

ISAP NEWS

The newsletter of the International Society for Archaeological Prospection

Issue 21, October 2009

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Editor's Note

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Welcome to the 21st issue of ISAP News. Once again I would like to thank those who have taken time to share their interesting experiences and developments with the membership. I hope you enjoy reading the Newsletter which is the final instalment for the year. If you would like to contribute to the next edition in the New Year, please email me your articles by 20th January 2010.

Preservation of Buried Archaeological Patrimony Through Georadar Studies. The Case of the Historical Center of the Merida City, Yucatán, Mexico.

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Introduction

As a result of the interpretation of topographic data and ancient documents the historical center of Merida City, Yucatan, has been classified as a "zone of high patrimonial value". The data renders testimony of the city's continuous development since Pre-Hispanic times when T'Ho was the great capital city of the Northern Maya area.

Following the first phase of the research in which old maps were examined, it was clear that the present-day historic center of Merida was built over the ancient city of T'Ho and settled on a large elevated natural terrain (contour line 4 masl). Above this natural level, evidence was found that some elevated areas (contour lines 5 and 6) were chosen to build "Noh Cah Ti Hoo" (the great town of T'Hó). In addition, in the environs of the central settlement zone, under the contour line 4, depressions were excavated and later used as water reservoirs.

Objective

The main goal of this project was to use georadar to prevent potential damage to the buried archaeological patrimony of the Merida historical city center, which was threatened by forthcoming urban infrastructure works.

Methodology

The equipment consisted in Georadar GSSI SIR System 2 with both 200 and 400 MHz monostatic antennas: this radar was used in researching all sites suggested by cartographic analysis and by Ligorred's hypothesis.

During the data acquisition phase, which lasted two weeks, 127 georadar continuous profiles, measuring 16 584m long, were acquired. Radan 6 software, developed for GSSI, was used in the data processing phase to remove background noises and improve resolution, topographic correction, horizontal distance normalization and finally depth estimations.

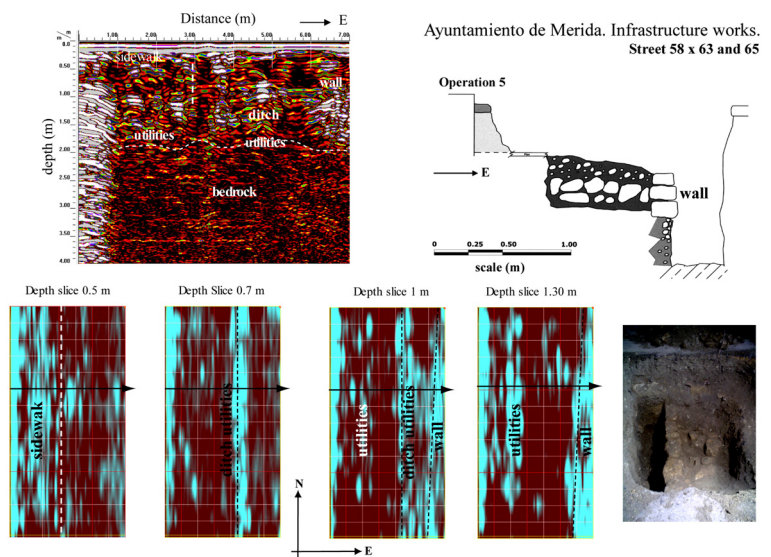


Figure 1

Results

Geophysical prospection of the streets of Merida city revealed buried archaeological remains while others appeared most likely related to geological phenomenon.

During the acquisition of Line F28, on 58th Street, continuous horizontal reflections associated to elevation zones were located, showing an interesting anomaly in direct correspondence to a pre-Hispanic wall located between streets 63 and 63A. In addition, in this place a small grid was set to perform an in-depth study of the wall path. (Figure 1)

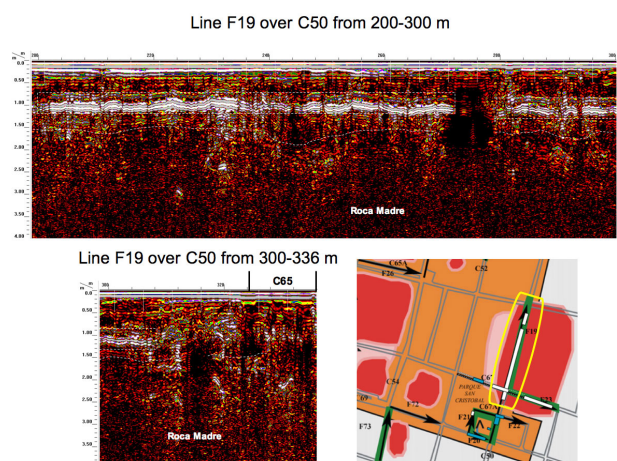


Figure 2

Line F19, on 50th Street, is a good example of the horizontal reflections interpreted as structures buried under Merida. This reflection is closely correlated to a subtle topographic elevation registered in this area marked in red (Figure 2).

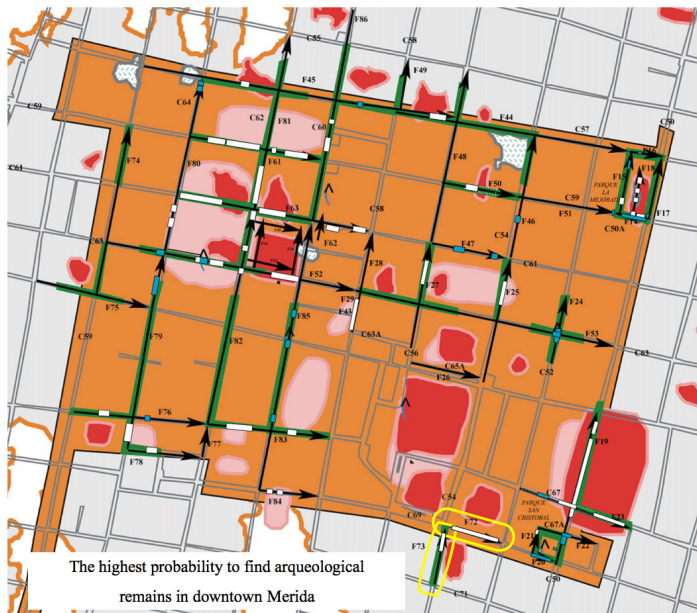


Figure 3

Final Comments

Most radargrams of the historical center of Merida enable the detection of the geological contact with the parent rock usually at a depth of about 1.5 or 2m.

The main cultural remains identified during geophysical profiling appear as strong continuous horizontal reflections nearly 1m deep and are represented in white in the map (Figure 3). They were interpreted as culturally levelled surfaces that once supported ancient buildings and now indicate the location of Mayan structures.

As a result of the combined efforts undertaken in this project, it was possible to map the historical center of Merida by tracing the distribution of the radar anomalies and their possible interpretation. This map, produced for the first time in Mexico, will enable the Merida city authorities to make low-impact decisions concerning the planning of the modern city, hence successfully preventing unnecessary damage to the archaeological patrimony of the ancient Maya city of T'ho.

Destripping Linears – A new approach to an old problem

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Destripping magnetometer data is frequently one of the most basic functions of any processing strategy. It often provides the biggest enhancement to a dataset for the smallest level of change to the data. However, it can also have a huge negative effect when a linear feature runs parallel to the direction of survey. Because each traverse is considered in isolation from all other data in the grid, there is no way to tell if the average of the traverse is due to the instrument or to real features. The result is that all deviation from the average, including any resulting from an anomaly that is constant along that traverse, is removed. This article presents a new variation on the Destripe method that handles this situation far better than the existing methods.

At the Archaeological Prospection conference in Paris this year, Tim Horsley presented a poster on a magnetometer survey carried out in Maryland, USA. One of the problems encountered with this

survey was a terrace that ran almost parallel to the direction of survey. Though the terrace response was clearly visible in the raw data, basic destripping – which was essential for the majority of the survey – almost completely removed portions of this anomaly. While pondering the problem, Tim considered the root cause of the stripes: sensor mismatch (when using a dual magnetometer) and heading errors. It occurred to him that a grid could in fact be considered as four separate but interlaced grids, one for each combination of sensor and direction. If these grids were separated out, the application of a grid matching function, (such as zero median grid), might better remove the heading and sensor error and match the component grids. The application of a sensor & heading based destripe process should therefore eliminate the striping without perceptibly affecting responses due to real linear features.

Tim produced an Excel file to manually create the four sub-grids for the worst affected grids of his dataset. These were then processed and recombined in Excel and used in the final dataset. The results were promising, but obviously very time consuming and not practical for general use.

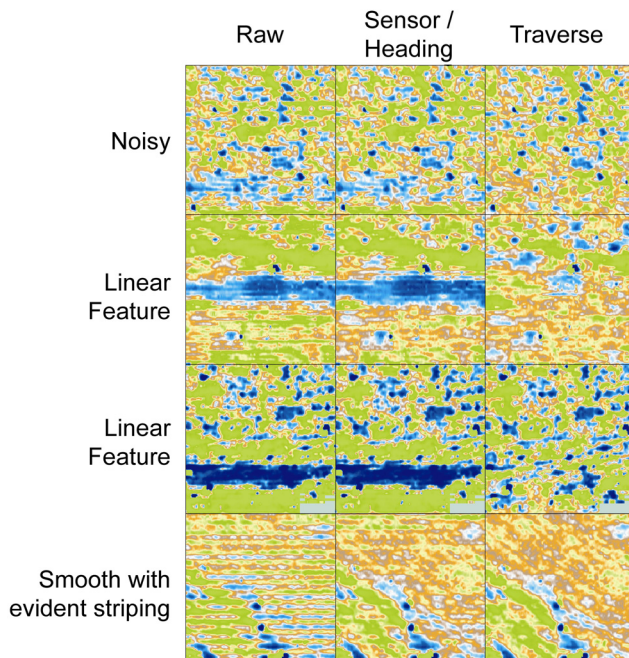


Figure 1: Detailed comparison of results

During the Paris conference Tim spoke to David Wilbourn, the creator of ArcheoSurveyor, about the problem and the new solution. David considered it an interesting idea and worth investigating. Tim therefore supplied David with a copy of the survey data for testing and the necessary code was implemented.

Figure 1 shows the raw data and the results of applying the two methods to 4 different grids. These grids were selected from the Maryland survey to illustrate a range of data 'types'. They include two linear features, a noisy and a quiet grid. The data has been band weight equalised and a garish colour scheme applied purely to highlight the features and effect of the processes. Each grid square is 30m and data were collected using a Bartington Grad601-2 dual fluxgate gradiometer at 0.125m intervals along traverses spaced 0.5m apart.

The remaining figures show a larger section of the same survey in basic greyscale. Grid lines have been turned off as these tend to mask edge problems. The two grids used for the example linear features can be seen left of centre and

bottom right. The area shown is 240m x 90m, and the top of the survey faces northwest.

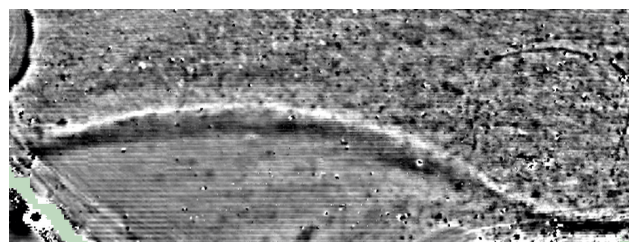


Figure 2: Raw Data. Processing is just clip at $\pm 1SD$. The long curving anomaly due to the terrace edge is clearly visible across the centre of the survey. However striping, especially in the relatively quiet area below the terrace feature, is severe.

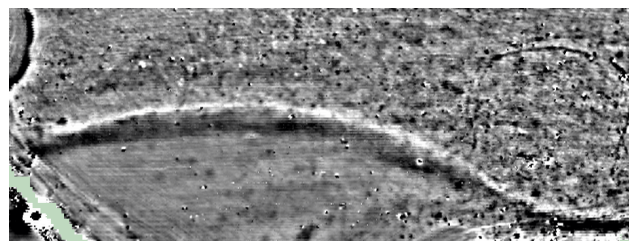


Figure 3: Sensor destriping. Sensor Destriping & clip at $\pm 3SD$. Now the linear anomaly remains intact and is almost identical to the raw version. There are only the slightest hints of grid edges and yet almost as much detail of the ploughmarks is visible in the quiet area.

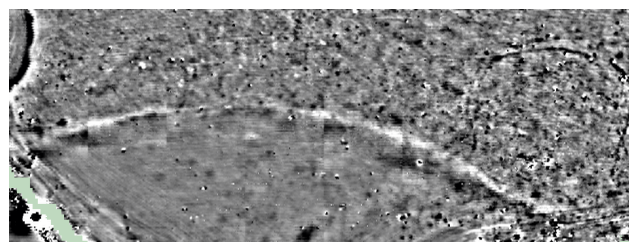


Figure 4: Traverse destriping. Traverse Destriping & clip at $\pm 3SD$. Destriping improves the appearance of the quiet area, allowing ploughmarks to show through. However, it has almost entirely removed the linear response where it runs parallel to the direction of survey. It also produces distinct disjunctions at grid edges.

In conclusion, Tim and David consider this new method to be successful and a significant addition to the set of processes available to users of magnetometers. Preliminary testing indicates that, in many instances, the basic traverse destripe functions may be more effective at removing striping since the mismatch between traverses is not always consistent and simply due to heading error and sensor mismatch. However, in data grids with both striping and anomalies due to features running parallel to the survey direction, the new sensor destripe function is a far more appropriate since it allows the unwanted striping to be reduced

while preserving archaeological or natural responses.

The new destripe mode will be made available in the next major release of ArcheoSurveyor. Due to

the complexity of line interlacing patterns, it currently only supports Bartington & Geoscan magnetometers but other instruments will be added as requested.

Georadar Survey in the Roman Dam of Consuegra, Toledo, Castille-La Mancha, Spain

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The roman dam located in the southwest of Consuegra (Toledo), in the Amarguillo river course, was known since the 18th century as a bridge, but it was not identified as a roman dam and studied until 1971 by F. Giles Pacheco. Since then only some research works during the 80's had been done. This dam is associated with Consuegra, identified as the roman mansio of Consaburum, located in the via 30 of the Itinerary of Antoninus (Item a Laminio.Toletum).

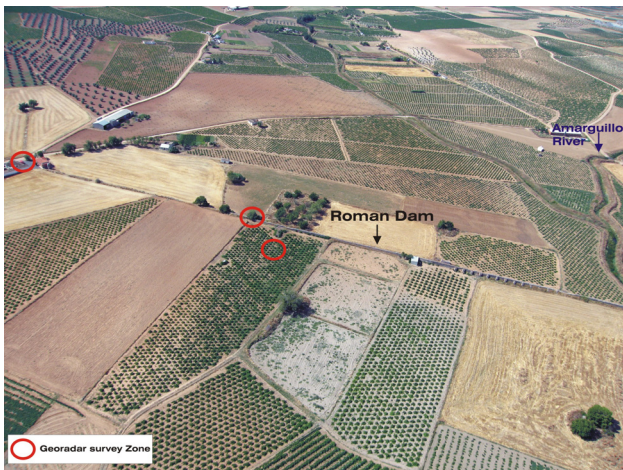


Figure 1: Aerial view of the roman dam of Consuegra, and location of the georadar survey zones.

During 2007 we carried out the project to study the roman dam and the remains of the roman hydraulic supply of Consaburum (Proyecto de Estudio de la Presa y Sistema Hidráulico Romano de Consuegra (TOLEDO)), with funds from the regional government (Programa de Subvenciones para la Investigación del Patrimonio Histórico de Castilla-La Mancha). The project includes archaeological research (survey, georadar, archaeometry), aerial photography and topography. The aim is to create a long term project of archaeological research, preservation and public dissemination of the roman remains of Consuegra.



Figure 2: Georadar surveying

Since we knew that the roman dam had been built in only one phase (as the mortar analysis shows), we had some problems to solve: what was the total length of the wall and why did it suffer a setback creating two walls not aligned, and how lengthy was the unique supply vaulted channel identified. These were the reasons why we decided to make a georadar (GPR) survey in those parts of the dam.

The work was carried out in separated transects, both perpendicular and aligned to the wall of the different parts of the dam that we wanted to study, with a 400 MHz georadar system.

The results were different in each part:

- The total length of the roman dam, as the georadar survey shown, is about 662 m. It's one of the biggest roman dams in Europe.
- The water supply: the georadar shown that the structure continues about 2m along, but then we lost readings of the georadar due to terrain disturbances. It is possible that the structures are lost, as well as their foundation trench. Another possibility is that the structures turn to the north, but this will carry the water again to the river.
- The wall setback: as we can see today, the dam shows two walls not aligned. The georadar survey shows that there is a

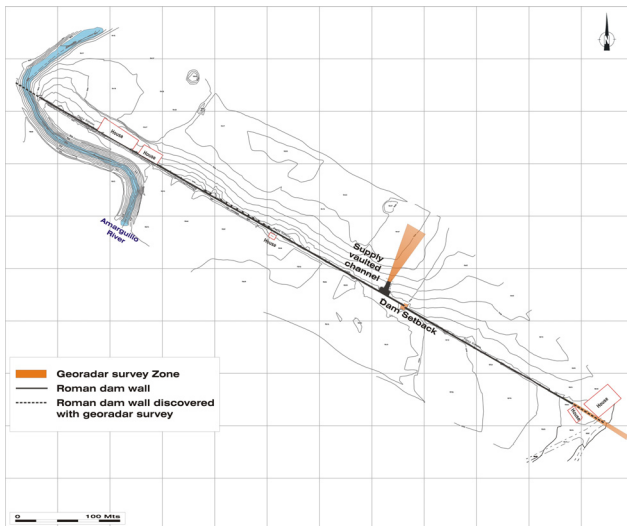


Figure 3: Map of the roman dam with the georadar survey zones and the final results

structure under the space between both parts of the wall, which is probably an access to the water supply upstream, probably in order to clean it up of lime.

The results of the project are going to be presented in November at the International Congress *Aquam Perducendam Curavit*. Captación, uso y administración del agua en las ciudades de la Bética y el occidente romano that will be held at the University of Cadiz (Spain).

Conference, Seminar and Course Announcements

EGU 2010

Austria Center Vienna, Vienna, Austria, 2-7 May 2010

A new session about archaeological prospection is organized for the next EGU General Assembly:

MPRG12

Magnetic and/or other geophysical prospection for archeology.

Convener: Y.Q. Quesnel (CEREGE, France)

Co-Convener: S. Piro (NRC, Italy)

The session is open to geophysical studies on potential/known archaeological sites, focusing on prospections which use magnetics combined with other methods (GPR, resistivity, etc.) or constrained by rock property constraints. The objective is to share different experiences as well as to highlight some needed improvements in some fields (e.g. new instruments?, new processing techniques?, etc.).

You are invited to submit an abstract via the EGU 2010 website on this link:

<http://meetingorganizer.copernicus.org/EGU2010/session/2550>

DEADLINE FOR RECEIPT OF ABSTRACT: 18 January 2010

38th International Symposium on Archaeometry (ISA 2010)

University of South Florida, Tampa, USA, 10-14 May 2010

The Symposium is composed of several sessions including one on Field Archaeology, which includes remote sensing and geophysical prospecting, organized by Luis Barba and Rob Sternberg.

The deadline for abstract submission is 1st December 2009. Instructions for submitting abstracts are available here:

<http://isa2010.cas.usf.edu/Abstract%20Submission.html>

Further details on the conference are available here:

<http://isa2010.cas.usf.edu/>

Announcements

ISAP Management Committee

During the ISAP Annual General Meeting 2009 in Paris in September, elections for the ISAP management committee took place. The results of which are as follows:

Chairman	Dr. Chris Gaffney
Vice-Chairman	Dr. Apostolos Sarris
Honorary Secretary	Dr. Armin Schmidt
Conference Secretary	Prof. Mahmut Drahor
Conference Vice-Secretary	Dr. Christophe Benech
Editor	Louise Martin
Treasurer	Chris Leech

Journal Notification

Archaeological Prospection 16:4

The final issue of the year of Archaeological Prospection has gone to press. I hope that you have enjoyed the wide ranging and thought provoking papers that the journal has published. We are always on the lookout for new submissions, both research articles and short reports. Please go to the authors' page (<http://www3.interscience.wiley.com/journal/15126/home/ForAuthors.html>) for more information on how to submit an article on-line. If you have written a book and can arrange a review copy then please contact the Book Review Editor (Dr Neil Linford, Neil.Linford@english-heritage.org.uk).

The following articles will be published in Volume 14: Issue 4.

Tracing a major Roman road in the area of ancient Helike by resistivity tomography. G. N. Tsokas, P. I. Tsourlos, A. Stampolidis, D. Katsonopoulou, S. Soter

Providing an archaeological bird's-eye view - an overall picture of ground-based means to execute low-altitude aerial photography (LAAP) in Archaeology. Geert J. J. Verhoeven

Three-dimensional inversion of automatic resistivity profiling data. Nikos G. Papadopoulos, Gregory N. Tsokas, Michel Dabas, Myeong-Jong Yi, Jung-Ho Kim, Panagiotis Tsourlos

Magnetic survey at Venta Icenorum, Caistor St Edmund: Survey strategies and initial results. D. Bescoby, W. Bowden, P. N. Chroston

From the air to beneath the soil – revealing and mapping great war trenches at Ploegsteert (Comines-Warneton), Belgium. Masters, B. Stichelbaut

The issue also includes a book review by Jamie Pringle of the following:

Geoforensics. A. Ruffell and J. McKinley, John Wiley & Sons, 2008. No. of pages: 332. ISBN 978-0-470-05735-3; (hardback), ISBN 978-0-470-05734-6

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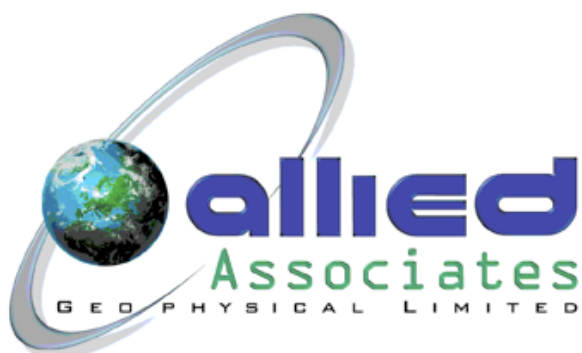
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Instruments for Archaeological & Geophysical surveying

- Foerster 4 channel fluxgate magnetometer
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- Allied Tigre resistivity imaging systems
- GSSI Ground Radar systems
- Geonics EM conductivity meters
- ArcheoSurveyor software
- Geometrics seismographs



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