ISAPNEWS

The Newsletter of the International Society for Archaeological Prospection
Issue 71, April 2024

Editorial – Issue 71

Welcome to Issue 71 of ISAPNews!

This issue has reports from two more ISAP Fund projects… The first of these involved a sub-bottom profiler survey of historic wrecks in Poole Bay (off the south coast of England) and tested the effectiveness with which the parametric sonar equipment could identify buried archaeological objects.

The second entailed magnetometer survey of an Iron Age banked enclosure in southwestern Germany, but required the adjustment of traditional data collection methods to accommodate the woodland conditions. Read on for the results of both surveys.

And a new column: "Born to Survey". Not as cheesy as it sounds. Check it out!

We also have a contribution relating to the design of GPR antennas. This was sent to ISAPNews in the hope that it might stimulate feedback and discussion, so please go ahead and discuss!

Happy surveying!

Hannah Brown & Michal Pisz

editor@archprospection.org

P.S. Don't forget there is 15% off ISAP merchandise from 25th to 29th April 2024. Scroll down for the link.

Cover: Suboptimal conditions for data collection. What if the Iron Age monument you want to survey is in woodland? (© A Schmidt; see p10).

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Membership renewal

Membership fees are £10 or €11 for the whole calendar year 2023. Online payments are possible through our web site at https://www.archprospection.org/renew/

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Take advantage of the deal offered to ISAP members by Wiley-Blackwell for this journal.

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Prospecting for wrecks beneath the sand

ISAP Fund Completion Report

Tom Cousins[1] & Rodrigo Ortiz[2]

[1]Bournemouth University, Poole, UK

[2]University of Southampton, Southampton, UK

tcousins@bournemouth.ac.uk

The entrance to Poole Harbour is the final resting place for three historic wrecks designated under the Protection of Wrecks Act 1973. These are the thirteenth-century Mortar Wreck, the sixteenth-century Studland Bay Wreck, and the seventeenth-century Swash Channel Wreck (Figures 1 & 2). Over the centuries these wrecks have become buried in the sand, protecting parts of the structure from the wood boring organisms that destroy any exposed timber within months (Knight *et al.* 2019). Due to a multitude of factors the archaeological remains can become exposed and, if not discovered, it can become a race against time to record or preserve these unique sites before they are lost. This can involve anything up to full scale recovery (for example, of the Mary Rose or the Vasa), but the preferred method is to try and rebury the exposed structures and attempt to preserve them *in situ*.

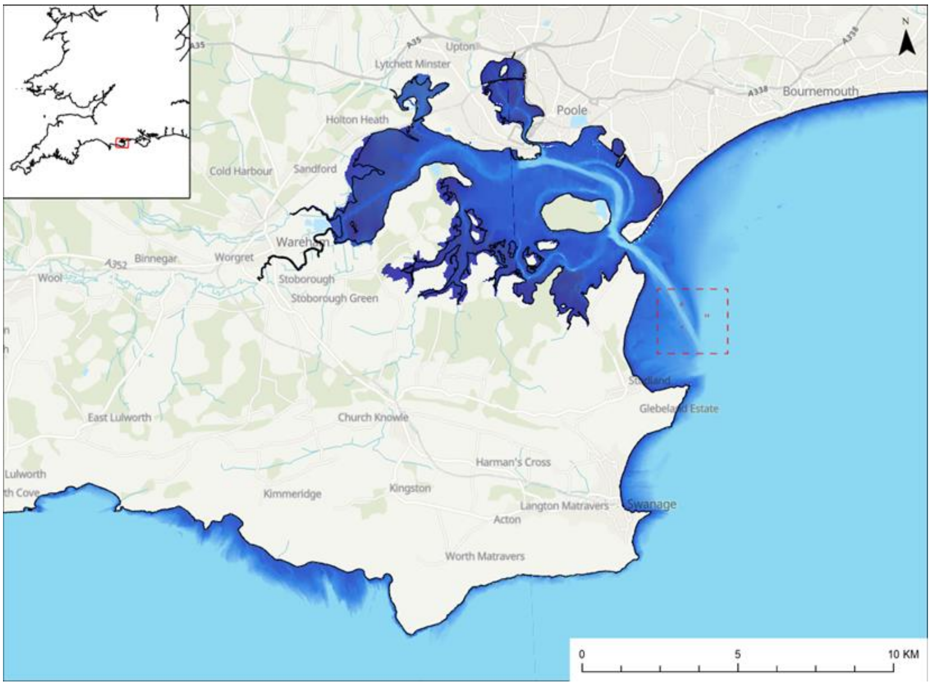

Figure 1: Location of the Survey within Poole Bay
(Contains OS data © Crown copyright and database right 2023).

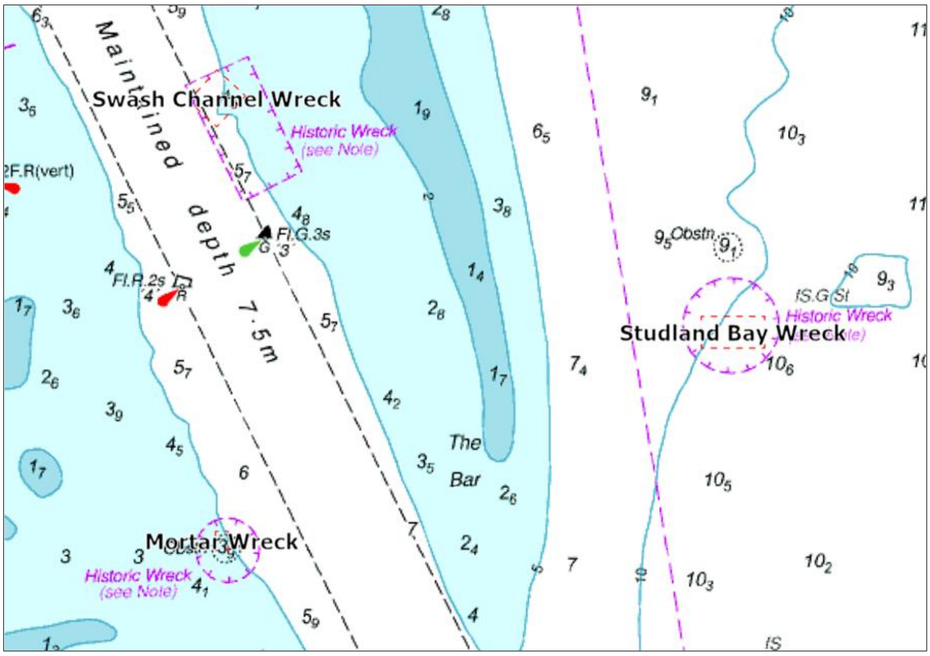

Figure 2. Location of the three historic wrecks in Poole Bay (© British Crown and OceanWise 2023. All rights reserved. Licence No. EK001-20180802. Not to be used for Navigation).

One of the largest issues in managing wrecks is knowing the potential of what is buried and what may become exposed. Frequently, by the time the site has been discovered, the funds raised and the work done, it may already be too late to save the remains. This has happened, for example, with the Swash Channel Wreck, where large amounts of the structure were lost between its discovery and the excavation (Figure 3).

Figure 3: The same area of the Swash Channel Wreck; left: when it was first exposed in 2004; right: on excavation in 2010, despite being buried as part of an in situ trial.

Therefore, it has always been a dream within maritime archaeology to be able to scan the seabed and conduct surveys in a way that is similar to terrestrial sites where Ground Penetrating Radar can be used for the discovery and management of sites.

As radio waves do not work in water marine geophysicists rely on sonar. In the last decade or so, multibeam bathymetry has allowed accurate images of the seabed, similar to LiDAR. However, for remotely seeing beneath the seabed, the only technology available are sub-bottom profilers (SBP), which work well for mapping wide area sites, such as submerged landscapes, but are not normally used in the detection of shipwrecks due to the difficulty in isolating anomalies that are caused by archaeological remains.

However, the Historic England Guidance for marine geophysics suggests that: "In theory, the parametric sonar should be able to produce higher horizontal resolution than the chirp system. However, there is currently little information on the use of these sources for archaeological object detection and more data are needed to show whether this system can become a standard tool for archaeological research" (Plets *et al.* 2013, p. 26). Therefore, when MSDS Marine offered the loan of a Seaking parametric SBP for use on protected wrecks and an ISAP Anniversary Fund grant was awarded for the charter of a marine survey vessel, we decided to put the technology to the test. Of the three protected wrecks in Poole Bay, two, the Swash and Studland, have already been fully excavated and reburied (in the case of the Swash, this had been done by the lead author) and it was therefore fairly clear what the results should look like. The third wreck, the Mortar Wreck, is part of an ongoing research project with active fundraising to research and preserve the site.

The SBP used markets itself as a compact device capable of penetrating the seabed and highlighting structural differences that are hidden from view. These work by transmitting two signals of slightly different high frequencies, with the lower (secondary) frequency penetrating the sea bottom and the primary frequency used to detect the seabed and determine water depth. It also had an advantage over other sub bottom methods in that it can be used in shallow water without ringing and it consists of a compact unit which can be pole mounted and deployed on small research vessels.

The SBP was set up on a pole mounted system with the positioning provided by RTK for the best accuracy (Figure 4). The poor weather conditions over the summer meant that the survey occurred late in August 2023 when, despite heavy thundery showers throughout the day, the sea was flat and perfect for surveying.

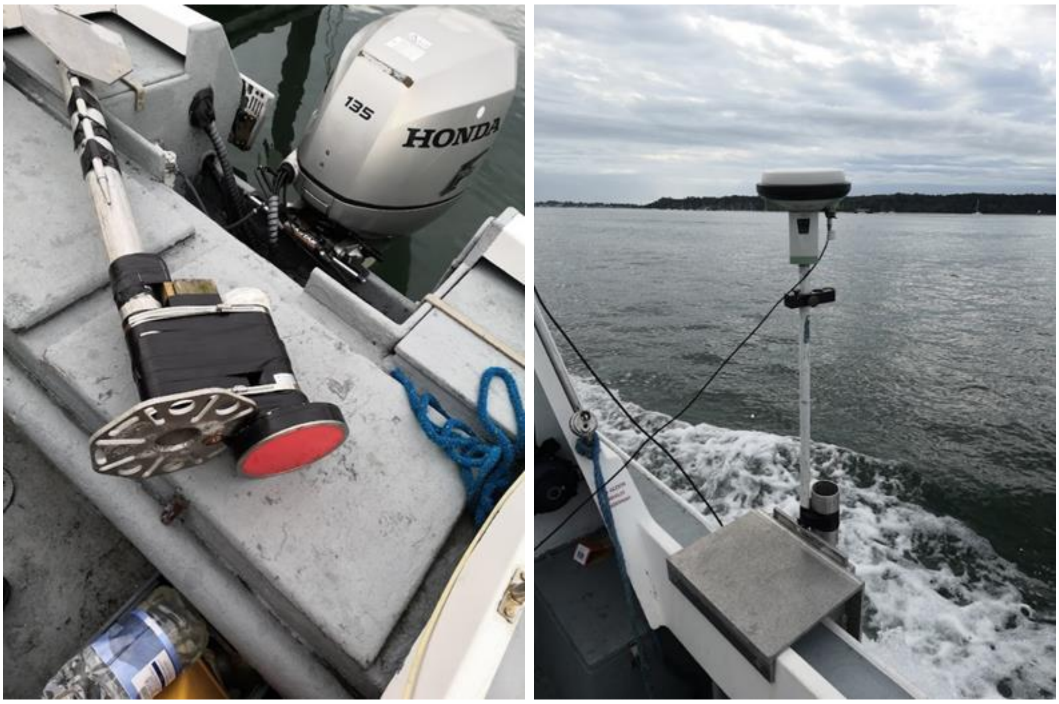

Figure 4: SBP head on the base of the pole (left) with the RTK mounted on top.

By combining high resolution bathymetry and archaeological records of the site it was possible to plan the survey lines to directly intersect the known archaeological remains and so provide a reference to indicate how wreck material may look in the survey data. However, despite the SBP identifying the deep changes in sediment noted from vibrocores of the channel (Wessex Archaeology 2004) the sandy seabed proved too hard of a reflector, masking any small features in the first few metres of the seabed. It did, however, show acoustic blanking underneath surface features such as the wreck mounds, showing that the signal could not penetrate underneath large structural features and particularly under the stone mound on the Mortar Wreck and the main bulk of the Swash (Figure 5). This is likely due to the "highly acoustic-attenuating character of wood" (Plets *et al.* 2008).

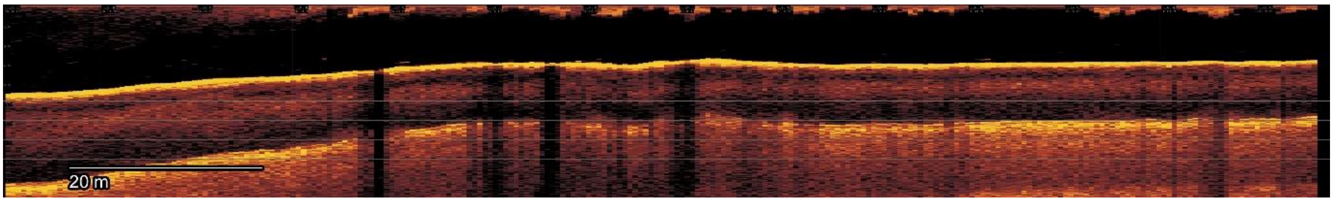

Figure 5: A track of the Swash Channel Wreck showing significant blanking where archaeological features may be present.

Interestingly, a large area of acoustic blanking reminiscent of a timber structure was observed to the southeast of the Swash. This was interesting as it is in an area where no archaeological remains have been observed so far and is on the opposite side to where one would expect any large remains associated with the wreck to be, perhaps suggesting another wreck that could merit further investigations (Figure 6).

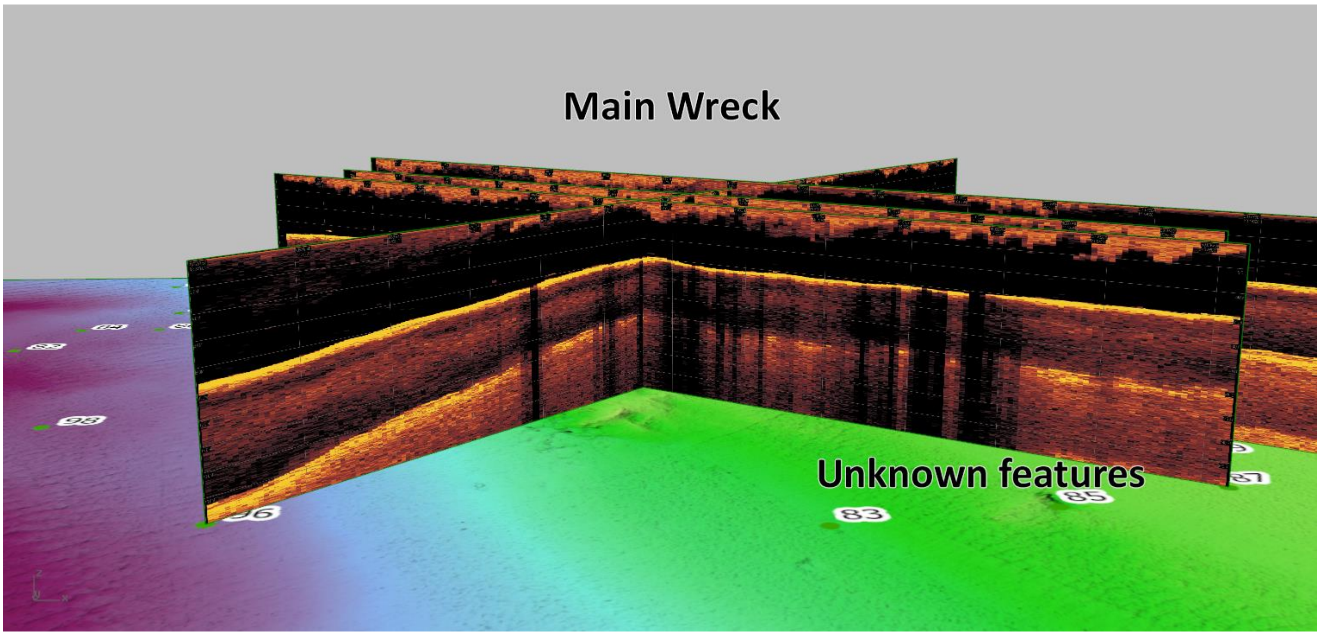

Figure 6: Isometric view of line 87 crossing with line 96, showing the blanking features over the known wreckage and the unknown features to the southeast.

Ultimately, the SBP did not perform as well as expected and lacked the resolution and penetration power to see through the sand to determine if there are buried archaeological features present. The most significant area for buried archaeological material was in the first few metres, which were blanked out by the hard reflection of the surface (hard yellow line on the figures). Localised areas of acoustic blanking have occurred throughout the survey that could potentially be archaeological remains and many coincide with what we know is buried. However, without ground-truthing we may never know if these are new areas of wreckage. Nevertheless, we will go out this summer and investigate, if there are any surface features visible.

The survey could be repeated with the parameters and resolution adjusted to concentrate on the first five metres of the seabed. This would potentially improve the resolution, making the data clearer and allow for a better interpretation of shipwreck sites, but it is likely that the reflectiveness of the sand may mask the key features. The unit should also be trialled on sites with different sediments.

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BORN TO SURVEY

What is that? A new column in ISAPNews!

You know their name, may have seen their faces – but how, you wonder, have they got into archaeological prospection? And why? And do they have any tips for the rest of us?

ISAPNews is here to answer these questions. And for that the editorial team approached various members of ISAP. It's not the Spanish Inquisition, but a set of questions with light-hearted responses and funny stories. We will make a start with members of the Management Committee; in this issue with the ICAP Conference Secretaries of the next (Ghent) and the last (Kiel) organising committees. And you may be next!

JEROEN VERHEGGE

BORN: 1987, Brought up in Geraardsbergen/Grammont (Belgium). The city is known internationally for the 'Wall of Grammont', which is (disappointingly) not an archaeological structure but an infamous hill climb for cycling fanatics.

LIVES: Antwerp (Belgium), known for:

-*Why did a Belgian keep on mixing up his indefinite articles? – (*"Because he was an twerp.*"*).

AFFILIATIONS / COMPANY: Department of Archaeology and the Department of Environment at Ghent University (Belgium), home of the ICAP2025 (shameless advertising).

EDUCATIONAL BACKGROUND: BA in major Archaeology - minor Geography, MA in Geoarchaeology and PhD in Archaeology at Ghent University.

Got lost in archaeological prospection via a detour to the University of Bradford for MSc Archaeological Prospection between MA and PhD.

Field of expertise: Mapping deeply buried prehistoric wetland landscapes using geophysical methods, direct push sensing and coring. Over the past few years, I have focussed on developing approaches to optimize survey strategies of subtle archaeological features, specifically traces of Neolithic land use in sandy to silty soils.

How would you name / describe what you do: Dreaming up prospection approaches for archaeological targets that don't want to be found.

Lots of trial and error, and learning some along the way.

Your first survey (of an archaeological target): Lieven Verdonck taught me to align and balance an FM256 while he was working on a GPR survey of a motte and bailey castle site in Ertvelde (Belgium) in June 2008.

I was scarred for life… due to a second-degree sunburn.

Why archaeological prospection: It's archaeology, which is a dream job, but it's not as backbreaking as field archaeology.

It's earth sciences, which gets you an actual job.

It's working with fancy instruments which do 'beep'.

It's the thrill of discovery when you're the first to see the new data of an unknown site.

Favourite geophysical method: Frequency Domain Electromagnetic Induction. It might not be the highest resolution survey method but I like it because of its applicability in mapping both archaeological landscapes and soilscapes.

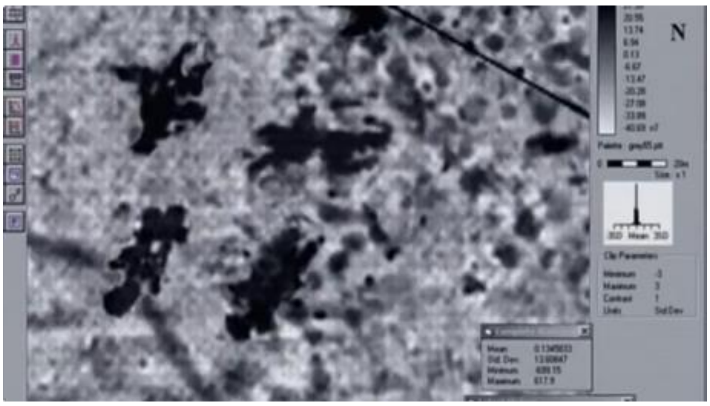
Least favourite geophysical method: Gravity because it brings me down. 😉

Favourite geophysical instrument: A true pocket-sized sidekick: the ZH SM30. Amazing sensitivity, three push buttons, four-digit seven-segment LCD display, and it sings 'beep' a lot.

Best professional experience: Any survey in Italy, because of the amazing food.

Most satisfying result: All the survey results at the Roman city of Ammaia (Portugal). It was one of those sites where any survey method would work amazingly.

Most surprising result: Corpse-shaped anomalies of 40 nT on a *Geoplot* screenshot in the TV show *Bonekickers*:



LEAST SATISFYING RESULT: Because it reads like a whodunnit but doesn't reveal the perpetrator at the end:

Schmidt, Armin. "Easy targets, or "who has marked out my anomalies"?." Archaeologia Polona 53 (2015): 571-574.

YOUR FAVOURITE ARCHAEOLOGICAL PROSPECTION-RELATED ANECDOTE: Armed with the despiking capability of the Snuffler freeware, you could effortlessly weave the quote "I sat on it like a moose" into your survey report or paper!

THOUGHT PROVOKING / YOUR FAVOURITE PUBLICATION YOU WOULD RECOMMEND: For an intellectually stimulating recommendation, why not revisit your own work from a decade ago? It's a true thought-provoker, evoking a range of contemplations—some more flattering than others. 😉 It's an enlightening journey that might just have you appreciating how far you've come, or at the very least, provide a few chuckles along the way.

WHERE DO YOU SEE YOURSELF IN FIVE YEARS' TIME: Surveying, …what else?

BEST CAREER ADVICE:

1. Before you venture into the great unknown, always check your batteries!

2. Don't ask ChatGPT for help to enliven the answers to this questionnaire.

WOLFGANG RABBEL

BORN: 1957

LIVES: in Böhnhusen near Kiel, Germany.

AFFILIATIONS / COMPANY: Institute of Geosciences, Kiel University.

EDUCATIONAL BACKGROUND: Diploma, PhD and Habilitation in Geophysics.

FIELD OF EXPERTISE: Applied seismology, multi-method near-surface geophysics.

HOW WOULD YOU NAME / DESCRIBE WHAT YOU DO: running a university research group on near-surface geophysics with a focus on archaeological prospection, near-surface reservoir research and quantitative data interpretation, teaching, managing and admin stuff.

YOUR FIRST SURVEY (OF AN ARCHAEOLOGICAL TARGET): depth mapping of the Lions' harbour in ancient Miletos, Turkey, using shear wave refraction seismic

WHY ARCHAEOLOGICAL PROSPECTION: exciting targets, challenging interpretational questions, ground truthing at hand, opens the possibility to demonstrate many different geophysical methods to students in a comparably easy way.

FAVOURITE GEOPHYSICAL METHOD: well-tuned multi-method approaches including seismics and down-hole geophysics.

LEAST FAVOURITE GEOPHYSICAL METHOD: does not exist.

BEST PROFESSIONAL EXPERIENCE: International interdisciplinary summer schools on archaeological prospecting in the frame of the EU Erasmus program.

MOST SATISFYING RESULT: Deciphering the structures of silted harbours and multi-phase tumuli and settlement hills such as the harbours of Miletos and the Yigma Tepe in Pergamon.

MOST SURPRISING RESULT: Finding the ground plan of a Byzantine church though GPR on a magnetically blank area in Iznik/Nicaea.

Evaluating methodologies for magnetometer surveys in wooded areas

ISAP Fund Completion Report

Armin Schmidt[1] & Werner Weber[2]

[1]Dr Schmidt – GeodataWIZ, Remagen, Germany

[2]Active Pensioners Parish of Eisenach, Germany

a.schmidt@geodatawiz.com

The Iron Age banked enclosure in the wooded area of the Messbüsch of Eisenach, Rhineland-Palatinate, Germany, is clearly visible in the LiDAR data, with an area of 40 m × 37 m inside its banks (Figure 1). Although overgrown with trees and shrubs, the topographic changes are still evident on the ground. Inside other Iron Age enclosures in Germany and the UK, magnetometer surveys have previously identified various internal features (Becker 1985; Marshall 1999; Marshall 2001; Berghausen 2014) and a magnetometer survey was hence selected to provide further information for this site. However, due to the dense vegetation a new survey methodology had to be developed and its results were compared with data obtained using conventional survey practice.

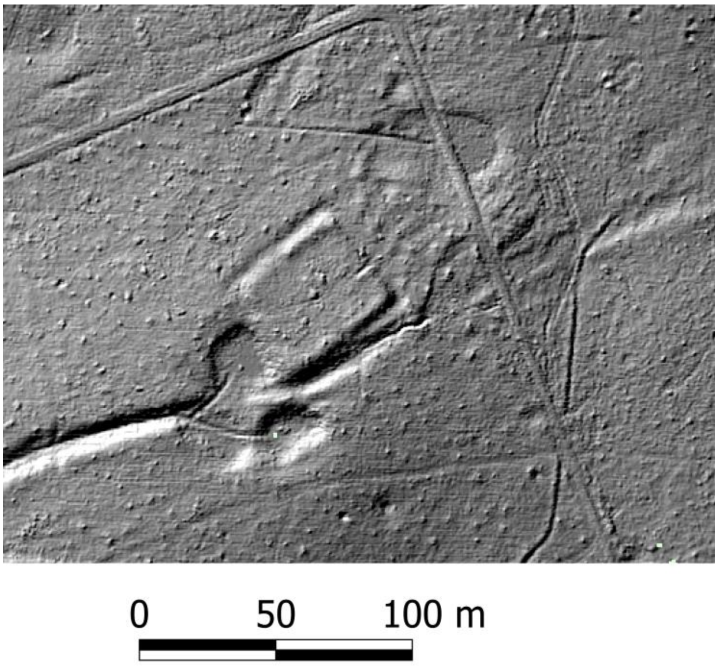


Figure 1: LiDAR data of the Iron Age enclosure in Eisenach, interpolated to 0.5 m × 0.5 m (LPG LPO, Vermessungs- und Katasterverwaltung RLP, Germany).

The only viable option for a magnetometer survey appeared to be using a handheld single sensor instrument, and a Geoscan FM256 fluxgate gradiometer was chosen. Due to the small size of expected features a spatial survey resolution of at least 0.25 m × 0.5 m was deemed necessary. Stationary measurements (i.e. holding the instrument still at each measurement position) would therefore have been too slow and it was decided to collect data while moving through the vegetation.

The survey area was subdivided into 25 data grids of 10 m × 10 m using tapes and ranging rods since no reliable signals could be obtained from GPS or Total Stations. The start and end positions of each 10 m survey line were marked with small flags of matching colours to help with the orientation while moving through the woods. To avoid obstacles (mostly trees) the start and end positions were then adjusted slightly in such a way that straight lines could be walked, all in the same direction (unidirectional survey; NE to SW). The root-mean-square (RMS) deviation from the 'correct' positions was 0.12 m and 0.36 m for start and end points, respectively (Figure 2). Due to the varying vegetation a constant walking pace could only be maintained for each individual survey line, not for all of them, as is required in conventional survey practice. Therefore, during data recording both start and end of each line had to be marked with a handheld trigger, similar to the methodology frequently used with caesium magnetometers. To accomplish this with a Geoscan gradiometer, a larger length was selected for the data grids (20 m) and when the recording was stopped, on reaching the end of a line, the remaining 'unused' data points were filled with 'dummy readings'. Each stored survey line hence contained a different number of valid measurements.

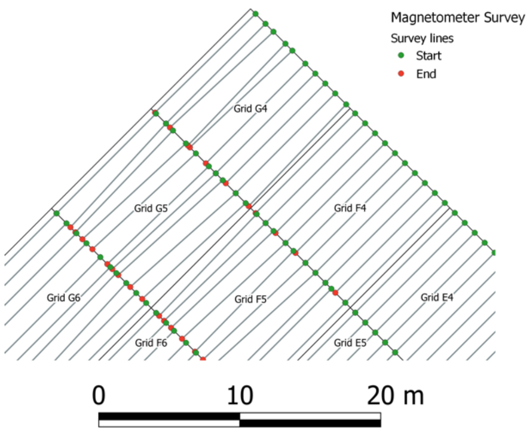


Figure 2: Excerpt from the survey area showing the deviation of start and end positions from a regular raster.

This adjusted data collection methodology required new processing schemes. First, the actual x/y position of each measurement was calculated from the known start and end position of each survey line, and the resulting data set was then interpolated to a regular grid of 0.125 m × 0.125 m. Second, given that the deviation of the survey lines from their correct position was small (see above), the recorded data were re-sampled to 0.125 m and then stored as regular survey lines for further processing in Geoplot, ignoring their slight slanting. A comparison of the results from these two processing schemes showed only small changes in the shape and position of anomalies and the simpler second approach was chosen for further analysis.

In an area where vegetation was low enough to use the standard fluxgate gradiometer survey procedure (same walking pace for all lines), a comparison was made between the new adjusted methodology, and the usual uni-directional and bi-directional collection. There were no discernible differences in the data.

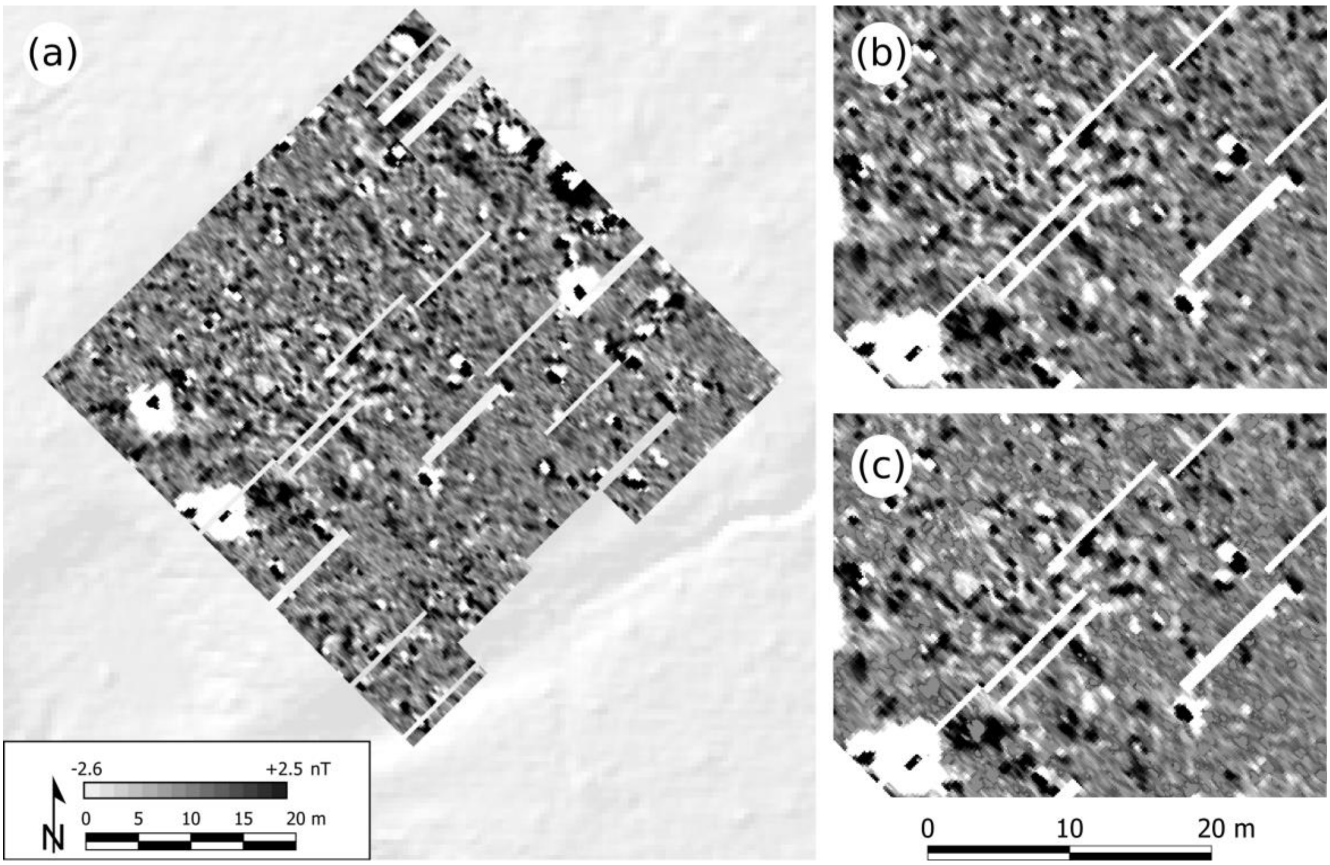


Figure 3: (a) Overview of all data; (b) excerpt; and (c) excerpt, anomalies with peak values between 1-3 nT masked in grey.

The final survey data for the site were dominated by many small and weak anomalies (Figure 3a) that are presumably caused by ammunition, since the woods were used as a shooting and training area for the Belgian army after the Second World War. Due to the strong screening effect of these ferrous anomalies there are no anomalies visible that could be attributed clearly to Iron Age habitation remains, even when masking all those weak anomalies that have peak values in the range of 1-3 nT (Figures 3b and c).

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Gopher antenna: a new GPR antenna with narrow beam

Veli Voipio[1]

[1]Aalto University, Espoo, Finland

veli-erkki.voipio@aalto.fi

I have been developing a new type of antenna for the GPR. Over my career, my work has included mobile base station antennas of the patch antenna type, including one simulated design that showed a good impulse response without any resistors. In addition, I am also interested in archaeology. When I retired, I started the design of a GPR antenna as a continuation of my doctoral dissertation research, which had been in hibernation while I worked in the mobile network boom. I have been doing the research as a hobby and with a low budget. But it seems to be successful, and I really hope to get opinions about the results. The antenna beamwidth is narrower than in the current commercial antennas. Some think a narrow beam is an advantage, and some are not so sure. In order to test its performance, I recently undertook a test to compare it to a commercial antenna. Unfortunately, there are many variables beyond my control, so it is better to say that I am comparing two radar systems. The following is basically a case study, to illustrate the point.

Figure 1: The large pipes below the bridge. The measurement line ran along the bridge.

The new GPR antenna has a narrowish beam, approximately 60° in E- and H-planes. Test measurements were done to compare a commercial GPR unit (Malå Ramac) and an experimental radar setup (based on the Easyrad electronics) with my antenna, called Gopher antenna. Both radars have the same nominal central frequency of 500 MHz and the polarity is the same in both: perpendicular to the pull direction. A line of data was collected across the bridge and culverts shown in Figure 1.

The results are shown in Figure 2 (below). Generally, the profiles correspond, showing the culvert tops in the same locations on both (around 4 m and 6.25 m). The Gopher antenna hyperbolas are shorter (it means that only the top of the hyperbola is visible) because of the narrower beamwidth. The Malå profile seems to show only noise after 60 ns, whereas the Gopher still shows features. The Gopher seems to show more details, particularly at the greater depths, because of the smaller footprint and the deeper penetration (the Gopher antenna has higher gain and better efficiency). The Gopher also seems to have less ringing, which is interesting as it has no damping resistors.

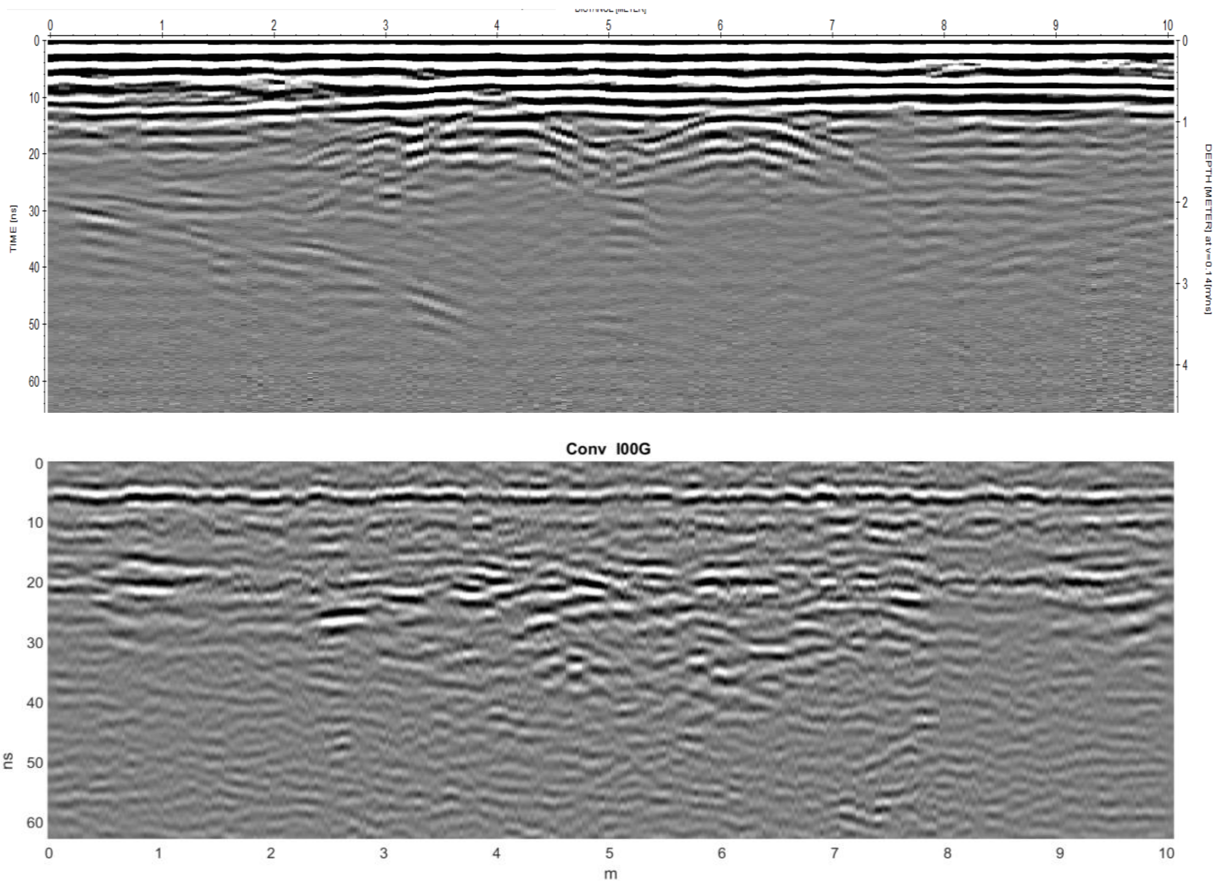

Figure 2: Profiles (two B-scans) for comparison, showing data collected over the large pipes: (top) Malå antenna; (bottom) Gopher antenna.

Nevertheless, the Malå data show the pipes more prominently because it has a wide beamwidth: large objects provide a stronger reflection from a wide-beam antenna. The Gopher antenna's footprint is smaller, and therefore it does not distinguish large objects from small ones.

Both datasets show a 5 ns offset, then 10 ns (0.75m) travel time down through the material (large gravel) to the top of the culvert at 15 ns. Then 5 ns in the void (air, 0.75m), thus both profiles show the bottom of the culvert/water surface at 20 ns. I think the Gopher antenna shows a stronger reflection there. The frequency of both systems is 500 MHz, thus the resolution would be 0.8 ns, about 0.25 m in the air.

There seem to be two small pipes in the centre at a 'depth' of 35 ns, closer to each other than the large pipes. The bridge is quite new, and if there was an older bridge/road, they perhaps just buried the old pipes. This is speculation, as those could alternatively be radar artefacts.

Nevertheless, Gopher's narrow beamwidth allows scanning, and that could be used to detect objects or object details under rubble, as shown schematically in Figure 3:

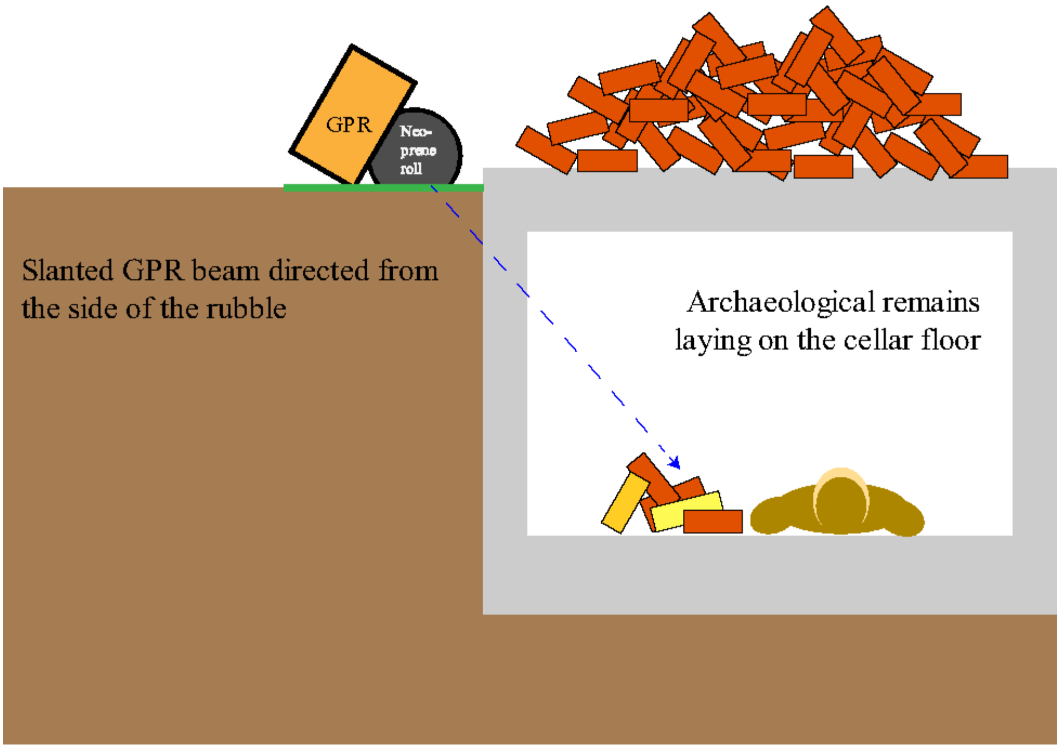

Figure 3: The slanted beam may help check archaeological remains under rubble.

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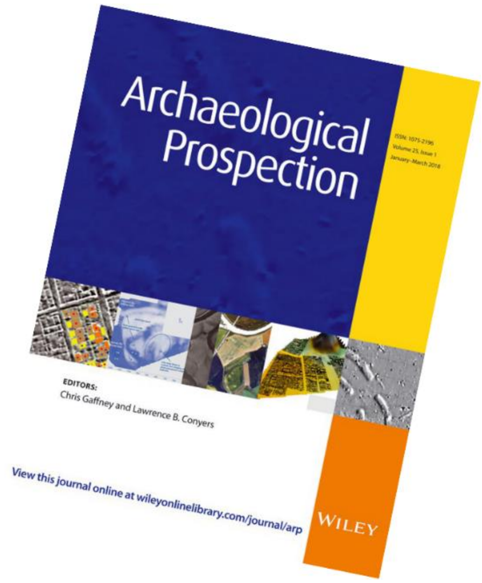

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Purchases support the ISAP Anniversary Fund and can be made here:

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