UNDERSTANDING THE ANOMALY – INTRODUCING THE NEW POLISH ROMANIAN RESEARCH PROJECT[1]

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Abstract: Articolul de faţă prezintă stadiul proiectului international Understanding the Anomaly-Castrele Romane din Banat. Acesta este un proiect româno- polonez, de fapt o continuare a cooperării între arheologii instituţiilor implicate, cooperare începută în 2014.

Keywords*:* Archaeological Geophysics, Soil Science, Roman Archaeology, Landscape Archaeology, Dacian Limes

1. Introduction

Polish-Romanian cooperation in terms of archaeological research in Banat region lasts from 2014. Back then, the "Tibiscum Project" was launched. It was conducted by the Institute of Archaeology, University of Warsaw (UW), in a cooperation with County Museum of Ethnography and Border Regiment in Caransebeş (MJERG) and West University of Timisoara (UVT). Michał Pisz was the Principal Investigator (PI) and late prof. Tadeusz Sarnowski was the scientific advisor. The project was funded from the resources of the Polish Ministry of Science and Higher Education within the framework of the Diamond Grant Program. The aim of that project was to rediscover the settlement landscape around the Roman fort of Tibiscum. Secondary goals were to perform a series of tests of aerial thermography as a tool for archaeological prospection and to create a GIS database for Tibiscum and its hinterland. All goals have been achieved and the outcome of the project have been published on a regular basis in Romanian[2] and Polish[3] literature and presented on domestic and international conferences. Recently, the concluding study has been published in a highly recognized international journal[4].

Fruitful Polish-Romanian cooperation has been continued within the framework of the research of the Roman fort in Pojejena. Prelimiary research, led by Michał Pisz, have been performed in 2016 and served as a background for a bigger project. "Pojejena Archaeological Project" was held in cooperation with National Museum of Banat in Timisoara (MNB) and County Museum of Highland Banat in Resita (MBM). Emil Jęczmienowski (Institute of Archaeology, University of Warsaw) was the PI, prof. Tadeusz Sarnowski and dr hab. Agnieszka Tomas were scientific advisors, Dr Calin Timoc and Dr Ana Hamat were responsible for this research from the Romanian side. Multi-method geophysical measurements, combined with remote sensing techniques, field walking survey and GIS spatial data analysis allowed a precise

1 This scientific work is financed by National Science Centre (Poland) within the Preludium 16 programme (grant number 2018/31/N/ST10/01782).

2 Pisz and Timoc 2014; 2015; 2016.

3 Pisz 2018; Pisz and Pospieszny 2015.

4 Pisz *et al.* 2020.

reconstruction of two phases of the Roman fort and reconstruction of its hinterland[5]. Moreover, it was possible to establish the precise extent of the area occupied by the buildings in the military vicus. and their degree of conservation in the conditions of overlapping of the area by the buildings of modern housing[6].

Currently, the new cooperation between UW, MBM, MJERG, MNB and UVT is established within the framework of the new project: "Understanding the Anomaly: Roman Forts of Banat". The project, held by the Faculty of Geology of UW is funded within the framework of the Preludium 16 program of the National Science Centre of Poland. Michał Pisz is a PI of the project, which focuses mostly on soil science and geology in relation with geophysical responses registered in conditions of the selected Roman forts in Banat.

2. Understanding the anomaly (UTA) project

The main aim of the UTA Project is focused on problems concerning the application and proper interpretation of geophysical measurements on archaeological sites set in diverse subsurface and hydrological conditions. It is quite common that geophysical methods are a significant, or sometimes even dominant tool in a modern archaeological research[7]. The development of geophysical tools, which have been redesigned over years to better fit the needs of archaeological survey, has been significant and it highly affected the role of geophysical methods in revealing the past landscapes. For instance, one of the first geophysical surveys for purposes of archaeological prospection in Polish archaeological practice took place in Novae, Roman legionary camp in Bulgaria, in 1965[8]. During the whole campaign, the team performed a total number of 590 single-level electrical soundings. Nowadays, according to Guidelines of English Heritage[9] and European Archaeological Council[10] the recommended sampling (horizontal resolution) of electrical resistivity measurements in archaeology should be not less than 1 × 1 m for evaluation and from 0.5 × 1 up to 0.5 × 0.5 m for characterisation purposes. It means that a measurement grid of dimensions 20 × 20 m consists of 400 up to 1600 electrical soundings. This kind of resolution greatly improves the quality of geophysical imaging, eases the interpretation of obtained data and extends the potential of the use of geophysical method in archaeological research. The comparison of various spacing patterns with the possibilities of detection and correct interpretation of archaeological object are presented in Fig. 1.

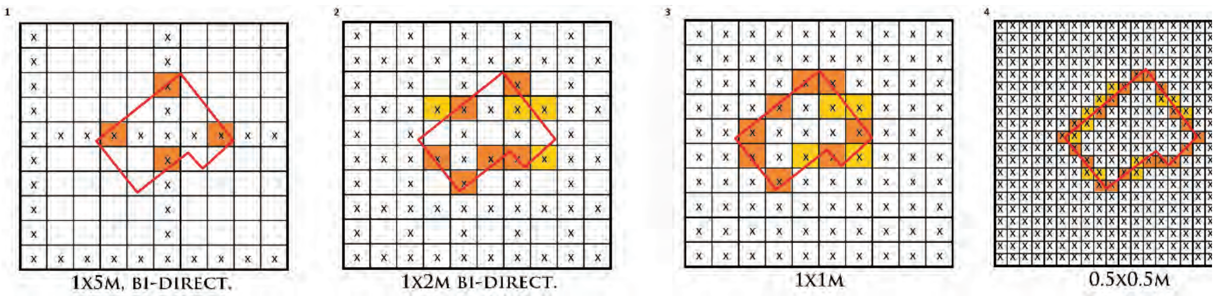

Fig. 1 – Comparison of detection possibilities of a potential archaeological structure (stone foundations – red outline) with various sampling. Dark orange squares indicate hypothetical high resistivity values, while light orange are supposed to be slightly higher resistivity values.

[5] Pisz *et al.* 2019; Timoc *et al.* 2018; Jęczmienowski 2019.

[6] Timoc *et al.* 2018, p. 63–64.

[7] Gaffney and Gater 2003; Clark 2003; Chapman 2006.

[8] Stopiński 1968.

[9] David *et al.* 2008.

[10] Schmidt *et al.* 2015.

Electrical resistivity is not the only method which got improved in terms of spatial resolution. One of the first magnetic measurements implemented in Polish archaeological research had a maximum spatial resolution of 1 × 1 m[11]. In this Project we assume the use of a modern, multi-channel gradiometer, providing maximum resolution of 0.25 × 0.02 m.

Sampling resolution is just one of many factors which changed the discipline of "archaeo-geophysics" over years. The instruments are becoming much more efficient, sensitive and easier to operate. Many of modern devices support a real-time sub-centimetre GNSS positioning, which allows to operate without staking out a grid in the field.

Nevertheless, geophysical methods still provide many challenges, either at the stage of taking measurements, as well as – or maybe most of all – during the interpretation of obtained data.

Geophysical methods are not a magic wand for detecting archaeological features. They deliver information about properties of various examined physical fields. Archaeological remains might have an influence on these fields and changing values registered with a proper resolution might indicate the presence of some types of objects. However, the effectivity of geophysical methods depends on contrasts between the buried objects and their surroundings. The question is, how to properly assess the estimated contrast and which methods choose for the best results?

Human activity in the past have left many footprints in the landscape. Some of them are plain to see, the other could be observed with a sophisticated instrumentation. The whole set of methods used for detecting archaeological traces is called archaeological prospection (Fig. 2). It consists of many tools, mainly counted into remote sensing or near-surface geophysics methods. Some of the remains could be detected with many different methods, some other are almost impossible to detect with any of them.

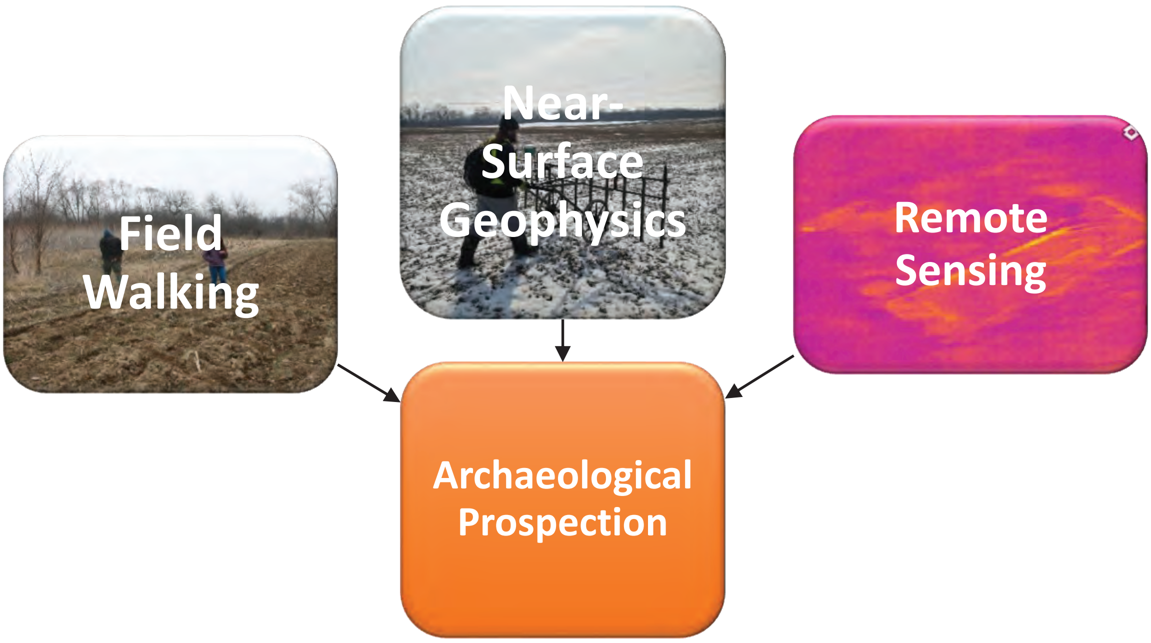

Fig. 2 – Main components of Archaeological Prospection

Physical properties of structures are not the only issue. The subsurface and hydrological conditions may affect the responsivity of geophysical methods in crucial way. The same kind of object, e.g. stone wall, might cause a negative, positive or dipolar magnetic anomaly. It might be

[11] Herbich 2011, p. 20.

well-detectable for earth resistivity measurements in loess subsurface, but also barely detectable in dry, sandy environment. The same situation could have an opposite impact on the GPR method.

The main goal of *Understanding the Anomaly Project* is to study the responsivity of various near-surface geophysical methods applied on certain archaeological sites and objects in an attempt to determine their responsivity pattern and interpretative key for using these methods in such particular conditions.

To achieve this goal certain methodological requirements have to be met. First of all, archaeological objects chosen for experiments must be similar, but differ slightly, according to natural environmental conditions. This assumption could be met by choosing a group of sites from one chronological period, the same cultural circle, but from the area which is geologically diverse. All of these conditions are met by Roman forts of Romanian Banat.

The Roman army forts selected for the research are representative archaeological sites and in the region they extend along two lines of defence which overlap two imperial roads. They connected the province of Dacia with Moesia Superior. The western line of fortifications was consisting of Roman forts Arcidava (Vărădia), Centum Putei (Surducu Mare) and legionary camp Berzobis (Berzovia). They were all constructed in the time of Trajan reign and first years of Emperor Hadrian. It is confirmed that they were used for a relatively short period and hence less construction phases were noticed on this sites[12]. Their short period of use is an important value from the point of view of architectural studies. No later intrusions provide an undisturbed image of early phase Roman forts in Dacia. The eastern line of Roman forts consists of Praetorium (Mehadia), Ad Pannonios (Teregova) and Tibiscum (Jupa). They might have been formed after the middle of the 2nd century. It is assumed that their stone architecture have been formed in the 3rd century. Some of them show traces from the 4th century AD[13]. All of them are located in Romanian Banat, Caraş-Severin county. Their location is depicted in Fig. 3 and 4. Most of these forts are very poorly researched. Their inner plans are incomplete or unknown.

The Roman forts are very interesting examples of buried archaeological objects from the point of view of geophysical prospection. They are all set in diverse subsurface and hydrological conditions. The geology of the region is also different for these sites, which resulted in using different building materials for constructing the structures by Romans. The evolution of the civil settlement in the vicinity of this forts it is also an interesting problem which could show the relation between human and environment in Roman times.

The proposed sites were carefully selected to be the subject of the research. The forts are set in different parts of Banat, representing the complexity of subsurface and hydrological conditions. The objects themselves are made of different kinds of stone, including igneous (e.g. dacite), metamorphic (slate) and sedimentary (limestone) rocks. This diversity was due to the nearest sources of stone in the vicinity of the forts. This wide representation of natural conditions provide a perfect, diverse case study over the geophysical responsivity on Roman archaeological sites.

Most of the Roman forts were constructed according to a common set of rules so regardless their size and location, they all should be comparable. Romans used the most common materials which could be found in the vicinity of a construction site. Therefore, in the river valleys the structures might be made of cobble; in the mountains we could find walls made of igneous, metamorphic or sedimentary stone blocks, obtained from the quarries located in the neighbourhood. Regarding the extraordinary geological heterogeneity of Banat region, we could find

12 Nemeth *et al.* 2011, p. 333–34.

13 Benea 2016, p. 326.

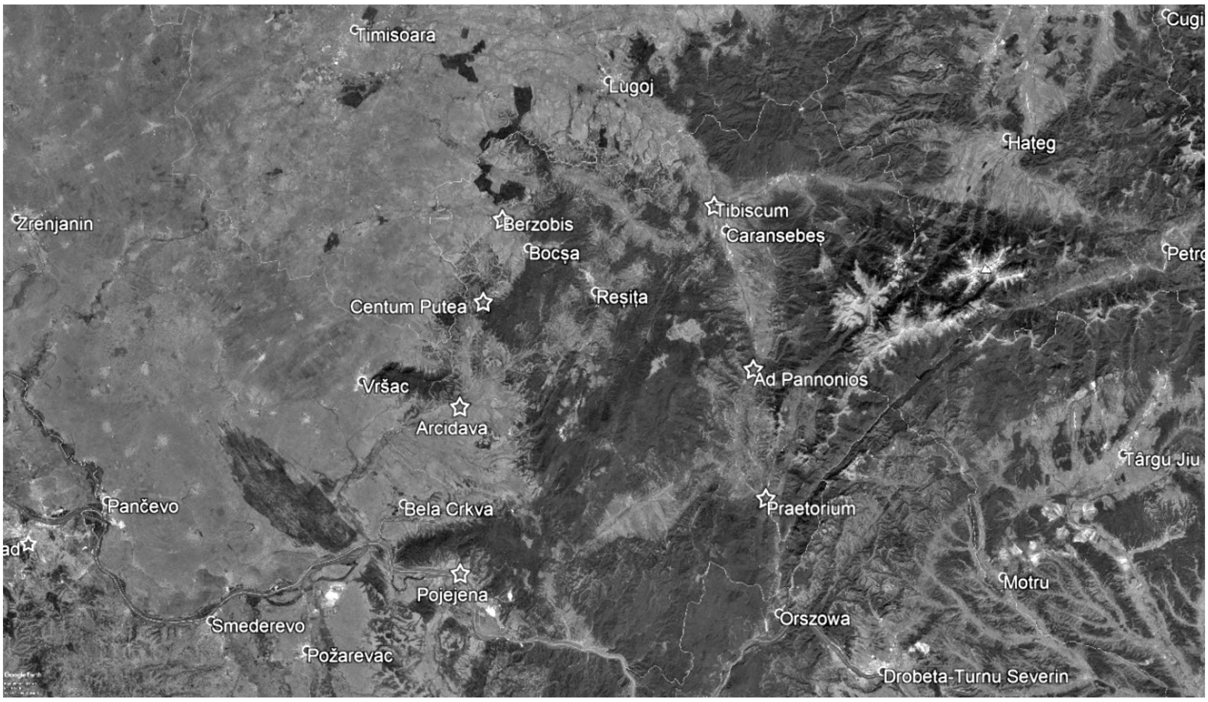

Fig. 3 – Seven Roman forts are marked in the map with stars. The forts labelled with yellow font will be a subject of research within UTA Project (Arcidava, Centum Putea, Berzobis, Tibiscum, Ad Pannonios, Praetorium). (Map created with Google Earth).

all of the examples mentioned above in the proposed research area. Furthermore, stone construction materials and the subsoil are not the only features which might be detected with geophysical methods. For instance, burnt rooftiles, one of the most common artefacts on Roman sites, can cause a thermoremanent magnetic anomaly[14]. The same situation concerns kilns, hearths or conflagrated structures and areas. Strong thermoremanent magnetic anomalies could distort and overlap slighter anomalies caused by lower-dynamic features. The proposed research would aim at delivering answers about the relation between the expected and actual output of geophysical measurements, regarding the state of knowledge about the archaeological objects and subsurface and hydrological conditions at the stage of planning the research. Also, where applicable, the ancient settlement landscape reconstruction can be proposed, as the outcome of our research[15].

The other important question about the proper use of geophysical methods in archaeology is the depth of the objects and the depth of anomalies. Some of the methods used in archaeological geophysics are just 2-dimensional, like magnetometry or magnetic susceptibility. The others, like multi-depth earth resistance pseudo-sections are pseudo–3-dimensional, while earth resistivity tomography or GPR done with high enough spatial resolution might deliver a full 3D datasets, while processed properly. Another goal of the project would be to find the best, most efficient, time-efficient and cost-efficient solutions for archaeological prospecting purposes which could then be proposed as a guideline for future archaeological research and cultural heritage management.

The research may bring additional observations which could be very valuable. The first one is a study on the post-deposition processes and their impact on the state of preservation of the

[14] Fassbinder 2015, p. 87.

[15] Compare with similar works for Roman Forts from Djerdap region; Ivanisevic, Bugarski, and Stamenkovic 2016.

settlement. During the surveys we would try to determine the scale of destruction of the site by environmental and anthropogenic factors. Observation of these processes might be an information about which geophysical methods fit best for this purpose and what are the exclusions for their implementation. The involvement of combined academic disciplines (geophysics, geology, archaeology, remote sensing, geomorphology, cartography) would be the effective way to estimate the degree of damage. The results are also intended to be a contribution for developing the strategy of preservation of the endangered archaeological sites, which are so important, both culturally and scientifically.

Last but not least, the results of the survey would shed a new light on previously poorly recognized archaeological sites. The outcome of the research will serve for reconstructing the archaeological settlement landscapes of surveyed forts. Many of these sites are endangered by nature or human activity, including illegal diggings. The results of the geophysical measurements may bring corrections or even substantial changes in the state of knowledge. There are many examples of successful implementation of non-destructive methods in a research over settlement landscapes around Roman military bases and adjacent settlements. Surveys made in Carnuntum, in present Austria[16] or Novae in Bulgaria[17] where the location of the legionary fortress and the *canabae* has been established, might be mentioned.

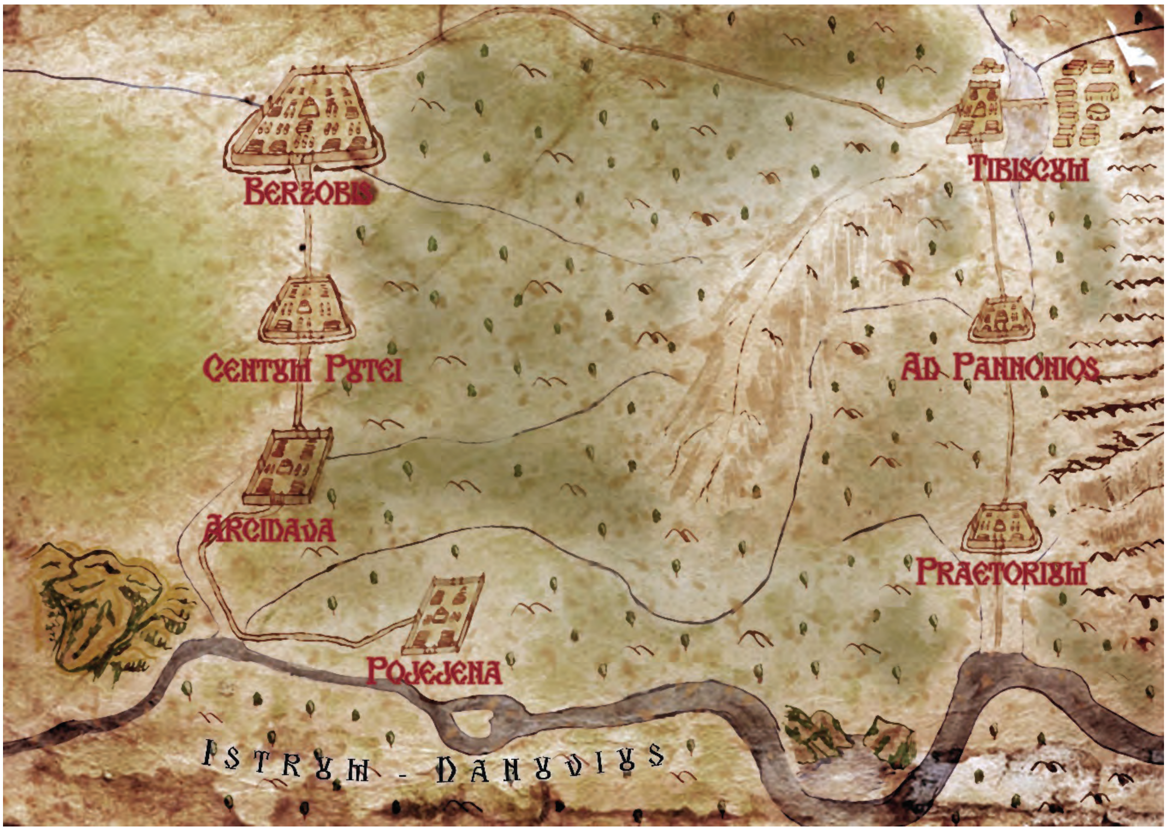

Fig. 4 – An artistic map of the region with seven Roman forts marked on it. Author: Patrycja Pichnicka

3. Significance of the project

Non-destructive methods in archaeology are getting more and more popular over years. Among them, geophysics is one of the most popular and fastest-developing methods. Geophysical

16 Doneus *et al.* 2013.
17 Tomas 2017.

equipment becomes more and more popular and easy to use. The unfortunate aftermath of this development is that sometimes geophysical instruments are operated by briefly trained personnel.

The importance of a presence of a geophysicist in the archaeo-geophysical works is a topic of an academic discussion nowadays. The data interpretation process requires at least some basic knowledge about the principals of operation of geophysical methods. On the other hand, interpreting of archaeo-geophysical data requires as well some basic knowledge about the archaeological objects. The scientific results of the project could be an important contribution to the interpretation of geophysical anomalies registered on Roman sites in conditions of Banat region and beyond. The project assumes a thorough study over the relation between registered geophysical signals and the objects and features, causing particular anomalies. One of the qualitative effects of the project would be a published "Atlas of the anomalies". Anomalies registered with various methods, laboratory analysis results and excavated features will be presented.

The project might have an impact on various aspects also for archaeologists. Reconstructing the settlement landscape of a few of the most important sites in this part of Roman Dacia seems to be a necessary step in the workflow of the further studies about the history and material culture of the province. The forts chosen for conducting the survey are one of the least recognized Roman forts in Romania. Geophysical measurements will probably reveal features and structures which haven't been known previously. Not just the architectural remains could be traced, but also other elements of infrastructure, like roads, aqueducts, quarries, as well as graveyards or remains of rural settlement. This might be an important contribution in the studies on the land use by the army and the civil settlers of Roman Dacia, as well as on the conceptualization of the landscape by ancient populations.

Another aspect is heritage management. Estimating a scale of destruction on the site by natural and anthropogenic factors may be very helpful in developing a protection strategy for these unique archaeological sites. Geological studies might help to reconstruct the processes which harmed the sites (depth of ploughing, erosion, etc.)

We strongly believe that the project could have an impact not only on the state of the knowledge on the application of geophysics on archaeological sites of Banat, but also on other, analogical sites in the Roman frontier provinces. The project has a chance to show the importance of geophysical methods and geological studies in archaeological sites evaluation, both in Poland and Romania, and prove the potential of multi-method, large-scale geophysical surveys. Satisfying results of the research can be another prove of how important can be the role of remote sensing in discovering of the past.

4. Methodology

The plan of the research is precisely developed, as the scientific problems have already been appraised during the PI's past research in Tibiscum and Pojejena. In the meantime, the plan has been thoroughly consulted upon with the Project's advisor, Romanian partners, archaeologists, geologists and geomorphologists.

The project is an interdisciplinary research, structured around the application of geophysical measurements, remote sensing methods and geological survey in archaeology, focused on recording of geophysical anomalies and interpreting the source of the registered signals, basing on analysis of the environmental conditions. The underlying scientific methodology of this project could be defined as an interdisciplinary study over methodology of geophysical measurements in landscape archaeology research approach. It is mainly focused on acquiring different types of geophysical (and other spatial) data, gathering them together in a GIS database and analysing them[18]. These analyses would be focused on answering particular scientific and archaeological questions, therefore, a precisely predefined set of methods and instruments would be involved in the project.

Fig. 5 – Magnetometry survey in Pojejena (2018) with the use of multi-channel SENSYS MX V3 magnetometer. Wiktor Rutkowski behind the bar.

We assume the implementation of a large variety of geophysical methods. Basically, all the instruments which are accessible to be used in the project, will be deployed, either as a base-method or as an experiment (like Seismic Refraction Tomography).

– Magnetometry[19] (Fig. 5) belongs to the group of passive geophysical methods. The measured value is the naturally occurring Earth's magnetic field and there are no additional physical parameters introduced into the environment when measurements are taken. Magnetometers are very sensitive to deviations in the strength or gradient of the magnetic field, and provide high spatial measurement resolution (up to 0.25 × 0.05 m) and speed. The magnetic method detects objects which disturb the Earth's magnetic field with their own ferromagnetic properties. This method is usually effective in cases of thermoremanent anomalies and objects which contain more or less iron oxides than surrounding soil. This can include the fills of archaeological features such as pits and ditches, as well as buried architectonic remains. The success of the implementation of the magnetic method – just like with all the other geophysical methods – depends on there being sufficient contrast between magnetic properties of the objects and their surroundings.

[18] Chapman 2006.

[19] Aspinall *et al.* 2008; Clark 2003; Gaffney and Gater 2003; Schmidt *et al.* 2015.

– Earth Resistance and Electrical Resistivity Tomography[20] (Fig. 6) are active geophysical methods, which means they require introducing an electric field into the examined environment. Once introduced, the current resistance or resistivity is measured at the given point. When the current flows through the objects or layers of higher resistance (like gravel, dry sand, stones) the registered resistance is usually high, while materials like clay or alluvia produce low resistance anomalies. Measurements can be performed as 2D profiles, planar maps of spatial distribution of the anomalies or 3D modelled anomalies. The maximum depth of penetration depends on the electrode array employed, but is usually set from 0.25m up to a few meters deep. The method is considered to be very efficient in detecting bigger structures, like architectural remains, but not to be the best choice for detection of objects or features smaller than 0.5 meter, like postholes. The measurements are usually taken on a grid of 1 × 1 or 1 × 0.5 m spatial resolution.

– GPR (Ground Penetrating Radar)[21] is an active geophysical method, where a set of two antennas – transmitting and receiving – emits an electromagnetic wave into the ground (usually with a 10–1000 MHz frequency). The wave breaks and reflects from different discontinuities within the ground. Some of the impulses are reflected from the structures in their way, some keep on penetrating deeper, which enables registration of the patterning of layers and objects, but only when these layers differ from each other in their dielectric constant. GPR provides very high resolution of the measurements along the measured profile, and the separation distance between subsequent profiles depends on the desired spatial accuracy. The depth of penetration is dependent on the antenna's frequency. The higher the frequency is, the better is the resolution, but the more shallow the depth of penetration. The results of the GPR survey are frequently processed into 3D composites and rendered out as "time-slices", which are 2-dimmensional planar maps of the distribution of reflexes. The success of a GPR survey depends on the type of subsoil – highly conductive materials would cause a loss of signal.

– Magnetic Susceptibility[22] determines the ability of materials for time magnetization. The field magnetic susceptibility survey is usually undertaken by collecting soil samples for subsequent magnetic susceptibility measurements in the laboratory. In Low Frequency Electromagnetic Survey (LFEM) specific magnetic susceptibility field coils may be used to measure the values *in situ*, which is usually referred to as magnetic susceptibility survey. The method is useful in pointing out greater susceptibility of topsoil compared with the underlying layers, as well as the enhancement of it by the activities of human occupation. Both field and laboratory measurements could be taken with a Magnetic Susceptibility Meter. In the practice of archaeological prospection it is usually used for large scale coarse field recognition with the field probe or laboratory analysis of soil samples with the sample probe (Clark 1997: 99–117; Schmidt *et al.* 2015: 15–16).

– Seismic Refraction Tomography[23] is a measurement of propagation of seismic wave introduced to the ground. Typical applications for seismograph instruments are depth to bedrock, bedrock quality, soil stability studies, finding fractures and weak zones, and geological mapping. In all these applications the seismograph is triggered by ground vibrations created by an energy source. Time is then measured accurately until the ground vibrations have propagated through the ground and can be measured by geophones connected to the seismograph. SRT method is not often used in archaeology, mostly due to its costs and not many references for effectivity of

20 Gaffney and Gater 2003; Schmidt 2013; Schmidt *et al.* 2015.
21 Conyers 2013; Gaffney and Gater 2003; Schmidt *et al.* 2015.
22 Clark 2003, p. 99–117; Schmidt *et al.* 2015, p. 15–16.
23 Clark 2003.

the method, hence the implementation of this method in the project would have an experimental character.

– Remote Sensing is a technique of remote data acquisition concerning objects or phenomena with the use of various types of sensors. It is applied in many fields, including archaeology. Beside geophysical measurements, remote sensing is also performed with aerial and space imagery. Recently, Unmanned Aerial Vehicles (UAV's, drones) are used for recording archaeological sites from the air. 3D photogrammetry software allows researchers to process the sets of aerial pictures into metric orthophotomaps and to generate precise Digital Terrain Models.

Fig. 6 – Electrical Resistivity Tomography measurements in the area of eastern gate, Pojejena (2019). Radoslaw Mieszkowski setting the instrument.

The geophysical methods presented above are complementary, which means that they are testing different properties of the surveyed environment, allowing a better chance of detecting a wide range of archaeological features. The complementary use of geophysical methods in a non-destructive archaeological survey is considered to be the best solution to achieve satisfying results. For example, while some objects, or parts of objects might produce magnetic anomalies (like brick-made buildings, kilns, hearths, etc.), the others (like walls made of non-magnetic stone buried in non-magnetic soil) might be "invisible" for this method, but are clearly detectable with other methods, like earth resistance or GPR. The workflow assumes performing the most extensive and large scale measurements (i.e. magnetometry) first, and then performing complementary measurements with more precise methods in areas of particular interest.

This project assumes interdisciplinary studies to achieve its goals, but beside involving geophysical methods, remote sensing and GIS, geomorphological and geological survey would be also an important part of the research. The main aim of this part of the project would be a study on the samples collected in the field. Laboratory analysis will help to determine the possible sources of the registered noise and let to conclusions about the most optimal methodology for this kind of research.

Fig. 7 – Joanna Szarkowska collects the soil sample from a bore hole, for further analysis.

The material from selected core samples (Fig. 7) will be taken for further laboratory analysis. It is assumed to perform the following analyses, where applicable:

– Granulometric analysis with aerometry which could help to determine the type of sediments, its type and origin; it will be an important data for comparison of GPR, ER and SRT measurement results;

– Rounding and Frosting analysis of quartz grains in the 0.8–1.0 mm or 0.5-0.8 mm fractions according to Cailleux methodology with later modifications, which allows the determination of the climate conditions, source of deposits and the conditions of transport and deposition;

– Organic Carbon Content (TOC) analysis, used to determine the organic matter content in sediments and indirectly to indicate changes taking place in the environment eg. deforestation or human activity;

– Magnetic Susceptibility with the use of Bartington MS3 susceptibility meter may identify whether under the layers of the hypothetical point bars there still are some remains of a highly-susceptible ancient land surface. The laboratory susceptibility analysis will help to determine the source of magnetic contrasts between archaeological objects and surrounding soil;

– Pollen analysis, which would help to determine the climate conditions prevailing during the deposition, vegetation changes and human impact on vegetation

Furthermore, the results of geophysical survey, conducted within this project, would require verification. Again, geological drillings provide core samples which could be tested for magnetic susceptibility, to prove relationships between the stratigraphy of the layers and periods of human presence in the area in the past. Palynological analysis of soil samples from the cores will also be conducted. Palynological analysis could bring to light interesting information about the settlement's environment, for example which types of trees or plants had grown in the neighbourhood[24].

[24] Tomas 2017, p. 54–55, 70–73.

The final, but by no means least important task would be creating of Digital Terrain Models of sites. In this case the drone 3D photogrammetry will be used. All selected sites will be covered with vertical aerial photographs. Subsequently, the obtained photographs would be processed in photogrammetry software, which would allow us to obtain a DTM (Digital Terrain Model) of a very high accuracy (horizontal resolution < 10 cm per pixel). Based on this model, a field verification will be conducted, with the possibility of some additional core drillings, which could bring some information about the post-deposition processes which might have influenced the objects.

All of the studies described above should provide the data which would allow a reconstruction of parts of natural landscape, which was an essential part of the settlement landscape[25].

5. Perspectives and expected research outcome

The UTA Project has been severely impacted by the outbreak of SARS-CoV2 virus in the beginning of 2020, what effected in COVID–19 pandemics. The initially planned six field campaigns would probably be not possible to conduct in the initially planned schedule. Due to numerous restrictions and health precautions, the number of field expeditions has to be limited to the necessary minimum. Despite this situation, the first field campaign took place in the Autumn of 2020. It was mostly aimed at collecting general data of the sites, including topographic survey and aerial pictures (Fig. 8). We hope that the situation in the following years would allow us to continue the research. We intend to gather enough data to draw final conclusions accordingly to assumed research goals.

The final conclusions of the study are hoped to be presented as a synthesis of the results of geophysical, geological and archaeological research. As the results are aimed to be an important contribution to the international practice of geophysical prospection in archaeology, the main outcome of the research will be published in a geophysical journal.

The "side effect" of the research on geophysical methodology and soil science will be a large set of archaeological spatial data. We intend to provide a precise location of archaeological remains for each of chosen archaeological sites. Some of the structures excavated back in the end of the 19[en] century and beginning of the 20[te] century lack precise topographical documentation. Some new contribution in this field is expected to be made particularly for Arcidava (Vărădia), Centum Putea (Surducul Mare), Berzobis (Berzovia), Praetorium (Mehadia) and Tibiscum (Jupa)[26].

This data shall serve as a basis for creating a holistic publication which could shed a new light on the military Roman installations in the Banat part of the Dacian Limes. The outcome of the prospection will be an important set of information for archaeologists. It will help to better understand military problems of this Limes sector, estimate the size of the garrisons and historical events related to them.

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[25] Chapman 2006, p. 113–28.

[26] Borza 1943, p. 60–66.

Fig. 8 – Remains of the Roman fort in Surducu Mare. Western corner of the fort is visible as overgrowing bushes. Bird's eye view in East direction.

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