ISAPNEWS

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Editorial – Issue 69

Welcome to Issue 69 of ISAPNews!

We hope you've all been enjoying the summer (or, depending where you are in the world, the winter) and had a relaxing time of it. But not too relaxing - we know this is prime fieldwork season for many of us, so we hope it has also been productive and successful... And we look forward to seeing some of your results here soon!

In the meantime, read on for a bit of inspiration. Our first article presents some of the results from a GPR survey (partly funded by the ISAP Fund) undertaken to investigate a castle in Ukraine. We also have discussion of geophysical survey in relation to land management practices, namely 'rewilding' in southern Britain, as well as a large-scale 'battlefield geophysics' case study investigating the landscape of Waterloo, Belgium.

And, of course, we have a reminder of how to purchase ISAP merchandise (feel free to send us pics of your purchases in use) and details of the latest issues of *Archaeological Prospection*.

Hannah Brown & Michal Pisz

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Researchers, students and volunteers from the Taras Shevchenko National University of Kyiv undertaking GPR survey at the Medzhybizh Fortress in western Ukraine. This project was supported by an ISAP Fund grant - see page 4 for more details of the survey.
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Geophysics reveals hidden architecture of the Medzhybizh Fortress, Ukraine

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The castle area, with its thousand-year history and several stages of rebuilding, hides numerous architectural elements and archaeological structures that can only be suggested using geophysics. This was the reason for the ground penetrating radar survey conducted in Medzhybizh Fortress (N49.43700, E27.41180) located in the Khmelnytskyi region of Ukraine. It is a monument of fortification architecture of the 14-17th century, built in the Renaissance style. The Fortress has the status of a permanent cultural monument of national significance. It has an elongated triangle shape with mighty walls, a bastion and towers. The total area of the courtyard is 2,025 ha, and the walls are up to 4 m thick and up to 17 m high. The first fortifications at the place of Medzhybizh Fortress were erected in the 12th century. These were earthen ramparts and ditches. A stone castle was built here at the end of the 14th century by Lithuanians. Since those times, the Fortress has gone through several rebuilding stages of the walls and courtyard. At the turn of the 15th-16th centuries, two powerful towers were added to the Fortress. In the 1540s, the owner of the Fortress, Polish Crown magnate Sieniawski, thoroughly reconstructed it and built a palace. From the middle of the 17th century, the Fortress lost its defensive importance and did not undergo modernization. The fortifications were used for utilitarian purposes. The lower storeys of towers, palaces and bastions were filled with debris and soil. The surface level of the courtyard was raised by covering it with earth several meters deep. As a result, the cultural layers formed during the Kyivan Rus' and Polish-Lithuanian eras in the 11th–17th centuries appeared to be buried.

A conventional approach to characterizing the construction stages of the Fortress, that based on limited archaeological excavations carried out between 1970 and 2022, fails to capture the full extent of underground heterogeneity. This led to restoration mistakes and an eclectic representation of the architectural ensemble of the Fortress.

The GPR prospection was carried out during a five-day field campaign in December 2022. Recent GPR measurements in loess-like loams proved pre-winter and winter months to be mainly suitable for GRP, due to the lowest water content in the deep subsoil.

We used a VIY5-37t – a dual-frequency (300 and 700 MHz) georadar instrument (Transient Technologies, Ukraine). Data was acquired within several plots at the courtyard (Figure 1), in continuous mode along survey lines, and processed using standard two-dimensional processing techniques. The transformed data will be subsequently merged together into 3D volumes and visualized in various ways to enhance the spatial correlations of anomalies of interest.

The GPR time slices from the courtyard indicate plenty of structures, not all of which can receive an unambiguous interpretation based on current knowledge. A fragment of the utility pipe at the centre of the measured area can be identified by a pronounced linear reflection in the time slice from 0.7m (Figure 1; also represented by a continuous orange line on the interpretation plan). This pipe was used to estimate the average velocity of the electromagnetic wave in the ground (0.1 mns^{-1}). A slightly more reflective area in the northeastern corner of the survey area (demarcated on Figure 1 by the orange line with hashes) probably indicates a decrease in soil dielectric permittivity due to specific land use in the past (gardening?). The area to the west and north of the church is marked as a graveyard (demarcated by the orange dashed line) and was partly excavated in 1993 (Tolkachev & Kramarova 2011). Reflections appear due to rubble left after rebuilding the church and later used to backfill the grave pits. The western part is supposed to be younger than the northern one, as corresponding anomalies appear at the (shallower) depth of 0.7 m.

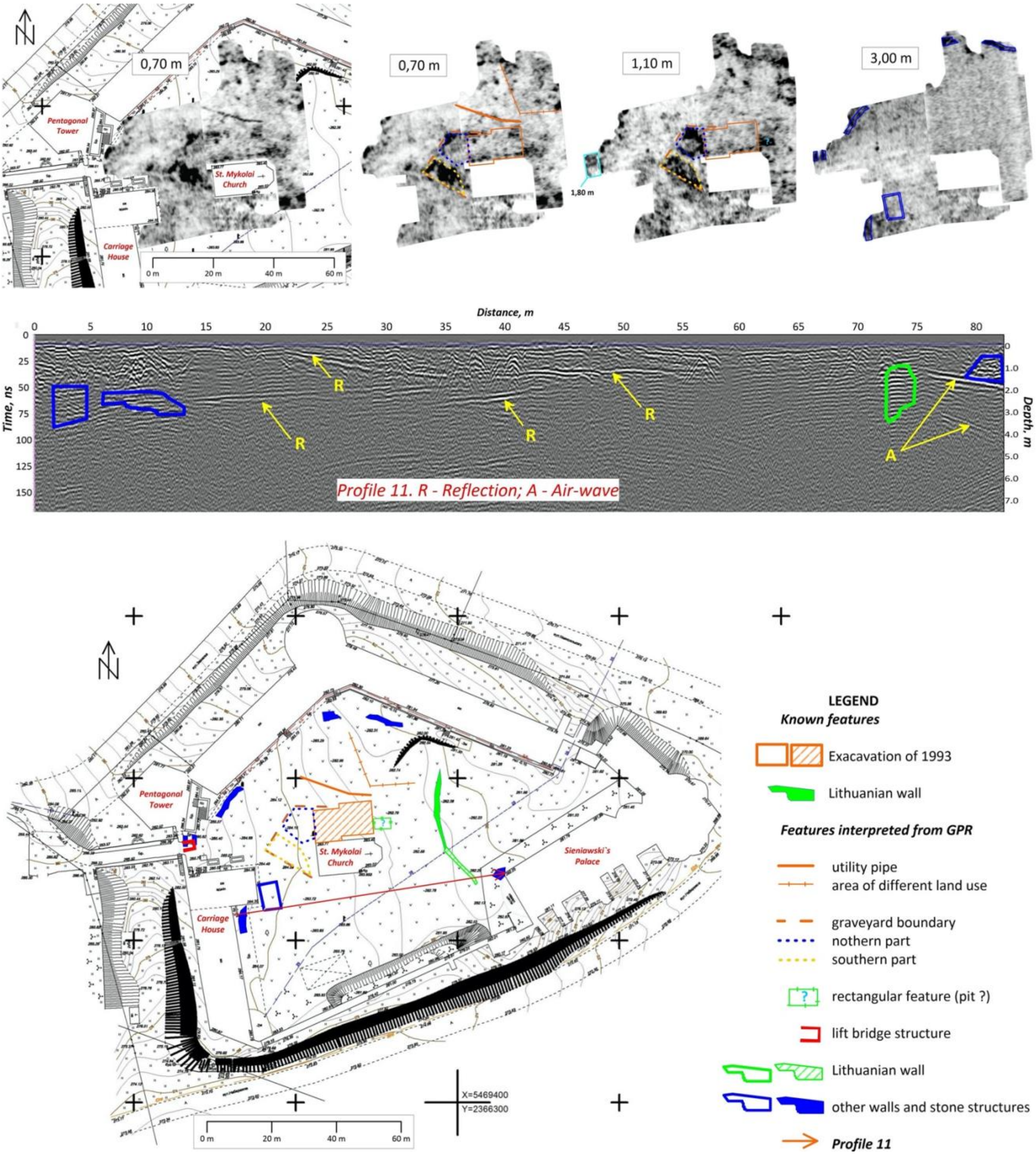

Figure 1: GPR survey results from the courtyard of Medzhybizh Fortress. Top: selected time slices and radargram with interpretation. Bottom: recognized structures overlaid on topographic plan.

Time slices of the courtyard at the depth interval of 1.6 m - 2.8 m show no anomalies except in the area adjacent to the bridge. There is a П-shaped feature located in front of the bridge (highlighted by a pale blue box on the time slice in Figure 1 and shown in red on the interpretation). It is interpreted as a possible counterweight chamber associated with the lift bridge. It was accessed from underground in 2016, during the archaeological investigation of the gate.

Linear anomalies showing a faint contrast with the background along the northern and western perimeter walls on the time slice at 3.0 m (indicated in dark blue in Figure 1) are suggested to be caused by stone walls and structures.

In the radargram obtained at Profile 11 (Figure 1; its location is marked crossing the courtyard approx. WSW-ENE on the topographic plan), several linear reflections could be seen, probably marking levels of backfill material. A continuation of the Lithuanian wall, known from excavations from previous years, as well as stone structures in the proximity of the Carriage House and Sieniawski's Palace, show up as strong reflections.

Measurements were also conducted on the floor of the St. Mykolai Church, situated in the centre of the courtyard. The church has two known crypts (Figure 2). The entrance to Crypt 1 appears as a standing wave generated in the underground void, followed by a reflection from the ceiling at 58 ns (depth 1.5 m) (Figure 2C). It points to the low average velocity of the EM wave (0.06 mns^{-1}) in the ground, which could be a result of a combination of wet concrete covering a clay-rich soil layer. The reflection seen at 80 ns could mark the floor, appearing like this due to the velocity pull-up effect. Crypt 1 is relatively small: 3 m long, 1 m wide and 1.9 m high.

Near the southern wall of the church, opposite Crypt 1, an unknown Crypt 2 was suggested from the anomaly with similar characteristics and dimensions (Figure 2F).

Surprisingly, the large Crypt 4, which occupies the whole space underneath the altar (see Figure 2A), caused no GPR anomaly (Figure 2K), although its entrance shaft is well distinguishable (Figure 2G-H). Possible explanation involves electromagnetic losses in the concrete pavement at low frequency. Additionally, a layer of clay between the ceiling of this crypt and the concrete floor of the altar is dramatically attenuating the EM wave. This crypt is supposed to be a part of the earlier fortification, included in the church's foundation in the 16th century.

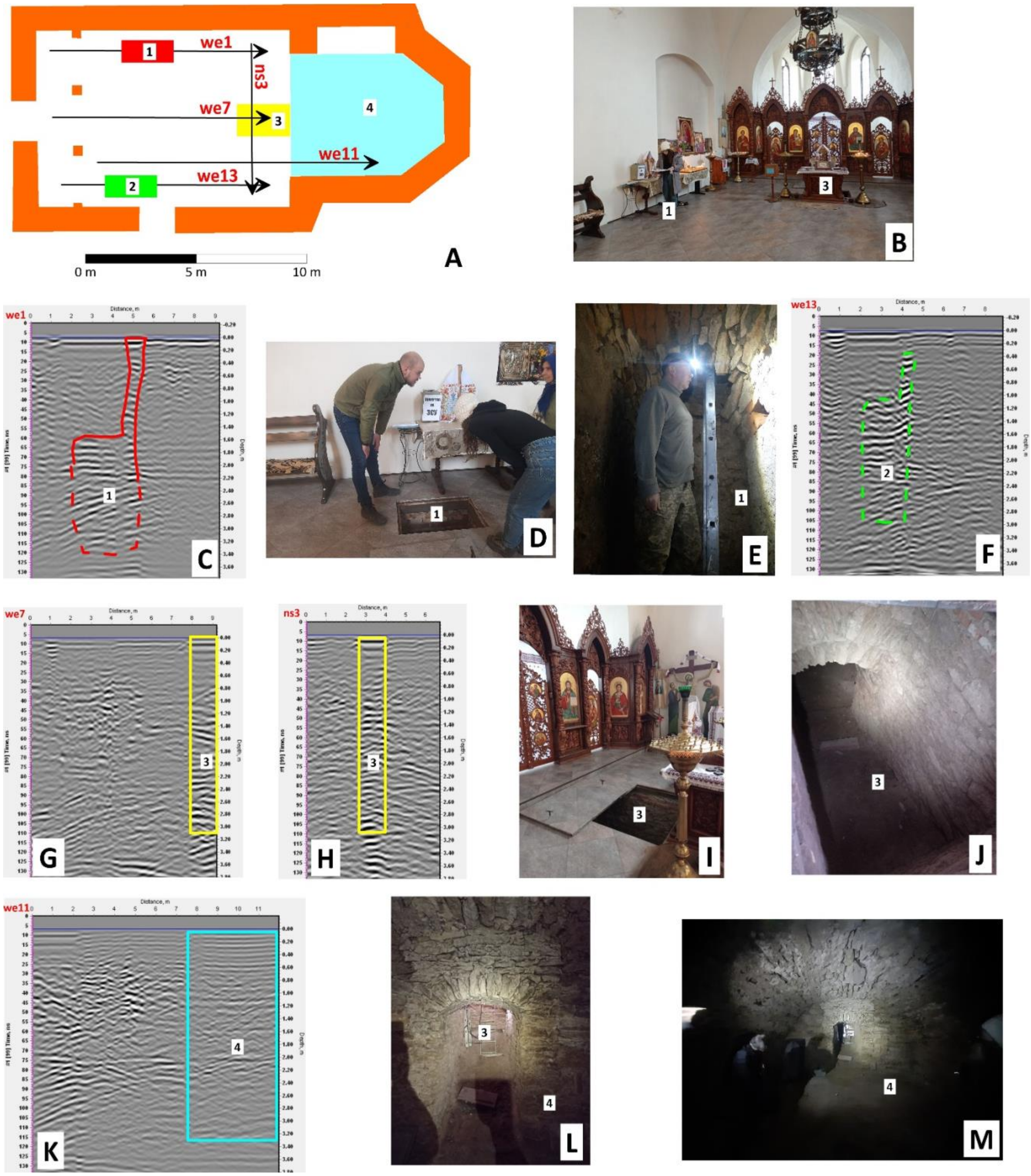

Figure 2: GPR survey results and photographs from the St. Mykolai Church. The plan (A; north to top) indicates the locations of Crypt 1 (red), the previously unknown Crypt 2 (green), the entrance shaft (3, yellow) to Crypt 4 (blue), and the locations of the following radargrams; B: interior view of church, showing above-ground locations of features 1 and 3; C: radargram showing known Crypt 1; D - E: entrance and interior of Crypt 1; F: radargram interpreted as showing previously unknown Crypt 2; G - H: radargrams showing entrance 3 to Crypt 4; I - J: entrance 3 to Crypt 4; K: radargram showing absence of reflections associated with Crypt 4; L - M: interior of Crypt 4.

Numerous reconstructions of fortifications are expressed in the design of the towers (Vietrova *et al.* 2021). A GPR survey of the floor of the Pentagonal Tower revealed the presence of linear stone structures at a depth of 1.6 m below the floor, which is 4.1 m below the current level of the courtyard (Figure 3).

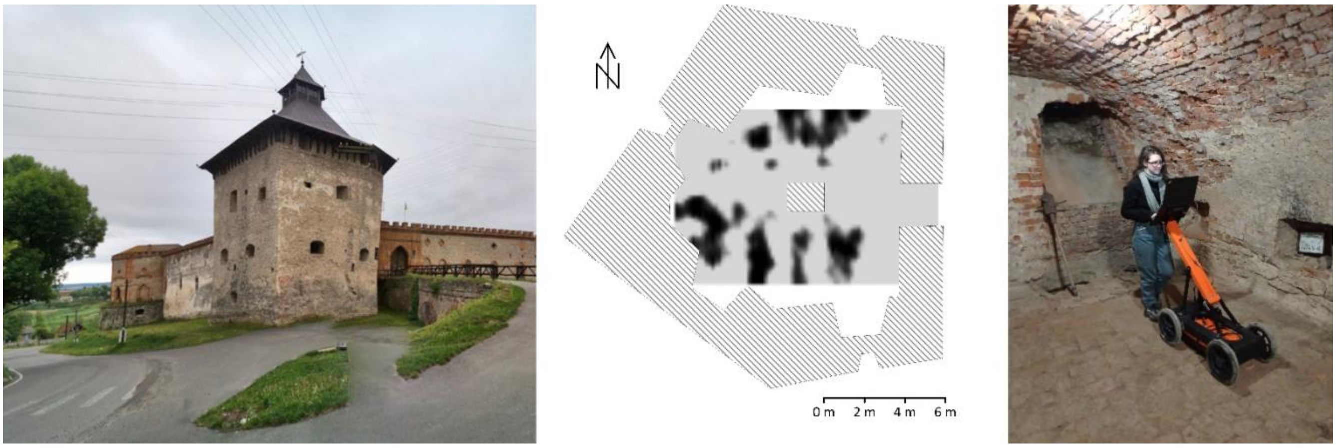

Figure 3: Pentagonal Tower of the Medzhybizh Fortress. Time slice from 1.83 m shows stone structures under the floor.

Thus, the GPR survey was capable of seeing elements of the ancient architecture of the Medzhybizh Fortress under a horizon of debris and soil up to 3 m thick. Possible limits of medieval/early-modern period graveyards were suggested, and a previously unknown crypt was discovered in the Church of St. Mykolai. Stone constructions were identified beneath the Pentagonal Tower.

However, the current interpretation represents only preliminary results. We believe that a careful comparison of geophysical and archaeological investigations will bring more discoveries.

The Project helps to draw the attention of State Cultural Administration bodies to geophysical methods as important tools to verify the structure and reveal the presence of possible hidden elements in architectural monuments, contributing to their proper restoration.

Two years of the COVID-19 pandemic, followed by the year of Russian full-scale military invasion of Ukraine, have hurt the education process in Ukraine. Not least, it has limited the lack of practical lessons and field training, which are indispensable activities in preparing professionals, in particular, in the field of geophysics. The Project provided a valuable opportunity for students from the Institute of Geology of Taras Shevchenko National University of Kyiv to gain practical skills in field geophysical measurements (Figure 4) in relatively safe conditions because Medzhybizh is situated in Western Ukraine. It is far from the front line and strategic objects, which are now under the constant threat of missile attacks.

Figure 4: Group photo of our team representing researchers and students from Taras Shevchenko National University of Kyiv, State Historical and Cultural Reserve "Mezhybizh" and volunteers.

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Early Results from Large-Scale Multi-Method Geophysical Surveys at the Battlefield of Waterloo, Belgium

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Large-scale geophysical surveys were recently undertaken at the Battlefield of Waterloo in Belgium (Figure 1), where Napoleon Bonaparte was famously defeated in June of 1815 by a European coalition led by the British Duke of Wellington and Prussian Marshal von Blücher. Archaeological research under the auspices of the British charitable organization Waterloo Uncovered has been ongoing since 2015, in a programme combining archaeological fieldwork with veteran care and recovery (Evans *et al*. 2019).

Battlefield sites have long been considered challenging for archaeological investigation due to the low-density ephemeral nature of their material evidence and their large spatial extents. Large-scale geophysical survey thus has potential for mapping these landscapes, which are difficult to survey with other, more invasive, prospection methods. Recognizing the limits of the latter methods, conventional metal detection is now regarded as the primary methodology for examining battlefield sites (Scott & McFeaters 2011). This has been shown to be a highly effective method but, in turn, limits the potential range of targets that are detectable compared to other geophysical methods.

While geophysical surveys have been attempted at many battlefields in the past, we believe that this survey represents the largest of its kind ever undertaken at an early modern battlefield. This has been enabled by mobile survey configurations, now well-established in archaeological prospection, which have shown their value in producing large-scale datasets for understanding vast landscapes.

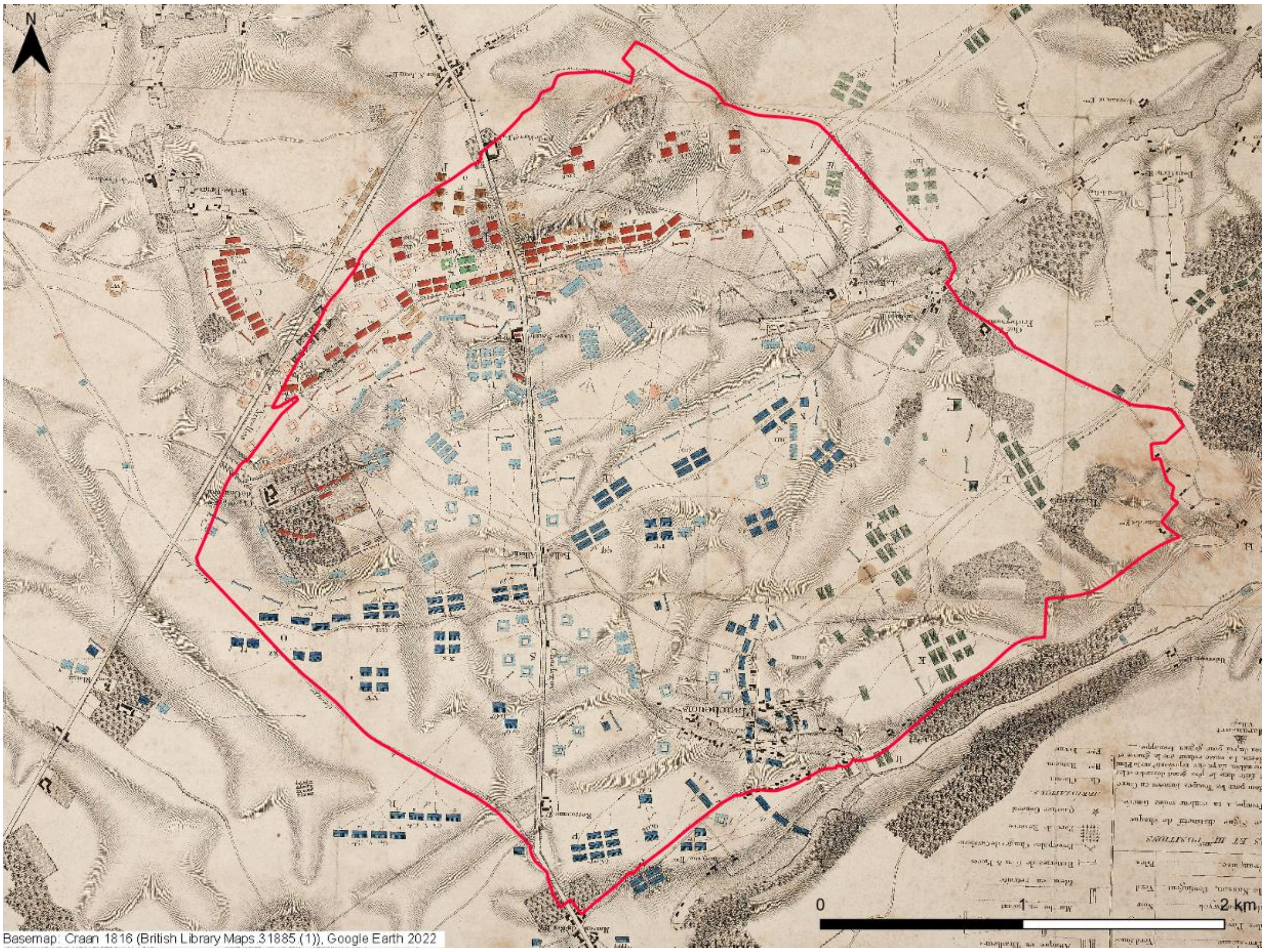

Figure 1: Map of the battle produced in 1816 showing initial troop deployments, with the protected battlefield area outlined in red. Wellington's Anglo-Allied army (shown in red) deployed along a ridge at the top of the map, with Napoleon's French army in the centre and south (in blue) and Blucher's Prussian forces (in green) approaching the village of Plancenoit in the southeastern corner.

Approximately 100 hectares of the Waterloo battlefield have now been surveyed using fluxgate magnetometry (Sensys MXPDA) (Figure 2) and multi-receiver frequency-domain electromagnetic induction (EM) (DualEM 21HS with coil separations of 0.5 m, 1 m and 2 m) (Figure 3). Magnetometry was undertaken using a five-sensor array with 0.5 m sensor spacing and a 100 Hz sampling rate. Coarser sampling was used for the EM surveys (2 m interline spacing at 8 Hz) to target broader pedological variations and larger archaeological features. These methods were selected for their ability to provide complementary datasets on both magnetic and electric properties at a range of depths and to enable identification of a wide range of potential targets (e.g. hearths and other features related to bivouacs, scatters of metal ordnance, mass graves/cremation pyres, expedient defensive works, and other relevant landscape features such as field boundaries, ditches, structures and paths).

A range of areas have been sampled, including the main ridge along which the Allied forces were deployed and where they bivouacked the night preceding the battle, areas around several farmhouses which played pivotal roles as expedient fortifications during the battle, and the hinterland of the village of Plancenoit which was the site of a crucial struggle between French and Prussian forces.

Figure 2: Magnetometer survey near Hougoumont Farm, Waterloo.

Figure 3: Electromagnetic induction survey near the Lion Mound monument, Waterloo.

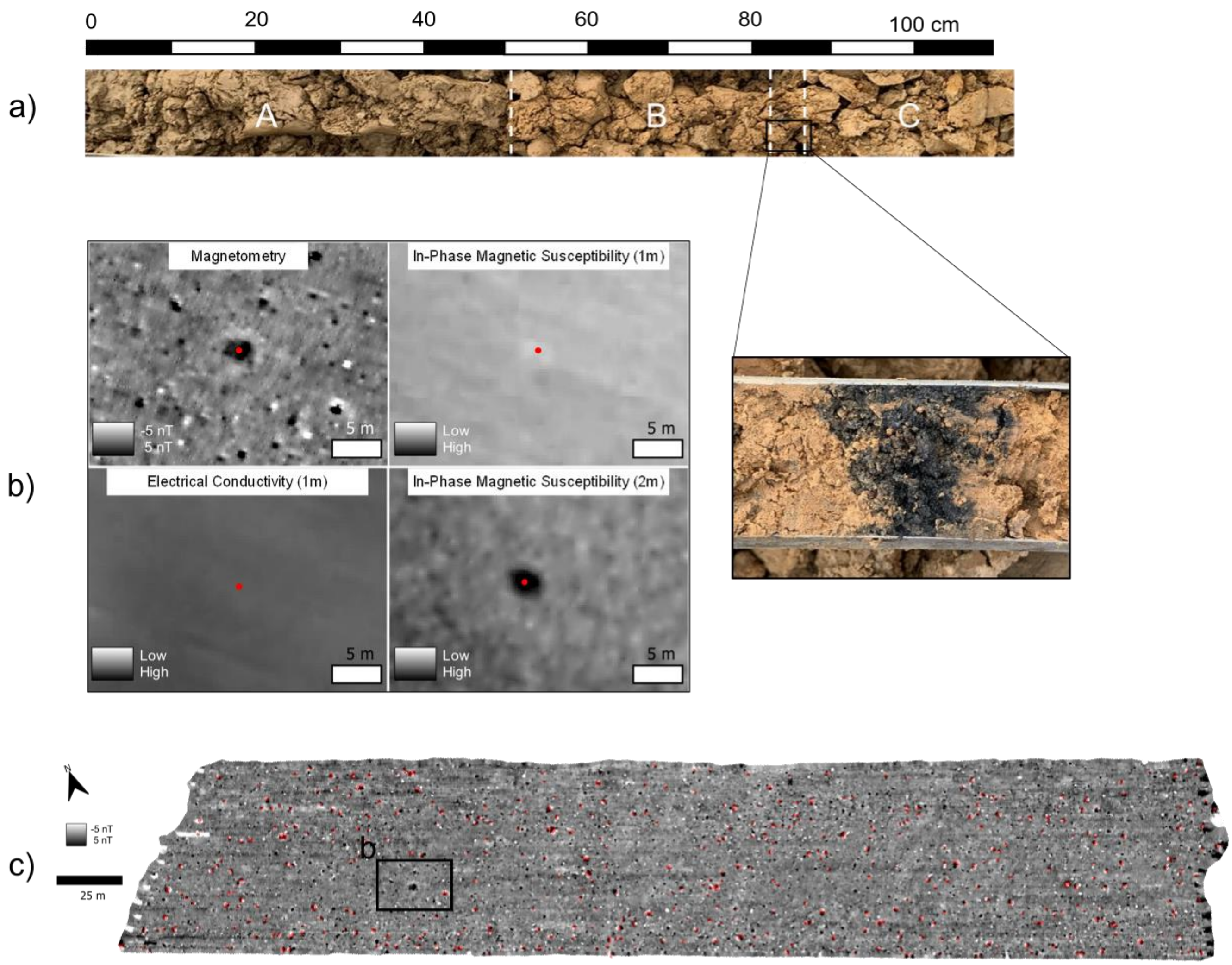

Figure 4: Example of a subtle archaeological feature detected near the ridge that comprised Wellington's main defensive position, consisting of a burnt soil lens and associated ferrous metal fragments beneath approximately 0.8 m of colluvial overburden. 4a: borehole results; 4b: the various geophysical contrasts caused by the feature in the FDEM and magnetometry data (the borehole location is indicated by the red dot); 4c: the larger magnetometry dataset (showing the inset area (b) with dipole anomalies highlighted in red).

One feature that may relate to the battle was mapped in close proximity to the present-day Lion Monument (which commemorates the spot where the Prince of Orange was wounded). The feature appears as a moderately strong positive anomaly in the magnetometry dataset and is also apparent in the in-phase (IP, magnetic susceptibility) component of the EM data (Figure 4). A sign change occurs in the cumulative IP response between the 1 m and 2 m EM IP data layers: it presents as a negative magnetic contrast in the shallower coil pair and a positive magnetic contrast in the deeper. This is related to the spatial sensitivity of the IP response of this geometry (Tabbagh 1986), which can serve as a qualitative means to assess the depth positioning of detected features by their ambiguous response in HCP measurements performed with different coil separations. In this case, the responses indicate that the feature is relatively deep (the signal change occurs at approximately 0.6 m for this instrument). No appreciable contrast is present in the quadrature-phase (electrical conductivity) EM component. Borehole sampling confirmed that the feature consists of a subtle lens of burnt material with associated ferrous fragments at a depth of approximately 0.8 m, beneath colluvial overburden. The function of the feature is at present unknown, but it may relate to the Allied encampment which was situated in the immediate area (e.g. remains of a hearth or cooking pit (cf Drnovský *et al.* 2021)).

Figure 5: Overview of apparent electrical conductivity (1 m horizontal coplanar coil pair) for entire surveyed area. Note especially the linear resistive zones correlating well with colluvial deposits (shown by the overlaid black outlines from mid-20th century soil surveys). The red outline indicates the protected battlefield zone (as shown in Figure 1).

Colluvial material is known to exist throughout the site and overlies archaeological remains of the battle with a depth of up to 1m in some places. This is problematic for the use of conventional metal detectors in identifying material that may be deeply buried. Electrical data layers from the EM surveys appear to capture these colluvial deposits as distinct resistive linear features, likely due to the coarser soil textures that characterize them (Figure 5). This allows for a more detailed mapping than the existing mid-20th century soil surveys (Louis 1958) and may be useful in planning further archaeological work.

As previously indicated by other researchers (e.g. Wiewel & De Vore 2018), magnetometry surveys have the added benefit of rapidly identifying scatters of ferrous material at battlefield sites, some of which may represent ordnance (Figure 4c). Comparison of results with conventional metal detector surveys from the site will seek to address the complementarity of the methods. Of further note, a repeat magnetometry survey of an area of the battlefield indicates significant accumulation of additional ferrous debris over a short period of time. This may be an example of the phenomenon of intrusive green waste, well-documented in British examples (Gerrard *et al.* 2015) but apparently less well known in the Belgian context.

In sum, large-scale multi-method surveys at the Battlefield of Waterloo have produced intriguing initial results and several further lines of inquiry. In particular, the surveys have shown promise for identifying subtle buried archaeological features and metal scatters possibly relating to the conflict, as well as enabling a more detailed mapping of the dynamic sedimentary environment which may inform further sampling strategies. Geophysical survey thus appears to have good potential for contributing to our understanding of this complex archaeological landscape.

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Rewilding Surveys at Court Green Manorial Settlement, Bere Regis, Dorset, UK

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In its aims of restoring natural processes and increasing biodiversity, the rewilding movement is principally 'natural environment' driven but in addition often aims to promote and enable community access. Land acquired by Dorset Wildlife Trust along the northern banks of the Bere Stream, to the east of Bere Regis (Dorset, UK), provides a good case study of the process of 'rewilding' with respect to our knowledge and understanding of the archaeological record of an historic landscape exploited and modified by humans for over 7000 years. Entitled Wild Woodbury, the project is named after the Woodbury univallate hillfort that overlooks the area.

Rewilding takes many forms, with the project undertaken at Court Farm being focussed on low-input farming where the term 'wilder farming' would be considered more appropriate. The project will involve some areas of natural scrub and woodland regeneration, and the removal of modern drainage to re-wet parts of the landscape (Farrington 2022). Whilst taking this area out of intense agricultural production protects the archaeology from the ravages of the plough, allowing nature to take its course will mean that in the future some areas may become less accessible for undertaking effective conventional geophysical survey. There are also plans to repurpose redundant agricultural buildings, create wildflower meadows and create a community food forest. Some project activities encroach on the scheduled area of the manorial settlement of Court Green and so appropriate scheduled monument consent is required. Geophysical survey had already been successfully applied to one area of the Court Farm manorial settlement and so it was logical to extend this work to cover the whole of the scheduled area, which has now been completed (Cheetham 2022). Survey involved the use of magnetometry, earth resistance and ground penetrating radar to investigate the archaeological potential and guide the management of the scheduled area. Despite the inherent limitations of geophysical survey with respect to the ephemeral nature of some medieval archaeology, perhaps fortuitously, the geophysical survey revealed that parts of the site are covered in relatively modern overburdens. These mask, but therefore protect, some of the area that may be affected by the changes in land use.

Next to be considered are the unscheduled areas of Wild Woodbury. Archaeological survey and excavation on adjacent areas of the southwest facing slopes of the Bere Stream valley revealed them to be rich in archaeological activity dating from the Mesolithic period onwards (Context One 2017), suggesting there were many sites to be discovered in the unscheduled parts the Wild Woodbury rewilding area. Local historian John Pitfield had also undertaken surface collection over parts of the rewilding area, and Dorset Wildlife Trust staff, when alerted to the signs of settlement and activity, reported several potential archaeological sites.

Figure 1: This randomly selected area of magnetic survey reveals a palimpsest of ditches, pits, lynchets and quarry pits, demonstrating the archaeological potential of the Wild Woodbury rewilding area. Data collected with Bartington 601-2 instrument at 0.25 m x 1 m intervals. Plotted at -3 nT to +3 nT, black = positive. (Aerial photographic data credit as Figure 2)

In another area that had been left a year to naturally regenerate, and in parts was in the process of being re-wetted, it was not possible to conduct large areas of gradiometry due to the vegetation and flooded areas. In this case topsoil magnetic susceptibility using a field coil was the primary prospection technique and was followed up, where the conditions allowed, by sample areas of gradiometry. Figure 2 demonstrates the success of this approach in that the high susceptibility areas yielded pits and ditches of an archaeological nature. It is hoped that parts of these areas can be temporally cleared to allow more extensive surveys of these sites.

Figure 2: In areas that have been allowed to naturally regenerate it is not possible to conduct extensive areas of gradiometry and so topsoil magnetic susceptibility survey has been used as the primary prospection technique. In this case it has followed up by restricted areas of gradiometry to confirm the presence and some idea of the nature of an archaeological site. Bartington MS3 + MS2D coil with a c. 7 m (uncorrected HH GPS) survey interval. Log scaled: high susceptibility = red.

Acknowledgements

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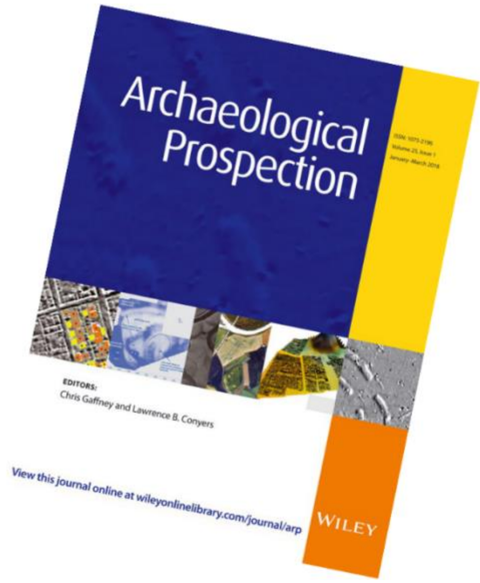

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* Yes, this is shameless exploitation of a cute niece for advertising purposes. Photo © H. Brown

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- opinion pieces
- cover photographs
- notifications
- the bits and pieces "that can't be published elsewhere"

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(we will even do the formatting for you!)