ISAPNEWS

The Newsletter of the International Society for Archaeological Prospection

Issue 68, May 2023

Editorial – Issue 68

Welcome to Issue 68 of ISAPNews!

We have three interesting case studies in this issue. The first is a GPR survey, undertaken in search of a partially-destroyed monastic cellar amid the imposing Gothic and Baroque buildings of Bamberg, Germany.

The other two are short versions of presentations delivered during the NSGG meeting in London on 6 December 2022, both of which tackle geophysical survey in potentially challenging circumstances. One (partly funded by the ISAP Fund) investigates approaches to identifying archaeological remains buried under accumulated sediment, while the other discusses the difficulties so-called 'green waste' presents for magnetic survey – an increasingly common problem faced by surveyors.

You can also check out what's in the current issue of *Archaeological Prospection* and, if you make it through to the end of the newsletter, you'll find a reminder of how to purchase ISAP merchandise – don't forget there are discounts available for a limited time!

Hannah Brown

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Reconstructed Viking-Age buildings at Hedeby/Haithabu. The 15th ICAP Conference, held in Kiel in March 2023, will be remembered by delegates for the inspired presentations, the excellent organisation and one of the coldest post-conference excursions ever! © H Brown

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Searching for a medieval cellar: GPR survey in the UNESCO world heritage site of Bamberg

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St. Gangolf: Location and History

The old city centre of Bamberg (Upper Franconia, Bavaria) has been listed as a UNESCO world heritage site since 1993. Especially on the left bank of the River Regnitz, many medieval and baroque buildings and churches are located. These include the Old Town Hall, the romanesque cathedral, several monasteries, such as St. Michael, and the residences of the prince-bishops. These well-known monuments are the reason that Bamberg hosts a huge number of tourists every year. Within this article, however, a less well-known site will be covered: the former canons' monastery of St. Gangolf in the Theuerstadt quarter, ca. 1.2km northeast of the cathedral. This canons' monastery was founded between AD 1057 and 1059, when a rural settlement structure developed along an important trunk road running north-south on the right bank of the Regnitz (Zimmermann 1982; Witowski 2021). Even today this quarter has kept its character as a small village within the city that is dominated by market gardens (Schütz n.d.). Some parts of the first church built in the 11th century still exist and St. Gangolf often is regarded as the oldest preserved church in Bamberg (Zimmermann 1982). However, due to considerable construction work in the Gothic (ca. 15th century) and the Baroque (ca. 18th century) periods, these old components are not visible anymore (Witowski 2021). The first monastery was located at the northern side of the church. After 1200 AD, around the church a series of eleven canons' curiae as well as several vicars' buildings were established. Canons' monasteries had their own jurisdiction and a waiver of taxes (Zimmermann 1982). In contrast to normal monasteries, the secular canons were not assigned to a fraternity (Witowski 2021). Most of the canons' curiae in St. Gangolf are preserved today, however, some have been demolished. Among the latter are parts of the St. Nikolaus curia directly northeast of the church. Whereas the maps of the 17th century (Figure 1a) and 19th century (Figure

1b) show the whole complex, the northern wing has since been removed (Figure 1c). The aim of the GPR survey was to map the former cellar construction that still exists buried in the ground after parts of it collapsed around 25 years ago. After the collapse the cellar was backfilled with soil to stabilize the construction. However, the exact location, and especially its state of preservation, is unknown.

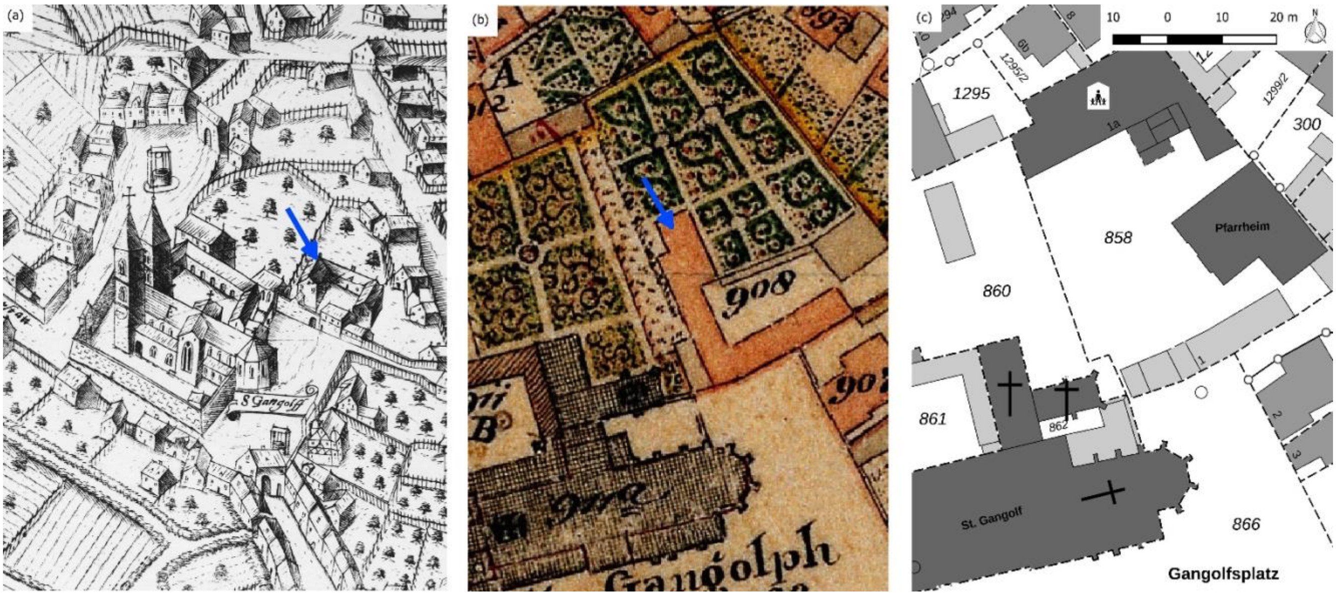

Figure 1: Selection of maps showing the relevant survey area at St. Gangolf, Bamberg. (a) "Gründtlicher Abriß der Statt Bamberg". Copper engraving drawn by Petrus Zweidler von Teuschnitz, engraved by Diderich Bang in 1602 (Staatsbibliothek Bamberg, Plan-No. V B 22/1-4); the blue arrow marks the target building; (b) "Uraufnahme". First official topographical map of Bavaria, drawn in 1822 (© Bayerische Vermessungsverwaltung. www.geodaten.bayern.de); the blue arrow again marks the target building; (c) Modern topographical map showing that the corresponding building has since been demolished (© Bayerische Vermessungsverwaltung. www.geodaten.bayern.de).

Results of the GPR Survey

The survey covered an area of 20 x 35 m including the supposed location of the cellar of the St. Nikolaus curia. Due to the modern use as a kindergarten playground, there is a multitude of disturbances due to trees, bushes, flower beds and play structures that cause holes in the depth slices. Furthermore, the varying surface material, ranging from grass over loose gravel to stone pavement, caused additional problems in the data. Particularly in the northwestern corner of the survey grid, a strong disturbance over the whole depth range can be observed. Furthermore, several modern pipes are located at a depth of 0.4 m – 0.6 m.

Although the survey took place in mid-November 2022, the soil conditions were still suitable for a successful GPR survey. An *in situ* Time-Domain Reflectometry measurement showed a soil moisture of only 19 vol% and a conductivity of only 0.95 dS/m for the topsoil due to the preceding extremely dry summer.

The GPR depth slices show the archaeological remains from 0.4 m below the modern surface downwards. This shallow upper edge of the former air-filled cavity caused the roof collapse some 25 years ago. In the data, the walls seem to vanish at a depth of 1.2 m; however, this is more due to the signal loss in the ground than reality. Otherwise, the cellar would have been very low, or the original roof not preserved. The latter cannot be true, as the local people recorded a preserved groined vault when entering after collapse.

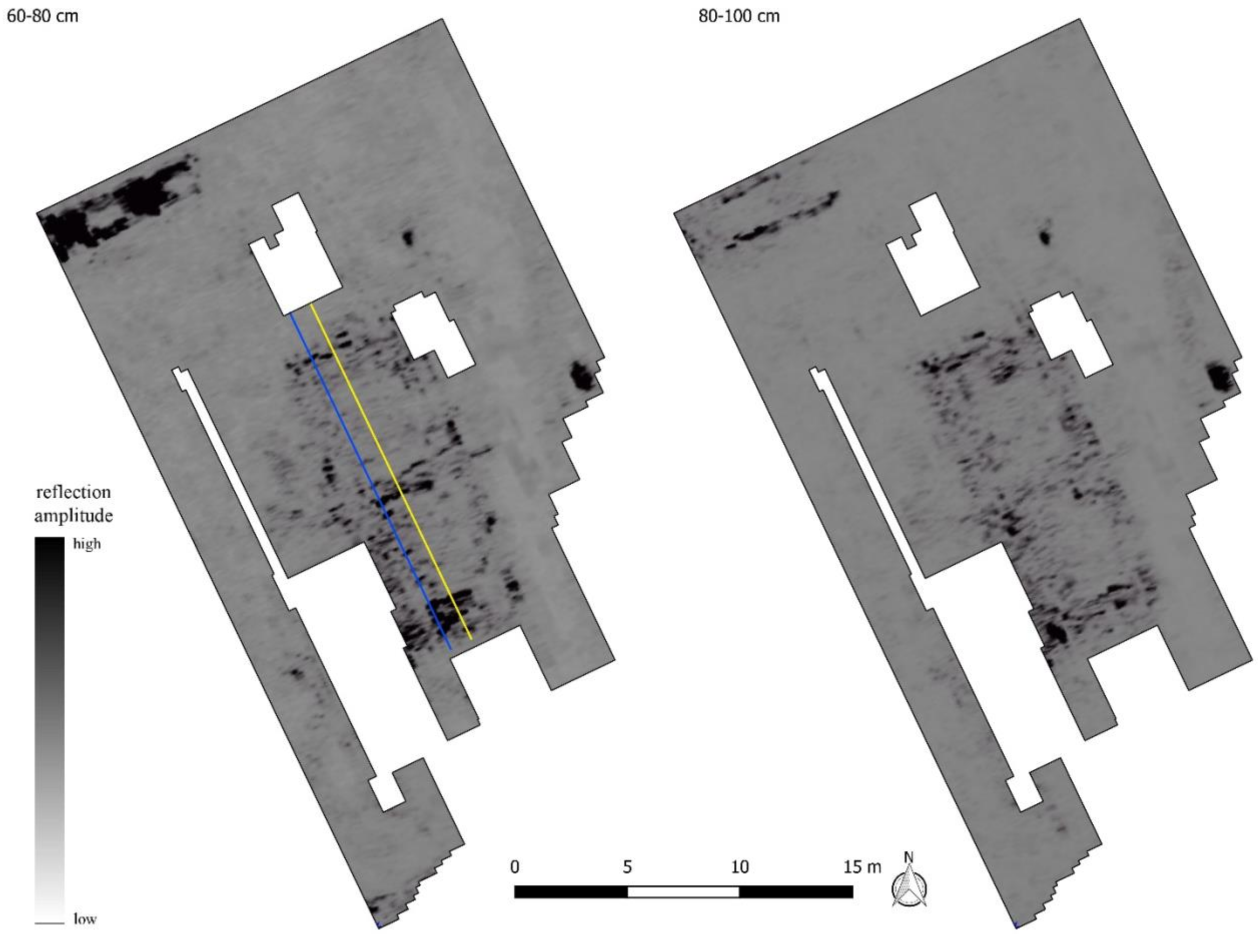

Figure 2: Selection of GPR depth slices showing the layout of the medieval cellar of the St. Nikolaus curia in St. Gangolf (Bamberg). The two lines mark the location of the profiles in Figure 4 (blue = Profile 1, yellow = Profile 2). GSSI SIR-4000 with 400 MHz-antenna, sample interval: 0.06 m x 0.25 m. Project-No. Ggf22rad.

The actual curia's cellar is visible in the centre of the survey grid as a 14 x 6.5m rectangular structure (Figures 2 & 3). The massive construction of 0.65 m thick walls supports the interpretation of a cellar. Whereas the topmost depth slices only show the outer walls, at a depth of 0.6 m – 1 m two square anomalies 0.65 m long and 1.6 m apart can be observed. These features can be interpreted as the probable remains of former pillars of the groined vault, as the position within the cellar fits ideally for this purpose.

Fig. 3: GIS-based interpretation of the archaeological structures at the St. Nikolaus curia in St. Gangolf (Bamberg). Colour coding: red = GPR results, brown = georeferenced rendering of Zweidler-map (1602), black = survey grid (Interpretation: Roland Linck, Rendering of Zweidler-map: Armin Röhrer; both BLfD).

The highly reflective area in between the pillars relates to the remains of the collapsed supporting arch. Assigning these reflections to a wall separating two cellar rooms is implausible, as such a construction would make the installation of a groined vault unnecessary, and the anomaly does not run as far as the outer walls. The analysis of single profiles in this area also shows that there is no solid wall-like structure between the pillars (Figure 4). The chaotic signal shape in the topmost 0.4 m in Figure 4 is due to the modern activity and refill of the area. At the southern side of the cellar, a rectangular region of high reflection amplitude is evident in the depth slices that is likely interpreted as staircase into the cellar (Figures 2 & 3).

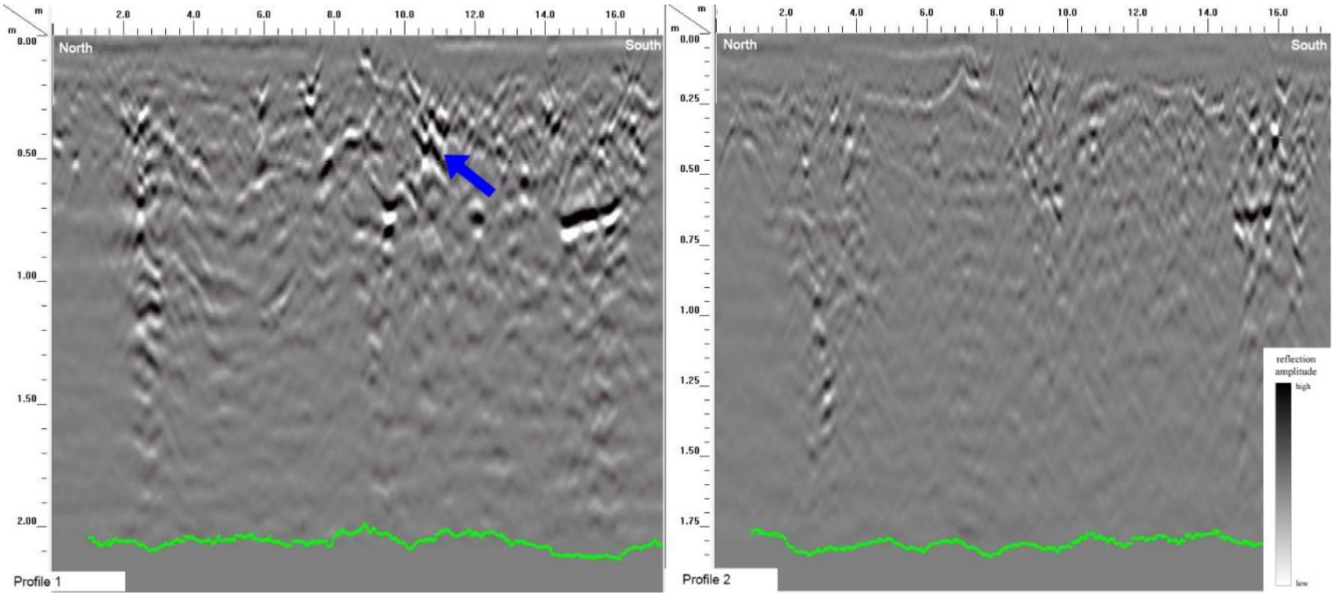

Figure 4: Comparison of two north-south profiles in the cellar area. Profile 1 crosses the supposed pillar, marked with a blue arrow. Profile 2 reveals that it is not a solid wall, as there is no anomaly at the corresponding position. Both profiles show the outer wall of the cellar to the north and the staircase to the south. The location of the two profiles is marked in Figure 2 (Profile 1 = blue, Profile 2 = yellow).

Conclusions

The medieval cellar of the St. Nikolaus curia can be clearly distinguished in the GPR data, as the undisturbed surrounding area does not show any anomalies at all. The data furthermore proves the records of a groined vault in this area, as the interpreted features fit perfectly to such a type of construction. For the first time, the cellar is exactly located. Comparing its position and layout with the old maps reveals that they coincide perfectly to the “Uraufnahme” of 1822 (Figure 1b) and the maps of the beginning of the 20th century. Only the referenced rendering of the Zweidler plan of 1602 (Figure 1a) does not seem to fit. However, the detected cellar and its staircase connect exactly to the mapped buildings south of it. Hence, perhaps the drawing is not really accurate and the building was slightly bigger. This thesis is supported by comparison with the surrounding buildings: it seems that the perspective was wrongly transcribed and the building ranged further to the north. Thus, our GPR survey helped to correct this error in the GIS plan of the city of Bamberg around 1600.

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Integrating geophysical and remote sensing data for the modelling of geoarchaeological resources in alluvial environments

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Shallow magnetic gradiometer surveys are now regularly deployed at a landscape-scale, covering 100s and sometimes 1000s of hectares, particularly prior to infrastructure projects, for the detection of archaeological features. The consideration of the geological, geomorphological, and topographical context of these large areas is fundamental, and without this context it is not possible to completely interpret these results. Moreover, in landscapes where archaeological resources do not lie immediately below the modern ground surface (i.e. a soil profile above bedrock) but are buried below and within accumulated sediments (e.g. alluvial, colluvial, aeolian, coastal, estuarine, and lacustrine deposits), most conventional (shallow) geophysical techniques will be largely ineffective. However, through integration with remote sensing techniques, other (deeper) methods of geophysical survey, and the construction of geoarchaeological deposit models, it is possible to map the likely distribution of buried deposits of archaeological interest (Carey *et al.* 2018). This allows for areas of greater and lesser archaeological potential to be established, which, in turn, enables the context of archaeological remains to be better understood and subsequent investigations to be more focused (Historic England 2020).

This research project, which was partly funded by the ISAP fund, has aimed to demonstrate how geophysical survey and remote sensing techniques can be integrated within the framework of geoarchaeological deposit modelling to provide an improved understanding of complex depositional zones, where standard shallow archaeological prospection methods are largely ineffective (Weston 2001). It focuses on alluvial environments, as they frequently contain rich and well-preserved archaeological and palaeoecological records, which are increasingly threatened by development, agriculture, and climate change (Howard *et al.* 2015). It includes a case study of the Lower Lugg Valley in Herefordshire, where previous research has recorded a complex depositional history, with closely related human-environmental interactions, and widespread archaeological activity (Dorling 2007; Jackson & Miller 2011). The results have implications for application of these methods in other geomorphologically complex depositional zones and it is argued that such an approach should be adopted more widely.

Modelling archaeological potential in alluvial environments

Geoarchaeological deposit models provide a visual representation of the spatial and stratigraphic relationships between subsurface sediments, archaeological features and palaeoenvironmental remains (Carey *et al.* 2018). Whilst they vary in their form and presentation, they generally aim to improve the understanding of depositional environments and make predictions regarding archaeological potential (Carey *et al.* 2017; Howard *et al.* 2008). They are conventionally constructed by combining pre-existing archaeological and Historic Environment Records, geological mapping, and geotechnical data. However, they can also incorporate proxy measurements of the subsurface provided by remote sensing or deeper geophysical survey methods.

Numerous projects have used airborne lidar for topographic modelling of landforms of variable archaeological or palaeoenvironmental potential (Brunning & Farr-Cox 2006; Challis & Howard 2006; Mozzi *et al.* 2018; Ninfo *et al.* 2011; Passmore & Waddington 2009). However, any archaeological resources that are not expressed topographically, due to significant alluvial deposition or agricultural activity, will not be identifiable. Whilst multispectral data is also limited to surface measurements (e.g. spectral reflectance relating to soil moisture or plant health), it can act as a proxy indicator of buried features, landforms and sub-surface sediment architectures (Crabb *et al.* 2022). Moreover, with reductions in costs and recent technological advancements, including the improving spatial resolution of satellite systems and the advent of lightweight UAS mounted instruments, these datasets are increasingly accessible for geoarchaeological research.

The Lower Lugg Valley, Herefordshire (UK)

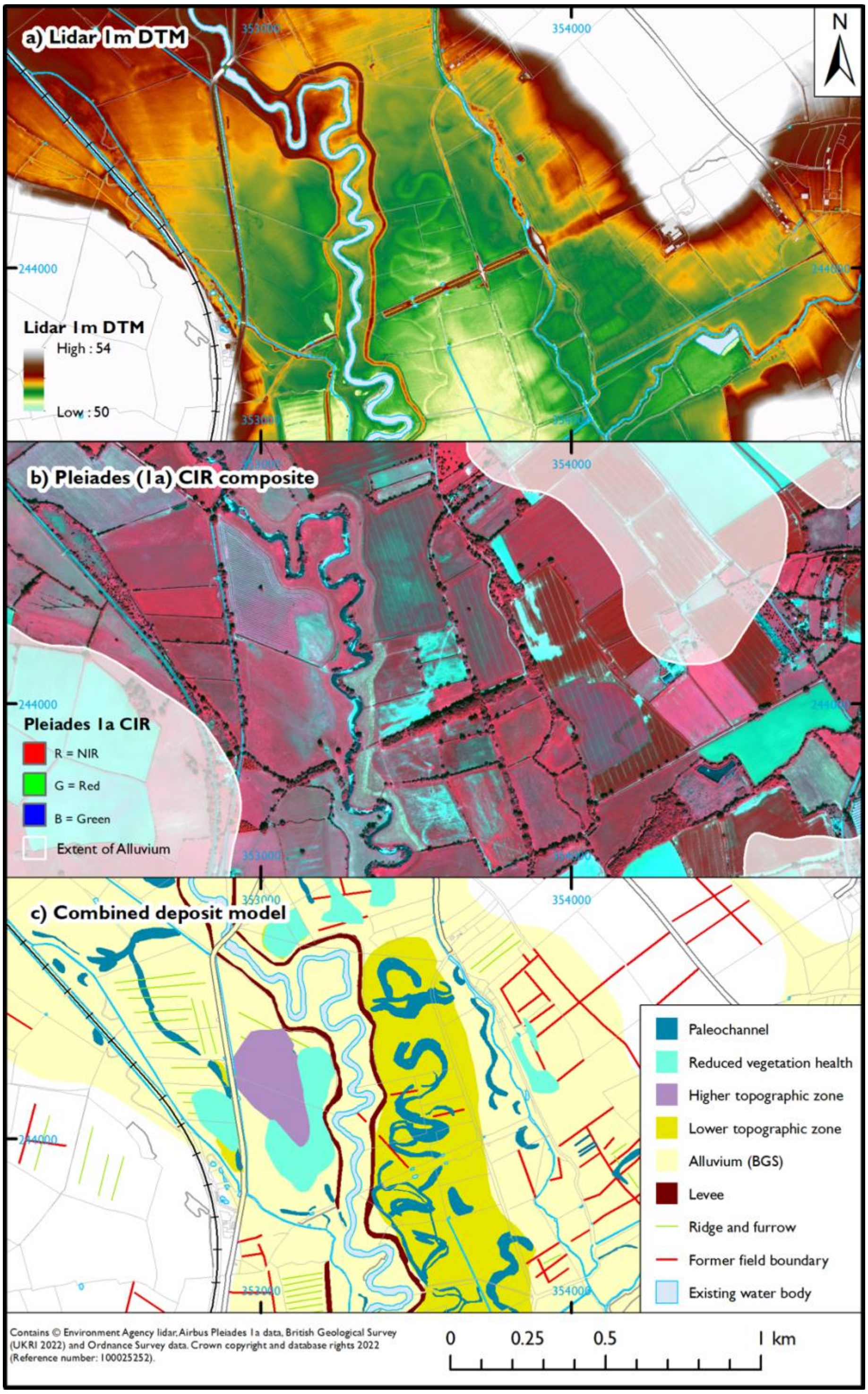

Figure 1: Alluvial landforms defined by remote sensing techniques to create a deposit model.

In the Lower Lugg Valley, open government licence lidar was used to define the central, vertically accreting portion of the alluvial corridor, together with a series of more discrete alluvial landforms, such as palaeochannels and gravel topographic high points (Figure 1a). These landforms were also identifiable within high-resolution satellite multispectral imagery, but in addition, larger scale landforms (e.g. a probable gravel island) were more apparent as variations in vegetation health (Figure 1b). Collectively, these datasets were used in conjunction with a small number of boreholes (Figure 2d) to produce a simple deposit model (Figure 1c). This enabled predictions to be made regarding the distribution of archaeological resources, where lower-lying (wetter) areas and palaeochannels were considered more likely to contain paleoenvironmental resources, whereas higher (dryer) zones, relating to upstanding gravel terraces or islands, are unlikely to contain such remains, but were more attractive for a range of past human activities.

To test the deposit model constructed from remote sensing and borehole data and better characterise the nature and distribution of subsurface deposits and alluvial landforms, an electro-magnetic induction (EM) survey was carried out over a 39 ha area of the floodplain (Figure 2a). This was focussed upon a gravel high point that contains a Neolithic standing stone (Figure 3), suggesting that the area has a very high potential for the preservation of a prehistoric land surface. The EM data was collected using a Geonics EM31 MK2 in traverses spaced approximately 5 m apart, with readings taken every second. The results confirmed the presence of a gravel as an area of lower conductivity, which had thinner deposits of alluvium on its surface defining a higher archaeological potential (Figure 2d).

Due to the higher and drier position of the gravel island, a gradiometer survey was also undertaken to identify any possible archaeological features on its surface (Figures 2b and c). This used five SenSys FGM650/3 gradiometers spaced at 1 m at a rate of 100 Hz, producing intervals of *c.* 0.08 m. The gradiometer survey defined some tentative anomalies, predominantly concentrated upon the topographic (gravel) high point, helping to confirm the predictions of the deposit model. However, although the gradiometer survey targeted an area of shallower alluvium, the alluvial deposit sequences were still predominantly >1 m in depth and consequently, are likely to have been too deep for the gradiometer to identify features at the Pleistocene/Holocene interface at the base of the sequences. Despite this, these results illustrate how appropriate geophysical survey and remote sensing techniques can be integrated to provide a better representation of the nature and distribution of archaeological resources within alluvial landscapes.

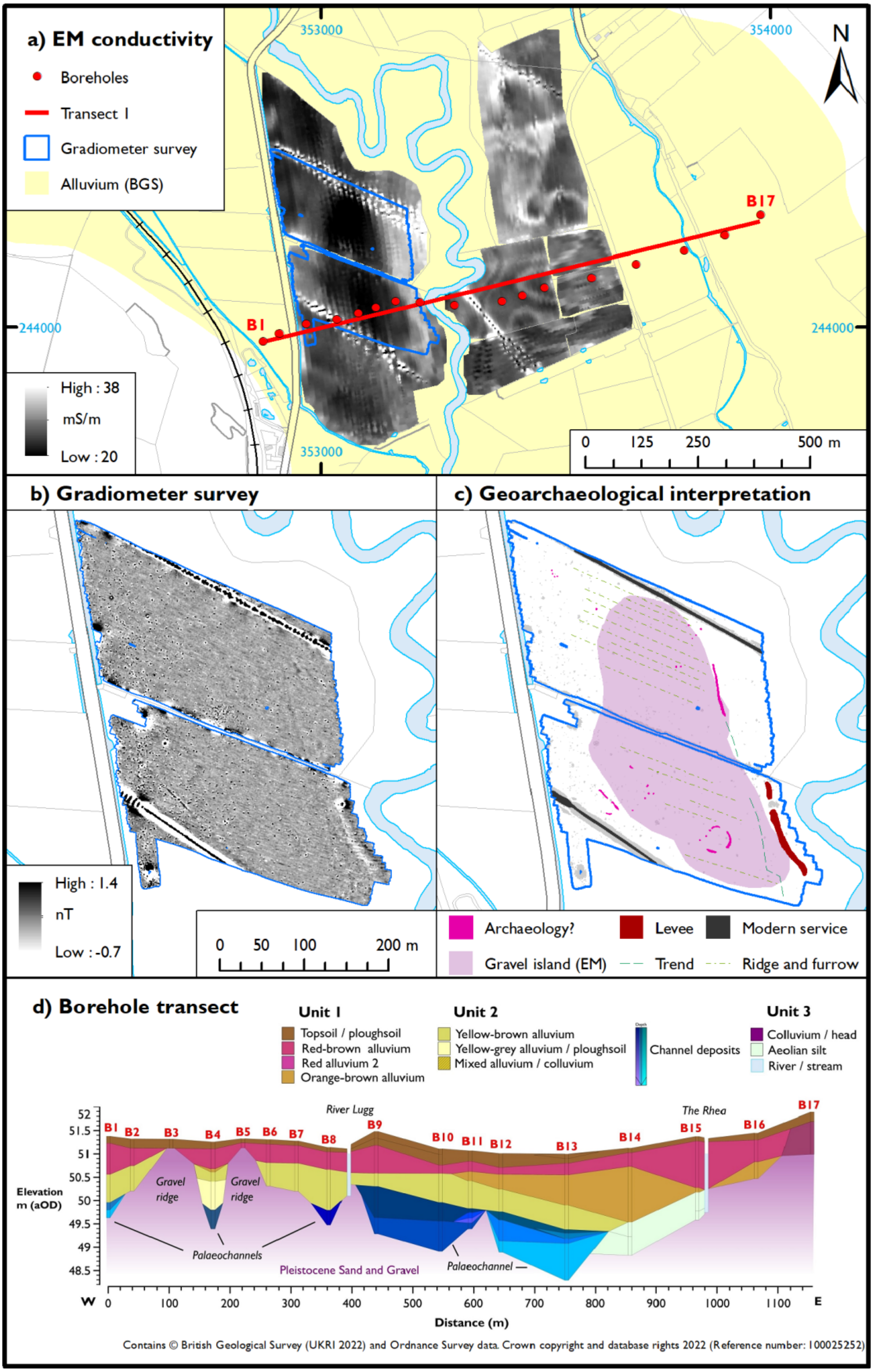

Figure 2: Alluvial landforms and archaeological features characterised through geophysical survey and borehole transect.

Figure 3: 'The Wergins Stone' from the south of the gradiometer survey area (Scheduled Monument NHLE 1005346).

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Municipal garden waste compost – its effect on magnetometry results

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Summary

Municipal garden waste compost appears to contain material which introduces a speckled appearance to magnetometry results. This may well lead to remains not being detectable by this method.

Figure 1: Air photo of Andersey Island with Abingdon bridge.

Background

The area concerned is at 51 deg 40' N 1 deg 16' 27'' W, on a fairly level gravel terrace near the River Thames (Figure 1). Bronze Age barrow circles are known to be there and there are documentary records of a medieval royal hunting lodge and church being in the vicinity. We have been doing magnetometry and earth resistance to identify likely locations for these remains as a research project.

Whilst attempting to get the records of the work into order for archiving, we found that we had surveyed the same area several times. Usually this was to test equipment (a Bartington grad 601-2 single axis fluxgate gradiometer and TR Systems Mk2 earth resistance meter) or to give other people experience in using it.

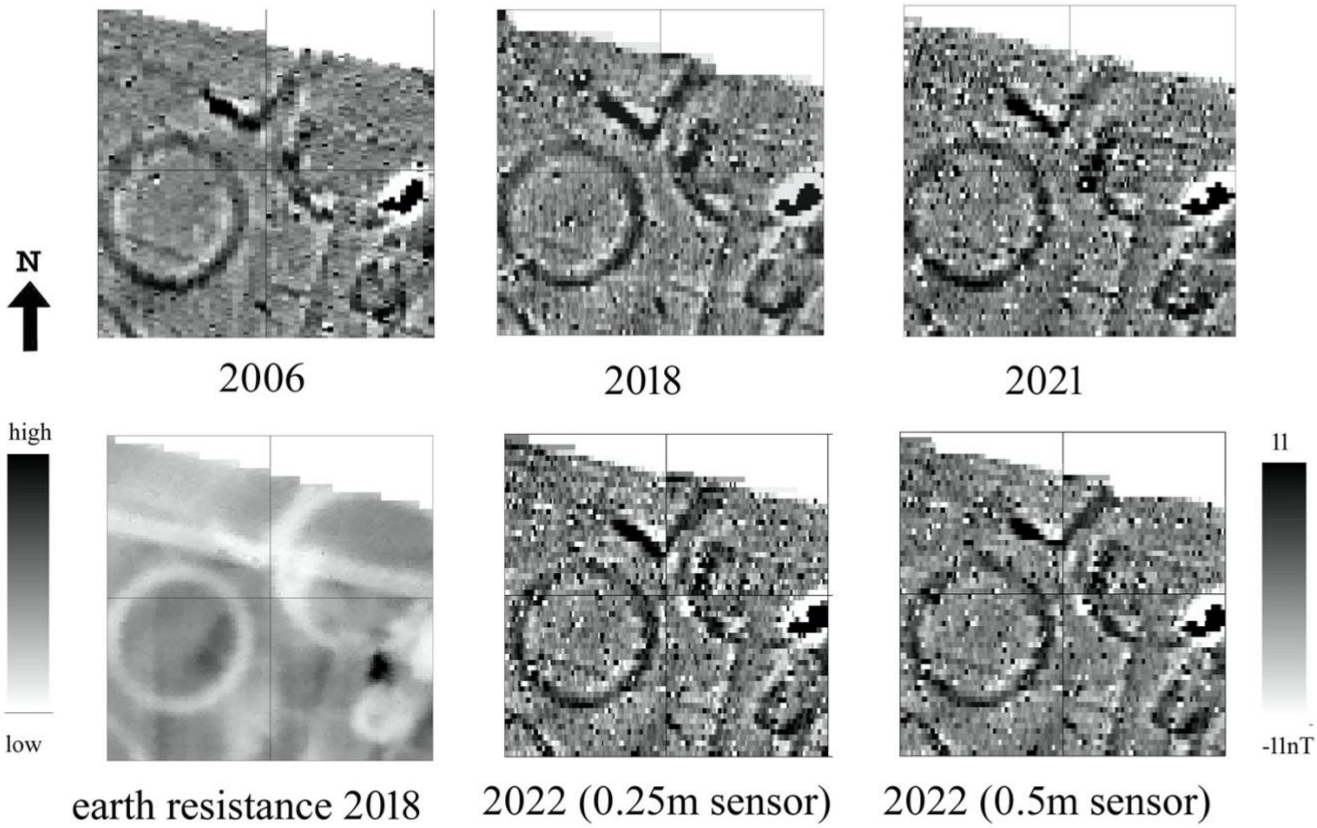

Figure 2: Survey results.

Results

The older magnetometry results were better than the later ones due to speckle on the later surveys. This appears to have gone from one piece of (presumably ferrous) speckle in the south-westerly round barrow area in 2006, to 6 in 2018 and 16 in 2021, since when there has been no increase.

The earth resistance results are in some respects clearer, although a line of low resistance running parallel to the northern edge of the field is a tractor track. The lack of vegetation on that route meant that there was less transpiration removing dampness from the soil there.

The farmer advised that this area has had municipal green soil conditioner used on it three times, at a rate of ten tonnes per hectare each time. He has stopped using it as he considered it contained too much plastic for the good of the soil, despite it being within the permitted limits.

We collected surface debris and found a good amount of garden-related plastic and pieces of wire and similar garden-related steel. A detectorist also identified several horseshoe-type nails. The field had been pasture under the Countryside Stewardship scheme to protect the archaeology. The farmer had withdrawn from that arrangement and had put down the first batch of compost (soil conditioner) and planted potatoes. This may have brought up nails and similar which had been taken downwards by worm action. Even if the 2018 ferrous spikes were all caused by old material getting to the surface, it does not account for the increase in the following years when wheat was planted.

In any event we are looking at a sample as the cone of detection for single axis gradiometers may miss many of the smaller pieces of steel, particularly at the 1 m line interval with eight readings per metre used here.

There is a slight difference between the 2022 grid locations and the previous ones. This is caused by Trinity House turning off its differential radio correction beacons. Apparently, they want us to get newer apparatus, although mobile phone signal-based equipment may also now be under threat as the government proposes to sell those wavelengths for other purposes.

We surveyed again in 2022 to see whether increasing the height of the bottom sensor from 0.25 to 0.5 metres made much difference. It appears not to, although some of the archaeological features became less distinct.

Discussion

This study might enable a view to be taken on whether ferrous material should be removed before such soil conditioner is used, although the costs of removing it are likely to be considered by the industry to be too high. The alternative is to have fields surveyed before it is deposited. Landfill sites are recorded for methane and heavy metal contamination aspects, so perhaps areas where this material has been deposited should similarly be in the public record.

There are different grades of this soil conditioner; it may be that we could have less of a problem if, rather than using the coarser material, farmers used the grade which has been through a finer sieve.

James Gerrard *et al*. have already put an article into *Archaeological Prospection* (2015) showing the masking effects of this substance and also giving detail of the amount of contamination it was permitted to contain. This seems not to have had the circulation it deserves. Metal detectorists were also concerned and there was even an item on the BBC TV programme *Countryfile* about it, but nothing appears to have been done to remove the problem.

Why it matters

A high amount of this contaminant can conceal almost everything. As sometimes remains are identified by the location of individual pieces of iron, a random scatter of it will stop remains being identified. Our finding that the comparison between caesium and fluxgate apparatus at Flint Farm was not fair hinged on detecting a single piece of iron (Ainslie 2015).

In terms of the planning and development process, areas where magnetometry is rendered useless will probably have test trenches instead of geophysical survey, rather than as an additional method. Whilst test trenches are better than magnetometry for small postholes, they also tend to miss features where there is insufficient colour contrast – such as the upper levels of backfilled ditches.

Figure 3: Plastic litter on the field.

It may have been seen as a good idea to reduce landfill by taxing active waste at almost £100 per tonne compared to £3 a tonne for inactive waste, but it doesn't appear to have been thought through.

The amount of plastic in this soil conditioner is the thing which most people see and are concerned about. The conditioner soon rots away, but the plastic doesn't and builds up year by year. In terms of carbon dioxide production this may be the same whether the material is spread over fields or in a tip. The main difference may be that they can cap tips, collect the methane and use it to generate electricity. Using green waste to feed wormeries to make vermicompost may also be a better use for it.

Encouraging the agricultural use of this soil conditioner, as presently authorised, may belong to the category of good ideas gone bad, such as asbestos insulation, high alumina cement, pitch fibre pipes etc.

Acknowledgements

We would like to thank the farmers and landowners for access, Sally Ainslie and Chris Oatley for surveying, and Drs. Armin Schmidt and James Gerrard for their advice.

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Journal Notification

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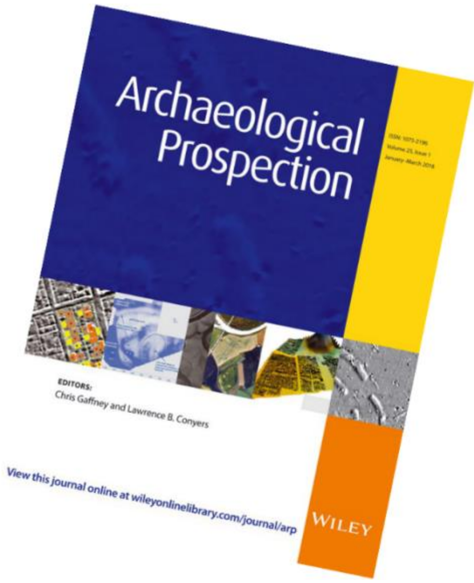

Structural detailing of buried Roman baths through GPR inspection.

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Fabio Cafiso, Alessandro Canzoneri, Patrizia Capizzi, Alessandra Carollo, Raffaele Martorana & Filippo Romano

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