage. Some soil-sediment material may be of local in situ-formed origin?). These have undergone a period of strong biological working (as a topsoil)(a bit like immature 'dark earth'), before being affected by renewed alluviation/rising sea levels/base levels. Possibly this was ground raising deposit, with local/possible some in situ soil sediment being used.*
MFT C2/SMT 6a2, 1b1, 1b3	M1262A2	28-35.5 cm SM: mainly homogeneous with very dominant SMT 6a2, but thin mixed layer of SMT 1b1 and 1b3; *Microstructure*: massive, with minor diffuse laminae, 30% voids, with fine channels and relict planar voids (dried out mud cracks?) partially infilled with matrix infills; *Coarse Mineral*: C:F as 6a, 1b1 and 1b3; *Coarse Organic and Anthropogenic*: trace of white nodules types 1a1, 1a2, occasional generally fine briquetage, with patch of many semi-fused phytoliths and fused phytolith fine fabric; occasional fine charcoal, including 750 µm size monocot section; *Fine Fabric*: as SMT 6a2, 1b1 and 1b3; *Pedofeatures*: *Textural*: very abundant matrix intercalations and micropanning and void infills (max 0.5mm); *Amorphous*: rare ferruginised/oxidised pyrite.	5731 Massive and weakly microlaminated fine charcoal-rich silty clay loam sediment, with matrix intercalations and micropanning and void infills (including relict planar voids). Occasional generally fine briquetage, with patch of many semi-fused phytoliths and fused phytolith fine fabric, with occasional fine charcoal, including 750 µm size monocotyledonous section. Rare pyrite spheroids are ferruginised/oxidised. *Massive and once-microlaminated muddy alluviation, containing only very small amounts of fine-size anthropogenic inclusions. Natural anthropogenic alluviation infilling channel.*

MFT C2/SMT 6a2, 4a2 MFT C1/SMT 1b2	M1262B	35.5-43 cm 35.5-37.5(38.0) SM: moderately heterogeneous with dominant SMT 6a2 and frequent coarse sand-size fragments of raw micaceous clayey SMT 4a2; *Microstructure*: massive, with minor diffuse laminae, 30% voids, with fine channels and relict planar voids (dried out mud cracks?) partially infilled with matrix infills; *Coarse Mineral*: C:F as 6a, *Coarse Organic and Anthropogenic*: rare white nodules types 1a1, 1a2 and very fine briquetage; occasional fine charcoal; *Fine Fabric*: as SMT 6a2, 4a2; *Pedofeatures*: *Textural*: very abundant matrix intercalations and micropanning and void infills (max 1.7mm). 37.5(38.0)-40(42.0) 5731 2-4cm-thick layer, 45% voids (mainly simple packing voids); fragmented (faulted/burrowed) layer (some clasts rounded) of very dominantly burned phytolith concentrations (SMT 1b2), with occasional monocot charcoal (max 3mm) and briquetage (max 4mm); 3.5mm thick basal layer over 5727, composed of partially welded small fine sandy loam aggregates (500 µm), and angular alluvial clay clasts (2-3mm); occasional textural intercalations and micropanning at junction with 5727. 40(42.0)-43 cm 5727 SM: essentially homogeneous SMT 6a2;	5731 Massive and weakly microlaminated fine charcoal-rich silty clay loam sediment, with matrix intercalations and micropanning and void infills (including relict planar voids). Occasional fine charcoal, and rare fine-size white nodules and briquetage. *Massive and once-microlaminated muddy alluviation, containing only very small amounts of fine-size anthropogenic inclusions. Natural anthropogenic alluviation infilling channel.* 5731 2-4cm-thick layer of concentrated burned phytoliths, some partially fused, with occasional fine (max 3mm) monocotyledonous charcoal and small briquetage (max 4mm), over partially welded 3.5mm thick layer of sand-size loamy sediment aggregates (alluvium as below) and angular alluvial clay clasts (2-3mm). This lower layer junction with 5727 characterised by textural intercalations and micropanning. *Channel cut(?) into underlying alluvium, led to initial muddy wash of eroded loamy and clayey fragments of alluvium. A thin layer of anthropogenic deposits dominated by burned monocotyledonous plant debris, was then*

MFT D4/SMT 6a2		*Microstructure*: massive and laminated silts, very sand and ZC; 30% voids, fine channels and closed vughs/vesicles; *Coarse Mineral*: as 6a2 (1004A), *Coarse Organic and Anthropogenic*: trace amounts of very fine coprolitic bone material; occasional charcoal (max 750 µm), fine briquetage and rare fused phytolith clasts; *Fine Fabric*: as 6a2; *Pedofeatures*: *Textural*: abundant textural intercalations and associated panning and closed vughs/vesicles; *Amorphous*: occasional ferruginised/oxidised pyrite spheroids in channels.	*deposited by inwash from local activities.* 5727 Massive and laminated silty clay loam with silty-very fine sand laminae, with very fine charcoal, trace amounts of very fine coprolitic bone material; occasional charcoal (max 750 µm), fine briquetage and rare fused phytolith clasts. Abundant textural intercalations and associated panning and closed vughs/vesicles, occur. Pyrite spheroids in 'root' channels have been oxidised/ferruginised. *Moderately anthropogenic alluvium, deposited as laminated intertidal muds.*
			Sequence 6 continued
SMT D3/SMT 5a2, 64a, 4a2, 1a1-3	M1380A	17-25 cm SM: very heterogeneous with SMT 6a4 and 5a2, and large (eg 8mm and 15mm) clasts of phytolith-rich 1b3	1746 Very heterogeneous with clayey sediment soils, with varying concentrations of very fine

		and raw clayey soil-sediment (SMT 4a2) *Microstructure*: massive, with semi-welded subangular blocky and crumbs, 40% voids, open and closed vughs, with coarse chambers; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), as below, with well sorted silt and very fine sand size quartz and mica in SMT 4a2; *Coarse Organic and Anthropogenic*: very abundant raw clay soil fragments, abundant briquetage (max 8mm), many fine charcoal, fuel ash nodules (eg 1a2 = 4mm); examples of fused sandy soil; trace of roots; *Fine Fabric*: SMT 4a2: dusty brown to dark dusty and speckled brown (PPL), moderately high interference colours (close porphyric b-fabric, stipple speckled b-fabric, with some grano and uni-striate b-fabric, XPL), pale grey (OIL), weakly humic and micaceous, with rare to many phytoliths and diatoms (soil formed in alluvium, which had been dug up; characterised by root channels and void coatings); *Pedofeatures*: *Textural*: many very thin brown clay void coatings (<50 µm) and occasional microlaminated infills and coatings (in chambers) of brown and dusty brown clay (up to 1mm thick); (Generally iron depleted, as below); *Fabric*: very coarse mixing, in part due to abundant very broad (up to 13mm wide) , broad and thin burrows; *Excrements*: very abundant very thin, thin and broad (eg 1mm) excrements, including possible mammilated ones.	charcoal etc, very abundant coarse clasts of raw ripened soil (8-15mm in size), with abundant briquetage (max 8mm), many fine charcoal, fuel ash nodules (eg aggregate = 4mm), examples of fused sandy soil and trace of roots. The soil is overall characterised by very abundant thin, broad to very broad (13mm) burrows and associated excrements, including mammilated ones. The whole fabric is lastly affected by very thin void clay coatings, with chambers and coarser porosity with microlaminated clay fills up to 1mm thick. *Coarsely dumped spreads of dug up local ripened alluvial soil (without charcoal – clean natural deposits), and mixed contemporary anthropogenic alluvium (charcoal rich), which also include large amounts of fine charcoal, fuel ash waste and briquetage. These have undergone a period of strong biological working (as a topsoil)(a bit like immature 'dark earth'), before being affected by renewed alluviation/rising sea levels/base levels. Possibly this was ground raising deposit.*
MFT C2/SMT 5a2 and 1b3	M1380B1	25-32.5 cm SM: coarsely heterogeneous with 30% patch of pale phytolith-rich anthropogenic sediment SMT 1b3 and dominant 5a2; *Microstructure*: massive with underlying welded granular, 35% voids, vughs and closed vughs;	1747 Rather compact fine charcoal-rich clayey soil-sediment, with large area of pale phytolith-rich sediment, with very abundant generally small (2-4mm) clasts of raw sediment, weakly

		Coarse Mineral: as sediment 5a; *Coarse Organic and Anthropogenic*: very abundant inclusions, but mainly 2-4mm in size (but example of 13mm size briquetage); very abundant finely fragmented inclusions such as 2-3mm size unburned or little burned plant-tempered estuarine sediment used for structures (diatoms and organic inclusions present) or as sediment fragments; many fuel ash nodules and abundant fine charcoal (max 1-<2mm), some monocot including stem sections; *Fine Fabric*: SMT 1b3: dusty grey palish brown (PPL), essentially isotropic (porphyric, undifferentiated b-fabric, XPL), pale grey (OIL), weakly humic, abundant very fine charred OM, with many phytoliths, patches of clay with diatoms, and other microfossils (semi-ashed gathered wetland plant residues); *Pedofeatures*: *Textural*: many very thin (max 50 µm) dusty clay void coatings; *Fabric*: very abundant thin and many broad burrows; *Excrements*: many thin organo-mineral excrements. 30.0-32.5 cm 1793 Relict patches of laminated dusty brown (SMT 5a2), fine charcoal rich clay, characterised by very abundant thin burrows, and microlaminated dusty brown and brown clay void coatings; 40% voids; rare fine briquetage and trace amounts of fine charcoal present. *Fine Fabric*: dotted and dusty dark brown (dark reddish brown in places)(PPL), very low interference colours, to isotic (open porphyric, stipple speckled to undifferentiated b-fabric, XPL), grey, dark grey, black speckled (OIL), humic staining with very abundant very fine OM and charred OM.	burned sediment and briquetage, charcoal including monocotyledonous material and stem sections. Rare thin dusty brown clay coats most voids. (Very high specific conductance) *Probable exterior occupation surface deposit formed by trampling, producing moderately well sorted fragmented anthropogenic materials (briquetage etc) and raw sediment fragments (employed for constructions). Phytolith-rich fabric is unfused wetland plant fuel ash residues, with included wetland clay containing diatoms for example.* 1793 Relict patches of laminated dusty brown, fine charcoal rich clay, and homogenised when characterised by very abundant thin burrows.

MFT C4/SMT 5a2			Secondary microlaminated dusty brown and brown clay void coatings occur throughout. (Very high specific conductance) *Partially weathered and burrowed charcoal-rich alluvium, marking a ripening episode and exposure. Even so, alluvial flooding led to microlaminated brown clay deposition in voids.*
MFT C3/SMT 5a1 (1a2, 6a4) MFT C2/SMT 1b1/2,1a1-3,6a4,5a	M1380B2	35.5-39 cm 1793 SM: moderately heterogeneous with dominant SMT 5a1 (alluvium) and burrowed-in anthropic 6a4, for example; some thin laminae are composed of SMT 6a4; *Microstructure*: massive and coarsely laminated (5-6mm); 35% voids, open vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 25:75, well sorted medium and coarse silt, with very few rounded sand-size clasts of alluvium; *Coarse Organic and Anthropogenic*: occasional briquetage (max 5mm), rare fuel ash nodules; *Fine Fabric*: as 5a1; *Pedofeatures*: *Amorphous*: occasional ferruginised pyrite; *Fabric*: occasional thin and broad burrows. 39-42 cm 1794 As below, but with fewer charcoal (many), but more briquetage (very abundant), with blackened examples which include diatoms (estuarine sediments?), rubefied crumb soil (part of burned installation?), fuel-ash waste variants, both fine alluvial soil-sediment (SMT 5a1 as infills) and dark clayey alluvial soil (SMT 6a4). Massive/very poorly layered with 'capping' of a horizontally oriented briquetage fragment (25mm long),	1793 Massive coarsely laminated (5-6mm) clay containing very fine detrital organic matter and charcoal. Minor amounts of rounded 'clay' clasts and anthropogenic inclusions occur also as thin laminae (briquetage fragments; max 5mm). Occasional thin and broad burrow fills include anthropic material; minor thin burrowing of anthropic laminae. Occasional pyrite have become oxidised (ferruginised).(Very high specific conductance) *Massive alluviation episodes interdigitated with wash of anthropogenic material (terrestrial wash?)(rainwash?). Short-lived minor burrowing of anthropogenic laminae indicate brief drying out (intertidal episodes?).* 1794 Heterogeneous with mixed fuel ash waste, varying from very strongly melted vesicular

		marking boundary to overlying 1793.	white nodules to weakly fused phytolith-rich sediments; briquetage includes variants of diatom-containing material, and relict crumb/soil aggegates (topsoil) as rubefied structural (?) components (accidental inclusions). Burned sediment fragments also occur. Partially biologically worked fine charcoal rich clayey sediments also occur as sediment infill. Boundary to overlying 1993 is marked by a horizontally oriented 25mm long briquetage fragment, on clayey sediment fill. *Heterogeneous anthropogenic deposit formed as loose trampled spread, with a surface forming marked by a horizontally oriented briquetage fragment. This was mainly dry ground/trampled occupation surface. Increasingly, however alluviation led to clayey sediment infills (see 1793 above), and spreads of coarse material over muddy mudflat ground.*
MFT C2/SMT 6a4, 1a1-1a3, 1b1, 1b2	M1381A	33-41 cm SM: very heterogeneous, with layer of 36-39cm of clayey SMT 6a4, and fragmented patches of SMT 1b1 (fused phytoliths), 1b2 (burned phytolith concentrations), loamy 8a, and 6a4; anthropogenic fabrics and inclusions (1a1-1a3) increase above 36cm; *Microstructure*: poorly layered fragments of subangular blocky; 40% voids, vughs and simple packing voids (fine root channels in clayey 6a4; 30% voids); *Coarse Mineral*: see 1004 and 1007; *Coarse Organic and Anthropogenic*: charcoal occasional to very abundant (max 4mm; monocot with stem sections), from many to	1794 Very strongly mixed/burrowed anthropogenic deposits very rich in monocotyledonous charcoal (max 4mm), with charred stem sections, consistent with type 1a1 fuel ash (vitrified stem sections)(one 7mm aggregate is also present). Large amounts of moderately to strongly burned phytolith remains occur alongside abundant briquetage. This material is also semi-layered, includes fragmented soil-sediments and characterised by both thin,

		abundant briquetage; burned and strongly burned and fused phytoliths from abundant to very abundant; fuel ash nodules (1a1-1a3) from occasional to abundant, including 7mm nodule; *Fine Fabric*: as in 1004 and 1007; *Pedofeatures*: *Textural*: rare brown clay infills and coatings, some with diatom concentrations, in lower slide; *Fabric*: very abundant thin to broad burrows throughout, apart from clayey SMT 6a4; *Excrements*: many thin excrements.	broad and very broad burrows. *A sequence of fuel ash and briquetage-debris rich spreads, where again wetland plants are probably the main fuel source. These deposits were exposed and became bioworked, but part of their layered character is probably due to trampling.* 1837 Very heterogeneous and burrow mixed dark brown soil-sediment, characterised by fine root channels (as in 1007A, 1143), and moderate amounts of phytolith-rich burned fuel debris, monocotyledonous charcoal and briquetage (see 1794 above); and soil-sediment inclusions. It is very strongly burrowed but shows relict layering, including one 3cm-thick ripened alluvium. Rare void infills of brown clay include diatom concentrations. *Dried out and biota-worked spreads/wash of fuel-ash debris, with possible ripened alluvial clay layer. Very coarse burrowing and trampling may also be responsible for this very mixed junction.*
			Sequence 14 (R-B Roundhouse outer ditch)
MFT C2/SMT 5a1	M1203A	3.5-11 cm SM: moderately homogeneous SMT 5a1; *Microstructure*: massive with prismatic fissuring	5430 Massive silty clay with prismatic fissuring, and coarse anthropic inclusions of an angular

		(drying out?), 35% voids, planar voids/fissures, with intra-pedal fine channels; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 55:45, very poorly sorted clay with silt, and fine and medium sand, with frequent anthropogenic clasts, 18mm size angular flint; *Coarse Organic and Anthropogenic*: occasional burned fine sand brickearth/nodules (hearth), sand and gravel size moderately to very strongly burned briquetage; example of 5mm-size wood charcoal; example of human? coprolite/cess nodule (rounded, 3mm, pale yellowish, non-birefringent, very abundant embedded monocot charcoal and charred material; phytoliths and Fe-hypocoatings of closed vughs); *Fine Fabric*: as SMT 5a; *Pedofeatures*: *Textural*: very abundant textural intercalations and associated embedded grains and closed vugh and impure void clay/matrix void coating features.	flint (18mm), sand and gravel size brickearth clasts, burned brickearth, strongly and moderately burned briquetage, and a 3mms-ze example of a human? coprolite embedding charred monocotyledonous waste, phytoliths, and has iron-stained closed vughs. *Post-occupation alluvium, with small amounts of washed in and dumped anthropic materials, including a human coprolite/cess fragment which embeds charred monocotyledonous fuel/cereal processing? waste.*
MFT F3/SMT 3a3 (3a1)	M1203B1	13.5-18 cm Very loose, open (60%) concentration of rubefied mud plastered, plant tempered daub/briquetage fragments (from brickearth mainly SMT 3a3)(30mm max); Also daub composed of mixed brickearth, sediment and anthropogenic alluvium rich in charcoal and phytolith-rich residues. 17mm wide void at base is lined with reddish brown silty clay alluvium.	5429 upper Very loose, open concentration of rubefied/moderately to low temperature burned mud plastered, plant tempered daub/briquetage fragments (from brickearth mainly)(30mm max). Daub also composed of clayey and anthropogenic sediments sometimes rich in fine charcoal and phytoliths. *Dump of destruction/dismantling debris of burned floors/low temperature hearths-briquetage. Inwash of brickearth-sourced alluvium.*

MFT F2/SMT 6a5 (4a) MFT F1/SMT 6a4		18-20.5 cm SM: moderately heterogeneous laminated SMT 6a5, with increasing amounts of clayey soil and sediment clasts (eg SMT 4a); *Microstructure*: microlaminated becoming fragmented into subangular blocky upwards, 30% voids, simple packing voids and poorly accommodated planar voids; *Coarse Mineral*: poorly sorted silts and fine to medium sands (from brickearth?), and gravel-size soil-sediment clasts, *Coarse Organic and Anthropogenic*: very abundant charcoal, monocot max 8mm, possible woody shrub stems charcoal? (max 6mm) thatching/hearth debris; example of fine burned bone; possible yellowish brown amorphous OM/faecal waste (also weakly FeP? stained charcoal example); examples of burned sand; occasional white nodules/fuel ash waste; many phytoliths and abundant amorphous OM fragments; *Fine Fabric*: SMT 6a5, eg grey and pale brownish grey (PPL), very low interference colours (close porphyric, stipple speckled b-fabric, XPL), grey (OIL), abundant plant fragments, amorphous OM and single and articulated phytoliths; *Pedofeatures*: *Crystalline*: occasional patches and infills of grey often prismatic crystalline material, sometimes with low order birefringence, gypsum? 20.5-21.5 cm Microlaminated, as below, clayey with very fine charcoal, phytoliths and articulated phytoliths; 7mm long, 3mm thick brown humic fill (unburned dung	5429 lower Dark, microlaminated, with very abundant monocotyledonous (max 8mm) and woody/shrubby (max 6mm) charcoal, sediment becoming fragmented into subangular blocky upwards. Very abundant phytoliths and articulated phytoliths; example of burned bone, with possible organic faecal material and weakly FeP stained charcoal ('night soil'). Rare fuel ash waste nodules. Occasional infills and formation of probable diatom death assemblages. *Waterlain mixed clayey brickearth and alluvium, with domestic/constructional debris (plant/crop processing, thatch, hearth waste), food and sewage(?) waste too. Becomes dried out and cracked upwards. (Inwashed diatoms)* 5428 As below, microlaminated with very fine charcoal, phytoliths and articulated phytoliths, and patch of dung residue. *Semi-waterlain byre waste*

		residues?)	
MFT F1/SMT 6a4	M1203B2	21.5-28 cm SM: moderately heterogeneous with coarse pebbles (max 20mm) and laminated and microlaminated 6a5; *Microstructure*: massive, 70% voids (?); planar voids and shrinkage cracks?; *Coarse Mineral*: common small stones (round fine glauconitic sandstone, and quartzite); laminated silty clay and silts with horizontally oriented long plant fragments, and clean to fine charcoal rich clayey fills; *Coarse Organic and Anthropogenic*: example of 1mm-size burned fish bone, and 2mm-size vesicular white nodule; very abundant 2-5mm long horizontally oriented plant fragments (monocot) mainly humified and dark reddish brown; also more obvious dung-like fragments; occasional wood charcoal (1-2mm max), some charred; alternating 2.5mm loamy (brickearth) and 4mm-thick clayey (massive becoming microlaminated with layered OM fragments upwards); upwards becomes more charcoal rich (max3mm), with abundant very fine charcoal, eg of red burned flint and dissolving burned bone (~1mm), and with a medium sandy component. *Fine Fabric*: as SMT 63, but with microlaminated long humified and charred humified monocot material; eg of *in situ* root; *Pedofeatures*: *Textural*: many impure clay panning (sediment infills) and void infills. 27.6-28 cm: Massive (20% voids), SMT 7a1 (brickearth), with occasional very fine charcoal; very abundant textural intercalatory pedofeatures with closed vughs (Fe depleted).	5428 Pebble- (20mm) rich fill, with alternating 1) clayey alluvium, 2) laminated silty clay with long (~5mm) horizontally oriented humified and sometimes charred monocotyledonous plant fragments (and charred probable dung) and 3) fine sandy loam (brickearth) layers. Rubefied (burned) bone examples, including fish bone (1mm); charcoal increases upwards from occasional to many (max 3mm wood charcoal); one white nodule (vesicular fuel ash waste) and burned flint. *Base of ditch became infilled with alluvial clay, followed by microlaminated silts full of waterlain probable byre waste; this was followed by silting of the brickearth ditch sides; small pebbles were also deposited. This sequence microlaminated fine material repeated 3 times upwards. Burned bone, including fish bone, burned flint and wood charcoal also testify to background domestic use of the area/round house. Stabling and domestic use recorded.* 5433 Massive, compact iron depleted fine sandy

MFT E1/SMT 7a1			silt loam, with closed vughs and intercalations; fine fabric includes very fine charcoal. *Truncated and slaked early Holocene terrestrial lower topsoil formed in brickearth (exposed by ditch cutting).*
			Sequence 15 (Roundhouse inner ditch)
MFT F4/SMT 6a1, 6a2(5a1)	**M1202B**	27-34.5 cm 27-31(34.0) cm (5328) SM: moderately heterogeneous SMT 6a1 with burrow fills of 6a2; *Microstructure*: massive with patchy subangular blocky and channelled; 25% voids, poorly accommodated planar voids and closed vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 6a1: patchy 40/50:60/50, coarse silt and very fine sand; *Coarse Organic and Anthropogenic*: occasional red and blackened (v strongly burned) briquetage (max 9mm) and abundant fine charcoal in burrows, along with	5328 Iron-depleted fine and medium sands (loamy sands), many void infills of brown silty clay and very broad burrow fills of anthropogenic charcoal and burned clay rich soil. *The roundhouse ditch was cut into top of Holocene sandy soils, and these collapsed into the ditch at times. Continued clayey alluviation also affected this fill, alongside burrowing of anthropogenic soils, from local*

		many sand-size burned soil-sediment; trace of charcoal in 6a1; *Fine Fabric*: as 6a1, 6a2; *Pedofeatures*: *Textural*: many intercalations and associated microlaminated dusty to impure clay void infills; *Amorphous*: rare weak ferruginous impregnations: Fabric: occasional broad (2-4mm) burrows. 31(34.0)-34.5 cm (5332) SM: heterogeneous with dominant SMT 7a1 and frequent 6a1 and 6a2 variants (silty clay alluvium/anthropogenic mixed alluvium); *Microstructure*: massive, 30% voids, channels, fissures and closed vughs; *Coarse Mineral*: as 7a1, with very few small gravel-size flint; *Coarse Organic and Anthropogenic*: in mixed clayey 6a1, 6a2 are occasional fine briquetage, and charcoal, with burned/blackened soil clasts, with rare articulated phytoliths, eg of fine sand-size mineralised cess/human cop?; *Fine Fabric*: as SMT 7a1 and 6a2; *Pedofeatures*: *Textural*: occasional very dusty clay void coatings associated with very abundant silty clayey infills (6a1) up to 6mm thick; *Amorphous*: occasional moderate Fe impregnations of 6a1; *Fabric*: many 3-6mm broad burrows mixing-in 6a1 and 6a2 soil.	*'redhill' type deposits.* 5332 Mainly massive silty clay with small amounts of fine charcoal; minor subangular structure formation and marked broad burrowing. Burrows filled with anthropogenic soil, very rich in charcoal, red and blackened burned sediment and briquetage; examples of articulated phytoliths and fine sand size amorphous cess nodules/human coprolite. *Inner ditch became rapidly infilled with local alluvium containing small amounts of charcoal. Moderate drying out and structural formation and broad burrowing from the overlying red hill deposits.*
MFT E2/SMT 7a1, 6a1, 6a2			
			Sequence 16 (Round house settling tanks)

MFT C2a/SMT 1b1, 4a2	M1224A	0-8 cm SM: very heterogeneous (SMT 1b1, 4a2), as below, with brown stained and rubefied clay and brickearth clasts; *Microstructure*: subwelded subangular blocky and granules, 35% voids, packing voids, vughs and channels; *Coarse Mineral*: as below, poorly sorted anthropogenic components, *Coarse Organic and Anthropogenic*: dominantly fused phytolith ash, as below, with abundant burned plant-tempered brickearth clay daub and briquetage; many examples of browned and rubefied dung and layered bioworked amorphous dung, and likely totally ashed/fused dung (max 7mm); example of totally calcined bone (2mm); very abundant monocot charcoal including stem sections (2mm); many white ash-fuel nodules; Fe-P stained ash/ash-dung residues; *Fine Fabric*: as 1b1, 4a2; *Pedofeatures*: *Textural*: rare brownish dusty clay coatings; *Amorphous*: very abundant moderate to strong iron staining, including likely Fe-P staining; *Fabric*: burrowing as below, but very abundant.	1362 diffuse boundary to 1363 Very ashy, with fused phytolith monocotyledonous burned plant residues, with white fuel ash nodules, burned plant temper briquetage/daub constructed from brickearth clay. Many rubefied and blackened dung fragments (max 10mm), with both layered and bioworked examples of amorphous dung; some fused phytolith remains are stained/originally dung. Very high amounts of monocotyledonous charcoal, including stem sections, are present. An example of calcined bone occurs. Iron staining is very abundant, and likely includes yellowish Fe-P impregnations. (Ashed dung as at GYE). The fill is characterised by very abundant broad and very broad burrows. Marked LOI, Zn, MSconv, and very strongly enriched P (highest amount recorded), and notable specific conductance, MSmax and Cu. *This fill is composed of fuel ash residues, associated moderately burned alluvial clay and brickearth soil (probably accidentally gathered with wetland* monocotyledonous *plant fuel). Clearly, also here herbivore dung has been incorporated and burned, possibly as an extra slow burning fuel source. Calcined bone is probably an accidental ashed inclusion. Iron and likely Fe-P stain the ashed fill and clay clasts; P sources from weathered plant ash and dung. Bulk data*

			consistent with micromorphology; concentrations of Zn appears to be of fuel ash origin.
MFT C1/SMT 1b1 (4a2)	M1224B	13-21 cm 13-18.0 cm SM: essentially homogeneous SMT 1b1 (with 4a2); *Microstructure*: massive, vughy and channels; 30% voids, open and closed vughs and channels; *Coarse Mineral*: poorly sorted; *Coarse Organic and Anthropogenic*: dominant: very abundant fused phytolith aggregates (SMT 1b1), with rare fused white nodules (especially types 1a3 and 1a2; very abundant phytoliths (up to 1mm long); very abundant subrounded estuarine clay and brickearth soil fragments (sand to small gravel size); possible burned dung-enriched brickearth and organic matter; very abundant, mainly monocot charcoal, including 'straw'/moncot sections; some clay fragments are weakly rubefied; rare briquetage; *Fine Fabric*: as SMT 1b1 and 4a2; *Pedofeatures*: *Textural*: many microlaminated dusty clayey pans (200-300µm), pale brownish (rubefied infills) especially in lower part of 1363 fill (below very broad burrowing); *Fabric*: abundant broad and very broad (max 22mm) burrows. BD: Marked LOI, Zn, MSconv, and very strongly enriched P (highest amount recorded), and notable specific conductance, MSmax and Cu. SEM/EDS: Plant(dung?) tempered daub with 0.38-0.54%P (*n*=3); Fused phytolith matrix material with 3.54-4.41%P; Vesicular fuel ash (white nodules) with	1363 Monocotyledonous ash residue dominated fills with fused phytoliths, coarse phytoliths (1mm), weakly rubefied burned local alluvial soil clay and brickearth. Lowermost fill very charcoal rich with monocotyledonous charcoal, including stem sections ('straw'); here also voids commonly infilled with brownish microlaminated finely dusty clay. (These are absent in very broadly burrowed 'ash' above. Marked LOI, Zn, MSconv, and very strongly enriched P (highest amount recorded), and notable specific conductance, MSmax and Cu. EDS indicates vesicular fuel ash and fused phytoliths contain up to 4.41% P. *Dump/fill of moderately sorted ashed wetland(?) plant and 'straw' and sand to fine gravel size weakly burned alluvial clay and brickearth soil. These are very phosphate-rich fuel ash and weakly burned clay from fire installation(s), presumably associated with use of settling tanks. Inwash of fine dusty clay (with brown colours reflecting local fire installations) records continued wash/water settling in tank. Upper fills dried out at times allowing some bioworking.*

MFT F5/SMT 4a2, 5a3		2.55-4.41%P and 29.6% Si (63.3% SiO_2). 18-21 cm SM: very heterogeneous, with alluvial clay fragments (SMT 4a2) and laminated brickearth (5a3); *Microstructure*: massive, coarsely and finely laminated, with cracking; 40% total voids and 20% intrapedal voids (closed vughs and fine channels); *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), variable C:F, 4a2 (10:90), 5a3 (70:30); poorly sorted 10mm size clay clasts; moderately sorted coarse silt and fine sand brickearth laminated fills; sand size brickearth fragments containing glauconite occur; *Coarse Organic and Anthropogenic*: dump/lining of local estuarine clay with small amounts of charcoal; abundant charcoal sub-horizontally oriented charcoal including monocot charcoal (max 1250 µm) – some charred amorphous OM fragments; trace of thin bone (coprolitic?) also horizontally oriented (1500 µm), rare blackened burned soil/sediment and phytoliths rare amorphous yellowish OM fragments (cess?); *Fine Fabric*: SMT 5a3, as 5a2, with abundant very fine charcoal , phytoliths present; *Pedofeatures*: *Textural*: abundant microlaminated void coatings and pans of 250-500 µm thick pale finely dusty poorly oriented clay; *Amorphous*: occasional	1364 Poorly mixed fill composed of 1) moderately coarse fragments of weakly ripened alluvial clayey soil containing small amounts of charcoal, and 2) microlaminated coarse silty and fine sandy fills rich in charcoal and containing small amounts of black burned sediment/soil, phytoliths and trace amounts fine (coprolitic?) bone and organic matter. Abundant finely microlaminated dusty clay void coatings and pans up to 0.5mm thick. *Likely, clay-lined tank cut into brickearth; 'clay' is composed of moderately coarse fragments of weakly ripened alluvial clayey soil. Use of tank led to inwash of local brickearth alongside charred and burned organic matter, some monocotyledonous, and small amounts of black burned sediment of 'fire installation'(?) origin. Small amounts of possible human waste also occurred. Water in tanks gently eroded brickearth tank sides, and this sediment settled as microlaminated deposits. Later pale dusty clay inwash is post-depositional feature of later fills(?)*

		weak iron staining of clay clasts.	
			Sequence 17 (round house hearth)
MFT G1/SMT 8a2, 8a4,1b1 MFT G2/SMT 1b1, 8a1,8a2,8a3	M1151A	3-18 cm 3-7 cm SM: very heterogeneous with loose and coarse (30mm) fill of burned brickearth, white nodules, fused phytoliths (fused monocotyledonous plant ash); *Microstructure*: massive with fine granular; 40% voids, fissures and simple packing voids; *Coarse Mineral*: as 1593 greyish (M1152B); *Coarse Organic and Anthropogenic*: as 1593 greyish (M1152B), but with coarser elements and including burned vesicular sands; *Fine Fabric*: see 1593; *Pedofeatures*: *Textural*: many textural intercalations in brickearth makeup, and many dusty clay brown infills; *Amorphous*: many iron staining of fused ash layers. 7-8 cm SM: 3mm – 1cm-thick layer of 1mm-size (sections) of charred monocotyledonous plants, with associated(?) layers of fused ash/phytoliths, white nodules, etc, as in blackish 1593 (M1152B).	1593 Very mixed, loose and coarse (30mm) fill of burned brickearth, white nodules, fused phytoliths (fused monocotyledonous plant ash); with clasts of vesicular burned sands. Many dusty clay brown infills. (High Zn, LOI, very high P and χconv; marked specific conductance) *Loose ash and burned hearth debris layer, probably representing re-use/reconstruction of hearth.* 1485 3mm – 1cm-thick layer of 1mm-size (sections) of charred monocotyledonous plants, with associated(?) layers of fused ash/phytoliths, white nodules, etc, as in blackish 1593 (M1152B). (High LOI, Pb,

MFT G1/SMT 8a2, 8a4,1b1		8-10.5 cm SM: As 1597 in M1151B, loosely packed very dominant strongly burned brickearth, white nodules (vesicular fused fuel ash), fused phytoliths and strongly burned sands, with rare traces of briquetage, rare sections of charred monocotyledonous plant.	very high P, Zn and Cu) *Charred hearth constructional layer composed of monocotyledonous plants ('straw') lining.* 1593 lower Loosely packed very dominant strongly burned brickearth, white nodules (vesicular fused fuel ash), fused phytoliths and strongly burned sands, with rare traces of briquetage, rare sections of charred monocotyledonous plant. *Loose fuel ash and burned hearth debris fill, relict of hearth use.*
MFT G4a/SMT 8a1, 8a2	M1151B	10.5-11.5 cm SM: as below, but pale because very dominantly coarse component (very coarse silt and fine sand)	1595 Broadly fissured dominantly sandy brickearth hearth layers. *Heated and burned sandy brickearth hearth*

			wall.
MFT G4a/ SMT 8a1,8a2		11.5-13 cm (1598) SM: as below, but with dark red and dominantly blackened brickearth (SMT 8a2); *Microstructure*: massive, fissured; 35% voids, fissures; *Coarse Mineral*: as below; *Coarse Organic and Anthropogenic*: burned brickearth hearth wall makeup; *Fine Fabric*: SMT 8a2; *Pedofeatures*: rare impure clay infills.	1598 Broadly fissured dark red and dominantly blackened brickearth layered hearth material. *Burned and heated brickearth hearth makeup.*
MFT G4/SMT 8a1/8a4		13-16.5 cm (1597) homogeneous SMT 8a1/8a4 (rubefied and blackened upwards), but diffusing into 1598 upwards; *Microstructure*: compact massive, with fissures, 25% voids, horizontal fissures; *Coarse Mineral*: as below, brickearth, *Coarse Organic and Anthropogenic*: brickearth plastering, with patchy rubefication and traces of plant tempering; *Fine Fabric*: as SMT 8a1 and 8a4; *Pedofeatures*: *Textural*: abundant textural intercalations; *Depletion*: possible layers of pure silt record elutriation; *Amorphous*: rare iron void hypocoatings; (Lowermost 15-16.5 cm: mixed SMT 4a2 (anthropogenic brickearth soil), and burned inclusions)	1597 Reddish brown to dark reddish brown layered, compact brickearth with fissures, textural intercalations, closed vughs and voids with iron hypocoatings. *Possible waterlain and trampled anthropogenic detritus-rich brickearth immediately pre-dating the hearth.*

MFT E3/SMT 7a1		16.5 -18 cm (1599) SM: homogeneous (but discontinuous) SMT 7a4 (clayey brickearth alluvium); *Microstructure*: massive, 30% voids, fissures; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 40:60, moderately poorly sorted silts and fine sand; *Coarse Organic and Anthropogenic*: very abundant fine charcoal, trace of root traces; *Fine Fabric*: as SMT 7a4; *Pedofeatures*: *Textural*: very abundant textural intercalations and associated clayey void infills; *Amorphous*: rare ferruginous diffuse impregnations; *Fabric*: rare thin burrows.	1599 Discontinuous, homogeneous, compact (now fissured) clay loam, rich in very fine charcoal. Characterised by very abundant textural intercalations and associated clayey void infills, with rare ferruginous diffuse impregnations. Rare thin burrow fills. *Muddy local anthropogenic alluvium derived from brickearth. Minor burrowing and rooting, prior to likely truncation.*
MFT G4/SMT 8a1(8a4)	M1152A	16-24 cm 16-19.5 cm 1595 SM: homogeneous SMT 8a1/8a4 (rubefied), but diffusing into 1594; *Microstructure*: massive, with fissures, 25% voids, fissures; *Coarse Mineral*: as below, brickearth, *Coarse Organic and Anthropogenic*: brickearth plastering, with patchy rubefication; *Fine Fabric*: as SMT 8a1 and 8a4; *Pedofeatures*: *Textural*: abundant textural intercalations; many brown clayey fills up to 2mm wide. 19.5-24 cm 1594 SM: homogeneous SMT 8a3; *Microstructure*: vertically fissured, 35% voids, 250µm – 1mm wide fissures;	1595 Compact pure brickearth with patchy rubefication; many brown clayey fills up to 2mm wide. *Outer brickearth plastered hearth wall, with patchy heating effects.*

MFT G3/SMT 8a3		*Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 90/70:10/30, very coarse silt-very fine sand-size quartz; *Coarse Organic and Anthropogenic*: very dominant 'plastered' brickearth; *Fine Fabric*: SMT 8a2 (patchy very low interference colours or totally isotropic); *Pedofeatures*: patchy, very abundant intercalations.	1594 Homogeneous, moderately burned/heated fine sandy silt loam (brickearth), vertically fissured with 250µm – 1mm wide fissures. *Heated plastered brickearth loam and sands hearth wall. heating and drying out causing fissuring.*
MFT G3/SMT 8a3 MFT G2/SMT 8a1, 8a2, 8a3, 1b1	M1152B	24-32 cm 24-25(25.5) cm 1594 SM: vertically fissured dark grey burned brickearth (SMT 8a3) – see above. 25(25.5)-25.5 cm (Blackish) 1593 SM: Thin to broad (vertical) layers (2.5-10 mm) of monocot charcoal and charred layered monocot plants, lined with patchy SMT 8a3 (plastered brickearth?), brickearth loam (8a1), with patchy fused phytoliths (SMT 1b1), burned brickearth (8a2), with partially burned moncot plant remains/stem sections; (Massive	1594 As above Vertically fissured dark grey burned brickearth. *Heated plastered brickearth loam and sands hearth wall.* 1593 (Blackish) Thin to broad (vertical) layers (2.5-10 mm) of monocotyledonous charcoal and charred layered monocotyledonous plants, lined with patchy dark grey (Ca-enriched; (4.33-5.39% Ca, mean 4.95% Ca, *n*=3) plastered brickearth, brown brickearth loam; with patchy fused phytoliths, burned brickearth, and partially burned monocotyledonous plant

		with 25% voids; thin vertical fissures); *Coarse Organic and Anthropogenic*: similar to below; *Fine Fabric*: SMT 8a3: dark grey (PPL), isotropic (close porphyric , undifferentiated b-fabric, XPL), white (OIL); *Pedofeatures*: as below. BD: (Very high LOI, and high specific conductance, P, Zn and Cu) SEM/EDS: Lime? plastered brickearth (eg 4.33-5.39% Ca, mean 4.95% Ca, *n*=3), brickearth silts (eg 2.26% Ca), constructional clay (eg 0.91% Ca); charred monocot/'straw' layer (eg 9.77-12.5% Fe, 16.9-24.9% Ca, 3.30-4.36% P, 1.23-1.77% S); fused phytoliths (eg 24.3-35.5% Si); burned bone/coprolitic waste (eg 1.99-2.01% F, 9.72-14.3% Ca, 22.5-28.8% Ca). 25.5-32 cm (Greyish) 1593 SM: very heterogeneous with layered rubefied brickearth loam and fine sands (SMT 8a1/8a4), burned/heated brickearth (SMT 8a2), strongly burned brickearth (SMT 8a3) and fused phytoliths (1b1); *Microstructure*: massive, layered, sub-vertically fissured; 35% voids, including vesicular fabric and simple packing; *Coarse Mineral*: C:F in places 80:20, 90:10, brickearth sands and medium sands and clasts of fused material; *Coarse Organic and Anthropogenic*: very abundant burned brickearth, strongly burned brickearth and sands (max 14mm clasts), very abundant fused ash/phytoliths; many white nodules (type 1, straw pseudomorphs); rare plant remains and charcoal, with many monocot charcoal (max 2.5mm) on	remains/stem sections (strongly Ca-Fe-P enriched); packing of more strongly burned plant ash/fused phytoliths. (Very high LOI, and high specific conductance, P, Zn and Cu) *Hearth construction layers composed of vertically oriented monocotyledonous/ straw, limed? plastered with brickearth, brickearth loam.. 'Straw' lining ashed and charred by hearth use (cf West Heslerton oven experiment).* 1593 (Greyish) Broadly vertically layered (10-20mm) reddish brown/rubefied brickearth loam (inside edge), with monocotyledonous charcoal remains (clayey plastering), and brickearth fine and medium sands, and fused ash/melted phytoliths. Ca-P cess staining and infills (nematode eggs, and ferruginised dietary remains?). These show various levels of heating, with loss of fine fabric birefringence and partial melting of sand grains. Burned vesicular bone/human coprolitic waste noted. Clasts of more strongly burned brickearth and sand (max 14mm), and white nodules (vesicular fuel ash waste and 'straw' pseudomorphs) are present throughout. (very high P, marked LOI, Zn and very high χconv)(cess: 1.99-2.01% F, 9.72-14.3% P, 22.5-28.8% Ca) *Roundhouse hearth composed of inside layering of rubefied, clayey plastered*

MFT G1/SMT 8a1, 8a2, 8a4,1b1		edge/brickearth loam lining; example of blackened burned briquetage (9mm); occasional cess/cess staining (isotropic yellowish [XPL, PPL], grey under OIL) of brickearth plaster fragments and fill generally; ferruginised organic remains, and nematode eggs (~40µm); *Fine Fabric*: SMT 8a2: speckled greyish brown (PPL), isotropic (loose close porphyric/coated and aggregated grain, undifferentiated b-fabric, XPL), whitish grey (OIL); SMT 8a3: as 8a2, with partially melted sand grains (white to colourless under OIL); SMT 8a4: as 8a1, reddish brown (OIL), with sublayered fine charcoal/'clay plastering'; *Pedofeatures*: *Textural*: occasional yellowish brown clay coatings and infills; *Amorphous*: occasional calcium phosphate infills and staining and hypocoatings of clasts and this hearth-waste layer generally . BD: very high P, marked LOI, Zn and very high χconv SEM/EDS: cess waste (eg 1.99-2.01% F, 9.72-14.3% Ca, 22.5-28.8% Ca).	*brickearth loam (with fine monocotyledonous charcoal), and relict hearth debris of more strongly burned brickearth loams and sands, with clasts of previously burned sand, and fused fuel ash, fused phytoliths/ash waste clasts. Clasts include cess stained brickearth plaster and cess-staining in general, testifying to the casual disposal of human waste. These are fills against 1593 blackish (see above). Inwash of marine clays have raised specific conductance as a post-depositional effect.*
			Redhill sequences (Sequence 19)
MFT C2c/SMT 1a1, 3a1,3a2, 4a1, 1b1, 5a5	M1362A1	0-7.5 cm SM: extremely heterogeneous with typical redhill anthropogenic inclusions (as below), but with higher proportions (frequent) of fused moncot ash waste (phytoliths), white nodules (vesicular melted fuel ash), and increasing amounts of occupation soil formed in alluvium (SMT 5a5); *Microstructure*: massive, vughy; 30% voids, open vughs; *Coarse Mineral*: very poorly sorted/unsorted, with 30mm-size flint stone (rounded pebble; iron staining is rubefied - burned); *Coarse*	6234 Moderately compact, extremely heterogeneous mix of anthropogenic materials, strongly burned phytolith-rich monocotyledonous fuel waste, with burned sediment and bricketage, brickearth pottery and many monocotyledonous charcoal including sections (2-3mm). A 30mm size burned flint pebble is present alongside brickearth alluvium occupation soil, rich in

		Organic and Anthropogenic: very abundant red burned sediment (max 17mm), non-rubefied burned iron-depleted sediment, many burned brickearth/brickearth pottery fragments (rounded max 15mm), with occasional blackened burned, semi-fused brickearth soil; many mainly monocot charcoal, including sections 2-3mm; patches of abundant fused phytoliths/monocot ash with fine monocot charcoal; many concentrations of finely fragmented charcoal, especially present as very broad burrow infills; *Fine Fabric*: as SMT 1a1, 3a1,3a2, 4a1, 1b1, 5a5; *Pedofeatures*: *Textural*: rare trace of thin yellowish brown void clay coatings; *Fabric*: abundant thin to very broad (max 25mm) burrows. BD: Marked LOI, χmax and very strongly enhanced MS(%χconv)	very fine charcoal. The latter and some fine charcoal has been mixed along very broad burrows (25mm). Only a rare trace of yellowish brown clay coating are present. (Marked LOI, χmax and very strongly enhanced MS - %χconv) *Occupation surface deposits in redhill sequence are becoming more strongly influenced upwards by occupation soils formed in brickearth alluvium, and burrowing small animals. Mixing-in of unburned humic alluvial occupation soil (and many charcoal residues) are consistent with slightly marked organic matter content (LOI*) and χmax.
MFT C2/SMT 1a1, 3a1,3a2, 4a1, 1b1 MFT C2/SMT 3a1,3a2, 4a1, 1b1	M1362A2	7.5-15 cm 7.5-10.5 cm 6235 As below, but slightly less compact (30% voids), with rare to occasional brown clay void coatings, and with additional occasional occurrence of white nodules (vesicular fuel waste); pale non-ferruginous burned sediment inclusions predominate. 10.5-15 cm 6236 As 6241 in M1362B, with fine to medium size anthropogenic inclusions (max 20mm), but with many monocot charcoal – fragments fused into burned sediments up to 3mm in length, only rare clay void	6235 Essentially, as below, but slightly less compact. *Occupation surface within redhill deposits.* 6236 Compact fine to medium size anthropogenic inclusions (as below), with many monocotyledonous charcoal fragments (max

		coatings. Compact, massive vughy, 25% voids, vughs. Example of 15mm long, 2.5mm thick burned/fused stabling floor crust from a byre (compact, microlaminated long (3mm) lengths of articulated phytoliths and monocot remains, with 'surface' of long (2.5mm) monocot charcoal, embedded in rubefied organic remains).	3mm), with very abundant fine excrements and burrows, but only rare yellowish brown clay void coatings. 15mm long, 2.5mm thick example of burned/fused stabling floor crust from a byre (compact, microlaminated long (3mm) lengths of articulated phytoliths and monocotyledonous plant remains. *Compacted (trampled) subaerailly weathered and bioworked occupation surfaces on rehill deposits, which include byre stabling floor crust material (burned fuel waste).*
MFT C2/SMT 3a1,3a2, 4a1, 1b1	M1362B	31-39 cm As below, but with only fine, medium and moderately coarse (18mm) size anthropogenic inclusions; major variations between context layers relates only to mix of anthropogenic materials and amount of clay void coatings: 6238: mainly fine, with some medium-size anthropogenic inclusions, with occasional to many thin clay void coatings; these post-date formation of very abundant thin excrements and thin to broad burrows..	6238/6241/6240 lateral variation with M1364A 6238: mainly fine, with some medium-size anthropogenic inclusions, with occasional to many thin clay void coatings; these post-date formation of very abundant thin excrements and thin to broad burrows. *Bioworked trampled spreads of redhill deposits, with much less flooding/alluvial effects compared to contexts below. (period of stasis?; less wet/prone to alluviation compared to 1364 sequence; may be just a cm difference in elevation makes a big difference in these estuarine sites.* 6241: mainly fine, medium and moderately coarse anthropogenic components, and fewer (abundant) yellowish brown void clay coatings.

		6241: unsorted fine to moderately coarse (coarse (18mm) size anthropogenic inclusions, with abundant microlaminated brown clay void coatings (max 100µm). 6240: mainly fine size clasts with max 5mm-size burned brickearth and brickearth pot; very abundant void microlaminated brown clay coatings up to 0.5mm thick.	*Less trampled(?) spreads and diminishing effects of clay alluviation; but no very coarse clasts/surfacing(?) evidence as found in M1364.* 6240: mainly fine to medium anthropogenic components, with very abundant microlaminated yellowish brown void clay coatings and pan-like infillings. *Trampled redhill with major alluvial flooding effects and deposition of alluvial clay. (Slightly greater alluvial clay deposition compared to 1365 sequence)*
MFT C2/SMT 3a1,3a2, 4a1, 1b1	M1364A	41-50 cm 41-42(43.5) cm 6238 SM: moderately heterogeneous fine SMT 3a1,3a2, 4a1, 1b1fragments; *Microstructure*: loose, structureless, 60% voids, open and closed vughs; *Coarse Mineral*: moderately poorly sorted sand to fine gravel size coarse anthropogenic burned briquetage and burned sediment; *Pedofeatures*: *Textural*: abundant microlaminated yellowish brown clay coatings and infills (non-rubefied)(100-300 µm thick); *Excrements*: very abundant thin excrements (pre-date clay inwash).	6238 lateral variation with M1362B Layer and coarse void fills of finely fragmented sand to gravel size burned briquetage and sediment, and fused ash clasts, often as thin excrements. Abundant microlaminated yellowish brown clay coatings and infills (non-rubefied)(100-300 µm thick). Very few fine sand grains. *Downward burrow mixing of finely fragmented (trampled and burrowed) salt making debris (rare quartz sand of aeolian origin), followed by marine alluviation and clayey inwash. Flood affected.* 6241 lateral variation with M1362B

			Layer composed of very coarse inclusions/makeup materials, at the base a brickearth pottery fragment (50x30mm), in the middle a partially burned brickearth soil fragment 45x20mm), at the top moderately strongly burned (fused) iron-depleted brickearth-based sediment (25x10mm). *Deliberate surfacing (cobbling) of redhill?*
MFT C2b/SMT 3a1, 8a		42(43.5)-46(49) cm 6241 SM: Layer composed of very coarse inclusions/makeup materials (35% voids, simple packing voids): Upper: 25 mm wide, 10 mm thick moderately strongly burned (fused) iron-depleted brickearth-based briquetage. Middle: 45 mm wide, 20 mm thick partially burned brickearth soil fragment. Base: 50mm wide, 30mm thick brickearth pottery fragment. *Pedofeatures*: *Textural*: occasional microlaminated reddish brown clay coatings on partially burned brickearth fragment, reddened when clast was burned; *Amorphous*: this clast also with occasional iron	6240 lateral variation with M1362B Loose finely fragmented very dominantly red burned briquetage and sediment clasts. Example of 9mm-long, 250 µm wide monocot charcoal that is vertically oriented (charcoal is embedded in burned briquetage). (very strongly enhanced MS with 53.6% χconv.) *Dumped/spread jumble of burned salt making debris; dominance of red burned material supports 2nd highest χconv at site. Fine fragmentation could argue for trampling. Episode of clayey alluvial sedimentation is*

MFT C2/SMT 3a1,3a2, 4a1, 1b1		impregnations, now rubefied too. 46(49)-50 cm 6240 SM: As 6375, below, but with example of 9mm-long, 250 µm wide monocot charcoal that is vertically oriented (charcoal is embedded in burned briquetage); very dominantly fine fragments of red burned briquetage, sediment, fused ashes and raw sediment (<7mm); occasional pale yellow inwash clays, partially infilling some coarse voids and forming very thin coatings elsewhere; thin excrements are very abundant. BD: very strongly enhanced MS with 53.6% χ_{conv}.	*recorded.*
MFT C2/SMT 3a1,3a2, 4a1, 1b1	M1365A1	6-13.5 cm SM: as below, but with frequent fused phytolith-rich ash waste; occasional wood charcoal (4-5mm) in addition to monocot charcoal; example of coarse-size (9mm wide, 11mm long fragment) brickearth pottery; *Pedofeatures* include many reddish brown clay to dusty brown clay coatings to packing voids (50-150 µm thick).	6375 over 6343 As below, but with inclusion of coarse (4-5mm) wood charcoal examples and brickearth pottery fragment (9mm wide, 11mm long), and frequent phytolith rich fused monocotyledonous ash waste. Many reddish brown clay to dusty brown clay coatings to packing voids (50-150 µm thick) are present. *Moderately compact as below, through trampling that likely more commonly finely fragments monocotyledonous ash waste compared to briquetage material. Post-*

			depositional (?) flooding of the site gave rise to increasing numbers of reddish clay coating features.
MFT C2/SMT 3a1,3a2, 4a1, (1b1)	M1365A2	13.5-21 cm SM: Components as in 6371 , below (M1365A2); very heterogeneous; *Microstructure*: massive with poorly formed prisms, 30% voids, simple and complex packing voids, poorly accommodated vertical planar voids, with marked horizontal planar voids (0.5-2mm wide) at 15.5 cm and 19 cm; *Coarse Mineral*: as below; *Coarse Organic and Anthropogenic*: as below (burned pale sediment example with gastropods – cf Wallasea), with rubefied reddish inclusions below 19 cm (6371); occasional monocot charcoal (sections); *Fine Fabric*: as SMT 3a1,3a2, 4a1, (1b1); *Pedofeatures*: *Textural*: trace to rare (upwards in 6370) of brown clay; *Fabric*: many thin burrows; *Excrements*: very abundant thin organo-mineral excrements.	6370 over 6371 Slightly compact, mix of coarse strongly burned marine alluvium/ sediment, brickearth, and sandy brickearth plant tempered daub, as below, and few coarse clasts of fused phytolith-rich ash waste and occasional charcoal (here an example of 1mm wide monocotyledonous sections). Trace of clay coatings increases upwards to 'rare'; many thin burrows and very abundant thin excrements. More burned rubefied (iron – stained) briquetage in lower unit (6371?) below 0.5-2mm wide horizontal fissure at 19cm. Another horizontal fissure is located at 15.5cm. *Trampled and slightly compacted and fragmented salt making installation waste, with small amounts of included fuel waste of likely monocotyledonous origin.*
MFT C2/ SMT 3a1,3a2, 4a1, (1b1)	M1365B	33.5-35.5 cm SM: As below, but layer is broadly more red, because of higher content of rubefied (more iron-rich) burned anthropogenic materials. BD: very strongly enhance MS with 50.1% χconv.	6371 As below, but with higher proportion of burned more iron-stained salt making installation material. (Very strongly enhance MS with 50.1% χconv.; Layer includes more ferruginous, red

MFT C2/ SMT 3a1,3a2, 4a1, (1b1)		35.5-41.5 cm SM: as below (M1366A) very heterogeneous with anthropogenic inclusions SMT 3a1, 3a2, etc, but with few fused phytoliths; *Microstructure*: loose, massive, 30% voids, simple and complex packing voids; *Coarse Mineral*: very poorly sorted sand to gravel (max 12mm) size angular to sub-rounded anthropogenic clasts; *Coarse Organic and Anthropogenic*: very dominant burned mudflat sediment/briquetage with common reddish bricketage and brickearth fragments (unburned brickearth is rounded); rare charcoal, including twigwoog sections (2mm diameter); *Fine Fabric*: finely fragmented 3a1, 3a2, 4a1 etc; *Pedofeatures*: *Textural*: trace of reddish brown clay; *Fabric*: many thin burrows; *Excrements*: very abundant thin organo-mineral excrements. BD: very strongly enhance MS with 43.1% χconv.	briquetage) *As below, but raw source material more iron-stained, hence slightly higher % χconv.* 6373 Slightly more compact, mix of coarse strongly burned marine alluvium/sediment, brickearth, and sandy brickearth plant tempered daub, as below, and few coarse clasts of fused phytolith-rich ash waste and rare charcoal (here an example of 2mm wide twigwood section). Only trace of clay coatings, but many thin burrows and very abundant thin excrements. (Note: very strongly enhance MS with 43.1% χconv.). *Continued accretion of mainly coarse spreads of burned salt working constructional waste material of local soil, sediment and marine sediment origin; major bioworking of ash residues testifies to subaerial weathering (only trace of clay wash recorded).*
MFT C2/SMT 3a1,3a2,1b1	M1366A	21-28 cm SM: as below (M1366B1) very heterogeneous with anthropogenic inclusions SMT 3a1, 3a2, etc, but also with coarse clasts of fused phytoliths SMT 1b1 (15mm); *Microstructure*: coarse subangular blocky and pellety in places; 35% voids, very poorly accommodated planar voids and simple and complex	6373 Loose, mix of coarse strongly burned marine alluvium/sediment, brickearth, and sandy brickearth plant tempered daub, as below, and coarse clasts of fused phytolith-rich ash waste and monocotyledonous charcoal (often associated with thin excremental

		packing voids; *Coarse Mineral*: as below; *Coarse Organic and Anthropogenic*: as below, but with fused ash/phytolith fuel ash waste and patchy concentrations of many monocot charcoal;; *Fine Fabric*: as SMT 3a1, 3a2, 1b1; *Pedofeatures*: *Excrements*: abundant thin excrements of burned ash waste.	microfabric). (Note: no textural pedofeatures here). *Continued accretion of coarse spreads of burned salt working constructional and wetland(?) plant fuel waste material of local soil, sediment and marine sediment origin; bioworking of ash residues testifies to subaerial weathering (no flooding recorded).*
MFT C2/SMT 3a1, 3a2etc, 5a4	M1366B1	28-42 cm 28-31(33) cm SM: very heterogeneous – anthropogenic redhill fragments (junction formed by laminated alluvium very rich in fine red burned debris - 6374); *Microstructure*: coarse subangular blocky and pellety in places; 30% voids, very poorly accommodated planar voids and simple and complex packing voids; *Coarse Mineral*: all anthropogenic; *Coarse Organic and Anthropogenic*: very abundant strongly burned marine alluvium/sediment (12mm), brickearth, and sandy brickearth plant tempered daub (25mm), with included microfossils in burned sediment; some appearing to be dung-like(?); very abundant fine pellety-worked ash-waste; occasional monocot charcoal (max 2.5mm); *Fine Fabric*: pellety burned debris (eg SMT 3a1 and 3a2); *Pedofeatures*: *Textural*: abundant pans (6374?) of fine charcoal and fine burned-debris rich silty clay (max 2+mm thick) at base of 6374; occasional thin reddish brown clay coatings; *Excrements*: very abundant thin organo-mineral excrements in ash waste and fine debris.	6374 over 6024 Loose, mix of coarse strongly burned marine alluvium/sediment (12mm), brickearth, and sandy brickearth plant tempered daub (25mm), with included microfossils in burned sediment; possible burned dung/dung-like material present. very abundant fine pellety-worked ash-waste; occasional monocotyledonous charcoal (max 2.5mm). Junction with 6378 formed by pans of fine charcoal and fine burned-debris rich silty clay (max 2mm thick) of redhill origin (6374?). Occasional thin reddish brown clay coatings. *Coarse spread of burned salt working constructional material of local soil, sediment and marine sediment origin; bioworking of ash residues testifies to subaerial weathering. Pans of 'redhill silts' (6734) suggests renewed activity/intensification of activity, here after a break in operations. (Trampled muddy alluvium below with lower concentrations of fine burned material)*

MFT C5/SMT 5a4		31(33)-33.5 cm As 6378, below (M1366B2), but not burrowed; vughy microstructure with 40% voids, with semi-horizontal alignment of partially collapsed voids; the last are associated with sorted clay void coatings, matrix coatings becoming dusty clay coatings, with intercalatory features and panning.	6378 Mainly homogeneous dark brown silty clay with very fine and fine charcoal and very fine burned briquetage etc, and small amounts of fine burned anthropogenic material. Voids, which appear to be horizontally aligned have partially collapsed and are associated with textural intercalations and sorted dusty clay void coatings. *Probable trampled muddy alluvial fills.*
MFT C5/SMT 5a4, 5a5	M1366B2	35.5-42 cm 35.5-37 cm SM: generally homogeneous SMT 5a4 and 5a5; *Microstructure*: massive/poorly formed prisms with fine subangular blocky; 35% voids, poorly accommodated planar voids and simple packing voids, with intrapedal closed vughs and vesicles; *Coarse Mineral*: as SMT 5a4; *Coarse Organic and Anthropogenic*: abundant very fine with occasional	6378 Mainly homogeneous dark brown silty clay with very fine and fine charcoal and very fine burned briquetage etc, and small amounts of fine burned anthropogenic material. Voids have partially collapsed and are associated with textural intercalations dusty clay void coatings. Some areas have been burrowed, and minor structures are poorly formed

		1mm-size monocot charcoal, including sections; rare burned sediment and briquetage; *Fine Fabric*: as SMT 5a4; *Pedofeatures*: *Textural*: abundant intercalations associated with dusty clay and impure clay void coatings in partially collapsed voids; *Fabric*: patches of occasional broad burrows.	prisms. *This layer records renewed alluvial silting from redhill source, with periodic drying out, structure formation, followed by partial structural collapse on renewed alluviation.*
MFT C2/SMT 5a5		37-40 cm SM: very heterogeneous with common areas of SMT 5a4 and coarse (8-10mm) many briquetage and very abundant burned sediment (including layered and porous 'turf' fragments; 2-3mm thick, with burned ferruginised organic horizons (now only 100 µm thick)(ripened surface sediment with algal crusts, containing scatter of phytoliths and microfossils – forams?; cf SMT 3a2); subangular blocky, 40% voids, poorly accommodated planar voids and simple packing voids; rare burned flint (3mm), rounded brickearth soil (7mm) and abundant mainly monocot charcoal (3mm) also occur; *Pedofeatures*: *Textural*: abundant micropanning/sedimentation of 5a4; occasional reddish brown clay coatings; *Fabric*: many broad burrows. BD: Very strongly enhanced with 27.7% χconv 40-42 cm As 6377 below	6379 Loose, subangular blocky with common areas of silty clay sediment and many coarse (8-10mm) briquetage and very abundant burned sediment (including layered and porous 'turf' fragments; 2-3mm thick, with burned ferruginised organic horizons; ripened sediment with algal crusts (cf Wallasea). Raw sediment and brickearth soil clasts (7mm), occur alongside abundant monocotyledonous charcoal (3mm max). Layer is burrowed and has occasional reddish brown clay void coatings. (Very strongly enhanced with 27.7% χconv) *Spread/trample of coarse anthropogenic inclusions within period of waterlain silting. Strongly burned sediment and burned surface 'turf' (rooted, ripened surface sediment; iron-replaced organic matter possibly seaweed cf Wallasea).* 6377 *Continuing burrowed waterlain redhill silts and coarser inclusions.*

MFT C5/SMT 5a4			
MFT C5/SMT 5a4, 5a5	M1366C	42-50 cm 42-42.5(46.0) cm SM: mainly homogeneous SMT 5a4; *Microstructure*: massive, with poor laminations; 30% voids, channels and vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 60:40, becoming more coarse 70:30 upwards; moderately well sorted coarse silt and fine sand, with	6377 Reddish silts and silty clay, containing very abundant small-size red burned clay/briquetage/sediment, which occur as inwash and poorly laminated fills, develop upwards into burrowed massive more sandy deposits, containing gravel size clasts of burned sediment and briquetage; with many

		inclusions of sandy brickearth; *Coarse Organic and Anthropogenic*: rare raw sediment sand-size clasts, occasional coarse briquetage and burned sediment, but very abundant fine red burned inclusions; many charcoal (eg monocot max 2mm); *Fine Fabric*: SMT 5a4: heavily speckled and dotted reddish brown (PPL), moderately low interference colours (close porphyric, stipple speckled b-fabric, XPL), grey with very abundant red inclusions (OIL), rubefied staining and inclusions, many very fine charcoal; phytoliths present; SMT 5a5 – as 5a4, but fewer fine burned inclusions; *Pedofeatures*: *Textural*: very abundant silty panning of matrix material at base and into 6389 below; occasional darkish reddish brown clay void coatings; *Fabric*: many broad burrows upwards. BD: Very strongly enhanced with 32.2% χconv 42.5(46.0)-50 cm SM: mainly homogeneous medium sandy loam SMT 6a; *Microstructure*: massive, 20% voids, channels; *Coarse Mineral*: C:F 70:30, well sorted medium sand mainly; quartz, quartzite, with flint; very few flint gravel; *Coarse Organic and Anthropogenic*: rare fine charcoal, occasional fine (max 2mm) blackened/burned microfossil-rich sediment clasts; rare fine briquetage; eg of burned flint (2mm); *Fine Fabric*: as SMT 6a; *Pedofeatures*: *Textural*: very abundant textural intercalations and associated void infills; example (many) of upward-fining silt and silty clay channel infill (max 3mm wide; many very fine charcoal); abundant broad (max 6mm) channel/fissure fills of 6377 material (SMT 5a4); *Amorphous*: many weak to strong iron impregnation of fine fabric, clayey inwash;	monocotyledonous charcoal. A last phase of reddish brown clay is recorded. (Very strongly enhanced with 32.2% χconv) *Channel fill continues upwards as 'redhill silts', composed of silty clay and coarse silts containing many fine charcoal and very abundant coarse silt-fine sand size red burned sediment and briquetage. This material infills channels in 6389 below and seals this layer, before becoming more coarse and burrowed (no longer waterlain).* 6389 Massive, mainly homogeneous medium sandy loam, containing small amounts of fine charcoal and blackened/burned microfossil-rich sediment (occasional; red under OIL) and fine red briquetage. Characterised by very abundant textural intercalations and infills. Later channels mainly infilled either with upward-fining silty clay with very fine charcoal, or later by 'redhill silts'. Minor iron staining. *Local muddy sandy alluvium (channel fill?) developed channels and these were infilled first by flood silts/silty clays, followed by very*

MFT D2/SMT 6a		*Fabric*: many broad burrows..	*localised 'redhill silts'.*
MFT C2/SMT 3a1, 3a2,4a1, 4a2,1b1 MFT E3(C2)/SMT 7a2/7a4 (3a,4a,1b)	**1371A1**	0-75 mm 0-55 mm 6238 SM: very heterogeneous mixture of anthropogenic materials SMT 3a1, 3a2,4a1, 4a2,1b1 (both rather fine and coarse material - max briquetage=14mm)(see 1362, 1365 and 1366 series); eg of fire cracked burned flint (3mm); fused phytoliths are frequent (1b1); rare plant traces and only occasional charcoal; *Microstructure*: structureless, massive, but with broad ~20mm layering; 40% voids, open vughs; *Pedofeatures*: *Textural*: rare thin reddish brown void coatings; *Fabric*: many thin to very broad burrows; *Excrements*: patches of many thin excrements. 55-75 mm 6241 SM: heterogeneous SMT 7a2/7a4 (3a,4a,1b); *Microstructure*: massive with microlaminations; 30% voids, as below; *Coarse Mineral*: poorly sorted because of anthropogenic inclusions; *Coarse Organic and Anthropogenic*: as below, but only 'many'; wood charcoal max = 4mm; *Fine Fabric*: as below; *Pedofeatures*: *Textural*: very abundant micropans and silty layers (as in 6240 below); abundant reddish brown clay void coatings, sometimes microlaminated (max 0.5mm thick).	6238 Broadly layered rubefied redhill deposits, with burned fragments of diatom-rich silty clay, daub made from silty clay, burned fuel waste rich in very fine charcoal and embedded phytoliths, charred peaty deposits?, burned flint; very small amount of reddish brown inwash clay. *Occupation surfaces/trampled and moderately bioworked spreads of salt making debris.* 6241 As Below, but also with remains of clean silt sedimentation, fewer anthropogenic inclusions; marked thick (max 0.5mm) reddish brown clay void coatings. *Formation of anthropogenic soil formed in charcoal-rich alluvium. With slaking history, in part likely associated with inundation and deposition of silts. Later burrowing mixed redhill deposits and clay wash through*

			overlying redhill deposits led to marked deposition of reddish brown clay.
MFT E3(C2)/SMT 7a2/7a4 (3a,4a,1b) MFT E2/SMT 7a2/7a1	**1371A2**	75-150 mm 75-90 mm 6241 Massive with structureless (35% voids) channels and open and closed vughs; matrix of 7a2 developing upwards into 7a4, with poorly sorted mixture of fine to moderately course (7mm max) burned anthropogenic inclusions (3a1, 3a2, 4a1,1b1), and including burned diatomite and burned brickearth; rare 50µm thick matrix void coatings; abundant thin to very broad burrows. 90-110(120) mm 6022a Junction between uppermost 6022b (truncated brickearth soil SMT 7a1) and thin (3-7mm) layer/pan of SMT 7a2; very abundant fine charcoal, many fine size burned sediment/briquetage; rare fine burned flints (from 6241 above?) 110- 120(140) mm 6240 Very broad (50+mm) infill of microlaminated 'redhill' silts (see M1366C), with very abundant mainly fine size burned sediment/briquetage (max 4mm), with fine charcoal and phytolith-rich fuel ash waste; uppermost	6241 Fine charcoal-rich silty clay loam with poorly sorted mixture of fine to moderately course (7mm max) burned anthropogenic inclusions (3a1, 3a2, 4a1,1b1), and including burned diatomite and burned brickearth; rare 50µm thick matrix void coatings; abundant thin to very broad burrows. *Coarsely mixed and burrowed occupation soil formed in anthropogenic alluvium, with much burrow mixing of redhill deposits from above.* 6022a Junction of uppermost, compact and massive brickearth (soil) and thin (3-7mm) layer/pan of very abundant charcoal and many fine burned sediment/briquetage. *Junction between inundation truncated slaked early Holocene soil and locally formed muddy alluvium containing very fine occupation/salt making debris.* 6240 Very broad (50+mm) infill of microlaminated 'redhill' silts; fine size burned sediment/briquetage (max 4mm), with fine charcoal and phytolith-rich fuel ash waste; uppermost 10-15mm composed of

MFT C5/SMT 5a4, 7a2 MFT E1/SMT 7a1		10-15mm composed of microlaminated silts with fine charcoal only; very abundant micropanning. 120(140)-150 mm 6022b SM: mainly homogeneous, with very dominant SMT 7a1 (depleted); *Microstructure*: massive, 20% voids, planar void fissures, original fine channels and fine channels with root remains, some closed vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), moderately poorly sorted with medium and coarse silt-size, and very fine, fine and medium sand-size – as SMT 7a1 in M1007B2; *Coarse Organic and Anthropogenic*: rare trace of fine size burned briquetage in burrows; trace of very fine root material; *Fine Fabric*: as SMT 7a1; *Pedofeatures*: *Textural*: many very dark brownish textural intercalations, with rare very pale thin void clay coatings and matrix infills; *Depletion*: general fabric iron depletion; *Amorphous*: rare ferruginous void hypocoatings; *Fabric*: rare broad burrows.	microlaminated silts with fine charcoal only. *Very broad burrowing/subsurface channelling, and alluviation picking up, first local redhill material and then 'clean' silts. (Erodes and infills below 6022a)* 6022b Massive, compact iron depleted fine sandy silt loam, with closed vughs and intercalations; fine fabric includes very fine charcoal; very fine root traces *Truncated and slaked early Holocene terrestrial lower topsoil formed in brickearth; in situ rooting.*
			Sequence 21 Floors in Late Roman building
MFT C4/SMT 5a2	**M1324A**	0-8 cm 0-2 cm 5753 SM: mainly homogeneous SMT 5a2 (fine charcoal rich alluvium); *Microstructure*: massive (very poor diffuse laminae), 20% voids, closed vughs and fine channels; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), poorly sorted silts and fine to medium sand, with small gravel-size anthropogenic inclusions and clay clasts (as	5753 Massive, diffusely laminated fine charcoal-rich poorly sorted fine sandy silt loam. Many coarse charcoal, burned sediment and briquetage, with patches of many yellow leached fine bone (<2mm) and organic matter (human coprolitic waste). Very abundant textural intercalations and partially collapsed vughs, with minor iron and manganese

		below); *Coarse Organic and Anthropogenic*: patches of many fine bone (max <2mm) and yellow amorphous OM fragments (coprolitic waste); abundant charcoal (max 2mm), with many burned briquetage/sediment; *Fine Fabric*: as SMT 5a2; *Pedofeatures*: *Textural*: abundant textural intercalations and partially collapsed voids, with clay clasts as embedded grains, and associated thin matrix void coatings, and micropans; *Amorphous*: both inherited Fe and Fe-Mn features (from below – 5752) and occasional *in situ* formed impregnative Fe-Mn mottling.	staining throughout. *Muddy anthropogenic alluviation associated with on-site occupation and middening/spreads and trample(?), including disposal of human waste.*
MFT C3/SMT 5a1		2-8 cm 5752 SM: essentially homogeneous with SMT 5a1 *Microstructure*: prismatic, with vughy; 30% (15% intrapedal), moderately accommodated vertical planar voids, fine partially collapsed channels and vughs; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), well sorted silt-size quartz, but with fine gravel size clasts of non-iron depleted 'clayey' alluvium (perhaps eroded from brickearth subsoils?); *Coarse Organic and Anthropogenic*: rare coarse charcoal and burned briquetage towards the top (mixing with 5753)(many very fine charcoal in fine fabric); *Fine Fabric*: as SMT 5a1; *Pedofeatures*: *Textural*: very abundant intercalations and partially collapsed voids, with clay clasts as embedded grains mainly; *Amorphous*: very abundant weak iron staining of clay clasts, many fine impregnative Fe-Mn mottling.	5752 Essentially homogeneous prismatic structured iron-depleted silty clay, with a very fine charcoal content. Sediment includes very abundant fine gravel size clasts of clayey brickearth soil-sediment which is weakly iron stained. Intrapedal voids (channels and vughs) are partially collapsed and associated with very abundant textural intercalations; clay clasts occur as embedded grains. Rare coarse charcoal and briquetage occur at the top of the deposit. *Muddy alluvium with eroded clasts of brickearth subsoil. Sediment experienced a period of ripening and structure/void*

			formation, before flooding and renewed alluviation led to partial soil-sediment collapse.
MFT H2/3a1, 3a2, 4a1, 4a2, 9b	**M1328**	14-22 cm SM: very heterogeneous with anthropogenic inclusions, fragmented floor make up and fragments of laminated floor trample (SMT 9b); intact floor trample at base of this sub-unit; *Microstructure*: structureless, with coarse subangular blocky, microlaminated floor trample; 40% voids, simple packing voids mainly; *Coarse Mineral*: unsorted; *Coarse Organic and Anthropogenic*: very abundant raw clay sediment (max 15mm), with abundant charcoal (wood charcoal max 6mm, as well as monocot charcoal; many various burned briquetage, unburned brickearth; examples of pot and fine burned bone; *Fine Fabric*: as SMT 3a1, 3a2, 4a1, 4a2; SMT 9b: mixed brown, dark brown, reddish brown and dotted (PPL), isotrpic, low to moderate interference colours (close porphyric, stipple speckled b-fabric, XPL), grey, dull brown to red (OIL), abundant fine charcoal (coarse wood and monocot charcoal is often horizontally oriented), variously humic stained, with phytoliths; *Pedofeatures*: *Textural*: rare thin clay void coatings (often iron stained); *Amorphous*: abundant iron-staining, especially of floor trample; *Fabric*: abundant thin to very broad burrows; *Excrements*: occasional thin excrements. BD: Notable LOI and P, with very strongly enriched Pb, marked %χmax and strongly enhanced χconv). SEM/EDS: Stained floor sediments (4.22% fe, 9.41% P, 16.4% Ca, 23.7% Pb), stained monocot charcoal	6144 upper Coarsely fragmented and often burrow mixed, once layered microlaminated (~1mm laminae of stained clay and fine burned material eg charcoal and bone (coprolitic bone with 1.58% F, 16.1% P, 35.9% Ca, 5.46% Pb, 0.71% S), and fine briquetage) charcoal-rich layers (trample fragments max 5mm thick) and coarse floor make up of raw clayey sediments (15mm max), brickearth and briquetage variants. Also present are coarse wood charcoal (roundwood, eg oak?; max 16mm). Trample laminae *in situ* at base developing above 'clay floor make up'(6144 lowermost). Major Fe-Ca-P-Pb (staining of laminated clayey floor layers and materials such as monocotyledonous charcoal (29.0% Pb); minor clay inwash features. (Notable LOI and P, with very strongly enriched Pb, marked %χmax and strongly enhanced χconv). *Despite sediment fragmentation, domestic trampling within, and in and out of structure (humic clayey into structure; burned debris within), is recorded. Iron staining of clayey laminae probably associated with poor drainage, and major contamination with calcium phosphates and lead (tin also recorded below); implies major industrial*

MFT H1/SMT 9a		(5.08% Fe, 6.71% P, 17.0% Ca, 29.0% Pb), coprolitic bone (1.58% F, 16.1% P, 35.9% Ca, 5.46% Pb, 0.71% S). 20-22 cm 6144 (Clay floor make up/initial trample) SM: moderately homogeneous SMT 9a (Clay floor make up), with more sandy and cleaner clayey variants; *Microstructure*: massive, very poorly laminated; 20% voids, closed vughs, some thin horizontal fissures; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), very poorly sorted with coarse silt and fine and medium sand-size rounded and subrounded quartz, and medium to very coarse sand-size various briquetage and pot; *Coarse Organic and Anthropogenic*: as above with many charcoal; example of compacted 1.5mm long dung fragment; *Fine Fabric*: SMT 9a: heavily speckled and dotted brown to very dark brown (PPL), close porphyric, stipple speckled and weakly formed uni-striated and grano-striated b-fabric, XPL), greyish brown, brown, reddish brown with numerous red inclusions (OIL), humic staining, abundant very fine charcoal, amorphous OM and many phytoliths present; *Pedofeatures*: *Textural*: occasional textural intercalations and associated matrix void infills (eg 500µm wide); *Amorphous*: occasional amorphous iron staining; *Fabric*: occasional thin burrows and fills. SEM/EDS: Staining of clay floor (9.11-9.58% Ca, mean 9.31% Ca, *n*=3; 2.30-4.14% Fe, mean 3.27% Fe; 7.80-8.11% P, mean 7.95% P; 2.40-13.5% Sn, 7.01% Sn, 46.5-54.1% Pb, mean 49.1% Pb).	*processes employing tin- and lead-based vessels, perhaps for heating brine.* 6144 lowermost Compact weakly humic silty clay loam containing many charcoal, phytoliths and occasional coarse sand-size briquetage variants, and example of 1.5mm long dung. Poorly laminated with thin horizontal fissures, poorly developed horizontal unistriated b-fabric, occasional textural intercalations and associated matrix void infills, and occasional amorphous 'iron' staining (lead/Pb dominated, with strong Ca, P and Sn (tin) enrichment). *Trampled 'clay floor' make up composed of varying thin spreads of mudflat 'clays', with many fine anthropogenic inclusions relating to local salt working and animal husbandry(?). Floor was muddy at times, and markedly contaminated with lead, and to a lesser extent, tin, alongside major calcium phosphate and iron staining. Again indicates use of lead- and tin-based vessels for heating brine(?), and leaching of calcium phosphate fuel ash waste.*

			Late Roman deposition (near Late Roman buildings) Sequence 22
MFT C2/4a1, 6a2 MFT C2/SMT 4a2/6a1	M1332A1	14.5-18.5 cm 1008 Similar to below (without stones), with broad layering (5-7mm) with microlayering (2mm) within; compact (25% voids) with very abundant coarse charcoal (10mm), including knotwood, often aligned to sloping layers; many to abundant bone (both fine orange burned and yellowish coprolitic bone; last includes 9mm example with poorly preserved birefringence). 18.5-22 cm 1007 As below, with a very compact (20% voids) 1 cm thick sloping brickearth soil layer (1007a) over coarse 1007b deposits. 1007a is diffusely laminated with textural intercalations, embedded grains, fine charcoal and occasional fine coprolitic bone. 1007b As below, with coarse burned flints (20mm) but with rare calcined bone fragments (2-5mm), very abundant coarse wood charcoal (embedded in reddish fine fabric), with coarse layering, some dominated by alluvial clay.	1008 Non-stony, compact, layered (5-7mm) and microlayered (2mm) brickearth and alluvial anthropogenic soil materials, with very abundant coarse charcoal (10mm), including knotwood, often aligned to sloping layers; many to abundant bone (both fine orange burned and yellowish coprolitic bone; last includes 9mm example with poorly preserved birefringence). *Domestic trampled occupation surface; interior(?) but 'disused' space; domestic hearth, kitchen and latrine waste spreads. (cf Tours and Fenchurch St).* 1007a Very compact sloping 1cm thick layer of fine charcoal and fine bone-rich anthropogenic brickearth soil, with diffuse laminae and textural intercalations. *Compacted muddy trample of fine occupation soil.* 1007b As below, but with coarse strongly burned (calcined) bone (2-5mm), and becoming microlayered with alluvial clay layers, and coarse wood charcoal and reddish fine soil

			layers. *Dumped spreads and occupation surface trample of domestic hearth waste, food residues, and ubiquitous background latrine waste.*
MFT C2/SMT 6a1	M1332A2	22-29.5 cm 22-27 cm 1007b SM: heterogeneous with dominant small stones and gravel, SMT 6a1 and medium sands; *Microstructure*: structureless, 50% voids, mainly simple packing voids, with poorly accommodated planar voids; *Coarse Mineral*: silty clay loam SMT 6a1, with unsorted rounded small stone size and flints (25mm) and flint gravel (angular), mixed with mainly medium sands; *Coarse Organic and Anthropogenic*: occasional pot (max 6mm), many charcoal (wood charcoal max 1.5mm); (embedded often in reddish iron(P?) stained matrix material – hearth ash residues?; examples of fungal bodies in reddish matrix); many burned flint; rare coprolitic bone; *Fine Fabric*: as SMT 6a1; *Pedofeatures*: *Amorphous*: many Fe(P?) impregnative staining; *Fabric*: many broad burrows . BD: markedly high LOI, enriched P and Cu, with strongly enhanced MS %χconv 27-29.5 cm 1006 SM: moderately homogeneous SMT 6a1; *Microstructure*: massive with prisms (relict silty laminae), 35% voids (15% intrapedal), coarse channels	1007b Unsorted coarse layer of dominant small stones (pebbles) of flint and gravel size angular flint (often burned) mixed with medium sands. Humic, fine charcoal-rich silty clay loam soil occur often as burrows between gravel and sand. Fine material includes many fine wood charcoal often embedded in reddish iron-stained ash residues(?). Rare cess bone occur alongside likely FeP staining. (Markedly high LOI, enriched P and Cu, with strongly enhanced MS %χconv) *Spread/dumps of hearth and coarse constructional debris, mixed with human waste disposal. (Cu derived from ashes and use of Cu-based vessels?)* 1006

MFT D1/SMT 6a1		and vughs; *Coarse Mineral*: as silty SMT 6a1, but poorly sorted with frequent generally fine anthropogenic inclusions and sands; silt laminae; *Coarse Organic and Anthropogenic*: many sand size burned sediment/briquetage, charcoal (max 0.5mm), with many fine yellowish coprolitic bone (max 1.5mm); rare burned flint; *Fine Fabric*: as SMT 6a1; *Pedofeatures*: *Textural*: very abundant textural intercalations, associated closed vughs and embedded grains, and 200 µm thick matrix coatings on some channels/planar voids (relict sedimentary silt laminae); *Amorphous*: very abundant Fe(P?) impregnative staining, with possible rare traces of CaP infills;	Massive dark brown silty clay with possible prismatic structures; relict silty laminae are present. Many sand size burned sediment/briquetage, charcoal (max 0.5mm), with many fine yellowish coprolitic bone (max 1.5mm); rare burned flint. Very abundant textural intercalations, associated closed vughs and embedded grains, and 200 µm thick matrix coatings on some channels/planar voids (relict sedimentary silt laminae). Very abundant Fe(P?) impregnative staining, with possible rare traces of CaP infills. *A mixed soil-sediment formed through generally fine alluviation and inputs of fine anthropogenic material including both salt making briquetage and large quantities of cess. This implies very local human occupation and waste disposal.*
			Sequence 23 Brickearth quarry pit
MFT F8/SMT 7a1, 7a2 (7a5)	**M1363C**	36-44 cm 36-37.5(38) cm 6457 Mainly homogeneous brickearth (SMT 7a1, becoming more fine charcoal-rich upwards SMT 7a2); massive, 30% voids, fine fissures; *Pedofeatures*: *Textural*: occasional sometimes microlaminated brown clay void coatings; *Crystalline*: occasional areas of sodium carbonate impregnation affecting burrows; *Fabric*: many thin and broad burrows.	6457 Massive brickearth fill, becoming more fine charcoal rich upwards (reflecting local anthropogenic soil development), with brown alluvial clay inwash features and 'carbonate' staining of burrow fills. *Disuse silting of pit, with inwash of later brown alluvium over the site, and small amounts of 'carbonate' staining of burrow*

MFT F7/SMT 7a5		37.5(38)-39.5 cm 6458a Mixed SMT 7a5 (jarosite-stained fill) and SMT 7a1; with very abundant fine (<3mm) size burned sediment/briquetage (eg SMT 3a1); very abundant fine charcoal; fissured with 35% voids; *Pedofeatures*: *Textural*: occasional sometimes microlaminated brown clay void coatings; *Crystalline*: many areas of sodium carbonate impregnation; *Fabric*: abundant thin burrows. 39.5(42)-44 cm 6458b Composed of two components; finely laminated silty laminae, with 24mm thick fill of: 10mm size decaying wood and around it, abundant fine bark fragments embedded and mixed into SMT 7a5; very abundant woody remains, example of 5mm-size white nodule (Type 1a1, pseudomorphic of monocot stem?); *Fine Fabric*: SMT 7a5: very dark brown, opaque (PPL), isotropic (close porphyric, undifferentiated b-fabric, XPL), very pale yellowish grey/white (OIL)(jarosite impregnated) *Crystalline*: abundant areas of jarosite impregnation and fine fills. EDS: general yellow fill (0.47-3.83% S, 0-0.95%K, 1.20-4.91% Fe); jarosite - KFe3+3(OH)6(SO4)2 (mean 6.35% S, 2.47% K, 13.8% Fe) 42-43(44) cm 43-43(44) cm G42 (6462) SM: homogeneous, semi *in situ* SMT 7a1, massive	*fills.* 6458a Mixed deposition of 'jarosite' soil fill and fine burned briquetage and charcoal; marked by thin burrowing. *Thin anthropogenic fill from local salt making processing.* 6458b Laminated silts with large (30+mm) wide fill composed of decaying wood (max 10mm size) and associated finely fragmented bark, mainly embedded in opaque and isotropic probable jarosite - KFe3+3(OH)6(SO4)2 (mean 6.35% S, 2.47% K, 13.8% Fe); an example 5 mm-size white nodule pseudomorphic of monocotyledonous plant stem?). *According to field photo (C. Carrey) this appears to be a wood lining to the pit.(Wood lining suggests this may be a 'well'/source of ground water/salt water sump, with pyrite showing it was constantly waterlogged at the base.) Upwards jarosite develops as a reaction product of weathering pyrite and K-bearing deposits (ash dumps?); typical; of acid sulphate marine soils.* G42 (6462) Massive, compact, iron mottled brickearth,

MFT F6/SMT 7a1		(20% voids); moderately poorly sorted fine sandy silt loam, with medium and coarse sand; *Pedofeatures*: *Textural*: very abundant textural intercalations; rare sometimes microlaminated brown clay void coatings; *Amorphous*: abundant moderately strong iron staining; abundant pyrite.	which includes coarse sand; textural intercalations, iron staining and pyrite present. *Primary fill of pit, with muddy slumping of pit sides; anaerobic water-saturated conditions led to pyrite formation.*
MFT B1/ SMT 2a1, 3a1, 4a1	M4240A1	SM: 17mm thick burned clay (1), with 0.5mm/max 2mm thick red burned layer (2), with uppermost 200-350 µm-thick vesicular 'green glass' surface (3). 1: laminated silty clay, with diffuse 0.3-5mm thick laminae; pale greyish brown and dotted dark greyish brown (laminae)(PPL), very low interference colours and isotropic fine fabric, respectively (porphyric, stipple speckled/undifferentiated b-fabric, XPL), white/grey (OIL), relict very weak OM staining/relict fine detrital OM, trace of ferruginised material (black carbonaceous residues); Coarse mineral composed of well-sorted coarse silt size quartz and feldspar with few	Large fragment in ditch fill 4226 17mm thick burned clay, comprising three layers: 1 (base): ~15mm thick laminated silty clay, with 0.3-0.5mm thick laminae with carbonised fine detrital organic matter; both relict estuarine plant and 1mm-thick plant tempering plant channel pseudomorphs; relict roots were pyritised then ferruginised. 2: 0.5-2mm thick reddened/rubified layer,

		mica; 35% voids; channels (<0.5-1mm channels), some pseudomorphs of plant tempering, others likely relict of original plant fragments within sediment (including ferruginised plant/root remains, ferrihydrite replacing pyrite – pyritised organic matter -); fabric pedofeatures include rare dusty clay intercalations. Post-dep brown silty clay void inwash. 2: bright red rubefied surface (material below is mainly iron-depleted - - - ?); essentially opaque, isotropic (sometimes extremely low interference colours, porphyric, XPL), bright red (OIL); 30% voids of fine channels, relict plant roots, pyritised-then ferruginised/rubefied; 3: colourless to blackish (PPL), vesicular (~75-150µm), isotropic apart from patchy needle form gypsum on some surfaces (XPL), lowermost 100 µm is whitish, the uppermost 250 µm is neutral/colourless (OIL); *Pedofeatures*: rare needle form gypsum-like crystals on some bubbled surfaces. EDS examples: briquetage Al-Si (8.20% Al, 31.2% Si), 4.12% Na; green glaze inner (25.2% Si, 5.34% Na), outer glaze (23.9% Si, 12.1% Na). Microprobe: Briquetage Line A, *n*=96 (eg 45.6% SiO_2, 12.4 Al_2O_3, 3.49% Na_2O, 0.076% P_2O_5, 0.101% SO_3), Briquetage Line B, *n*=98 (eg 47.0% SiO_2, 12.6 Al_2O_3, 4.28% Na_2O, 0.079% P_2O_5, 0.103% SO_3), Green glaze Line A, *n*=2 (41.1% SiO_2, 12.6 Al_2O_3, 9.45% Na_2O, 0.180% P_2O_5, 0. 484% SO_3), Green glaze Line B, *n*=4 (42.4% SiO_2, 11.8 Al_2O_3, 5.36% Na_2O, 0. 104% P_2O_5, 0.267 % SO_3); Green glaze max 13.3% Na_2O, 0.245%	now clay is mainly isotropic; relict pyritised roots etc are both ferruginised and reddened/rubefied. 3: uppermost 200-350 µm-thick vesicular 'green glass' surface, with fine vesicles, and composed of darkish grey becoming colourless upwards, with patchy needle form minerals in places. Instrumental analyses indicate: Al-Si dominated briquetage composed of mica-smectite clays, with iron staining picking out sedimentary layering and relict ferruginised plant material (void coatings and hypocoatings), with green glaze formed of silicate glass (minimum 700-800°C to around/below 1000°C) that is enriched in Fe, Na, P and S and probably K, in comparison to the briquetage. *Strongly burned straw(?)-tempered, once-rooted estuarine silty clay-based 'mud-plastered' hearth/briquetage surface. Subsequently (after inundation event(s)) affected by ferruginisation of plant temper residues, including original pyritised root remains. Inwash of estuarine clay (kaolinite) noted.*

		P_2O_5, 0.564% SO_3, *n*=6). Mann-Whitney U tests: compared with the briquetage, the glaze contains significantly ($p < 0.05$) higher concentrations of Fe, P, Na and S and lower concentrations of Si, Ca and Mg (but very low green glaze samples). Probe element maps: Maps at different scales (Fig 7) show Na, P, Fe and K concentrations along the glaze surface. Fe is also picks out layering and relict (ferruginised) organic traces in voids pseudomorphic of plant temper.	
	M4240A2	***FTIR sample***	Large fragment in ditch fill 4226 (see Fig 29)
MFT B1/SMT 2a1, 3a1, 3a2, 4a1	M4240B1	SM: 12mm-thick red-burned clay (1), with 0.5mm-2mm thick blackish burned layer (hand specimen visible), to 8mm thick 'black' opaque under PPL (2), with uppermost 250 µm-thick vesicular 'green glass' surface (3). 1: semi-laminated, compact, with 50% voids (max 3.5mm, plant pseudomorphs), C:F @ 50:50; very well-sorted silt size quartz, with few fine sand, few mica; very abundant fine to coarse plant stem(?)/straw traces (temper), with trace amounts of plant residues; dusty reddish brown to blackish brown (PPL), moderate interference colours (close porphyric, weakly strial b-fabric, XPL), orange and dull orange (OIL), trace amounts of very fine detrital OM and phytoliths. Abundant partial infilling of some voids with yellow dusty clay ('alluvium'). 2: as layer 1, dusty reddish blackish brown to	Small fragment in ditch fill 4226 14mm-thick burned clay, comprising three layers: 1 (base): ~12mm thick mainly strongly rubefied laminated silty clay, with very diffuse fine laminae with; max 3.5mm-thick plant tempering/original rooting plant channel pseudomorphs, with abundant partial dusty yellow ('alluvial') clay infillings; 2: 2-8mm thick very strongly reddened/rubified/blackened (opaque) layer, clay is mainly isotropic; trace of relict plant ferruginisation; 3: uppermost 250 µm-thick vesicular 'green

		black/opaque (PPL), isotropic (close porphyric, undifferentiated, XPL), bright orange (OIL); trace of relict plant ferruginisation; rare partial infilling of some voids with yellow dusty clay ('alluvium'). 3: colourless to blackish (PPL), vesicular (~75-125µm), isotropic apart from patchy needle form gypsum on some surfaces (XPL), lowermost 100 µm is whitish, the uppermost 150 µm is neutral/colourless (OIL); *Pedofeatures*: rare needle form gypsum-like crystals on some 'bubbled' surfaces. EDS: inner glaze 30.5% Si, 4.50% Na; outer glaze (25.4-26.2% Si, 8.58-10.1% Na).	glass' surface, with fine vesicles, and composed of colourless becoming blackish upwards, with patchy unidentified needle form minerals in this surface. Instrumental analyses indicate: Al-Si dominated briquetage composed of rubefied (400°C - <700°C) mica-smectite clays, with blackened clay (>700 °C) with green glaze formed of silicate glass (minimum 700-800°C to around/below 1000°C). *Strongly burned straw(?)-tempered, but mainly once-rooted 'raw' estuarine silty clay-based 'mud-plastered' hearth/briquetage surface. Subsequently (after inundation event(s)) affected by ferruginisation of plant temper residues, including original pyritised root remains. Inwash of estuarine clay (kaolinite) noted.*
	M4240B2	***FTIR sample***	Small fragment in ditch fill 4226 (See Fig 30)
			White nodules
MFT A1/ SMT 1a1, 1a2	M1593	SM: 7+ nodules, 2-7 mm in size, round to subrounded; colourless, pale brown and dark greyish opaque in colour (PPL), isotropic (XPL), whitish to greyish, with pale brown staining in some examples (OIL); all strongly vesicular; Type 1: with some 'hollow' circular examples, with 400µm-wide vesicular rims (possible poor straw/monocot pseudomorphs); interior of rim and associated vesicles with ~5 µm wide pale yellowish 'glass'/clay(?) lining, which has moderate interference colours. Interior is also iron-stained/has ferruginised	1330 (x1593) Essentially, numerous (7+), 2-7mm-size colourless, dark greyish to opaque, isotropic nodules, which are whitish to greyish under OIL, and which occur as two main types. Type 1 is hollow and round, with a thin 400µm-wide vesicular rim. One example is characterised by

		once-organic(?) coating/fill (to be tested). Type 2: eg largest 7mm-size fragment more irregular shape, with only fine to coarse vesicles; much variation in greyish colours and iron staining of matrix and as void hypocoatings; no ferruginised fill lining.	~5 µm wide pale yellowish 'glass'/clay 'lining', with iron-replaced organic matter partial fill. Type 2 are larger subrounded/lozenge-shaped aggregates, with no central hollow, but a variety of sized vesicles. Iron staining of the matrix occurs, including void hypocoatings, but no amorphous iron-replaced organic matter fill is evident.
MFT A2/ SMT 1a1, 1a2	M1597	SM: Essentially as M1593 and M5565, with burned sediment daub; white nodules are often blackish (PPL), with birefringent inclusions/fine granular texture (some needle-like; probably gypsum), whitish with iron staining (OIL); vesicles often have pale yellow isotropic very thin lining (as Type 1, M1593); gypsum occurs as granular patches within nodule, or as void infills and nodule 'coatings'. These nodules also seem a little impure, with quartz silt, mica and heavy minerals (eg zircon) present. This sample also includes 3mm-size greyish (PPL), isotropic or with low interference colours (XPL), whitish or brown (OIL, iron-depleted and iron-stained sediment); heated part has isotropic fine fabric with silt-size clasts of quartz and mica; thin voids pseudomorphic of plant tempering also occur.	1329 Similar to M5565 and M1593, but with 'blackish'/opaque nodules with fine (embedded) granular or fine prismatic (coatings and void formations) gypsum. Silt-size quartz and mica present in some nodules. Example of fine plant-tempered sediment daub, with some strongly burned parts where fine fabric has become isotropic. *As M5565 and M1593, but with incorporation of fine sediment that is sometimes gypsum-rich; secondary gypsum also formed in this (estuarine) depositional environment, sometimes gypsum forming within nodules.*
MFT A2/SMT 1a1, 1a2	M1617	SM: ~16 Type 2 and ~3 Type 1 nodules, with secondary gypsum affecting examples, secondary iron staining post-dates gypsum formation. 6mm-size reddish burned (rubefied) silty estuarine sediment occurs (plant pseudomorphs and iron-replaced root are original characteristics).	1321 As M1597, fine gypsum crystal formation affecting parts of the nodules, sometimes followed by iron staining. 6mm size burned clay is a fragment of plant rich and once-rooted intertidal silty clay sediment,

			burned/rubefied at ~300-400ºC.
MFT A1/SMT 1a1, 1a2, 1a3	M5565	SM: ~13+ nodules, again 2-7mm in size; Type 1 example with flattened shape, as large as 7mm; greyish to opaque (PPL), whitish to yellowish under OIL; exterior shows 5-10 µm thick discontinuous clay coatings. Type 2 are very vesicular, with abundant iron staining, and occasional birefringent (clayey) fine sediment coatings. A possible Type 3, is completely colourless, vesicular and unstained (whitish or neutral under OIL) SEM/EDS: very strongly siliceous (mean 26.9% Si; max 34.7% Si - 74.2%SiO_2); rich in cations (mean 3.00% Na, 2.62% Mg, 4.46% K, 4.94% Ca, *n*=13); generally moderately rich in P (mean ~1.23%P for those with P; range 0-1.89%P); Fe always present (mean 4.83; some with strong iron-staining/replacement eg. 44.4% Fe).	1216 As 1593, with same size and types of nodules; rare to occasional very thin clay/sediment coatings. Abundant iron staining of Type 2 example. Possible colourless vesicular, unstained, Type 3, present. SEM/EDS: very strongly siliceous (mean 26.9% Si; max 34.7% Si - 74.2%SiO_2); rich in cations (mean 3.00% Na, 2.62% Mg, 4.46% K, 4.94% Ca, *n*=13); generally moderately rich in P (mean ~1.23%P for those with P; range 0-1.89%P); Fe always present (mean 4.83; some with strong iron-staining/replacement eg. 44.4% Fe).

Stanford Wharf Soil Micromorphology Figures 1-136

Fig. 1: Scan of ‘white nodules’/glassy slags in M1593 (Context 1330); 7+ 2-7mm size nodules. Frame width is ~25mm.

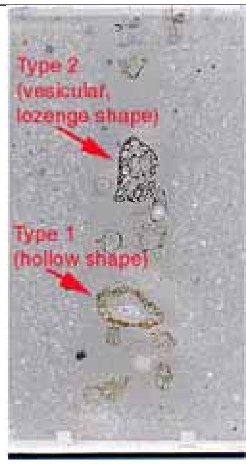

Fig. 2: Scan of ‘white nodules’/glassy slags in M5565 (Context 1216); Hollow (Type 1 have a ~400µm rim) and vesicular lozenge shape (Type 2) examples. Frame width is ~25mm.

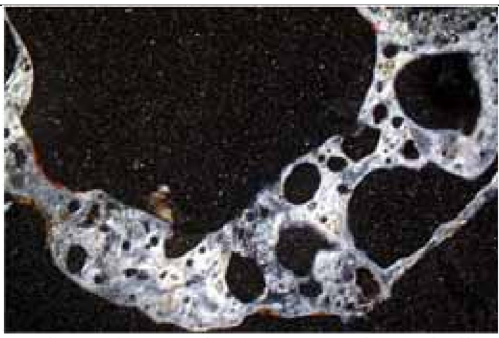

Fig. 3: Photomicrograph of M5565; edge of hollow Type 1 ‘white nodule’, showing vesicular rim. Oblique incident light (OIL), frame width is ~4.62mm.

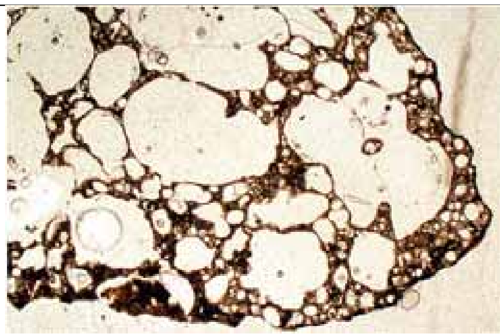

Fig. 4: Photomicrograph of M5565; vesicular lozenge shape Type 2 ‘white nodule’, showing vesicular character throughout. Note iron staining. Plane polarised light (PPL), frame width is ~4.62mm.

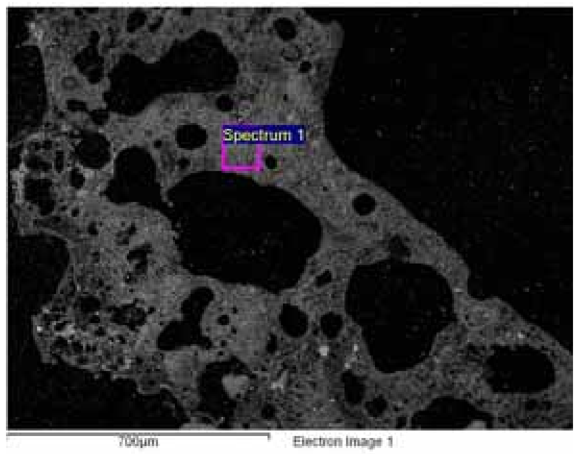

Fig. 5: SEM X-ray backscatter image of rim of hollow type vesicular white nodule (Type 1).

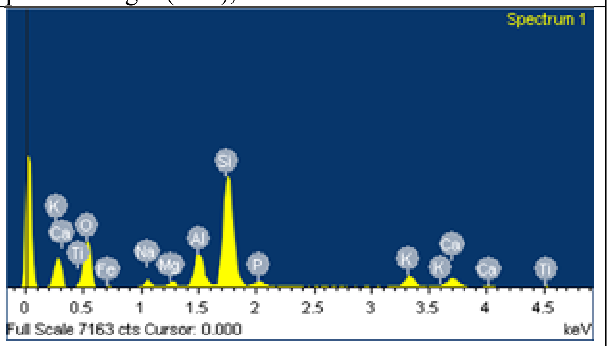

Fig. 6: As Fig 5; Si- (28.2%; 60.2% SiO_2) dominated X-ray spectrum.

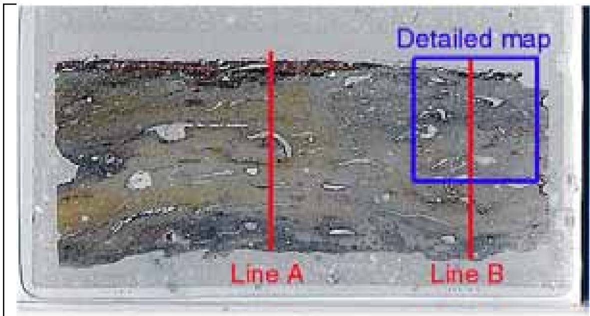

Fig. 7: Scan of M4240A1 (large 'Green Glaze' fragment in ditch 4226); composed of vesicular glass coated plant tempered briquetage. Sample underwent both SEM/EDS and microprobe analyses. Whole thin section and smaller (detailed map in blue) were mapped for elements. Two quantitative line analyses (x100 100x100µm areas): Lines A and B (see Tables and Figs). FTIR employed on parallel thin section M4240A2. Frame width ~48mm.

Fig. 8: Photomicrograph of M4240A1 (large 'Green Glaze', Context 4226); microlayered briquetage composed of silty clay (of estuarine alluvial origin), with voids pseudomorphic of relict rooting and plant tempering. PPL, frame width is ~4.62mm.

Fig. 9: As Fig 8, under crossed polarised light (XPL), showing silt content.

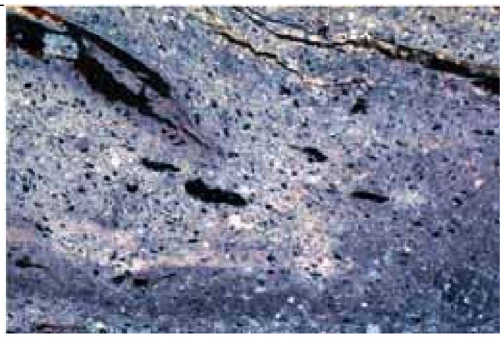

Fig. 10: as Fig 9, under OIL. Roots were pyritised (FeS_2) ahead of oxidation (FeO). Note iron-poor/depleted character (1-2% Fe).

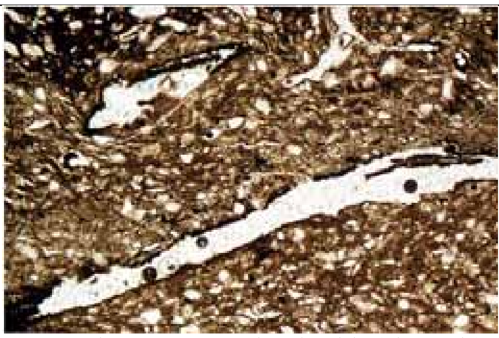

Fig. 11: As Fig 8; an example of voids (channels) pseudomorphic of plant tempering, with relict plant traces. PPL, frame width is ~2.38mm.

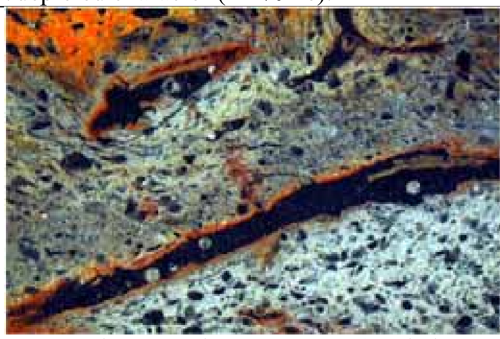

Fig. 12: As Fig 11, under OIL. Note 1) pale iron-depleted character of estuarine sediment employed to construct briquetage, and 2) later iron-staining and impregnation of relict plant material (see Fe probe map).

Fig. 13: Photomicrograph of M4240A1 (large 'Green Glaze', Context 4226); plant temper pseudomorphs and 250µm-thick green glaze surface (part of detailed elemental map; see Figs 17-20). PPL, frame height is ~4.62mm.

Fig. 14: As Fig, detail of vesicular green glaze glass composed mainly of SiO_2 (~40-60%, see Tables 4-5). PPL, frame width is 0.90mm.

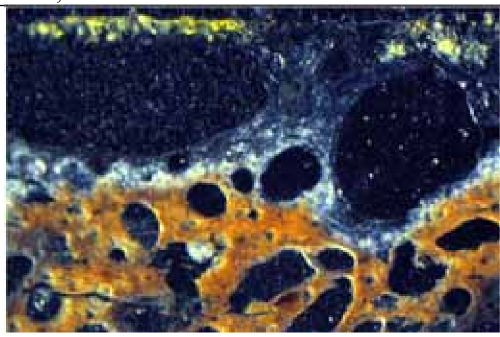

Fig. 15: As Fig 14, under OIL. Note iron-stained uppermost surface and lower vesicular part (3-9% FeO).

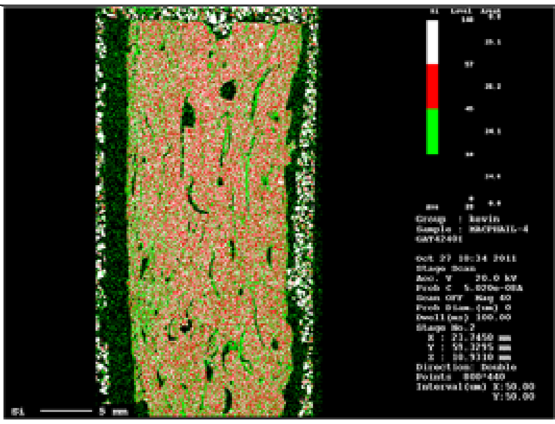

Fig. 16: Microprobe map of Si – silicon (whole thin section slide M4240A1); it contains Si throughout both as quartz silt (red specks) and as clay (aluminium silicates). Scale=5mm.

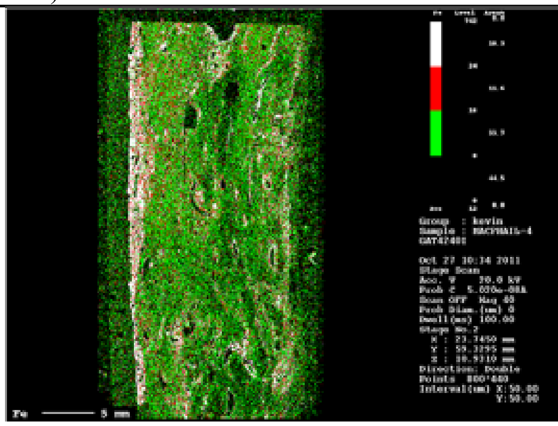

Fig. 17: Microprobe map of Fe - iron (whole thin section slide M4240A1); particularly iron-rich areas are: parts of the green glaze surface (see Fig 15), voids pseudomorphic of plant temper and laminae, possibly relict of original alluvial sediment employed. Scale=5mm.

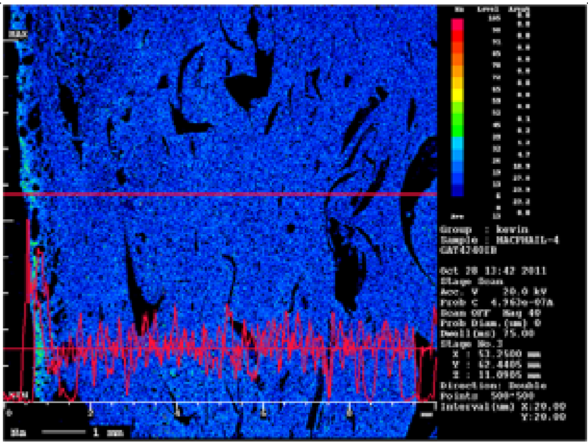

Fig. 17: Detailed microprobe map area (see Fig 7); Na (sodium) is specifically concentrated in the green glaze layer (left edge)(See EDS and Mann-Whitney U tests, Tables 5-6). Scale=1mm.

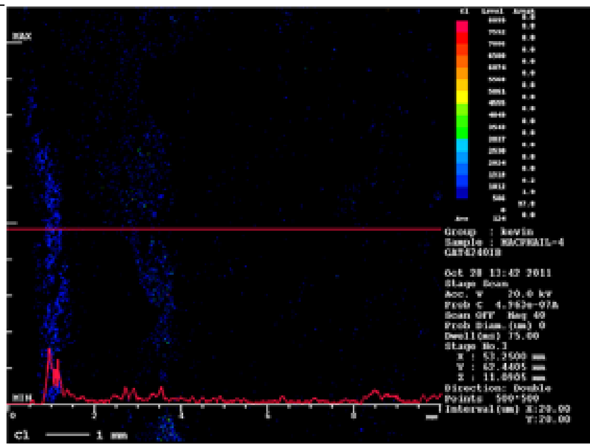

Fig. 18: As Fig 17; Cl – chlorine also appears to be focused here, but as Cl is a major component of the resin impregnating the thin section, Cl in the form of salt (NaCl) *sensu stricto* cannot be proven to be focused in the green glaze. Scale=1mm.

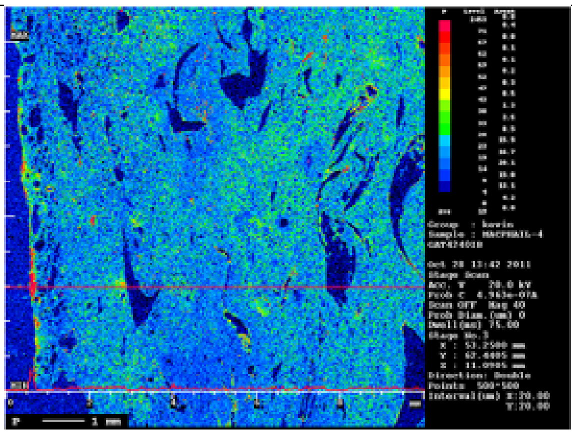

Fig. 19: As Fig 17, P – phosphorus is also concentrated in the surface green glaze (left edge)(See EDS and Mann-Whitney U tests, Tables 4 and 6). Scale=1mm.

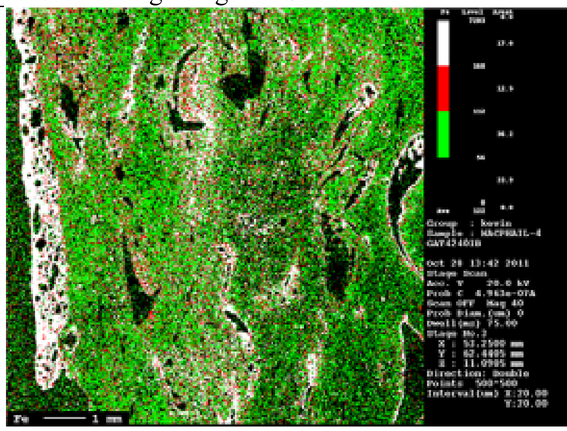

Fig. 20: As Fig 17, Fe – iron is most strongly concentrated along the green glaze surface (left edge)(See EDS and Mann-Whitney U tests, Tables 4 and 6), but also is found picking out the laminated structure and relict plant temper material (void pseudomorphs). Scale=1mm.

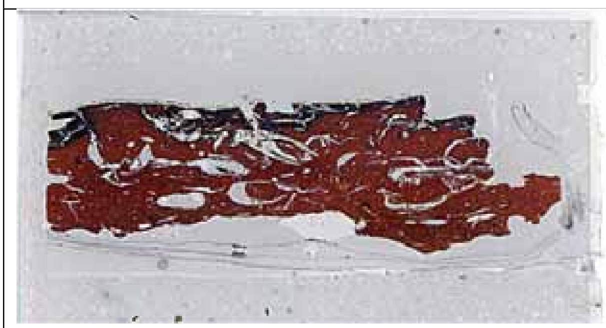

Fig. 21: Scan of M4240B1 (small 'Green Glaze' fragment in ditch 4226); composed of vesicular glass coated plant tempered briquetage. Void pattern is probably in part pseudomorphic of original rooting in salt marsh sediment used as briquetage. Note general heat-induced rubefication, the more strongly heated

black layer underlying the green glaze surface. Sample underwent SEM/EDS and FTIR analyses. FTIR employed on parallel thin section M4240B2 (Fig 30). Frame width is ~39mm.	Fig. 22: Photomicrograph of M4240B1 M4240B1 (small 'Green Glaze' fragment in ditch 4226), showing opaque burned briquetage and surface vesicular glaze. Voids are pseudomorphic of plant remains, most of which appear to be of likely *in situ* salt marsh sediment origin. PPL, frame height is ~4.62mm.
 Fig. 23: As Fig 22, under XPL, showing very fine sand and silt content of clayey sediment, which has lost its birefringence.	 Fig. 24: As Fig 22, under OIL; note heat effects; briquetage is generally rubefied (iron-rich, 6% Fe), becoming blackened upwards below siliceous green glaze layer.
 Fig. 25: Detail of Fig 22, showing vesicular siliceous (e.g. 30.5% Si/65.2% SiO_2) glaze with 5.34-5.74% Fe, and sodium enrichment: inner glaze: 4.50% Na; outer glaze: 8.58-10.1% Na (see Figs 27-28, Table 4);	 Fig. 26: As Fig 25, under OIL.

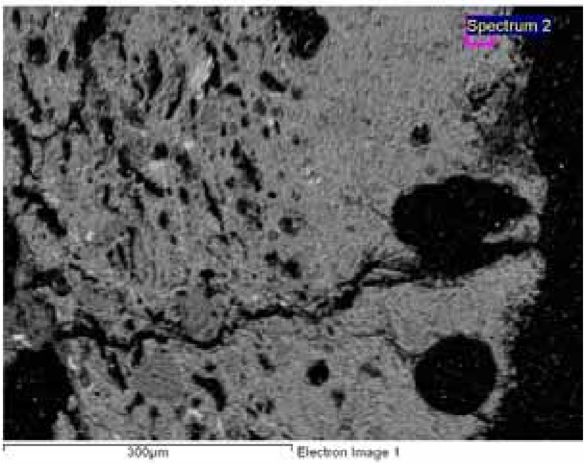

Fig. 27: Sample M4240B1, BSE image of vesicular Si green glaze on briquetage; analysis of outer glaze (see Fig 28).

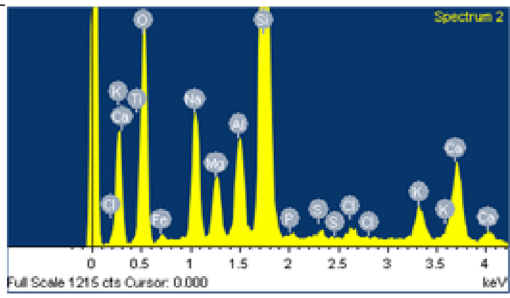

Fig. 28: As Fig 27, EDS Spectrum of out glaze with 10.1% Na (see Table 4)

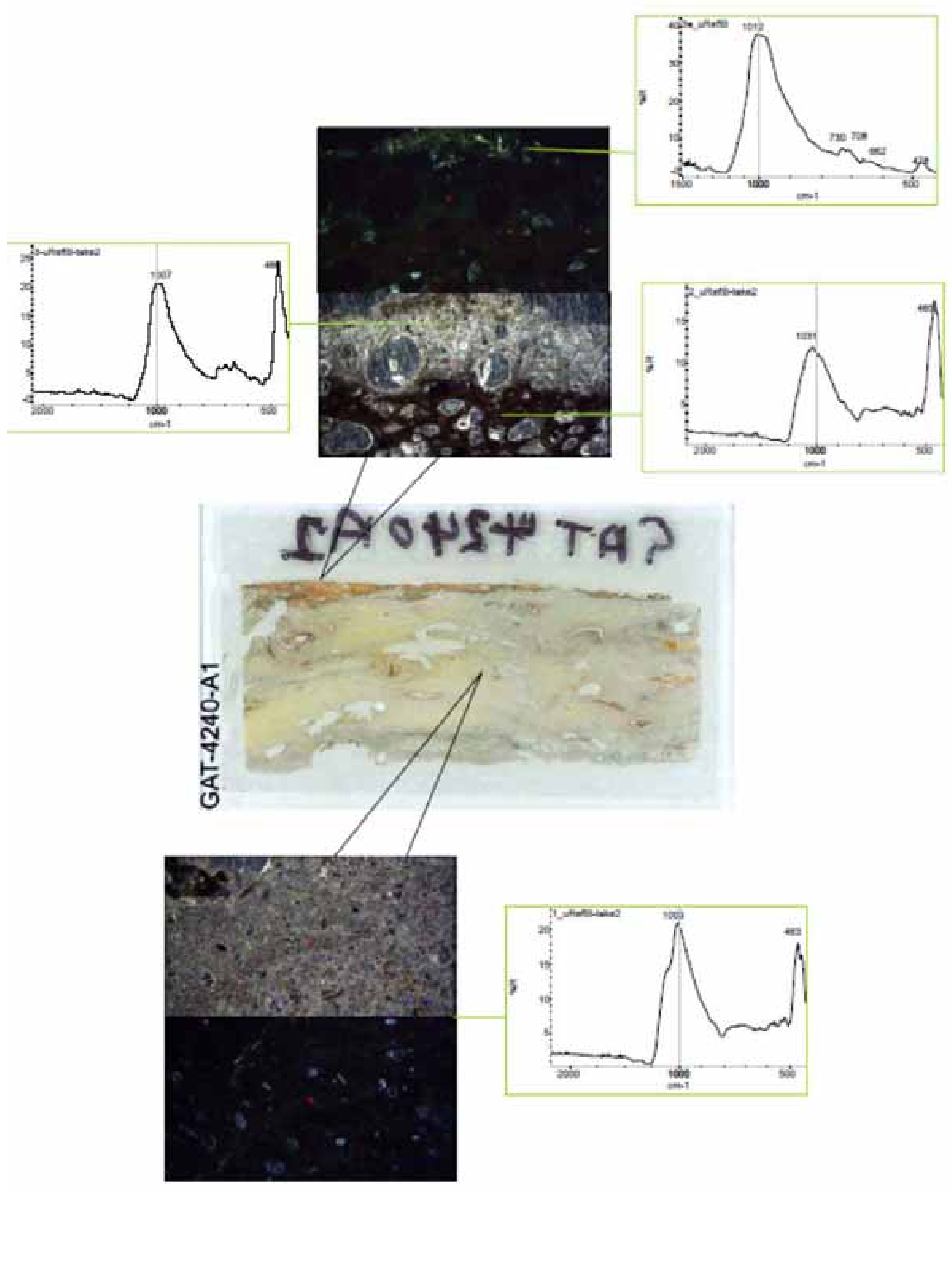

Fig. 29: Examples of FTIR analyses of M4240/A2, showing green glaze is composed of material that shows FTIR patterns compatible with silica glass; isotropic neo-formed 'green' spinel may also possibly be present. The briquetage clay 'sediment' is formed of mica-smectite clay (images by F Berna, Boston University).

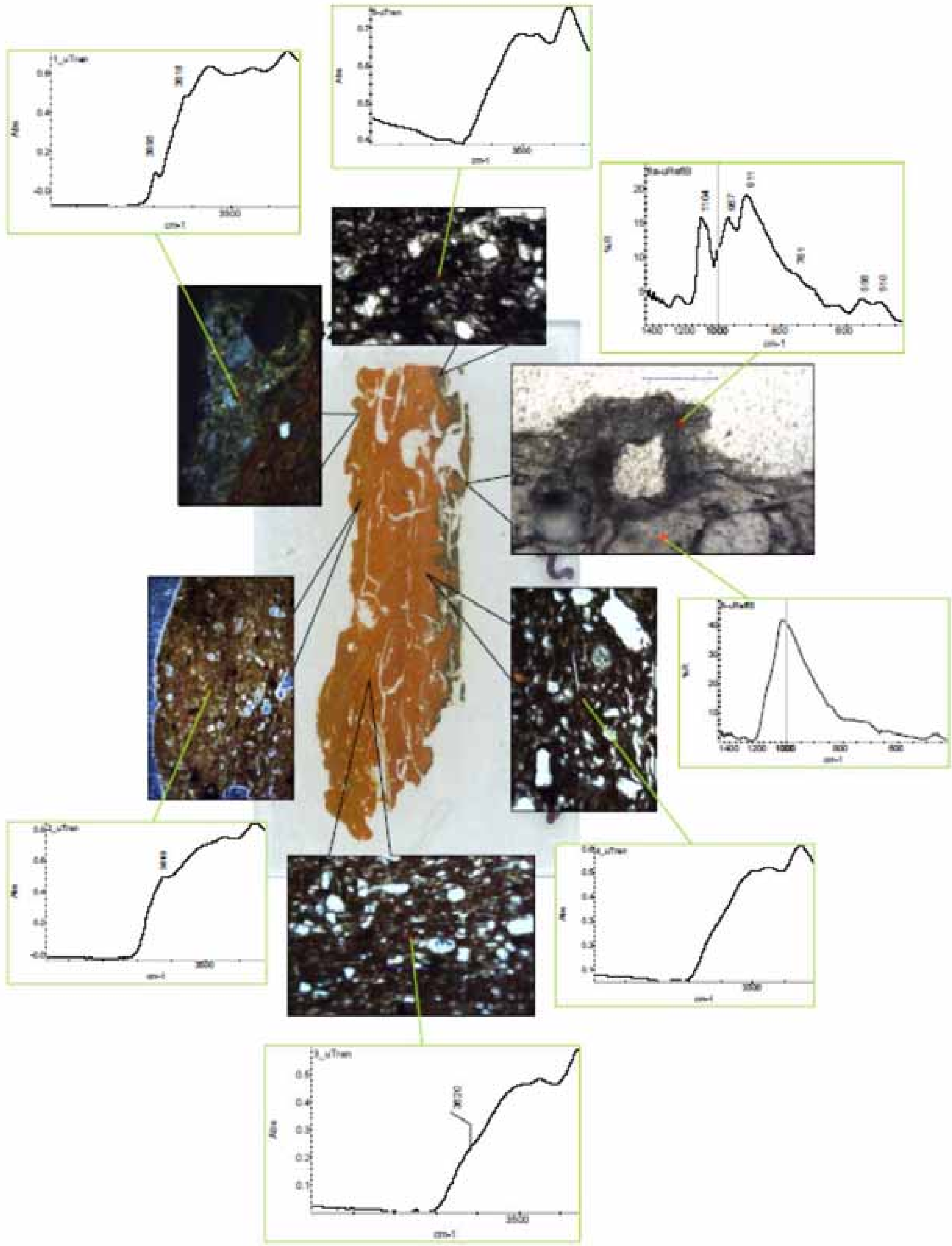

Fig. 30: Examples of FTIR analyses of M4240/B2; the IR spectra show progressive decreasing of the intensity of the mica-smectite absorption at 3620 cm-1 towards the glaze surface (from left to right). This observation suggests temperature above 400° and below 700° C for the orangey red material. The black material shows no absorption at 3620 cm-1 suggesting that the temperature reached by this part of the briquetage should have been higher than 700° C. The IR pattern of the glaze is compatible with silica glass. Some clay adhering to the fragment (at left) show the IR absorptions of kaolinite at 6395 and 6320 cm-1 suggesting that this material is fresh local soil. (images by F Berna, Boston University)

Fig. 31: Scan of M1007B2 (Context 1145); massive structured, iron-depleted fine sandy silt loam containing flints (and rare charcoal and small burned flints). This is the result of marine inundation and the structural collapse of the Holocene soil formed in brickearth. Frame width is ~50mm.

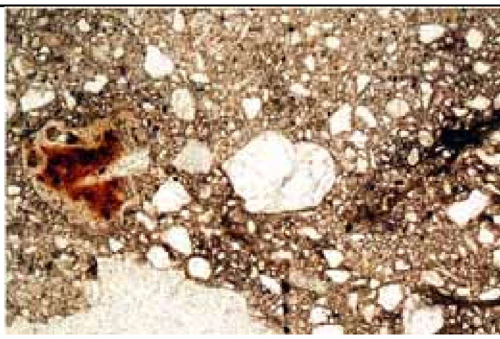

Fig. 32: Photomicrograph of M1007B2 (Context 1145); red-burned flint, and massive (collapsed) soil. PPL, frame width is ~2.38mm.

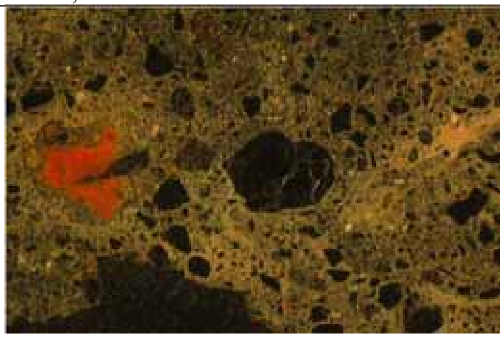

Fig. 33: As Fig 32, under OIL. Slaked fine soil formed (yellowish) clayey intercalations.

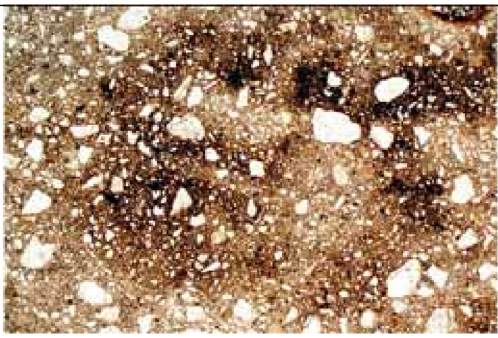

Fig. 34: As Fig 32; relict earthworm burrows of Holocene palaeosol origin, picked out by iron staining of once-humic 'topsoil'. PPL, frame width is ~4.62mm.

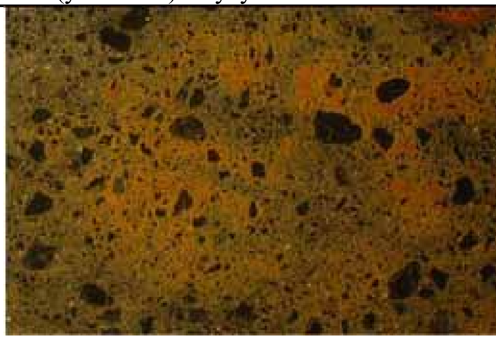

Fig. 35: As Fig 34, under OIL.

Fig. 36: Scan of M1007B1 (laminated clayey Context 1143 over massive 1077. This records saline water structural soil collapse, local erosion and deposition of eroded Holocene palaeosol, before being sealed by marine alluvium.

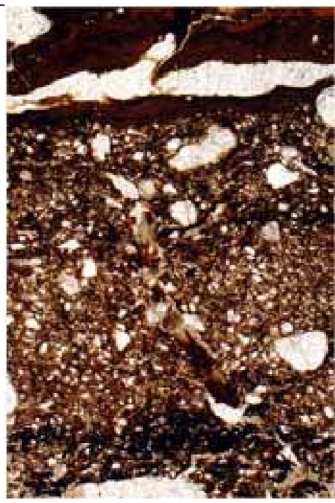

Fig. 37: Photomicrograph of M1007B1 (laminated clayey Context 1143 over massive 1077). Note reworked palaeosol and occupation material just below alluvial clay laminae. PPL, frame height is ~4.62mm.

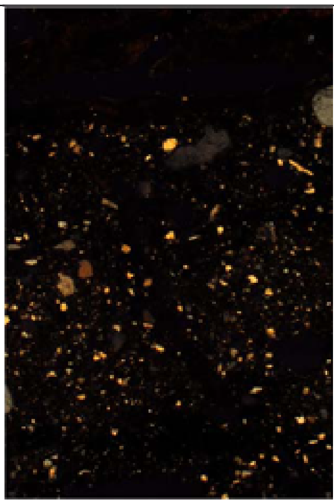

Fig. 38: As Fig 37, under OIL; clayey alluvium over fine sandy silt loam layers containing fine gravel.

Fig. 39: As Fig 37, under OIL, showing various layers at top of the inundated and reworked Holocene soil.

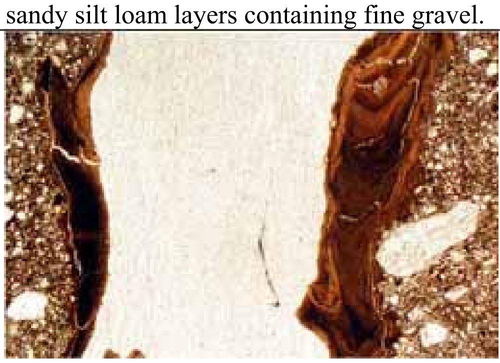

Fig. 40: As Fig 37, showing inwash of alluvial clay into fissures formed in the Holocene palaeosol. PPL, frame width is ~4.62mm.

Fig. 41: As Fig 40, under XPL, recording clayey marine alluviation 'sealing' Holocene substrate.

Fig. 42: Photomicrograph of M1007A (Contexts 8506/1142); anthropogenic deposits rich in semi-fused siliceous material (phytolith-rich) and embedded monocotyledonous charcoal, suggesting plant fuel waste. Voids are coated by brown alluvial clay. PPL, frame width is ~2.38mm.

Fig. 43: As Fig 42, under OIL.

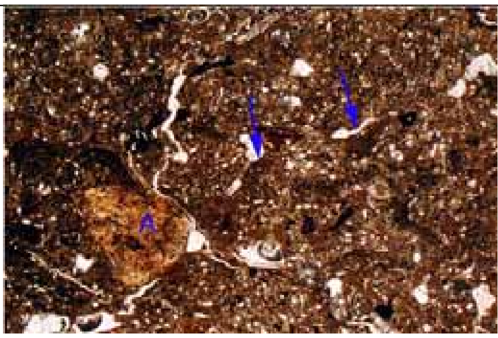

Fig. 44: Photomicrograph of M1004B2 (mixed Contexts 1135-1136) ; muddy soil-alluvial sediment with textural intercalations and associated matrix soil void coatings (arrows). Charcoal and fused ash wash waste (A) are also present. Specific conductance indicates that this is saline alluvium (Table 1). PPL, frame width is ~4.62mm.

Fig. 45: As Fig 45, under XPL; oriented matrix clay around the fused ash waste indicates that it is an 'embedded grain' within this muddy soil- sediment.

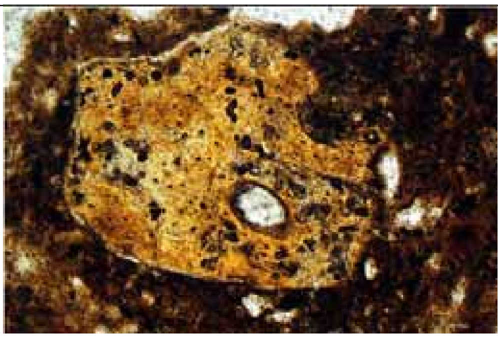

Fig. 46: Photomicrograph of M1004A (Context 1135[1132]); anthropogenic debris rich layer includes coprolitic bone as evidence of occupation and latrine waste disposal . PPL, frame width is 0.90mm.

Fig. 47: Photomicrograph of M1004A (Context 1135[1132]); examples of silt and fine sand laminae within mud flat marine alluvium (with high specific conductance). PPL, frame height is ~4.62mm.

Fig. 48: Scan of M1381A (Context 1837 over 1794); mixed anthropogenic deposits over ripened alluvial clay. Frame width is ~50mm.

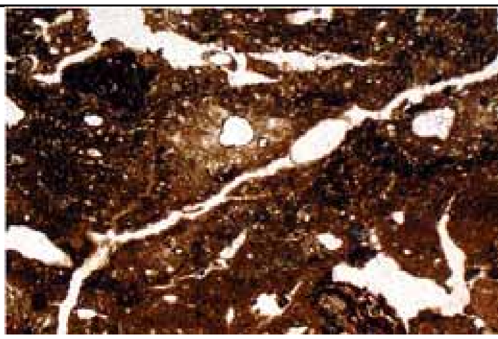

Fig. 49: Photomicrograph of M1381A (Context 1794); ripened clayey alluvium with rooting channels. PPL, frame width is ~4.62mm.

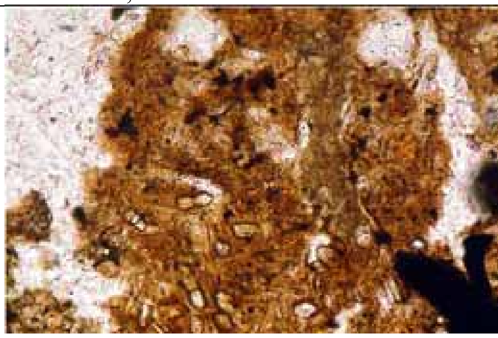

Fig. 50: As Fig 49, detail of alluvial clay containing microfossils (foraminifera?). PPL, frame width is ~0.47mm

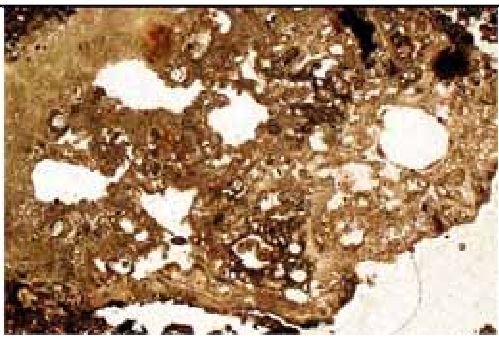

Fig. 51: As Fig 49 (Context 1794) showing probably trample-mixed in fused plant fuel ash waste. PPL, frame width is ~4.62mm.

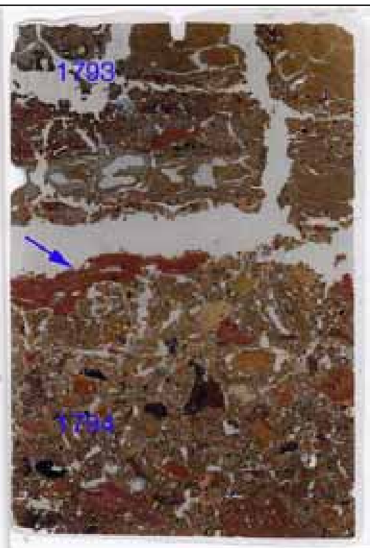

Fig. 52: Scan of M1382B2; interbedded massive alluvial clay and anthropogenic inclusions (1793), over trampled occupation surface deposits/spreads (1794); note horizontally oriented briquetage fragment (arrow). Frame width is ~50mm.

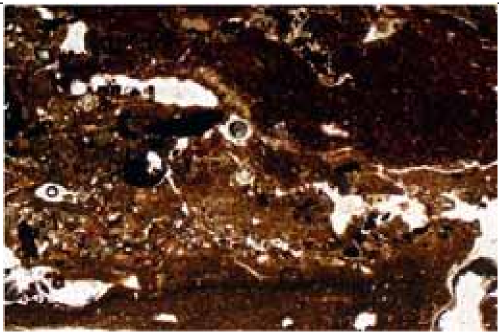

Fig. 53: Photomicrograph of M1382B2, Context 1793; interbedded alluvial clay and spreads of anthropogenic material including red-burned sediment. PPL, frame width is 4.62mm.

Fig. 54: As Fig 53, under OIL, showing different colours of alluvial clay sediment (base), mixed clay and debris (middle) and large burned sediment (redhill material).

Fig. 55: Photomicrograph of M1380B1 (Context 1747), heated wetland sediment with high amounts of phytoliths. PPL, frame width is ~2.38mm.

Fig. 56: Detail of Fig 55, showing presence of both diatoms and phytoliths. PPL, frame is ~0.90mm.

Fig. 57: As Fig 55; trample/fragmented briquetage (redhill) fragments in alluvial matrix.; hence very strongly enhanced magnetic susceptibility. PPL, frame width is ~4.62mm.

Fig. 58: As Fig 57, under OIL; material making up redhill deposits when concentrated.

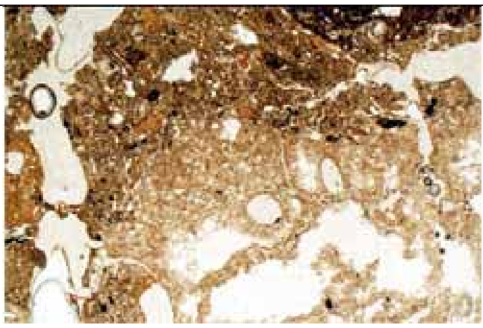

Fig. 59: Photomicrograph of M1380A (Context 1746); deposits include red-burned briquetage (top), mixed clay and fine anthropogenic inclusions (middle) and raw sediment (bottom). PPL, frame width is ~4.62mm.

Fig. 60: As Fig 59, under XPL. Note root channels in fragment of raw alluvial sediment, as evidence that this is from a ripened and vegetated sediment surface (collected when gathering wetland plant fuel.

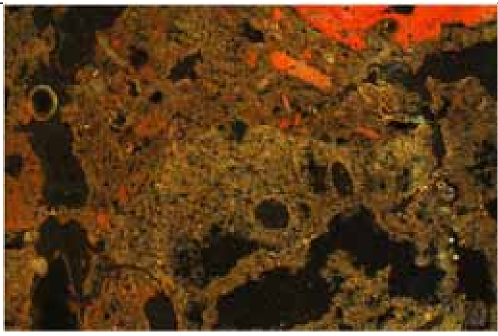

Fig. 61: As Fig 59, under OIL. Raw sediment is unburned (bottom); fine burned material is present in the matrix (middle).

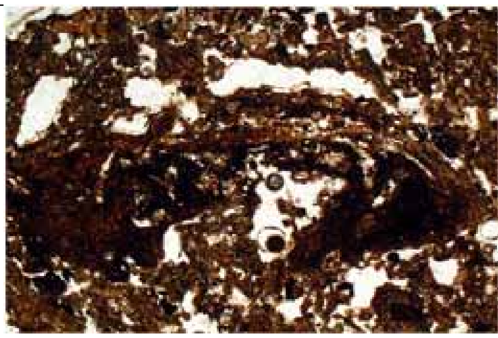

Fig. 62: Photomicrograph of M1262A1 (Context 5732); burned alluvial sediment with plant traces and microfosssils. PPL, frame width is ~4.62mm.

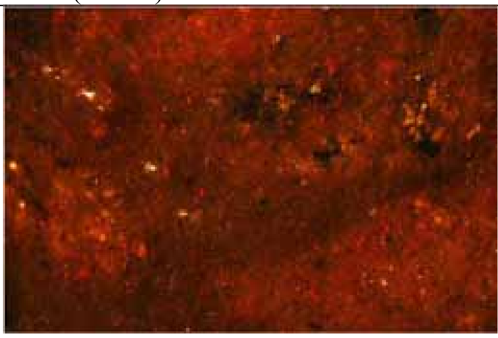

Fig. 63: As Fig 62, under OIL; detail showing burned sediment and microfossils. Frame width is ~0.90mm.

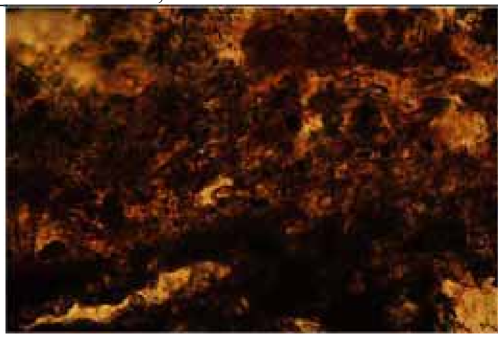

Fig. 64: Further detail of Fig 62; burned foraminifera (?). PPL, frame width is ~0.47mm.

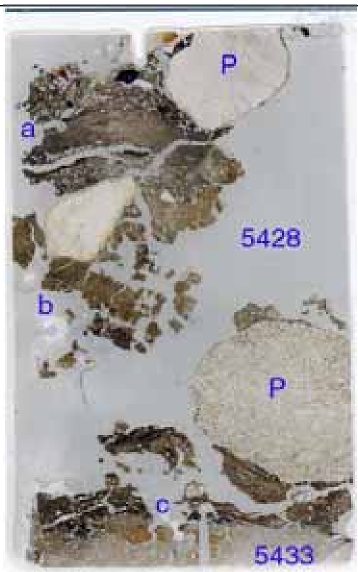

Fig. 65: Scan of M1203B2; truncated Holocene brickearth palaeosol (5433) and roundhouse outer ditchfill (5428) made up of pebbles (P) and a sequence of possibly 3 (a,b.c) intercalated microlaminated fills, of alternating 1) clayey alluvium, horizontally oriented monocotyledonous plant remains, and brickearth loam. Frame width is ~50mm.

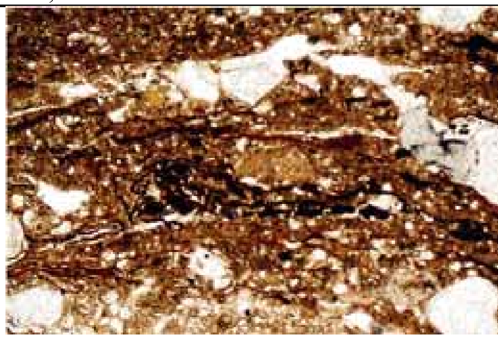

Fig. 66: Photomicrograph of M1203B2 (Context 5428); example of horizontally oriented monocotyledonous plant remains, some blackened and humified and possibly of byre waste origin. PPL, frame width is ~2.38mm.

Fig. 67: As Fig 66, under OIL; blackened humified plant remains are visible.

Fig. 68: As Fig 66, another view of layered organic remains over truncated brickearth soil; horizontally oriented fish bone is also present (top, see Fig 69). PPL, frame height is ~4.62mm.

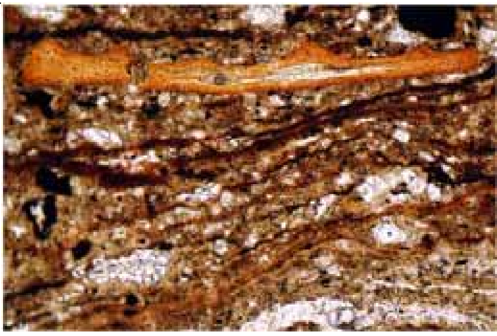

Fig. 69: Detail of Fig 68, showing horizontally oriented plant material and rubefied/burned fish bone. PPL, frame width is ~0.90mm.

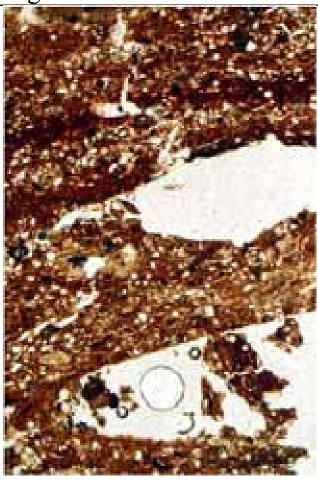

Fig. 70: Photomicrograph of M1203B1 (Context 5429); example of plant tempered, mud-plastered brickearth-based daub/briquetage. PPL, frame height is ~4.62mm.

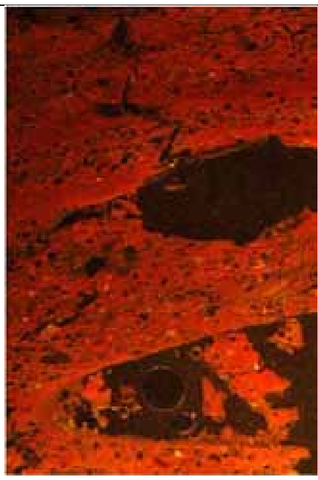

Fig. 71: As Fig 70, under OIL.

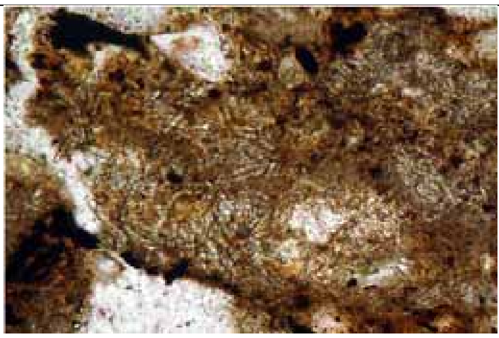

Fig. 72: Photomicrograph of M1203B1 (Context 5429); detail showing death assemblage concentration of diatoms washed into this ditch. PPL, frame width is ~0.47mm.

Fig. 73: Scan of M1203A (Context 5430), brickearth alluvial ditch fill, containing small amounts of relict anthropogenic debris. Frame width is ~50mm.

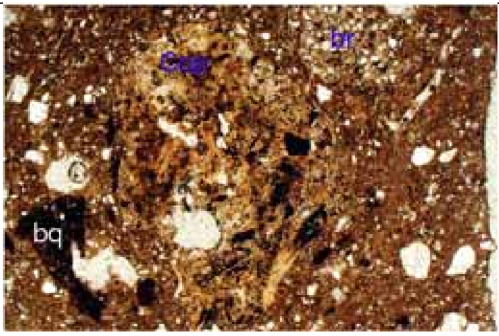

Fig. 74: Photomicrograph of M1203A (Context 5430), alluvial fill includes a clast of burned brickearth (br), briquetage (bq) and a probable human coprolite (Cop) with embedded charred monocotyledonous plant remains. PPL, frame width is ~4.62mm.

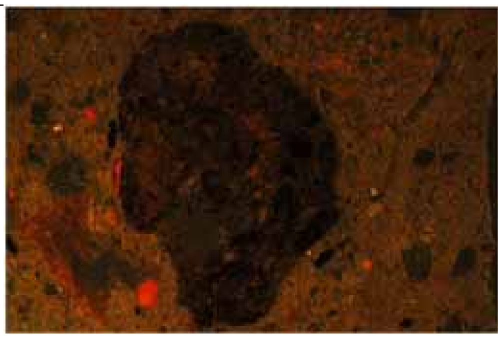

Fig. 75: As Fig 74, under OIL; note fine charcoal and burned brickearth clast and briquetage.

Fig. 76: As Fig 74, iron-stained vesicles in coprolite composed of Ca-P (isotropic and BL autofluorescent). PPL, frame width is ~0.90mm.

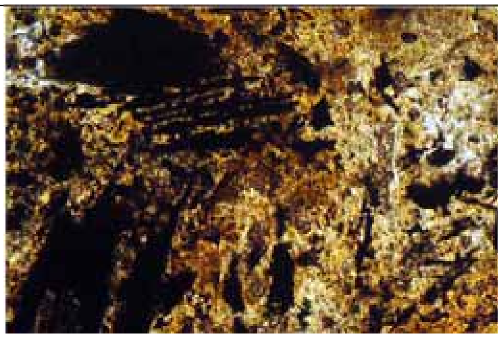

Fig. 77: Detail of Fig 76; embedded charred monocotyledonous plant remains. PPL, frame width is ~0.47mm.

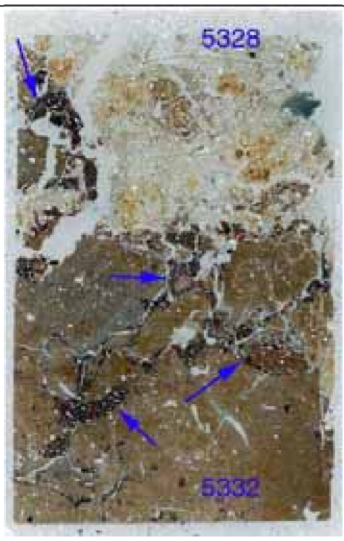

Fig. 78: Scan of M1202B; inner roundhouse ditch clayey alluvial fill 5332, overlain by local sandy fill 5328; note burrow fills of anthropogenic 'redhill' material (arrows). Frame width is ~50mm.

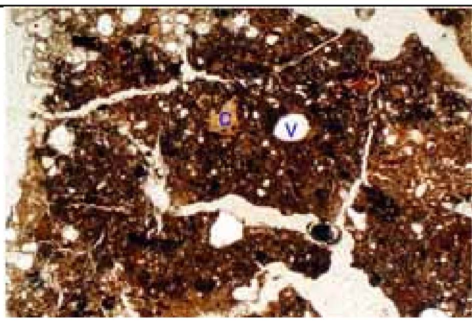

Fig. 79: Photomicrograph of M1202B (Context 5332); anthropogenic burrow fill includes probable human coprolitic material (c); soil was muddy, hence presence of vesicles (v). PPL, frame width is ~4.62mm.

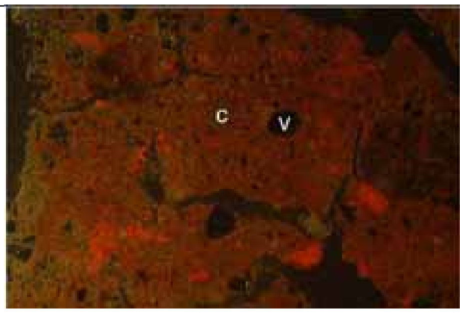

Fig. 80: As Fig 79, under OIL; note many small red burned fragments (from redhill deposits/salt making).

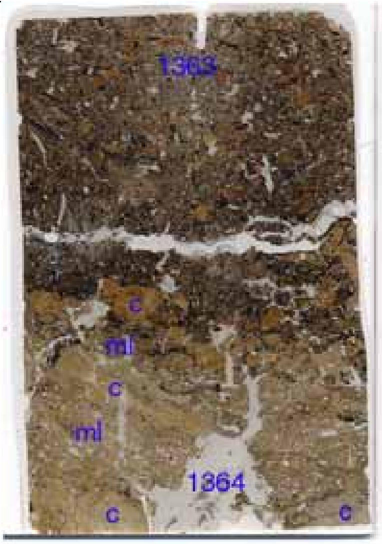

Fig. 81: Scan of 1224B, showing Context 1364 composed of clasts of alluvial clay ('c'; settling tank lining) and microlaminated basal fills (ml), silty sands with charcoal, phytoliths and trace amounts of coprolitic bone. Layer 1363 is a moderately sorted monocotyledonous charcoal and ash deposit, with very high organic and Zn content, and very strong phosphate enrichment (see Table 1). Frame width is ~50mm.

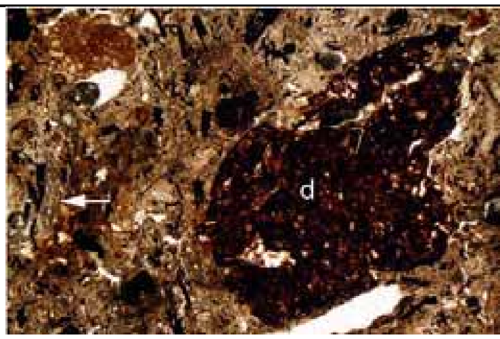

Fig. 82: Photomicrograph of M1224A (Context 1362); mixed fused ash containing many phytoliths, including articulated material (arrow); clasts of charred dung (d)/byre waste also occur (see Fig 83). PPL, frame width is ~2.38mm.

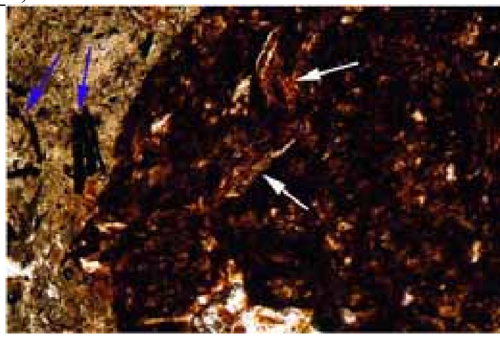

Fig. 83: Detail of Fig 82; articulated phytoliths (white arrows) in humified organic matter (byre waste), and examples of monocotyledonous charcoal (blue arrows). PPL, frame width is ~0.90mm.

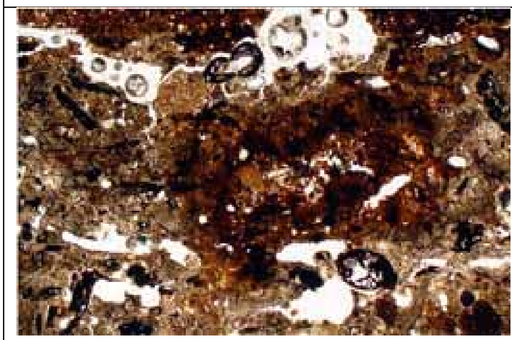

Fig. 84: As Fig 82, showing probable Fe-P stained monocotyledonous ash, as evidence of phosphate (cess?) enrichment (domestic waste disposal). PPL, frame width is ~4.62mm.

Fig. 85: Detail of Fig 84, under OIL, showing yellow Fe-P(?) staining of burned ash waste.

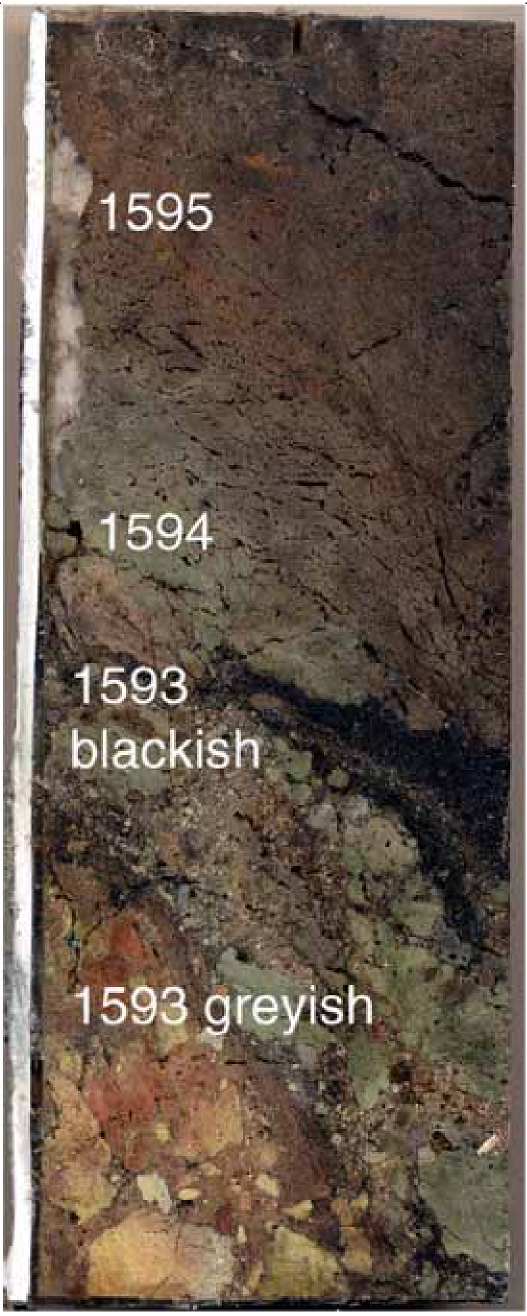

Fig. 86: Scan of resin-impregnated block (M1152A and B), a horizontal monolith through the roundhouse hearth. Horizontally layered 1593 greyish includes rubefied brieackearth and large amounts of more strongly burned sands and monocotyledonous plant remains and even burned human coprolitic material;1593 blackish (cf 1485 in M1151) is a lime(?) plastered constructional layer using *Juncus*(?) as a temper (now charred; see Figs); 1594 and 1595 are brickearth constructional layers, now variously rubefied and fissured due to heating. Frame height is ~16.5cm.

Fig. 87: Scan of resin-impregnated block (M1151A and B), a vertical monolith through the roundhous hearth. Contexts 1599 (muddy anthropogenic alluvium), 1597 (possible waterlain and trampled anthropic brickearth layer), 1598 and 1595 (variously heated brickearth plastered hearth constructional layers), 1593 and 1593 lower (loose, strongly burned sands, brickearth, white nodules and other phytolith-rich fuel ash debris) and 1485 (thin layer of charred *Juncus* plant material) (?; Kath Hunter, pers. comm.)

Fig. 88: Scan of 1152A (see Fig 86); Contexts 1594 and 1595, variously heated and fissured brickearth hearth construction layers (R-B roundhouse). Frame width is ~50mm.

Fig. 89: Scan of 1152A (see Fig 86); Contexts 1593 (strongly burned fuel ash waste and constructional material) and 1593 'blackish' (charred plant temper constructional layer), supporting(?) brickearth hearth layer 1594. Frame width is ~50mm.

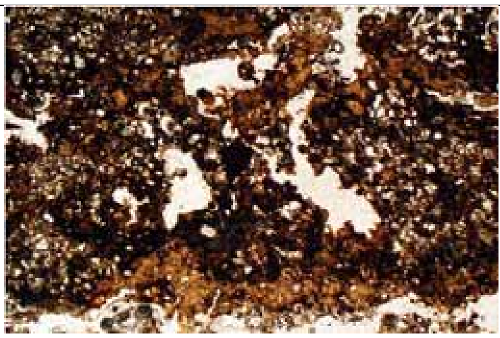

Fig. 90: Photomicrograph of M1152B (Context 1593); loose fill including yellow cess-stained brickearth. PPL, frame width is ~4.62mm.

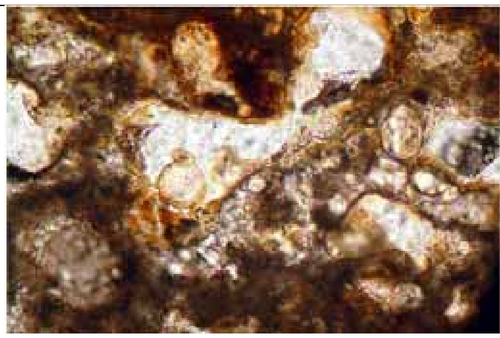

Fig. 91: Detail of coprolitic material in Fig 90, showing possible presence of nematode eggs. PPL, frame width is ~0.47mm.

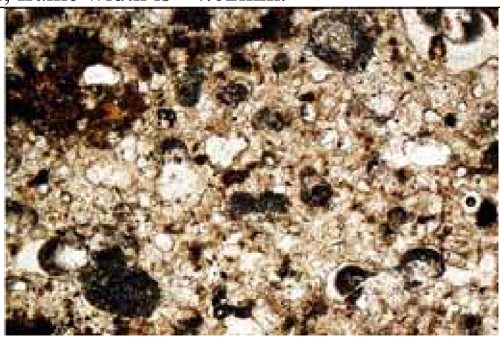

Fig. 92: As Fig 90, moderately strongly burned and altered brickearth sands. PPL, frame width is ~2.38mm.

Fig. 93: As Fig 92, under OIL.

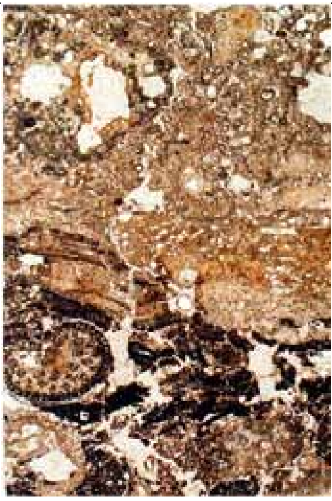

Fig. 94: Photomicrograph of M1151B (Context 1485) charred remains of plant material used in the construction of the hearth (see Figs 87, and also Fig 89 from M1152). This material is tentatively identified as *Juncus maritimus* (sea rush)(Kath Turner, pers. comm.). PPL, frame height is ~4.62mm.

Fig. 95: As Fig 94, under OIL.

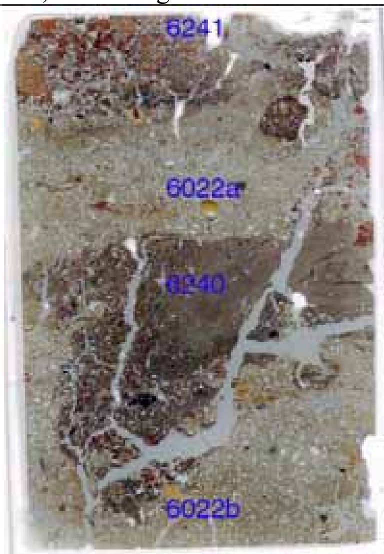

Fig. 96: Scan of M1371A2 (base of Redhill Sequence 19); complicated slaking and erosion of vegetated brickearth palaeosol (6022a and 6022b) by alluvial inundation (6240) and effects of 'terrestrial' down-profile burrowing from overlying redhill (6241). Frame width is ~50mm.

Fig. 97: Photomicrograph of 1371A1 (Context 6241) ; silting laminae recording continued episodic alluviation. PPL, frame width is ~4.62mm.

Fig. 98: Photomicrograph of 1371A1 (Context 6238); burned flint recording fire installation dumps from salt making. OIL, frame width is ~4.62mm.

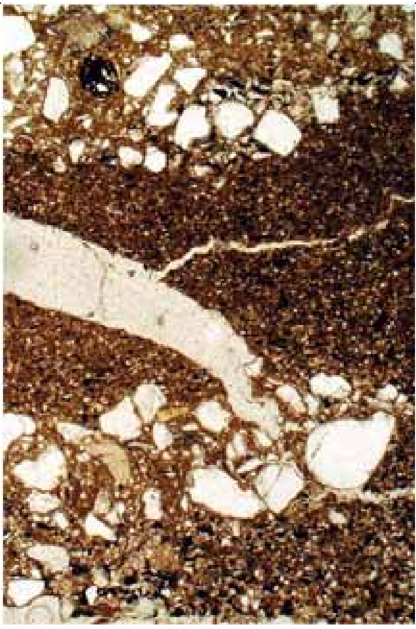

Fig. 99: Photomicrograph of 1366C (Context 6377, Sequence 19); layered 'redhill' silts (see Figs 100-101). PPL, frame height is ~4.62mm.

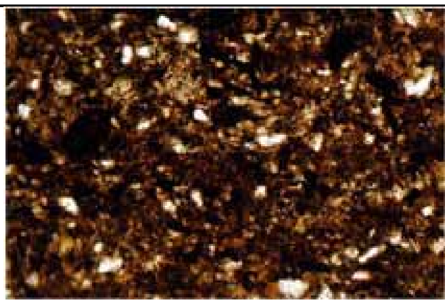

Fig. 100: Detail of Fig 99; 'redhill' silts composed of quartz silt (from brickearth) and fine burned material and monocotyledonous charcoal (fuel ash waste). PPL, frame width is ~0.90mm.

Fig. 101: As Fig 100, under OIL, showing fine rubefied burned wetland sediment (probably relict of wetland plant fuel burning).

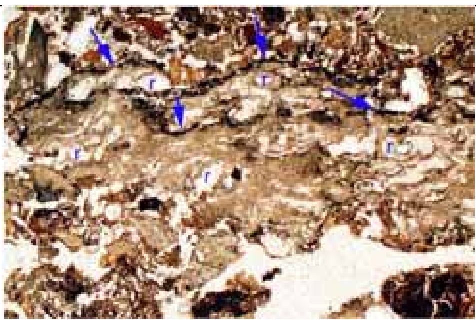

Fig. 102: Photomicrograph of M1366B2 (Context 6379); a burned fragment of generally iron-poor ripened sediment, showing original probable algal layers (arrows) and rooting (r); sediment, accidentally gathered along with rooted wetland plant fuel. PPL, frame width is ~4.62mm.

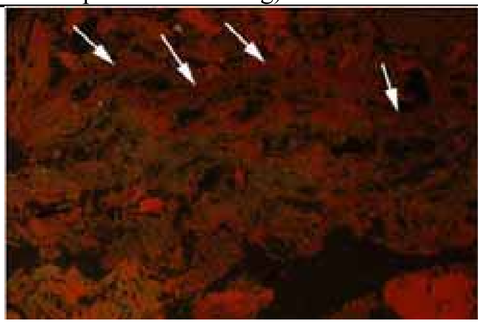

Fig. 103: As Fig 102, under OIL, showing rubefied, iron-replaced probable algal layers, as identified in experimental salt marsh sediments.

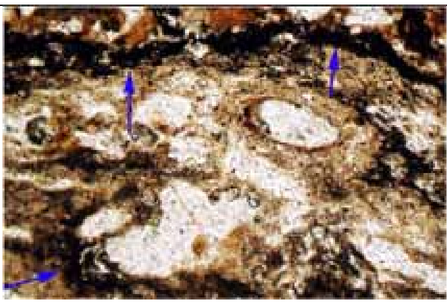

Fig. 104: Detail of Fig 102; two probable algal layers (tidal episodes) are arrowed; fine sediments contain amorphous organic matter, fine silty clay and phytoliths; note root channels. PPL, frame width is ~0.90mm.

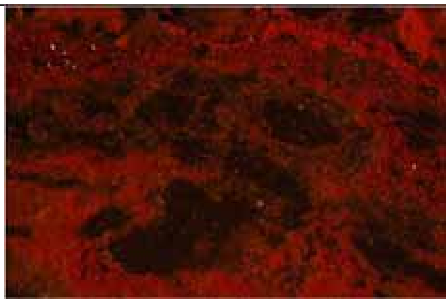

Fig. 105: As Fig 104, under OIL; note rubefied, iron-replaced probable algal layers.

Fig. 106: Scan of M1366A (redhill Context 6373); loose mix of coarse clasts of burned saltmarsh sediment, bricquetage and fused phytoliths (ash waste); with subaerial bioworking. Frame width is ~50mm.

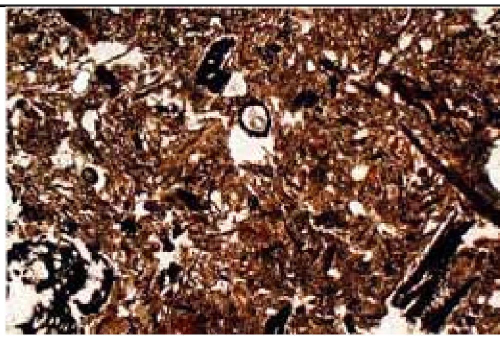

Fig. 107: Photomicrograph of M1366A (redhill Context 6373); fused phytoliths, charred monocotyledonous plant remains and burned sediment. PPL, frame width is ~4.62mm.

Fig. 108: As Fig 107, under OIL.

Fig. 109: Scan of resin-impregnated block 1065A, incorporating Contexts 6375/6343/6370/6371, compact fine and coarsely fragmented briquetage, burned mudflat sediment and phytolith-rich fuel ash waste. (Trampled occupation spreads and surfaces) Frame height is ~16cm.

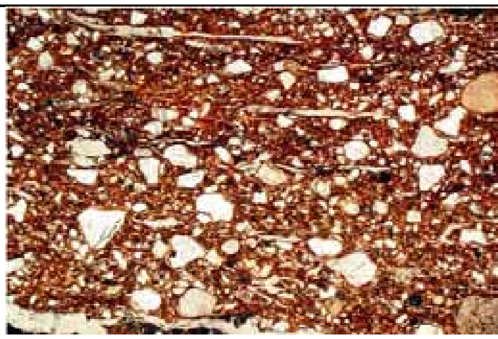

Fig. 110: Photomicrograph of M1365A1 (Context 6375); coarse fragment of plant-tempered brickearth pottery. PPL, frame width is ~4.62mm.

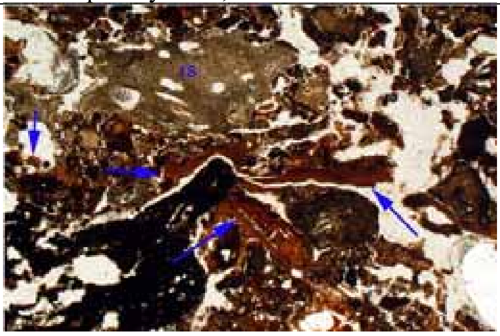

Fig. 111: As Fig 110; burned inclusions, such as pale, iron-poor rooted sediment (rs); note reddish brown clay void coatings (arrows) – inundation effects? PPL, frame width is ~4.62mm.

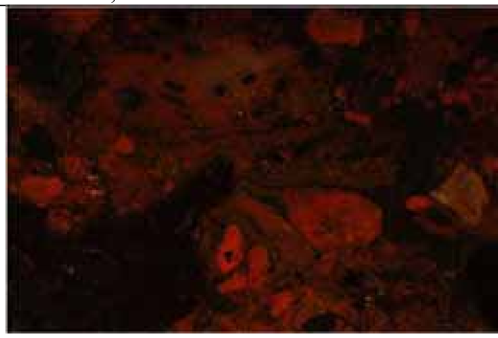

Fig. 112: As Fig 111, under OIL; note relatively pale colours of iron-poor sediment and brown clay inwash.

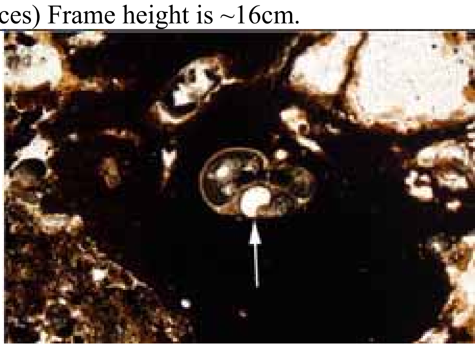

Fig. 113: Photomicrograph of M1362B (Context 6241); burned sediment including mollusc, in redhill deposits. PPL, frame width is 2.38mm.

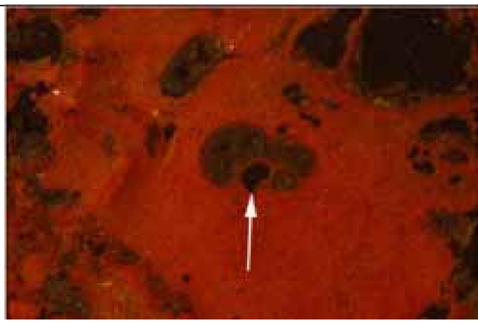

Fig. 114: As Fig 113, under OIL; shell and sediment are rubefied.

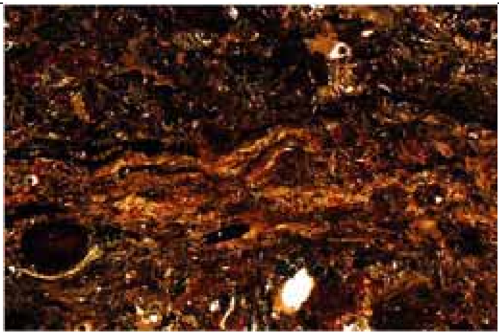

Fig. 115: Photomicrograph of M1362A2 (Context 6236); part of a long fragment of byre floor waste, composed of layered long articulated phytoliths and plant fragments. PPL, frame width is ~4.62mm.

Fig. 116: As Fig 115, under OIL; note long charred plant fragments.

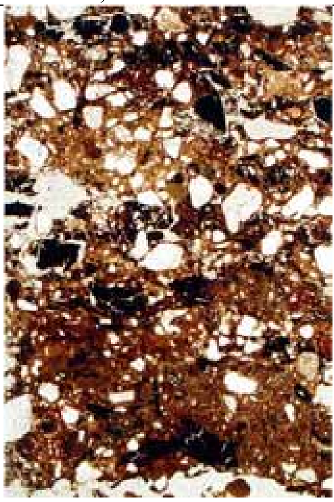

Fig. 117: Photomicrograph of M1328 (Lowermost 6144) showing layering of beaten anthropogenic floor deposits over trampled mudflat clay floor make-up. PPL, frame height is ~4.62mm.

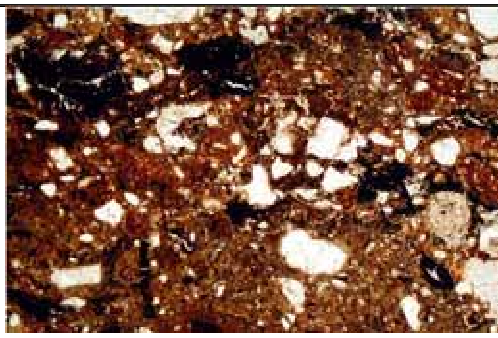

Fig. 118: Detail of Fig 117, layering of muddy clay (lower) from outside, and charcoal-rich debris (upper) from within structure. PPL, frame width is ~2.38mm.

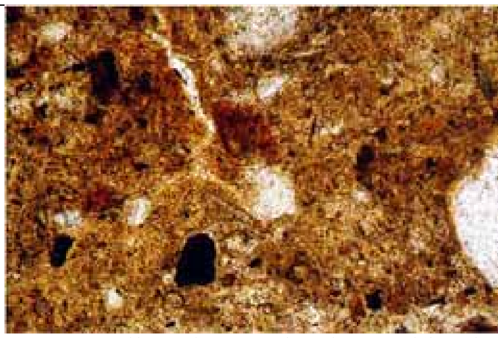

Fig. 119: Detail of Fig 118, showing mudflat clay floor make up; note humic content and phytoliths. PPL, frame width is ~0.47mm.

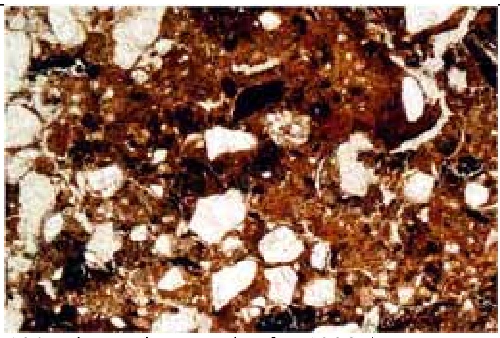

Fig. 120: Photomicrograph of M1328 (Lowermost 6144); 'iron-stained' floor deposits; with 3.27% Fe, 7.01% Sn (tin), 7.95% P, 9.31% Ca, 49.1% Pb (lead)(mean values.

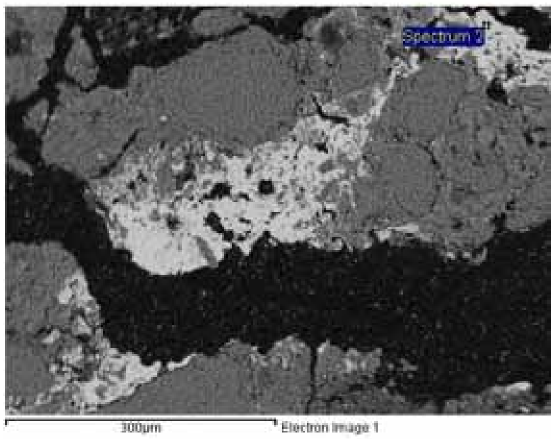

Fig. 121: SEM/BSE image of 'iron-staining' in Fig 120 (M1328), showing very bright 'colours' of Pb (lead). Scale is 300 µm.

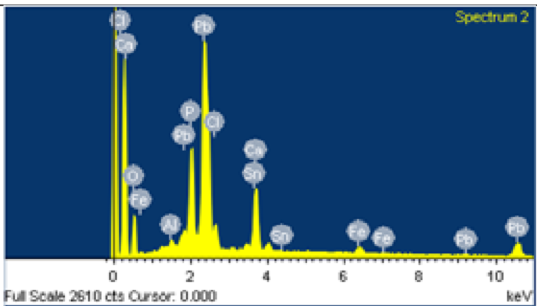

Fig. 122: As Fig 121, X-ray Spectrum; here there is 54.1% Pb (lead).

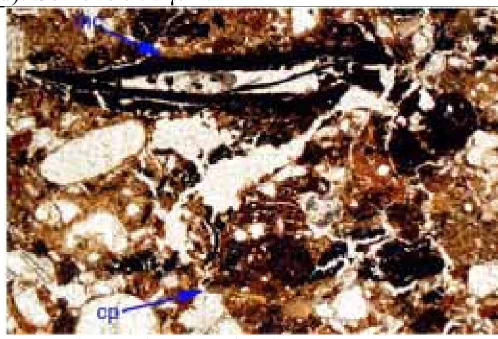

Fig. 123: Photomicrograph of M1328 (Upper 6144); in this trampled floor deposit SEM/EDS found lead in the 'iron' stained sediment (23.7%Pb), coprolitic bone ('cp'; 5.46%Pb) and monocotyledonous charcoal ('mc'; 29.0%Pb)(See Table 4). PPL, frame width is ~2.38mm.

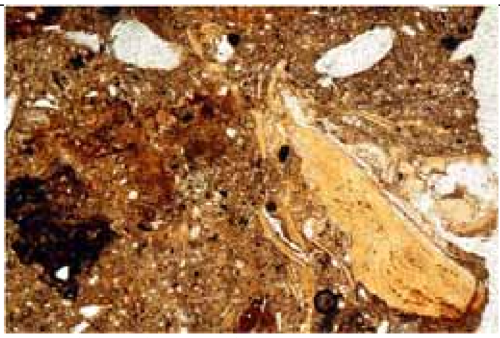

Fig. 124: Photomicrograph of M1332A2 (Context 1006); yellow coprolitic bone in sediments containing fine burned mineral material; from local occupation and latrine waste disposal. PPL, frame width is 2.38mm.

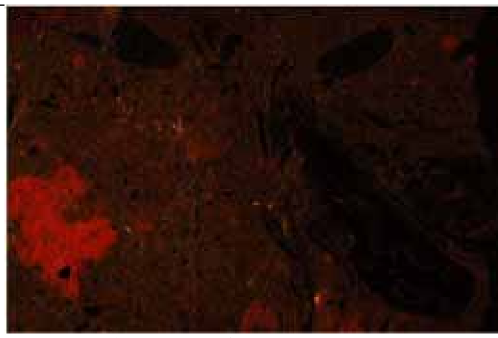

Fig. 125: As Fig 124, under OIL.

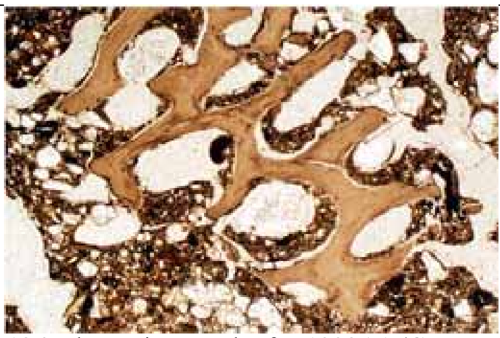

Fig. 126: Photomicrograph of M1332A1 (Context 1007b); calcined bone within trampled sweepings(?). PPL, frame width is ~4.62mm.

Fig. 127: As Fig 126, under OIL; note whitish colours of calcined bone, from kitchen waste.

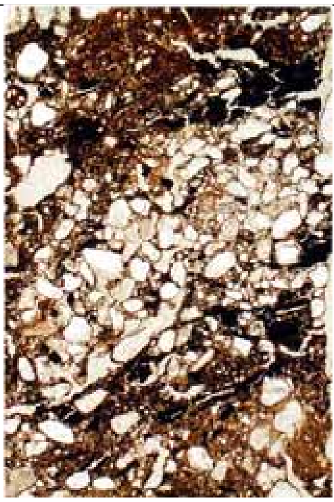

Fig. 128: Photomicrograph of M1332A1 (Context 1007a and 1008); sloping fill deposits, formed through possible 'protected' trampling of sweepings. PPL, frame height is ~4.62mm.

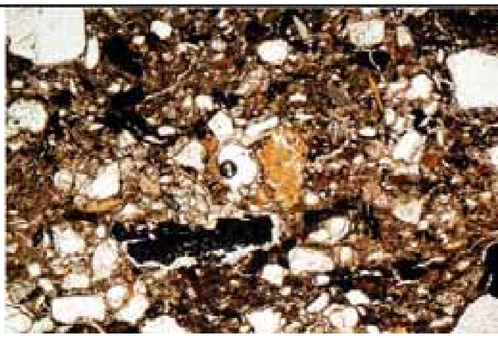

Fig. 129: Detail of trampled floor(?) sweepings, that contain burned bone, coprolitic bone and amorphous phosphate, was well charcoal and fine burned mineral material. PPL, frame width is ~2.38mm.

Fig. 130: As Fig 129, under OIL; note ubiquitous burned mineral material of hearth and probable salt making origin.

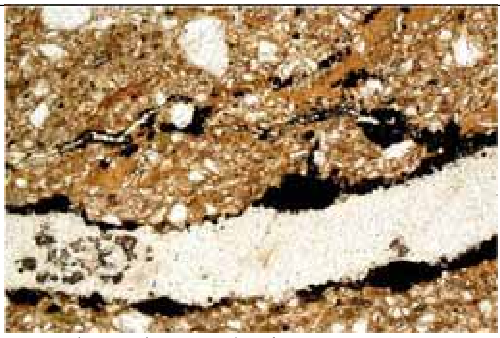

Fig. 131: Photomicrograph of M1663C (Context 6462); primary muddy brickearth fill of pit, with black pyrite (FeS_2) indicating waterlogging. PPL, frame width is 2.38mm.

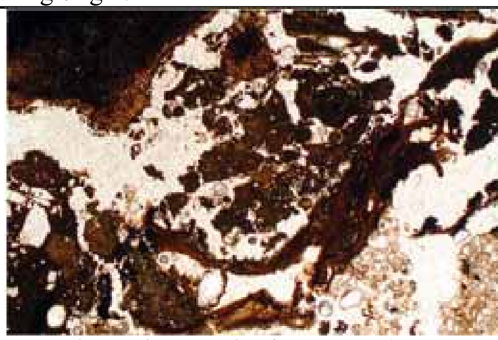

Fig. 132: Photomicrograph of M1663C (Context 6458b); 'yellow fill', here composed of wood, wood bark (lignin) and jarosite (iron sulphate) impregnated sediment. PPL, frame width is ~4.62mm.

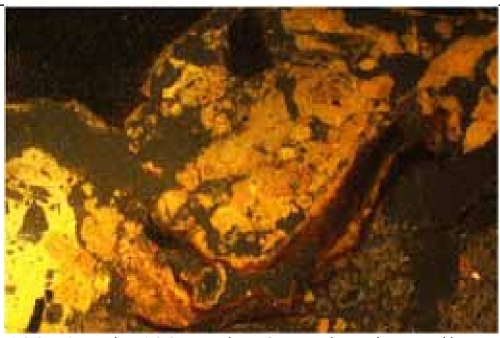

Fig. 133: As Fig 132, under OIL, showing yellow jarosite and blackish brown wood residues.

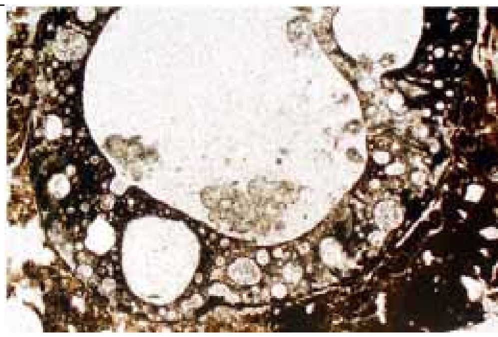

Fig. 134: As Fig 132, note presence of siliceous vesicular white nodule embedded in jarosite sediment; nodule indicates dumping of fuel ash waste. PPL, frame width is ~4.62mm.

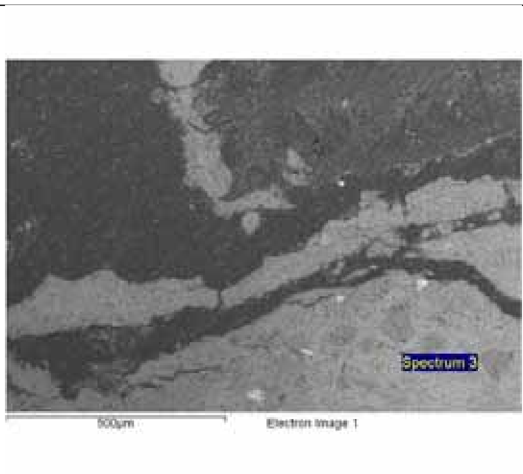

Fig. 135: SEM/EDS analysis of M1663C (Context 6458b), with presence of jarosite indicated by S (6.92%), SO3 (17.3%) and Fe (15.3%), FeO (19.7%), with 2.65% K (3.19% K_2O).

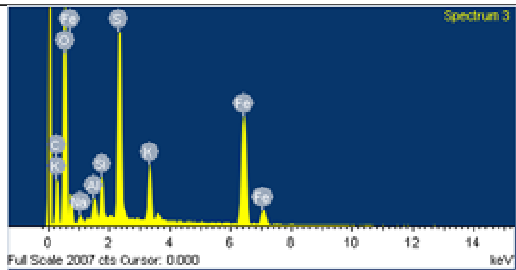

Fig. 136: SEM/EDS analysis of M1663C (Context 6458b); X-ray Spectrum.

Oxford Archaeology Monograph No.18

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ISBN 978-0-904220-71-1

Janus House, Osney Mead, Oxford OX2 0ES
ISBN 978-0-904220-71-1