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ARCA

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AYLESBURY GOLF COURSE: GEOARCHAEOLOGICAL STUDY OF MONOLITHS

Prepared for Rubicon Heritage Ltd

by
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with pollen assessment by DR. M. Simmonds

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SUMMARY

In April 2021 ARCA examined two monoliths of sediment from a trench excavated by Rubicon Heritage Ltd and Network Archaeology Ltd at the Aylesbury Golf Course site, Aylesbury, Buckinghamshire. The two sequences were comparable and represented a colluvium that had developed over fine grained alluvium laid down in a pond

The deposits of the pond are derived primarily from the Kimmeridge Clay Formation that forms the topography of the watershed and from remnant superficial deposits. They are dated to the medieval period.

The pond deposits are truncated and overlain by c. 0.5m of yellowish brown oxidised colluvium derived from erosion of Head and the Portland Sand Formation outcropping on the southern valley side. It is proposed that cultivation in the post-medieval period exposed these geological units to erosion.

Four sub-samples for pollen were taken, however, the mineralogenic nature of the sediments and their oxidation militated against the survival of pollen and no environmental reconstruction was possible.

1 INTRODUCTION

1.1 This report discusses the results of a geoarchaeological investigation of two monolith samples taken from excavations at the Aylesbury Golf Course site, Aylesbury, Buckinghamshire. (henceforth 'the site'). The work was carried out by ARCA in April 2021 on behalf of Rubicon Heritage Ltd.

1.2 The site is centred on National Grid Reference (NGR) SP 7992 1297. It lies west of the outskirts of Aylesbury occupying a very shallow, broad valley of c. 0.7km^2 bound by the 80m OD contour. An unnamed stream occupying canalised ditches rises near Upper Hartwell to join the Bear Brook 1.5km to the east in Aylesbury. The Bear Brook is a tributary of the River Thame that lies to the north of the town.

1.3 The British Geological Survey (BGS) map (1:50,000 1994, sheet 237) the bedrock geology of the site as the Kimmeridge Clay Formation of Late Jurassic age (*c.* 163 – 145Ma). The Portland Sand Formation outcrops in the south eastern corner of the site. Superficial Quaternary deposits unconformably overly the bedrock: Head on rising ground to the south; a thin (200m at its maximum) east-west band of Alluvium on the valley floor; and River Terrace Deposits (RTD1) lie to the east of the site. The bedrock lithology is highly fossiliferous (both white calcareous and black phosphatised fossils are present), dark bluish black marine mudstone (Gallois 2004; 1-4; Horton *et al* 1995; 60-69). Head is a generic polymict, unlithified deposit of poorly sorted, angular gravel, sand and clay that mantles a hillslope. It was laid down by processes of mass movement (e.g. solifluction) under periglacial conditions in the Pleistocene. Alluvium is unlithified clay, silt, sand and gravel laid by fluvial action during the Holocene (11.7ka – present day) (British Geological Survey; 2021a; 2021b). The site is located on a former golf course which has introduced Made Ground in the form of sands and topsoils not mapped by the BGS. Construction of the golf course has caused topographical reworking in the form of greens and bunkers etc. affecting the top *c.* 0.5m – 1.0m of the stratigraphy.

1.4 Two monolith samples were taken using plastic pipe with an open rectangular section measuring 590 x 70 x 60mm and labelled <AY16102> and <AY16103> from Trench 161 (see Rubicon Heritage Ltd drawing: 'DWG0156 north facing section of box in pond TR161'; Figure 1, and Figure 2) by the excavation staff. The samples were delivered to Oxford for assessment by the author.

1.5 The aims of the work were to:

1.5.1 Characterise the sedimentary sequence preserved in the monolith samples; and
1.5.2 Report on the palaeoenvironmental potential of deposits.

2 METHODOLOGY

2.1 Lithology

2.1.1 The monolith samples were cleaned by scalpel to expose fresh surfaces and photographed. Recording of the bulk lithology took place according to standard geological criteria (Jones *et al.* 1999; Munsell Color 2000; Tucker 2011). To investigate the lithological characteristics of the clastic content further two sub-samples one each from the pond silt/clay (16112) and from the overlying yellowish brown silt/clay (16115) were taken from AY16102. Each sub-sample (*c.* 150g) was washed through a 0.25mm sieve. The residue retained on the sieve (>0.25mm) was air dried and examined under a binocular microscope at magnifications of x3 and x10. The finer fraction that passed through the sieve was also dried and examined. The deposits identified were grey silt/clays pertaining to the fill of a pond overlain by yellowish brown silt/clay of probable colluvial origin.

2.2 **Pollen** *by M. Simmonds*

2.2.1 Four sub-samples were taken for an assessment of the pollen content from both the colluvial and pond deposits and delivered to Quaternary Scientific, University of Reading. One sub-sample was analysed from monolith AY16102 at 0.4m (16112) in the silt/clay (pond) deposits (Table 1). Three sub-samples from monolith AY16103 were analysed at 0.10m (16104) in the colluvial sediment and at 0.23m (16102) and 0.50m (16101) from the silt/clay (pond) sediment (Table 2).

2.2.2 The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) deflocculation of the sample in 1% Sodium pyrophosphate; (3) sieving of the sample to remove coarse mineral and organic fractions (>125µ); (4) acetolysis; (5) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm3); (6) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and

assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore et al (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide) (Appendix: Table 3).

2.3 Archive

2.3.1 The material archive comprises the two monolith samples which will remain in storage at the University of Winchester pending decisions on further work until 20th July 2022 whereupon they will be discarded with no further notification. Pollen slides are held at the University of Reading.

2.3.2 The digital archive consists of photographs in JPG format and this report in PDF format. These digital archives are stored both on the University of Winchester server and on an external hard drive stored outside the University of Winchester. Copies of these data can be supplied on request.

2.3.3 OASIS records will be completed on approval of this report.

3 RESULTS

3.1 Lithology

3.1 The results are tabulated in Table 1 and Table 2 below and discussed in the following Sections. The sedimentary units described in the monoliths are referred to by their archaeological context numbers (in parentheses) wherever it is possible, rather than by geological unit numbers for ease of comprehension.

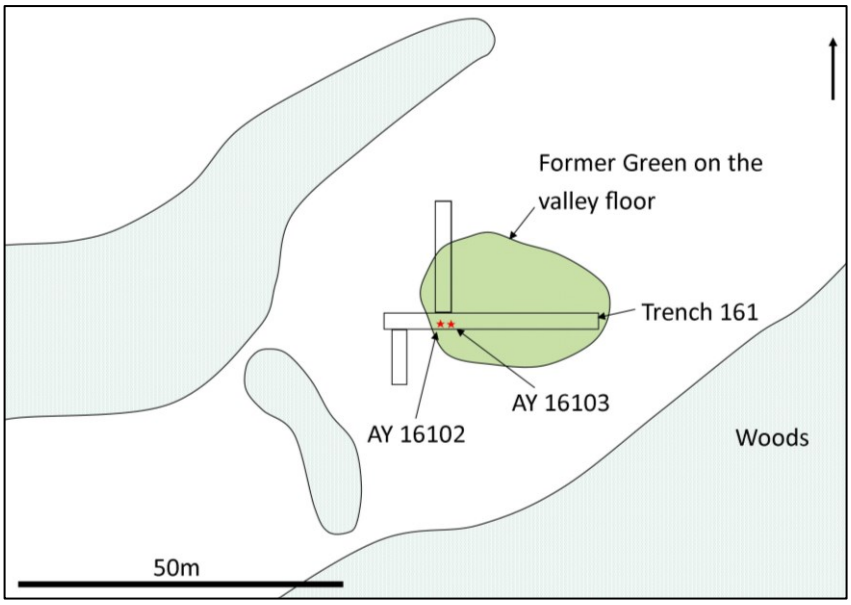

Figure 1. Location of monoliths AY16102 and AY16103 in Trench161 on the edge of a former golf course green on the valley floor.

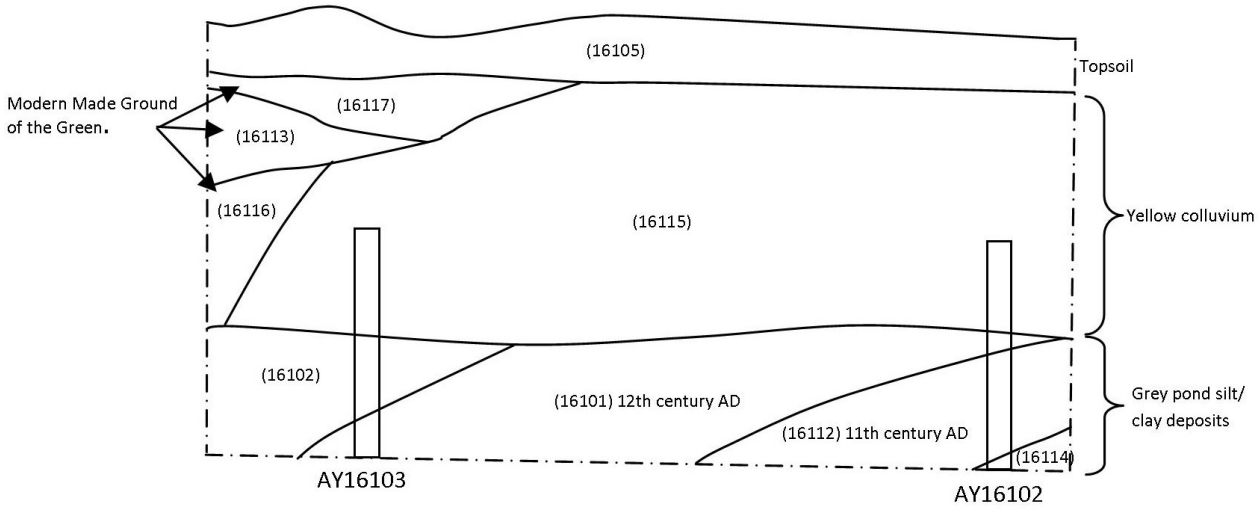

Figure 2. Monolith locations in north-facing section. Monolith length is 0.59m.

<AY16102>	**Depth m**	**Unit (context)**	**Description**
	0-0.25	1 (16115)	10 YR 4/6 Dark yellowish brown moist and firm silt/clay. Frequent orange (7.5YR 5/8) iron oxide stains c. 50%. Occasional very fine roots. Slightly silty texture. A concoidal-like tear fracture. Sharp boundary to:
	0.25-0.59	2 (16101 12th century AD) (16112 11th century AD)) (16114)	*Separate contexts indistinguishable*. 10YR 4/1 Dark grey moist and firm silt/clay with a very poorly developed granular structure. Rare sand–sized grains of white shell. Slight colour gradation towards the base to 10YR 5/1 Grey. Occasional very fine roots; iron oxide coatings. Top 10mm is slightly darker. Rare well-rounded vein quartz granules; 2 granular-sized small mammal femurs and unidentified bone fragment; sub-angular siliceous concretion; occasional very fine sub-angular sandstone granules; occasional sub rounded limestone granules; occasional black well-rounded quartzite granules, coarse sand-sized iron pan concretions; I *Trochulus hispidus*; 1 *Valonia* sp.; rare sand-sized shell fragments; rare sub-angular flint granule; rare sub-angular fossil fragment; rare charcoal grain.
	0.40 pollen	3 (probably 16112 11th century AD)	

Table 1. <AY16102> lithology from Trench 161. Clastic lithology from sieving. Pollen sub-sample locations.

<AY16103>	**Depth m**	**Unit (context)**	**Description**
	0-0.20 *0.10 pollen*	1 (16115)	10YR 4/4 Dark yellowish brown, moist and soft to firm silt/clay. Frequent very fine roots and root holes with red iron oxide coatings. Towards base root/earthworm holes filled with grey silt/clay. Rare very fine sand (slight silty texture). Concoidal–like tear fracture. Frequent orange (7.5YR 5/8) iron oxide stains c. 50%. Rare sub-angular black flint granule. (Possible colluvium). Sharp boundary to:
	0.20-0.27 *0.23 pollen* 0.27-0.59	2 (16102)	10YR 3/1 very dark grey moist and firm silt/clay. Frequent fine scale (mm) dark red iron oxide oxidation mottles: difficult to distinguish. Slight gritty texture. Rare well-rounded granule of black flint; rare irregular granular-sized nodular concretion of siliceous material; and white patinated flint granule. (More humic horizon) Sharp boundary to:
	0.50 pollen	3 (16101 12th C AD)	10YR 4/1 Dark grey, lustrous, moist and firm silt/clay with a friable granular structure. Frequent fine root holes with dark red iron oxide coating. Occasional coarse sand-sized mineral grains. Occasional granules of sub-rounded, grey to black quartzite; rare small mammal bone fragment; angular calcareous granule. Rare coarse side-sized white shell fragment. (Alluvium).

Table 2. <AY16103> lithology. Pollen sub-sample locations.

3.2 In <AY16112> the lowermost unit (16112 and 16101) is a dark grey silt/clay: no distinction can be made between the two contexts although the top of the unit appears very slightly darker probably as a result of a greater humic content. The unit has a rare gritty texture and the matrix is composed of very poorly formed ped-like granules. Fine root bioturbation is occasional and root holes are cast with iron oxide coatings. Clastic content is rare and coarse sand- to fine pebble-size (0.5-8mm). Microscopic inspection revealed that it consists of a heterogeneous mix of well-rounded quartzites and vein quartz; sub-angular limestone and sandstone (calcareous and siliceous); iron pan and rare grains of charcoal, flint, fossil fragments, small mammal bone and shell fragments; of the shell an apex of *Trochulus hispidus* and *Vallonia* sp. were identified.

3.3 The overlying unit (10115) is bound by a sharp boundary and consists of an oxidised, homogeneous, yellowish brown silt/clay. Clasts are absent. Microscopic inspection noted a high frequency of very fine sub-rounded quartz grains in comparison to the underlying grey silt/clay where these mineral grains are rare.

3.4 The second monolith <AY16113> was taken *c.* 1.5m further east in the same trench section. The lowermost unit (16101) is a grey silt/clay. It is overlain by a darker grey silt/clay and the boundary is gradual. The lithology of both units is the same as that described in <AY16112> (16112 and 16101) in Section 3.1 above.

3.5 The overlying unit (10115) is bound by a sharp boundary and consists of an oxidised, homogeneous yellowish brown silt/clay as has been noted in Section 3.3 above.

3.3 Pollen Assessment *by M. Simmonds*

3.3.1 The results of the assessment indicate a high concentration of palynomorphs across both monolith samples, with a lower concentration from the colluvial material than the silt/clay (pond) deposits.1 However, in all cases, the pollen preservation is very poor (Appendix: Table 3), restricting the identification of many grains and spores. The reason for this poor preservation is unknown, however, pollen is best preserved in organic, acidic and anoxic environments, which differ from the highly minerogenic sediments present across all four samples. Alternatively, or in

[1] Non-pollen palynomorphs (NPP) are the remains of organisms with organic walls that are not destroyed during pollen preparation. They are derived from a wide range of taxonomies including species of worm, the cysts of dinoflagellates and algae. Many remain unidentified (Shumilovskikh and van Geel, 2020).

addition to this, it is possible that the material comprising both the pond fill and colluvium is comprised of eroded or reworked material. Those taxa identifiable from the silt/clay deposits indicate an environment comprised of mixed woodland, shrubland and open ground. However, the high proportion of unidentifiable grains means that no robust palaeoenvironmental reconstruction can be drawn from these results, and consequently no further work is recommended.

4 DISCUSSION

4.1 The grey silt/clay deposits of the pond lie at a shallow angle that suggests a broad gently sloping basin of deposition (Figure 2). Pottery evidence dates (16112) to the 11th century AD and (16101) to the 12th century AD (Simon Roper 2021; pers. com.).

4.2 The lithology of the deposits indicates that they are fine grained mineralogenic alluvium that settled out of suspension under low energy conditions. The matrix is silt/clay from reworking of the Kimmeridge Clay Formation mudstone bedrock. Clasts are rare and point to infrequent higher energy streamflow transporting material from eroding outcrops within the very small watershed. Limestone and sandstone originates from the Portland Sand Formation; and quartzites, vein quartz and flint from remnant River Terrace Deposits identified to be present on the site (see Watson 2021). Head bordering the valley floor will also contain similar lithologies derived from higher lying units. Biological clasts (bone and shell) are accidental inclusions from the pond bank. The shell is from terrestrial molluscs and no aquatic species are present.

4.3 The top of the pond deposits is slightly darker in colour that suggests a more humic content as a result of soil forming processes operating across the former pond. Pollen is very poorly preserved as a result of the mineralogenic nature of the sediment and its oxidation: sand-sized fragments of iron pan are ubiquitous.

4.4 The pond deposits are sharply truncated probably as a result of post-medieval cultivation on the valley floor and more generally within the watershed. The destabilisation of the landscape that this would incur leads to erosion of the regolith on the gently inclined slopes of the valley and the formation of colluvium. The source of the yellowish brown silt/clay colluvium (16115) is twofold; the Portland Sand Formation *c.* 400m upslope to the

south and the Head deposits that lie between the Portland Sand and the valley floor. The Head consists of a heterogeneous unit of yellowish brown, gritty silt/clay blanketing the mudstone valley side to *c.* 0.5m in thickness. It formed from periglacial processes acting in the Pleistocene on the higher lying Portland Sand Formation breaking down the constituent clay-rich mudstones and siltstones and the calcareous limestones and sandstones. Erosion of the plough-exposed Head and the Portland Sand via sheet wash and rain splash on low inclines preferentially sorts the sediment particles transporting the finest grains (very fine sands – evident in the microscopic inspection – silts and clays) to the valley floor. The consequence is the formation of a homogeneous, fine grained colluvium *c.* 0.5m thick that has been sampled in the monoliths. The modern topsoil has developed within the top of the colluvium.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 The alluvial silt/clay deposits of the pond are derived primarily from the Kimmeridge Clay Formation that forms the main topography of the watershed and from remnant superficial deposits. The mineralogenic nature of the sediment and its oxidation militates against the survival of pollen and no environmental reconstruction is possible other than a generic statement of the presence of mixed woodland, shrubland and open ground.

5.2 The pond deposits are truncated and overlain by *c.* 0.5m of yellowish brown oxidised colluvium derived from erosion of exposed units of Head and Portland Sand Formation outcropping on the southern valley side. It is proposed that cultivation in the post-medieval period has exposed these geological units to erosion.

5.3 No further work is recommended on the monolith samples.

6 ACKNOWLEDGEMENTS

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APPENDIX: TABLE 3 RESULTS OF THE POLLEN ASSESSMENT FROM MONOLITHS AY16102 AND AY16103

	Context Number	16101	16102	16104	16112
		Silt/Clay	Silt/Clay	Colluvium	Silt/Clay
Latin Name	Common Name				

Trees					
Alnus	alder		1		
Quercus	oak	5	10		7
Pinus	pine	5	8		2
Shrubs					
Calluna	heather	5	3	1	8
Corylus	hazel	15	23		5
Salix	willow	1			
Herbs					
Aster type	daisy	1			1
Chenopodium type	goosefoot family				
Cyperaceae	sedge family	4	9	3	6
Lactuceae type	daisy family	10	13	12	13
Plantago lanceolata	ribwort plantain		1		
Poaceae	grass familiy	8	26	4	15
Rosaceae	rose family	1	3		1
Rumex undiff.	dock/sorrel	1			
Aquatics					
Nuphar type	water-lily	1			1
Potamogeton	pondweed	2			1
Spores					
Dryopteris	wood fern	1		4	2
Equisetum	horsetails				1
Osmunda	royal fern		1		
Polypodium	polypody fern				1
Pteridium	bracken		1		2
Sphagnum	peat moss			1	
Tiletia sphagni	peat moss fungi		2		
Unidentifiable		++	++	+	++
Total Land Pollen (Grains Counted)		56	97	20	58
Non Pollen Palynomorphs		Yes	Yes		Yes
Spores		Yes	Yes	Yes	Yes
Concentration		5	5	3	5
Preservation		1	2	3	1
Micro-Charcoal		3	4	2	3
Suitable for further analysis		No	No	No	No

*Key: *Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide; **Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent; ***Microcharcoal Concentration: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant*