

Købmagergade, Copenhagen, Denmark; Soil Micromorphology

by

Richard I Macphail Institute of Archaeology, University College London (UCL), 31-34,
Gordon Sq., London WC1H 0PY, UK

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Extended Summary

A six-thin section study was carried out on latrine pits 3100 and 8000. It seems likely that at *Latrine No. 3100 (71755-70651; M1513C)* the latrine pit was lined with a base of chalky earth-based material, but after a short phase of cess infilling became disused for a period, and was vegetated; root mixing took place (*70651*). A second phase of organic cess inputs then took place, although examples of fine leached (partially ‘digested’) bone were noted. In *M1513B, 71755*, records alternating dark brown organic and yellow phosphatic cess. Organic cess is often bioworked and includes seeds such as probable legumes. There are also laminae with subhorizontally oriented partially humified monocotyledonous plant (grass) remains (possibly added to seal in smells). Phosphatic cess commonly embeds articulated phytoliths of probable cereal (bran?) origin, as well as few strongly altered bone remains, including a fish bone example. In *M1513A, 71755* includes a layer of organic matter identified as thin ‘turf’ (‘Laminated Mull Humus’). Phosphatic cess deposition continues upwards in overlying *70606*, where organic plant remains of dietary origin (e.g. legume testa) and alternate with these thin ‘turf’ deposits. Again this ‘turf’ was probably used to seal-in smells and possibly to encourage composting. Upwards, phosphate seems to be geochemically altered, and gypsum and iron staining reflect these chemical changes to the deposits. In one case probable gypsum was replaced by phosphate (phosphatisation).

Fills in *Latrine No. 8000 (13017-11680; M849C)* include a basal silty clay loam (*11680*) which can be considered as the primary silting deposit formed after the latrine pit was excavated; the coarse wood fragment is also probably relict of using wood for lining the pit (?). A trace amount of fine rooting here likely records a short-lived period of vegetation growth prior to the inputs of cess. Also the silty clay loam becomes progressively more fine ash rich upwards, and includes fine charcoal, indicating possible wind blown fire installation waste occurred. Upwards (*13017*), records very dominant phosphatic cess deposition marked by embedded humified plant remains, or mainly dietary origin, including likely legume testa. Amongst this material a ~30mm long subhorizontal wood fragment (splinter) is present, and has a probable wood working origin. Weathering of the phosphatic cess led to weak to moderate iron staining; some burrowing and bioworking has also occurred. Both Layers *13004* and *13009 (M849B)* record phosphatic cess embedding plant-rich dietary residues, with intercalated fine sands in Layer *13009*, and included legume testa and fine bone (involving fish bone), especially in Layer *13004*. Continued phosphatic cess deposition is recorded in the upper part of Layer *13004 (M849A)* where less mineralised organic cess had also been dumped, and this became pelletised by biological working. There is a burrowed boundary to heterogeneous Layer *12778* which is characterised by fragments of cess and the dumping of calcareous silty clay loam material of presumed cob constructional origin, may have been dumped in the latrine pit to help seal in any noxious smells, for example; followed by backfill Layer *11262* (field photo evidence).

The report is supported by two tables, 71 figures and a CD-Rom/download archive.

Introduction

Two 500mm long monoliths through Latrine Numbers 3100 and 8000 from the inner city part of Copenhagen were forwarded by Simone Fabienne Mayer, Hanna Dahlström and Zenon Topcagic (Kultur- og Fritidsforvaltningen, KØBENHAVNS KOMMUNE) to *Terrascope*, Troyes, France for subsampling of the major layers, and where six 90mm long thin sections were manufactured. The finished thin sections underwent soil micromorphology investigation, employing standard methods (see below).

Samples and methods

Soil micromorphology

The undisturbed monolith samples (Tables 1 and 2) were impregnated with a clear polyester resin-acetone mixture, then topped up with resin, ahead of curing and slabbing for 90x60 mm-size thin section manufacture by Spectrum Petrographics, Inc., Vancouver, USA (Goldberg and Macphail, 2006; Goldberg et al., 2022; Murphy, 1986) (Figs 1 and 16). The thin sections was further polished with 1,000 grit papers and analysed using a petrological microscope under plane polarised light (PPL), crossed polarised light (XPL), and oblique incident light (OIL), at magnifications ranging from x1 to x200/400. Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs) (see Tables 1 and 2), and counted according to established methods, and as used on Norwegian sites previously (Bullock et al., 1985; Courty, 2001; Courty et al., 1989; Goldberg et al., 2022; Karkanis and Goldberg, 2019; Macphail and Cruise, 2001; Macphail and Goldberg, 2018; Nicosia and Stoops, 2017; Stoops, 2003).

Results

Soil micromorphology

Soil micromorphology results are presented in Tables 1 and 2, illustrated in Figs 1-72, and supported by material on the accompanying CD-Rom/download. 35 characteristics were identified and counted from the 10 layers in the 6 thin sections analysed.

Latrine No. 3100

71755-70651 (M1513C): The fills are essentially layered with dark brown, mainly non-calcareous strongly humic well sorted silty clay, containing plant fragments and examples of

fine to coarse bone at 0-20 mm, becoming very dark brown humic silty clay with many subhorizontally oriented plant fragments at 0-35 mm (and with a thin patch of yellow phosphate (SMT YP; 0-0(5mm) (71755), over layered and heterogeneous weakly calcareous dark brown humic silty clay at 30-60 mm, and with poorly sorted calcareous ('chalky') fine and medium sandy loam which embeds plant fragments and organic clasts at 60-90 mm, with roots and plant remains (70651) (Figs 1-15). Present are: occasional leached bone (max 6.5mm) (Figs 10-12), occasional altered bone/phosphatic ccess, very abundant organic ccess, abundant plant remains (wood, possible seeds, unidentified) and many to abundant amorphous organic matter, rare fine charcoal, trace calcitic ashes (Figs 13-15) and occasional roots at 0-35 mm, with below trace of leached bone (including fish bone), 2 teeth fragments, abundant plant remains (wood (max 2.5mm), possible seeds, unidentified), trace of phosphatic ccess inclusions, abundant very fine and fine roots and many amorphous organic matter, abundant organic ccess, rare fine charcoal, very abundant chalky cob (calcitic with very abundant matrix intercalations; Figs 1-5), trace of probably weathered bio-calcite (Arionid plate?) and many roots (Brönnimann et al., 2017; Karkanas and Goldberg, 2018; Macphail, 2022; Villagran, 2017). Many void infills of gypsum crystals and microsparitic calcite (including root pseudomorphs) at 35-90 mm (Figs 6-9), a trace of iron staining throughout with amorphous phosphate (CaP?) in the uppermost thin layer, many thin burrows, over occasional thin burrows, and occasional very thin and many organo-mineral excrements, occur (Bullock et al., 1985; Stoops, 2003).

These deposits can be interpreted as recording an original – presumed – latrine pit lining of 'chalky' cob/clunch earth-based building material which makes up much of Layer 70651. Although not totally clear, it seems that primary organic ccess infilling occurred, which also brought in plant remains and very small amounts of bone and phosphatic ccess; a fish bone example is present. A period of stasis then took place leading to the location becoming disused and vegetated and where root disturbance took place; deposits became fragmented and mixed. Some decalcification and drainage effects also led to some recrystallization of calcium carbonate, with plant roots becoming CaCO₃ replaced. In addition, post-depositional gypsum crystals formed infills (CaSO₄), probably due to organic matter breakdown under anaerobic conditions. Upwards (Layer 71755) is a microlaminated organic ccess deposit with plant remains being commonly subhorizontally oriented; a partially leached ('digested') ~6.5 mm long bone fragment is also subhorizontally oriented. Only small amounts of minerogenic silt occur in this deposit, with trace of amounts of calcitic ash residues also being present –

something that is not unusual in latrine deposits. Lastly, a thin yellow phosphatic cess layer is present at the very top of the sample.

It seems likely that at *Latrine No. 3100 (71755-70651; M1513C)* the latrine pit was lined with a base of chalky earth-based ('cob') material, but after a short phase of cess infilling became disused for a period, and was vegetated; root mixing took place (70651). A second phase of organic cess inputs then took place, although examples of fine leached (partially 'digested') bone were noted.

71755 (M1513B): Subhorizontally oriented alternating thin layers of yellow and pale brown phosphate at ~15-25 mm, 30-35 mm, 50-55 mm and 70-90 mm, with interbedded dark brown, often pellety amorphous organic matter (Fig 16). There are alternating very abundant phosphate-embedded articulated phytoliths (cereal remains/bran?; Figs 17-18), with occasional strongly altered bone remains including probable fish bone (Figs 19-20), with layers of very abundant amorphous organic matter, sometimes embedded relict layers of abundant plant remains (grasses?; Figs 21-22), as well as many embedded seeds (max ~4.5 mm), as well as occasional probable legume seeds (~1mm; Figs 23-25), with trace of fine roots. Very abundant alternating probable phosphate layers (CaP?) and rare iron staining of plant remains, alternating very abundant thin burrows, and alternating very abundant very thin and thin organic excrements, were found.

Latrine inputs record alternating organic and mineralised phosphatic (CaP?) cess layers. Mineralised (calcium phosphate) phosphatic cess embeds large amounts of cereal remains (with articulated long phytoliths – bran?) and highly altered (digested) bone, including fish bone. Organic cess deposits are strongly biologically worked, and involve coarse seeds (max ~4.5 mm), finer probable legume seeds (~1mm size legume testa), and layers of monocotyledonous (grassy?) plant remains. Clearly an omnivorous diet is recorded. The organic layers which alternate with the phosphatic cess may include the remains of organic waste other than human faecal material; the possible grassy dumps may come from discarded flooring/bedding, iron staining being relict of plant rotting. Such organic dumping may have been employed to mitigate the smells emanating from the latrine pit.

70606-71755 (M1513A): Moderately root disturbed layered dark yellow 'altered' phosphatic cess and thin alternating 'turf' layers (laminated Mull humus; Barrat, 1964) at 0-45 mm, over dominant dark brown organic cess with few yellow phosphatic cess layer remains, and including a thin turf at the base and a 15mm size clast of calcareous silt loam at 45-90 mm

(Figs 26-38). Deposits are characterised by very abundant phosphate-embedded fine size plant remains, including probable legume testa and other fine fragments (Figs 29-32), with probable abundant phytoliths (cereal remains/bran?), with trace amounts strongly altered bone remains with often alternating very abundant layers of laminated Mull humus turf (Figs 33-36), a trace of fine charcoal and occasional fine roots, over very abundant phosphate-embedded fine size plant remains, including probable legume testa and other fine fragments (possible hazel nut shell material may be present), with probably many phytoliths (cereal remains/bran?), with many laminated Mull humus turf at the base, rare fine roots and abundant plant fragments, with 15mm size calcareous silt loam embedding a fine gravel size (possible grindstone) basalt fragment (Figs 26-28); both layers include abundant fine roots of 'turf' origin. There are many void infills of gypsum crystals, including acicular growths at ~30-45 mm (Figs 37), very abundant altered calcium phosphate with secondary phosphatisation of earlier-formed acicular gypsum(?) (Figs 38), with abundant moderate iron staining at 0-45mm, with abundant phosphate and many moderate iron staining, occasional thin and many broad burrows, over very abundant thin and occasional broad burrows, and very abundant very thin organic excrements, over abundant (relict turf), with many very thin and thin organo-mineral excrements over very abundant very thin and thin organo-mineral excrements.

The layered nature and components of Layer 71755 continue upwards, and showing bioworking. Of note is a thin layer of 'turf' which can be identified as a Laminated Mull humus. In addition, a 15mm size clast of calcareous silt loam is present, and can be interpreted as a probable fragment of building material. It also embeds a fine gravel size basalt, an exotic rock of presumed grindstone origin. Upwards (70606), alternating 'altered' phosphatic cress and Laminated Mull humus 'turf' dominate; again 'turf' can be seen as a way to help seal-in bad latrine smells, and possibly to aid composting – here not successfully. The phosphatic cress embeds fine plant remains of likely dietary origin, and one likely example is a fragment of probable legume testa. Geochemical changes in the fill included the formation of gypsum (CaSO₄) and phosphatisation within this environment also seems to have led to replacement of acicular gypsum. Deposits are also increasing iron stained upwards. It can be noted that Laminated Mull Humus turf develops in areas of poorly drained grassland/pastures, and archaeological samples have been found on flood plains and coastal areas (Barrat, 1964).

It seems likely that at *Latrine No. 3100 (71755-70651; M1513C)* the latrine pit was lined with a base of chalky earth-based material, but after a short phase of cess infilling became disused for a period, and was vegetated; root mixing took place (70651). A second phase of organic cess inputs then took place, although examples of fine leached (partially 'digested') bone were noted. In *M1513B, 71755*, records alternating dark brown organic and yellow phosphatic cess. Organic cess is often bioworked and includes seeds such as probable legumes. There are also laminae with subhorizontally oriented partially humified monocotyledonous plant (grass) remains (possibly added to seal in smells). Phosphatic cess commonly embeds articulated phytoliths of probable cereal (bran?) origin, as well as few strongly altered bone remains, including a fish bone example. In *M1513A, 71755* includes a layer of organic matter identified as thin 'turf' ('Laminated Mull Humus'). Phosphatic cess deposition continues upwards in overlying 70606, where organic plant remains of dietary origin (e.g. legume testa) and alternate with these thin 'turf' deposits. Again this 'turf' was probably used to seal-in smells and possibly to encourage composting. Upwards, phosphate seems to be geochemically altered, and gypsum and iron staining reflect these chemical changes to the deposits. In one case probable gypsum was replaced by phosphate (phosphatisation).

Latrine No. 8000

13017-11680 (M849C): Layered and laminated dark orange weathered phosphatic cess, with wood remains at 0-60 mm, over dark grey very weakly calcareous silty clay loam and bark-rich wood fragment at 60-90 mm (Figs 39-51). Very abundant phosphatic cess, embedding plant (dietary) remains (including trace amounts of legume testa) (Figs 39, 46-49), many wood fragments (subhorizontally oriented max ~25mm, wood working fragment?; Fig 39, 50-51), occasional fine roots, over coarse (~35mm) woody bark fragment (Figs 39, 44-45), rare fine charcoal and trace to rare calcitic ashes, a trace of very fine roots and very thin bone (small mammal?) examples at 60-90 mm, occurs. Many matrix intercalations at the base (Figs 40-43, very abundant phosphate with abundant weak to moderate iron staining, over rare weak iron staining and yellow probable phosphatic infills at the base, occasional thin and many broad burrows at 0-60mm, and abundant very thin organo-mineral excrements at 0-60 mm, were recorded.

The basal silty clay loam (11680) can be considered as the primary silting deposit formed after the latrine pit was excavated; the coarse wood fragment is also probably relict of

using wood for lining the pit (?). A trace amount of fine rooting here likely records a short-lived period of vegetation growth prior to the inputs of cess. Also the silty clay loam becomes progressively more fine ash rich upwards, and includes fine charcoal, indicating possible wind blown fire installation waste occurred. Upwards (13017), records very dominant phosphatic cess deposition marked by embedded humified plant remains, or mainly dietary origin, including likely legume testa. Amongst this material a ~30mm long subhorizontal wood fragment (splinter) is present, and has a probable wood working origin. Weathering of the phosphatic cess led to weak to moderate iron staining; some burrowing and bioworking has also occurred.

13004-13009 (849B): Layer 13009, although it is now characterised by biological fragmentation and burrowing was originally a microlaminated phosphatic cess deposit with (dietary?) plant remain and embedding fine sands, with a 7.5mm size charred cereal grain example(?) (Figs 52-57). Above, intact Layer 13004, is a still intact microlaminated, subhorizontally oriented plant residue-rich phosphatic cess deposit, with occasional legume testa throughout, and occasional bone fragments (max ~5mm), especially at 0-20 mm, including rare likely fish bones (max ~>3mm) and with rare fine probable sedge roots (Figs 52, 58-61). The last testify to post-depositional open probably poorly drained conditions in this now-vegetated latrine pit feature.

Both Layers 13004 and 13009 record phosphatic cess embedding plant-rich dietary residues, with intercalated fine sands in Layer 13009, and included legume testa and fine bone (involving fish bone), especially in Layer 13004.

12778-13004 (849A): The weathered remains of often intact microlaminated phosphatic cess occurs at the top of Layer 13004, as well as pelletised organic cess remains – the latter being seemingly less mineralised and more easily bioworked (Figs 64-67). Overlying Layer 12778 is much more minerogenic and heterogeneous, with dominant amounts of calcareous silty clay loam material of presumed cob constructional origin (Figs 64, 68-70). This may have been dumped in the latrine pit to help seal in any noxious smells, for example. Backfilling continued up into Layer 11262 (field photo evidence) and a 25mm size brick present in the thin section probably comes from the mixing-in this backfill. The weathered remains of microlaminated cess in this layer also record the presence of fine bone, including fish bone (Figs 64 and 71).

Continued phosphatic cess deposition is recorded in the upper part of Layer 13004 where less mineralised organic cess had also been dumped, and this became pelletised by

biological working. There is a burrowed boundary to heterogeneous Layer 12778 which is characterised by fragments of cess and the dumping of calcareous silty clay loam material of presumed cob constructional origin, may have been dumped in the latrine pit to help seal in any noxious smells, for example; followed by backfill Layer 11262 (field photo evidence).

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Table 1: Købmagergade, Copenhagen, Denmark; Soil Micromorphology samples and counts

Thin section	Relative depth	Layer	MFT	SMT	%Voids	Gravel	Roots	Wood	Charcoal	Calc cob
<i>Latrine No. 8000</i>										
M849A	0-60(70) mm	12778	D2	3a1,3a2,WMPC,Br	40%	*	a*		a-1	aaaaa
M849A	60(70)-90 mm	13004	C6a	WMPC,POC	35%		a*			a
M849B	0-50(60) mm	13004	C6	MPFC	35%		a(sedge)			
M849B	50(60)-90 mm	13009	C5	WOC,FSPF	60%		aa		a-1	
M849C	0-60 mm	13017	C4	MPC	35%			aaa		
M849C	60-90 mm	11680	D1	3a,WB	20%	f	a*	a-1(bark)	a	
<i>Latrine No. 3100</i>										
M1513A	0-45 mm	70606	C3	APC,T	35%		aa(aaaa)		a*	
M1513A	45-90 mm	71755	C2	OC,PC (T)	35%	f			a*	(aa)
M1513B	0-25-35-55-70-90mm	71755	C1	YBP/2d/YBP/2d	0-60%	a-1	a*			
M1513C	0-20-35 mm	71755	B2	(YP)2a,Bo,PF	35%		aa		a	
M1513C	35-90 mm	70651	A1(B1)	1a,2c,RPR	30%	ff	aaaa		a	aaaa
<i>Table 1, cont.</i>										
Thin section	Amorph OM	Plant remains	Cereal (Phyto)	Charred cereal?	Monocot (grass?)	Mull turf	BurntMinn brick	Seeds (legume?)	Phos ccess	Org ccess
<i>Latrine No. 8000</i>										
M849A		aaa					a-2		aaaa	
M849A	aaaa?	aaa							aaaaa	aaaa?
M849B		aaaaa	?					aa	aaaaa	
M849B		(aaaaa)	?	a-1				a	(aaaaa)	

M849C	aaa	aaaa						a	aaaaa	
M849C										
Latrine No. 3100										
M1513A	aaaaa	aaaaa	aaaa			aaaaa		a	aaaaa	
M1513A	aaaaa	aaaaa	aaa			(aaa)		a	aaaaa	aaaaa
M1513B	aaaaa	aaaaa	aaaaa			aaaa		aaa	(aaaaa)	(aaaaa)
M1513C	aaa-aaaa	aaaa							aa	aaaaa
M1513C	aaa	aaaa							a*	aaaa
<i>Table 1, cont.</i>										
<i>Table 1, cont.</i>										
Thin	Bone	Fish	Calc	CaCO3	BioCalc	Matrix	2ndary	Gypsum	2ndary	CaP?
section		bone	ashes	Roots	incl	intercal	CaCO3		Fe	
Latrine No. 8000										
M849A	aaa	a							aaa	aaaa
M849A									aaa	aaaa
M849B	aa	a							aaaa	aaaaa
M849B									aaaa	(aaaaa)
M849C									aaaa	aaaaa
M849C	a-1		a/a*			aaa			a	a*
Latrine No. 3100										
M1513A	a							aaa	aaaa	aaaaa
M1513A	a								aaa	aaaa
M1513B	aa	a-1							a	(aaaaa)
M1513C	aa		a*						a*	aaa/0
M1513C	a*(2 teeth)	a-1		aa	a-1		aaa	aaa	a*	
<i>Table 1, cont.</i>										
Thin	Thin	Broad	V thin	V thin	Thin	Broad				

section	burrows	burrows	Org excr.	OM excr.	OM excr.	OM excr.				
<i>Latrine No. 8000</i>										
M849A	aaaa	aaaa		aa	aaa	aaaa				
M849A	aaa	aaaa	aaaaa	aa	aaa					
M849B	aa	aa		aa						
M849B	aaaaa	aaaaa		aaaaa	aaaaa					
M849C	aa	aaa		aaaa						
M849C										
<i>Latrine No. 3100</i>										
M1513A	aa	aaa	aaaaa	aaa	aaa					
M1513A	aaaaa	aa	aaaa	aaaaa	aaaaa					
M1513B	(aaaaa)			(aaaaa)	(aaaaa)					
M1513C	aaa			aa	aaa					
M1513C	aa			aa	aaa					

* - 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 2: Købmagergade, Copenhagen, Denmark; Soil Micromorphology samples (Descriptions and preliminary interpretations)

Microfacies type (MFT)/Soil microfabric type (SMT)	Sample No.	Depth (relative depth) Soil Micromorphology (SM)	Contexts and preliminary findings and interpretations
		0-90 mm SM: ; <i>Microstructure</i> :: <i>Coarse Mineral</i> :: <i>Coarse Organic and Anthropogenic</i> :: <i>Fine Fabric</i> : ; <i>Pedofeatures</i> : <i>Textural</i> : <i>Amorphous</i> :: <i>Fabric</i> :: <i>Excrements</i> :	
			<i>Latrine No. 8000</i>
MFT D2/SMT 3a1, 3a2, WMPC, Br Over MFT C6a/SMT WMPC, POC	M849A	0-90 mm SM: Strongly heterogeneous dark grey calcareous silty clay loam (SMT 3a1) and dark brown variants (SMT 3a2), with coarse clasts of weathered yellow microlaminated phosphatic ccess (SMT WMPC) which include silts, and coarse brick inclusion (SMT Br) at 0-60(70) mm, over partially fragmented weathered yellow microlaminated phosphatic ccess (SMT WMPC) and dark brown pelletised probable organic ccess (SMT POC) at 60(70)-90 mm; <i>Microstructure</i> : weakly massive with fine and coarse aggregates, 40% voids, simple and complex packing voids and channels, over remains of microlaminated and massive, with pellety, 35% voids, complex packing voids and subhorizontal fissures; <i>Coarse Mineral</i> : as SMT 3a, very few gravel; <i>Coarse Organic and Anthropogenic</i> : trace of fine roots throughout, 25mm-size brick fragment, burnt gravel example,	<i>12778-13004</i> Strongly heterogeneous dark grey calcareous silty clay loam and dark brown variants, with coarse clasts of weathered yellow microlaminated phosphatic ccess which include silts, and coarse brick inclusion at 0-60(70) mm, over partially fragmented weathered yellow microlaminated phosphatic ccess and dark brown pelletised probable organic ccess at 60(70)-90 mm. There is a trace of fine roots throughout, 25mm-size brick fragment, burnt gravel example, abundant fragments of microlaminated phosphatic ccess, embedding many plant remains, many fine bone in various weathered conditions, including fish bone, with very abundant probable calcareous cob

		<p>abundant fragments of microlaminated phosphatic ccess, embedding many plant remains, many fine bone in various weathered conditions, including fish bone, with very abundant probable calcareous cob remains, with rare shell and burnt shell fragments, over very abundant microlaminated phosphatic ccess, and probable abundant organic ccess, now pelletised, with single 5mm-size charcoal fragment; <i>Fine Fabric</i>: SMT 3a1-3a2: dark grey to dark brown calcareous silty clay loam (PPL), XPL as SMT 3a, grey – brownish grey (OIL); <i>Pedofeatures</i>: <i>Textural: Amorphous</i>: abundant phosphatic staining/make up of ccess, with many probable phosphate stained fine soil materials, and many weak iron stained organic matter and ccess materials; <i>Fabric</i>: abundant thin and broad burrows, over many thin and abundant broad burrows; <i>Excrements</i>: occasional very thin, many thin and abundant broad organo-mineral excrements, with below, very abundant very thin organic excrements, with occasional very thin and many thin organo-mineral excrements.</p>	<p>remains, with rare shell and burnt shell fragments, over very abundant microlaminated phosphatic ccess, and probable abundant organic ccess, now pelletised, with single 5mm-size charcoal fragment. Abundant phosphatic staining/make up of ccess, with many probable phosphate stained fine soil materials, and many weak iron stained organic matter and ccess materials, abundant thin and broad burrows, over many thin and abundant broad burrows, and occasional very thin, many thin and abundant broad organo-mineral excrements, with below, very abundant very thin organic excrements, with occasional very thin and many thin organo-mineral excrements, were noted. <i>The weathered remains of often intact microlaminated phosphatic ccess occurs at the top of Layer 13004, as well as pelletised organic ccess remains – the latter being seemingly less mineralised and more easily bioworked. Overlying Layer 12778 is much more minerogenic and heterogeneous, with dominant amounts of calcareous silty clay loam material of presumed cob constructional origin. This may have been dumped in the latrine pit to help seal in any noxious smells, for example. Backfilling continued up into Layer 11262 (field</i></p>
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			<p>photo evidence) and a 25mm size brick present in the thin section probably comes from the micing-in this backfill. The weathered remains of microlaminated cess in this layer also record the presence of fine bone, including fish bone.</p>
<p>MFT C6/SMT MPFC over MFT C5/SMT WOC, FSPF</p>	M849B	<p>0-90 mm SM: Microlaminated subhorizontally-oriented plant remains-rich moderately weathered phosphatic cess with legume testa, with minerogenic silts (SMT MPFC), and with fine bone fragments upwards, at 0-50(60) mm, over partially fragmented and pelletised layered and laminated dark orange weathered phosphatic cess (SMT WOC), once-laminated plant remains (cf Organic cess; SMT FOC) and few laminated fine sand-rich plant fragments (SMT FSPF), at 50(60)-90 mm; <i>Microstructure</i>: microlaminated, with subhorizontal fissures and vughs, 35% voids, over structureless, aggregates and pellety, 60% voids, simple packing voids, at the base; <i>Coarse Mineral</i>: moderately well sorted fine sands in laminae at the base; <i>Coarse Organic and Anthropogenic</i>: very abundant (very dominant) microlaminated, subhorizontally oriented plant residue-rich cess, with occasional legume testa, throughout, and occasional bone fragments (max ~5mm), especially at 0-20 mm, including rare likely fish bones (max) and with rare fine probable sedge roots, over fragmented very abundant phosphatic cess, embedding plant (dietary) remains, as well as</p>	<p>13004-13009 Microlaminated subhorizontally-oriented plant remains-rich moderately weathered phosphatic cess with legume testa, with minerogenic silts, and with fine bone fragments upwards 0-50(60) mm, over partially fragmented and pelletised layered and laminated dark orange weathered phosphatic cess, once-laminated plant remains (cf Organic cess) and few laminated fine sand-rich plant fragments, at 50(60)-90 mm. Very abundant (very dominant) microlaminated, subhorizontally oriented plant residue-rich cess, with occasional legume testa, throughout, and occasional bone fragments (max ~5mm), especially at 0-20 mm, including rare likely fish bones (max) and with rare fine probable sedge roots, over fragmented very abundant phosphatic cess, embedding plant (dietary) remains, as well as abundant plant remains, a 7.5mm size charred cereal grain example(?), occasional fine</p>

		<p>abundant plant remains, a 7.5mm size charred cereal grain example(?), occasional fine roots, at 50(60)-90 mm; <i>Fine Fabric</i>: ; <i>Pedofeatures</i>: <i>Textural</i>: <i>Amorphous</i>: very abundant phosphate with abundant weak iron staining throughout at the base; <i>Fabric</i>: occasional thin and broad burrows, with below: probably very abundant thin and broad burrows at the base; <i>Excrements</i>: occasional very thin organo-mineral excrements, over very abundant very thin organic and organo-mineral excrements at the base.</p>	<p>roots, at 50(60)-90 mm, were observed. Layers are characterised by very abundant phosphate with abundant weak iron staining throughout at the base, occasional thin and broad burrows, with below: probably very abundant thin and broad burrows at the base, and occasional very thin organo-mineral excrements, over very abundant very thin organic and organo-mineral excrements at the base.</p> <p><i>Layer 13009, although it is now characterised by biological fragmentation and burrowing was originally a microlaminated phosphatic cess deposit with (dietary?) plant remain and embedding fine sands, with a 7.5mm size charred cereal grain example(?). Above, intact Layer 13004, is a still intact microlaminated, subhorizontally oriented plant residue-rich phosphatic cess deposit, with occasional legume testa throughout, and occasional bone fragments (max ~5mm), especially at 0-20 mm, including rare likely fish bones (max ~>3mm) and with rare fine probable sedge roots. The last testify to post-depositional open probably poorly drained conditions in this now-vegetated latrine pit feature.</i></p>
MFT C4/SMT WOC, W	M849C	0-90 mm	13017-11680

<p>over MFT D1/SMT 3a, WB</p>		<p>SM: Layered and laminated dark orange weathered phosphatic cess (SMT WOC), with wood remains (SMT W) at 0-60 mm over dark grey very weakly calcareous silty clay loam (SMT 3a) and bark-rich wood fragment (SMT WB) at 60-90 mm; <i>Microstructure</i>: layered and laminated, 35% voids, channels, and chambers, massive, 20% voids, fine channels; <i>Coarse Mineral</i>: SMT 3a C:F=20:80, with few fine gravel; <i>Coarse Organic and Anthropogenic</i>: very abundant phosphatic cess, embedding plant (dietary) remains (including trace amounts of legume testa), many wood fragments (subhorizontally oriented max ~25mm, wood working fragment?), occasional fine roots, over coarse (~35mm) woody bark fragment, rare fine charcoal and trace to rare calcitic ashes, a trace of very fine roots and very thin bone (small mammal?) examples at 60-90 mm; <i>Fine Fabric</i>: SMT 3a: dusty and cloudy dark grey (PPL), generally low interference colours (open porphyric, stipple speckled and rarely crystallitic b-fabric, XPL), very pale yellowish grey (OIL), essentially minerogenic, but becoming many very fine charcoal and calcitic ashes upwards; <i>Pedofeatures: Textural</i>: many matrix intercalations at the base; <i>Amorphous</i>: very abundant phosphate with abundant weak to moderate iron staining, over rare weak iron staining and yellow probable phosphatic infills at the base; <i>Fabric</i>: occasional thin and many broad burrows at 0-60mm; <i>Excrements</i>: abundant very thin organo-mineral excrements at 0-60 mm.</p>	<p>Layered and laminated dark orange weathered phosphatic cess, with wood remains at 0-60 mm, over dark grey very weakly calcareous silty clay loam and bark-rich wood fragment at 60-90 mm. Very abundant phosphatic cess, embedding plant (dietary) remains (including trace amounts of legume testa), many wood fragments (subhorizontally oriented max ~25mm, wood working fragment?), occasional fine roots, over coarse (~35mm) woody bark fragment, rare fine charcoal and trace to rare calcitic ashes, a trace of very fine roots and very thin bone (small mammal?) examples at 60-90 mm, occurs. Many matrix intercalations at the base, very abundant phosphate with abundant weak to moderate iron staining, over rare weak iron staining and yellow probable phosphatic infills at the base, occasional thin and many broad burrows at 0-60mm, and abundant very thin organo-mineral excrements at 0-60 mm, were recorded. <i>The basal silty clay loam (11680) can be considered as the primary silting deposit formed after the latrine pit was excavated; the coarse wood fragment is also probably relict of using wood for lining the pit (?). A trace amount of fine rooting here likely records a short-lived</i></p>
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			<p><i>period of vegetation growth prior to the inputs of cess. Also the silty clay loam becomes progressively more fine ash rich upwards, and includes fine charcoal, indicating possible wind blown fire installation waste occurred. Upwards (13017), records very dominant phosphatic cess deposition marked by embedded humified plant remains, or mainly dietary origin, including likely legume testa. Amongst this material a ~30mm long subhorizontal wood fragment (splinter) is present, and has a probable wood working origin. Weathering of the phosphatic cess led to weak to moderate iron staining; some burrowing and bioworking has also occurred.</i></p>
			Latrine No. 3100
MFT C3/SMT APC, T over MFT C2/SMT OC, PC (T)	M1513A	<p>0-90 mm SM: Moderately root disturbed layered dark yellow ‘altered’ phosphatic cess (SMT APC) and thin alternating ‘turf’ layers (laminated Mull humus; SMT T) at 0-45 mm, over dominant dark brown organic cess (SMT OC) with few yellow phosphatic cess layer remains (SMT PC), and including a thin turf at the base (SMT T) and a 15mm size clast of calcareous silt loam at 45-90 mm; <i>Microstructure</i>: massive, with layers, 35% voids, fissures and channels; <i>Coarse Mineral</i>: few small stone size inclusions at the base; <i>Coarse Organic and Anthropogenic</i>: very abundant phosphate-embedded</p>	<p>70606-71755 Moderately root disturbed layered dark yellow ‘altered’ phosphatic cess and thin alternating ‘turf’ layers (laminated Mull humus) at 0-45 mm, over dominant dark brown organic cess with few yellow phosphatic cess layer remains, and including a thin turf at the base and a 15mm size clast of calcareous silt loam at 45-90 mm. Deposits are characterised by very abundant phosphate-embedded fine size plant remains, including probable</p>

		<p>fine size plant remains, including probable legume testa and other fine fragments, with probable abundant phytoliths (cereal remains/bran?), with trace amounts strongly altered bone remains with often alternating very abundant layers of laminated Mull humus turf, a trace of fine charcoal and occasional fine roots, over very abundant phosphate-embedded fine size plant remains, including probable legume testa and other fine fragments (possible hazel nut shell material may be present), with probably many phytoliths (cereal remains/bran?), with many laminated Mull humus turf at the base, rare fine roots and abundant plant fragments, with 15mm size calcareous silt loam embedding a fine gravel size (possible grindstone) basalt fragment; both layers include abundant fine roots of ‘turf’ origin; <i>Fine Fabric:</i> ; <i>Pedofeatures:</i> <i>Textural:</i> <i>Crystalline:</i> many void infills of gypsum crystals, including acicular growths at ~30-45 mm; <i>Amorphous:</i> very abundant altered calcium phosphate with secondary phosphatisation of earlier-formed acicular gypsum(?), with abundant moderate iron staining at 0-45mm, with abundant phosphate and many moderate iron staining; <i>Fabric:</i> occasional thin and many broad burrows, over very abundant thin and occasional broad burrows; <i>Excrements:</i> very abundant very thin organic excrements, over abundant (relict turf), with many very thin and thin organo-mineral excrements over very abundant very thin and thin organo-mineral excrements.</p>	<p>legume testa and other fine fragments, with probable abundant phytoliths (cereal remains/bran?), with trace amounts strongly altered bone remains with often alternating very abundant layers of laminated Mull humus turf, a trace of fine charcoal and occasional fine roots, over very abundant phosphate-embedded fine size plant remains, including probable legume testa and other fine fragments (possible hazel nut shell material may be present), with probably many phytoliths (cereal remains/bran?), with many laminated Mull humus turf at the base, rare fine roots and abundant plant fragments, with 15mm size calcareous silt loam embedding a fine gravel size (possible grindstone) basalt fragment; both layers include abundant fine roots of ‘turf’ origin. There are many void infills of gypsum crystals, including acicular growths at ~30-45 mm, very abundant altered calcium phosphate with secondary phosphatisation of earlier-formed acicular gypsum(?), with abundant moderate iron staining at 0-45mm, with abundant phosphate and many moderate iron staining, occasional thin and many broad burrows, over very abundant thin and occasional broad burrows, and very abundant very thin</p>
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			<p>organic excrements, over abundant (relict turf), with many very thin and thin organo-mineral excrements over very abundant very thin and thin organo-mineral excrements.</p> <p><i>The layered nature and components of Layer 71755 continue upwards, and showing bioworking. Of note is a thin layer of 'turf' which can be identified as a Laminated Mull humus. In addition, a 15mm size clast of calcareous silt loam is present, and can be interpreted as a probable fragment of building material. It also embeds a fine gravel size basalt, an exotic rock of presumed grindstone origin. Upwards, alternating 'altered' phosphatic cess and Laminated Mull humus 'turf' dominate; again 'turf' can be seen as a way to help seal-in bad latrine smells, and possibly to aid composting – here not successfully. The phosphatic cess embeds fine plant remains of likely dietary origin, and one likely example is a fragment of probable legume testa. Geochemical changes in the fill included the formation of gypsum (CaSO₄) and phosphatisation within this environment also seems to have led to replacement of acicular gypsum. Deposits are also increasing iron stained upwards.</i></p>
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MFT C1/SMT YBP-2d-BP-2d	M1513B	<p>0-90 mm</p> <p>SM: Subhorizontally oriented alternating thin layers of yellow and pale brown phosphate (SMT YBP) at ~15-25 mm, 30-35 mm, 50-55 mm and 70-90 mm, with interbedded dark brown, often pellety amorphous organic matter (SMT 2d);</p> <p><i>Microstructure</i>: broadly layered with microlaminated (0% voids), with fine blocky and pellety, 60% voids, complex packing voids; <i>Coarse Mineral</i>: C:F, 2d=05:95, very well sorted silt, with single (burnt) gravel; <i>Coarse Organic and Anthropogenic</i>: alternating very abundant phosphate-embedded articulated phytoliths (cereal remains/bran?), with occasional strongly altered bone remains including probable fish bone, with layers of very abundant amorphous organic matter, sometimes embedded relict layers of abundant plant remains (grasses?), as well as many embedded seeds (max ~4.5 mm), as well as occasional probable legume seeds (~1mm), with trace of fine roots; <i>Fine Fabric</i>: SMT 2d: dark brown, dark reddish brown (PPL), isotropic (very open porphyric – silts – undifferentiated b-fabric, XPL), blackish brown (OIL), amorphous organic matter with unidentifiable plant inclusions; <i>Pedofeatures</i>: <i>Textural: Amorphous</i>: very abundant alternating probable phosphate layers (CaP?) and rare iron staining of plant remains; <i>Fabric</i>: alternating very abundant thin burrows; <i>Excrements</i>: alternating very abundant very thin and thin organic excrements.</p>	<p>71755</p> <p>Subhorizontally oriented alternating thin layers of yellow and pale brown phosphate at ~15-25 mm, 30-35 mm, 50-55 mm and 70-90 mm, with interbedded dark brown, often pellety amorphous organic matter. There are alternating very abundant phosphate-embedded articulated phytoliths (cereal remains/bran?), with occasional strongly altered bone remains including probable fish bone, with layers of very abundant amorphous organic matter, sometimes embedded relict layers of abundant plant remains (grasses?), as well as many embedded seeds (max ~4.5 mm), as well as occasional probable legume seeds (~1mm), with trace of fine roots. Very abundant alternating probable phosphate layers (CaP?) and rare iron staining of plant remains, alternating very abundant thin burrows, and alternating very abundant very thin and thin organic excrements, were found.</p> <p><i>Latrine inputs record alternating organic and mineralised phosphatic (Cap?) cess layers. Mineralised phosphatic cess embeds large amounts of cereal remains (with articulated long phytoliths – bran?) and highly altered (digested) bone, including fish bone. Organic cess deposits are strongly</i></p>
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			<i>biologically worked, and involve coarse seeds (max ~4.5 mm), finer probable legume seeds (~1mm size legume testa), and layers of monocotyledonous (grassy?) plant remains. Clearly an omnivorous diet is recorded.</i>
MFT B2/SMT (YP) 2a, Bo, PF over MFT A1(B1)/SMT 1a, (2c, RPR)	M1513C	0-90 mm SM: Essentially layered with dark brown, mainly non-calcareous strongly humic well sorted silty clay (SMT 2a), containing plant fragments and examples of fine to coarse bone (SMT Bo) at 0-20 mm , becoming very dark brown humic silty clay (SMT 2b) with many subhorizontally oriented plant fragments (SMT PF) at 0-35 mm (and with a thin patch of yellow phosphate (SMT YP; 0-0(5mm) (71755), over layered and heterogeneous weakly calcareous dark brown humic silty clay (SMT 2c) at 30-60 mm, and with poorly sorted calcareous ('chalky') fine and medium sandy loam (SMT 1a) which embeds plant fragments and organic clasts at 60-90 mm, with roots and plant remains (SMT RPR); <i>Microstructure</i> : massive, with compact layered and laminated, 35% voids, fissures and channels, over massive, 30% voids, channels and fissures; <i>Coarse Mineral</i> : C:F (Coarse:Fine limit at ~10µm), SMT 2a-2b, C:F=30:70, well-sorted silts, SMT 2c and 1a, C:F=40:60, moderately poorly sorted silts and fine sands, and 80:20, poorly sorted silts, sands and frequent gravels, including flints and 'chalky' clasts; <i>Coarse Organic and Anthropogenic</i> : occasional leached bone (max 6.5mm), occasional altered bone/phosphatic ccess, very abundant	71755-70651 Essentially layered with dark brown, mainly non-calcareous strongly humic well sorted silty clay, containing plant fragments and examples of fine to coarse bone at 0-20 mm , becoming very dark brown humic silty clay with many subhorizontally oriented plant fragments at 0-35 mm (and with a thin patch of yellow phosphate (SMT YP; 0-0(5mm) (71755), over layered and heterogeneous weakly calcareous dark brown humic silty clay at 30-60 mm, and with poorly sorted calcareous ('chalky') fine and medium sandy loam which embeds plant fragments and organic clasts at 60-90 mm, with roots and plant remains (70651). Present are: occasional leached bone (max 6.5mm), occasional altered bone/phosphatic ccess, very abundant organic ccess, abundant plant remains (wood, possible seeds, unidentified) and many to abundant amorphous organic matter, rare fine charcoal, trace calcitic ashes and occasional roots at 0-35 mm, with below

		<p>organic ccess, abundant plant remains (wood, possible seeds, unidentified) and many to abundant amorphous organic matter, rare fine charcoal, trace calcitic ashes and occasional roots at 0-35 mm, with below trace of leached bone (including fish bone), 2 teeth fragments, abundant plant remains (wood (max 2.5mm), possible seeds, unidentified), trace of phosphatic ccess inclusions, abundant very fine and fine roots and many amorphous organic matter, abundant organic ccess, rare fine charcoal, very abundant chalky cob (calcitic with very abundant matrix intercalations), trace of probably weathered bio-calcite (Arionid plate?) and many roots; <i>Fine Fabric</i>: SMT 1a: cloudy grey (PPL), moderate interference colours (close porphyric, crystallitic b-fabric), pale grey (OIL), minerogenic; SMT 2a-2c: brown to dark brown (PPL), isotropic (very open porphyric, undifferentiated b-fabric, XPL), pale brown to dark brown (OIL), humic stained with very abundant very fine amorphous organic inclusions; <i>Pedofeatures</i>: <i>Textural</i>: <i>Crystalline</i>: many void infills of gypsum crystals and microsparitic calcite (including root pseudomorphs) at 35-90 mm; <i>Amorphous</i>: trace of iron staining throughout, with amorphous phosphate (CaP?) in the uppermost thin layer; <i>Fabric</i>: many thin burrows, over occasional thin burrows ; <i>Excrements</i>: occasional very thin and many organo-mineral excrements.</p>	<p>trace of leached bone (including fish bone), 2 teeth fragments, abundant plant remains (wood (max 2.5mm), possible seeds, unidentified), trace of phosphatic ccess inclusions, abundant very fine and fine roots and many amorphous organic matter, abundant organic ccess, rare fine charcoal, very abundant chalky cob (calcitic with very abundant matrix intercalations), trace of probably weathered bio-calcite (Arionid plate?) and many roots. Many void infills of gypsum crystals and microsparitic calcite (including root pseudomorphs) at 35-90 mm, a trace of iron staining throughout, many thin burrows, over occasional thin burrows, and occasional very thin and many organo-mineral excrements, occur.</p> <p><i>The deposits are as above, which records an original – presumed – latrine pit lining of ‘chalky’ cob/clunch earth-based building material making up Layer 70651. Although not totally clear, it seems that primary organic ccess infilling occurred, which also brought in plant remains and very small amounts of bone and phosphatic ccess; a fish bone example is present. A period of stasis then took place leading to the location becoming vegetated and root disturbance took place; deposits became</i></p>
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			<p><i>fragmented and mixed. Some decalcification, and drainage effects also led to some recrystallization of calcium carbonate, with plant roots becoming CaCO₃ replaced. In addition, post-depositional gypsum crystals formed infills (CaSO₄), probably due to organic matter breakdown under anaerobic conditions. Upwards (Layer 71755) is a microlaminated organic cess deposit with plant remains being commonly subhorizontally oriented; a partially leached ('digested') ~6.5 mm long bone fragment is also subhorizontally oriented. Only small amounts of minerogenic silt occur in this deposit, with trace of amounts of calcitic ash residues also being present – something that is not unusual in latrine deposits. Lastly, a thin yellow phosphatic cess layer is present at the very top of the sample.</i></p>
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Købmagergade, Copenhagen, Soil Micromorphology Figures 1-71

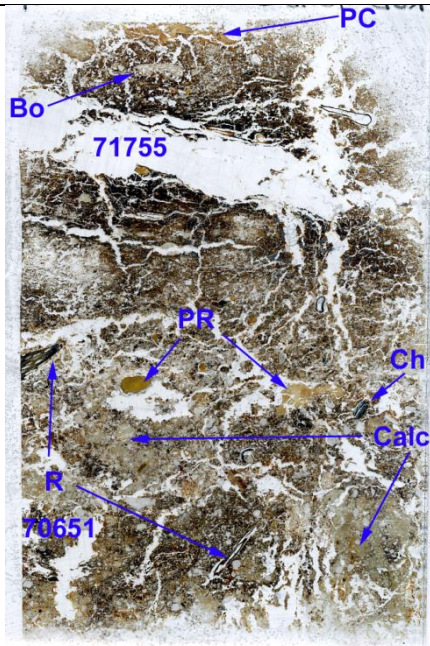


Fig. 1: Scan of M1513C (Latrine 3100); root (R) mixed lower Layer 70651 includes the remains of a calcareous earth-based latrine pit lining (Calc; Figs 2-5), and inclusions of plant remains (PR) and charcoal (Ch); rooting and decalcification/recalcification of Layer 70651 produced calcite root pseudomorphs (Figs 6-7), while post-depositional anaerobic conditions produced gypsum formations (Figs 8-9). Microlaminated organic cess in Layer 71755 is characterised by subhorizontally oriented inclusions, such as leached bone (Bo; Figs 10-15); a thin layer of yellow phosphatic cess is present at the top of the sample (PC). Frame height is ~90mm.

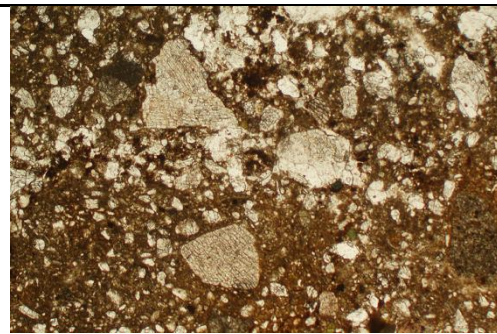


Fig. 2: Photomicrograph of M1513C (Latrine 3100; Layer 70651); 'chalky' cob/clunch building material lining the latrine pit; note matrix intercalations associated with puddling process (to remove any air). Plane polarized light (PPL), frame width is ~4.62mm.

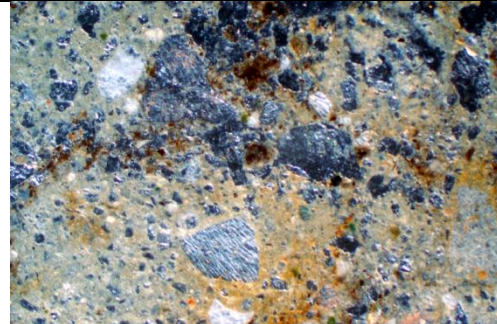


Fig. 3: As Fig 2, under oblique incident light (OIL), showing some weak iron staining and inclusion of small amounts of organic matter.

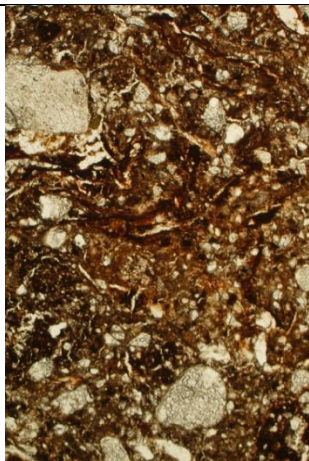


Fig. 4: Photomicrograph of M1513C (Latrine 3100; Layer 70651); 'chalky' cob/clunch building material lining the latrine pit showing root disturbance. PPL, frame height is ~4.62mm.

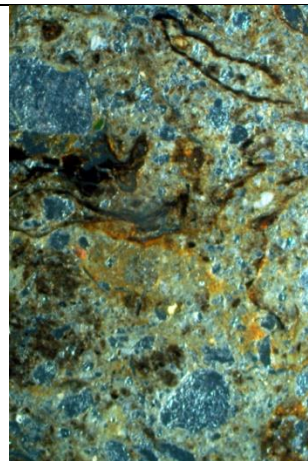


Fig. 5: As Fig 4, under OIL; note organic matter and root remains, with some iron staining.

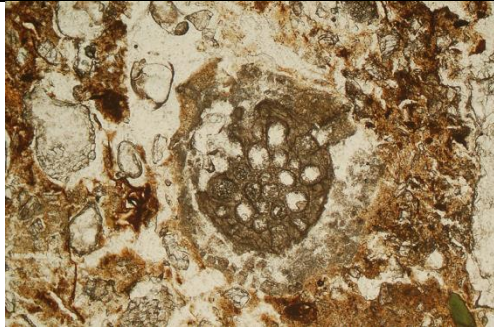


Fig. 6: Photomicrograph of M1513C (Latrine 3100; Layer 70651); calcium carbonate root pseudomorphs. PPL, frame width is ~4.62mm.

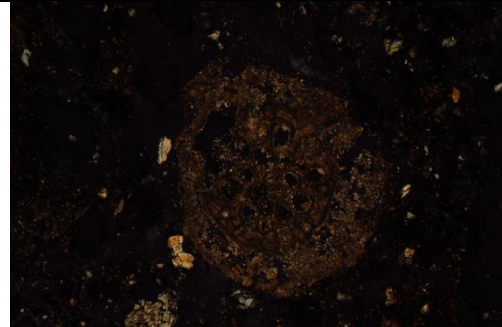


Fig. 7: As Fig 6, under crossed polarised light (XPL); micritic calcite is present.

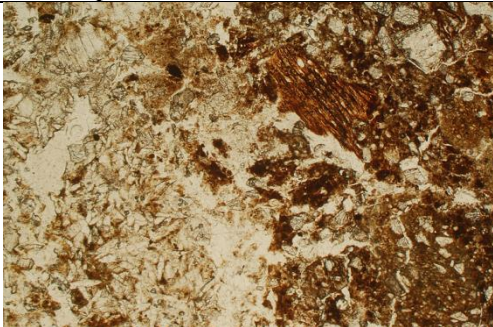


Fig. 8: Photomicrograph of M1513C (Latrine 3100; Layer 70651); mixed deposits with included plant remains; void is loosely infilled with secondary formed prismatic gypsum (CaSO_4). PPL, frame width is ~4.62mm.

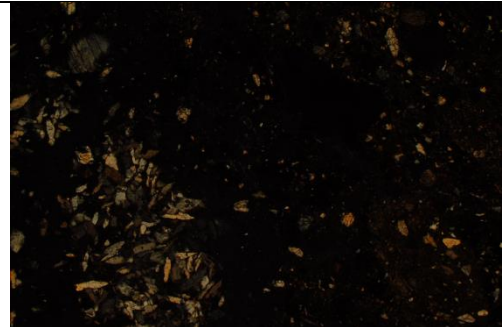


Fig. 9: As Fig 8, under XPL; gypsum shows 1st order grey birefringence.

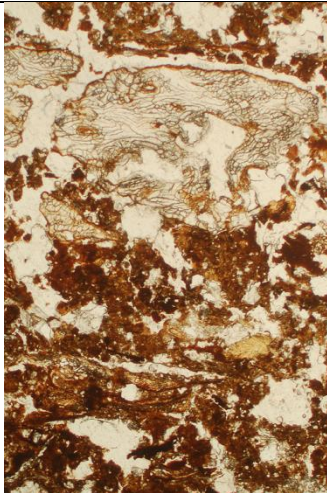


Fig. 10: Photomicrograph of M1513C (Latrine 3100; Layer 71755); microlaminated organic cess, with subhorizontally oriented leached (partially 'digested') bone. PPL, frame height is ~4.62mm.

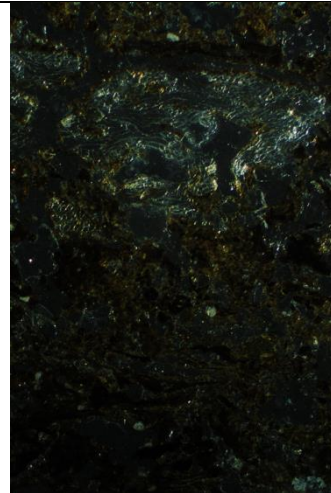


Fig. 11: As Fig 10, under OIL.

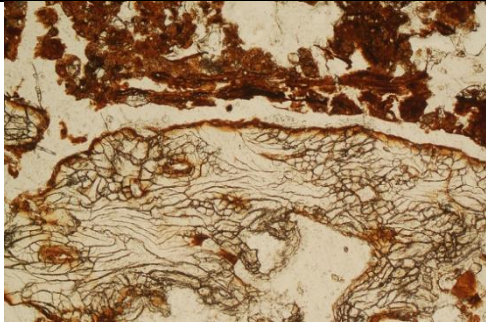


Fig. 12: Detail of Fig 10, showing bone remains and organic cess. PPL, frame width is ~2.38mm.

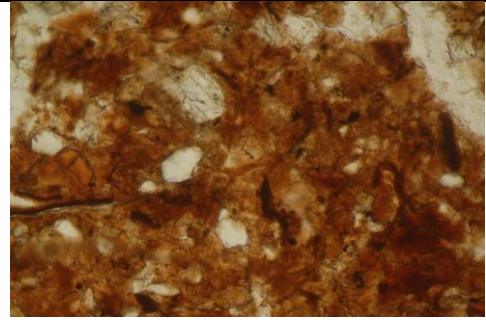


Fig. 13: High magnification image of Fig 10; amorphous organic matter remains and stained cess infill. PPL, frame width is ~0.47mm.

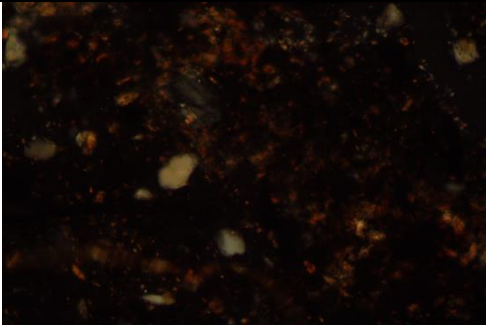


Fig. 14: As Fig 13, under XPL; fine crystallitic material is probably calcitic ash dumped into the cess pit.

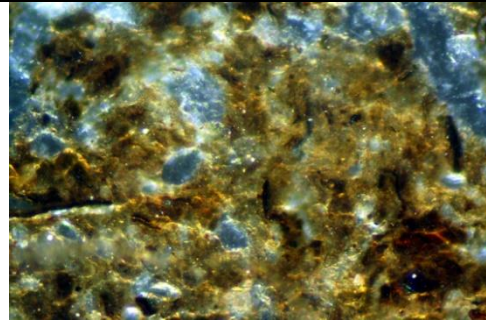


Fig. 15: As Fig 14, under OIL; ashy remains are organic matter stained.

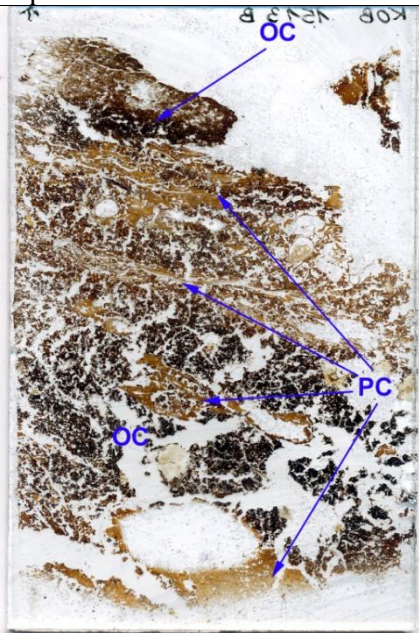


Fig. 16: Scan of M1513B (Latrine 3100; Layer 71755); alternating layers of dark brown organic cess (OC) and yellowish brown phosphatic cess, which embeds microlaminated phytoliths of presumed cereal origin (PC; Figs 17-18), occasional bone (Figs 19-20), with organic cess including layers of monocotyledonous plant remains (grasses?; Figs 21-22), and seed remains, such as probable legume testas (Figs 23-24). Frame height is ~90mm.

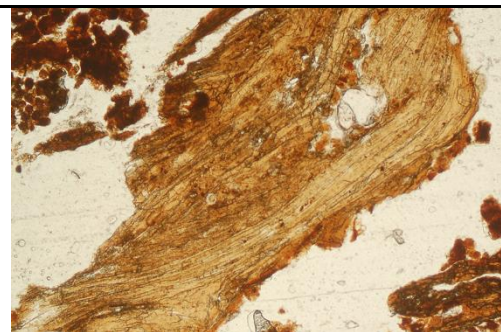


Fig. 17: Photomicrograph of M1513B (Latrine 3100; Layer 71755); phosphate-mineralised (CaP) articulated phytoliths. PPL, frame width is 2.38mm.

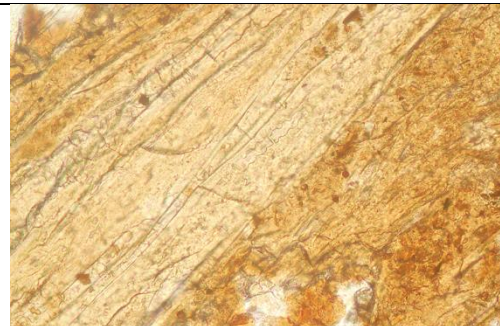


Fig. 18: High magnification image of Fig 17, showing articulated phytoliths of cereal/bran(?) origin. PPL, frame width is ~0.47mm.

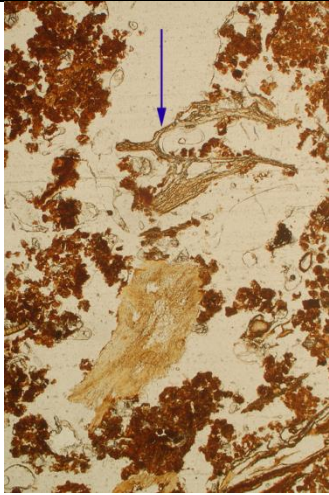


Fig. 19: Photomicrograph of M1513B (Latrine 3100; Layer 71755); pelleted bioworked organic cess, with phosphatic cess, and strongly altered probable fish bone (arrow). PPL, frame height is ~4.62mm.

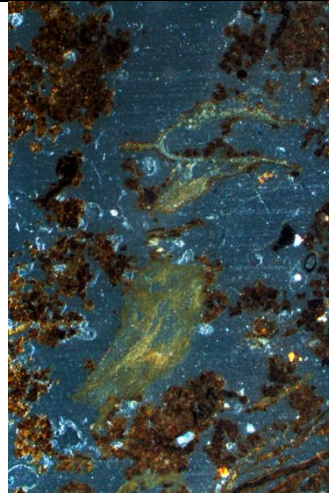


Fig. 20: As Fig 19, under OIL.

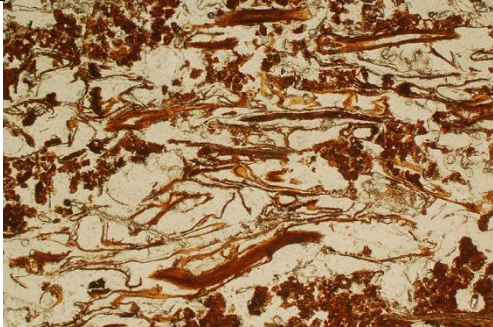


Fig. 21: Photomicrograph of M1513B (Latrine 3100; Layer 71755); organic cess with subhorizontally oriented monocotyledonous plant remains (grasses?). PPL, frame width is ~4.62mm.

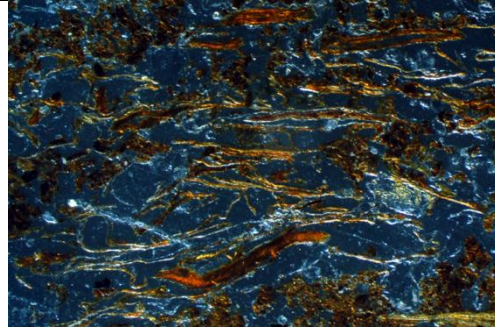


Fig. 22: As Fig 21, under OIL, showing some iron staining of plant remains.

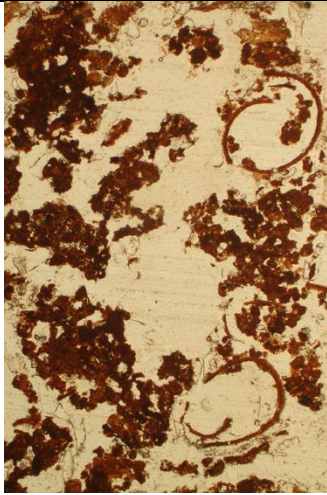


Fig. 23: Photomicrograph of M1513B (Latrine 3100; Layer 71755); pelletised organic cess with two 1mm-size seeds. PPL, frame height is ~4.62mm.

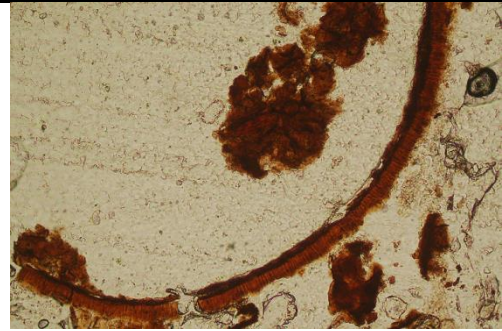


Fig. 24: Detail of Fig 23; probable legume testa. PPL, frame width is ~0.90mm.



Fig. 25: High magnification image of Fig 23; seed with typical legume testa character. PPL, frame width is ~0.47mm.

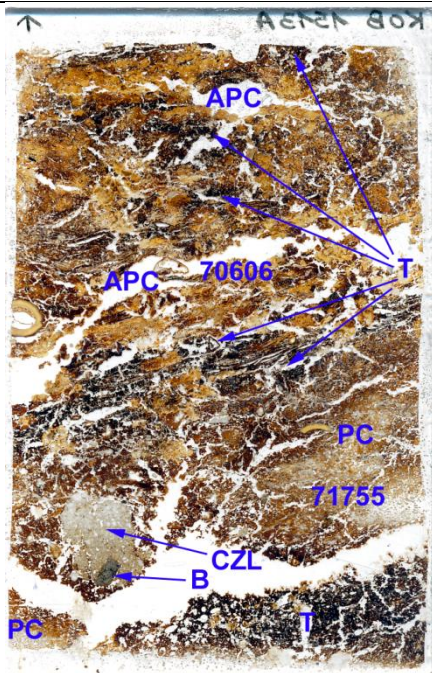


Fig. 26: Scan of M1513A (Latrine 3100; Layers 70606-71755); the phosphatic cess (PC) in 71755 includes a thin turf layer (T) and a clast of calcareous silt loam (CZL; Figs 27-28), with overlying Layer 70606 characterised by alternating altered phosphatic cess (APC; Figs 29-32) and thin turf layers (T; Figs 33-36), and geochemical changes forming gypsum (Fig 37) and the phosphatisation of gypsum on occasion (Fig 38). Frame height is ~90mm.

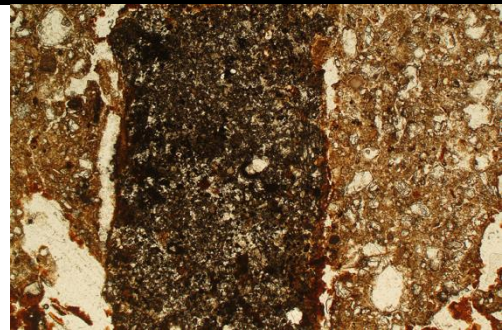


Fig. 27: Photomicrograph of M1513A (Latrine 3100; Layer 71755); calcareous silt loam clast with embedded basalt. PPL, frame width is ~ 4.62mm.

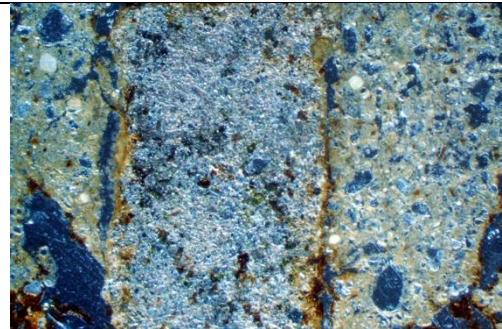


Fig. 28: As Fig 27, under OIL.

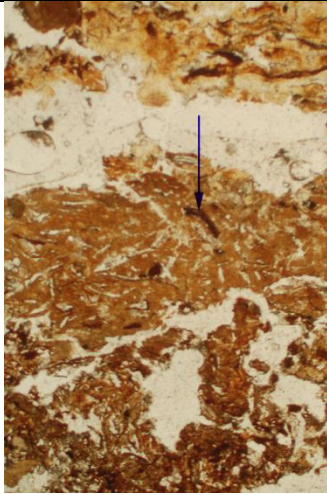


Fig. 29: Photomicrograph of M1513A (Latrine 3100; Layer 70606); altered/weathered phosphatic cess with embedded fine plant remains – possible legume testa fragment arrowed. PPL, frame height is ~4.62mm.

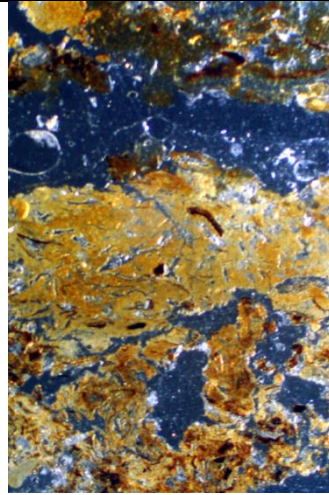


Fig. 30: As Fig 29, under OIL.



Fig. 31: Detail of Fig 29; – possible legume testa fragment within cess.



Fig. 32: As Fig 31, under OIL, illustrating weak iron staining of suggested testa.

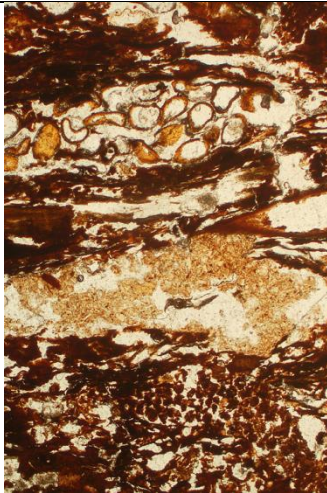


Fig. 33: Photomicrograph of M1513A (Latrine 3100; Layer 70606); Laminated Mull Humus (turf) layer with fine grass(?) roots, and pelletised organic matter; some cess infilling has occurred. PPL, frame height is ~4.62mm.

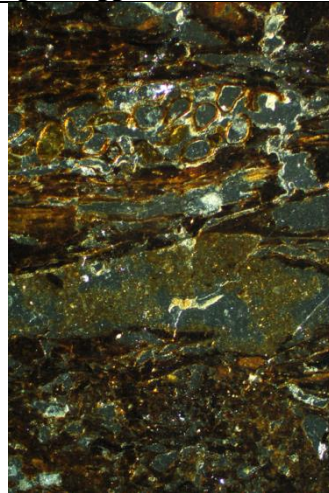


Fig. 34: As Fig 33, under OIL.

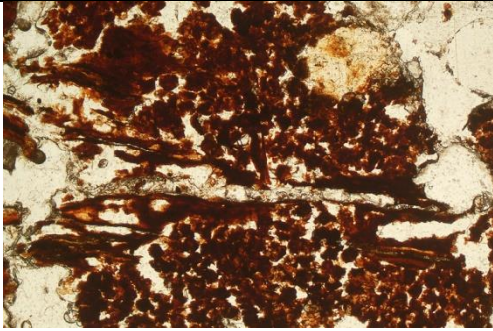


Fig. 35: Detail of Fig 33; pelletised organic matter with leaf litter and fine root remains. PPL, frame width is ~0.90mm.

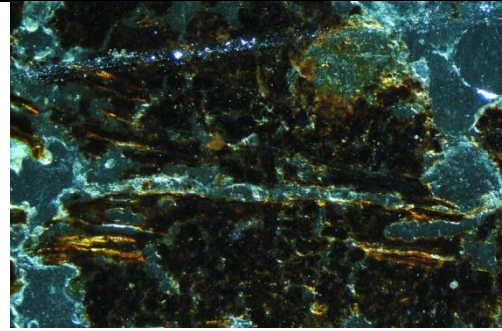


Fig. 36: As Fig 35, under; some plant remains are iron staining.

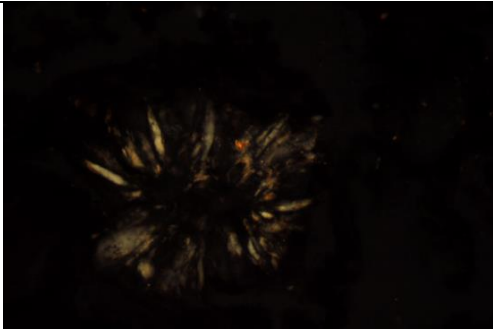


Fig. 37: Photomicrograph of M1513A (Latrine 3100; Layer 70606); acicular gypsum. XPL, frame width is ~0.90mm.

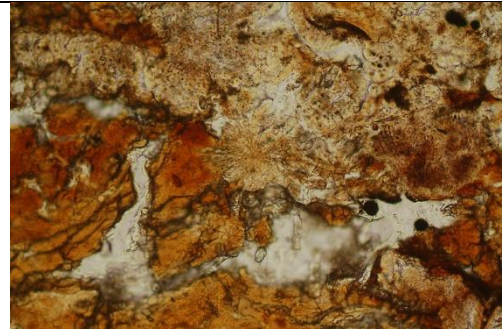


Fig. 38: Photomicrograph of M1513A (Latrine 3100; Layer 70606); altered/neofomed phosphate seems to have produced a pseudomorphs of acicular gypsum (centre). PPL, frame width is ~0.90mm.

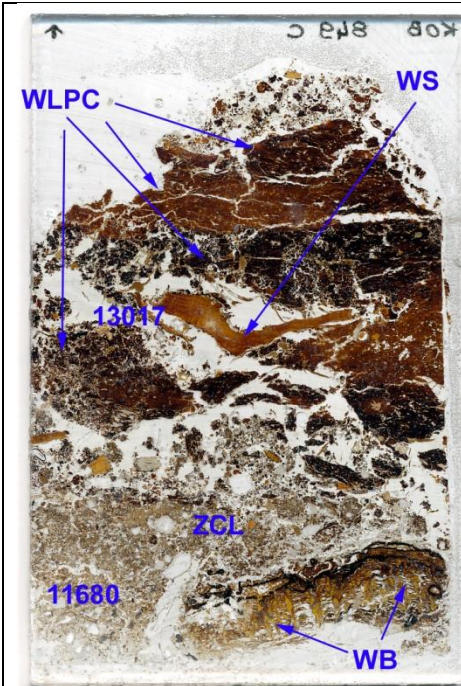


Fig. 39: Scan of M849C (Latrine Pit 8000; Layers 13017-11680); Layer 11680 is characterised by a silty clay loam infilling (ZCL; Figs 40-43) and coarse woody bar fragment (WB; Figs 44-45), and overlain by partially weathered laminated phosphatic cess (WLPC) in Layer 13017 (WLPC; Figs 46-49), where subhorizontally oriented wood splinter occurs (WS; Figs 50-51). Frame height is ~90mm.

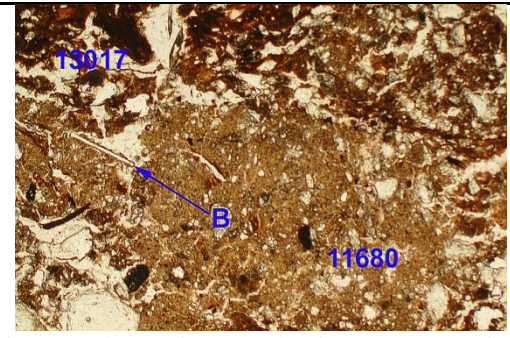


Fig. 40: Photomicrograph of M849C (Latrine Pit 8000; Layers 13017-11680); mineralogically silty clay loam basal fill (Layer 11680), including very thin bone of probable small mammal origin (B), and overlain by bioworked remains of latrine deposit 13017. PPL, frame width is ~4.62mm.

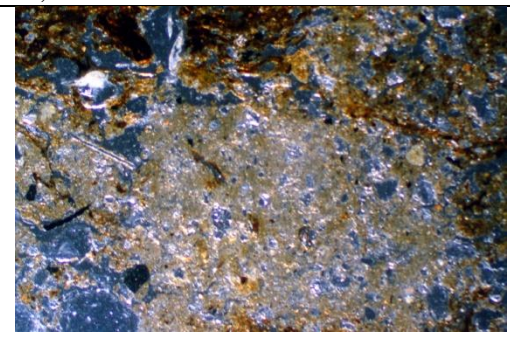


Fig. 41: As Fig 40, under OIL.

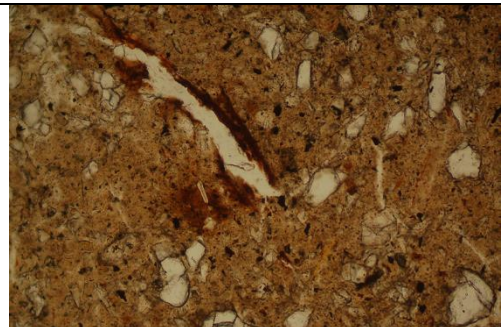


Fig. 42: Detail of Fig 40, showing matrix intercalations and very thin rootings. PPL, frame width is ~0.90mm.

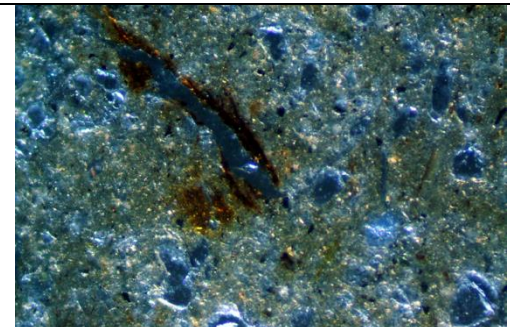


Fig. 43: As Fig 42, under OIL; note iron stained root trace and patchy matrix intercalations; the last could record trampling of the basal 'muddy' fill of the newly excavated pit.

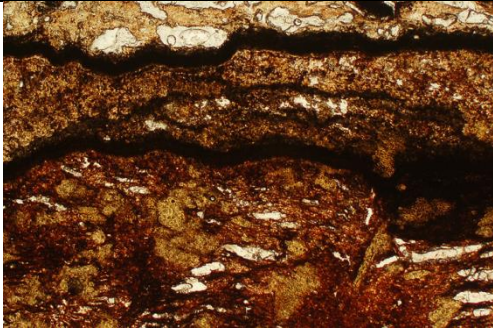


Fig. 44: Photomicrograph of M849C (Latrine Pit 8000; Layer 11680); woody bark fragment, with moderate iron staining effects. PPL, frame width is ~4.62mm.

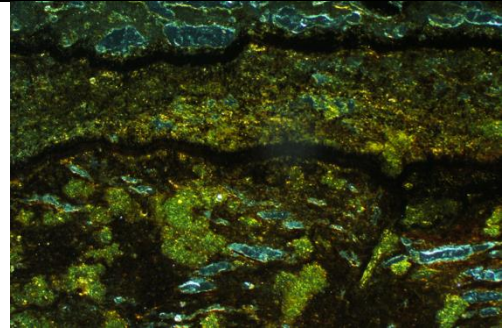


Fig. 45: As Fig 44, under OIL.

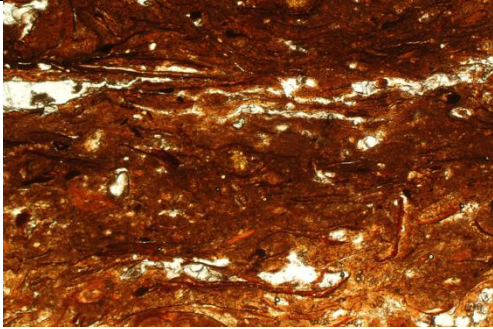


Fig. 46: Photomicrograph of M849C (Latrine Pit 8000; Layer 13017); microlaminated phosphatic cress with subhorizontally oriented plant fragments. PPL, frame width is ~4.62mm.

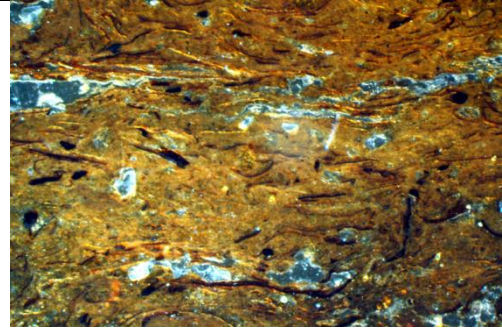


Fig. 47: As Fig 46, under OIL; plant remains probably include dietary residues, and showing various amounts of iron staining.

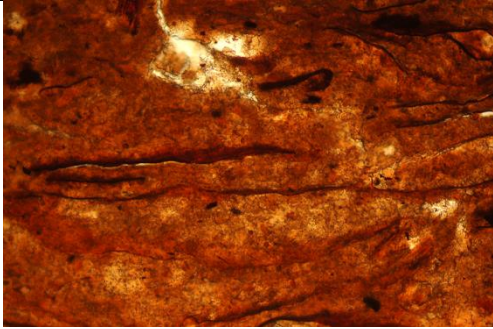


Fig. 48: Detail of Fig 46; plant fragments. PPL, frame width is ~0.90mm.



Fig. 49: As Fig 48, under OIL.

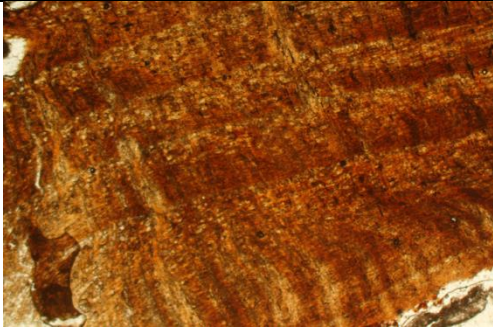


Fig. 50: Photomicrograph of M849C (Latrine Pit 8000; Layer 13017); wood working splinter (?), showing wood fibres. PPL, frame width is ~4.62mm.

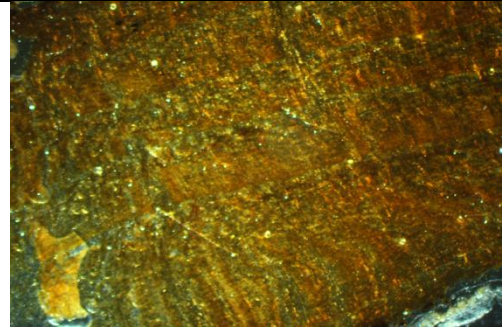


Fig. 51: As Fig 50, under OIL, showing a small amount of iron staining.

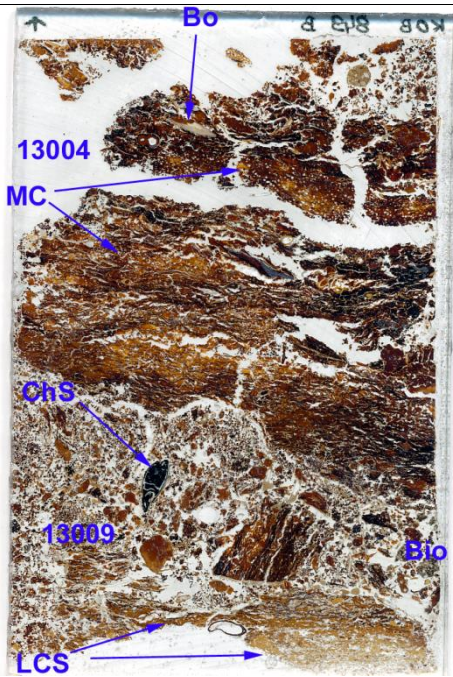


Fig. 52: Scan of M849B (Latrine Pit 8000); 13009 is composed of microlaminated cess with fine sands at the base (LCS; Figs 53-54), much of which has been strongly bioworked (Bio; Fig 56), which seems to include a charred seed – possible charred cereal grain (ChS; Fig 57). Layer 13004 is made up of microlaminated plant remains-rich cess (MC; 58-59), with upwards occasional fine bone occurs (Bo; Figs 60-61), including fish bone (Figs 62-63). Frame height is ~90mm.



Fig. 53: Photomicrograph of M849B (Latrine Pit 8000; 13009); microlaminated phosphatic cess with intercalated fine sands. PPL, frame height is ~4.62mm.

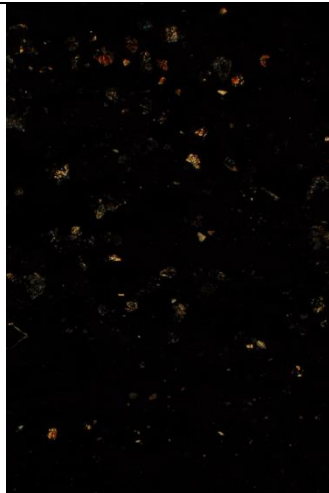


Fig. 54: As Fig 53, under XPL, illustrating fine sands.

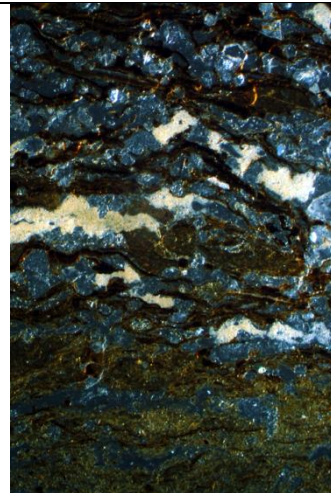


Fig. 55: As Fig 53, under OIL, showing plant remains and amorphous cess.

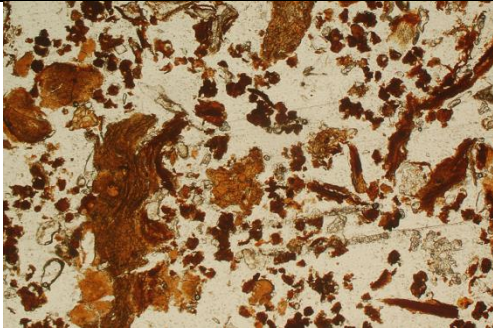


Fig. 56: Photomicrograph of M849B (Latrine Pit 8000; 13009); bioworked cess deposits. PPL, frame width is ~4.62mm.

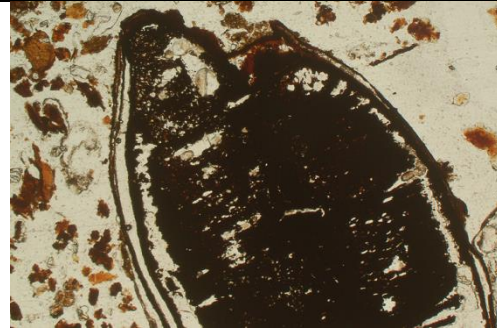


Fig. 57: Photomicrograph of M849B (Latrine Pit 8000; 13009); probable charred seed – possible charred grain. PPL, frame width is ~4.62mm.

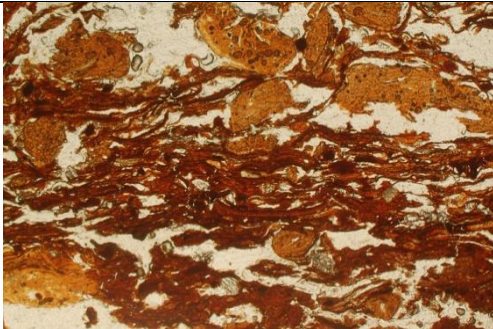


Fig. 58: Photomicrograph of M849B (Latrine Pit 8000; 13004); microlaminated amorphous phosphatic cess, including probable legume testa. PPL, frame width is ~4.62mm.



Fig. 59: Detail of suggested legume testa. PPL, frame width is ~0.90mm.

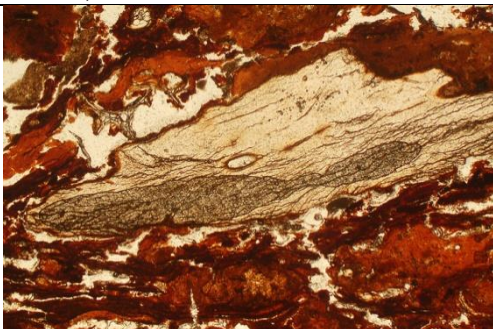


Fig. 60: Photomicrograph of M849B (Latrine Pit 8000; 13004); amorphous phosphatic cess with embedded bone fragment. PPL, frame width is ~4.62mm.

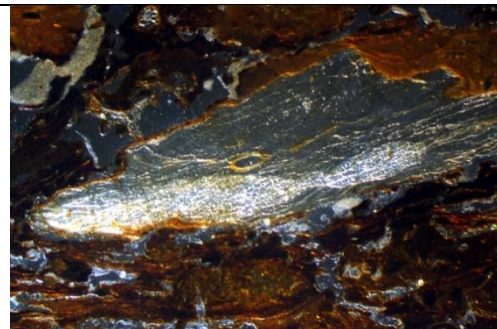


Fig. 61: As Fig 60, under OIL.



Fig. 62: Photomicrograph of M849B (Latrine Pit 8000; 13004); cess with embedded probable fish bone; note presence of likely sedge root. PPL, frame width is ~4.62mm.



Fig. 63: As Fig 62, under XPL, illustrating relict bone birefringence, and cellulose making up the sedge root.

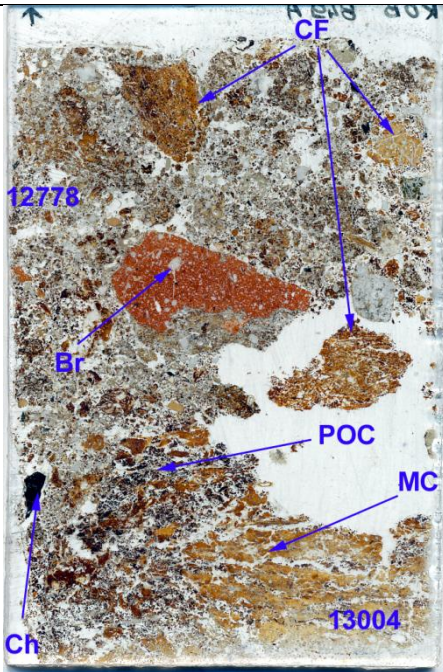


Fig. 64: Scan of M849A (Latrine Pit 8000); Layer 13004 continues upwards with weather microlaminated cess (MC) and pelletised organic cess residues (POC; Figs 65-67), charcoal example (Ch) and burrowed boundary upwards to heterogeneous Layer 12778, which contains a coarse brick fragment (Br), and is made up of a calcareous silty clay loam of likely cob constructional origin (Figs 68-70), and remains of ccess fragments (CF; Fig 71). Frame height is ~90mm.

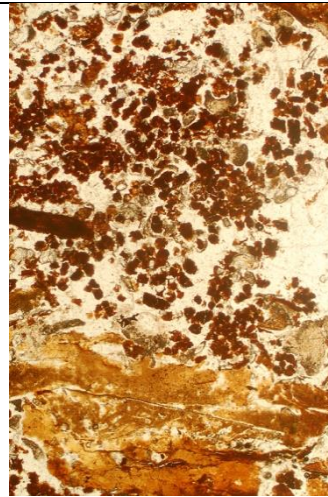


Fig. 65: Photomicrograph of M849A (Latrine Pit 8000; Layer 13004); microlaminated phosphatic ccess and pelletised less mineralized organic ccess. PPL, frame height is ~4.62mm.



Fig. 66: As Fig 65, under XPL; note silt content.

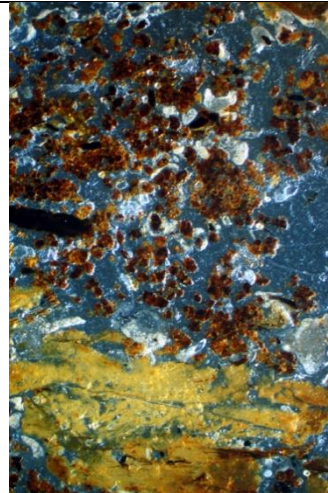


Fig. 67: As Fig 65, under OIL.

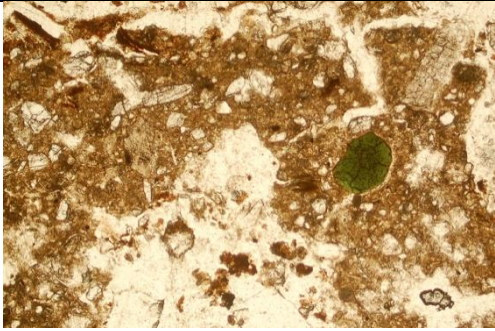


Fig. 68: Photomicrograph of M849A (Latrine Pit 8000; Layer 12778); calcareous silty clay loam of suggested cob building material origin. PPL, frame width ~2.38 mm.

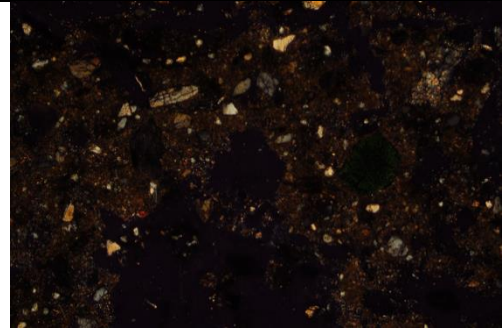


Fig. 69: As Fig 68, under XPL, illustrating calcitic content.

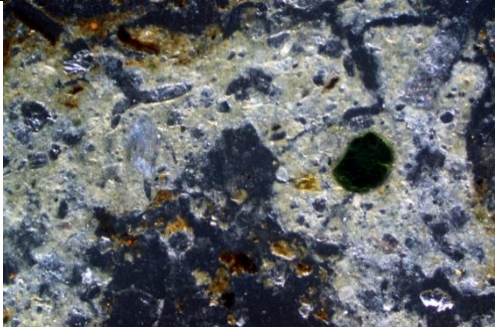


Fig. 70: As Fig 68, under OIL.

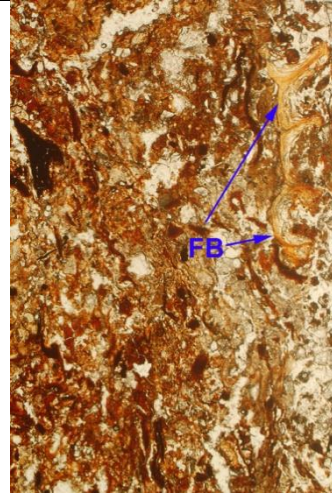


Fig. 71: Photomicrograph of M849A (Latrine Pit 8000; Layer 12778); unoriented fragment of weather microlaminated cress, with embedded fish bone. PPL, frame height is ~4.62mm.