

Various use of geophysical measurements during new archaeo-hydrological project along the Jizera river, Czech Republic

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Abstract

The new archaeo-hydrological project has been based on the combination of old and new archaeological and hydrological data from riverine cultural landscape of the Jizera river. The role of geophysical methods is additional terrestrial survey along the river banks, inside of flood plain areas or on settled or enclosed terraces.

Keywords

bathymetry; geophysical survey; hydrology; river archaeology; underwater archaeology

Introduction

The new project “Riverine cultural landscape of the Jizera river from the Mesolithic to the Early Middle Ages in the light of archaeological resources and hydrological data” has been supported by the Grant Agency of the Czech Republic since 2022 (Machová et al. 2022-2024; project no. 22-05413S). The project is based on wider interdisciplinary cooperation of different specialists from the Institute of Archaeology in Prague and the Czech University of Life Sciences, Faculty of Environmental Sciences.

Goals and methods

The archaeological goal of the project is based on a large-assessment of archaeological structures surrounding the Jizera River and the study of the relationship of past societies to various parts of this watercourse. Comprehensive understanding to riverine cultural landscape and land-use requires a wide range of interdisciplinary methods, such as bathymetric measurement (Hradilek et al. 2015), hydrological modelling, underwater archaeological research

(Machová 2017; Machová 2021), historical river banks reconstructions, dating methods (dendrochronology and 14C) and also particular geophysical prospections. Three working packages (WPs) were defined for this three-years project.

Geophysical surveys belong to WP1 (Cultural and historical development of the settlement pattern surrounding the Jizera River and elements of the Jizera riverine cultural landscape), where their close integration with other field research methods (bathymetric measurement, underwater archaeological research, archaeometric analyses, dendrochronological dating etc.) is assumed. The most intensively applied geophysical method was an areal magnetometer verification survey with a five-channel Sensys fluxgate gradiometer array in a network of 0.5×0.2 m along the banks of the Jizera River especially in places with positive indications for settlement and other activities derived from aerial photographs. Additional near surface resistivity measurement (RM-15, Geoscan Research) were planned in particular areas of archaeological sites, i.e. rampart fortifications of hillforts, supposed places of



Fig. 1: Example of typical agricultural landscape area along the middle part of the Jizera River from aerial photography in 2020 compared with a segment of an old map of the second Austrian military mapping from the middle of 19th century (source: www.mapy.cz; © GEODIS BRNO, s.r.o. and © 2nd Military Survey, Austrian State Archive).

abandoned communications to flood plain area or across the river. Further, additional ERT profile measurements are planned in places of old meanders.

The test magnetometer measurements inside of flood plain areas also announced possibility of identification of old meanders on levelled meadows (Fig. 3).

Results

In the first year of field surveys of the project, an archaeologically and hydrologically perspective (modernly uncontaminated) parts of the watercourse and floodplain of the Jizera River were selected. For future interdisciplinary research, several sections of the river with a close connection to a certain type of prehistoric or early medieval settlement were selected (Fig. 2). From some parts along the river exists earlier archaeo-geophysical results and experiences (i.e. Neolithic roundel and settlements near Benátky nad Jizerou – Křivánek 2004; Křivánek 2006). New magnetometer results from the first year of the project showed wider possible use of prospection in case of various hillforts, their additional communications to the river, different enclosed or settled areas overlooking river area. Some situations were also repeatedly verified by resistivity measurements.

Discussion

The choice of geophysical method in such a project is dependent also on the selected part of the riverine cultural landscape and character of present land use. Magnetometer survey in forested terraces with fortified or unfortified settlement is sometimes very restricted. But in case of fortifications, enclosures or expected abandoned communication ways to the river, we can combine it with resistivity measurements. Magnetometer survey seemed also useful in verification of places of old meanders in the flood plain area. This type of riverine situation is also planned to be verified by additional ERT profile measurements.



Fig. 2: Example of Lidar map along the middle part of the Jizera River and the main archaeological sites with clear relation to the riverine landscape. 1 - Middle Age stronghold Hrušov, 2 - Prehistoric settlement, 3 - Bronze Age and Early medieval hillfort area, 4 - Late Bronze Age and Hallstatt hillfort area.

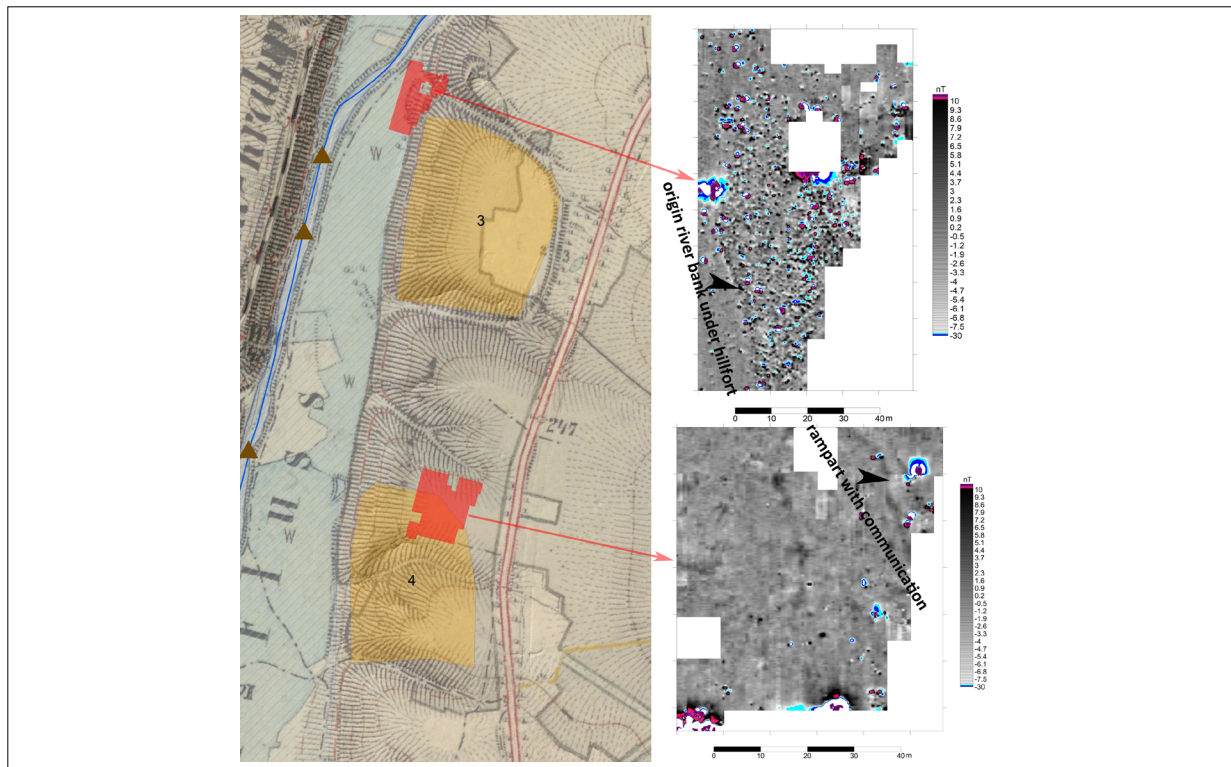


Fig. 3: Example of particular fluxgate magnetometer measurement inside a flood plain area and on lower terraces of the river combined with segment of the third Austrian military mapping.

Conclusion

A new archaeo-hydrological project is based on wider interdisciplinary cooperation of many field prospection and research methods. Application of geophysical measurements is then connected with particular archaeological and other questions primary focusing on the character, intensity or extent of archaeological activities along the river banks of the Jizera River. The first results showed that the different geophysical methods can efficiently be used for different archaeological sites and/or the identification of defunct meanders or communications in the flood plain area.

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References

- Hradílek V, Bašta P, Vizina S, Máca P, Pech P. Verification of remote sensing data for measuring bathymetry on small water reservoirs. In SGEM Proceedings 2015: 1219-1226.
- Křivánek R. 2.3. Geophysical prospection. New perspectives for settlement studies in Bohemia. In: Gojda, M. (ed.) et al., Ancient Landscape, Settlement Dynamics and Non-Destructive Archaeology - Czech research project 1997 -2002, Academia 2004: 39-71.
- Křivánek R. Magnetometric prospection of various types of large ditched enclosures in Bohemia. Archaeological prospection vol. 13/1, Wiley InterScience, Gaffney, C. - Aspinall, A. - Conyers, L. B. (eds.), University of Bradford 2006: 25-43. doi: [10.1002/arp.264](https://doi.org/10.1002/arp.264)
- Machová B. Watercourse and water area archaeology. Options of underwater archeology in different underwater environment in the Czech Republic. In: Borke, Ch., Skylis 15/2. Zeitschrift für maritime und limnische Archaeologie und Kulturgeschichte. Großschönau: Deutsche Gesellschaft zur Förderung der Unterwasserarchaeologie e.V. Erlangen (DEGUWA), 2017: 205-211.
- Machová B. Říční archeologie na rozcestí: ohlédnutí se za minulostí a úvaha nad budoucností archeologie pod vodní hladinou v České republice. Živá archeologie: rekonstrukce a experiment v archeologii. 23(2021), 2021: 31-35. Czech.
- mapy.cz [Internet]. Praha: Seznam.cz, a.s., Praha 5 - Smíchov; c2022 [cited 2022 Aug 23]. Available from: <https://www.mapy.cz/>.