The Archaeology of the A30 Bodmin to Indian Queens Road Scheme
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Soil micromorphology, chemistry and magnetic susceptibility

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INTRODUCTION

Four excavated site areas (A, B, C and D) of the A30 (Bodmin to Indian Queens) routeway were visited and discussed with Oxford Archaeology staff (Stuart Foreman, Project Manager; Paul Clark, Site Supervisor; Seren Griffiths, Environmental) on the 2nd of December 2005. A further area, Site E was subsequently excavated. Soil monoliths were collected by Seren Griffiths and Carl Champness from Areas A, B, C, D and E. A number of soil questions had been identified on the sites during excavation (Rebecca Nicholson, Environmental Manager, Oxford Archaeology, pers. comm.). Chief amongst these were the origin and character of dark 'fills' and staining features. These questions, which included the function of various circular features, pits, accumulations and enigmatic and undated features, and their relationship to the cultural and natural landscape were investigated (see below) employing field observation, regional soil and archaeological soil information; a post-excavation soil study was recommended (Macphail, 2006).

SAMPLES AND METHODS

A series of 40-50 cm-long monolith samples were received from Oxford Archaeology after some had been already sub-sampled and assessed for pollen (Allen and Brown, May 2006, University of Exeter). These were evaluated, and subsampled for fourteen thin section (Tables 2-3) and twenty-one bulk analyses; the latter comprised eight standard analyses (LOI, pH, fractionated P, magnetic susceptibility including χ_{max}) and thirteen assays that included tin (Sn) analysis, because of the possibility that some features could be associated with tin mining and or/processing (Carl Champness and Stuart Foreman, OA, pers. comm.). Radiocarbon dating suggests that some new dates for the studied features (Rebecca Nicholson, Oxford Archaeology, pers. comm.).

The post-excavation investigation focused upon (Tables 1-4):
Area A: the fills of ditches and re-cut ditches of an Iron Age (now medieval?) roundhouse, the soils sealing this feature.
Area B: the ditch fills of a Bronze Age (now iron Age?) circular feature (roundhouse or enclosure).
Area C: an example of the medieval soil (4131) associated with a boundary/droveway.
Area C: the fill of Bronze Age pit 4428.
Area D: examples (pits 4310 and 4388) of the enigmatic and undated pits (thin section across the 1: 'natural', 2: the dark soil marking the boundary of this pit fill and the natural it was cut into, and 3) the pit fill itself). Bulk samples were taken from examples of the purest dark soil (4329a; 4329/4160; pit 4310) and slightly mixed dark fill (4329b; 4329/4159), a characteristic of several of these undated and enigmatic pits.
Area E: Neolithic post-hole (1123) fill in a hengiform monument and the fill of a Neolithic pit (1064) within this hengiform monument.

Chemistry and magnetic susceptibility

The soils in the vicinity of the site are developed on weathered Palaeozoic slates, siltstones and mudstones (see below). They are mapped as being of the Hafren and Manod associations (Findlay *et al.*, 1984), which predominantly comprise Ferric stagnopodzols and Typical brown podzolic soils, respectively, but also include more heavily gleyed soils (e.g. Cambic stagnohumic gley soils of the Wilcocks series). It should be noted podzolic soils exhibit wide variability in Fe content down through the soil profile, with low concentrations in the topsoil and eluvial horizons, and much higher concentrations in the underlying illuvial horizons. As a consequence, such soils exhibit marked natural variability in magnetic susceptibility (which is strongly dependent upon the amount and nature of Fe present) and phosphate retention (in acidic soils phosphates released by mineralisation processes tend form insoluble compounds with Fe), and relatively soluble components such as heavy metals (e.g. Sn) are quite vulnerable to leaching. In the case of gleyed soils, Fe concentrations are often depleted as a result of Fe mobilization under anaerobic conditions, and this not only limits the potential magnetic susceptibility where a soil has been subject to heating/burning, but may also lead to subsequent changes in the quantity and mineralogy of Fe present. Thus, types of soil at the site are not ideal for the standard range of anthropogenic 'signatures' (magnetic susceptibility, phosphate and heavy metals) investigated, and the results must therefore be interpreted with caution.

Methods

Analysis was undertaken on the fine earth fraction (i.e. <2 mm) of the samples. LOI (loss-on-ignition) was determined by ignition at 375^{o}C for 16 hours (Ball, 1964); pH (1:2.5, water) using a standard combination electrode; and Sn by atomic absorption spectrophotometry following extraction with 1N HCl. The intention had been to undertake phosphate fractionation analysis (i.e. to separate the inorganic and organic components), but this proved impossible using standard colorimetric methods because of high levels of interference from acid-soluble humic substances in the 1 N HCl inorganic phosphate extract. As a consequence, total phosphate (phosphate-P) was determined on finely ground, ignited samples from the LOI determination using 1 N HCl, and concentrations were determined colorimetrically using molybdenum blue at a wavelength of 720 nm.

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 (Scollar *et al.*, 1990; Tite, 1972;). In many respects this is a better indicator of magnetic susceptibility enhancement than raw χ data, particularly in cases where soils have widely differing χ_{max} values (Crowther and Barker, 1995; Crowther, 2003). A Bartington MS2 meter was used for magnetic susceptibility measurements. χ_{max} was achieved by heating samples at 650°C in reducing, followed by oxidising conditions. The method used broadly follows that of Tite and Mullins (1971), except that household flour was mixed with the soils and lids placed on the crucibles to create the reducing environment (after Graham and Scollar, 1976; Crowther and Barker, 1995).

Soil micromorphology

Fifteen 8 cm to 15 cm-long samples were impregnated with a clear polyester resin-acetone mixture; samples were then topped up with resin, ahead of curing and slabbing for 75x50 mm-size thin section manufacture by Spectrum Petrographics, Vancouver, Washington, USA (Goldberg and Macphail, 2006; Murphy, 1986). 14 thin section samples were selected from all the resin-impregnated material, the resin impregnated sawn blocks being used to select the best and most representative material. Thin sections (Figs 3-6) were analysed using a petrological microscope under plane polarised light (PPL), crossed polarised light (XPL), oblique incident light (OIL) and using fluorescent microscopy (blue light – BL), at magnifications ranging from x1 to x200/400. Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs)(see Tables 2 and 3), and counted according to established methods (Bullock *et al*., 1985; Courty, 2001; Courty et al., 1989; Goldberg and Macphail, 2006; Macphail and Cruise, 2001; Stoops, 2003).

Microprobe analysis comprised the mapping of thin section M4129A (Context 4432) for Si, Fe, S, Cu, Mn, Ca, K, Na, Mg, Al, Ti, P, and Sn, and the quantitative grid analysis of two Sn (tin)-rich areas (see Figs 3-28.

RESULTS

Chemistry and magnetic susceptibility

Details of the contexts sampled and the analytical results (annotated to highlight anthropogenic signatures and other key features of individual samples) are presented in Table 1. Here, a general overview/interpretation of the individual properties is presented to underpin the annotations in Table 1.

Basic soil characterisation: pH, LOI and χ_{max}

As would be anticipated, the soils and feature fills are all acidic (pH range: 4.5-5.9), though many of the pH values recorded are somewhat higher than might have been anticipated and presumably reflect some degree of modification through anthropogenic activity (e.g. neutralizing effects of ash deposits, manuring, later liming of soils for land improvement, etc.). Although all are largely minerogenic, some contexts do have relatively high organic matter concentrations (maximum LOI, 10.6%), which is presumably a result of relatively slow rates of organic decomposition, particularly in areas of impeded drainage. Although no determinations were made of Fe content, the χ_{max} values do provide a somewhat crude indication of relative Fe concentrations. Samples with notably low χ_{max} values of < 500 x 10^{-8} SI seem likely to be from eluvial (i.e. heavily leached) and/or gleyed horizons, whereas those samples with values of > 2500 x 10^{-8} SI are likely associated with illuvial and/or non-gleyed horizons. Notably higher pH and LOI values and the more extreme χ_{max} values are highlighted in Table 1.

Phosphate-P

As is typical of leached acidic soils, phosphate-P concentrations are relatively low, and what variability there is between the samples (range, 0.080-0.800 mg g^{-1}) needs to be interpreted with caution because of the podzolic and/or gleyed nature of the soils. Often on archaeological sites there is a strong underlying relationship between phosphate-P and LOI, which reflects the contribution made by organic phosphates to the total phosphate content and the importance of organic sources. In this case, however, the relationship is very weak and not statistically significant (r = 0.303, p = 0.182; Fig. 1), which suggests that variation in phosphate retention capacity may be a more important factor. As noted above, Fe content strongly affects phosphate retention in acidic soils, and this would appear to be reflected in the somewhat stronger, though not statistically significant, correlation (r = 0.429, p = 0.052; Fig. 2) between phosphate-P and χ_{max}. In these circumstances, the residuals of linear regression analysis between phosphate-P (dependent variable) and χ_{max} (independent variable) are likely to provide a better measure of the degree of phosphate enrichment than the 'raw' phosphate-P data. In the present study, the residuals have been reported as a percentage of the predicted concentration, and values in the ranges 25.0-99.9% and 100.0-199% have been classified as 'slightly enriched' and 'enriched', respectively.

Magnetic susceptibility

In view of the very wide variability in χ_{max}, χ_{conv} (rather than χ) provides by far the best measure of susceptibility enhancement as a result of human activity, though (as noted above) even this may be unreliable in circumstances where there may have been subsequent loss or gain of Fe as a result of podzolisation and/or gleying. Under UK conditions, χ_{conv} values of ≥ 5.00% are often taken to be indicative of enhancement through heating/burning (Crowther, 2003). In Table 1, values in the ranges 5.00-9.99% and 10.0-19.9%, respectively, are tentatively identified as being 'enhanced' and 'strongly enhanced'.

Tin

Ten of the 13 samples analysed have low concentrations of Sn (range, 53.3-134 $\mu g\ g^{-1}$) which are likely to reflect natural background concentrations. The remaining three samples, all from fills of Bronze Age pit 4428, show clear signs of 'enrichment' (here identified as 1000-4990 $\mu g\ g^{-1}$) or (in case of context 4432) 'strong enrichment' (5000-9990 $\mu g\ g^{-1}$) – as is likely to be associated with tin-processing/working activities.

Conclusions

Despite the potential difficulties posed by the podzolisation and/or gleying of soils and feature fills in terms of the retention of anthropogenic signatures and their interpretation, the results have clearly identified several contexts that have been affected by:

- phosphate enrichment – as might be associated with middens, manuring, etc.,
- magnetic susceptibility enhancement – which is likely associated with heating/burning, and/or
- tin enrichment – which is undoubtedly a result of some form of metal processing activity.

In addition, certain contexts have a rather higher pH than might have been anticipated, and this may also be related to human activity (e.g. neutralizing effects of ash deposits, manuring and liming).

Soil micromorphology

The characterisation of 9 SMTs (15 variants) and counting of 22 attributes established the presence of 6 MFTs (12 variants) according to archaeological site and context, and bulk analytical and microprobe data. These findings are presented in Tables 2-4, and illustrated in Figs 3-28.

DISCUSSION

Local mapped soils

The chief soils mapped along the routeway belong to the Hafren and Manod soil associations on Palaeozoic slaty mudstone and siltstone or slates, mudstone and siltstone, respectively (Findlay *et al*., 1983, 1984). Near the present A30 for example the soils are Cambic stagnohumic gley soils (Wilcocks soil series) and the Hafren soil association. The latter includes Ferric stagnopodzols (Hiraethog soil series) and is probably associated with rough grazing that includes *Juncus* (Avery, 1990). The term 'stagno' indicates poor drainage through drainage impedance, whereas 'gley' indicates both general waterlogging and the effects of groundwater (high water tables associated with flushes). On the slopes, where parts of the new routeway is located (sites A, B, C, D and E), better drained Typical brown podzolic soils are mapped (Manod soil association), which include the Moretonhampstead soil series in Cornwall (Avery, 1990; Findlay *et al*., 1983). On some low ground nearby Typical humic gley soils occur that can have peaty surface horizons and peats (Laployd soil association).

A number of soil variants were noted (dealt with individually below), that relate to differences in drainage, original soil character and to degree of burial/preservation. One important aspect of the Manod soil association here (and many other upland edge areas of England and Wales) is the effect on the soils of moderately recent 'improvement', carried out through ploughing and some forms of manuring. This soil improvement homogenised the original podzolic horizons to form 'brown soils' that can sustain better grassland. That is, soils that were probably podzols have been converted into brown soils, in some cases this also may have led to erosion, and colluviation. An example of this Typical podzolic brown soil (Moretonhampstead soil series) from Bodmin Moor, which had been improved by ploughing but that still retains remnant features of podzolisation (traces of the humic Bh and relict sesquioxide-enriched Bs horizon), is described by Avery (1990, 236 and 239-240). Some upslope and plateau areas still retain their ironpan character indicative of not being improved, as probable analogues of the soil cover along the routeway as it was during later prehistory and medieval times. Along the routeway it was also noticed that some improved soils were already beginning to redevelop ironpan features because of gleying. This drainage impedance partly reflects the geology and the effect of late Pleistocene periglacial activity forming fragipans in subsoils. All these pedological factors are relevant to the analysis of the soils, both as bulk samples and as thin sections. These are discussed according to date.

Neolithic pit and post holes in hengiform monument (Area E)

Primary fill 1122 of Neolithic Post hole 1123 (M1054B) shows a very heterogeneous soil mixture to be present, which apparently represents infilling of leached Ea and disturbed Bw soils, occupation (fine charcoal-rich) humic topsoils, and much polymorphic and sesquioxide stained podzolic soil (Bs, Bh and Bhs horizon soil)(Figs 5-6). The presence of rubefied grains shows a history of iron-sesquioxide staining of soil (and the effects of burning) prior to this post hole feature. The variety of included soil materials infers not only disturbance of local soils, but their acidification and 'early' podzolisation.

The natural early-mid-Holocene soil cover of Cornwall included brown soils and podzolic brown soils prior to human impact (Maltby and Caseldine, 1982; Smith *et al*., 1996). At Neolithic Carn Brea, Cornwall acid brown soils were converted to weakly formed humo-ferric podzols during the life of the site, the newly-developed podzol being sealed below a late rampart (Macphail, 1990; Mercer, 1981). At Carn Brea this soil change was believed to have arisen because of management of the vegetated landscape by fire. Equally, in Brittany (on granite) a number of Neolithic (some megalithic) sites show soil micromorphological, pollen and charcoal evidence of the site undergoing rapid acidification during Neolithic occupation through management of the landscape by fire (Gebhardt, 1993)(see also review in Macphail, 1990 and seminal works by Dimbleby [1962] and Duchaufour [1982, eg 296]). It therefore can be inferred that the hengiform monument was located in an area that was already being managed by fire and was developing an acidifying (pH 4.5-4.6) soil cover; at Carn Brea (on granite) a timescale of decades to a hundred years for podzolisation to develop was suggested.

Horizontal fissuring and associated fine silty clay inwash noted in this primary fill (M1054B) may record emplacement of the post, recording compaction(s) of primary fill during its emplacement (Figs 3 and 5).

The overlying post pipe fill is, in contrast, a homogeneous humic and weakly/developing podzolic fill, which is rich in charcoal (wood charcoal and Poaceae?) and burned sand and stones (see Table 1: LOI, χ and χ_{conv})(Fig 6). Thus the post pipe fill contains probable contemporary evidence of major local burning – not just charcoal but high amounts of burned sand and stones – consistent with an enhanced magnetic susceptibility. This activity is presumably contemporary with the recent use of this site (see below for pit 1064) and the hengiform monument itself, given the possibility of the post rotting during the lifetime of the monument (Reynolds, 1995).

Neolithic Pit fill 1064 within hengiform monument

In thin section 1053B the burrowed junction between poorly sorted pit fill, shows mixing between acidifying Bw(Bws) soil and upper more humic (and acidic) and very charcoal-rich fill (see Table 1: compare LOI of samples 1074 and 1075)(Fig 7). The Bw soil shows that it was once earthworm-worked and includes spore cases of vesicular arbuscular mycorrihizae. The fill is characterised by very abundant fine to coarse (5 mm) charcoal (lignified shrubby roots and twig wood?), which according to charcoal analysis (see D. Challinor - charcoal) may be significant. The fill has also been affected by the post-depositional effects of podzolisation (polymorphic B-fabric) and sesquioxidic impregnation and minor iron staining (see χ_{max})(Avery, 1990).

These fills show a lower infilling of local acidifying brown soils (natural to area), and charcoal-rich soil containing charred lignified roots/shrub wood(?) that is possibly indicative of post-clearance secondary clearance environment (see above; D. Druce and L. Verrill - pollen).

Upwards (M1053A), 1075 is a humic fill probably resulting originally from *in situ* humic soil formation and silting, prior to some secondary/post depositional podzolic Bh/Bhs/Bs horizon formation effects). It contains high amounts of fine organic matter and charred organic matter (finer than below; cf. 750 µm v 2250 µm) that includes both lignified and woody charcoal and charred monocotyledonous (Poaceae?) material (Druce and Verrill found pollen evidence of disturbed grassland/pasture)(Fig 8). This humic character is reflected in the bulk analysis (see Table 1, sample 1075 LOI). Traces of rubefied mineral matter also occur.

This upper more organic and charcoal-rich soil fill could reflect local burning of Poaceae and secondary woodland, a hypothesis requiring confirmation from charcoal analysis (see Challinor), but already consistent with the pollen assessment (Allen and Brown, 2006 and findings by Druce and Verrill). As noted above, clearance and management of the landscape by fire has the probable effect of acidifying soils; the influence of podzolic Bh horizon formation within pitfill supports this view. The theory that the hengiform monument was contemporary with, or located within an occupation area is also totally consistent with the magnetic susceptibility data (Table 1, sample 1120).

As the primary fill of post hole 1123 includes soil fragments implying that podzolisation of the local soil had already commenced, whereas the lower fill of pit 1064 contains only brown soil material, it can be tentatively suggested that pit 1064 is an earlier feature. The fill of pit 1064 could be contemporary with localised(?) early clearances and occupation, and the presence of secondary shrubby woodland and grass vegetation that was managed by fire. A consequence this human impact appears to have been the acidification (and possibly incipient podzolisation) of the local soil (as at Carn Brea) and on Bodmin Moor (see Geary *et al*., 2000a, b), cited by Druce and Verrill). It can therefore be suggested from the soil evidence that the hengiform monument was thus likely constructed in a site that already had a history of occupation and management, although this hypothesis obviously needs to be tested against new data from current pollen, charcoal and radiocarbon dating studies.

Bronze Age Pit 4428 (Area C)

Monolith sample 4131 was badly fragmented and dried out, so 30 cm of it were conserved in resin, of which two 75 mm thin sections were selected. Context 4433 (moderately intact lowermost fill; M4129B) is a coarse and fine charcoal-dominated fill, with both coarse wood and probably some monocotyledonous material (also phytoliths) present. It contains much rubefied material, possible fused soil (rubefied) and a large vesicular 'slag' or crucible fragment (J. Merkel, Institute of Archaeology, UCL, pers. comm. February 2008), that is formed of clay with a large quartz sand content, some of which appears to be heat fractured (Figs 9-11). These are all consistent with an enhanced magnetic susceptibility (Table 1, sample 4433). There are also sand-size aggregates of probable cassiterite (see 4432); individual grains are sub-rounded indicating that these are originally from placer (alluvial) deposits (Hatch and Rastall, 1965, 138; Merkel, 1997; Merkel, pers. comm.). This context also contains pieces of enigmatic iron-cemented charcoal-rich soil. This fill of burned material is sealed by a layer of subsoil Bw soil (noted on the section drawing as a 'redeposition of natural').

The high amounts of coarse wood charcoal, burned mineral material, example of slag, fused soil and overall enhanced magnetic susceptibility, together indicate possible metalurgical activity. It is also possible that the iron-cemented charcoal-rich soil also indicates the presence of an anthropogenic occupation surface that was influenced by processing that employed water. The inclusion of some Poaceae material may indicate other non-industrial activities.

Upwards, fill 4432 (M4129A) contains much coarse wood charcoal, rare burned mineral, and homogenised very abundant fine amorphous and charred organic matter and phytoliths, with mixed subsoil Ea, Bw and Bhs soil (from above). Additional aggregates of cassiterite/tin ore [SnO_2] were noted. The cassiterite has the petrological characteristics of high relief, high birefringence and extinction parallel to cleavage; Kerr, 1959, 197-198) and subrounded character of placer deposits (Figs 12-18). The presence of cassiterite is consistent with tin enrichment and strong enrichment measured in bulk samples 4431 and 4432, respectively (Table 1). In addition, microprobe mapping and quantitative analyses found average amounts of 6.6% and 2.4% Sn in the upper and lower areas (Fig 12) and individual very high concentrations of tin (70.0 to 74.6 wt% Sn, equivalent to about 94 to 98 wt% SnO2) as discrete particles of very pure material (Fig 13; Table 3)(T. Rehren, Insititute of Archaeology, UCL, pers. comm.). This may suggest that these individual point quatitifications are associated with mapped Sn concentrations and aggregates of cassiterite identified at the same locations in the thin section (Figs 14-18). Trace amounts of possibly glassy (tin?) slag (Salter, 1997) were also noted. Overall, this layer shows evidence of tin ore processing including possible tin smelting, but the last suggestion would require further studies (Salter, 1997). Microprobe analysis found copper, but only in very small (mean 0.01-0.02% Cu), essentially only trace amounts (also present in rock fragments), and thus bronze smelting cannot be recognised here.

Thin section M4129B records what appears to represent a period of biological homogenisation of subsoil material that was produced by pit-silting, and burned mineral and tin-rich metallurgical waste, and very abundant fine charcoal (and phytoliths). This could suggest the dumping of burned Poaceae/cereal processing waste; there is no micromorphological, microprobe or phosphate-P indications of burned dung inputs.
Biological working of the original pit fill and post-sampling fragmentation makes it a little difficult to understand the exact history of the pit, but it can be suggested that the pit fill possibly records a change in use of site/pit, from a tin ore processing and possible tin smelting metallurgical site to a plant/crop processing area. A full appreciation of tin processing at this site, however, would require further analyses of this context and other Bronze Age pit fills at the site. Nevertheless, the discovery of this tin processing site and use of cassiterite is of great interest because very little is known about pre-16th century AD tin smelting; Cornwall was a major source of tin from the Middle Bronze Age onwards (see Dr Gerry McDonnell's Ancient Tin website http://www.brad.ac.uk/acad/archsci/field_proj/crift/crift.html (Penhallurick, 1986; Tylecote *et al.*, 1989). This also appears to be an important record of tin ore processing in an otherwise supposed domestic site (Merkel, pers. comm.).

Iron Age
Bronze Age (Iron Age?) roundhouse/enclosure features (Area B)
Context 4375 (Fill of ditch 4059) is a highly compact fine stony and micaceous silty clay with very finely mixed/burrowed humic silty clay, with rare inclusions of burned rock (M4137B). There are also possible intercalations and post-depositional gleying (pale colours and example of bleached stone rim) and trace amount of downwash of amorphous organic matter (organans).

This layer appears to have been a wet and waterlogged trampled(?) fill containing finely burrowed organic matter (organic matter enriched; see Table 1, sample 4375 LOI). It does not have the typical microfabric of a buried mature Ah horizon soil, and so there is the possibility that it has been enriched with dung, although in this gleyed fill there is no clear chemical enrichment of phosphate-P. The fact that gleying can remove and translocate phosphate has to be kept in mind, however (Thirly *et al*., 2006).

The overlying soil (4381; upper M4137B and M4137A) that is associated with this round house/enclosure is a coarsely stony mixture of fine silty Bhs soil, humic fine sandy Ah and other soil, which includes rare charcoal and burned mineral material burrowed into 4375 below. There is also evidence of post-depositional burrowing of Bhs soil from above, and earlier inwash of clay, fine silty clay and fine silts, which occurs alongside with iron staining.
The humic fine sandy soil that is associated with the roundhouse/enclosure-associated soil is turf-like and contains fine charcoal, burned mineral and burned soil inclusions consistent with an enhanced magnetic susceptibility (Table 1, sample 4381). This soil that seals fill 4375 is turf material associated with occupation. It does not have the grain-size, microfabric or phosphate-P character of a soil that formed 'naturally' over 4375, for example it is much stonier and less humic. It seems more likely that it is turf from the collapse of a wall or bank from this circular structure. In addition, this 'turf' apparently records a local (previous?) history of grassland management by fire; perhaps a continuing trend began in the Neolithic (see above). As no obvious micro-inclusions of domestic waste were noted in 4375 or 4381, and only burned topsoil and rock fragments were found, the structure may not have had a primarily domestic function, but rather any burned features stem from occupation associated with animal stocking management (see round house features in Area A - below).

Medieval

Medieval round house ditch 3237, recut 3237 and ditch 3263 (Area A)

The boundary between 3471 and 3472 (Primary fill of ditch 3237 ~control bulk sample) sampled by M3068 shows moderate biomixing, into the compact humic ditch silts of 3472, of more humic soil and some dung residues from 3471 above. There is also burrow mixing of very poorly humic subsoil material of the primary fill (3237) below. A trace amount of amorphous yellow, probable Fe-P infills occur in M3068.
M3068 sampled a lower ditch fill that records moderately humic soil silting (from round house turf walls?) which sealed the poorly humic primary ditch fill. There was also subsequent downward mixing of dung residues (see 3471 below) and inwash of very small amounts of phosphate – presumably from associated animal activity around this ditch- and turf wall-constructed round house.

Fill 3471 is a poorly sorted stony and humic fill, which includes occasional coarse compact subsoil, some iron-stained, some with ferri-argillans and some with associated dung residues ('clay floor' fragments), occasional partially ferruginised dung residues, and rare charcoal in humic (turf-like) soil (Figs 19-22).

This outer ditch fill appears to be showing the disposal of humified dung residues and seemingly associated 'clay floor' (stable floor?) material into the ditch; this is consistent with slightly enriched phosphate-P (Table 1, sample 4371). These fragments could result from the cleaning of a byre, or simply result from trampling and animal passage. The supposed 'clay floor' fragments could obviously occur through deliberate floor construction (cf Trethallan Farm, Cornwall, Macphail, 1991) or be partially accidental through stock trampling local soils into the structure (cf Butser Ancient Farm and Roman and Medieval London; Macphail et al., 2004, 2007). There are also Gallo-Roman, Norse and Danish analogues (Guélat *et al*., 1998; Milek, 2005; Nørnberg and Courty, 1985). This dumping seems to have accompanied humic topsoil silting and/or collapse of turf wall material, which became mixed with rare traces of burned soil and charcoal.

The fills (M3079) of recut ditch 3237, namely 3449 and 3450 are composed of similar humic soil, with both humic dung residues and strongly ferruginised amorphous features and coatings (see Figs 23-24; the latter are probable ferruginised herbivore faecal inputs (as identified elsewhere employing microprobe, pollen and macrofossils; Macphail *et al*., 1998; Murphy and Fryer, 1999; Wiltshire, 1999). Upwards, fills 3458 and 3442 (M3062A and M3062B) are again composed of humic, sometimes fine charcoal and dung-enriched(?) ditch silts. An example of an 8 mm-long microlayered 'floor' fragment includes weakly iron-stained Bs soil and 'dung' layers (see Figs 21-22). Coarsely mixed stony podzolic subsoil Bs-Bhs soil and peat (H), also occur.

The fills of this recut ditch thus closely resemble the fills of the outer ditch, and probably resulted from similar ditch silting from turf walls(?), along with topsoil (and byre floor; Figs 25-26) trample and mixing-in of dung residues; some faecal inputs from stock became ferruginised. Animal activity probably accelerated the infilling of these ditches. As noted above, hydromorphic effects that included the ferruginisation of soil and supposed faecal material – as linked to the measurement of a high χ_{max} (3442) – probably led to the loss of phosphate. These findings suggest that the prime function of this structure continued to be associated with stock management.

There is a homogenised soil junction between 3225 ('colluvium') and 3441 (soil sealing round house) as shown in M3077. The soil is composed of humic fine silt-coarse silt-very fine sand, with included small stones, much 'coarse' charcoal and fine and coarse burned mineral grains and rock fragments, consistent with a strongly enhanced magnetic susceptibility. There are also areas of compact fabric and poorly formed intercalations indicative of unstable soil conditions in the past.
Essentially thin section M3077 records the sealing and burial of the medieval round house by humic colluvium; a common medieval phenomenon (Kwaad and Mücher, 1979; Van Vliet-Lanoë *et al*., 1992). It can be suggested that this occurred through the erosion of humic topsoil in a landscape markedly managed by burning (see $\%\chi_{conv}$ Table 1, samples 3225 and 3441). These are also slightly enriched to enriched in phosphate-P probably due to manuring/development of pasture, although the effects of recent land improvement and resulting colluviation, must also be considered.

Medieval boundary/droveway soil (Area C)
Context 4464 (M4131) is a once-dense and layered silt-very fine sand humic deposit, with textural pedofeature evidence of being trampled and compacted when wet. It includes trace amounts of dung, along with both wood and monocotyledonous charcoal/charred material, some of which is iron stained. It also includes many coarse fragments of humic Ah and H horizon soil and their burned variants occur alongside burned subsoil clasts.
These humic layered deposits, which contain traces of dung are weakly phosphate-enriched. This, together with the textural pedofeatures, suggest passage by stock (Gebhardt and Langohr, 1999; Macphail, 2003). The presence of charcoal and burned mineral material (note enhanced magnetic susceptibility) may indicate tracking-in of occupation material; the possibility that it is also spillage of occupation material being used for manuring can also be considered a possibility. In fact, the deposit has similarities to the soil (and colluvium) sealing the roundhouse in Area A, perhaps indicating attempts to improve the soils of this locality, as perhaps suggested by notably higher pH values in some of these medieval soils.

Undated Pit 4388 in circle ('Prospecting Pit context 4330 is medieval)(Area D)
Thin section M 4142 (Fig 4) sampled across the side of the pit and included: (1) the geological natural, (2) the thin (10-15 mm wide) dark pit-edge fill and (3) the pit fill itself (Figs 27-28); bulk samples from two examples of the dark pit-edge fill were taken from two monoliths from Pit 4310 (4392a and 4392b). The different soil materials are described thus:

1: the natural substrate (C horizon) is a very stony silty clay with textural pedofeature evidence of periglacial emplacement, and can be interpreted as a natural *in situ* head deposit.

2: the dark pit-edge fill is composed of leached silt and fine sands with fine amorphous organic matter, charred fine organic matter and some rubefied grains, consistent with measurements of LOI and magnetic susceptibility from pit 4310 (samples 4392a and 4392b). It is a totally burrowed fine soil, and contains an example of a birefringent spore case of vesicular arbuscular mycorrihizae (Fig 27). These dark pit-edge fills appear to be formed from weakly humic and leached (see χ_{max}) topsoil that contains fine charcoal and burned grains. It is probable that this soil washed into a pit-edge void that formed as the soil infilling the pit (see 3 below), shrank. This soil became becoming biologically worked *in situ*. This weakly humic soil probably reflects local land use, and presence of a birefringent spore case of vesicular arbuscular mycorrihizae is a faint argument suggesting that the fill is not modern; Romans and Robertson (1983) suggested that such spore cases became increasingly birefringent with age (~900 years).

3: The pit has a homogeneous stony fill with very weakly humic and strongly biologically-worked fine fabric, which suggests a likely back-fill of subsoil that has developed a Bw microfabric (cf SMT 3b) through time (Fig 28). This homogeneous Bw microfabric also argues for the pit not to be modern.

In short, these two examples (pits 4310 and 4388) could be medieval ‘prospection’ pits, which were backfilled with subsoil. Shrinkage of the fill and the natural tendency of soil water to move into depressions and cause leaching (Veneman *et al*., 1984) produced the dark pit-edge fills.

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Table 1: Analytical data

Context	Description	LOI[a] (%)	pH[b]	Phosphate-P[c] (mg g^{-1})	Resid phos-P[d] (%)	χ[e] (10^{-8} SI)	χ_{max}[f] (10^{-8} SI)	χ_{conv}[e] (%)	Sn[g] (µg g^{-1})
A: Iron Age roundhouse ditches									
3225	Subsoil (colluvium?)	**7.89***	5.6	**0.800****	**124.9****	**282****	2000	**14.1****	-
3441	Soil sealing roundhouse	5.75	**5.8***	**0.596***	**51.1***	**348****	**2530***	**13.8****	115
3442	Upper fill of ditch 3263	5.22	5.6	0.408	2.7	74.4	**2570***	2.89	93.6
3458	Lower fill of ditch 3263	5.11	**5.8***	0.360	21.3	21.2	1190	1.78	53.3
3449	Fill of recut ditch 3237	4.37	**5.9***	0.342	-7.3	46.7	2180	2.14	-
3450	Fill of recut ditch 3237	4.60	**5.9***	0.345	3.8	12.3	1680	0.732	55.3
3471	Fill of ditch 3237	4.64	**5.8***	**0.463***	**49.1***	9.9	1380	0.717	104
3472	Primary fill of ditch 3237 (control)	3.55	**5.9***	0.258	-22.7	6.4	1700	0.376	83.7
B: Bronze Age circular feature									
4381	Soil assoc with roundhouse/enclosure	4.61	5.7	0.251	3.5	**29.0***	**445°**	**6.52***	81.4
4375	Fill of ditch 4059	**8.97***	5.6	0.470	-14.1	56.6	**4620****	1.23	134
4070	Natural	5.61	5.4	0.368	-9.2	75.6	**2680***	2.82	72.0
C: Medieval boundary/droveway									
4464	Medieval soil	5.86	**5.6***	**0.420***	**34.3***	**123***	1410	**8.72***	-
C: Bronze Age pit 4428									
4431	Fill	3.76	**5.9***	0.248	-35.1	33.3	2360	1.41	**1080***
4432	Fill	6.43	**5.8***	0.228	-41.3	49.1	2450	2.00	**7070****
4433	Lowermost fill	**7.97***	**5.9***	0.080	-74.5	**79.7***	1420	**5.61***	**1470***
C: Undated rectangular pit 4310									
4329a	Fill (44-52 cm; mon. 4160)	6.95	-	0.163	-26.2	2.5	**149°**	1.68	-
4329b	Fill (39-47 cm; mon. 4159)	4.44	5.2	0.126	-48.4	2.7	**470°**	0.57	122
E: Neolithic pit 1064 in hengiform monument									
1075	Fill (11-19 cm)	**10.6****	-	0.471	24.2	31.0	2320	1.34	-
1074	Fill (19-27 cm)	3.79	-	0.215	-41.0	5.2	2120	0.245	-
E: Neolithic posthole 1123 in hengiform monument									
1120	Post pipe fill	**7.76***	4.6	0.342	-2.5	**102***	1930	**5.28***	-
1122	Primary fill	7.44	4.5	0.297	-2.6	40.0	1300	3.08	-

[a] **LOI:** Figures highlighted in bold reflect notably higher concentrations of organic matter: * = slightly enriched (5.00-9.99%), ** = enriched (10.0-14.9%).

[b] **pH:** Figures highlighted in bold and asterisked have notably higher pH values (≥ 5.8); - = not determined.

[c] **Phosphate-P:** Figures highlighted in bold show likely signs of phosphate-P enrichment, based on residuals from regression between phosphate-P and χ_{max}[d].

[d] **Residual phosphate-P:** Residuals from regression between phosphate-P and χ_{max}, expressed as percentage of concentration predicted from linear regression equation. Values highlighted indicate likely phosphate enrichment: * = slightly enriched (25.0-99.9%), ** = enriched (100-199%).

[e] **χ:** Figures highlighted in bold show signs of magnetic susceptibility enhancement (i.e. ($\chi_{conv} \geq 5.00\%$) : * = enhanced (χ_{conv} = 5.00-9.99%), ** = strongly enhanced (χ_{conv} = 10.0-19.9%).

[f] **χ_{max}:** Figures highlighted in bold are notably low or high: ° = low (< 500 x 10^{-8} SI), * = high (2500-4490 x 10^{-8} SI). ** = very high (≥ 4500 x 10^{-8} SI)

[g] **Sn:** Figures highlighted in bold show clear signs of Sn enrichment: * = enriched (1000-4990 µg g^{-1}), ** = strongly enriched (5000-9990 µg g^{-1}); - = not determined.

Table 2: Bodmin A30: soil samples and micromorphology

Area	**Monolith**	**Thin section Sample**	**Depth (cm)**	**Thin Sections**	**Context**	**MFT**	**SMT**	**Voids**	**Stones**	**Burned Mineral**	**Crucible?**
Medieval(?) roundhouse ditches											
A	**3077**	M3077	26-34 cm	M3077	3225	D1	8a	30%	ff	aa	
A	**3077**	M3077	26-34 cm	M3077	3441	D1	8a	30%	ff	aa	
A	**3062**	M3062AB	20-28 cm	M3062A	3442	E6	7a, 7c(7d); 2a-c(7b)	40%	(ff)	a	
A	**3062**	M3062AB	28-36 cm	M3062B	3458	E5	7d (7a, 2a-2c)	20% (40%)	ff	a*	
A	**3079**	M3079	12-15.5 cm	M3079	3449	E4	7a, 7c	35-40%	f	a*	
A	**3079**	M3079	15.5-19.5 cm	M3079	3450	E3	7a, 7c	35-40%	ff	a*	
A	**3068**	M3068	10-13.5 cm	M3068	3471	E2	7c, 7a (7b)	35%	ff	a*	
A	**3068**	M3068	13.5-17.5 cm	M3068	3472	E1	7a(7b, 7c)	10-20%	*	a*	
Iron Age(?) Age circular feature fills											
B	**4137**	M4137A	19-27 cm	M4137A	4381	C3	4a(2a, 2b)	30%	ff	aa	
B	**4137**	M4137B	33-41 cm	M4137B	4381	C2	4a, 3b, 2a-2c	35%	fffff	a	
B	**4137**	M4137B	33-41 cm	M4137B	4375	C1	5a	10%	fff	a*	
B	**4137**				4070						
Medieval boudary/droveway soil 4464											
C	**4131**	M4131	28-36 cm	M4131	4464	D2	8a	15% (30%)	f	aa	
Bronze Age Pit 4428											
C	**4129**	M4129A	17-25 cm	M4129A	4431	D2	6b, 6c, 3b (2c)	35%?	fff	a	
C	**4129**	M4129A	17-25 cm	M4129A	4432	D2	6b, 6c/3b	35%?	fff	a	
C	**4129**	M4129B	32-40 cm	M4129B	4433	D1	6a, 6b, 6c/3b	40%	fff	aaa	a-1
Undated Pit (in circle)											
Pit 4388											
D	**4142**	M4142	24-32 cm	M4142	4329	F1	9a	5%	fffff		
						F2	9b	30%	*	aa	
						F3	9c	20%	fffff	a-1	

Neolithic Pit in hengiform monument										
Pit 1064										
E	**1053**	M1053A	11-19 cm	M1053A	1075	A2	2b and 2c	30-40%	ff	a*
E	**1053**	M1053B	19-27 cm	M1053B	1074	A1	1a and 2a	25-40%	ff	a*
Neolithic Postholes in hengiform monument										
Post hole 1123										
E	**1054**	M1054A	10-18 cm	M1054A	1120	B2	2b(2c)	25%	f	aaa
E	**1054**	M1054B	18-26 cm	M1054B	1122	B1	2a-c, 3a-c	30%	f	aa

Table 2 cont:

Thin Sections	**Context**	**Cassiterite tin ore**	**Charcoal**	**Lignified Charcoal**	**Monoct. Charcoal**	**Fungal Spore Cases**	**Dung residues**	**Clay' floor fragments**	**Textural Pedofeatures**	**Bs Sesquioxide Staining**	**Bhs Sesqui. Staining**
M3077	3225		aa						a		
M3077	3441		aa						a		
M3062A	3442		a				aa	a-1	a	(aaa)	(aaa)
M3062B	3458		aa(a*)			a	a		aa	(aaa)	(aaa)
M3079	3449		a*				aaa				
M3079	3450		a*				aaa				
M3068	3471		a				aaa	aa	(a)	a?	a*?
M3068	3472		a*				a		a*		a*?
M4137A	4381		aa			a			a	(aa)	(aa)
M4137B	4381		a						aaaa	aaaaa	aa
M4137B	4375								a*		
	4070										
M4131	4464		aa		a		a*		aa		
M4129A	4431	a*	aa		aa?						
M4129A	4432	a	aaa		aaa?						
M4129B	4433	a	aaaaa		aa?						

M4142	4329		aa			a-1			aaaaa		
M1053A	1075		aaaaa	a	aaa					aaa	aaaaa
M1053B	1074		aaaaa	aa		a*				aa-aaaaa	
M1054A	1120		aaaaa		a*	a*			a	aaaaa	aaaaa
M1054B	1122		aaaaa	aa	a				aa	aaa	aaaaa

Table 2 cont.

Thin Sections	**Context**	**Organans**	**Vivianite**	**Fe-P?**	**Iron Staining**	**Very thin Burrows**	**Broad Burrows**	**Very Thin Excrements**	**Broad Excrements**	**Welded Excrements**
M3077	3225					aa	aa	aa	aa	
M3077	3441					aa	aa	aa	aa	
M3062A	3442				a	aaa	aaaa	aaa	aaa	
M3062B	3458				a	(aaa)	(aaaa)	(aaa)	(aaa)	
M3079	3449				aaa	aa	aaaaa	aaa	aaaaa	
M3079	3450				aaaa	aa	aaaaa	aaa	aaaaa	
M3068	3471				aa	aa	aaaaa	aa	aaaaa	
M3068	3472	a*		a*	a*		aa			
M4137A	4381	a*			(aa)	(aa)	aaaaa(aaaaa)	(aa)	(aaaa)	(aaaaa)
M4137B	4381				aaaa		aaaaa	aa		
M4137B	4375	a*				aaaaa				
	4070									

M4131	4464				aaa			
M4129A	4431		aa		aaaaa			
M4129A	4432		aa		aaaaa			
M4129B	4433		aaa	aa	aaaaa	aaa		
			aa					
M4142	4329				aaaaa	aaa	aaaa	
			aa	aaaa		aaa		
M1053A	1075	a-1		aaaaa	aaaaa	aaaaa	aaaaa	
M1053B	1074		a	aa-aaaaa	aaaa	aa-aaaaa	aaaaa-aa	aaaaa-aa
M1054A	1120		aa	aaaaa	aaaaa	aaaaa	aaaaa	aaaa
M1054B	1122		aaa	aaaaa	aaaaa	aaaaa	aaaaa	

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

Table 3: A30 Bodmin, Pit : Microprobe quantitative analysis of selected elements including tin (Sn) as %weight. Selected Upper and Lower Areas in thin section sample M (context

Upper Area	**Si**	**Fe**	**S**	**Cu**	**Mn**	**Ca**	**K**	**Na**	**Mg**	**Al**	**Ti**	**P**	**Sn**
Mean	12.1	2.8	0.02	0.01	0.02	0.28	0.80	0.06	0.18	5.49	0.31	0.04	6.56
Standard Deviation	11.6	2.5	0.02	0.01	0.04	0.41	1.04	0.14	0.23	4.64	1.06	0.03	16.51
Range	40.9	10.3	0.09	0.05	0.20	1.97	5.29	0.95	1.41	20.0	7.72	0.11	74.63
Minimum	0.000	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00
Maximum	40.9	10.4	0.09	0.05	0.20	1.97	5.29	0.95	1.41	20.1	7.72	0.11	74.63
Count	54	54	54	54	54	54	54	54	54	54	54	54	54

Lower Area	**Si**	**Fe**	**S**	**Cu**	**Mn**	**Ca**	**K**	**Na**	**Mg**	**Al**	**Ti**	**P**	**Sn**
Mean	15.9	2.5	0.03	0.02	0.07	0.38	1.01	0.04	0.19	4.03	0.19	0.02	2.34
Standard Deviation	14.5	2.75	0.12	0.03	0.15	0.79	1.57	0.06	0.29	3.84	0.58	0.02	10.50
Range	40.5	12.18	0.74	0.10	0.95	3.39	7.93	0.29	1.44	12.64	3.98	0.10	69.97
Minimum	0.25	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Maximum	40.7	12.2	0.74	0.10	0.95	3.39	7.93	0.29	1.44	12.67	3.98	0.10	69.97
Count	47	47	47	47	47	47	47	47	47	47	47	47	47

Nb: Upper Area Sn max=74.6% (=98% of count); Lower Area Sn max=70.0% (=94% of count)

Table 4: A30 Bodmin: Soil Micromorphology (Descriptions and preliminary interpretations)

Microfacies type (MFT)/Soil microfabric type (SMT)	Sample No.	Depth (relative depth) Soil Micromorphology (SM)	Preliminary Interpretation and Comments
			Area A
MFT F1/SMT 8a	**M3077**	26-34 cm Homogeneous; *Microstructure*: massive with subangular blocky, 30% voids, fine channels and vughs and medium (1-3 mm) chambers and poorly accommodated planar voids; *Coarse Mineral*: C:F, 50:50, fine silt, fine sand, with frequent stone-size (max. 16 mm) rock fragments; *Coarse Organic and Anthropogenic*: example of 1 mm size root; occasional 200 µm – 1 mm size charcoal; occasional rubefied very fine mineral grains and rock fragments; *Fine Fabric*: SMT 8a: finely speckled and occasionally dotted darkish brown (PPL), very low interference colours/anisotropic (open porphyric, crystallitic (mica) b-fabric, XPL), dark orange brown with occasional fine black specks and occasional red specks (OIL); very abundant amorphous with many charred fine OM; *Pedofeatures*: *Textural*: occasional poorly formed intercalations and associated dense fabric and closed vughs; *Fabric*: abundant broad (1-2 mm) and occasional very broad (4 mm) burrows; *Excrements*: occasional very thin and broad organo-mineral excrements. BD (3225): 7.89% LOI, 0.800 mg g^{-1} phosphate-P, 282 x 10^{-8} SI χ, 2000 x 10^{-8} SI χ_{max}, 14.1% χ_{conv} BD (3441): 5.75% LOI, 0.596 mg g^{-1} phosphate-P, 348 x 10^{-8} SI χ, 2530 x 10^{-8} SI χ_{max}, 13.8% χ_{conv}	Medieval round house 3225 (colluvium?) and 3441 (soil sealing round house) Homogeneous soil junction between 3225 and 3441; soil composed of humic fine silt-coarse silt-very fine sand, with included small stones, much 'coarse' charcoal and fine and coarse burned mineral grains and rock fragments; areas of compact fabric and poorly formed intercalations. *Essentially humic colluvium sealing the round house and forming a colluvial soil, associated with topsoil erosion of a landscape markedly managed by burning (hence also strongly enhanced magnetic susceptibility - %χ_{conv}); slightly enriched to enriched phosphate-P probably due to manuring.*
MFT E6/7a, 7c(7d); 2a-c(7b)	**M3062A**	20-28 cm SM: Very heterogeneous (dominant SMT 7a and 7c, with 7d – ditchfill microfabrics, and common SMT 2a-2c, 7b (Bs-Bhs soil, subsoil Bw) – that is also mixed with peaty fragments; *Microstructure*: poorly formed medium prisms, 40% voids, poorly accommodated planar voids; *Coarse Mineral*: as below, 'ditchfill' is well sorted coarse silt-very fine sand; coarsely mixed Bs-Bhs soil fragments include frequent rock fragments (max 11 mm), example of embedded grain (relict of periglacial soil formation); *Coarse Organic and Anthropogenic*: examples of rubefied rock fragments; rare fine charcoal; rare fine dung fragments and few dung-enriched(?) SMT 7c; example of 8 mm long micro-layered Bs and organic (dung?) 'floor'/'trample' fragment, with examples of rubefied grains; *Pedofeatures*: *Textural*: rare dusty to impure clay intercalations and infills; *Amorphous*: sesquioxide impregnation in Bs-Bhs soil fragments; weak iron impregnation and partial organic matter replacement in 'floor'/'trample' fragment; *Fabric*: very abundant coarse mixing of unknown origin; as upper M3062B; *Excrements*: as upper M3062B. BD (3442): 5.22% LOI, 0.408 mg g^{-1} phosphate-P, 74.4 x 10^{-8} SI χ, 2570 x 10^{-8} SI χ_{max}, 2.89% χ_{conv}	Iron Age round house ditch 3442: Upper fill of ditch 3263 Humic, sometimes fine charcoal and dung-enriched(?) ditch silts and coarsely mixed stony subsoil Bs-Bhs soil and included peat (H), and example of 8mm long microlayered 'floor' fragment – weakly iron-stained Bs soil and dung layers. *Humic ditchfill silts resulting from animal stocking and associated occupation (fine charcoal and traces of fine burned material); use of subsoil Bhs and Bs horizon soil for construction; occurrence of 'floor'/'trample' fragment with Bs soil and dung layers.*
MFT E5/SMT 7a and 2a-2c; SMT 7d at base	**M3062B**	28-36 cm SM: Extremely heterogeneous (common SMT 7a, with common 2a-2c, and frequent 7d especially in lower part of thin section; *Microstructure*: poorly formed medium prisms, 20% voids (fine channels and vughs) becoming 40% upwards (chambers and poorly accommodated planar voids); *Coarse Mineral*: moderately poorly sorted with frequent rock fragments (max 14 mm), C:F,	Medieval round house ditch 3458: lower fill of ditch 3263 Lower part of thin section displays a compact organic silt-very fine sand sediment, rich in fine charcoal (with fine rubefied mineral grains) and containing rare fine dung fragments, becoming like the fill of 3237; upper part is coarsely burrowed

		SMT 7d: 60:40; *Coarse Organic and Anthropogenic*: many fine (max 500 µm) charcoal (in SMT 7d), also rare spore cases of vesicular arbuscular mycorrihizae; upwards example of 8 mm long rubefied ferruginised SMT 2a; rare dung fragments; *Fine Fabric*: SMT 7d: dotted and speckled blackish brown (PPL), very low interference colours/anisotropic (open porphyric, crystallitic (mica) b-fabric, XPL), blackish brown with many fine black specks and occasional red specks (OIL); very abundant mainly charred fine OM; *Pedofeatures*: *Textural*: occasional very dusty intercalations, void infills and even a 500 µm thick pan/void infill of silty clay (sesquioxidic?); *Amorphous*: rare iron impregnations; *Fabric*: very abundant broad (2 mm) to very broad (10 mm) burrows upwards; *Excrements*: many thin and broad excrements, upwards. BD (3458): 5.11% LOI, 0.360 mg g^{-1} phosphate-P, 21.2 x 10^{-8} SI χ, 1190 x 10^{-8} SI χ_{max}, 1.78% χ_{conv}	mixing in humic and sesquioxidic Bhs materials and peaty soil; example of coarse fragment of burned B(h)s horizon is present. *Fill originally dominated by fine charcoal-dominated humic 'silts', showing textural pedofeatures of being wet and probably trampled (by stock – rare dung fragments); reflects burning of organic matter (peat fuel?).* *Upwards mixing-in of podzolic Bhs horizon materials reflecting changing soil conditions on site and/or import of these soils to the site?*
MFT E4/SMT 7a and 7c MFT E3/SMT 7a and 7c	**M3079**	12-15.5 cm SM: Heterogeneous as M3068-3471; *Microstructure*: coarse subangular blocky, showing some horizontal fissuring at 20 mm intervals (compaction?); 35-40% voids, as M3068-3471; *Coarse Mineral*: as M3068, few stones (no obvious 'clay floor' clasts; *Coarse Organic and Anthropogenic*: many strongly ferruginised dung residues as 2m size masses and 300 µm thick coatings (faecal inwash?), some fills include charcoal; rare charcoal; *Pedofeatures*: *Amorphous*: occasional amorphous Fe impregnations/coatings and infills (dung/faecal residues); *Fabric* and *Excrements*: as M3068-3471. BD (3449): 4.37% LOI, 0.342 mg g^{-1} phosphate-P, 46.7 x 10^{-8} SI χ, 2180 x 10^{-8} SI χ_{max}, 2.14% χ_{conv} 15.5-19.5 mm SM: As above, with frequent stones (max 17 mm); and abundant amorphous Fe impregnations and void coatings. BD (3450): 4.60% LOI, 0.345 mg g^{-1} phosphate-P, 12.3 x 10^{-8} SI χ, 1680 x 10^{-8} SI χ_{max}, 0.732% χ_{conv}	Medieval round house ditch 3449: Fill of recut ditch 3237 Humic soil ditchfill, with humic dung residues and strongly ferruginised amorphous features and coatings (ferruginised herbivore faecal inputs). *Ditch silting from turf walls(?) and mixing with dung residues and ferruginised faecal inputs from stock; likely hydromorphic loss of phosphate down profile.* 3450: Fill of recut ditch 3237 *As above, indicate presence of stock, use of round house for stock.*
MFT E2/SMT 7c, 7a (7b)	**M3068**	10-13.5 cm Heterogeneous (common SMT 7c, with common 7a, and very few 7b and 3b; *Microstructure*: fine to medium subangular blocky; 35% voids, poorly accommodated curved planar voids; *Coarse Mineral*: C:F, as below, SMT 8a: 20:80, poorly sorted with frequent small stones and coarse inclusions (max 5 mm); *Coarse Organic and Anthropogenic*: occasional compact soil fragments, sometimes iron stained, sometimes with ferruginous iron clay infills (subsoil SMT 3a, 3b-like), some also associated with many fine to 2-4 mm size ferruginised dung (stabling waste?) fragments (see below); rare fine charcoal and burned mineral grains; example of blackened/burned turf soil, trace of rubefied mineral grains; *Fine Fabric*: SMT 7c: similar to 7a, but very low interference colours to anisotropic, abundant amorphous organic matter and occasional fine charred OM; *Pedofeatures*: *Textural*: occasional ferri-argillans in some compact soil fragments; *Amorphous*: many iron impregnation of reddish dung fragments, some compact soil fragments; *Fabric* and *Excrements*: occasional very thin burrows and organic and organo-mineral excrements, abundant broad burrows and excrements. BD: (3471): 4.64% LOI, 0.463 mg g^{-1} phosphate-P, 9.9 x 10^{-8} SI χ, 1380 x 10^{-8} SI χ_{max}, 0.717% χ_{conv}	Medieval round house ditch 3471: Fill of ditch 3237 Poorly sorted stoney and humic fill, which includes occasional coarse compact subsoil, some iron-stained, some with ferri-argillans and some with associated dung residues ('clay floor' fragments'; occasional partially ferruginised dung residues and rare charcoal, in humic (turf-like) soil. *Outer ditch fill showing disposal of humified dung residues and seemingly associated 'clay floor' (stable floor?) material, into ditch alongside humic topsoil (turf silting), along side rare traces of burned soil and charcoal. Byre cleaning? Presence of dung is consistent with slightly enriched phosphate-P; lack of magnetic susceptibility enhancement is consistent with non-domestic/non-industrial use of structure.*

MFT E1/SMT 7a (7b, 7c)		13.5-17.5 cm (3472 SM: Mainly homogeneous (very dominant SMT 7a, with very few 7b and 7c); *Microstructure*: massive, compact 10-20% voids, fine (0.5-1 mm) channels and fissures; *Coarse Mineral*: C:F SMT 7a: 40:60, SMT 7b: 70:30; moderately sorted very fine silt, coarse silt-very fine sand-size quartz and mica, with sand to (very few) small stone (max 10 mm) size rock fragments (quartzite, phyllites, granites); *Coarse Organic and Anthropogenic*: rare traces of fine charcoal; rare dark brown, dark reddish brown (PPL; reddish under OIL) amorphous organic fragments (max 500 µm) – probable dung; examples of peat H horizon) fragments (1 mm); rare traces of burned mineral grains; *Fine Fabric*: SMT 7a: finely speckled reddish/yellowish brown (PPL), very low interference colours (open porphyric, crystallitic (mica) b-fabric, XPL), brown (OIL); moderately humic with very fine amorphous organic matter; SMT 7b: finely speckled yellowish brown (PPL), low interference colours (open porphyric, crystallitic (mica) b-fabric, XPL), yellowish brown (OIL); thin humic staining; *Pedofeatures*: *Textural*: traces of dusty and humic intercalations; *Amorphous*: rare iron impregnation, especially reddish amorphous organic matter and possible thin (75 µm) organic coatings; rare trace of fine yellowish Fe-P? infills; *Fabric*: occasional broad (1-2 mm) burrows. BD (3472): 3.55% LOI, 0.258 mg g^{-1} phosphate-P, 6.4 x 10^{-8} SI χ, 1700 x 10^{-8} SI χ_{max}, 0.376% χ_{conv}	Boundary between 3471 and 3472 (Primary fill of ditch 3237 ~control bulk sample) Moderate biomixing of more humic and some dung residues from 3471 above into compact humic ditch silts; also burrow mixing-in of very poorly humic subsoil material of primary fill; trace amount of amorphous Fe-P infills. *Moderately humic soil silting (from turf walls?) over very poorly humic primary ditch fill; downward mixing of dung residues and inwash of very small amounts of phosphate. Ditch and turf wall constructed round house.*
			Area B
MFT C3/SMT 4a (2a, 2b)	**M4137A**	19-27 cm SM: Heterogeneous (dominant SMT 4a, with increasingly frequent SMT 2a-2c variants upwards; *Microstructure*: massive with poorly formed prisms; 30% voids, very fine to fine channels (0.5-2mm) and planar voids; *Coarse Mineral*: C:F (as SMT 2 and 4a); dominant very fine sand-size quartz, sand and frequent small (5 mm) stone-size rock fragments; *Coarse Organic and Anthropogenic*: mainly in SMT 4a: rare 300 µm size spore cases of vesicular arbuscular mycorrihizae; rare burned (rubefied) rock fragments; rare clasts of possible blackened/burned topsoil (SMT 4a); occasional charcoal (2-300 µm); example of 2 mm charcoal in SMT 2; *Pedofeatures*: *Textural*: rare very thin (50 µm) organans, dusty organic clay void coatings in SMT 4a, and associated void infills and closed fine vughs; *Amorphous*: rare Fe staining of SMT 2 fabric; *Fabric*: very abundant broad to very broad (2-7 mm) burrows; *Excrements*: very abundant welded/total biological fabric in SMT 4a, thin to broad excrements of SMT 2. BD (4381): 4.61% LOI, 0.251 mg g^{-1} phosphate-P, 29.0 x 10^{-8} SI χ, 445 x 10^{-8} SI χ_{max}, 6.52% χ_{conv}	Bronze (Iron Age?) Age circular features 4381: Soil associated with roundhouse/enclosure Moderately heterogeneous soil fill, because of burrowing of Bhs soil from above into humic fine sandy soil (roundhouse/enclosure-associated soil); humic soil is turf-like and contains fine charcoal, burned mineral and burned soil inclusions (see χ_{conv}); minor post-depositional organans/associated coatings, as well as some burrow mixing from above. *Soil associated with enclosure, sealing fill 4375, is turf material associated with occupation, but does not have the grain-size, microfabric or phosphate-P character of a soil that formed 'naturally' over 4375. More likely it is turf from a wall or bank from this circular structure which may have had a animal stocking use (little obvious domestic waste making up 4375). 'Turf' records local (previous?) history of grassland management by fire?*
MFT C2/SMT 4a, 3b, 2a-2c burrowed into MFT C1/SMT 5a	**M4137B**	33-41 cm SM: Very heterogeneous (common 5a, with frequent SMT2a-2c variants and SMT 3b and 4a); *Microstructure*: massive and channel; 10% with 35% in burrowed/channel part; very fine vughs or fine to medium (1-2 mm) channels; *Coarse Mineral*: C:F (as SMT 2 and 3); SMT 4a: 80:20, SMT 5a: 70:30; very poorly sorted (also coarse burrow mixing); SMT 5a (4375): common to dominant very coarse sand- and small (3-4 mm) stone-size rock fragments (sandstones, gritstones, ferruginised fine sandstone, amphibole-rich metamorphic rock, quartzites, phylites); up to 11 mm size rock fragments in	Bronze (Iron Age?) Age circular features 4381: Soil associated with round house/enclosure Coarsely stony mixture of fine silty Bhs and humic fine sandy Ah and other soil, with rare charcoal and burned mineral material burrowed into 4375 below; post-depositional inwash of clay, fine silty clay and fine silts; iron staining. (*Burrowed soil from 4381 – see above*) 4375: Fill of ditch 4059

		burrowed part (4381); *Coarse Organic and Anthropogenic*: 4375: examples of 3 mm rubefied rock fragment with 200 µm wide bleached rim and fine sand-size rubefied rock; 4381 burrow: rare charcoal (2 mm) and rubefied rock fragments; *Fine Fabric*: SMT 5a (4375): finely dotted (thinly burrowed) very pale brown or brownish (PPL), low or very low interference colours (close porphyric, speckled b-fabric, XPL), greyish brown or brown (OIL); very weakly or weakly humic stained micaceous fine material; SMT 4a (Ah clasts and burrow fill from 4381): blackish brown (PPL), anisotropic (close porphyric, undifferentiated b-fabric, XPL), blackish brown (OIL); very abundant fine amorphous OM and occasional fine charred OM; *Pedofeatures*: *Textural*: abundant (in burrowed 4381): rare very thin (50 µm) ferriargillan void infills, many thin very poorly oriented dusty and finely silty clay microlaminated (sesquioxide-stained) void coatings (150 µm), with are 150 µm thick fine silty second coatings; 4375 – possible poorly developed intercalations, some associated with fine closed vughs; *Depletion*: probable iron depletion of matrix and forming bleached stone rims in 4375; *Amorphous*: many sesquioxide stained SMT 2 Bh-Bhs soil fragments; rare ferrihydrite void coatings; rare trace of organans in 4375; *Fabric*: very broad (5 mm) fabric mixing of coarsely stony 4381 into gleyed 4375; *Excrements*: occasional thin excrements associated with burrowed-in soil. BD (4375): 8.97% LOI, 0.470 mg g^{-1} phosphate-P, 56.6 x 10^{-8} SI χ, 4620 x 10^{-8} SI χ_{max}, 1.23% χ_{conv} BD (4070 – Natural): 5.61% LOI, 0.368 mg g^{-1} phosphate-P, 75.6 x 10^{-8} SI χ, 2680 x 10^{-8} SI χ_{max}, 2.82% χ_{conv}	Highly compact fine stony and micaceous silty clay with very finely mixed/burrowed humic silty clay, rare inclusions of burned rock; possible intercalations and post-depositional gleying (pale colours and example of bleached rim) and trace amount of downwash of amorphous organic matter (organans). *Wet and waterlogged trampled(?) fill containing finely burrowed organic matter (organic matter enriched; see LOI) that is not obviously A horizon soil but could have a dung origin.*
			Area C
MFT /SMT 8b	**M4131**	28-36 cm SM: Moderately heterogeneous (dominant SMT 8b, with few soil inclusions (some blackened); *Microstructure*: poorly developed medium prisms and subangular blocky (once massive, examples of 1-2 mm silt and silt and fine sand layering), 15% (intrapedal) and 30% voids, fine channels and vughs, and fine to medium planar voids and coarse (7 mm) chambers); *Coarse Mineral*: SMT 8b, C:F 40:60; (limit at 10 µm), moderately sorted silt to medium sands, with few stone-size (12 mm) rock fragments; *Coarse Organic and Anthropogenic*: occasional reddish humified organ fragments; occasional wood charcoal (3 mm), some iron-stained, rare charred and humified (blackened) monocotyledonous plant fragments; many coarse (12 mm) fragments of 1: poorly humic leached sands (Ah) with fine charcoal, 2: poorly silty organic soil (peaty H) and blackened (burned) H soil; some with included charcoal; rare traces of probable dung; occasional burned mineral including burned soil (3 mm size); *Fine Fabric*: SMT 8b: finely speckled brown, reddish brown (PPL), very low interference colours (close porphyric, speckled/crystallitic (mica) b-fabric, XPL), orange with reddish specks and few blackish (OIL); abundant amorphous fine organic matter, occasional charred OM; rare phytoliths and reddish organs; *Pedofeatures*: *Textural*: many 200 µm intercalations and associated grain and void matrix coatings; *Fabric*: occasional 1-2 mm layering/bedding of silt and silt-sand material; many broad to very broad (2-4 mm) burrows. BD (4464): 5.86% LOI, 0.420 mg g^{-1} phosphate-P, 123 x 10^{-8} SI χ, 1410 x 10^{-8} SI χ_{max}, 8.72% χ_{conv}	Medieval boundary/droveway soil 4464 A once dense and layered silt-very fine sand humic deposit, with textural pedofeature evidence of being trampled and compacted when wet. It includes trace amounts of dung, along with both wood and monocotyledonous charcoal charred material – some iron stained; many coarse fragments of humic Ah and H horizon soil and burned variants occur alongside burned subsoil clasts. *The humic layered deposits that are humic and contain traces of dung are weakly phosphate-enriched suggesting passage by stock; the presence of charcoal and burned mineral material (enhanced magnetic susceptibility) may indicate tracking-in of occupation material; spillage of occupation material used for manuring can also be considered a possibility. The deposit has similarities to the soil (and colluvium) sealing the roundhouse in Area A.*
MFT D2/SMT 6b, 6c, 3b and	**M4129A**	17-32 cm	Bronze Age pit 4428

2c		SM: (Partially fragmented) heterogeneous (common SMT 6b and 6c, with SMT 3b and very few SMT 2c); *Microstructure*: fine and coarse subangular blocky, 35%? Voids, fine channels and vughs (also complex packing voids etc); *Coarse Mineral*: C:F as below, very poorly sorted with 25+ mm size rock fragments (eg. quartzite, granite and phyllite); *Coarse Organic and Anthropogenic*: many coarse (1-5 mm) wood charcoal; rare burned mineral grains; very abundant fine charcoal in SMT 6b with occasional phytoliths; possible cassiterite ore??; *Pedofeatures*: *Textural*: rare examples of dusty 100 µm-thick clay ped coatings; rare intercalations associated with closed vughs in SMT 6b material; *Amorphous*: rare iron staining and ferrihydrite infills, eg associated with charcoal; *Fabric*: probable abundant broad to very broad (2-5 mm) burrows; *Excrements*: mainly total excremental fabric. BD (4431): 3.76% LOI, 0.248 mg g^{-1} phosphate-P, 33.3 x 10^{-8} SI χ, 2360 x 10^{-8} SI χ_{max}, 1.41% χ_{conv}; 1080 µg g^{-1} Sn BD (4432): 6.43% LOI, 0.228 mg g^{-1} phosphate-P, 49.1 x 10^{-8} SI χ, 2450 x 10^{-8} SI χ_{max}, 2.00% χ_{conv}; 7070 µg g^{-1} Sn Probe: Grid analysis of two areas: Upper Area mean 6.557% Sn (max 74.631% Sn, 98.290% of count); Lower Area mean 2.337% Sn (max 69.969% Sn, 94.349% of count)	4431: Fill *Fragmented, but probably subsoil dominated.* 4432: Fill Much coarse wood charcoal, rare burned mineral including concentrations of sand-size cassiterite aggregates and rare possible glassy slags, and homogenised very abundant fine amorphous and charred organic matter and phytoliths, with mixed subsoil Ea, Bw and Bhs soil (from above). *Biologically homogenised mixture of subsoil (silting) with burned mineral and very abundant fine charcoal (and phytoliths) suggesting burned Poaceae/cereal processing waste (no phosphate indicators of burned dung inputs) locally; fused soil, partially burned aggregates of cassiterite, possible greenish tin? slags, bulk evidence of strongly enriched tin and microprobe identified tin concentrations, with enhanced magnetic susceptibility all indicate industrial activity that included tin ore processing; iron cemented charcoal-rich soil also indicate some process using water; some Poaceae material also got included generally.* *probable fragmentation/mixing with coarse wood charcoal of different (industrial origin – see below); inwash of finely silty clay and iron (drainage into pit).* *(Suggests change in use of site/pit, from industrial to plant/crop processing)*
MFT D1/SMT 6a, 6a (3a and 3b)	**M4129B**	32-50 cm SM: Heterogeneous (dominant SMT 6a and 6b, with common SMT 3a and 3b upwards); *Microstructure*: massive with coarse sub-angular blocky; 40% voids, mainly fine to coarse simple and complex packing voids; *Coarse Mineral*: C:F, 6a: 60:40, 6b: 40:60, 6c: 90:10; very poorly sorted with common sand to small stone-size rock fragments, including weathered feldspar (8 mm, ferruginised with sericite) and 14 mm long phyllite; *Coarse Organic and Anthropogenic*: very abundant coarse (1-3 mm) wood charcoal; many rubefied mineral grains, rubefied weakly fused soil?, 11+ mm fragment of partially vesicular clay silicate(?) material with dominant embedded quartz (fractured quartz), with pale orange to blackish (PPL; white under OIL) matrix; also possible fine greenish material (black under OIL) and 'burned' probable cassiterite (SnO_2; opaque and whitish OIL, with crystals with very high relief and birefringence, extinction parallel to cleavage; microprobe recording concentrations of Sn – see below; phytoliths present; *Fine Fabric*: SMT 6a: heavily speckled and dotted pale yellowish brown (PPL), moderately low interference colours (close porphyric, speckled and crystallitic (mica) b-fabric, XPL), heavily dotted greyish brown (OIL); pale humic staining with very abundant fine charred OM (monocot shreds?) with rare phytoliths; 6b: mixtures of SMT 3b and 3a with occasional charcoal and soil fragments, including probable peat (amorphous organic matter); SMT 6c: loose mixture of fine charcoal, fine sand grains and soil clasts; occasional enigmatic clasts of ferrihydrite cemented material rich in coarse charcoal; *Pedofeatures*: *Amorphous*: many iron staining and ferrihydrite infills, eg associated with charcoal – enigmatic earlier-formed inclusions; *Fabric*: very abundant broad and very broad (17 mm) burrowing and fine fragmentation of charcoal (small	Bronze Age pit 4428 4433: Lowermost fill Coarse and fine charcoal-dominated fill, with both coarse wood and probably some monocotyledonous material (also phytoliths present); much rubefied material, large vesicular slag fragment (crucible), cracked quartz, possible fused soil (rubefied), and sand-size aggregates of probable cassiterite and possible metal glass; enigmatic iron-cemented charcoal-rich soil (from use of water during processing); subsoil Bw soil seals this layer ('redeposition of natural'); major very broad burrowing fragmenting the materials. *High amounts of coarse wood charcoal, burned mineral material, example of vesicular/crucible? material, fused soil, partially burned aggregates of cassiterite, possible greenish tin? slags, bulk evidence of enriched tin and microprobe identified tin concentrations (in M4129B), with enhanced magnetic susceptibility all indicate industrial activity that included tin ore processing; iron cemented charcoal-rich soil also indicate some process using water; some Poaceae material also got included generally.*

		mammals?); *Excrements*: abundant thin excrements. BD (4433): 7.97% LOI, 0.080 mg g^{-1} phosphate-P, 79.7 x 10^{-8} SI χ, 2680 x 10^{-8} SI χ_{max}, 5.61% χ_{conv}; 1470 µg g^{-1} Sn	
			Area D
MFT F1/SMT 9a MFT F2/SMT 9b 20/12/10 MFT F3/SMT 9c	**M4142**	75 mm horizontal section through 1: natural geology; 2: 10-15 mm thick humic soil infill (4392a) and 3: pit interior (4392b). 1: *Microstructure*: massive, 5%, very fine to fine (<0.5-1.0 mm) root (root traces) channel; *Coarse Mineral*: C:F, 60:40, silt and very fine sand-size quartz with dominant small and medium (25 mm) size rock fragments (eg phyllites); *Coarse Organic and Anthropogenic*: rare trace of fine roots; *Fine Fabric*: SMT 9a: fine speckled pale yellow (PPL), moderate interference colours (close porphyric, speckled and grano-striate b-fabric, XPL), pale yellow (OIL); *Pedofeatures*: *Textural*: abundant intercalations: *Amorphous*: occasional weak iron impregnation. 2: *Microstructure*: massive and subangular, 30% voids, very fine, fine (0.5-1 mm) planar voids and medium chambers (3 mm); *Coarse Mineral*: C:F, 40:60, moderately well sorted silt, fine and medium sand-size quartz; *Coarse Organic and Anthropogenic*: occasional fine (100 µm) charcoal, rare traces of fungal material (300 µm size spore case – birefringent), example of H horizon material; rare rubefied fine mineral grains; *Fine Fabric*: SMT 9b: speckled and dotted blackish brown (PPL), very low interference colours (moderately open porphyric, speckled/crystallitic (mica) b-fabric, XPL), dark brown with black and red specks (OIL); moderately weak humic staining, abundant fine amorphous with many charred OM; rare fungal material; *Pedofeatures*: *Fabric*: very abundant broad burrows and mixing into SMT 9a and 9c; *Excrements*: very abundant broad organo-mineral excrements; many thin excrements. CF – humic soil from pit 4310: BD (4329a; 4329/4160): 6.95% LOI, 0.163 mg g^{-1} phosphate-P, 2.5 x 10^{-8} SI χ, 149 x 10^{-8} SI χ_{max}, 1.68% χ_{conv} CF – mixed dark soil from pit 4310: BD (4329b; 4329/4159): 4.44% LOI, 0.126 mg g^{-1} phosphate-P, 2.7 x 10^{-8} SI χ, 470 x 10^{-8} SI χ_{max}, 0.57% χ_{conv} 3: *Microstructure*: massive, 20% voids, fine (0.5-1 mm) channels; *Coarse Mineral*: C:F, 70:30, very poorly sorted, very fine silt to dominant stone-size (13 mm) rock fragments (phyllites, quartzites, ironstones, granite), *Coarse Organic and Anthropogenic*: example of rubefied ironstone (in burrow); *Fine Fabric*: SMT 9c: finely speckled pale to darkish yellow brown (PPL), moderate interference colours (close porphyric, speckled b-fabric, XPL), brown (OIL); thin humic staining and occasional fine amorphous organic matter; *Pedofeatures*: Amorphous: occasional coarse (8 mm) patches of moderate to strong iron impregnation and hypocoatings (associated with channels); *Fabric*: abundant very thin and thin burrows; *Excrements*: total excremental (Bw) fabric, with many thin organo-mineral excrements.	Undated Pit 4388 in circle Horizontal thin section sample across pit edge; across: (1) the geological natural, (2) the thin (10-15 mm wide) humic pit fill edge (4392a and 4392b) and (3) the pit fill itself. 1: the natural substrate (C horizon) is a very stone silty clay with textural pedofeature evidence of periglacial emplacement. *Natural in situ head deposit.* 2: Leached silt and fine sands with fine amorphous organic matter, charred fine organic matter and some rubefied grains (consistent with LOI and magnetic susceptibility), as totally burrowed fine soil; contains birefringent spore case of vesicular arbuscular mycorrihizae. *Weakly humic and leached topsoil (containing fine charcoal and burned grains) that washed into void around pit fill, as pit fill soil shrank; becoming biologically worked in situ. Weakly humic soil reflects local land use; presence of birefringent spore case is a faint argument suggesting the fill to be medieval or earlier, rather than modern (Romans and Robertson 1983).* 3: Homogeneous stony fill with very weakly humic and strongly biologically-worked fine fabric. *Homogeneous back-fill of subsoil that has developed a Bw microfabric (cf SMT 3b), again arguing that the pit is not modern.*
			Area E
MFT A2/SMT 2b and 2c	M1053A	11-19 cm: SM: broadly layered/mixed: 11-13(15) cm: SMT 2c; 13(15)-19 cm: SMT 2b; *Microstructure*: mainly sub-angular blocky with underlying fine pellety; 30-40% voids, very poorly accommodated planar voids (1-4 mm), fine complex packing voids; *Coarse Mineral*: C:F, SMT 2b – 40:60, SMT 2c: 30:30; as	Neolithic Pit 1064 in hengiform monument – base of upper fill (1075) is a humic fill probably resulting originally from *in situ* humic soil formation and silting, prior to some secondary/post depositional podzolic Bh/Bhs/Bs horizon formation effects;

		M1053B, poorly sorted, with frequent stones (max 12 mm); *Coarse Organic and Anthropogenic*: rare root traces; SMT 2b: abundant coarse charred charcoal including monocotyledonous (max 2.2mm), with seed fragments, twig/shrub wood?; SMT 2c: many mainly fine (750 µm) charcoal; possible fine (750 µm) example of Fe-P nodule with vivianite; traces of very fine rubefied mineral grains; *Fine Fabric*: SMT 2b: coarsely dotted blackish brown (PPL), anisotropic (open porphyric, undifferentiated b-fabric, XPL), blackish brown (OIL); very abundant dark brown amorphous organic matter, with many charred tissue fragments, rare traces of phytoliths and spores; SMT 2c: dotted and speckled darkish yellowish brown (PPL), very low interference colours (open porphyric, speckled [micaceous] b-fabric, XPL), dark brownish (OIL); very abundant brown amorphous organic matter, with many charred tissue fragments, rare traces of phytoliths and spores; *Pedofeatures*: *Crystalline*: rare fine example of possible Fe-P and vivianite formation/nodule; *Amorphous*: very abundant moderately strong (SMT 2c) to very strong (SMT 2b) organic (polymorphic) staining (sesquioxidic Bh); *Fabric*: abundant thin (0.5 mm) and broad to very broad (2-4 mm) burrows; *Excrements*: very abundant fine pellety (very thin) organic (SMT 2b) and broad (2-3 mm) organo-mineral excrements. BD (1075): 10.6% LOI, 0.471 mg g^{-1} phosphate-P, 31 x 10^{-8} SI χ, 2320 x 10^{-8} SI χ_{max}, 1.34% χ_{conv}	high amounts of fine charred organic matter (finer than below; cf. 750 µm v 2250 µm) that includes both lignified and woody charcoal and charred monocotyledonous (Poaceae?) material (see LOI); traces of rubefied mineral matter are perhaps consistent with higher χ compared to 1074; possible example of vivianite in a nodule and material relict of burned organic matter likely responsible for slight phosphate-P enrichment. *Organic and charcoal-rich soil fill reflects local burning of Poaceae and secondary woodland? vegetated landscape; affected by acidification/incipient podzolic B horizon formation within pitfill*
MFT A1/SMT 1a and 2a	M1053B	19-27 cm SM: Heterogeneous (dominant SMT 1a, especially in lower part of slide; common SMT 2a, especially in burrows and on top of large rock fragment; *Microstructure*: burrow, chamber and sub-angular blocky becoming massive with depth; 40% voids becoming 25% with depth, complex packing voids, medium (2 mm) curved poorly accommodated planar voids and coarse (4 mm) chambers, becoming fine (0.5 mm) channels, chambers and vughs; *Coarse Mineral*: C:F (limit at 10 µm), SMT 1a: 40:60, SMT 2a: 30:70; very poorly sorted fine silt, coarse silt, fine to very coarse sand and small to medium (35 mm) stones; quartz, mica and rock fragments: schist (weathering schist), ironstone/iron-stained sandstone, granite (orthoclase feldspar, quartz, muscovite, hornblende, sericite), quartzite, mudstone etc; *Coarse Organic and Anthropogenic*: abundant (especially in SMT 2a) charred twig-wood/shrub?wood/woody [lignified] root charcoal; rare examples 350 µm-size spore cases of vesicular arbuscular mycorrihizae (birefringent 'bright rings'; Romans and Robertson, 1983), *Fine Fabric*: SMT 1a: occasionally dotted, cloudy pale to darkish brown (PPL), moderately low interference colours (open porphyric, speckled [micaceous] b-fabric, XPL), orange and brownish orange (OIL); moderate to thin humic (sesquioxidic) staining, with occasional charred organic matter and patchy occasional amorphous organic matter; SMT 2a: commonly speckled and dotted, cloudy brown to darkish brown (PPL), very low to moderately low interference colours (open porphyric, speckled [micaceous] b-fabric, XPL), brownish orange to darkish brown (OIL); moderate to strong humic (sesquioxidic) staining, with very abundant charred organic matter and very abundant amorphous organic matter; *Pedofeatures*: *Amorphous*: very abundant moderate to moderately strong sesquioxidic (SMT 1a) and organo-sesquioxidic (polymorphic) staining; rare ferruginous impregnation of fine fabric and rarely rock fragments; *Fabric*: many thin (0.5 mm) and abundant broad to very broad (2-4 mm) burrows; *Excrements*:	Pit 1064 – middle fill (1075) Burrowed junction between poorly sorted pit fill, mainly composed of acidifying Bw(Bws) soil (once earthworm-worked and with spore cases of vesicular arbuscular mycorrihizae) and upper more humic (and acidic) and very charcoal-rich fill (see LOI). Very abundant fine to coarse (5 mm) charcoal (lignified shrubby roots and twig wood?); effects of weak podzolisation (polymorphic B-fabric?) and sesquioxide impregnation and minor iron staining (see χ_{max}). *Fills show lower infilling with local acidifying brown soils (natural to area), and charcoal-rich soil containing charred lignified roots/shrub wood indicative of post-clearance secondary clearance environment (cf. Carn Brea). Post-depositional weak podzolisation and developing subsoil Bws horizon and minor waterlogging.*

		Lower part/mainly SMT 1a: total biological fabric with very abundant broad (2-3 mm) organo-mineral excrements and welded excrements, with occasional very thin (50-100 µm) excrements; Upper part/mainly SMT 2a: abundant broad (2-3 mm) organo-mineral excrements; very abundant very thin to thin (50-500 µm) (humic) organo-mineral excrements. BD (1074): 3.79% LOI, 0.215 mg g^{-1} phosphate-P, 5.2 x 10^{-8} SI χ, 2120 x 10^{-8} SI χ_{max}, 0.245% χ_{conv}	
MFT B2/SMT 2b(2c)	**M1054A**	10-18 cm SM: Mainly homogeneous (very dominant SMT 2b, with very few SMT 2c); *Microstructure*: massive, 25%, fine (<0.5 mm) channels and vughs, with compact complex packing voids; *Coarse Mineral*: as M1053A, C:F, 70:30; moderately poorly sorted with max 14 mm size rock fragment; *Coarse Organic and Anthropogenic*: occasional wood charcoal (max 4 mm) with charred monocotyledonous; trace of fine fungal bodies (birefringent); many rubefied very fine to small stone-size rock fragments; abundant fine charcoal; *Pedofeatures*: *Textural*: rare reddish brown (pale orange under OIL), isotropic to very poorly oriented very fine silty clay microlaminated void coatings, and possible broad infills (now obscured by sesquioxides; *Amorphous*: very abundant organic-sesquioxidic impregnation; *Fabric* and *Excrements*: as M1053A. BD (1120): 7.76% LOI, 0.342 mg g^{-1} phosphate-P, 102 x 10^{-8} SI χ, 1930 x 10^{-8} SI χ_{max}, 5.28% χ_{conv}	Neolithic Post hole 1123 in hengiform monument Post pipe fill 1120 Homogeneous humic and sequioxidic impregnated fill, which is rich in charcoal (wood charcoal and Poaceae?) and burned sand and stones (see LOI, *x* and χ_{conv}). Minor evidence of fine silty clay inwash; biologically homogenised Bhs horizon. *Post pipe fill contains probable contemporary evidence of major local burning – not just charcoal but high amounts of burned sand and stones – consistent with enhanced magnetic susceptibility.*
MFT B1/SMT 2a-2c, 3a-3c	**M1054B**	18-26 cm SM: Very heterogeneous (as M1053, with very few clasts of SMT 3a and few SMT 3b); *Microstructure*: apparently layered/separated/horizontally fissured every 10-15 mm; poorly formed medium subangular blocky with burrows, 35% voids, mainly complex packing voids; *Coarse Mineral*: as M1053A, max stone size is 7mm; C:F, SMT 3a: 30:70 (coarse silt and sand dominated); SMT 3b: 50:50 (fine silt, with coarse silt and sand); SMT 3c: 60:40; *Coarse Organic and Anthropogenic*: very abundant charred twig wood, lignified material and monocotyledonous charcoal (max 4 mm); many rubefied mineral grains and sand-size ferruginous material; *Fine Fabric*: dominant mixing/fragments of SMT 1a, 2a-2c; SMT 3a (Leached Ea?): very pale yellowish brown (PPL), low interference colours (close porphyric, speckled b-fabric, XPL), very pale brown (OIL); possible trace of very fine charcoal; SMT 3b (Bw horizon): finely speckled brown (PPL), moderate interference colours (close porphyric, speckled b-fabric, XPL), brownish orange (OIL); rare humic staining?, trace of charcoal; SMT 3c (anthropogenic topsoil?): doted and speckled blackish brown (PPL), low interference colours (close porphyric, speckled b-fabric, XPL), darkish brown with many black specks and occasional rubefied material; humic with very abundant fine charred OM; *Pedofeatures*: *Textural*: occasional reddish brown (pale orange under OIL), isotropic to very poorly oriented very fine silty clay microlaminated 250+ µm void coatings, forming pan-like fills along horizontal fissures; many dusty void coatings and intercalations in example of SMT 3b; *Amorphous*: very abundant probable sesquioxidic and many Fe staining; *Fabric*: horizontal fissuring affecting whole deposit; very abundant thin to broad burrows; *Excrements*: as M1053A. BD (1122): 7.44% LOI, 0.297 mg g^{-1} phosphate-P, 40 x 10^{-8} SI χ, 1300 x 10^{-8} SI χ_{max}, 3.08% χ_{conv}	Neolithic Post hole 1123 in hengiform monument Primary fill 1122 Very heterogeneous fill, with horizontal fissures every 10-15 mm (these show 250+ µm void coatings/pan like silty clay fills); dominantly humic and sesquioxide stained polymorphic SMT 2a-2c, with clasts of SMT 3a-3c (leached Ea horizon, Bw [example showing textural pedofeatures] and an anthropogenic fine charcoal-rich topsoil); very abundant wood and monocotyledonous charcoal and many fine burned mineral grains; very abundant burrowing. but horizontal fissuring pattern remains; continued post-depositional sesquioxide and iron staining. *Primary post hole fill shows very heterogeneous soil mixture, apparently representing leached Ea and disturbed Bw soils, occupation (fine charcoal-rich) humic topsoils, and much polymorphic and sesquioxide stained podzolic soil; rubefied grains show history of iron-sesquioxide staining. Horizontal fissuring and fine silty clay inwash may represent emplacement of post-hole, and represent compaction(s) of primary fill by post hole emplacement.* *The variety of included soils infers not only disturbance of local soils, but their acidification and early podzolisation (see Carn Brea, Brittany examples)*

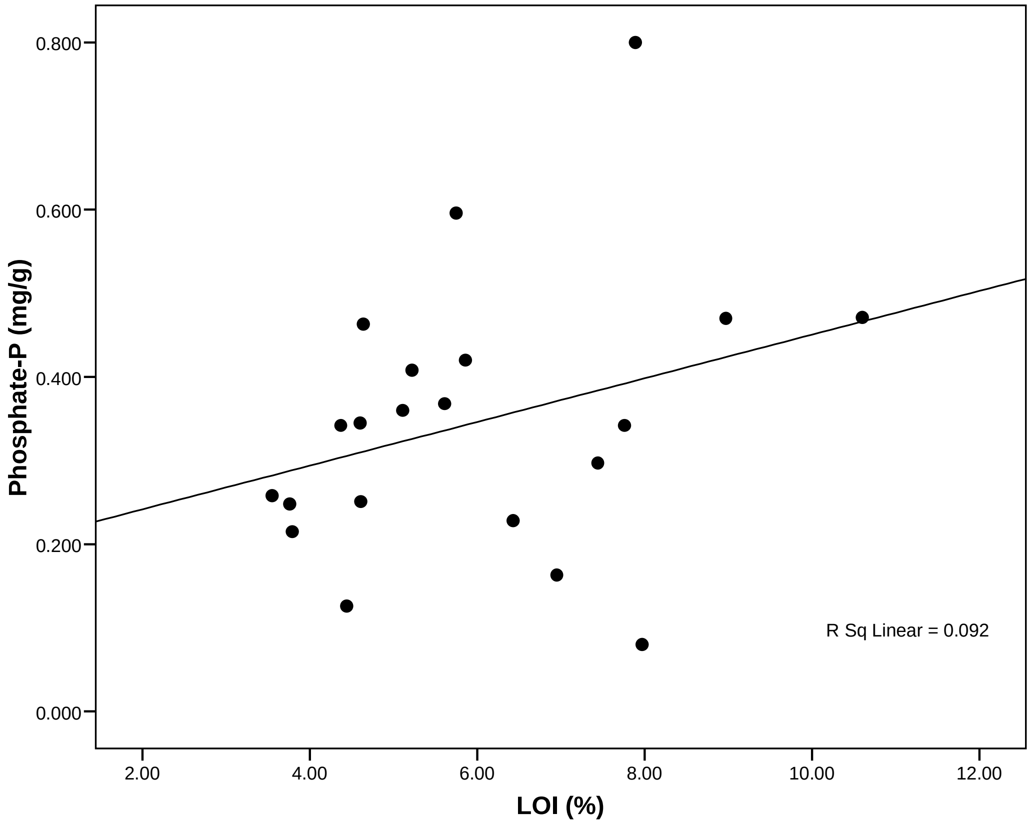

Fig. 1: Plot of relationship between phosphate-P (mg g^{-1}) and loss-on-ignition (LOI, %)

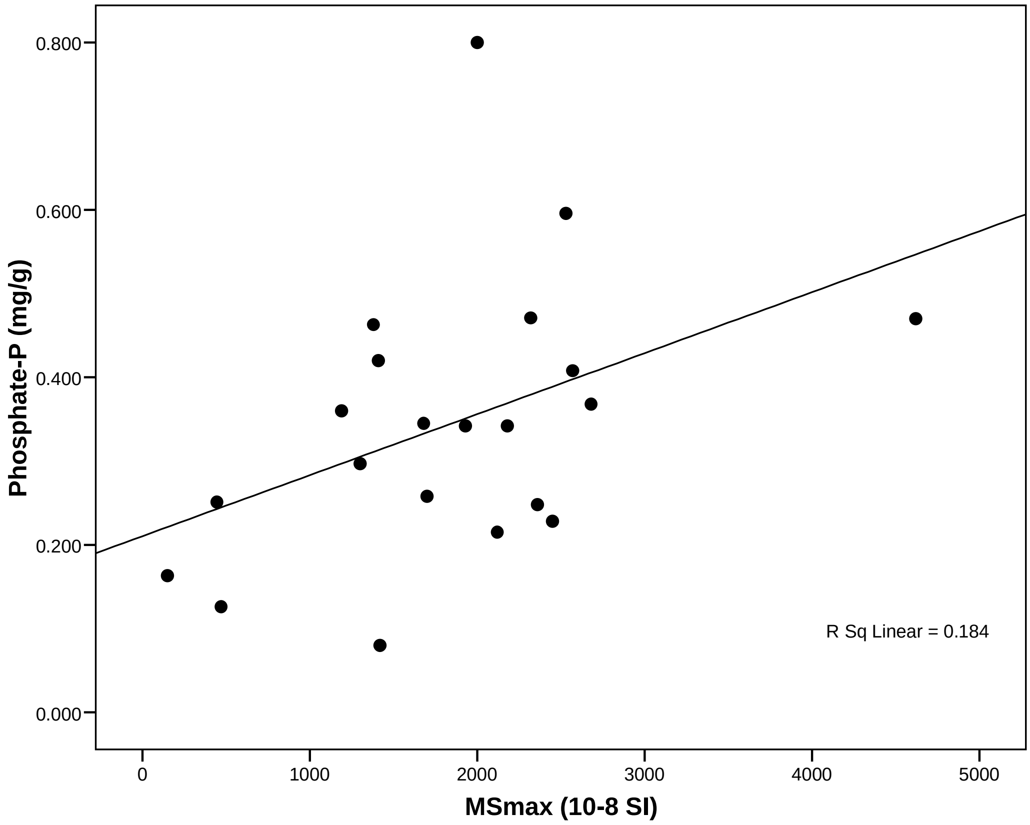

Fig. 2: Plot of relationship between phosphate-P (mg g^{-1}) and χ_{max} (10^{-8} SI)