ISAP NEWS

The newsletter of the International Society for Archaeological Prospection

Issue 49
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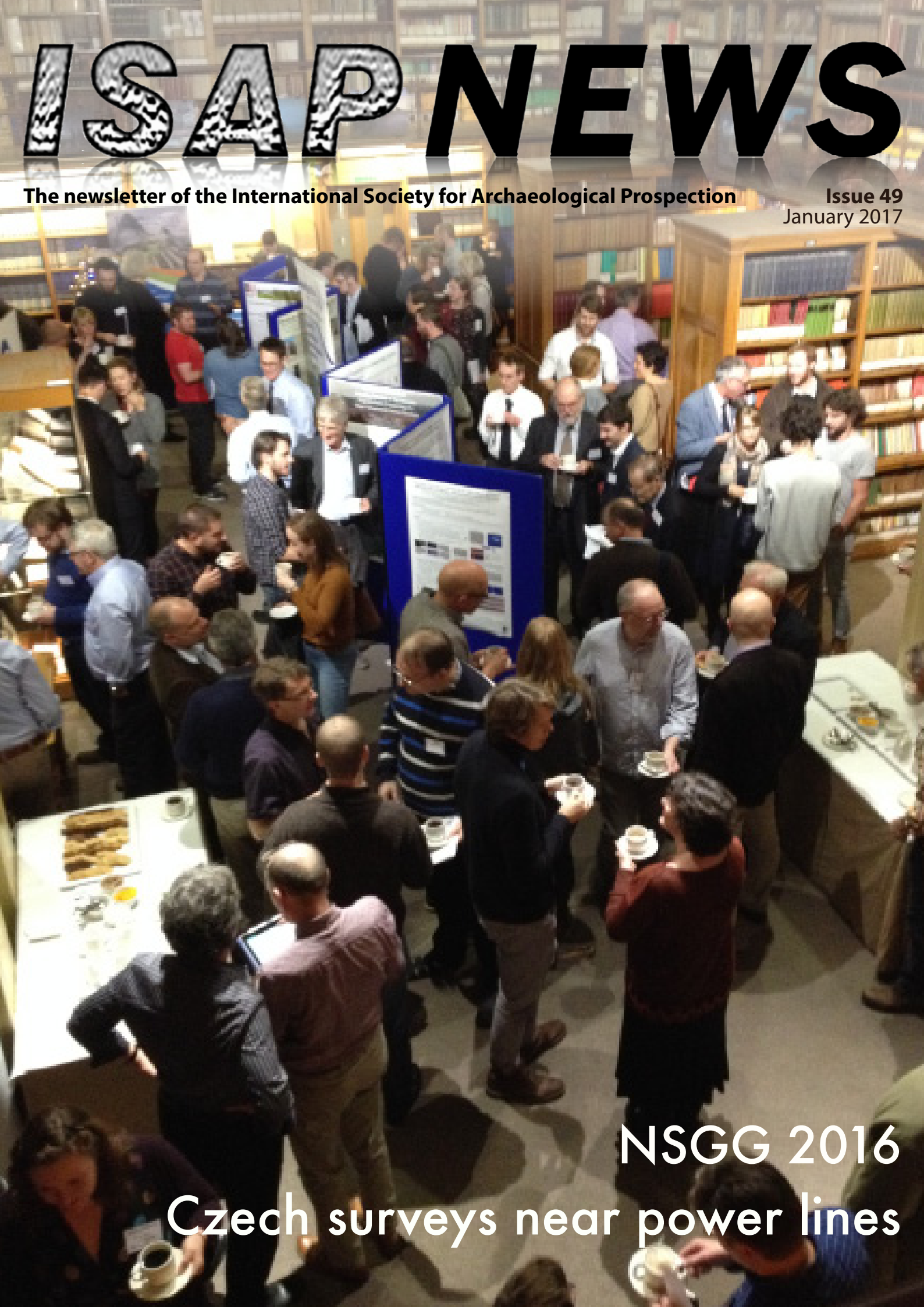

NSGG 2016

Czech surveys near power lines

Welcome to the 49th issue of ISAP News! And Happy New Year to everybody: hopefully 2017 will bring good survey conditions and exciting datasets all round.

Our main article this time is on the problems and possibilities of conducting magnetic surveys near power lines. We also hope this issue will give you a quick look back at the NSGG Recent Work in Archaeology meeting held in London before Christmas - whether that's a short reminder of the day, or a rapid overview of what you missed.

We know you are all busily working on your abstracts for the 2017 Bradford ICAP conference (details on page 13), but if you were to find time to throw together 700 or so words for the next issue of ISAP News, or dig out an interesting image, it would be much appreciated!

Hannah Brown & Paul Johnson

editor@archprospection.org

P.S. Don't forget that ISAP membership is due if you haven't paid it already - see the link below right.

The Cover Photograph shows the process of caffeination in progress at the 2016 NSGG Recent Work in Archaeological Geophysics meeting at Burlington House, London. (Photo: Hannah Brown)

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The possibility of using magnetometers for surveying archaeological sites around power lines

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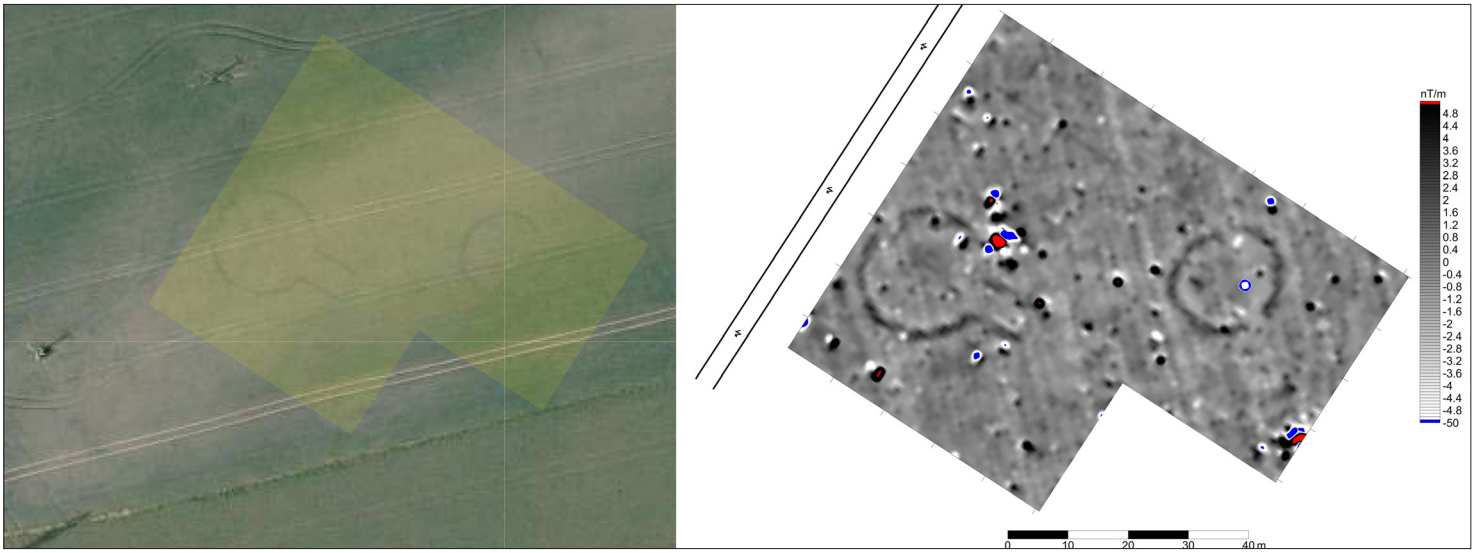
The Czech Republic features a number of industrial regions (e.g. North Bohemia and North Moravia) and industrial agglomerations (e.g. the agglomerations of Prague, Brno, Ostrava, Pilsen, Pardubice, Kladno, etc.) where the occurrence of numerous power lines and various other electricity structures is typical. In terms of archaeological prospection, such areas are not a popular part of the cultural landscape. Besides the potential numerous changes to and interferences in the original terrain relief, a large group of recent sources also exists that can have a significant effect on the possibilities and results of geophysical measurements. Power lines, pylons or even railway (tram or trolley car) lines nearby create electromagnetic fields and fluctuating disturbances that often have a significant effect on the local magnetic (and electric) fields. The efficiency of large-scale magnetometer measurements is therefore limited here by measurement circumstances that cannot be easily controlled, and in most cases entire archaeological sites cannot be observed, while it is possible to observe only the areas outside the actual range of electromagnetic disturbances. From the point of view of archaeological sites, the unreadable results of magnetometer measurements can also involve a significant portion of an area of interest (e.g. a few dozen meters from power lines). The distance between the efficient use of a magnetometer and interfering electromagnetic sources depends on several varying factors (e.g. the amount and stability of the voltage in the electricity network, the number of power lines, the height of the lines above the surface, the type of pylons, their earthing, etc.). The manifestation of electromagnetic disturbances in results also depends on the orientation of the magnetometer to the power lines and on the orientation of measured profiles. It is also shown that results are affected by the type of magnetometer used.

The problem of variability of electromagnetic fields near industrial zones or mines in Czech archaeology has been resolved by the selection of the appropriate measurement methodology. Two magnetometer sensors were most frequently used for the measurement of the vertical gradient of a magnetic field; another method was to use two magnetometers measuring the total magnetic field values (followed by a gradient calculation) with one mobile (measuring) sensor and a second (reference) sensor at a fixed location. In the first case, it was actually possible to effectively measure to a distance of a few dozen meters from a strong electromagnetic source. In the second, more laborious, case of monitoring the variability of the total magnetic field, the results were not any better (they could not be, due to the limited time of synchronization of the same measurements on the mobile and the reference sensors). Disruptive disturbances were also registered at a distance of several dozen meters from electromagnetic sources and they were more dependent on the stability of the voltage used (and the working frequency). Due to the above mentioned reasons, even nowadays priority is always given, in similar industrial areas, to measurements of the magnetic field gradient. The possibilities gradually changed according to the availability of various types of magnetometers.

Proton magnetometers were used in Bohemia in the 1980s and 1990s. While a point method of measurement significantly limits the actual possibilities in the area of daily measurements (and their density), the measurement of the total field or gradient was very accurate. Near pylons

Figure 1 *Comparison of aerial photo (source www.mapy.cz) and result of proton magnetometer survey of ploughed-up burial mounds around regular power lines near Všestudy, Central Bohemia (survey: Křivánek 1997).*



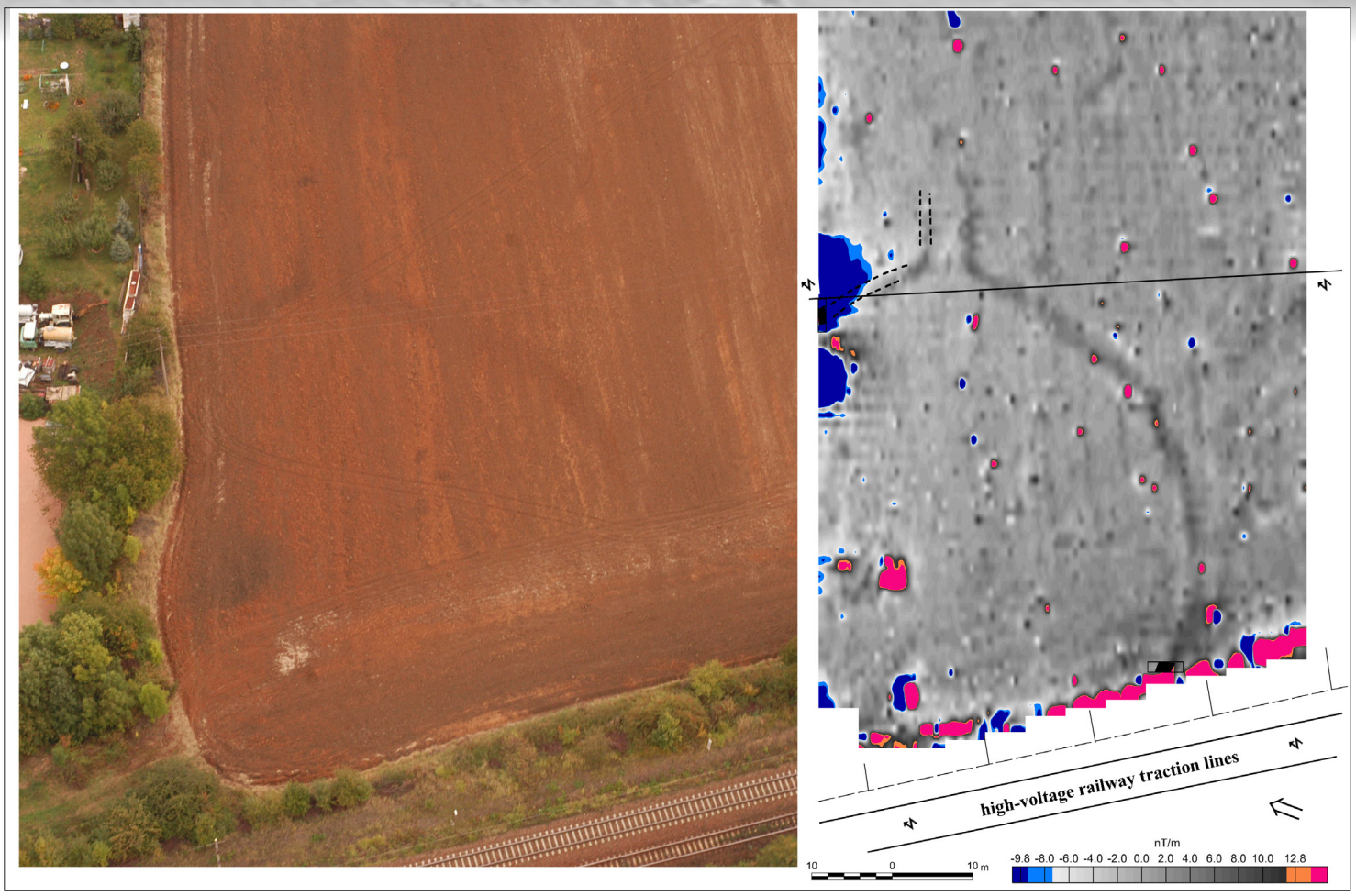
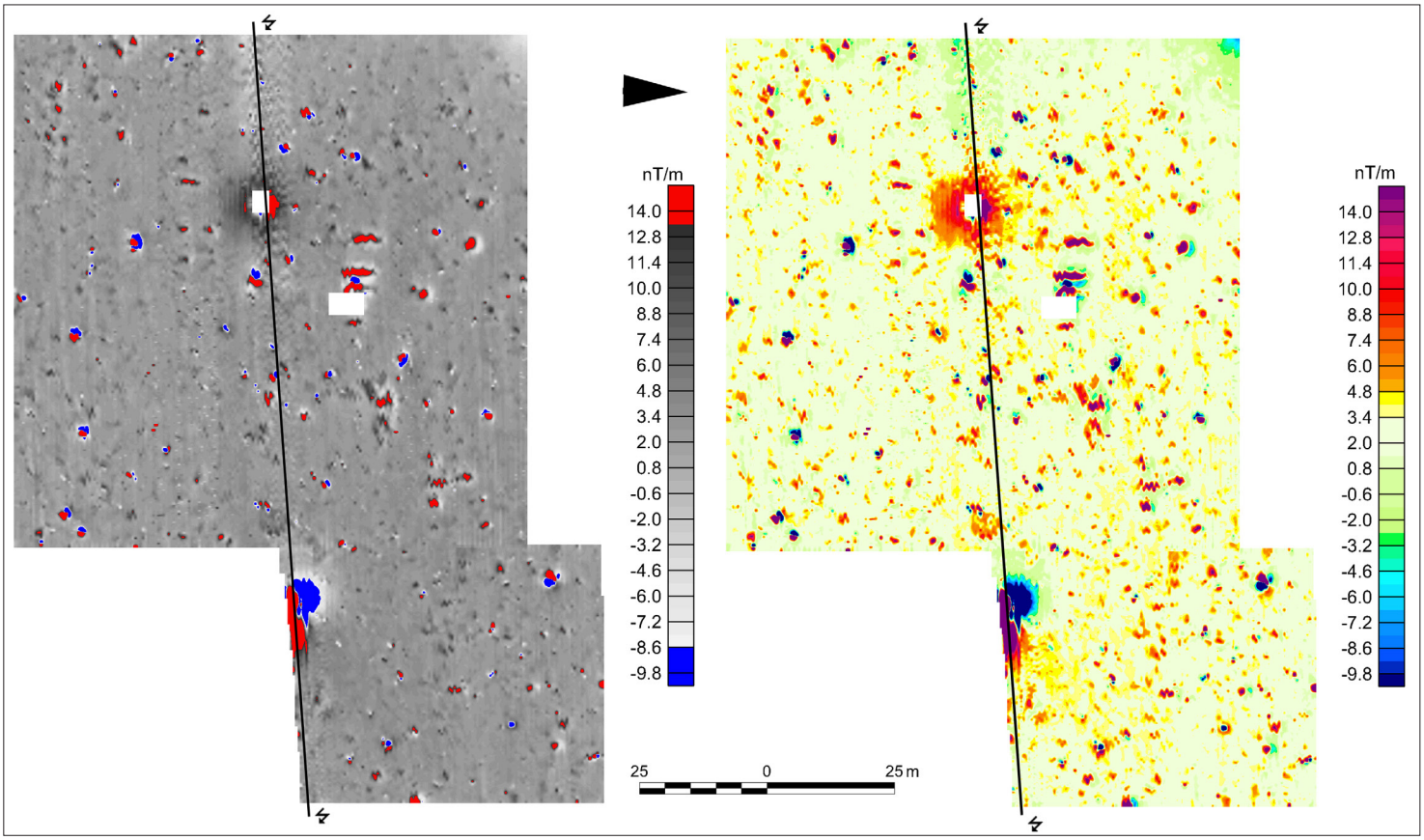


Figure 2 *(above) Comparison of aerial photo (source: Metlička 2004) and result of caesium magnetometer survey of the last segment of the second Neolithic roundel near high-voltage railway lines at Vochov, West Bohemia (survey: Křivánek 2004).*

Figure 3 *(below) Examples of results of caesium magnetometer survey of a specific Bronze Age settlement and production site beneath regular-voltage line near Březnice, South Bohemia (survey: Křivánek 2006-2008).*



and regular power lines, measured values often exceeded the measurable limits of a given manufacturer's device, or the accuracy of measurement was low. Nevertheless, at distances greater than 10 m from the interfering (not high-voltage) sources of electricity, it was possible to distinguish values of magnetic vertical gradients that reflected changes in the fills of archaeological features beneath the surface. The results of verification tests conducted in 1997 on a segment of a ploughed-up prehistoric barrow cemetery near the village of Všestudy, discovered previously during an aerial survey (**Fig. 1**, page 3), can be seen as an example of the successful measurement by proton magnetometers around regular power lines (Křivánek 2004, 58 and plate 8). Only an area up to a distance of c.10m from the power lines experienced strong (and immeasurable) magnetic interference. Further away, ditches of the ploughed-up burial mounds, without funeral pits or central chambers, were confirmed. The measured area was only locally disturbed by metals in the topsoil.

From the late 1990s (1998), caesium magnetometers began to be used in Czech archaeology, thus opening up new possibilities for monitoring much larger archaeological areas. However, even the results of gradient measurements demonstrated the insurmountable limits of prospection at densely electrified sites. The extent of disruptive magnetic interferences was often dependent on either the voltage of the power lines or on the structure (amount of metal), as well as on the density and height of the power pylons and lines. Using the example of measurements over the last segment of the arc of the second Neolithic roundel near the village of Vochov from 2004 (e.g. Pavlů – Metlička 2013, fig. 129), the possibility can be confirmed of the successful verification of previous aerial prospection and collections in an area with overhead power lines of regular voltage **(Fig. 2**, previous page**)**. Along the edge of a field below an embankment of a railway line (Prague-Pilsen-Nurnberg) with high-voltage contact lines, it was not possible to distinguish the archaeological situation to a distance exceeding 10m from the edge of the field (a distance of about 20m from the interfering sources). Several similar experiences in other areas of high-voltage lines and traction lines repeatedly showed that the measurement values of caesium magnetometers (local gradient of magnetic field) can be deformed even up to a few dozen meters from the source of interference.

In the case of conventional voltage power lines though, the situation for the application of caesium magnetometer measurement is more favourable. Using as an example the survey of a specific Bronze Age settlement and production site near the village of Březnice, conducted in 2006-2008 (Křivánek 2010, 263-264), it can be demonstrated that small archaeological features can be distinguished even directly beneath regular-voltage power lines (**Fig. 3**, previous page). Outside of the power line area, shallow sunken pits and elongated furrows filled with burned ceramic material were distinguished in results; these features also contain numerous spindle whorls and weaving weights (verified by subsequent archaeological excavations – e.g. Chvojka – Šálková 2011). The measured anomalies immediately below the power lines are, however, irregular and deformed due to electricity interference.

Since 2010, multi-channel devices using fluxgate gradiometers were also intensively used in Czech archaeology, which allowed for the conducting of surveys of more extensive sites at a lower cost (and single-profile measurement errors). While the known greater sensitivity and depth penetration of caesium magnetometers was confirmed during multiple measurements at survey locations, the new contribution toward the prospecting of areas with interfering sources in heavily eroded, industrialized and electrified areas of the Czech countryside was shown. Measurements of the limited gradient of magnetic fields and smaller depth penetration seems to allow the distinguishing of separate anomalies and archaeological features even in the vicinity of electromagnetic interference sources where neither a proton nor caesium magnetometer is able to distinguish the two. Differences in the extent of disturbances of earthed pylons can be demonstrated, for example in the results of repeated surveys of a part of a prehistoric ditch enclosure with the adjacent ploughed-up remains of small burial mounds near the village of Hrdly, conducted in 2002 (Křivánek 2006, 28-29 and fig. 2) and 2013 (Kůt et al. 2014, fig. 3). The remains of atypically interrupted ditches around square mounds are visible (at unequal amplitude of magnetic anomalies) in both results (**Fig. 4**, overleaf). However, the extent of anomalies (and amplitudes) of sources of interference (around pylons, poles and the underground metal earthing) is wider in measurement results using caesium magnetometers. The magnetically disturbed area in fluxgate gradiometer results was smaller at this archaeological site.

The five-channel fluxgate gradiometer has been repeatedly and successfully used in recent years in surveys of sites, including terrain directly below regular low-voltage power lines. Disturbance anomalies were naturally registered only several meters away from the power pylons and from the solid metal. The possibility of effective device measurement in an area of numerous high-voltage lines was not anticipated. New results from a survey in 2016 of small Iron Age (Hallstatt and La Téne) settlements in the vicinity of high-voltage lines (400 kV) near the village of Boudy were surprising (**Fig. 5**, overleaf). During a rescue excavation along a water supply trench, surfaces of fields and meadows were observed lying partially along several high-voltage lines and other electricity structures in the area. The continuation of sunken settlement features was confirmed not only in areas several dozen metres from the power lines, but also another group of sunken features was distinguished without any signs of interference, directly

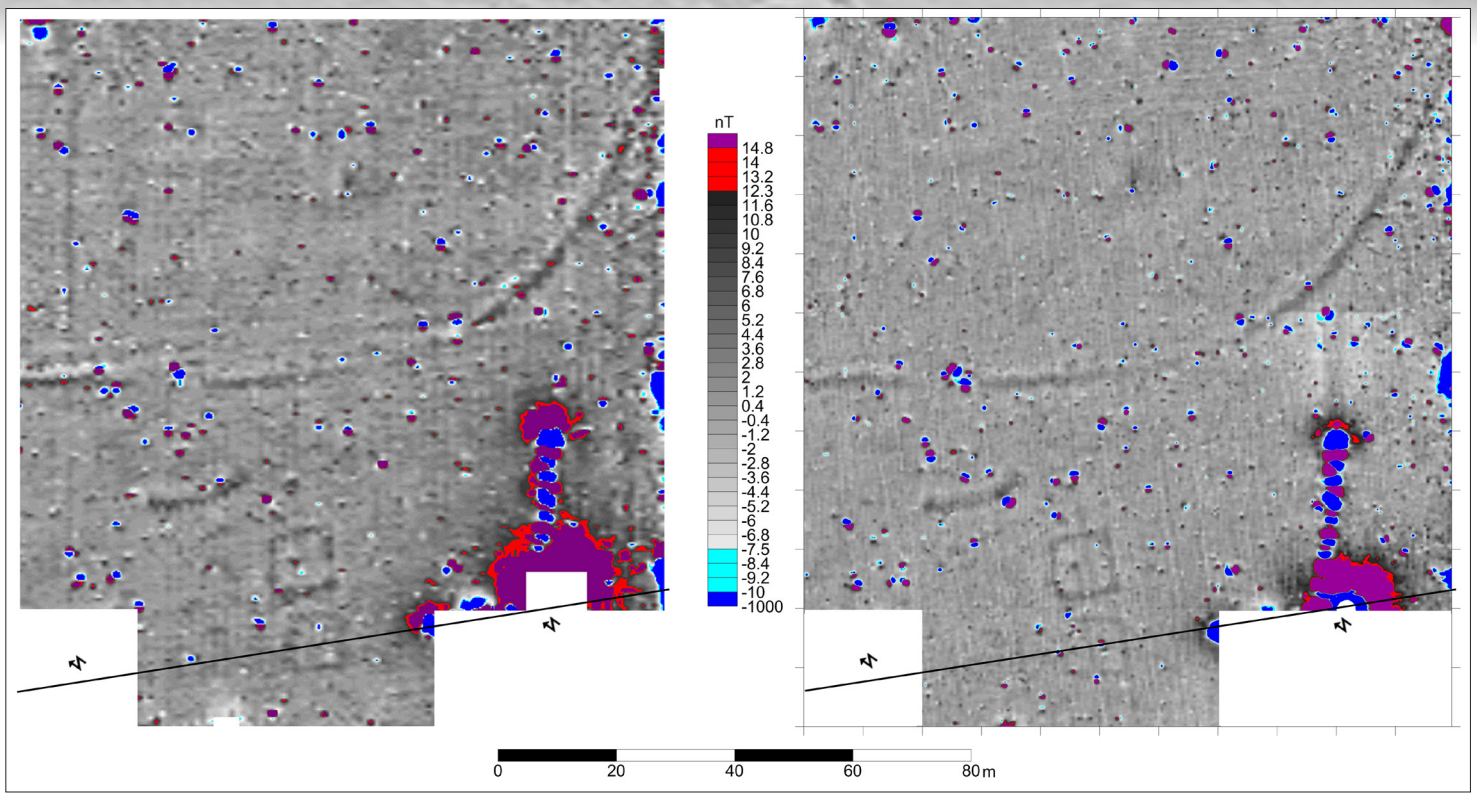
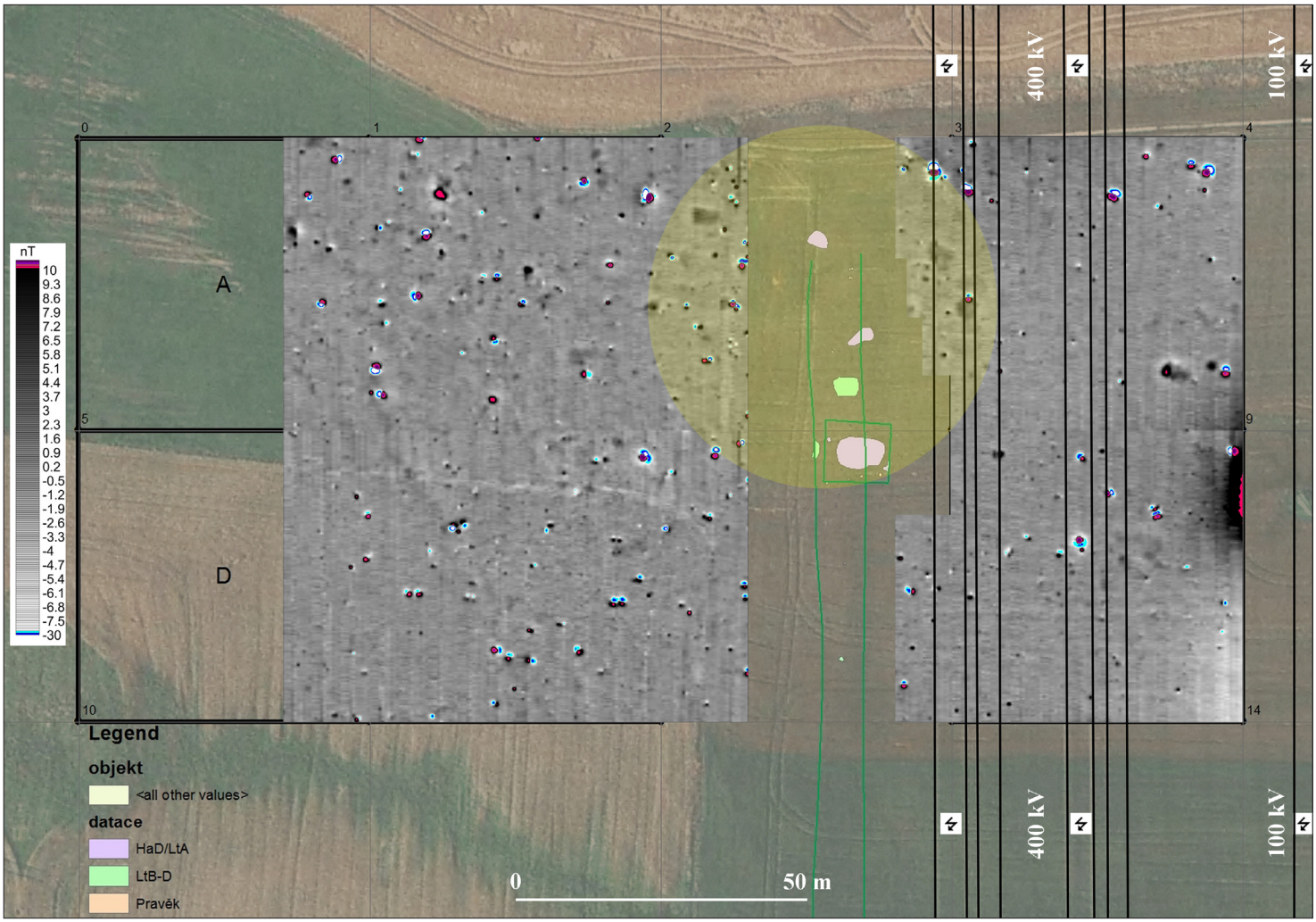


Figure 4 *(above) Comparison of results of caesium magnetometer and 5-channel fluxgate gradiometer survey of prehistoric interrupted ditch enclosure near power line poles (with the underground metal earthing) at Hrdly, North Bohemia (survey: Křivánek 2002 and 2013).*
Figure 5 *(below) Combination of aerial photo, field archaeological documentation (source: Prácheň museum Písek) and results of 5-channel fluxgate gradiometer survey around and under several high-voltage power lines near Boudy, South Bohemia (survey: Křivánek 2016).*



under six tall high-voltage lines.

Just like recent settlements, industry, roads, pipelines and electricity structures, archaeological sites often lie in similar areas in the Czech countryside. The extent of fertile agricultural land is continuously shrinking, while areas of development and mining of raw materials are on the increase. Intensive non-destructive archaeological surveys will have to be one of the necessary working tools of archaeology in the future. In many areas around settlements and industrial zones, these non-destructive archaeological surveys will have to put up with a landscape scarred by existing roads and electricity infrastructure. Some of these examples should demonstrate that even archaeological sites with power lines can be monitored with various magnetometers in various ways. After many years of experience with several types of magnetometers in Bohemia, all indications show that the largest undisturbed areas of archaeological sites can be monitored with powerful multi-channel fluxgate gradiometers. The range of areas disturbed by strong sources of electromagnetic interference affecting their measurement is smaller for these instruments, also enabling survey of areas closer to disturbance sources. Naturally though, there are still other parts of sites where the use of magnetometers (electromagnetic methods) cannot be effective (around gas pipelines, warehouses, electricity substations or strong transmitters).

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ISAP News continues overleaf...

Recent work in archaeological geophysics: NSGG 2016

Hannah Brown, with facts and figures from Paul Linford

Earthsound Archaeological Geophysics hannah@earthsound.net

6 December 2016. Half past nine-ish. I am scampering down Piccadilly in central London, into the east wing of the Palladian ginormity that is Burlington House, past the stony gaze of the resident ichthyosaur and into the lower library, where a crowd is accumulating and the air fizzing with well-caffeinated anticipation. With, it seems, good reason: the 12th Near Surface Geophysics Group day meeting on Recent Work in Archaeological Geophysics turned out to be another highly enjoyable, interesting and inspiring conference.

Armin Schmidt started off the day with a presentation on post-earthquake GPR survey in Nepal. (Photo: Jimmy Adcock)

No fewer than 119 other delegates also found their way to Burlington house - not quite a record attendance, but close to the 123 maximum-so-far for the one-day format. Of these, some 20 delegates (that is, 17.5%) came from 'overseas' (primarily from the rest of Europe), with individuals travelling from as far away as Hungary, Romania and even Georgia, USA. And while we're on conference composition stats, I can also tell you that 21 delegates were students and 18 were Fellows of the Geological Society. On a slightly more serious note, only about 22% of delegates were female, although this proportion was reflected in the oral presentations, three of which (20%) were given by women and twelve by men: at least the proportion of female speakers was representative of the audience. On the other hand, only one poster first author was female (that is, 7% of first authors), although women were well represented as session chairs, taking charge in three out of the four sessions.

The day inevitably revolved around the presentations - the usual mixture of 15 minute papers in the auditorium and posters in the Lower Library, with 8 commercial exhibitors squeezed in between the posters and the book shelves. A total of 15 talks were packed in, with perusal time at coffee and lunch for the 14 posters (the number of posters being slightly down on recent years). Meanwhile, for the benefit of those interested parties that could not be in the room on the day, a steady stream of tweets were released into the ether by Kayt Armstrong and James Bonsall among others, using the hashtag #NSGG2016.

The tweets are storified here: https://storify.com/girlwithtrowel/tweets-from-the-nsgg-recent-work-in-archaeological

A PDF of the programme and presentation abstracts is still available at: http://www.nsgg.org.uk/meetings/2016/NSGG2016-Abstracts.pdf

There was plenty of interest in the posters throughout the day. Congratulations to Lieven Verdonck and co-authors Giovanna Bellini, Alessandro Launaro, Martin Millet and Frank Vermeulen on winning the Best Poster prize - decided by popular vote by all delegates - for 'Beneath the surface of Roman Republican cities: large scale GPR survey of Falerii Novi and Interamna Lirenas (Lazio, Italy).'

For those who couldn't make it, the programme was a nicely balanced mixture of site-specific case studies, methodological approaches and philosophical observations. A quick glance at the lecture schedule demonstrates the wide range of papers on offer: a wide range in the sense of their geographical origins, project scales, archaeological contexts and technical leanings.

In geographical terms, we were transported from the south of England to Nepal (courtesy of Armin Schmidt) and back,

Tomasz Herbich presenting an overview of magnetometer survey of Ancient Egyptian towns. (Photo: James Bonsall)

Adam Booth, talking about geophysical and geochemical survey of a Mosquito crash site. (Photo: Magnitude Surveys)

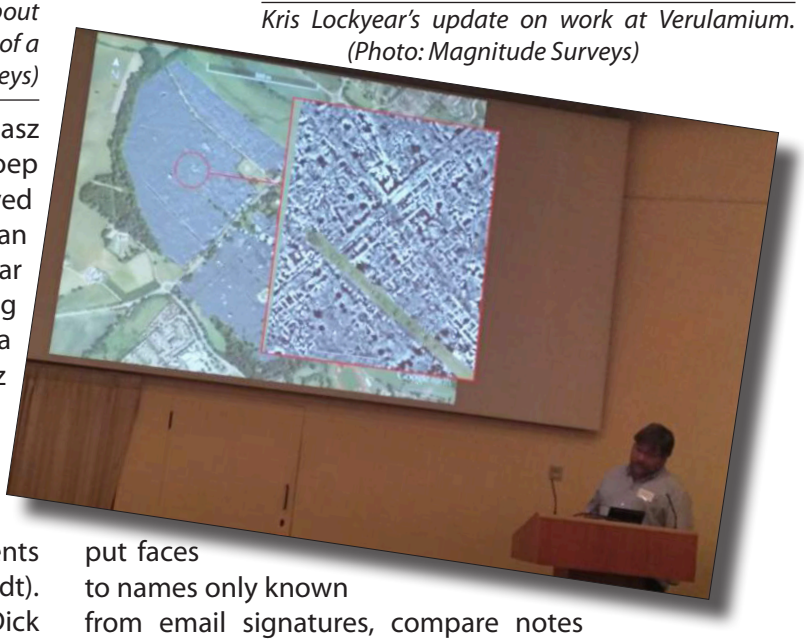
by way of Iraqi-Kurdistan (Jörg Fassbinder), Egypt (Tomasz Herbich), and various continental European stop-offs (Joep Orbons; Michał Pisz). Archaeologically, the talks displayed a slight (inevitable?) bias towards Roman as well as urban remains, with Kris Lockyear's update on the spectacular community work at Verulamium demonstrating both elements simultaneously. They incorporated a chronological spread from the Ancient Egyptian (Tomasz Herbich) to the post-medieval (Daniel Carter presented survey results from a Verwood pottery) and twentieth-century (in the form of Adam Booth's look at a conflict archaeology site), and a social cross-section from the 'decidedly non-elite' Neo-Assyrian frontier settlements (Jörg Fassbinder) to Nepalese palaces (Armin Schmidt). Some papers considered individual features - Henry Dick drew our attention to the complexity involved in identifying graves and Erica Carrick Utsi presented results from the survey of graves of the Shakespeare family in the chancel of the Holy Trinity Church, Stratford Upon Avon - while others took a much broader landscape-scale approach, including the survey of the hinterland of the Roman fort of Tibiscum in Romania (Michał Pisz). Conspicuous in its lack of direct archaeology was Petra Schneidhofer's paper on the importance of drawing out responses generated by other palaeoenvironmental sources in order to enhance our interpretation of landscape context.

Overall, there was a strong leaning toward multi-method approaches to aid understanding of sites, some of which introduced more novel complementary techniques, as demonstrated by the use, by Adam Booth, of portable XRF as a means to investigate the crash site of a de Havilland Mosquito aircraft (made primarily of wood with brass screws). Henry Webber reminded us of the potential overlaps between archaeological prospection and precision agriculture. Copious quantities of magnetic data were evident, as were various GPR datasets, although Anne Harding was the only presenter to use her GPR data to tackle the subtleties of topographic migration velocity analysis - and came up with a confident and polished presentation by an undergraduate!

The final papers of the afternoon took a slightly different approach, with James Lyall and Cornelius Meyer discussing the availability of commercial survey data and the role of the geophysicist respectively. Is the role of geophysicist being usurped by the archaeologist? What are the best ways to generate greater cooperation between the two? Do we need to cultivate more critical thinking of ourselves and each other in order to obtain this? I suspect the latter paper in particular was intended to stir up debate, but, at the end of a full day, few people were biting. At least until suitable refreshment had been taken...

As always at these things, one of the highlights of the day was undoubtedly the chance to catch up with familiar faces,

Kris Lockyear's update on work at Verulamium. (Photo: Magnitude Surveys)



put faces to names only known from email signatures, compare notes and hear about other people's ideas. This was undertaken with great gusto all round, aided both by the availability of lunch for all delegates in the Lower Library (a thoughtful provision of recent years that promotes inclusivity and timekeeping) and the proximity of a local hostelry for post-meeting refreshment.

All round, a great day: many thanks and gold stars to the organisers, Chris Leech (chairman) and Paul Linford.

Delegates engaged in post-conference "networking" (Photo: Magnitude Surveys)

National Park Service's 2017 Archaeological Prospection Workshop

The National Park Service's 2017 workshop on archaeological prospection techniques entitled Current Archeological Prospection Advances for Non-destructive Investigations of the Pea Ridge Civil WarBattlefield will be held **May 15 - 19, 2017**, at the Pea Ridge National Military Park in Benton County, Arkansas.

Lodging will be in Roger, Arkansas, at a motel to be determined. The lectures will be at a meeting room in Rogers, Arkansas, at a place to be determined. The field exercises will take place at the Pea Ridge National Military Park. The park commemorates the March 7-8, 1862 Civil War battle between Federal and Confederate troops in northwestern Arkansas. The resulting Federal victory keep the State of Missouri in the Union. Co-sponsors for the workshop include the National Park Service's Midwest Archeological Center, Pea Ridge National Military Park, and the National Center for Preservation Technology and Training, as well as the Arkansas Archaeological Survey.

This will be the twenty-seventh year of the workshop dedicated to the use of geophysical, aerial photography, and other remote sensing methods as they apply to the identification, evaluation, conservation, and protection of archaeological resources across this Nation. The workshop will present lectures on the theory of operation, methodology, processing, and interpretation with on-hands use of the equipment in the field.

There is a registration charge of $475.00. Application forms are available on the Midwest Archeological Center's web page at **http://www.nps.gov/mwac/**. Payment may be made by credit card through the Friends of NCPTT for non-government employees. Federal employees may pay through a training form (SF-182) sent to the Midwest Archeological Center or by credit card through the Friends of NCPTT (NCPTT webpage announcement).

For further information, please contact Steven L. DeVore, Archeologist, National Park Service, Midwest Archeological Center, Federal Building, Room 474, 100 Centennial Mall North, Lincoln, Nebraska 68508-3873.
Tel: (402) 437-5392, ext. 141; fax: (402) 437-5098
email: steve_de_vore@nps.gov

12th International Conference of Archaeological Prospection

The Organising Committee are pleased to invite you to take part in the 12th International Conference on Archaeological Prospection which will take place in Bradford, UK.
The Conference is organised by the School of Archaeological Sciences at the **University of Bradford** and the **International Society for Archaeological Prospection**.

All relevant information concerning the venue, programme, accommodation and events will be found on the Conference website:

www.ap2017.brad-vis.com

The Conference will be held between**12th and16th September 2017**.

ICAP 2017 focusses on a range of topics, including:

- Interpretation and presentation of prospection results
- Integrated prospection approaches
- Processing and visualisation of data
- GIS and prospection
- Technical aspects

In addition, there are three special sessions, focussing on the themes of:

1 Marine & Inter-tidal Archaeology and Prospection
2 Low Altitude Prospection
3 Commercial Prospection

Abstracts

Abstracts have a 1200 word limit and may contain references and up to 3 illustrations. For submission see:

www.ap2017.brad-vis.com/abstracts/

Deadline for abstract submission: ~~1st February 2017~~
15th February 2017

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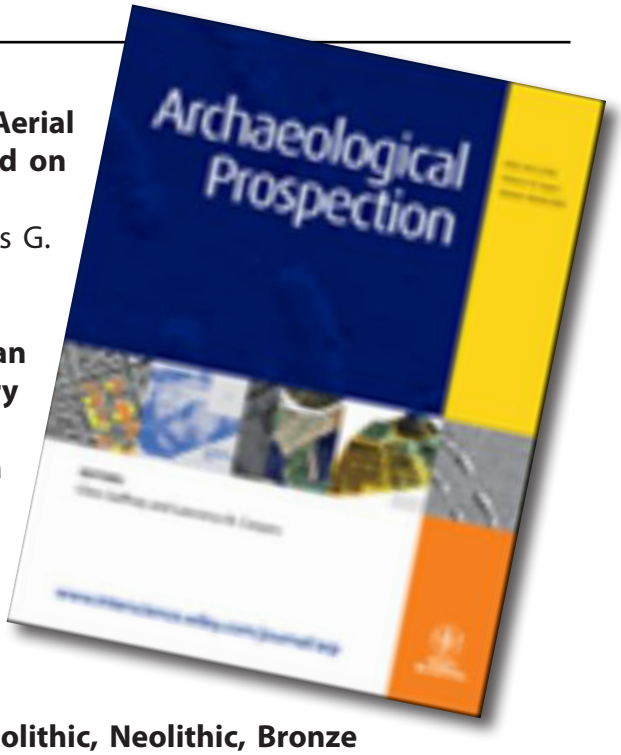
Journal Notification

Archaeological Prospection 23 (4)



Colour to Greyscale Pixels: Re-seeing Greyscale Archived Aerial Photographs and Declassified Satellite CORONA Images Based on Image Fusion Techniques
Athos Agapiou, Dimitrios D. Alexakis, Apostolos Sarris & Diofantos G. Hadjimitsis

Magnetometer Survey at the Newly-discovered Roman City of Auritz/Burguete (Navarre). Results and Preliminary Archaeological Interpretation
Ekhine Garcia-Garcia, Juan Mari Mtz. Txoperena, Roger Sala, Arantza Aranburu & Juantxo Agirre-Mauleon

Detection of Buried Roman Wall Remains in Ground-penetrating Radar Data using Template Matching
Lieven Verdonck

Geophysical and Archaeological Evidences of Buried Epipalaeolithic, Neolithic, Bronze Age and Roman Architecture in West-Central Syria
Mahjoub Himi, Angel Armendariz, Luis Teira, Jesus González, Juan José Ibáñez, Maya Haïdar-Boustani & Albert Casas

Multi-methodological Geophysical Exploration for the Interpretation of the Ancient Landscape of Phaistos (Greece)
Rosa Di Maio, Mauro La Manna, Ester Piegari, Cecilia Mancini, Vladimiro Achilli & Massimo Fabris

Joined Interpretation of Buried Anomalies from Ground Penetrating Radar Data and Endoscopic Tests
Loredana Matera, Raffaele Persico, Nadia Bianco, Gaetano Leopizzi & Giuseppe Leopizzi

Palaeogeographic Reconstruction in the Transition Zone: The Role of Geophysical Forward Modelling in Ground Investigation Surveys
Charles R. Bates & Martin R. Bates

Capturing the Past for the Future: an Evaluation of the Effect of Geometric Scan Deformities on the Performance of Aerial Archival Media in Image-based Modelling Environments
Christopher Sevara

From Low Cost UAV Survey to High Resolution Topographic Data: Developing our Understanding of a Medieval Outport of Bruges
Jeroen De Reu, Jan Trachet, Pieter Laloo & Wim De Clercq

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