

## Z. WORLD ARCHAEOLOGIES: THE PAST, THE PRESENT AND THE FUTURE

### 21. World Archaeologies: the past, the present and the future

#### Session Z21-04: World archaeo-geophysics: State of the art & case studies (COST Action SAGA-CA 17131)

Organised by **Carmen Cuenca-Garcia** (Norwegian University of Science and Technology (NTNU), Norway), **Andrei Asandulesei** ("Al.I. Cuza" University, Romania), **Kelsey Lowe** (University of Queensland, Australia)

Geophysical prospection currently stands as a powerful method in archaeology to study sites in a non-destructive and minimally invasive manner. In the last decade, major technological developments have delivered more compact sensors, multi-arrays systems, as well as motorised or robotised ground or aerial platforms that are revolutionising archaeological research. These technological breakthroughs have allowed the implementation of extremely fast and high-resolution surveys to discover, explore, record and monitor sub-surface archaeological sites and landscapes. Geophysical techniques have been employed in archaeological research for decades and the result has been their steady establishment as routine procedures in cultural heritage management (CHM). However, the use of archaeo-geophysics, both in research and CHM, faces an unbalanced adoption across European countries but also in the rest of the world. Why? What are the experiences or challenges? How can we promote the uptake of geophysical approaches there with little or no-experience of their use?

To promote an adequate use of geophysics in archaeological research as well as to advance in geophysical data interpretation beyond basic prospection (presence/absence of possible archaeological features), the *Soil science & Archaeo-Geophysics Alliance* (SAGA) was funded by the EU COST Association. COST Action SAGA (CA17131) is a research network, which brings together archaeologists, geophysicists and soil scientists from 36 countries. This session is organised under the auspices of COST Action SAGA and is open for contributions (overviews or case-study papers) from SAGA and WAC members, or other external participants working in archaeo-geophysics in research, management or commercial environments, all around the world. We aim to exchange experiences, discuss common and/or specific challenges and solutions, and identify pathways to facilitate the adoption of archaeo-geophysics especially in those countries with high needs- and where the expertise and infrastructures are not readily available.

**Keywords:** archaeological geophysics/archaeo-geophysics, near surface geophysics, combined archaeo-geophysical and soil science approaches, cultural heritage management, non-destructive methods in archaeology

#### SAGA (COST 17131): SEARCHING FOR INNOVATION IN INTEGRATION OF GEOPHYS AND GEOCHEM DATA: COMPOSITIONAL DATA, GPR, MAGNETICS, RANDOMIZATION (ID 1114)

**Jan Horák** (Czech University of Life Sciences, Prague, Czech Republic), **Richard Hewitt** (Universidad Complutense Madrid, Madrid, Spain), **Julien Thiesson** (Université Sorbonne, Paris, France), **Martin Janovský** (Czech University of Life Sciences, Prague, Czech Republic)

SAGA WG3 is focused on search for innovation in integration of data analysis. Here we present two major branches of our activities. The first one is about Compositionality: inspiration taken from geochemistry applied on geophysical data. The geochemical data – content of the elements in soils – are of compositional nature. That means that elemental content cannot reach random values, but it is influenced by the content of other elements. Therefore, they are not suitable for usual statistical approaches, but it can be analysed using specific tools of Compositional data analysis. Hence, we searched if there would be some geophysical data suitable for such analytical approaches. The work on this topic showed that at least GPR data are perfect candidate. As resulting activities, R scripts for working with GPR data were produced. We present the examples of this approach. The second branch is focused on using randomization and iteration of the data to be used in searching for patterns in the real data and for potential data in datasets, that could be used effectively for integration of geophysical and geochemical data. We worked mainly with magnetometry results within this task, and processes and results of it are also presented.

**Keywords:** Geophysics, Geochemistry, Data integration, Compositional data, Randomization

**HISTORY OF LARGE AREAS SURVEYS IN LAND USE PLANNING IN FRANCE AND THE CONSEQUENCES FOR PRESERVATION OF OUR HERITAGE (ID 1175)****Michel Dabas** (CNRS- ENS PSL, Paris, France)

Geophysical surveys over large areas (i.e. more than 100 ha) for development projects in France have been made possible by the development of high-speed systems since 2001. But in the previous decade, pioneering work for motorways (A77) tried to map these large areas using coarse grids and proxies such as magnetic susceptibility. The importance of soil processes and the analysis of the validity of the data by geostatistics was demonstrated. The first consequence was to make the preservation of archaeological sites possible on the basis of geophysical information – and not only on direct observations in test trenches. Magnetic susceptibility measurements were subsequently used on several motorway projects (A89, A20 and A66).

Later, in 2001, a CNRS spin-off (Géocarta) started to design high-speed mapping systems for precision agriculture, and more particularly for electrical mapping (ARP systems in 2004). Similar mapping systems using an array of magnetic sensors (AMP in 2006) and multi-coil EM sensors (EMP) were designed specifically for the spatial accuracy needed in archaeology. Over the next ten years, more than ten large-scale projects were undertaken using these systems. The largest of these was the 430 ha Milano-Brescia motorway project in Italy (BREBEMI). The originality of this project was to study the whole environment of "potential" archaeological sites as a continuum and not as "sites".

At a time when the areas to be prospected are becoming smaller, it is possible to take stock of the experience acquired on large areas for a better preservation of our heritage.

**Keywords:** archaeogeophysics, geostatistics, large-scale projects, Automatic Resistivity Profiling

**ARCHAEO-GEOPHYSICAL PROSPECTION IN ROMANIA: SHORT RETROSPECTIVE – LEGAL FRAMEWORK – PERSPECTIVES (ID 718)****Andrei Asandulesei** ("Alexandru Ioan Cuza" University, Iași, Romania)

Modern archaeological research, based on the integration of some of the most successful non-invasive prospection methods, has started to increasingly consolidate in Romania, as borne out by the initiatives and results, particularly for case studies belonging to prehistory or the Roman period.

This apparently reassuring state of affairs, with several noteworthy initiatives coming into the limelight, is unfortunately put into question by the reality that the implementation of standardized research procedures relying on non-invasive methods continues to be unmet.

Overlooking the issue of under-financed research, in general, and the branches involved in the protection and valorisation of the immovable heritage, in particular, we prefer to highlight a number of positive aspects enjoyed by Romanian archaeology when there is openness on part of those with vested interests.

As such, without a direct support for non-invasive research on part of the authorities, it was nevertheless possible to institutionally accommodate this component into universities and museums, by establishing interdisciplinary archaeological research platforms or institutes. Such is the case of the Arheoinvest Research Center part of Interdisciplinary Research Institute from the University of Iasi, Romania.

On the basis of an experience of almost ten years acquired by our team, in this paper we draw attention to a series of aspects with which we have been confronted during the last decade, detail the state of non-invasive archaeological research in Romania (in terms of archaeological research itself, preventive archaeology, monitoring of the archaeological heritage, feasibility studies for infrastructure works, etc.), and put forward future prospects.

**Keywords:** geophysics, Romania, Arheoinvest Research Center

**A NEW DISCOVERY OF GEOPHYSICAL ARCHAEOLOGY OF MOHR TEMPLE SITE IN KASHI, XINJIANG (ID 400)**

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Mohr Temple site is located in Kashi, Xinjiang. It is an early Buddhist site of the silk road. The site is a landmark building of the ancient city of Hanoi and a national key cultural relic protection unit. It is of great significance in the study of Buddhism spread in Xinjiang and Kashi area of Han and Tang Dynasties. In this archaeological exploration, electrical resistivity tomography (ERT) method and ground penetrating radar (GPR) method are used to explore the distribution of pagodas, buildings, peripheral sites and other relics in the site, so as to obtain the information of underground remains to the maximum extent. Good results have been achieved through reasonable geophysical exploration, which provides scientific basis for the conservation and planning of Mohr Temple site. Through the geophysical and archaeological exploration and interpretation of Mohr Temple site, the following conclusions are obtained:(1) A doorway was found in the north-south axis of the square pagoda, and there may be a underground palace under the round pagoda;(2) There are many buildings left between the two pagodas. The whole stratum in the survey area of the Mohr pagoda is covered with adobe structure layer. It is speculated that there is a large project and a large amount of ground base in the Buddhist temple;(3) The outside area of the temple is about 5000 square meters.

**Keywords:** Mohr Temple, ERT, GPR

**FRENCH ARCHAEOGEOPHYSICS: A REVIEW OF 60 YEARS OF DEVELOPMENT (ID 1141)**

**Michel Dabas** (CNRS – ENS PSL, Paris, France), **Julien Thiesson** (Sorbonne Université, Paris, France), **Christophe Benech** (CNRS- Université Lyon 2, Lyon, France), **Christian Camerlynck** (Sorbonne Université, Paris, France), **Guillaume Hulin** (INRAP, Paris, France), **Vivien Mathé** (CNRS- Université La Rochelle, La Rochelle, France), **Christophe Petit** (Université Paris I Panthéon-Sorbonne, Paris, France), **François Xavier Simon** (INRAP, Paris, France), **Quentin Vitale** (Evéha International, Ivry-sur-Seine, France)

As a result of a long history in both archaeology and geophysics since the 1960s, France presents a wide range of practices in archaeogeophysics. First developed by geophysicists who used archaeological sites as test sites, it has developed as an autonomous discipline (A. Hesse, A. Tabbagh, M. Martinaud) while exploring different contexts and thematic issues.

Nowadays well accepted in archaeology, the opposition between development-directed excavations and programmed excavations in French archaeology has had some consequences on the development of archaeogeophysics. After some statistics showing the evolution of geophysical surveys in Archaeology since year 2000 gathering most of the actors in France (1100 surveys analyzed), we will show some examples that illustrate the diversity: first, a set of surveys on rural areas. Second, we will present how archaeological sites in urban areas are assessed with geophysical techniques. Third, we will explore the potential of geophysics in a specific context such as caves, excavations, coastal areas. Three highlights on specific French developments in archaeogeophysics will be made: development of the electromagnetic Slingram method, continuous electrical measurements and electrostatic measurements.

In conclusion, the ways of development of the discipline are as much due to the progress of the instruments and the processing of the geophysical data as to a better integration with other disciplines of the geosciences such as geology, soil science, geotechnics or geochemistry and finally as well as with a better dialogue with the archaeologist.

**Keywords:** archaeogeophysics, preventive archaeology, urban archeology, large scale surveys

**MAGNETIC PROSPECTION IN THE FLYSCH ENVIRONMENT. SURVEY AND TRIAL TRENCHING RESULTS FROM TWO MULTIPERIODIC SITES IN SLOVENIAN ISTRIA (SW SLOVENIA). (ID 1123)**

**Igor Medarić** (Department of Archaeology, Faculty of Arts, University of Ljubljana, Slovenia, Ljubljana, Slovenia), **Manca Vinazza** (Department of Archaeology, Faculty of Arts, University of Ljubljana, Slovenia, Ljubljana, Slovenia)

This paper aims to discuss the efficiency of small trenching over previously measured geophysical anomalies and the advantage of properly documenting and conducting of in-situ geophysical measurements during the excavations. In 2021 and 2022 a detailed evaluation of the effectiveness of the magnetic method for identification and determination of the type and physical properties of archaeological remains in the soils on flysch was carried out at typologically and chronologically different archaeological sites in the inner regions of the Slovenian Istria (SW Slovenia). After the completion of the magnetometer measurements, magnetic susceptibility mapping, and electrical resistance survey, trial

trenching was carried out at the two multiperiodic archaeological sites Lucan and Kaštelir. During the excavations, along with the comprehensive archaeological documentation, the geophysical properties including the physical and especially magnetic properties of the soils (eutric brown soils), bedrock (sandstone, marl), and buried archaeological structures, were recorded. Collected magnetic data was also used for the application of advanced quantitative processing procedures with various transformations of the magnetic field, as well as for 2D and 3D magnetic modelling for effective solutions to specific problems in the researched environment. These “small windows” determined based on the careful analysis of magnetic anomalies significantly contributed to the interpretation and understanding of geophysical results over whole surveyed areas. To a certain extent, it was also possible to expand the results to the regional geo-pedological context.

**Keywords:** Magnetometry, Magnetic susceptibility, Flysch, Trial trenching

### ARCHAEO-GEOPHYSICS AND PREVENTIVE ARCHAEOLOGY IN ROMANIA. THE CASE OF TĂRTĂRIA–PODU TĂRTĂRIEI VEST HALLSTATTIAN SITE (ID 734)

**Corina Bors** (National History Museum of Romania, Bucharest, Romania), **Andrei Asandulesei** (“Alexandru Ioan Cuza” University, Iasi, Romania), **Felix-Adrian Tencariu** (“Alexandru Ioan Cuza” University, Iasi, Romania), **Vlad Rumegea-Irimus** (National History Museum of Romania, Bucharest, Romania)

The prehistoric site from Tărtăria – Podu Tărtăriei vest (Alba County) was discovered in 2012 by large-scale preventive archaeological field investigations occasioned by the construction of the A1 motorway along the Mureş river valley. The site is located north to Tărtăria village (Sălişteia commune), on a plateau situated on the upper left terrace of the mentioned valley. In 2012, throughout an open area archaeological excavation was completely investigated an area of about 2 hectares where significant archaeological features and vestiges were discovered, providing major new data and finds for Middle Hallstatt period – the Basarabi pottery style. Since 2016 was initiated a multi-annual scheduled archaeological project, aiming both field excavations and geophysics surveys. As a result, a series of large-scale magnetic survey and aerial photography were made for documenting the setting of the prehistoric site on successive archaeological campaigns.

Numerous positive anomalies were detected and was also possible to confirm the existence of a western ditch for outlining / defending (?) the prehistoric settlement. Considering all the data recorded up to now and the preliminary analysis of the very rich archaeological finds from Tărtăria – Podu Tărtăriei vest, one can consider this site as a very important one for the study of middle period of the First Iron Age in Transylvania and neighboring areas. Last but not least, the new non-invasive prospections made in 2021 provided more interesting data, suggesting once again that this site in characterized by particular features, emphasizing also the necessity for its long-term field research and protection.

**Keywords:** Middle Hallstatt period, Magnetic Prospection, Site Planimetry

### 3D GPR ATTRIBUTE CHARACTERIZATION FOR ARCHAEOLOGICAL PROSPECTION (ID 662)

**Wenke Zhao** (School of Earth Sciences, Zhejiang University, Hangzhou, China), **Guoze Lu** (School of Earth Sciences, Zhejiang University, Hangzhou, China), **Gang Tian** (School of Earth Sciences, Zhejiang University, Hangzhou, China)

3D Ground-Penetrating Radar (GPR) dataset with multi-direction profiles can provide more reliable views of archaeological remains, while attribute analysis can be applied to extract more quantitative information and further to characterize subsurface features in terms of extension and shape. A 3D full GPR survey, acquired with 250-MHz central-frequency antennas, was performed to image potential wreckage remains of World War II, in Shangyu, China. The grid was established based on parallel and perpendicular profiles, with 0.5 m × 0.02 m trace spacing. A multi-attribute approach was used through different attribute categories, involving instantaneous and textural attributes. A global optimal decision of multi-attribute fusion was developed to improve subsurface imaging, and iso-attribute surfaces were also calculated to emphasize spatial variations in GPR data volumes. The results demonstrate that our proposed method can visualize GPR features in an automatic manner and enhance the accuracy of GPR archaeological interpretations.

**Keywords:** 3D GPR Attribute, Archaeological Prospection, Multi-attribute Fusion, Iso-attribute Surfaces

## GEOPHYSICAL PROSPECTION AT IBERIAN SITES IN THE EASTERN COAST OF THE IBERIAN PENINSULA: FIRST RESULTS (ID 1273)

**Carmen Cuenca-Garcia** (Norwegian University of Science and Technology (NTNU), Trondheim, Norway), **Krzysztof Kiersnowski** (Norwegian University of Science and Technology (NTNU), Trondheim, Norway), **Consuelo Mata Parreño** (Universitat de Valencia, Valencia, Spain), **Agustin Diez Castillo** (Universitat de Valencia, Valencia, Spain), **David Quixal Santos** (Universitat de Valencia, Valencia, Spain), **Lucia Soria Combadiera** (Universidad de Castilla la Mancha, Albacete, Spain)

This presentation will discuss the preliminary findings of GEOIbers (Geophysical prospection at Iberian sites). This is a research project that focuses on the investigation of three types of Iberian sites (settlement, metallurgical production, and necropolis) using ground-based geophysical methods, in particular, ground-penetrating radar (GPR) and magnetometer surveys. In winter 2021, an intensive geophysical field campaign explored six Iberian sites (VI-II BC). The objective was to detect remains of buried structures related to semi-excavated oppida to complete urban layouts, locate unknown smelting ovens related to craft centres, and characterise hidden Iberian funerary landscapes. During the presentation, the authors will report on the first results as well as consider the overall potential/challenges of these (and other) non-destructive techniques in Iberian Archaeology. The project is a research collaboration between the University of Valencia, University of Castilla la Mancha, and the Norwegian University of Science and Technology (NTNU), funded by the Generalitat Valenciana (AICO AICO2020/250).

**Keywords:** archaeology, geophysics, iberian

## PALAEOENVIRONMENTAL ANALYSIS OF ARCHAEOLOGICAL SITES BASED ON HIGH-RESOLUTION 3D INVESTIGATIONS – NEW EXAMPLES FROM DENMARK AND NORWAY (ID 1210)

**Arne Stamnes** (Department of Archaeology and Cultural History, NTNU University Museum, Trondheim, Norway), **Søren M. Kristiansen** (Department of Geoscience, Aarhus University, Aarhus, Denmark)

The effect of landscape change on changes in past land use and settlement patterns due to isostatic uplift, flash floods, extreme events, and drift sand are important factors to study. Especially as ongoing climatic changes likely will cause more coastal erosion along coasts worldwide. The use of non-intrusive geophysical survey methods has, in many cases, added an extra dimension to the research of fundamental archaeological questions concerning the use of space. In contrast, the time dimension has been more challenging to assess by non-intrusive methods. Geophysical surveys are increasingly used as part of the archaeologists' toolkit, as it also is a non-destructive way of mapping archaeological sites and larger landscapes. Furthermore, at coastal sites with an isostatic rebound, an approach based on 3D ground-penetrating radar (GPR) and digital elevation models (Lidar), could, in theory, provide new information on relationships between *continuity* and *breaks* in past human activities, as well as *space* – expressed through human occupation, and hence *time*.

This paper will present examples of large-scale, high-resolution geophysical investigations of areas with isostatical rebound from Denmark and Norway. The presented examples demonstrate how a better understanding of the temporal landscape development is achievable by combing data-heavy geophysical methods, remote sensing and dating in coastal areas. Such an approach will help understand how prehistoric people reacted to changes in coastlines in the past and gain a better 3D insight into the archaeological records of coastal sites through time.

**Keywords:** Archaeo-geophysics, Landscape archaeology, Coastal communities

## MULTIMETHOD GEOPHYSICAL SURVEY AT THE NEMOCÓN SALT MINE ARCHAEOLOGICAL SITE, COLOMBIA (ID 1320)

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Ancient salt exploitation sites present different methodological challenges for archaeological research. Surveys using test pits and/or surface collection can help in the delimitation of the site magnitude but will likely not locate specific activity areas. Nonetheless, understanding the concentration of materials and complex stratigraphy, as well as the general site magnitude, are the main challenges when considering areas for excavations.

Geophysical methods such as magnetometry, ground-penetrating radar, and other electromagnetic methods, often open new perspectives for the research on ancient salt production sites. We then designed a survey using geophysical methods looking for activity areas, the general magnitude of the ceramics deposit, and to decide the location for an

excavation area in the site of La Salina de Nemocón, located in Cundinamarca, Colombia. The archaeological site comprises a deposit of mainly discarded ceramic sherds, ashes, animal and human bones up to 12 meters deep, covering approximately 60 hectares on top of the salt mine.

In this study, we present the results from different geophysical methods (i.e., ground-penetrating radar, electromagnetic conductivity profiles, magnetometry, geoelectric), with the potential identification of different areas that might be related to fire pits and human burials, the integration of these methods, and their perspectives for the research on technological and social characteristics of the pre-Hispanic salt production in Nemocón and the Sabana de Bogotá, Colombia.

**Keywords:** Salt Production, Multimethod survey, Activity Areas

### TO SEE AMBIGUITY IN MAGNETOMETER DATA AND UNCERTAINTY IN ANOMALIES, HOLD INTERPRETATION AND ANALYSIS IN THE PALM OF YOUR HAND: THE MANY APPROACHES TO AUTOMATED ANALYSIS OF MAGNETOMETER DATA (ID 1321)

**Agnes Schneider** (Technische Universität Berlin/Leiden University, Berlin/Leiden, the Netherlands, Leiden, the Netherlands)

The aim of this presentation is to focus on the rationale behind the *modus operandi* of a recently started PhD project, which' subject is the automated analysis of magnetometer data. The PhD is part of an international, collaborative DFG funded project "The Late Antique and Early Islamic Hira – Urbanistic Transformation Processes of a Trans-regional Contact Zone". It focusses on the (semi-)automated analysis of two magnetometer surveys conducted in 2016 and 2021 at the site of al-Hīra, located in south-central Iraq.

Magnetometers record anomalies which emerge due to the contrast in the magnetic properties between the (archaeological) objects in the ground and the surrounding medium. These observed anomalies can be very complex because the various sources of magnetic anomalies such as soil particles, naturally occurring rocks, archaeological and recent objects might be in superposition, meaning they will be registered additively as a single signal of mixed origin. Also, objects that are deeper and display higher amplitudes can appear similarly to objects that are nearer to the surface but emit lower amplitudes.

This complexity creates ambiguity and uncertainty and affects magnetometer data sets on data, interpretation, and analysis level. The PhD is going to touch upon uncertainty on these different levels. Investigations to address uncertainty on data level (using magnetic susceptibility mapping) has been conducted in spring fieldwork season 2022 and the first results will be presented. Approaches to uncertainty on interpretation and analysis level using state-of-the-art Deep Learning architectures will be discussed.

**Keywords:** archaeological remote sensing, large-scale magnetometer prospection, automated analysis, magnetic susceptibility, Deep Learning architectures

### MAGNETOMETRIC AND SEISMOACOUSTIC INVESTIGATIONS OF A ROMAN ARCHAEOLOGICAL SITE LOCATED ON THE DANUBE RIVER SHORE (ID 1325)

**Sorin Anghel** (GeoEcoMar, Bucharest, Romania)

Sacidava archaeological site was an important strategic and military location in late antiquity and was part of the Scythian limes (the Roman frontier on the Lower Danube). The main objective of the magnetometric method applied in archaeology, as well as other non-invasive geophysical methods, is represented by the identification and mapping of anomalies in the basement that may be of archaeological interest. The two marine geophysical methods for an archaeological survey on the Danube river, used in this paper are: a morphological survey of the surface by means of the side scan sonar and the magnetic method. They also permit the detection of traces of ancient coastlines and submerged walls. The geophysical methods applied to underwater archaeology represent a standard of experimental research. In the magnetometric investigations, due to the angularity and size of the deposits, we considered that the zones with the magnetic field maximum intensity represent civil structures that could contain ceramic elements. The result of the GPR surveys can be exploited in a further, more elaborate, excavation and this specific method offer one of the best data resolutions, if not the best. Side scan sonar mosaic map are carefully analyzed to identify the archaeological targets and characterize their nature and size. In conclusion, the results showed that the combination of side scan sonar and GPR methods can better distinguish the archaeological target of interest from other artificial and natural objects.

**Keywords:** Ground penetrating radar, magnetometry, side scan sonar

## POSTERS

**COST ACTION SAGA (CA17131) (ID 312)**

**Carmen Cuenca-Garcia** (Norwegian University of Science and Technology (NTNU), Trondheim, Norway)

This poster will introduce our international research network. The poster will synthesise SAGA's vision and goals as well as its structure and goals. The poster will complement an oral presentation on SAGA activities and plans.

**Keywords:** COST Action SAGA, archaeo-geophysics, geoarchaeology, soil science, non-destructive methods

**ACCESSING THE HIDDEN URBAN HERITAGE: LARGE-SCALE MAGNETOMETER SURVEY OF THE LATE-ANTIQUITY AND EARLY-ISLAMIC AL-ĤĪRA (IRAQ) (ID 1209)**

**Agnes Schneider** (Technische Universität Berlin/Leiden University, Leiden, the Netherlands), **Rudolph Kniess** (Eastern Atlas GmbH, Berlin, Germany), **Sandra Kniess** (Eastern Atlas GmbH, Berlin, Germany), **Jochem Dorrenstein** (University of Groningen, Groningen, the Netherlands), **Burkart Ullrich** (Eastern Atlas GmbH, Berlin, Germany), **Martin Gussone** (Technische Universität Berlin, Berlin, Germany)

This poster is introducing first results of the collaborative research project “The Late Antique and Early Islamic Hira – Urbanistic Transformation Processes of a Transregional Contact Zone” funded by the DFG, a cooperation between the German Archaeological Institute, Technische Universität Berlin, Museum for Islamic Art Berlin and the Iraqi State Board of Antiquities and Heritage (SBAH) as local partner. In its framework a large-scale magnetometer prospection of 50 Ha was carried out south of the Najaf International Airport in autumn 2021 by Eastern Atlas.

The main objective of the magnetometer prospection was to determine the extent and gain insight into the settlement structure of the Late-Antique and Early-Islamic al-ĤĪra. For the prospection the ultra-light GNSS-controlled LEA MAX system (developed by Eastern Atlas) with ten Förster FEREX CON 650 fluxgate gradiometer probes was used, with a sensor spacing of 0.5 m and 0.1 m point distance.

The magnetometer prospection undertaken in 2021 – a follow-up of previous surveys (2015–2018) – produced rich results of a dense urban fabric and will be the base for further archaeological investigations. The analysis of the magnetometer results already interpreted manually will be enhanced by AI-based strategies of an automated analysis.

Beyond the scientific gain for the study of late antique and early Islamic architecture and urban planning, the results of the surveys are important arguments for the preservation of the areas that are highly endangered by modern land use.

**Keywords:** magnetometer prospection, cultural heritage management, non-destructive methods, historical urbanism