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GEOARCHAEOLOGICAL INVESTIGATION OF DEPOSITS AT GLOUCESTER CATHEDRAL

Prepared for Border Archaeology

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SUMMARY

Excavation in the North Transept of Gloucester Cathedral in advance of possible building works has revealed two 18th century graves. In order to assess the depth of the archaeological deposits and test the bedrock a single location was selected and hand augered. The depth of the grave deposits was estimated to be 2.89m below ground level (BGL). The underlying stratum was waterlogged sand believed to be part of the superficial deposits, the Cheltenham Sands and Gravels. Approximately 1.6m of sand was recovered without reaching the bedrock geology. The auger hole was terminated at 4.76m BGL.

1 INTRODUCTION

1.1 On 22nd October, at the request of Border Archaeology, ARCA carried out a geoarchaeological auger hole in an excavation of two graves in the North Transept of Gloucester Cathedral.

1.2 This document presents the results of the investigation. It is arranged as follows: first an account is provided of the methodology and the results of the auger hole; the significance of the results are then assessed with reference to the geological background and an earlier geophysical investigation; and finally conclusions and recommendations for further work complete the document.

1.3 The report is intended to address the following aims:

1.3.1 To determine the depth and nature of the grave deposits;

1.3.2 To determine the depth and nature of the bedrock geology;

2 METHODOLOGY AND RESULTS

2.1 Of the two 18th century graves in the excavation, the north grave contained a partially uncovered lead coffin at *c.*1.5m below ground level (BGL) which was taken to be the top of the paving stones of the North Transept floor. There was too little space in the corners of the grave to allow for the drilling of an auger hole. A location was therefore chosen within the southern grave at its east end, *c.*1m BGL (Figure 1).

2.2 The position of the auger hole was as close to the east section and central baulk between the graves as was possible to avoid striking buried human remains while still allowing free manipulation of the auger handle. An Edelman soil auger with extension rods was employed and the sediment recovered described according to standard geological criteria (Jones *et al* 1999; Tucker 2011).

Figure 1. Excavation of the graves. Location of the auger hole is marked by the arrow.

2.3 The results of the augering are listed in stratigraphical order in Table 1 below. Depth is measured from the surface of the grave fill where the auger hole was begun. The results of augering need to be read with the following proviso in mind: sediment samples derived from the auger chamber are disturbed as a result of the twisting action on augering, therefore, fine sedimentary structures, for example laminations, are often destroyed and the depths of subtle or gradual boundaries are difficult to measure. It is also worth noting that the colours described here were recorded under artificial light.

Table 1. Description of the auger hole sediments.

Depth m	*Unit*	*Description*
0.0-0.6	1	10 YR 3/3 Dark brown mixed with 10 YR 3/2 Very dark greyish brown, fine sandy clay. Very friable. Frequent granular to medium pebble-sized, white mortar fragments: some very friable others well cemented. Occasional red cbm and charcoal grains. Rare fine to medium pebble-sized rounded quartz. (Grave deposits). Unknown boundary to:

0.6-0.7	2	10 YR 4/4 Dark yellowish brown, friable, fine sandy clay with rare mortar grains, cbm granules and degraded, soft bone granule. (Grave deposits). Unknown boundary to:
0.7-1.00	3	10 YR 3/3 Dark brown mixed with 10 YR 3/2 Very dark greyish brown fine sandy clay. Very friable. Frequent granular to fine pebble-sized, white mortar fragments: some very friable others well cemented. Occasional red cbm and charcoal grains. Rare fine to medium pebble-sized rounded quartz and sub angular flint clast. (Grave deposits). Sharp boundary to:
1.00-1.06	4	10 YR 2/2 Very dark brown friable silt/clay with fine pebble-sized sub angular flint and weathered limestone fragments. (Grave deposits). Sharp boundary to:
1.06-1.70	5	10 YR 4/4 Dark yellowish brown mixed with 10 YR 3/2 Very dark greyish brown silt clay with frequent fine sand (intraclastic like structure). Friable. Occasional granular to fine pebble-sized, white mortar fragments: some very friable others well cemented. Occasional red cbm and charcoal grains. Rare fine to medium pebble-sized rounded quartz. Rare degraded soft bone granules. (Grave deposits, moist). Diffuse boundary to:
1.70- 1.84	6	10 YR 4/1 Dark grey, firm, silt/clay mottled with 5 Y 4/4 Reddish brown iron oxide. Occasional grains of mortar and charcoal. (Grave deposits). Gradual boundary to:
1.84-2.10	7	10 YR 4/1 Dark grey, firm silt/clay with fine 5 Y 4/4 Reddish brown lenses and laminations and frequent fine sand. Pebble-sized lens of fine sand. (Superficial deposit). Gradual boundary to:
2.10-3.71	8	10 YR 4/3 Brown fine to medium sand becoming very wet. Rare fine to medium pebble-sized, rounded clasts of vein quartz and rock fragments. (Superficial deposit). End of auger hole.

3 DISCUSSION OF THE RESULTS

3.1 Contrary to normal practice the results will be discussed from top down beginning with the uppermost deposit.

3.2 The elevation of the auger hole was *c.*1.05m BGL. The top of the grave deposit in the excavation section was *c.*0.3m BGL and was similar in lithology to Unit 1. The grave deposit includes Units 1 to 6 and was recorded to a depth of *c.*2.89m BGL. It was characterised by its very friable structure as a result of a high fine to medium sand content and a consistent, though minor presence of eroded bone granules (2-4mm), charcoal grains and red grains of ceramic building material (cbm). White, degraded medium sand-sized to medium pebble-sized (0.25-16mm) mortar fragments were also present. Upon augering it was noticeable that occasional obstacles – probably larger sized mortar fragments based on the remains of ground deposit on the auger blades – hindered penetration of the deposits.

3.3 The colour of the grave deposit was generally a dark brown 10 YR 3/3 with frequent fine lenses of slightly different shades (greater or lesser value and chroma with the same 10 YR hue). The units recorded cannot be assigned to different fills but considered rather as a heterogeneous whole. Occasionally the sediment displayed an intraclast like structure where distinct fine lenses of sandy clay are set within the deposit sample and may represent deliberate disturbance resulting in mixing.

3.4 At *c.*2.05m BGL Unit 4 represents a slight change in deposit characteristics with an increase in clay content and moisture content. The deposit terminated at 2.89m BGL with a change in characteristics rather than the presence of a laid stone, brick or mortar base. Within the fill there was no evidence of wooden or metal coffins and only slight evidence of skeletal remains (assumed to be human). The lowermost Unit (6) was grey in colour and contained rare charcoal and mortar grains. It was mottled with iron oxide as a result of the rise and fall of the water table. The height of the water table is estimated at 2.75m BGL. A gradual boundary marked the base of the archaeological deposits.

3.5 Units 7 and 8 represent superficial geological deposits underlying the grave deposits. The top *c.*0.2m (Unit 7) was a dark grey sandy silt/clay with iron oxide mottles, no archaeological material culture remains were recorded. From *c.*3.15m to 4.76m BGL (Unit 8) approximately 1.6m of brown

fine to medium sand was recorded with a minor silt/clay fraction and very rare rounded, medium pebble-sized vein quartz and rock fragments (Figure 2). The deposit was wet and very malleable. With depth the auger hole walls collapsed and suction prevented deeper penetration. The auger hole was terminated at 4.76m BGL.

3.6 Units 7 and 8 are believed to be superficial deposits of the Cheltenham Sand and Gravel. No superficial deposits are mapped within the Cathedral precinct. The closest known deposit is a very limited outcrop 200m south and at a slightly higher elevation than the Cathedral (BGS 2015). The Cheltenham Sand and Gravel formed in the Quaternary Period up to 3my BP. It consists of fine to medium sand with lenses of poorly sorted limestone gravel. This is a mixed deposit with the gravel derived by solifluction from the Jurassic Cotswold escarpment and the sand fraction transported by wind action from river terraces. No evidence of limestone clasts were recorded in the Units 7 and 8, however, clastic content was very rare. Rare limestone clasts were recorded in the archaeological deposits.

Figure 2. Sand recovered from Unit 8.

3.7 The British Geological Survey (BGS) map the Cathedral as lying on undifferentiated bedrock of the Blue Lias Formation and Charmouth Mudstone Formation, deposits dating to the Jurassic and Triassic Periods approximately 183-204 my BP (BGS 2015). Both Formations are typically composed of grey

mudstones that have been recorded as grey clays in geotechnical boreholes within 300m of the Cathedral at *c.*4m below ground level. Superficial sands were not recorded in the boreholes. The presence of the superficial sand deposits was unexpected as neither the BGS nor the Ground Penetrating Radar survey suggested that they would be present (Ashby and Watson 2015).

3.7 The Ground Penetrating Radar survey carried out in August 2015, failed to recognise the depth of the archaeological deposits and the underlying sand deposit because the relative dialectric permittivity of the grave deposits and the sand deposit is essentially the same. Boundaries can only be identified by radar if there are different physical properties either side of the interface that reflect energy of the passing wave back to the radar receiver. The fact that all the units are composed of a high proportion of sand and that sand is the underlying lithology then the two deposits, distinct as they were to the naked eye, are invisible to GPR. It must be admitted however that with hindsight and the eye of faith, the archaeological deposits are distinguishable on the radar plot although the depth of the interface is not.

3.8 The geology beneath the archaeological deposits in the North Transept must also be reinterpreted from the erroneous conclusions in the GPR survey. The archaeological deposits appear to have been cut into a superficial sand deposit that is at least 1.6m thick. The top of the sand is likely to be at a higher elevation than that recorded in Unit 6/7, *c.*2.89m BGL in areas of the North Transept where grave disturbance is shallower. The base of the sand deposit is unknown although it must overly the undifferentiated bedrock of the Blue Lias Formation and Charmouth Mudstone Formation. The elevation of the top (rockhead) of the solid bedrock is unknown but it lies below 4.76m BGL.

3.9 It had been expected that the cathedral crossing was based firmly upon the bedrock, however, this work suggests that there is a possibility that it is not. This disquieting supposition is supported by architectural evidence. The reconstruction of the Norman crossing in the 15th century required diagonal bracing within the South Transept and exterior buttressing from above the nave roof both of which imply that the master mason had reason to doubt the efficacy of the early foundations.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 The archaeological deposits below the southern grave in the excavation of the North Transept extends to 2.89m BGL. No evidence was found of coffins nor was there a built base. The water table is estimated at 2.75m BGL.

4.2 The deposits appear to be cut into the top of the Cheltenham Sand and Gravel. Approximately 1.6m of homogenous, brown, fine to medium sand was recorded and the final depth of the auger hole was 4.76m BGL. The rockhead was not proven.

4.3 To determine the elevation of the bedrock it is recommended that a small geotechnical rig be employed to drill through the backfilled excavation trench.

5 ACKNOWLEDGMENTS

5.1 ARCA would like to thank the site director and her team for their help with the field work.

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