Geoarchaeological Analysis of Monolith samples from Number 1 Poultry

Site code: ONE94

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Geoarchaeological analysis

of

Monolith samples from Number One Poultry (ONE94)

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Contents

1 Introduction

This report is concerned with the analysis of soils and sediments from selected monolith samples, taken during the excavations at Number One, Poultry. The samples investigated are all from the SW part of the site. In this area a former tributary valley of the Walbrook existed ('Tributary 1'). The valley was probably infilled, by both deliberate actions and events triggered by human activity, early in the Roman period, if not before. Because of its sink-like morphology, collecting material eroded from up-slope, good sequences of pre- and early Roman 'natural' stratigraphy have been found in this area. These deposits preserve evidence for the environment and landscape existing immediately prior to and during the earliest Roman activity.

The aim of the geoarchaeological analysis is to examine how the pre- and earliest Roman sediments sampled within the tributary valley accumulated, and were subsequently transformed. This information is needed for two further and interlinked areas of research. The first is to better understand the taphonomy of pollen and other environmental inclusions recovered from the deposits. The second is to reconstruct the changing landscape conditions within the tributary valley and to determine the role of human activities in causing this change.

The geoarchaeological analysis is intended to address the following research objectives, identified in the *UPD*:

- *Was the area cleared in the pre-Roman period?*
- *Was the area cultivated in the pre-Roman period?*
- *Were changes induced in the local ecological conditions as a result of human activity?*
- *Did the human occupation of the area lead to erosion of the interfluves and effect valley sedimentation?*

A better understanding of the deposit formation processes will enable more reliable interpretations of the microfossil (and macrofossil) assemblages extracted from them to be made. Characteristics of the deposits influencing their environmental inclusions include:

- Their rate of accumulation (single event or gradual accretion)
- The depositional processes involved (fluvial, colluvial, anthropogenic)
- The degree of post-depositional transformation (whether the deposit is a sediment or a soil; weathering, bioturbation or other disturbance, water level fluctuation etc)
- Anthropogenic input
- Sediment source

These factors must be considered alongside the taphonomic processes through which pollen (for example) is produced, liberated, transported and incorporated into a soil or sediment body, which is especially complex in archaeological, and particularly urban situations (Maloney & de Moulins 1990; Greig 1982).

The Tributary 1 valley was identified during excavation as a channel, about 6-10m wide and 1m deep, with its floor falling from *c* 7m OD to *c* 6.5m OD eastwards. It was cut down from the more level shoulder of the hillside, which lay at around 8m OD. Above this Pleistocene river terrace deposits, through which the stream had been incised, sloped gradually northwards to over 9m OD in the northern part of the site.

The nature of Tributary 1 will have influenced the earliest Roman activity in this area. It may have been clear flowing right up until the landscape disturbance caused by Roman construction work. Alternatively, it may already have been in the process of silting up prior to any Roman activity. It is intended to examine these issues by studying the pre-and early Roman deposits and their microfossil inclusions, as sampled in a series of monoliths taken across the floor and SW-facing valley side of 'Tributary 2' (see fig 1 and sample location fig xx).

2 Methodology

The approach adopted for this geoarchaeological analysis is essentially 'qualitative'. It is concerned with examining patterns in the data and it is considered that the (fairly crude) methodologies employed here are adequate to identify these trends. The analysis provides information at an intermediary scale between the site records and mico-scale thin section and microfossil analysis.

2.1 Sample location: geomorphology and topography

The tributary valley examined ('Tributary 1') cuts across the SW corner of the site. The topography of the valley was recorded by levels obtained on the top of natural during excavation. 'Natural' refers to the Pleistocene river terrace gravels (Taplow Gravels) or its brickearth (Langley Silt Complex) capping, where this survives. In many cases however, it was difficult to differentiate during excavation between these Pleistocene 'natural' deposits and deposits that had accumulated through natural fluvial and colluvial processes during the Holocene. In no part of the valley had the Pleistocene sediments been eroded to expose the underlying London Clay bedrock. The valley was incised into the Pleistocene river terrace, which rises to over 9m OD further north. The valley/channel side appears to have sloped quite sharply from a little above 8m OD on its flatter shoulder, to about 7m OD in the central part of the valley floor, which fell to about 6.5m OD eastwards (downstream).

The six monolith sequences examined in this report were taken through sediments accumulated at various elevations above the surface of river terrace gravel within the tributary valley. The sequences did not all go down to the underlying Pleistocene deposits, however. The elevation of each sample above or in relation to the Pleistocene gravel, as recorded during excavation, is illustrated in Fig 1.

The topographical characteristics of the monoliths examined are:

- {812} and {906} taken from the shoulder of the terrace. Both samples may be from palaeochannels or gullies incised into the shoulder of the hillside, infilled with fluvial/colluvial sediments.
- {890} and {900} taken from a little above the valley floor at the northern edge of the valley (neither extend down into Pleistocene deposits).
- {895} and {898} taken from the central axis of the valley (only {898} extends down into Pleistocene deposits).

2.2 Lithology

The monoliths were previously described in detail as part of the geoarchaeological assessment and the assessment descriptions are included in this report. The correspondence of the units described to the site stratigraphy is given in Figs 2-4.

2.3 X-radiography

As x-rays operate at a different wavelength to visible light they can pick up properties of a sediment, especially those relating to sediment density, mineral content, bedding and packing that cannot easily be seen by eye. Examination of x-ray negatives can also overcome problems where changes in the sediment are masked by more visible properties, such as colour. Thus x-ray analysis of monolith tin samples helps to enhance the litho-stratigraphic analysis in a number of ways (see Barham 1995). It enhances description through highlighting often non- or poorly- visible structures in the sediments (eg: laminae and unit boundaries) as well as giving some indication of the size and angularity of inclusions buried in the samples. Furthermore, x-rays can highlight areas of disturbance caused by bioturbation, which can influence the interpretation of the results of microfossil analysis.

The x-radiography was carried out by Graham Spurr (MoLSS).

- The plastic insert containing the sediment was lifted out of each monolith tin and placed diagonally to fit onto the floor of an x-ray machine (in the MoL conservation laboratory) above a Kodak Industrex 10x40cms Pb contact film.
- Lead letters were used to label the top of each sample and the details were logged into the lab x-ray log book.
- Each sample was x-rayed for 70 seconds at 70Kv.

2.4 Particle size

Particle size composition reflects the source material, the mechanisms of erosion and transport, and the post depositional processes (such as soil formation and weathering) that subsequently acted upon a sediment body. In this study an examination of trends in particle size composition was undertaken to contribute to a determination of the extent to which soil formation, colluvial re-deposition of upslope soil material, fluvial activity including surface wash processes, and/or human dumping had been responsible for the formation of selected period 1 and 2 deposits.

The qualitative particle size technique adopted was undertaken once all the other forms of analysis were completed, as wherever a sub-sample for particle size was taken it used up the entire amount of sediment remaining in the tin.

- Slabs of sediment of as even width as possible, but respecting deposit interfaces, were cut from the sample and air-dried.
- Each slab was weighed, and washed over a nest of sieves with 2mm, 0.5mm and 63um apertures.
- The sediment from each size fraction was dried, weighed and the weight of the < 63um fraction (that had been washed through the sieves) calculated by subtraction.
- The weights of each size fraction were expressed as percentages and are presented in histogram form in the results section.

2.5 Magnetic susceptibility

The qualitative magnetic susceptibility tests undertaken in this analysis looked for variations in the 'magnetisability' of the sediments (and inclusions) in order to highlight any levels of abnormality or interest in the sedimentary profile.

Sediments become susceptible through a variety of ways such as chemical change through pedogenesis (soil formation - which increases the presence of iron oxides) and chemico-structural change through burning/heating. This can indicate land/occupation surfaces, episodes of burning, or other anthropogenic disturbances. Granular remains of fired objects such as pot or brick can also be detected. By this means, fluctuations in the human input to a deposit might be detected by the presence of minute flecks of ceramic material that are not easy to detect by eye. In addition, differences in magnetisability can be due to different sediment sources. For this reason the magnetic susceptibility of a brickearth 'control' sample was also recorded.

The magnetic susceptibility analysis was undertaken by Graham Spurr (MoLSS).

- Each tin was passed through a Bartington Magnetic Susceptibility loop sensor and measured at 2cm intervals (as outlined in Dearing 1994).
- The results were calibrated to volume susceptibility (*k*) values and are presented in graph form in the results section.

2.6 Loss-on-ignition (LOI)

In this technique first soil moisture, then organic matter and finally carbonate are burnt off small sub-samples of sediment, of known original weight. From the differences in weight loss at set temperatures it is possible to calculate the proportion of organic, carbonate and mineral (non-carbonate) fractions in each sub-sample.

Trends through the profile, or through an individual context in each of these variables can indicate the sort of conditions under which a deposit has accumulated. In particular it can suggest whether soil formation has occurred and whether and at what level in the profile the addition of external inputs has taken place. Comparison between contexts can help identify differences in types of depositional and post-depositional events.

The analysis was undertaken by Graham Spurr (MoLSS), following the methodology outlined in Gale and Hoare (1991).

- Sub-samples were taken from key locations down the profile, as evenly spaced as could be managed to allow sampling of targeted areas. As only 45 crucibles comfortably fit in the muffle furnace, the location of the sub-samples had to be carefully selected to maximum the spread and detail of information that could be obtained from 45 sub-samples.
- The selected sub-samples were ground, placed in weighed crucibles, dried to drive off any moisture and re-weighed.
- The dry sediment plus crucibles were then fired at 550 and later 1100 degrees centigrade in a muffle furnace. After each firing they were removed, cooled in a desiccator, and re-weighed to calculate the weight loss as organic matter and carbonate, respectively were burnt off.
- The sediment remaining in the crucible is the non-carbonate mineral component of the sample.
- The weights of the organic, carbonate and mineral component of each sub-sample were calculated by subtraction, expressed as a percentage and are presented in graph form in the results section.

2.7 Integration and synthesis of the results for each profile

The limitations of the methodologies adopted are not discussed here, but many exist. Furthermore, each of the sedimentary techniques outlined above is only really meaningful when viewed alongside the results of the other types of analysis. For example, magnetic susceptibility is to some extent dependant on the organic and carbonate content of a deposit (as both have very low levels of magnetisability). Therefore it is useful to interpret the magnetic susceptibility data *in tandem* with the LOI results. Similarly, as the particle size of a deposit can result from both depositional and post-depositional processes, the results need to be compared to evidence from other analytical techniques and in particular those relating to the structure of a deposit (description, x-ray and thin section analysis) to be reliably interpreted.

In addition, the results of pollen, diatom and environmental macro-remain analysis will produce information that, if examined together with the sedimentary evidence, is likely to produce a better understanding of site formation processes and as a result provide more robust and informative reconstructions of past environments.

Undisturbed blocks of sediment for thin section analysis were taken adjacent to several of the monolith tins. Where these have been selected for analysis they will provide geoarchaeological information from the micro-scale characteristics of a deposit. In many cases such information can be informative when compared to larger-scale characteristics. Thus where thin sections have been analysed from adjacent to one of the monoliths examined in this report, the complimentary, but smaller-scale and on the whole quantitative results (see soil micromorphology report) have been considered alongside the larger scale, qualitative approach adopted for the monolith analysis.

In order to illustrate the inter-relationship of the different techniques discussed in this report and to enable the results and discussion to be followed by the reader, the distribution of the samples taken from the six monolith profiles is shown in (Figs 1-3). These figures also indicate where adjacent blocks for soil-micromorphological thin section analysis were taken and the location of bulk samples for plant remains and insects. The information from the various techniques is integrated separately for each monolith profile sampled in an attempt to understand the sequence of changing environments and landscape/formation processes that each represents.

In section 4 the information from each profile is compared within the framework of the site stratigtraphy.

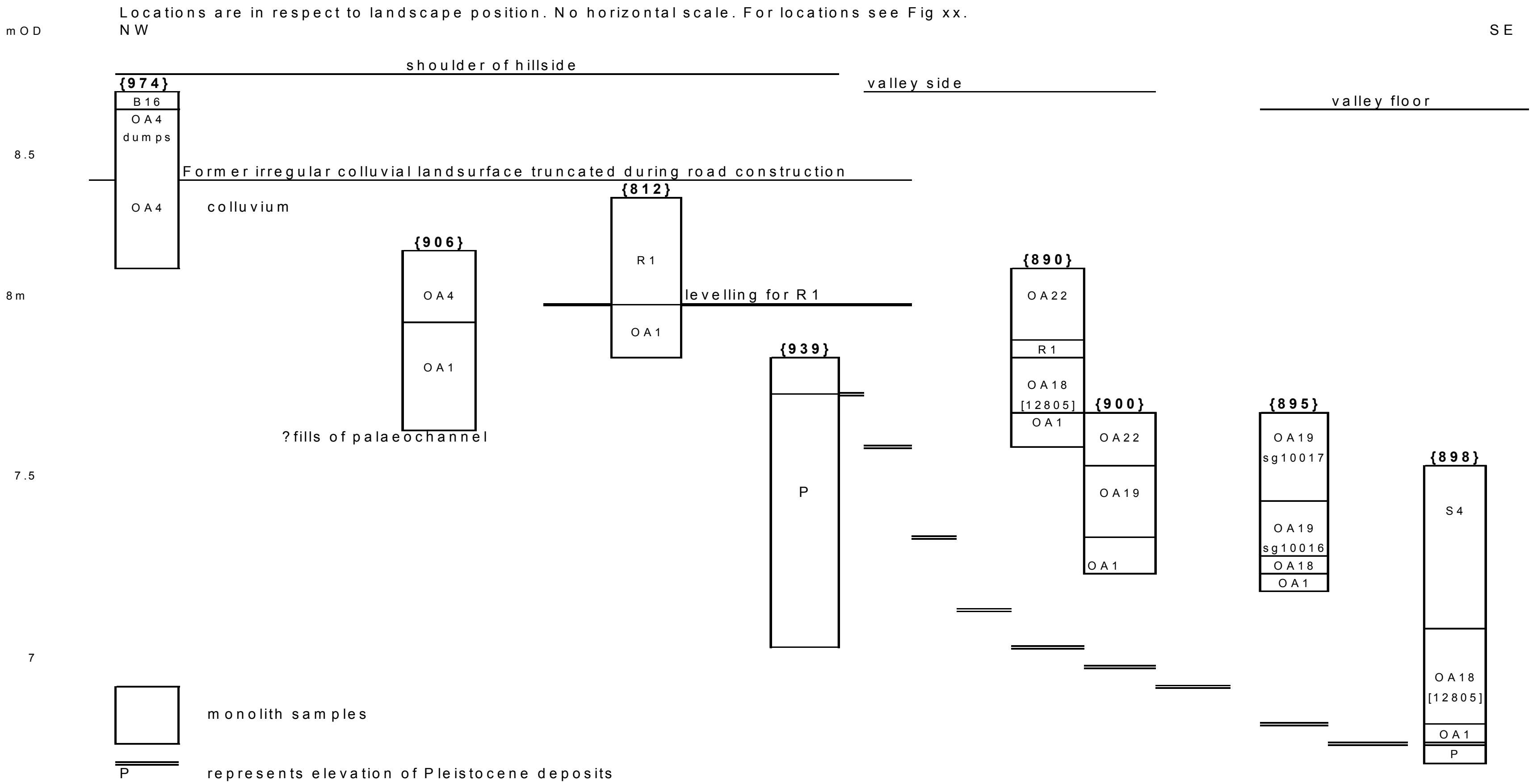


Fig 1: Diagrammatic transect across Tributary 1 to illustrate the relationship of deposits and monolith locations discussed in the report

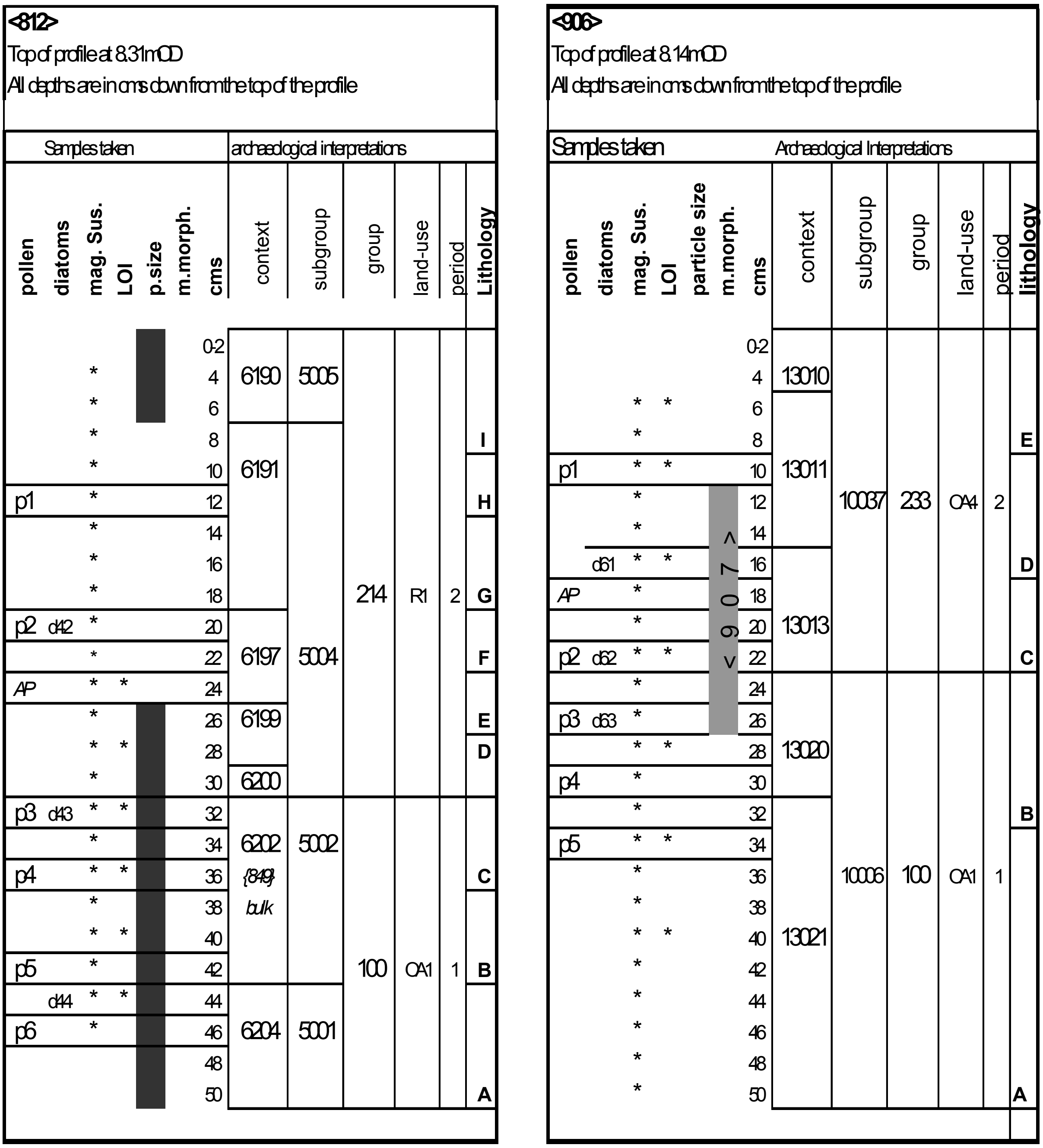


Fig 2: The sub-samples taken from monoliths {812} and {906} (on valley shoulder)

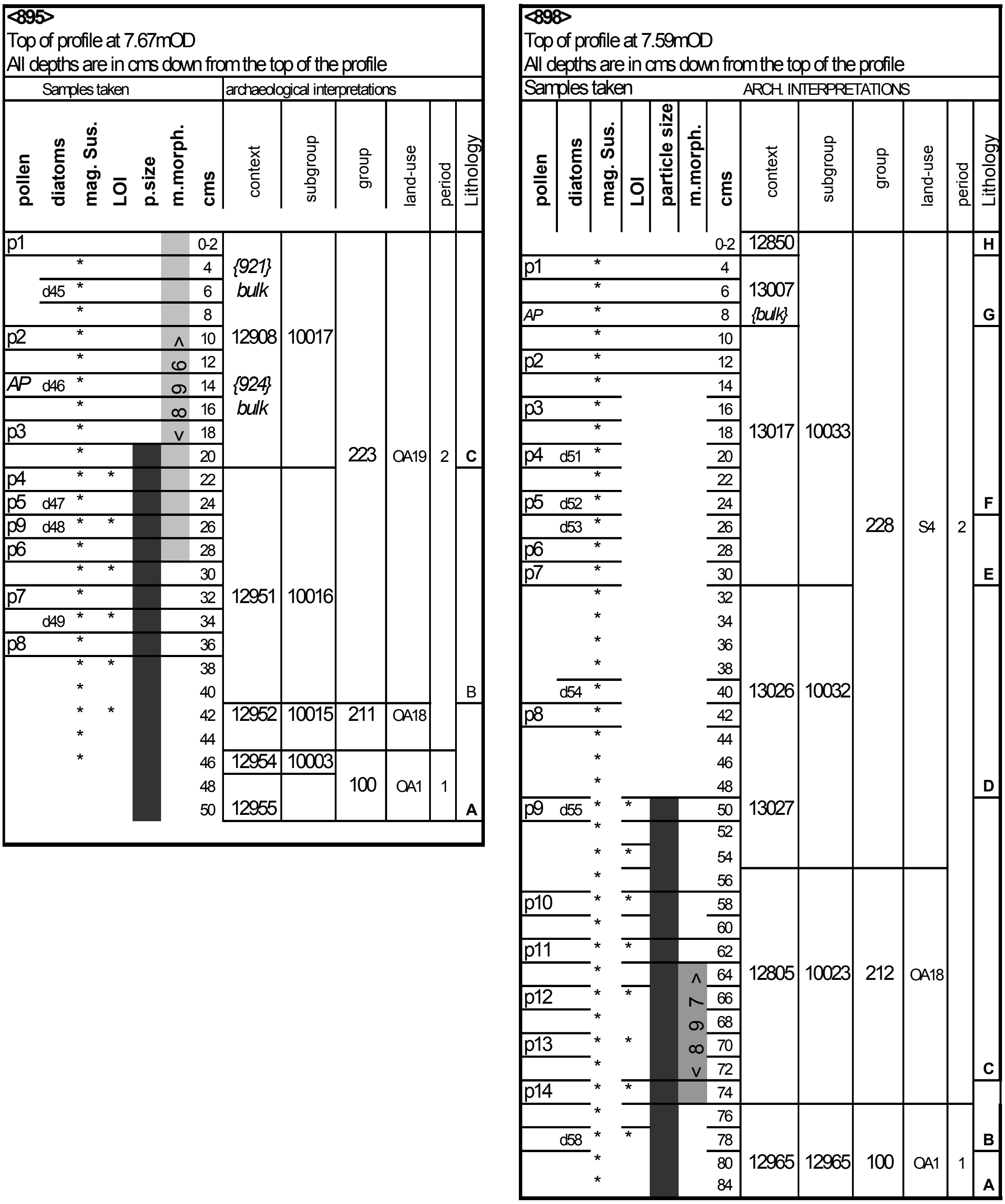


Fig 3: The sub-samples taken from monoliths {895} and {898}(valley floor)

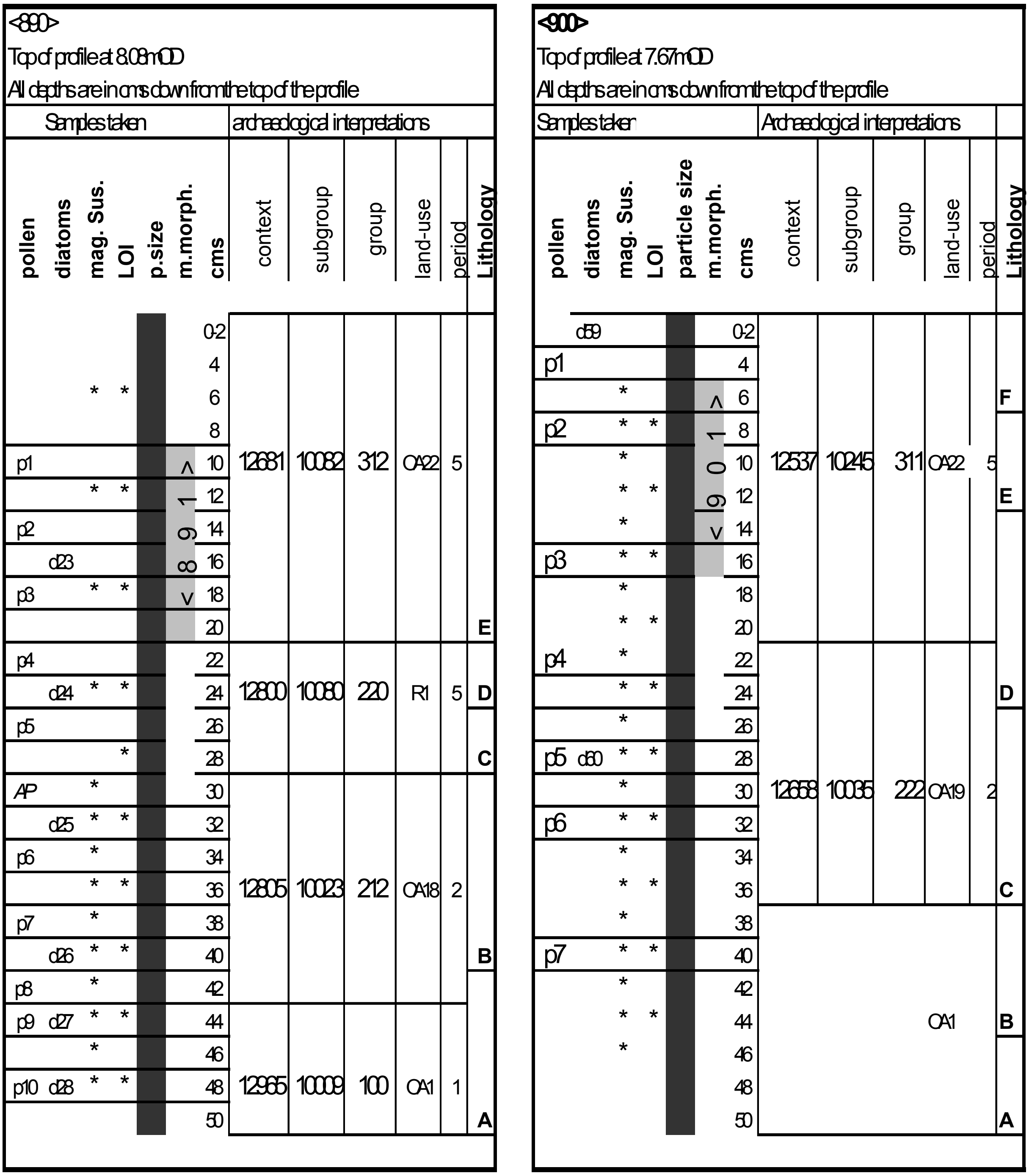


Fig 4: The sub-samples taken from monoliths {890} and {900} (valley side)

3 Results

3.1 Geomorphology and topography

From the location of the samples themselves (see Fig 1 and location plan) it is possible to predict the predominant landscape processes operating in each place and the type of sediments likely to be encountered in each tin.

Monoliths {812} and {906} were located on the plateau surface of the shoulder of the hillside above the tributary channel and would therefore be expected to have experienced a fairly stable environment, with the effect of soil forming (ie: post depositional) processes outweighing sedimentary processes (erosion and deposition). However, interpretation of the processes operating at these locations is complicated by the fact that both samples are likely to have been taken through former channel features (as such features would have preserved sediments below the general level of ground truncation that removed contemporary deposits from the surrounding area).

Although monolith {939} was not examined during analysis, it has been included on fig 1 as it was located towards the edge of the plateau, immediately above the tributary valley and records the top of the underlying *in situ* Pleistocene deposits at *c* 7.70m OD. In this location erosion would be expected to predominate over the accumulation of sediments. This might have been the case, as no fine-grained deposits similar to those found above gravel elsewhere on the shoulder, side and floor of the tributary valley were found in this location. Instead the upper part of the gravel was disturbed and may have formed the subsoil for a thin gravely soil, which had been truncated during road levelling activities. Monolith {974} was sampled for pollen and adjacent samples were taken for soil micromorphology ({793}). It has been included on fig 1 as it was located on the upper part of the shoulder, closer to the higher ground to the north. In contrast to {939} it is likely to have been situated in a 'receiving' location for the accumulation of sediments derived from upslope ('colluvial' deposits). This has been supported by the thin section results (see soil micromorphology report).

Monoliths {895} and {898} were located above the valley floor itself. It is likely they experienced a diversity of fluvial (ie: produced by flowing water within a river system) erosional and depositional events, as is characteristic of a valley floor situation. However, this cannot be examined as the entire sequence was only sampled down to Pleistocene deposits in {898}.

On the other hand, {890} and {900} at the foot of the valley side were likely to have been subjected to the regular accumulation of colluvial sediments (as a result of similar processes to those experienced by {974}, but influenced by the steeper nature of the slope above). As these monoliths did not extend down to the Pleistocene gravels it is likely that in neither case has the earliest prehistoric sediments pre-dating slope disturbance and colluviation been sampled, which may have been deposited by fluvial processes. It is also likely that considerable colluvial deposition, especially in the area of {890} had already taken place prior to the base of the (OA1) sequences sampled (see fig 1).

3.2 Lithology

The monoliths descriptions are summarised below (in each case 'A' represents the base of the sequence and the depth represents the part of the monolith tin occupied by the unit described, measured up from its base). The correspondence of the units described with the site stratigraphy is shown on Figs 2-4.

Sample 812

unit	depth (cms)	description
A	0 - 10	2.5Y6/3 light yellowish brown sandy clay. Diffuse contact to unit B.
B	10 - 13	10YR4/3 brown clayey very slightly sandy silt. Charcoal + brick/tile flecks. Pebble sized gravel. Iron stained veins. Diffuse contact to unit C.
C	13 - 22	10YR3/2 very dark greyish brown sandy silt; infrequent granule sized gravel clasts; charcoal flecks. Small patches of manganese with iron-stained rims. Sharp contact to unit D.
D	22 - 24	2.5Y7/4 pale yellow coarse sand. Fingers of manganese staining with iron-stained rims protrude into unit from above. Granule sized gravel clasts. Sharp irregular contact to unit E.
E	24 - 27	7.5YR4/3 brown slightly clayey sandy silt. Occasional granule sized gravel. Manganese stained patches. Sharp irregular contact to unit F.
F	27 - 32	10YR6/2 light brownish grey gravelly silty clay. Iron-stained patches. Sharp contact to unit G.
G	32 - 37	Predominantly 10YR5/4 yellowish brown mottled silty sand. Greyer reduced patches and manganese staining. Possible slanting alignment of occasional small pebble / granule sized gravel clasts and organic lenses. Sharp slanting contact to unit H.
H	37 - 41	10YR4/2 dark greyish brown sandy silt. Similar to units C and E. Small pebble sized clasts at top. Sharp irregular contact to unit I.
I	41 - 50	2.5Y5/3 light olive brown slightly silty sandy gravel. Iron-staining at base.

Top of sequence at 8.31m OD

Sample 890

unit	depth (cms)	description
A	0 - 11	7.5YR black slightly sandy organic silt with visible sand grains. Paler

		patches with varied texture and faint iron-stained perimeters. Very infrequent small pebble sized flint clasts. Charcoal patch at base of unit. Sharp contact to unit B.
B	11 - 22	7.7YR3/2 very dark brown slightly silty coarse sand. Infrequent granule to pebble sized flint clasts. Haphazard, discontinuous, iron-stained laminae. Infrequent charcoal flecks and non-humified plant (?stem) fragments. Non-humified plant material more abundant at contact with unit C. Sharp contact to unit C.
C	22 - 25	7.5YR 2/1 black slightly silty coarse sand. Frequent pebble sized gravel and bone clasts. Poorly consolidated (loose). Clay lens towards top of unit. Sharp contact to unit D.
D	25 - 28	10YR2/1 black slightly sandy organic silt. Non-humified wood fragments. Frequent charcoal. Poorly consolidated. Diffuse contact with unit E.
E	28 - 50	10YR4/2 dark greyish brown slightly silty coarse sandy gravel. Moderately poorly sorted; granule to pebble sized clasts of flint, stone, wood, bone and shell. Infrequent iron-concreted nodules. Lenses of yellow sand at top of unit.

Top of sequence at 8.08m OD

Sample 895

unit	depth (cms)	description
A	0 - 11	7.5YR4/2 brown sandy silt. Pebble sized flint clasts become more abundant towards top of unit. Lenses of iron-stained coarse sand (7.5YR5/8-strong brown) more common towards top and black (?manganese) lens at base. Sharp irregular contact to unit B.
B	11 - 30	7.5YR4/1 dark grey slightly sandy clayey silt. Frequent granule to small pebble sized flint clasts. Unit fines upwards - sandier silt at base and clayey silt at top. Extensive black reduced/anaerobic areas associated with lenses of manganese and non-humified plant-macros - twig, stem, hazelnut shell. Sharp irregular contact to unit C.
C	30 - 50	7.5YR2.5/1 black silty woody peat. Sub-horizontal to slanting laminae of compressed and matted plant material interspersed with clay lenses (5Y7/1 grey) and infrequent sand lenses towards base. Visible sand grains within organic laminae at top. Fine gravel, oyster shell and non-humified twig, wood and stem macro-fossils at top of unit. Manganese stained patches and vivianite nodules towards base. Rings of iron-staining (?former roots).

Top of sequence at 7.67m OD

Sample 898

unit	depth (cms)	description
A	0 - 3	2.5Y6/3 light yellowish brown very well sorted medium-coarse sand. Sharp contact to unit B.
B	3 - 11	10YR5/2 greyish brown silty sandy gravel. Matrix fines upwards. Poorly sorted granule to pebble sized flint clasts. Diffuse contact to unit C.
C	11 - 37	7.5YR3/2 dark brown highly organic silt, slightly darker at base. Frequent visible sand grains. Frequent flint clasts mostly granule to very small pebble sized. Occasional silty clay lenses. Well consolidated. Discrete darker patches speckled with manganese and with faint orange iron-stained perimeter throughout. Sharp, irregular, disrupted contact to unit D.
D	37 - 56	10YR6/6 brownish yellow, darkening upwards to 10YR4/6 dark yellowish brown, poorly consolidated, coarse sand. Granule to pebble-sized flint clasts more common towards base. Lenses and sub-continuous laminations of well-consolidated 10YR4/2 dark greyish brown clayey silt and less frequently of 10YR8/2 very pale brown medium sand. Frequent iron-concreted nodules, iron-stained stones and patches, particularly at top and base of unit. Sharp contact to unit E.
E	56 - 59	2.5Y3/1 very dark grey gravelly organic silt. Frequent non-humified wood, twig and stems. Pebble sized flint clasts. Black lens at top of unit (?charcoal, ?manganese, ?organics). Diffuse contact to unit F.
F	59 - 74	2.5Y4/2 dark greyish brown slightly gravelly sandy organic silt; occasional non-humified twig and stem. Mottled clayey silt lenses. Diffuse contact with unit G.
G	74 - 82	2.5Y5/2 greyish brown silt; fining upwards. More organic towards base but discrete lenses of compressed plant material and possible charcoal fragments towards top. Occasional iron concretions and manganese stained patches. Sharp contact to unit H.
H	82 - 84	10YR5/6 yellowish brown unconsolidated iron-stained sandy gravel.

Top of sequence at 7.59m OD

Sample 900

unit	depth (cms)	description
A	0 - 7	7.5YR7/1 light grey moderately compact silty sandy gravel. Organic, silty lenses. Diffuse contact with unit B.
B	7 - 14	7.5YR5/2 brown organic gravelly silty sand.
C	14 - 25	7.5YR3/2 dark brown slightly clayey, sandy organic silt. Occasional small pebble sized flint clasts. Infrequent non-humified plant macros, wood and charcoal. Sharp, irregular contact to unit D.
D	25 - 38	7.5YR4/3 brown, silty sandy gravel. Moderately poor sorting; granule to pebble sized flint clasts. Sub-continuous 10YR8/2 very pale brown sand laminae. Lenses of finer (?more organic) material. Iron

		concretions. Diffuse contact to unit E.
E	38 - 43	7.5YR3/2 dark brown organic sandy silt. Non-humified wood. Fine flint gravel clasts. Diffuse contact with unit F.
F	43 - 50	10YR4/2 dark greyish brown silty sand. Flint gravel, charcoal and iron-concreted clasts.

Top of sequence at 7.67m OD.

Sample 906

unit	depth (cms)	description
A	0 - 17	Mottled 10YR4/3 brown sandy silt and 10YR5/6 yellowish brown (iron-stained) sand. Lenses of gravelly sand and of organics. Frequent small pebbles - well sorted. Iron staining and concretions, especially towards top of unit. Sharp wavy contact to unit B.
B	17 - 27	7.5YR5/2 brown silty gravelly sand; frequent small flint pebbles. Manganese stained patches throughout. Similar to unit D but coarser and more poorly sorted. Sharp contact to unit C.
C	27 - 34	7.5YR3/2 dark brown, smooth compact highly organic silt. Pebble sized non-humified wood, with sub-horizontal orientation and granule-sized rounded clay clasts. Sharp irregular contact to unit D.
D	34 - 42	Mottled 10YR4/2 greyish brown silty sand and 10YR3/2 dark greyish brown sandy silt. Infrequent pebble sized clasts. Sand lenses. Patches of manganese and iron-staining. Similar to unit B, but finer and better sorted. Sharp irregular contact to unit E.
E	42 - 50	10YR4/3 brown, loose, slightly silty, very sandy gravel. Granule to small pebble sized flint clasts. Iron-concretions.

Top of sequence at 8.14m OD.

3.3 X-radiography

The negatives were developed and studied over a light box in order to see whether there was any evidence for bedding, rooting, cracking or any other characteristics that had not been visible by eye. The results were used to determine the type of depositional and post-depositional processes contributing to the formation of the different sediment units sampled. The negatives will form part of the site archive.

3.4 Particle size

The main aim of particle size analysis was to attempt to detect evidence for:

- Depositional processes
- Soil formation - by trends within a context
- The re-deposition of upslope material
- human input to a deposit

The percentage composition of each slab is illustrated in histogram form in Figs 5-9, which also show the parts of each monolith sampled, the particle size composition of each and its relationship to the other sub-samples taken. The full results can be found in the site archive.

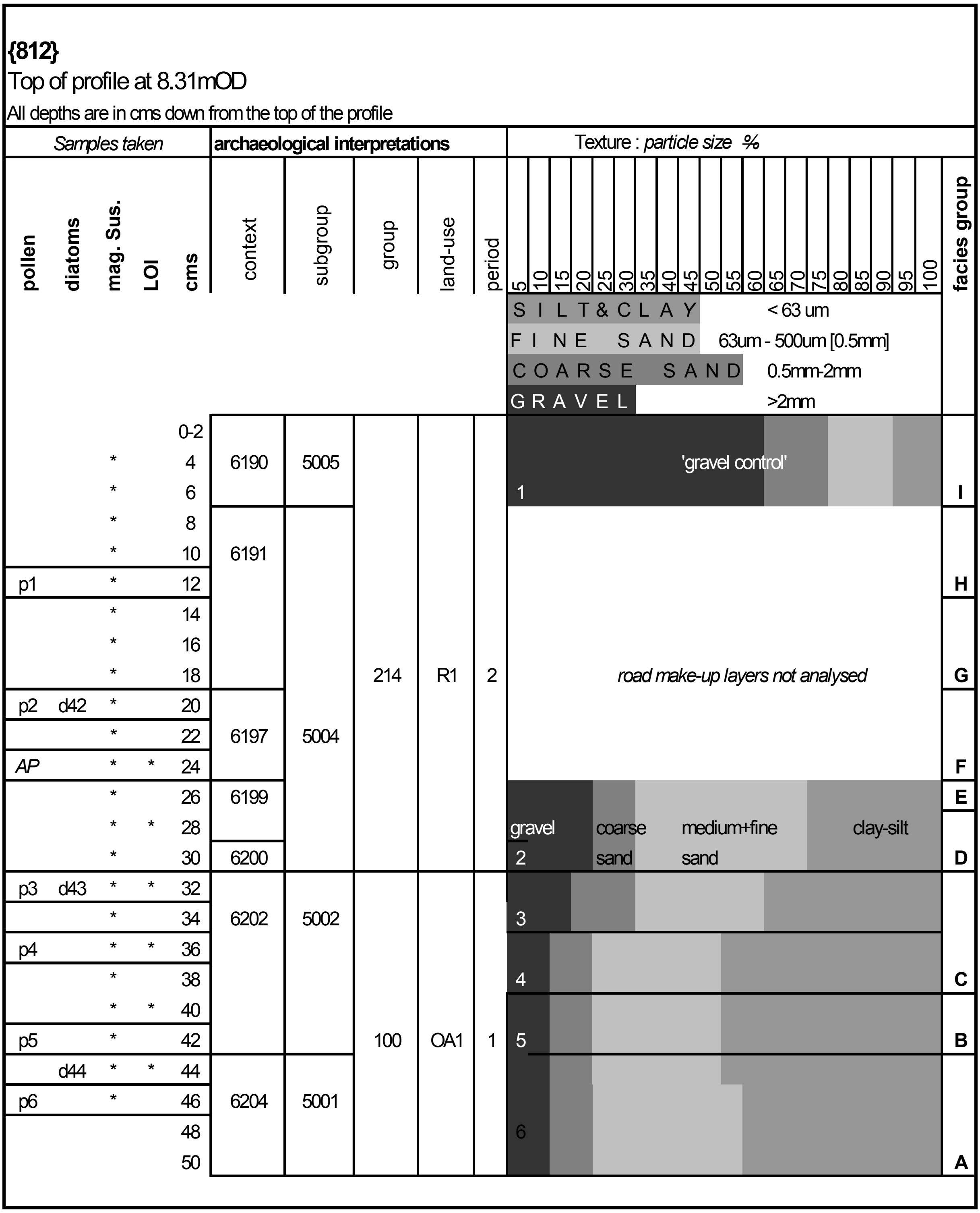


Fig 5: Particle size distribution – sample {812}

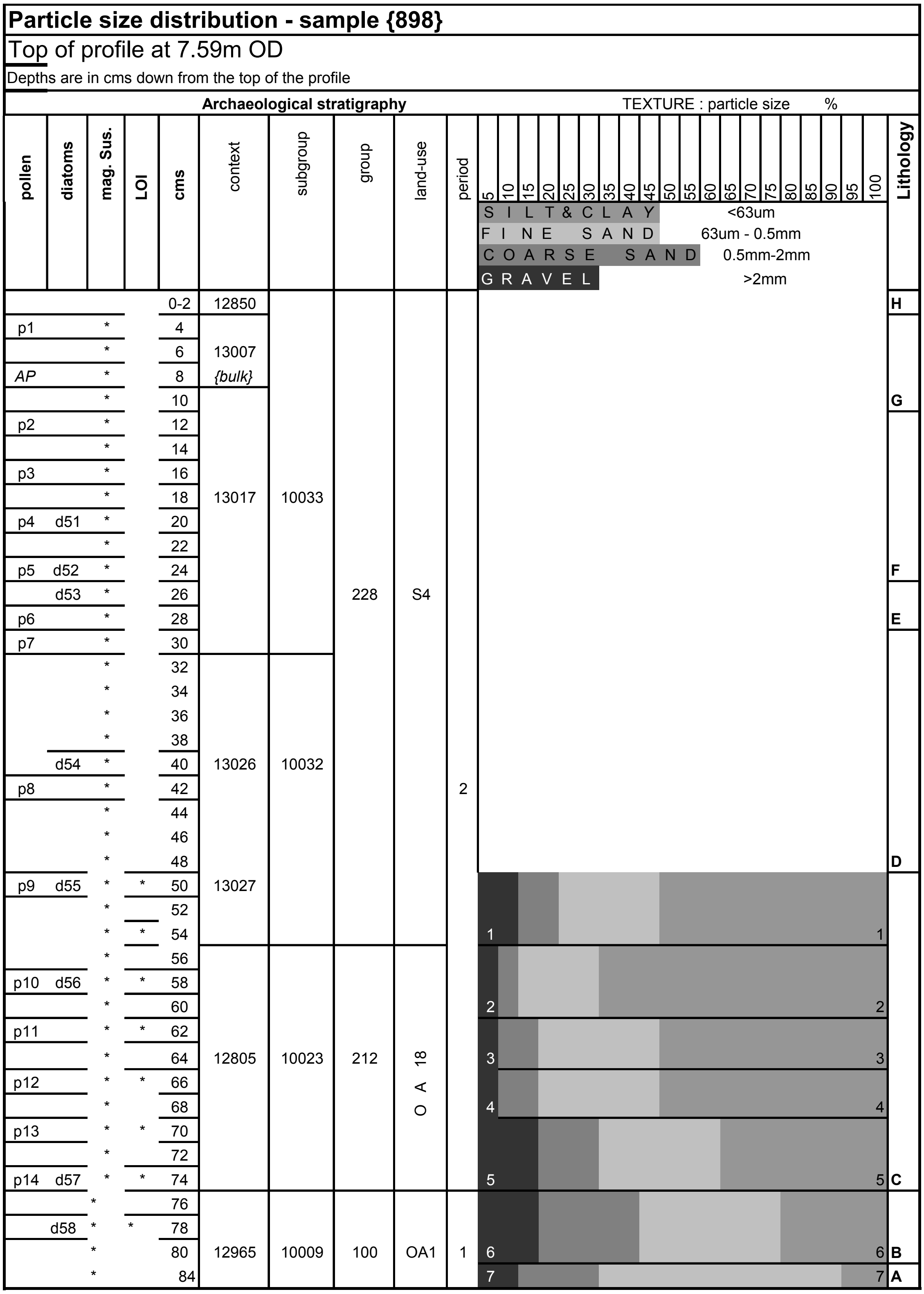


Fig 6: Particle size distribution – sample {898}:

{890}

Top of profile at 8.08mOD

All depths are in cms down from the top of the profile

pollen	diatoms	mag. Sus.	LOI	cms	context	subgroup	group	land-use	period	Texture unit	Lithology
				0-2							
				4							
		*	*	6							
				8							
p1				10	12681	10082	312	OA22	5	1	
		*	*	12							
p2				14							
	d23			16							
p3		*	*	18							
				20						2	E
p4				22							
	d24	*	*	24	12800	10080	220	R1	5		D
p5				26							
			*	28						3	C
AP		*		30							
	d25	*	*	32						4	
p6		*		34							
		*	*	36	12805	10023	212	OA18	2		
p7		*		38	*{bulk}*					5	B
	d26	*	*	40							
p8		*		42							
p9		*	*	44						6	
		*		46							
p10		*	*	48	12965	10009	100	OA1	1		
				50						7	A

Samples taken: pollen, diatoms, mag. Sus., LOI, cms. Archaeological interpretations: context, subgroup, group, land-use, period.

Texture : *particle size %*

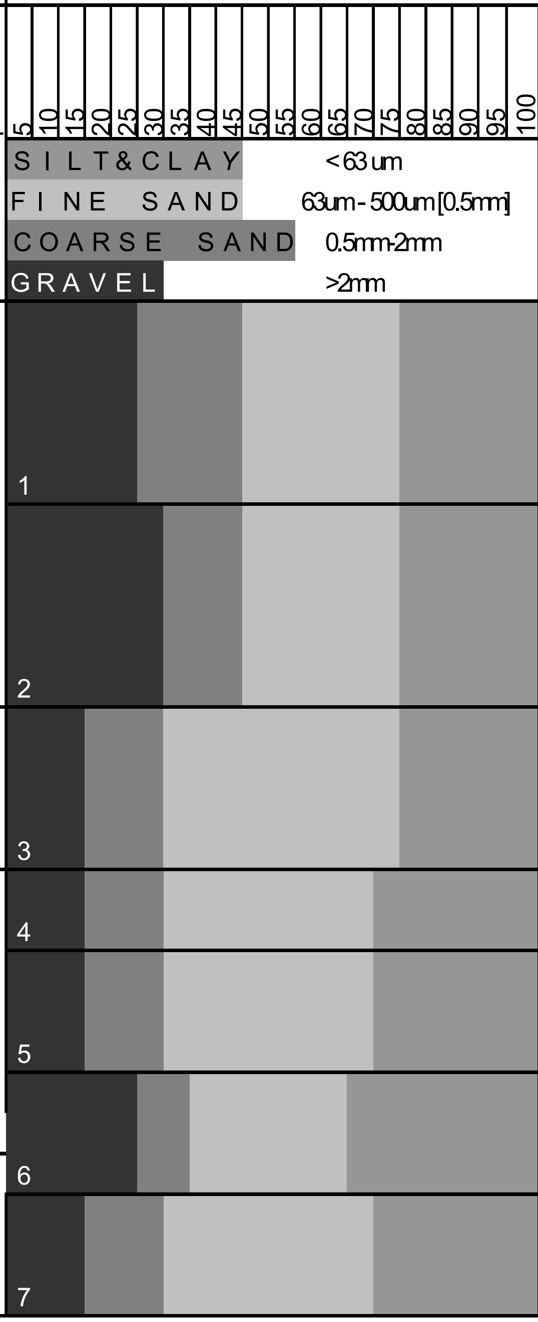


Fig 7: Particle size distribution – sample {890}

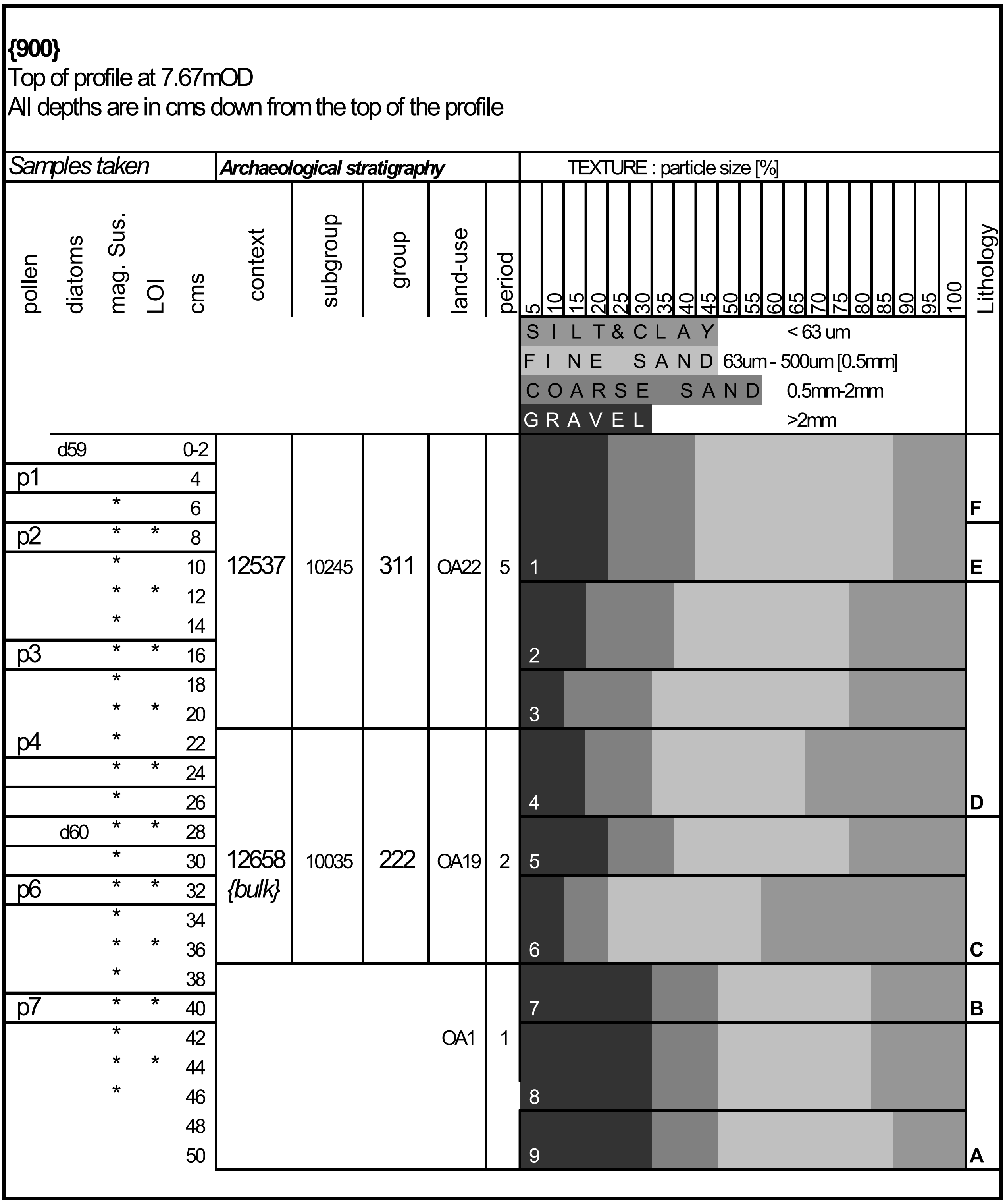


Fig 8: Particle size distribution – sample {900}

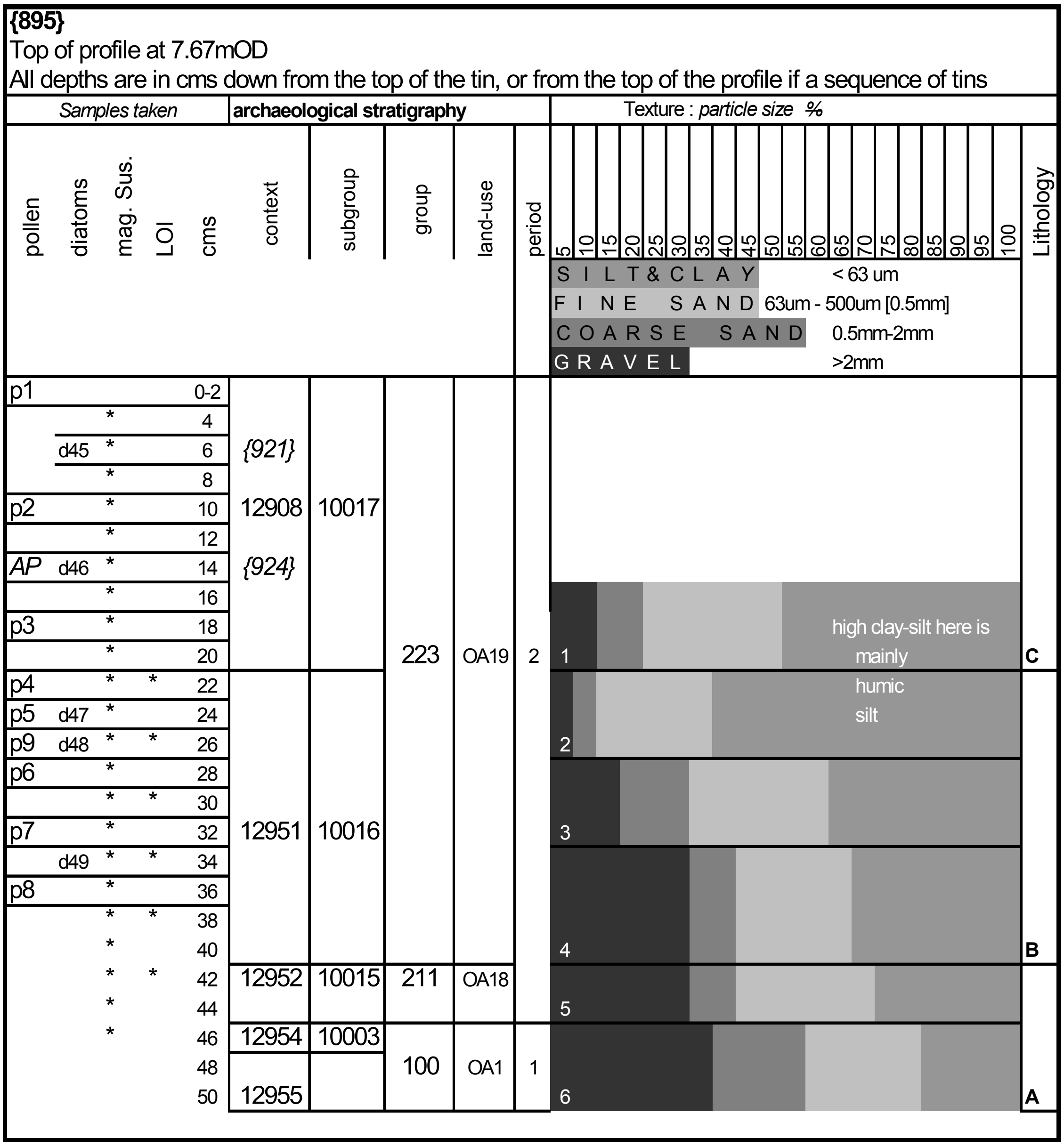


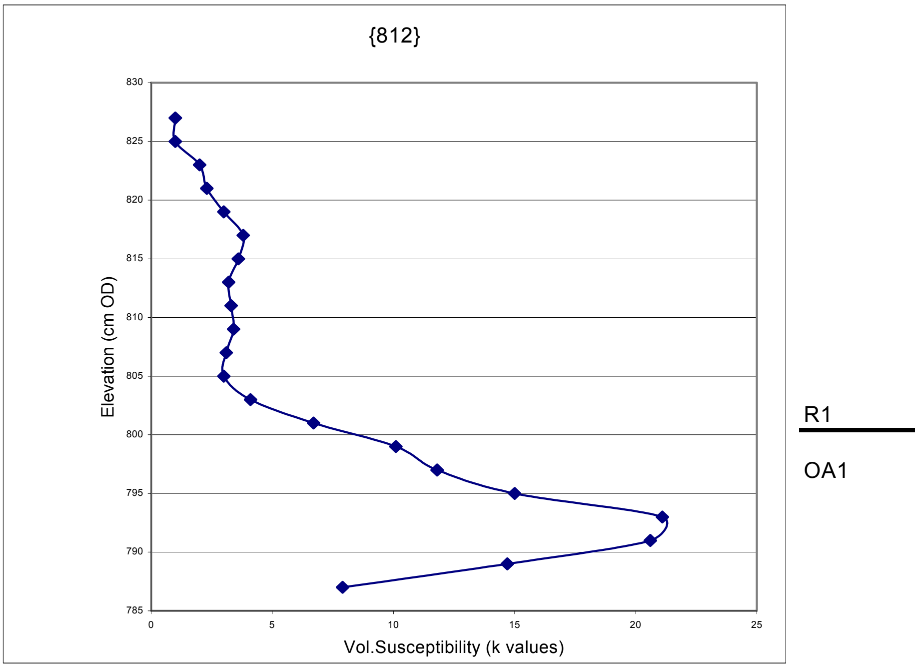
Fig 9: Particle size distribution – sample {895}

3.5 Magnetic susceptibility

The main aim of the magnetic susceptibility determination undertaken in this analysis was to look for evidence of:

- soil formation – through peaks in susceptibility and trends through the profile
- evidence for human activity having led to the erosion / transport / deposition of a context – through high k-values.
- Differences in source material and distinct episodes of deposition – through sharp changes in k-values and by comparison between profiles and with the brickearth 'control'.

The results of the qualitative magnetic susceptibility technique used in this analysis have been calibrated to volume susceptibility (*k*) values and are presented here in graph form in Figs 10-12.



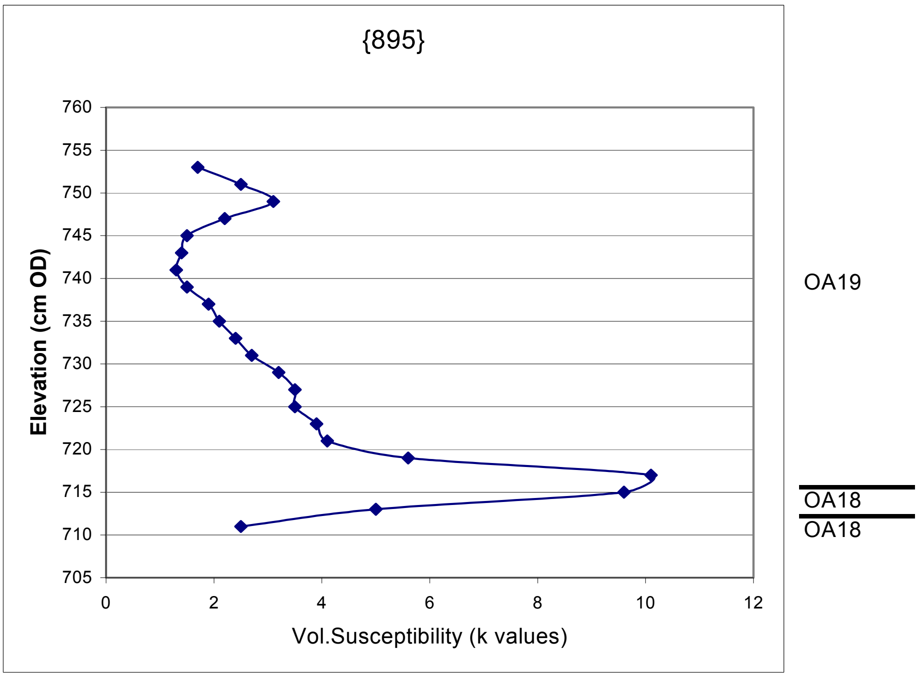


Fig 10: Magnetic susceptibility of samples {812} and {895}

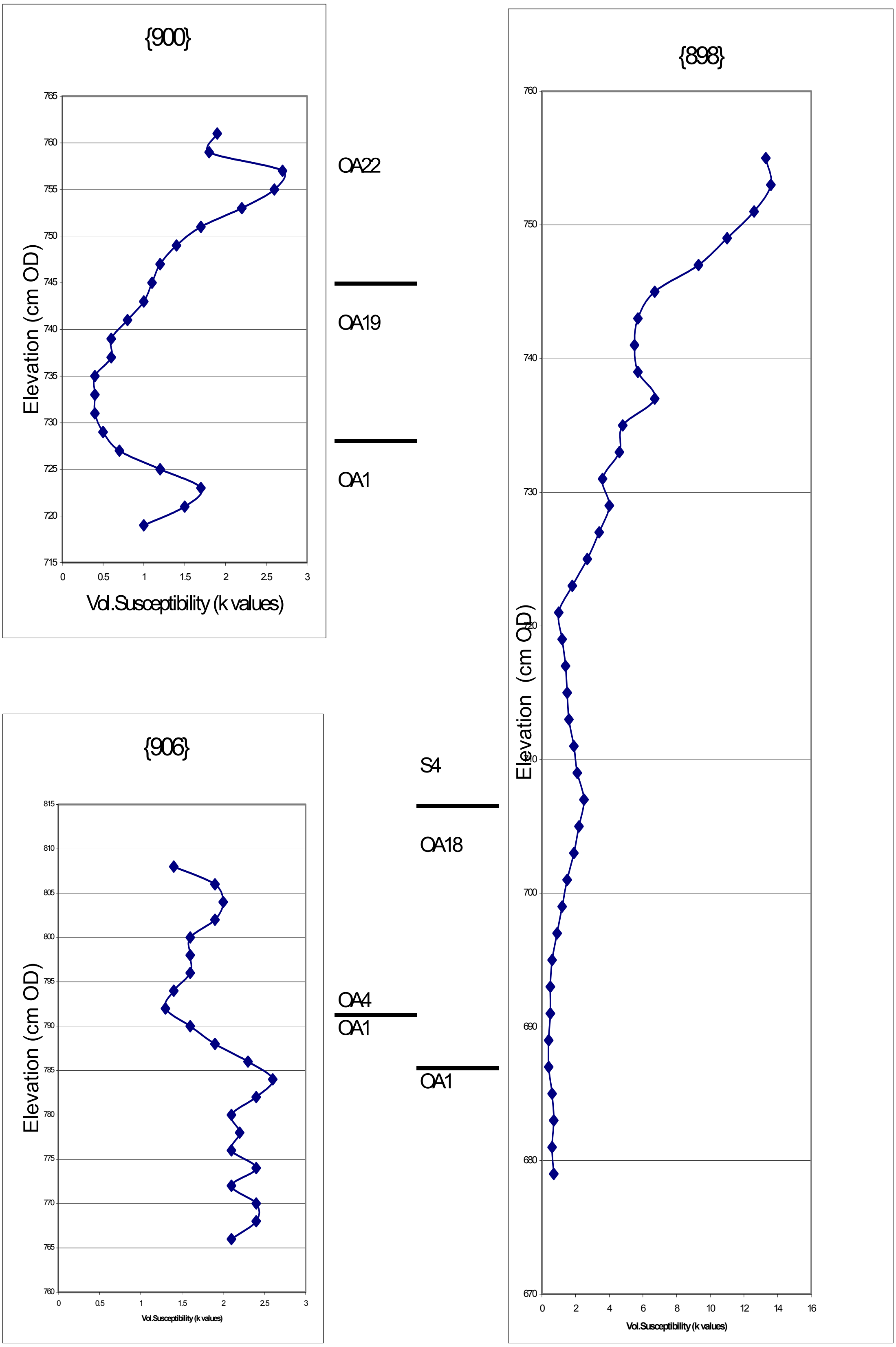
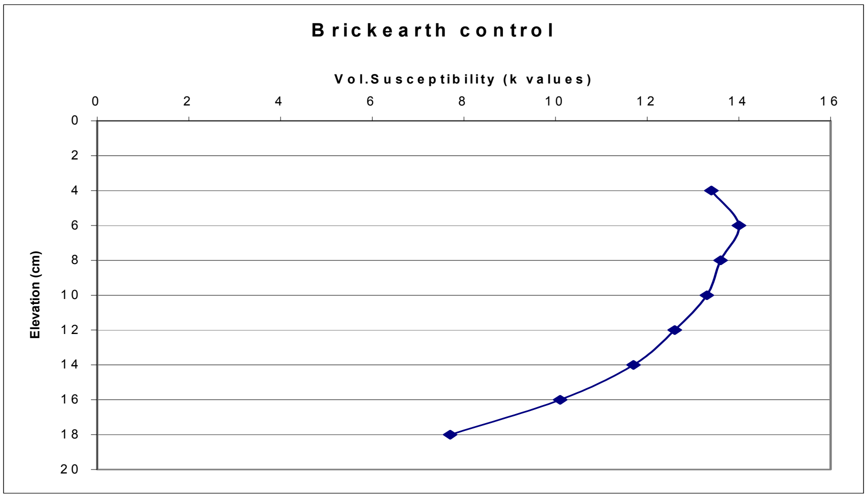


Fig 11:Magnetic susceptibility of samples {898}, {900} and {906}



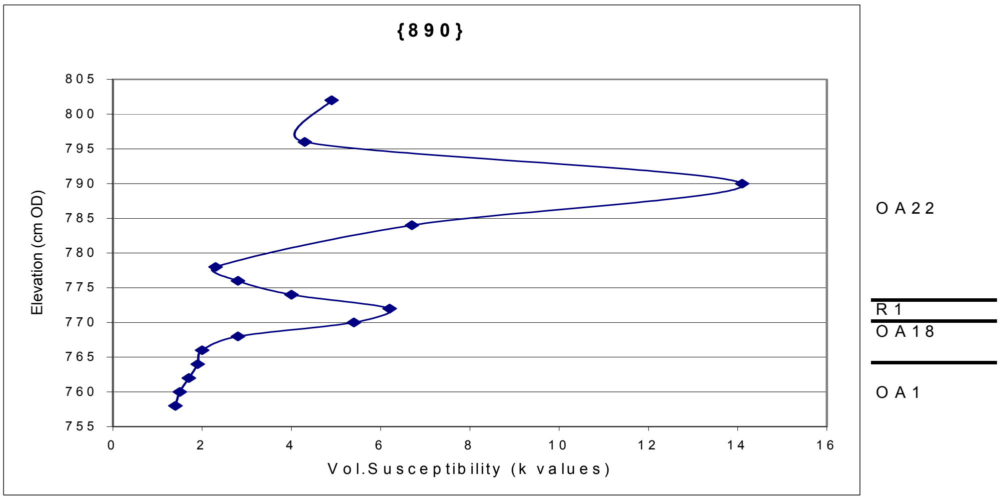


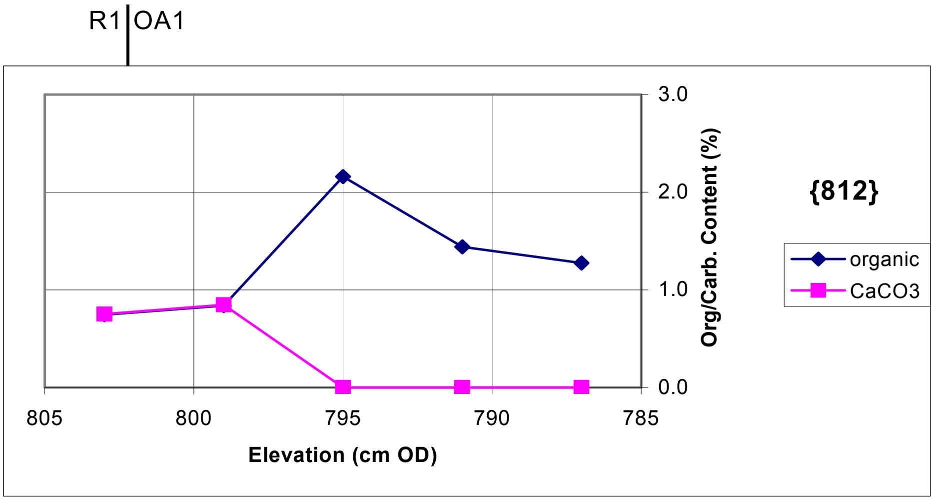
Fig 12:Magnetic susceptibility of samples {890} and the brickearth 'control'

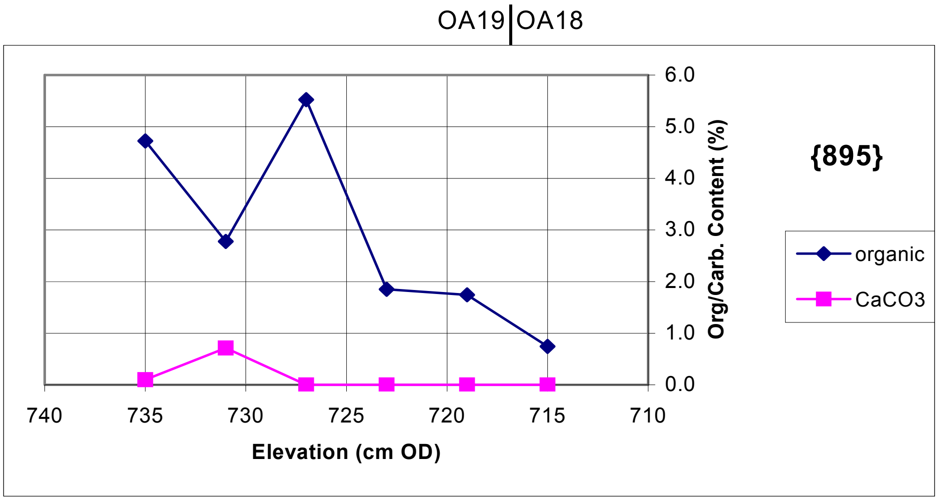
3.6 Loss-on-ignition

The main aim of the loss on ignition analysis was to examine trends through certain facies that were thought likely to be buried soils, redeposited soil material, or visibly homogenous units, which would enable a better understanding of their origin to be gained. In particular, the main aim of the loss on ignition was to:

- Look for evidence of soil formation – through trends in decreasing organic content downwards through a unit / the profile
- Look for evidence of changes/fluctuations in source material and distinct episodes of deposition – through sharp changes in organic, carbonate and mineral values within a deposit or between deposits.
- Provide supporting data with which the magnetic susceptibility values could be interpreted.

The results of this analysis are illustrated in Figs 13 and 14. The full table of weights can be found in the site archive.





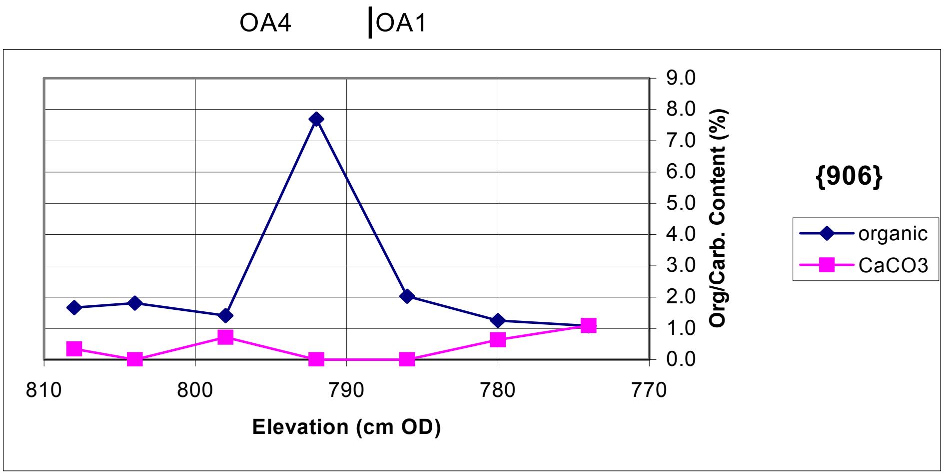
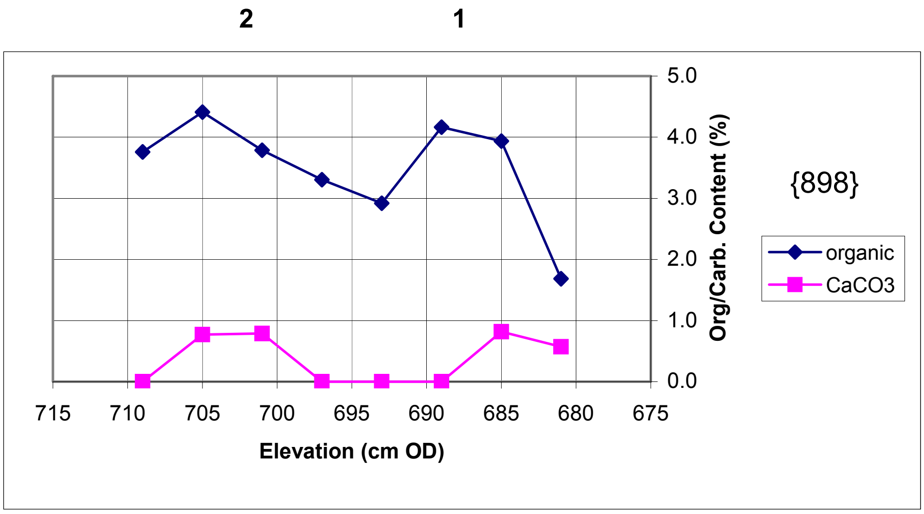
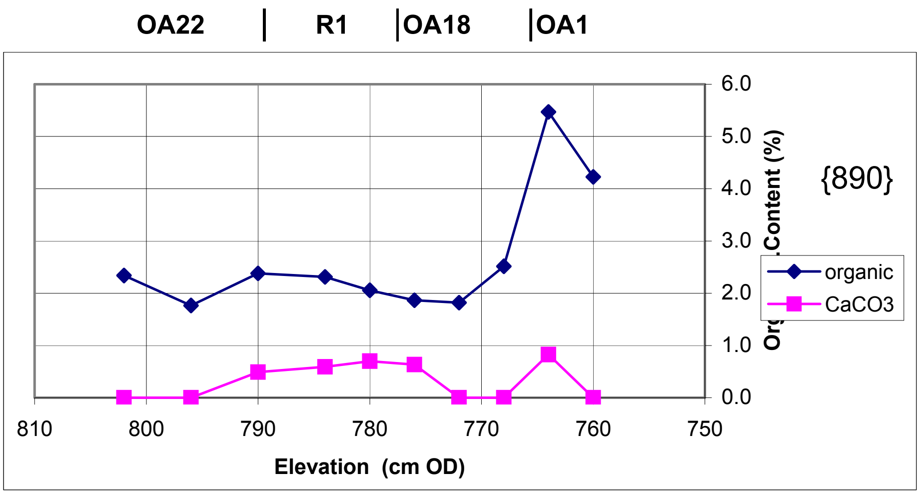


Fig 13: Loss on ignition results – samples {812}, {895} and {906}





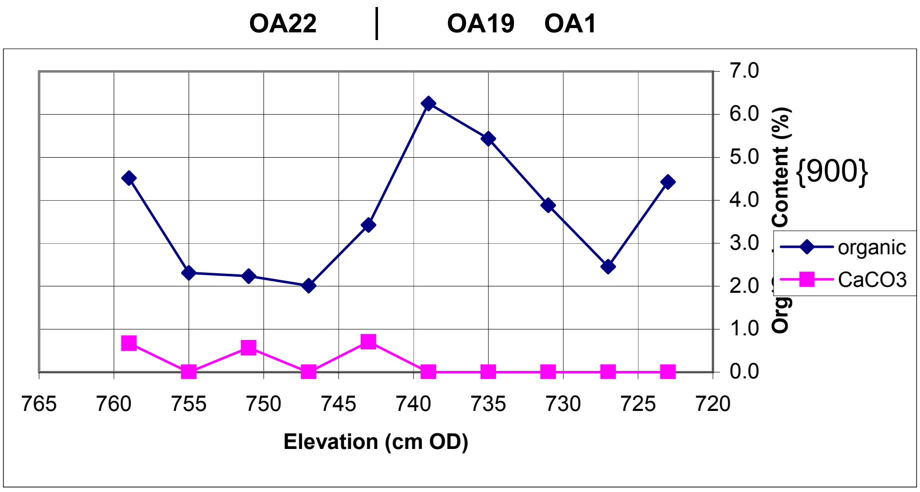


Fig 14: Loss on ignition results – samples {898}, {890} and {900}

3.7 Integration of the results for each profile

Monolith samples from the shoulder of the valley

{812}
Monolith {812} was located towards the edge of the shoulder of the valley side. It was taken through the subsoil of a soil, developed in alluvial/colluvial material, which had been truncated by the levelling of the landscape to 8m OD for the construction of Road 1. The upper part of the tin sampled the bedding for the road and will not be discussed here.

Period 1: OA1 (sg5001 and sg5002)
The location of the sample was apparently within the channel of a tributary stream or gully, incised into the Pleistocene river terrace deposits, which were not sampled by the monolith. The stream or gully was estimated to have been *c* 6m wide and *c* 1m deep. Whether it was of Holocene or Pleistocene origin is not known. The lowest deposit sampled (unit A: sg5001) a sandy clay, may equally be of Pleistocene of Holocene origin. However, pollen preserved within it (P6 on Fig 2) is of similar oak-hazel-alder-grass composition to other pre-road pollen assemblages examined (see pollen report), which suggests it may have accumulated during the early or immediately pre-Roman period. Alternatively the pollen may have been translocated into this subsoil deposit, as it appears to contain a larger proportion of durable pollen and spores, such as those of bracken, which would be expected in the subsoil of a palaeosol. In addition, the slightly higher quantity of undifferentiated/degraded pollen in the basal level could be derived from translocation down the profile.

Soil formation is also indicated in units B and C (sg5002) by evidence for rooting and possibly for the translocation of silt+clay downwards (Fig 5). A peak in magnetic susceptibility in unit B (Fig 10) a little below a peak in organic content (Fig 13) might also indicate the truncation took place in the upper part of a subsoil, a little below the topsoil. If the brick/tile flecks in these levels were also introduced through bioturbation it suggests that the landsurface was exposed for long enough in the pre-road period for fragments of building material to be incorporated into the subsoil.However, the upper part of the former subsoil may have been disturbed by trampling and other activities during the levelling process, which would seem to be more likely. This alternative is supported by the diverse assemblage of plant remains recovered from the bulk sample ({849}) taken from this deposit (see archaeobotany report).

The pre-road landsurface sampled in {812} appears to have been wet and boggy. The iron-staining within units B and C (sg5002) might result from the aeration of previously waterlogged deposits during levelling and road construction. The sharp interface between unit C and unit D (which is the basal sand bed for the road) represents the truncated horizon and the overlying sand and gravel make-up for the road might have caused the gleyed subsoil to become oxidised, especially around former root channels. The vegetation of the pre-raod landsurface also indicates a marshy environment. Despite its elevation above the valley floor, the pollen present in samples P3-

6 is characterised by several wetland species (crowfoot, marsh marigold and spores of sphagnum moss and liverworts). It also contains evidence for plants of fairly acidic soils such as heather, bracken and various ferns.

Of particular note is the high proportion of alder, given the location of the monolith sample well above the tributary valley floor. The recovery of alder seeds amongst the plant macro-remains in bulk sample {849} taken from this deposit ([6202]) also contrasted with their absence from samples on the valley floor itself, although that is where they might have been expected. This suggests alder was growing on the level shoulder of the hillside above Tributary 1 prior to the construction of the road, which implies a wet environment, possibly less 'open' than that on the valley floor was likely to have existed here.

It is possible that the 'palaeochannels' recorded as cutting the river terrace deposits in this area created wet hollows on the poorly drained shoulder of the hillside above the tributary valley. Here a mosaic of boggy areas dominated by alder trees and wetland plants may have existed alongside drier areas covered by bracken, other ferns, heather, scattered trees and grasses. Notably, high alder was also recovered from period 2 (OA4) deposits that are likely to be of colluvial origin, in monolith {974}, which was located slightly north of {812} (see fig 1 and pollen report).

{906}
Monolith {906} was located on the shoulder of the hillside, slightly north of RI. It consisted of interbedded deposits, which may have infilled a former channel or hollow and which probably accumulated by surface wash processes that could have been triggered by landscape clearance associated with road construction and use.

Period 1: OA1 (sg10006)
The deposits sampled by the lower half of the monolith (units A and B: sg10006) appear to be waterlain, containing sand and organic lenses, which might be indicative of flowing water as part of water-aided colluvial or fluvial processes. Sg10006 was thought to infill a palaeochannel during excavation, thus the deposits may have built up as the result of water flowing along or into the channel feature. The erratic nature of the magnetic susceptibility curve through unit A probably reflects the greater influence of depositional to post-depositional (ie: soil forming) processes in its formation. This suggests that the deposit may have accumulated fairly rapidly, although the concentration of iron-staining at its surface might suggest a period of weathering prior to the accumulation of unit B.

The thin section examination of [13020] (unit B) found evidence for bedding and horizontally orientated plant fragments. Although faint evidence for rooting was seen it would appear that this deposit was also characterised by depositional, as opposed to post-depositional characteristics and may therefore also have accumulated fairly quickly. It was coarser-grained than the underlying unit and may represent a period of more active surface wash into the hollow formed by the palaeochannel feature.

Wetland plants were low in the pollen samples taken from OA1 in this monolith, which might support the suggestion that the deposits accumulated fairly quickly, given that wetland plants might be expected to grow in the episodically wet/waterlogged conditions suggested by the gleyed characteristics of the deposits. The pollen is therefore likely to be derived from the surrounding landscape (as suggested by the high bracken values, which might be derived from old soils). Its ‘background’ composition of oak-hazel-grass-alder (see pollen report) resembles the other OA1 samples examined from the site, which places the accumulation of units A and B within the same pre- early- Roman period. Many of the herbaceous plants represented however, are often found in fairly acidic, well-drained places (heathers*,* *Dianthus* type, devils bit scabious, birds foot trefoil, sheep’s sorrel) suggesting that at least parts of the shoulder of the hillside were dry.

Period 2: OA4 (sg10037)
The sharp interface between unit B and the overlying unit C ([13013]) may be erosional and could represent truncation of the underlying silty sand, as the x-ray negative shows possible iron-concreted roots at the top of unit B (OA1) that do not continue into unit C (OA4). The granule-sized clayey clasts observed in unit C were seen in thin section {907} to be eroded fragments of a brickearth soil, suggesting that the deposit represents a further episode of surface wash processes. The horizontal orientation of the wood fragments within the deposit may also represent material washed into the deposit. Although the woody remains could have been dumped and subsequently flattened. The humic matrix suggests plant material was decaying *in situ.* The sampling location may have been a boggy hollow, receiving organic inputs from the surrounding soil and vegetation. This may have been as a result of the levelling of the landscape adjacent to the road. Pollen from this level may therefore be derived from dumped organic material, from slopewash from the surrounding landsurface, or have been growing *in situ.* The lack of alder and fern in this level suggests these plants were not part of the vegetation growing on or adjacent to the sampling location at this time, or constituents of the dumped material.

The x-ray showed a fairly gradual interface with the overlying bedded silty sand (unit D), which might suggest continued and more aggressive slope wash across the sampling location. This could have taken place after the vegetation and topsoil had been stripped off the surrounding landsurface, as the inputs were no longer organic. It is possible this more sandy sediment was derived from the road, or from fines washed out of gravel dumps beside the road during its construction (etc). A large proportion of the pollen composition of this deposit (P1 on Fig 2 {906}) is likely to represent reworked earlier pollen and it has a similar background oak-alder-grass-hazel-bracken composition to the earlier OA1 samples. However, it also includes a number of herb plants that did not occur earlier in the profile, which might reflect the vegetation colonising the area as the road became established. These include Vicia type (vetch)*,* *Lathyrus* type (sweet pea), *Galium* (woodruff and lady’s bedstraw), *Centaurea scabiosa* type (greater knapweed) which are often found as ‘wayside’plants today. Others, such as *Filipendula* (meadowsweet), *Geum* (avens) *Polygonium aviculare* (knotgrass), *Rumex conglomeratus* (clustered dock) suggest damp grass, woodland edges and bare ground. The base of the overlying gravel (unit E) interfingers with the underlying sand, which implies that the sand was wet and soft when the gravel was deposited on top.

Monolith samples from the valley side

{890}

Monolith {890} consisted of three distinct parts. Pre-road deposits (unit A: sg10009; OA1; period 1 and unit B: sg10023; OA18; period 2) were sampled in its lowest part. These were separated by the feather-edge of R1 gravel and tread silts (units C and D; sg10080; R1; period 5) in its central part from those thought to relate to the disuse of R1 following the Boudican revolt (unit E: sg10082; OA22; period 5) sampled in its upper part.

Period 1: OA1 and Period 2: OA18

The deposits belonging to both OA1 and OA18 in this sample are likely to be of colluvial origin, accumulating through soil creep and surface wash processes. Such an interpretation would be compatible with the location of the sample, at roughly the break of slope between the valley side and floor of Tributary 2. Although no finds suitable for dating were obtained from these deposits and they have not been radiocarbon dated, the pollen composition from pollen samples P9+10 (for location see Fig 4) is dominated by oak-hazel-alder and grasses. This is compatible with a late prehistoric/very early Roman date (see pollen report). However, the sample did not extend down to pre-Holocene deposits. The base of the sample at 7.58m OD is about 0.5m above deposits recorded on site in this location as the surface of the natural topography (Pleistocene gravel or brickearth). Thus it is not known whether the deposits existing below the sampled monolith were of fluvial or colluvial origin or when they were deposited.

OA1

The OA1 deposits (unit A) are more organic than those of OA18 (unit B), which probably explains why they felt more silty during description, as the particle size results have shown that the OA1 and OA18 deposits have a similar texture (Fig 7). The higher organic content of unit A (Fig 14) suggests a lower input from soil material moved downslope to that of unit B and a higher input from *in situ* decaying plant matter. This would imply that a more stable landscape existed during the accumulation of unit A (OA1) than during the accumulation of unit B (OA18). In addition, it might indicate that the pollen assemblages from OA1 (P9+10) are less likely to include derived pollen than those from OA18 (P6-8).

A peak in organic content was recorded at the top of unit A, which corresponded with good diatom preservation (D27) although diatoms had not survived (or were never present) in the samples taken from the rest of the profile (see Fig 4 for locations). The diatom species present indicated a shallow freshwater context of low nutrient content, low salinity and below neutral pH (see diatom report). These characteristics suggest that in the hollows created by the irregular topography of the colluvial deposits, pools of surface water collected. The low magnetic susceptibility (Fig 12) and the gleyed root-channels with iron-stained rims of the OA1 deposits also indicate wet conditions, suggesting the valley floor was episodically waterlogged. This gleying may have been contemporary with the accumulation of the deposits, but might imply a period of raised water levels occurred at some time after the deposits had accumulated and plant growth developed in them.

The pollen (P8-10) is associated with a decline in oak-hazel-alder and an increase in grass and cereal, which might suggest an initial phase of upslope clearance, perhaps for cultivation. This may have led to the characteristics of the OA1/OA18 interface deposits..

OA1/OA18 interface

The interface between OA1 and OA18 (at the top of unit A in the monolith tin) is associated with a more poorly sorted texture, with more gravel, less sand and more silt/clay than the rest of the OA1/OA18 deposits (Fig 7). This horizon could represent an episode of harsher surface wash processes, with gravel being transported downslope, sand washed out of the profile and subsequently finer-grained sediment settling out of suspension in the hollows created by irregular deposition of the coarser-grained colluvium. Such an event might introduce pollen from older soil material derived from up-slope. This could be the origin of the high level of (durable) bracken and other spores in P8. It would also lead to the lower representation of wetland (and other) plants growing on the valley floor and sample location itself (eg: sedge, crowfoot, alder and holly) in this level. This colluvial event may have been a prelude to a period of more intense slope processes, suggested by the lower organic content but similar particle size distribution in the overlying OA18 deposits (unit B) compared with those of OA1.

Period 2: OA18 ([12805])

The haphazard orientation of iron-stained plant fragments in unit B (OA18) could suggest that the colluvial material was trapped by and accumulated amongst vegetation. Much of the pollen present in these colluvial assemblages must have been transported downsope with the sediment matrix and the plants present in pollen samples P6+7 reflect its derivation from upslope soils, with the appearance of plants of drier and cultivated ground (eg: charlock, sheep’s sorrel and saw-wort). In contrast, the plant remain assemblage from [12805] (ie: unit B) was characterised by the seeds of plants preferring wet habitats beside streams, ditches and ponds and contained remains of water fleas and caddis flies, characteristic of shallow standing water (see archaeobotany report). These plants and invertebrate remains probably indicate the environment surrounding the sample location itself. Of these plants only crowfoot (*Ranunculus spp.*) appears to have also been present in the pollen assemblage (P6-8) suggesting it may have been growing in the sample location and on the slope above.

The discontinuous haphazard iron-stained laminae in unit B might imply bioturbation (or other mixing processes) and aeration, which is supported by the magnetic susceptibility peak (Fig 12) just below the surface of these deposits. It is possible that the accumulation of colluvial sediments raised this area above the waterlogged conditions of the valley floor. The frequent plant fragments, lying horizontal at the surface of this deposit might indicate groundcover flattened or transported by the activity and surface processes involved with the deposition of unit C.

Period 5: R1 OA22

The texture of units C and D (sg10080; R1) were slightly sandier, but otherwise little different to that of the underlying deposits. This suggests a similar source and depositional processes to those previously operating. Surface creep and surface wash from the surrounding soil appears to have taken place with very little erosion of the sand and gravel of the road itself, perhaps due to maintenance. The pollen from the R1 deposits appears to have a different composition to the underlying colluvial assemblages, which might reflect the rapid colonisation of cleared areas alongside the road by wayside plants.

Period 5: OA22

A much higher proportion of gravel was present in the overlying unit E (sg10082, OA22). The peak in magnetic susceptibility towards the base of this deposit (see Fig 12) might be associated with (Boudican) burning. Alternatively it may be the result of the occasional iron-concreted nodules that were eroded from the road with the gravel. Sand lenses recorded at the top of unit E in the monolith tin suggest that colluvial (surface wash) processes were also responsible for the accumulation of these upper deposits. This might be compatible with the evidence for interbedded silts and organic matter in the thin section {891} taken adjacent to the monolith (see Fig 4 for location). Although soil micromorphology identified dumped stable waste as a major factor in the source of this deposit, off-road drainage and wash was also thought to have played a part (see soil micromorphology report). The dumped material may have contributed to the range of additional plants found in the pollen assemblages in sg10082 compared with the underlying levels.

{900}

Monolith {900} represents two colluvial cycles, each followed by a period of landscape stabilisation.

Period 1: OA1 and Period 2: OA19

The first cycle is represented in the lower half of the tin. Here a fining-up sequence from silty, sandy gravel with organic lenses (unit A: OA1) to sandy organic silt, with some gravel (unit B: sg10035; OA19) was recorded.

Period 1: OA1

The lithological characteristics would be compatible with fluvial deposition, as a point-bar accumulating at the edge of a watercourse, or water-aided colluvial deposition, as a fan at the foot of a rill or gully incised into the valley-side. Both options would fit in with the location of sample {900}, at the edge of the Tributary 2 valley floor, with the elevation of {900} possibly favouring colluvial processes.

In general the pollen from units A to C (OA1 and OA19) was similar in its oak-alder-hazel dominance to other profiles examined on the site that probably represent the later prehistoric period and the immediately pre-Roman environment (P7-4, for locations see Fig 4). Thus it would appear that units A to C are likely to have accumulated in the period immediately pre-dating the Roman occupation of the site (ie: not in early Holocene/early prehistoric times). However, the tree species, though at low levels, are more diverse than seen in (later) oak-alder-hazel-grass dominated assemblages. In general a wet environment is represented (see pollen report).

A peak in magnetic susceptibility at the top of OA1 is probably associated with burnt flint observed in the sample at this level. The particle size distribution (Fig 8) indicated a pronounced change existing between the more gravely lower units A and B (OA1) and the overlying organic silt of unit C (OA19).

Period 2: OA19 (sg10035, [12658])
OA19 (unit C) could represent a period of landscape stabilisation following the erosion and colluvial deposition represented by OA1. Evidence for this comes from a peak in organic content (Fig 6) at the top of unit C ([12658]) at a level corresponding to low clay+silt and high gravel. Viewed against the high proportion of clay+silt to gravel in the base of unit C (Fig 8), this may indicate translocation of fine-grained sediment downwards through the profile, from the middle to the base of the OA19 deposits. The pattern of magnetic susceptibility reflects the organic content and grain size distribution. Low magnetic susceptibility occurring with the high organic and gravel levels and higher magnetic readings where the levels have a greater silt+clay content and lower organic content.

Taken together these characteristics suggest that unit C (ie: the middle and lower part of the OA19 deposits sampled in this location) may represent a stable surface, exposed for long enough for weathering and plant growth to allow post-depositional processes to have an effect of the stratigraphy. Degraded or otherwise unidentifiable pollen was found in P5 (for location see Fig 4), which might support the interpretation of a weathered surface at this level. In addition, higher quantities of bracken and fern spores, which are durable and often characterise the basal horizons of palaeosols were found in pollen samples P6+7, taken from the lower levels of unit C and from unit B.

The environment represented by the stable landsurface is indicated to some extent by the diatoms preserved in D60 (see Fig 4 for location) that are indicative of standing water with episodic drying out, suggesting a wet, marshy environment with temporary pools of standing water. However, the diatom report suggests that no evidence for river flooding existed at this level. (Flooding would have brought in to the assemblage far-travelled diatoms from a range of habitats including those of flowing water). The diatoms also indicated low-nutrient levels (suggesting little human activity) and higher than neutral pH (possibly a result of the high organic content at this level).

Although pollen of wetland plants continues from OA1, their composition changes. *Cyperaceae* (sedges, rushes, cottongrass) and *Filipendula (*probably meadowsweet, which is characteristic of wet ditches and riverside meadows) expand and *Hydrocotyle* (probably marsh pennywort) appears. *Alnus* (alder) briefly diminishes and *Salix* (willow) disappears, which might reflect the greater input from plants actually growing at the sample location that might be expected when input from inwashed sediment decreases. *Viburnum* and *Populus*, which include both wetland tolerant and dryland species only occur in this level.

Plant macro-remains recovered from a bulk sample taken from the same context [12658] suggest that organic material, including crop processing waste and domestic refuse was being dumped onto the wet landsurface at the edge of the valley (see archaeobotany report). Holly and meadowsweet were found in both the pollen and plant macroremains and may have been growing *in situ.* Notably alder remains were not found in the bulk sample, which might also suggest it was not growing at the sampling location. Whilst alder pollen in the underlying colluvial sediments suggest it may have been growing upslope.

Period 5: OA22

The second colluvial cycle is represented in the upper half of the tin. Immediately above the stable landsurface, at the base of unit D (which may correspond to the uppermost part of OA19) dipping beds and diagonally orientated clasts were observed in the x-ray plates. These beds are likely to represent a re-activation of colluvial processes. This period of landscape instability may have been triggered by Roman activity associated with landscaping and clearance for occupation and/or road construction. The OA22 deposits consisted of three units. At the base was silty sandy gravel, with organic lenses and sand laminae (unit D), which probably represents higher energy surface wash. Overlying this deposit was sandy silt with wood and flint gravel clasts (unit E), which was overlain at the top of the profile by silty sand with charcoal flecks and iron concretions (unit F). The more detailed examination of these deposits afforded by soil micromorphology ({901}) suggested that they might represent periods of organic dumping and surface wash from the road surface. If so, the pollen assemblages in P1-3 (for locations see Fig 4) probably both represent the local vegetation and the dumped organic material. The gradual progression in pollen composition from the base to the top of {900}, as discussed in the pollen report, probably argues for the pollen assemblages to a large extent representing the local vegetation and not dumped stable waste.

Magnetic susceptibility (Fig 11) steadily increased upwards through the OA22 deposits, reaching a peak at around 7.60m OD. In contrast, organic content (Fig 14) steadily decreased above the level of the underlying stable landsurface and remained low before also peaking at around 7.60m OD. The particle size data (Fig 8) show a gradual coarsening-upwards trend and a higher proportion of sand throughout OA22 than that recorded in the lower deposits. These trends suggest that an initial period of surface wash, most probably associated with road construction, its early use in a newly cleared landscape, or its disuse and lack of maintenance resulting from the Boudiccan destruction of the area, caused the OA22 deposit to accumulate. Its original depositional structure survives in the laminations seen on the x-ray plates and in the sand lenses and orientated clasts its lower part.

Subsequently, stabilisation of the landscape may have occurred, perhaps as vegetation colonised the previously cleared ground surface. As a result, the upper part of the profile has lost its depositional structure, has higher organic levels and is coarser, owing to translocation of fine-grained sediment down the profile. High magnetic susceptibility in this part of the profile may be caused by the iron concreted nodules, which may have formed by alternate wetting and drying out of the soil, or have been eroded and transported downslope with the road gravels.

Monolith samples from the valley floor

{895}
The sharp interfaces observed between the three distinct units described for this sample (see lithology) suggest it represents three separate depositional events.

Period 1: OA1 (sg10003)
(includes deposition of deposits considered to be Period 2: OA18 (sg10015) and base of OA19 (sg10016))
Owing to the high proportion of sand and gravel in the unit A deposits (OA1 and OA18) they were not sub-sampled for pollen. This is unfortunate, as a relative date and additional information on their depositional environment is therefore not available. The OA1 deposits are unlikely to belong to the Pleistocene river terrace, however. They are more likely to represent Holocene alluvium/colluvium of early or pre-Roman date.

The fining-up sequence from gravely sandy silt (unit A; sg10003; OA1) through sandy silt to clayey silt in unit B (sg10016; OA19) might indicate that these units were deposited as a result of decreasing energy in a fluvial/colluvial system. This gradual trend is visible in the particle size histogram (Fig 9). The elevation of these deposits above the valley floor suggests they are most probably colluvial in origin.

OA18 (sg10015: [12952])
A concentration of gravel (OA18 [12952]) was visible at the top of unit A during monolith description, which was also apparent on the x-ray plate. This may not have been picked up in the particle size analysis because of the thickness of the sub-samples processed (see Fig 9). It could indicate 'deflation' of the deposit, caused by the winnowing out of finer material during a higher energy water flow event.

Given the slope of [12952], following the topography of the valley side, a colluvial, rather than fluvial origin for the winnowing event is more likely. It may represent a hillwash episode within the general period of colluvial activity (ie: upslope erosion and deposition further downslope or on the valley floor).

Such hillwash typically occurs as sheetwash on the shoulder of an interfluve, forms rills on the upper slope and gouges gulleys lower down. It is possible that the linear markings observed on site in the surface of [12952] were incised by hillwash processes. Although this event is part of the general epsiode of colluvial deposition represented by OA1, OA18 and the base of OA19 and may indicate nothing more than a severe rainstorm, it could be associated with the clearing of the site prior to R1 construction. This would have removed vegetation upslope and exposed large areas of soil, exacerbating the landscape processes already operating on the site and potentially causing dramatic (if small scale) hillwash events.

The coarse sediment of [12952] (the top of unit A) is picked out by iron-staining, which is likely to be a post-depositional characteristic, caused by fluctuations in waterlogging and aeration of the deposits. The iron-staining is likely to be the cause of the high magnetic susceptibility at this level (Fig 10) and emphasises the sharp interface between unit A (covering OA1+OA18) and unit B (base of OA19).

Base of OA19 (sg10016)
The fining-up nature of unit B (Fig 9) is likely to represent decreasing energy of colluvial processes, probably soil creep replacing hillwash. Thus sg10016 probably represents slowly accreting colluvium in a relatively stable landscape. High bracken and more diverse tree pollen was found in the basal sample, which might be derived from redeposited pre-road soil material. In general the pollen from unit B (sg10016) is characterised by the oak-hazel-alder-grass composition thought to represent the 'pre-Roman' or at least pre-'dateable' Roman activity on the site (*lpaz {895} zone 1*: see pollen report). However, OA19 is considered to post-date R1 construction and the deposit may have accumulated as a result of Roman activities. Thus it is possible the pollen has been redeposited and represents earlier vegetation or dumped heathy organic material. But the pattern illustrated in the pollen diagram is too smooth and not sufficiently erratic for it to represent dumped material and is more consistent with the picture of gradual sediment accumulation by soil creep indicated by the lithology.

Low magnetic susceptibility values throughout the deposit (Fig 10) and black reduced patches, preserving plant remains, suggest waterlogging. The plant remains included twigs and hazelnut shell, which could be derived from *in situ* or detrital material that became incorporated into the deposit as it accumulated. They also included root fibres, which indicate *in situ* plant growth that could be contemporary with or post-date the accumulation of the deposit. Again this is compatible with a slowly accumulating colluvial deposit. The rooting observed throughout the sequence probably indicates that waterlogging might be post-depositional and possibly associated with the accumulation of the overlying deposit (unit C). This is possibly supported by the non-preservation of diatoms in all the sub-samples from this profile and by the low values of wetland plant species recorded during pollen analysis.

An increase in landscape stability as the deposit accumulated is echoed in the increasing organic content upwards (Fig 13) and is supported by the pollen evidence. A larger quantity and more diverse range of herbs and shrubs was found in the upper pollen samples taken from unit B (sg10016). This may represent both proximity to a stable landsurface (with fewer and increasingly more durable species occurring with depth) and the thicker vegetation cover. Notably bracken (*Pteridium aquilinium*) and heather (*Calluna*) increase again at this level, which might suggest scrub developing over previously disturbed or cleared ground. Heather develops when trees are cleared on poor acidic soils and grazing or burning prevents them from becoming re-established. But various other plant species, several representing rough pasture or grassland and a few of damp/wet ground, were also found just in this part of the profile. In addition, it was from this horizon that the intestinal parasite *Trichuris* was recorded, which might suggest grazing or human activity, associated with the landsurface.

Root channels, which had been truncated, were observed during description and on the x-ray negative at the top of unit B (sg10016). Implying that the uppermost part of the stable landsurface represented by sg10016 and the plants growing in it had been removed by a natural erosion event or human activity prior to the accumulation of the overlying unit C (sg10017).

Period 2: OA19 (sg10017)
Unit C was characterised by compressed finely bedded organics interbedded with sand and clay lenses. The high organic content is probably responsible for the low magnetic susceptibility values (Fig 10) with the slight peak in susceptibility at the top of the profile possibly associated with clay lenses at this level. Although the organic material may be derived from the dumping of refuse composed of plant remains (from stabling, bedding, flooring etc) the decay and compaction of plant remains growing *in situ* should not be entirely ruled out, especially as iron-stained rings associated with rooting were observed. Either way, the location of {895} was influenced by flowing and standing water. Lenses of sand towards the base and clay towards the top indicate periods of surface wash and standing water, with episodic waterlogging implied by the iron-concretions and manganese staining. Vivianite nodules (especially at the base of the deposit) suggest high phosphate levels, which might add support to the possibility that stabling waste was a component of the material accumulated, but it might equally suggest phosphate-rich inputs through surface run-off or even animal pounding at the sample location itself.

The erosional interface between units B and C (sg10016 and sg10017) may have been caused by deliberate human activity or it may indicate another period of erosion by hillwash and surface water flow. Whatever its cause, it separates the pollen profile (see pollen report) into two distinctly different zones. The lower zone, as discussed above, is not untypical of the early or 'pre-Roman' profiles examined elsewhere on the site. The upper zone, corresponding to unit C (sg10017) however, is unlike any others recorded in the Tributary 1 area. Trees disappear to virtual absence but herbaceous plants and in particular plants of pasture and meadowland expand. These include *Ranunculus* type (buttercups, crowfoot and various other wetland and meadow plants), *Trifolium* (probably clover), *Filipendula* (probably meadowsweet), Apiaceae (the carrot family, which includes plants of all sorts of habitats), *Plantago lanceolata* (ribwort plantain) *and Centuara spp* (knapweed). Together with the unusually large quantity of cereal pollen also recorded it could suggest the dumping of hay and straw. The distinctly bedded nature of the deposits does not suggest a single dumping episode, however. It is more characteristic of compaction between dumping events. This could suggest the area was used as an animal pen, with trampling and compaction of inputs of hay feed and straw bedding. The organic deposit was interpreted as 'turves' on site, suggesting the organic laminae (when seen in a larger exposure) were discontinuous and broken up. Although this could result from trampling, it is probably more likely that they represent shovelfuls of stable flooring material, redeposited on the sampling location.

Sand and clay lenses within unit C (sg10017) would appear to indicate at least episodic flowing and standing water. As sand lenses predominated at the base and clay lenses were more common at the top of the unit it is possible that the nature of waterflow became more sluggish with time. The wet conditions might be the result of raised groundwater levels or could have been caused by run-off from the road and roadside drainage. Of two bulk samples taken adjacent to the monolith tin, through the lower and upper parts of unit C (sg 10017), the upper sample {921} contained plant remains that would be compatible with stable refuse, whereas the lower sample {924) contained wetland plant species, caddis fly and water flea remains. Although wetland pollen was not especially common in the lower part of this deposit, mint, crowfoot and water plantain appear, which may reflect the (wetland) plants growing locally. Given the evidence for waterlogging in the underlying deposits and episodic flowing / standing water in unit C itself it is quite probable that the wetland plants and insect remains from the lower bulk sample are *in situ.* They probably reflect the wet environment of the sampling location itself at this time, prior to the dumping of organic material derived from hay and straw.

{898}
This monolith, taken from immediately above the valley floor close to the axis of the valley, preserved evidence for fluvial activity, followed by soil development and a series of colluvial deposits, representing fluctuations in the intensity of hillwash, which might reflect clearance and road construction or earlier activity upslope. In the later deposits a combination of hillwash and dumping is likely to have produced the deposits examined.

Period 1: OA1 (sg10009)
It is not possible to tell from the monolith sample whether the sand (unit A) recorded at the base of monolith {898} is an *in situ* Pleistocene deposit (ie: deposited by the Thames and subsequently forming part of the Taplow Terrace) or is of Holocene date. The sample location is close to the axis of the Tributary 1 valley and the sand, which has an irregular surface at about 6.8m OD, could have been deposited during the Holocene by the tributary stream. It is overlain by gravel with a fining-upwards silty sand matrix (unit B), although the sub-sample slices examined for particle size analysis were too coarse to detect this trend in its matrix (Fig 6). Despite its poor sorting unit B is likely to

represent fluvial (or water-aided colluvial, at the foot of a gully) deposition. Its fining-upwards matrix probably filtered into the interstices between the gravel clasts as water flow slackened at the sampling site, perhaps as the stream migrated across the valley floor or ceased to flow. There is no dating evidence for this period, which most probably represents the active stream channel, but it is likely to be pre-Bronze Age (see below).

Period 2: OA18 (sg 10023; [12805])
At the base of OA18 is evidence for a soil developed in the underlying fluvial deposits, which became buried by the accretion of humic silts, most probably derived from gradual colluvial processes. Unit C (OA18; sg 10023; [12805]) was a humic silt with visible sand grains and occasional gravel. It was slightly darker at the base and this was shown, by loss-on-ignition to be due to higher organic content (see (1) on Fig 14, {898}). The interface between unit B (the underlying fluvial sediment) and unit C was diffuse, which may be due to a continuation of the same process of deposition between the two deposits, or be the result of post depositional translocation of fine-grained and humic particles downwards (ie: soil formation). It is most probable that both of these processes occurred and the high organic content at the base of unit C probably represents a period of plant growth and soil formation in the underlying fluvial sediment. It is significant that pollen from this level (P14, see Fig 6 for location) contained high counts of Lime, which might suggest that the soil developed prior to the Lime decline, which probably took place at some time in the Bronze Age (see pollen report). This would suggest, therefore, that by the Bronze Age a stream was no longer flowing across this part of the valley floor.

Above its darker more humic base, unit C ([12805]) was characterised by a high proportion of clay+silt (Fig 6), occasional clay lenses, manganese speckles associated with reduced patches and iron-stained root channels, which together suggest an episodically waterlogged and possibly waterlain deposit. As monolith {898} was taken from the central part of the valley and immediately above the valley floor, it is likely that unit C accumulated as a result of fine particles settling out of suspension, as pools of surface water drained away. Rather than caused by overbank flooding from the stream, the surface water was probably the result of run-off associated with the colluvial processes identified in the other monolith tins. These processes eroded sediment from upslope, incised rills and gulleys in the valley side, deposited sands and gravel at the break of slope and carried fine particles in suspension across the valley floor, where they built up as the water drained away. This interpretation is supported by diatom evidence. Both diatom samples taken from unit C (D56 and D57, see Fig 3 for location) preserved diatoms and both had assemblages dominated by soil-diatom species and those representing shallow standing water bodies. Neither provided any evidence for flooding (which would have introduced diatom species from a wider range of habitats).

The plant macrofossil assemblages from [12805] were dominated by the seeds of wetland herbs and in particular by crowfoot (*Ranunculus sp.*) and standing water was indicated by caddis fly larvae and water flea ephippia. The evidence from the sediments would suggest that these plants were growing *in* *situ,* on the valley floor. The pollen assemblages from P10-13 (see Fig 3 for locations) provide evidence for a more diverse range of herb plants, representing wetland, wet meadowland, rough grassland, weeds of cultivation and disturbed ground. It is likely that these assemblages were derived from pollen rain and pollen carried downslope by run-off as well as pollen growing *in situ.* They therefore reflect the vegetation of the valley floor and sides, which were probably covered by rough grassland besides the valley floor, which was likely to have been a mosaic of drier grassy hummocks, wet muddy flashes, sedge and water-filled hollows and scattered with willow and alder trees. Although the pollen counts of alder reached 20% no macrofossil remains of alder were recovered from the bulk samples, which suggests the tree cover was not extensive at the sampling location. It is very unlikely that the environment of the tributary valley floor resembled the dense Alder Carr, which had existed on the floodplain of the Thames in the late Neolithic and Bronze Age.

The organic content throughout unit C ([12805]) is high but a second peak (see (2) on Fig 14, {898}) towards the top suggests that fluctuations in the influx of mineral sediment may have occurred, with a further period of 'stabilisation' at this level. Unit C ([12805]) appears to represent a gradually accreting, gleyed, valley floor soil, with episodes of faster and slower accretion depending on the influx of fine-grained mineral sediment from upslope. It is possible that the reduction of lime pollen at the base of the deposit is linked to the onset of landscape disturbance that effectively led to the accumulation of the deposit itself. Context [12805] has not been dated, but it is likely to be earlier than the intensive activity associated with the Roman development of the site. Diatom evidence indicates it has low nutrient levels, which would imply it was little influenced by anthropogenic or grazing activity and this interpretation was supported by the low phosphate levels recorded in the adjacent thin section ({897}; see soil micromorphology report). The background pollen composition (oak-hazel-alder-grass) is similar to those thought to be of pre- or very early Roman date. Thus the initial episode of woodland clearance and landscape destabilisation appears to have taken place before the bulk of the landscape clearance associated with the laying out of this part of the town and before the sample location was greatly affected by the input of the waste products of nearby human activity. The low magnetic susceptibility throughout the deposit (Fig 11) is probably a result of its gleyed (waterlogged) nature.

Thus the woodland clearance and landscape destabilisation that appears to have led to the accumulation of unit C ([12805]) might have been caused by an episode of agricultural activity upslope, as low levels of cereal pollen were recorded. However, it would also seem feasible that the reduction in lime noted at the base of [12805] was associated with the earliest disturbance of the landscape required before the road could be constructed. This could potentially have triggered a period of low-level colluviation, which led to the accumulation of [12805] with erosion decreasing as the disturbed landscape recovered (ie: became stabilised by vegetation).

Period 2: S4 (sg10032 and 10033)

Although unit C ([12805]) appeared homogenous in the monolith tin, the x-ray negatives showed faint bedding at the top, which might correlate with [13027] (sg10032; S4). This most probably indicates a re-activation of colluvial processes. Notably the pollen at this level (P9), though similar to the underlying levels, includes an increase in the pollen from plants of drier, disturbed and cultivated ground and fewer wetland species, indicating it may be derived from soil material eroded from upslope. The bedding was visible by eye in the overlying context [13026] (sand with silt laminae: unit D), indicative of water flow, probably surface wash downslope onto the valley floor. Thus sg10032 (as seen in the monolith tin) would be compatible with a period of increasing colluvial processes and surface run-off, which could perhaps be associated with road construction (or its use). Increases in alder and bracken pollen in P10 from this deposit could imply erosion of older soil material at this time. However the general pollen composition remained the oak-hazel-alder-grass assemblage, which characterised the earlier environment of the site, prior to more intensive development and activity.

A subsequent period of stabilisation is indicated by the humic silt of unit E, which corresponds to the lowest part of sg10033. Root channels visible in unit E on the x-rays, appeared to be truncated, as they did not extend up into unit F, where faint evidence for bedding was visible on the x-ray negative, suggesting the more stable surface was followed by a further episode of slope processes. Unit F contained clayey lenses, which became more common in unit G. Units F and G also appeared to become less humic upwards. Taken together these characteristics might indicate that sg10033 (units F and G) represent a third cycle of colluvial activity in the vicinity of sample {898}. The pollen from sg10033 (P1-5 in Fig 3; ie: above unit E) suggests that these later slope processes took place in a landscape largely cleared of trees and characterised by an increase in arable activity (either as cultivated fields or crop processing).

As in the earliest colluvial episode (ie: context [12805]) the hillwash represented by units F and G appears to have been of fairly low intensity. The clayey lenses suggest pools of standing water as opposed to the higher energy slope wash that deposited sand on the site in the second colluvial episode (represented by context [13026]). Standing water during the accumulation of unit G is also indicated by the caddis fly larvae found in the bulk sample taken from [13007] and iron and manganese staining is also evidence of episodic waterlogging. However, there is little pollen or plant macro-remain evidence for wetland plants growing *in situ* at the sample location at this time. Compressed organic material and charcoal at the top of unit G are likely to indicate some direct human input to the deposit, perhaps as a result of dumping, which could have taken place at the same time as ‘natural’ slope processes. Plant remains of many edible plants in the bulk sample taken from [13007] were thought to represent domestic waste (see archaeobotany report). Increased magnetic susceptibility in this deposit compared to the rest of the profile is also probably an indication of increased human inputs, which is verified in the considerable quantity of pot recovered from this context. Thus it is possible that *in situ* plant growth was fairly sparse during the later accumulation of sg10033 and the deposit built up by a combination of dumping of organic refuse and silting-up as run-off drained into the valley, probably forming pools of standing water that slowly drained away.

4 Synthesis and discussion of the results

Period 1: OA1

Pleistocene deposits were only sampled in {898} on the axis of the valley floor (sand, with a surface at *c* 6.80m OD) and in {939}, under R1 and immediately below the shoulder of the valley side, (surface at 7.70m OD). Monolith {939} was examined during assessment, but not selected for analysis, as it consisted almost entirely of Pleistocene sands and gravel. The level of Pleistocene deposits in these two samples corresponds with the conjectured topography of Pleistocene sediments, as recorded on site and defines the upper edge and base of the Tributary 2 channel/valley (Fig 1).

Relative pollen dating suggests the OA1 deposits sampled at the base of all the monoliths (excepting {898}) accumulated during the immediately pre Roman or very early Roman period (see pollen report). As the monoliths did not extend down into the Pleistocene gravel, it is possible that deposits representing the early to mid Holocene part of the OA1 sequence may have existed below the samples taken, especially where preserved at the edge of the valley floor. This was the case in {898} where evidence for the later prehistoric environment of Tributary 1 was found. The fining-up sequence of sandy gravel to gravely silt, above the Pleistocene sand at the base of this monolith ([12965]; sg10009) probably represent slackening water flow along the axis of Tributary 1. A soil subsequently developed in these alluvial deposits (base of [12805]; sg10023), which preserved a pollen assemblage characteristic of the later Neolithic to earlier Bronze Age woodland composition (as currently understood for the central London area, see pollen report and Scaife 2000). Thus the stream had probably ceased to flow along this part of the valley floor by the later Neolithic or earlier Bronze Age. Whether this was because the thalweg (the main flow of water) had migrated across the valley floor, away from the sample location, or was the result of the stream itself drying up is not known.

Gravely debris fans were recorded in the base of samples {900} (sg1003) and {895}, at the break of slope between the valley side and valley floor. These coarse colluvial deposits accumulated at the foot of rills and gullies incised into the valley side during fairly dramatic hillwash events. In each case the gravel was overlain by fine-grained sediments, deposited as the surface water drained away. Organic silts also considered to belong to OA1 ([12965]; sg 10009) accumulated further upslope ({890}) and probably represent periods of less severe erosion, when fine-grained material was transported down-slope by soil creep processes and vegetation trapped particles carried short distances by surface wash. The colluvial deposits are likely to have created an irregular topography on the valley side and floor. The environmental data data suggest it was probably a mosaic of drier grassy hummocks, sedge-filled hollows, where water collected, and muddy flashes where marsh marigold and other wetland plants grew amongst the roots of scattered willow and alder trees (see pollen and archaeobotany reports).

The colluvial episodes are likely to be associated with human activity upslope that disturbed the vegetation and exposed bare soil to the impact of heavy rainfall and gravity. Such activity could have included bouts of cultivation, over-grazing or landscaping. There is insufficient dating evidence to determine whether the deposits recorded in the samples were contemporary or whether they represented localised colluvial events. In addition, although the OA1 colluvial processes appear to have taken place on the sides of the Tributary 1 valley prior to the disturbance associated with road construction, it is not possible to determine whether they accumulated in the earliest Roman or pre-Roman period. Pollen assemblages from the base of {890} and {900} have a similar background grass-oak-hazel-alder composition to the OA18 and OA19 deposits of period 2. Thus, although these deposits post-date the Elm and Lime declines and are therefore likely to be Iron Age and later, there is nothing to suggest they are not very early Roman and associated with very preliminary clearance phases.

A similar grass-alder-oak-hazel background pollen composition was obtained from the OA1 deposits examined in samples {812} and {906} from the shoulder of the hillside. These deposits were fine-grained and are likely to represent the silting-up of hollows that may have been former stream channels or gullies. Sg1006 from {906} retained waterlain depositional characteristics indicative of silting up quite rapidly. In contrast, evidence for soil formation was observed in sg5001 and sg5002 from {812} (which was truncated by R1) and this sample could represent the subsoil horizons of a soil profile (that had developed in waterlain sediment). The gleying observed in these deposits implies the area was susceptible to waterlogging and the many wetland plants recorded in the pollen and plant macro assemblages indicate that the shoulder of the hillside was likely to be poorly drained and boggy. Wet hollows were probably interspersed with ridges of drier ground however, as many herbaceous plants of fairly acidic, well-drained habitats were also recorded in the pollen assemblage from sg10006 in {906} (heather, devil's bit scabious, sheep's sorrel, birds foot trefoil etc). It may have been in this area that the alder trees recorded in all the profiles grew thickest. Higher percentages of alder pollen were recorded from {812} (and the nearby sample {974}) than from the samples on the valley floor itself. Alder seeds were also recovered from the bulk sample taken from sg5002, whereas they were not found in samples taken from the valley floor, where a more open wetland environment may have existed.

Period 2: OA18

The woodland clearance associated with the demise of lime pollen in the {898} profile probably triggered colluvial processes that led to the accumulation of [12085] (sg10023). This context formed a wedge thickening downslope and was examined in monoliths {890} and {898}. Its characteristics differ between the two samples, which probably reflects the different processes dominating on the valley side ({890}) and valley floor ({898}). On the valley side, where it was more sandy and oxidised, it probably accumulated as vegetation trapped fine-grained sediment creeping downslope by gravity and rain-splash. On the valley floor it was more clayey with gleyed patches and was likely to represent silt and clay carried in suspension by run-off and accumulating as surface water drained away. These characteristics indicate that the erosion represented by [12805] was of a fairly low-level.

In contrast, a 'deflated' gravel deposit, from which the fine-grained matrix had been winnowed out was sampled in {895} ([12952]; sg10015) and is likely to represent more serious hillwash. This deposit was associated with linear grooves in the surface of the underlying gravel, which might represent rills incised into the valley side by surface run-off, although they are considered to be possible ard marks and may be associated with marking-out for R1.

The processes responsible for these OA18 deposits are essentially the same as those that led to the accumulation of the OA1. It is likely that the environment of the Tributary 1 valley was little different in OA18 to that described for OA1 above (and indeed the deposits might be virtually contemporary). They imply that fairly localised (given the genarally similar background pollen composition) 'disturbance' events were taking place upslope, which may have been associated with cultivation or with preliminary landscape clearance in preparation for road construction. These events produced a fairly dynamic environment within the Tributary 2 valley. Though predominantly a marshy area it would have been relatively open, with scattered trees and rough grasses on the hillside and possibly more thickly wooded, but still a mosaic of boggy hollows and drier hummocks, on the higher shoulder of the hill.

Period 2: OA4

On the shoulder of the hillside, bedded deposits in {906} (sg10037) were also likely to have accumulated by surface wash processes, which transported soil and woody plant material eroded from the surrounding landsurface into the boggy hollow that existed at the sample location. Such deposits suggest a fairly low level of landscape disturbance, but evidence for increasingly severe surface wash was recorded in the transition from the predominantly organic composition of [13013] to the sandy [13011]. It is possible that these deposits register first the disturbance caused by vegetation clearance and then the activities associated with the construction of R1.

Period 2: R1

Deposits likely to represent run-off from R1 road construction were sampled in monolith {890}, located immediately south of the road. The characteristics of these deposits (sg10080) were similar to the underlying colluvium, with a larger sand component that was probably washed out from the road gravels. The pollen profile reflects the clearance likely to have taken place immediately prior to road construction, with the shift from the oak-alder-hazel-grass composition characteristic of *{890} zone I* to grass-herb dominated assemblages, which characterise *{890} zone II* occurring in the R1 deposits.

Period 2: OA19

The fine-grained organic sediment of sg10035 (in monolith {900}) represents a period of landscape stabilisation. Diatoms, pollen and plant macro remains from this deposit indicated a wet marshy environment with pools of standing water. The composition of the wetland plant assemblage differs from those in the underlying levels however, suggesting that the local vegetation was changing although the environment remained predominantly wet. Evidence for crop processing and food waste amongst the plants recovered from the bulk samples also indicates that dumped material was being discarded into the valley at this time.

The lower part of OA19 examined in {895} (sg10016) also represents a period of slackening colluvial processes, probably with soil creep replacing hillwash in an increasingly stable landscape. Here increases in heather and bracken, together with evidence for the intestinal parasite *Trichuris* might indicate animal grazing on scrub, which had developed across the drier areas of the previously disturbed ground.

The sg10016 deposits in monolith {895} appeared to be truncated. They were overlain by compressed finely bedded organic material interbedded with sand lenses, which fined upwards into clay lenses (sg10017). The sharp interface between the lower and upper part of OA19 in this monolith might represent a man-made cut, but it could equally have been caused by a renewed episode of surface wash. It is associated with a pronounced change in the pollen assemblage from the oak-hazel-alder-grass background composition in sg10016 to one dominated by clover-grass-cereal-ribwort plantain-cornflower/knapweed. The sand lenses in the base of sg10017 indicate flowing water and the clay lenses towards the top suggest water flow subsequently decreased and had become replaced by sluggish or standing water. Plant macro, pollen and thin section evidence suggest the organic beds are derived from hay and straw, which combined with high phosphate levels (and vivianite visible in the monolith sample) probably represents stable refuse. It is difficult to tell however, whether the 'stable waste' was *in situ* straw and fodder for pounded animals or whether it represents deliberately dumped refuse material, although the latter is probably more likely.

It is possible that these deposits represent the re-activation of waterflow along the valley, perhaps as a result of increased run-off from the road. The inputs of hay and straw were likely to have masked any evidence for plant growth at the sample location or from the surrounding landscape. So we cannot see whether landscape clearance had taken place prior to the accumulation of sg10017. However, a reduction in oak and hazel pollen and an increase in the diversity of herbaceous plants appear to have taken place within the upper levels of the pollen samples from the underlying sg10016. This might provide evidence for landscape clearance immediately prior to the hillwash events recorded in the sediments.

Period 2: S4
Faint bedding was observed in the uppermost part of [12085] (OA18) in monolith {898}, on the axis of the valley floor. This was probably a precursor to the more severe surface wash implied by the interbedded sands and silts

(sg10032), recorded in the lowest S4 deposits in this sample. The hillwash episode was followed by a period of possible stabilisation, when organic matter accumulated and plant growth took place, prior to renewed (but less severe) hillwash (sg10033) characterised by faint bedding of organics and clay lenses. This later hillwash was associated with a shift from the oak-hazel-alder–grass dominated background pollen composition to one dominated by grasses and a more diverse assemblage of herbaceous plants (see *{898} zone III* in the pollen report). This is likely to represent the largely cleared landscape of the surrounding area by this time. It also suggests that the more severe hillwash of sg10032 may have been caused by landscape clearance, which produced the relatively treeless landscape of sg10033.

Period 2: OA22
The deposits examined from OA22 in monolith {890} (sg10032) and {900} (sg10245) were characterised by evidence for surface wash and dumping, which the thin section and plant macro evidence suggests may have been partially derived from stable refuse. Stable refuse was unlikely to have formed as large a component to the deposit as in the upper part of {895} however (see OA19, sg10017, above) where inputs of hay and straw or organic material derived from stabling had blocked out pollen from any other sources. However, the fluctuating assemblages might suggest that the evidence for the local environment in the pollen assemblage could be masked to a certain extent by dumped material in this deposit. In monolith {900} sand lenses, orientated clasts and hints of bedding suggest that sg10245 may have accumulated faster initially, but subsequently stabilised, as the upper part of the deposit is more organic with rooting. In contrast sand lenses occur throughout sg10080 in monolith {890}, possibly because its location was closer to the road and further up-slope than {900}.

5 Environment of the Tributary 1 valley.

The lack of samples from basal deposits (ie: immediately overlying the Pleistocene ‘natural’) prevented any examination of the pre Roman stream to be made. However, a soil apparently developed in the underlying alluvial deposits on the valley floor during the Bronze Age, which suggests that there was little water flow down the valley by this time. But waterlain deposition continued to take place, as colluvial sediments eroded from upslope (probably as a result of human activity) were transported into the valley by run-off and surface wash processes. There is insufficient dating evidence to determine when this silting up took place, but relative pollen dating suggests it may have been during the immediately pre Roman or very early Roman period., which would be compatible with evidence from the Walbrook (Maloney & de Moulins 1990; Shepherd 1998, 216). Although the evidence suggests an earlier phase of landscape disturbance and colluvial deposition may have resulted from cultivation activity. More severe episodes of hillwash appear to have been associated with clearance and levelling prior to road construction. Subsequent low-level hillwash is associated with dumping and increased waterlogging/standing water on the tributary valley floor.

The deposits sampled from the valley of Tributary Stream 1 appeared (in the monolith tins) to be almost entirely of colluvial origin. They are likely to represent the impact of episodes of landscape disturbance on the 'natural' environment of the valley. Disturbance led to soil material being eroded and transported downslope, causing an irregular topography of hummocks and hollows to develop at the break of slope between the valley side and valley floor. The later deposits recorded in the monoliths are likely to have formed by a continuation of these colluvial processes together with inputs of deliberately dumped material.

The colluvial episodes are likely to be associated with human activity that disturbed the vegetation and exposed bare soil to the impact of heavy rainfall and gravity. Such activity could have included bouts of cultivation, over-grazing, quarrying or levelling and landscaping. Although the colluvial processes appear to have taken place on the sides of the Tributary 1 valley prior to and as a result of the disturbance associated with road construction, it is in general not possible to determine whether they accumulated in the earliest Roman or pre-Roman period. With only one exception, the pollen assemblages from the OA1 deposits have a similar background grass-oak-hazel-alder composition to the OA18 and OA19 deposits of period 2. Thus, although these deposits post-date the Elm and Lime declines and are therefore likely to be Iron Age and later, there is nothing to suggest that even the OA1 deposits are not very early Roman and associated with preliminary clearance phases. There is also insufficient dating evidence to determine whether the deposits recorded in the samples were contemporary or whether they represented localised colluvial events.

A soil developed in waterlain deposits on the axis of the valley floor contained pollen evidence for lime-dominated woodland, which provides a likely Late Neolithic/Bronze Age date for the soil (see pollen report). This would imply that a stream was no longer flowing down the valley by this period (although its course may have migrated across the valley floor).

Subsequent disturbance of the landscape caused a mosaic of different deposits to be juxtaposed across the valley sides and floor. Coarse gravely deposits accumulated at the foot of rills and gullies incised into the valley side during fairly dramatic hillwash events. Fine-grained deposits carried across the valley floor suspended in surface run-off, built-up as the water drained away. Organic silts accumulated as vegetation trapped fine-grained sediment creeping downslope by gravity and rain-splash during episodes of less severe erosion. Interspersed with these events is evidence for stable landsurfaces, when little sediment moved downslope and organic material accumulated as plants grew and soils developed in the earlier colluvial material. Throughout the immediately pre-Roman and earliest Roman periods the landscape of the valley was likely to have been a mosaic of different habitats. Drier grassy hummocks, probably existed alongside sedge-filled hollows, where water collected, and muddy flashes where marsh marigold and other wetland plants grew amongst the roots of scattered willow and alder trees (see pollen and archaeobotany reports).

On the shoulder of the hillside above the tributary channel there is evidence for the natural silting-up of hollows (that may have been former stream channels or gullies) during the same very early or immediately pre-Roman period. The gleying observed in these deposits implies the area was susceptible to waterlogging and the many wetland plants recorded in the pollen and plant macro assemblages indicate that the shoulder of the hillside was likely to be poorly drained and boggy. Wet hollows were probably interspersed with ridges of drier ground where plants of fairly acidic, well-drained habitats were recorded (heather, devil's bit scabious, sheep's sorrel, birds foot trefoil etc). It may have been in this area that the alder trees recorded in all the profiles grew thickest. High percentages of alder pollen were recorded from the pollen profiles from the shoulder of the hillside and alder seeds were recovered from bulk samples taken through these deposits, whereas no alder macro remains were found and rather lower counts of alder pollen was recorded from the valley floor itself.

6 References

Barham, AJ, 1995 'Methodological approaches to archaeological context recording:x-radiography as an example of a supportive recording, assessment and interpretative technique'. In *Archaeological sediments and soils: analysis, interpretation and management* (eds AJ Barham & RI Macphail) Institute of Archaeology, UCL, 145-82.

Dearing, J, 1994 *Environmental magnetic susceptibility* Bartington Instruments

Gale, AJ and Hoare PG, 1991 Quaternary sediments: petrographic methods for the study of unlithified rocks

Greig, JRA, 1982 'The interpretation of pollen spectra from urban archaeological deposits' in *Environmental archaeology in the urban context* (eds AR Hall & H Kenward) CBA Research Report 43, 47-65

Maloney, C & de Moulins, D, 1990 *The upper Walbrook in the Roman period* CBA Research Report 69

Scaife, R, 2000 'Holocene vegetation development in London' in *The Holocene evolution of the London Thames: archaeological excavations (1991-1998) for the London Underground Limited Jubilee Line Extension Project* (E Jane Sidell, Rob Scaife, Keith Wilkinson & Nigel Cameron)

Shepherd, J, 1998 *The Temple of Mithras, London: excavations by WF Grimes and A Williams at the Walbrook* English Heritage & Museum of London