Archaeologia Polona, vol. 53: 2015, pp. 472-476

"Atypical" use of combinations of geophysical methods for archaeological heritage preservation in the Czech Republic

Roman Křivánek[a]

KEY-WORDS: geophysical survey, non-destructive archaeology, archaeological heritage preservation, medieval siege camp, flood plain area, archaeology of castle parks and gardens

INTRODUCTION

The scope of long-term application of geophysical methods at the Institute of Archaeology in Prague is fully subordinated to ongoing or planned research and current archaeological projects. Separate funding of non-destructive research projects is rare and limited to threatened sites of recognized cognitive importance. In recent years, however, new applications of methods have been tested outside of big projects and with only limited funds (internal institutional plan AVOZ80020508, institutional support RVO67985912, regional cooperation R300021241). These applications have demonstrated the wider opportunities for monitoring less conventional archaeological situations and terrain which is difficult because of the ground relief or specific geological conditions.

GROUND CONDITIONS AND GEOPHYSICAL METHODS

The paper presents examples of geophysical monitoring or study of specific archaeological sites, monuments and terrain, documenting the different possibilities of the methods. In all of the case studies, it was necessary to apply more than one geophysical method, often producing different information depending on the actual conditions in the field and the type of archaeological situation. A five-channel magnetometer Magneto-Arch with fluxgate gradiometers FMG-650B (Sensys) was used for magnetic research. For geoelectric resistivity surveys the instrument used was a RM-15 (Geoscan Reseach), mainly in a Wenner probe array (A0.5M0.5N0.5B or A1M1N1B) and for profile radar measurements a Cobra-wifi II radar (Radarteam). Clearer and more probable interpretations of observed situations were possible thanks to a combination of methods and sufficient collections of archaeological material.

EXAMPLES OF RESULTS

Geophysical survey of a medieval siege camp

Siege camps are relatively specific archaeological sites with typical short-term and temporary usage, only in connection with a military event. From the point of view of prospection methods, it is a site with many probable metallic remains, disturbances, but with less probable presence of deeper situations. In many cases, the original ground relief has undergone change, having

[a] Institute of Archaeology, Academy of Sciences of the Czech Republic, Prague, Czech Republic

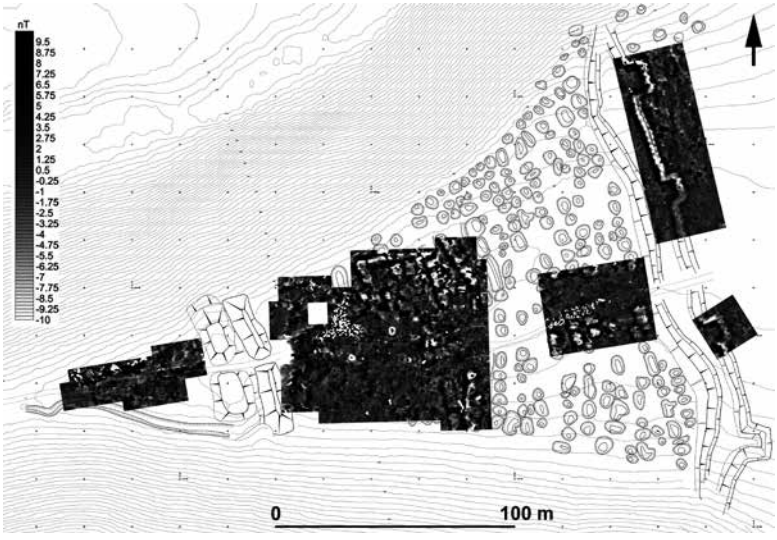

Fig. 1. Prague-Kunratice. Compiled new plan of the Hussite siege camp and magnetic map (Plan courtesy of the National Heritage Institute in Prague; total surveyed area approx. 0.91 ha; geophysical survey, R. Křivánek 2014)

been ploughed or afforested, some have been forgotten or are now inaccessible. Variously dated landscape changes also seem to be problematic for interpretation.

A new geophysical survey of the grounds of the Hussite siege camp in front of the conquered castle of Nový Hrad (1420/1421) in Prague-Kunratice was conducted as an experiment to see what kind of results can be achieved with non-destructive methods in a forested area. The remains of fortifications and the internal frame of provisional dwellings are still easily discernible on the ground. The survey was carried out in cooperation with archaeologists from the National Heritage Institute in Prague (Kypta and Podliska 2014). Suitable areas for magnetic and additional resistivity surveys were chosen in relation to the old archaeological probes from the 1950s and the ground topography. Linear magnetic anomalies inside the camp enabled demarcation of the built-up area with sunken dwellings (huts and tents, many with burnt materials or metals inside) and isolation of spaces with different function without sunken features (Křivánek 2014: Fig. 1). The combination of magnetic and resistivity results covering the perimeter fortifications distinguished different materials in the structure of the rampart nearest to the castle. The results also indicated activities outside of the bastions on the opposite side of camp. Geophysical results from different places within the camp confirmed the variable state of archaeological subsurface preservation.

Geophysical survey of sites situated in flood plain areas

Settlement typical of the many lowland areas of the Czech Republic is an intensive polycultural occupation, often closely linked to the presence of the most fertile soil. A relatively

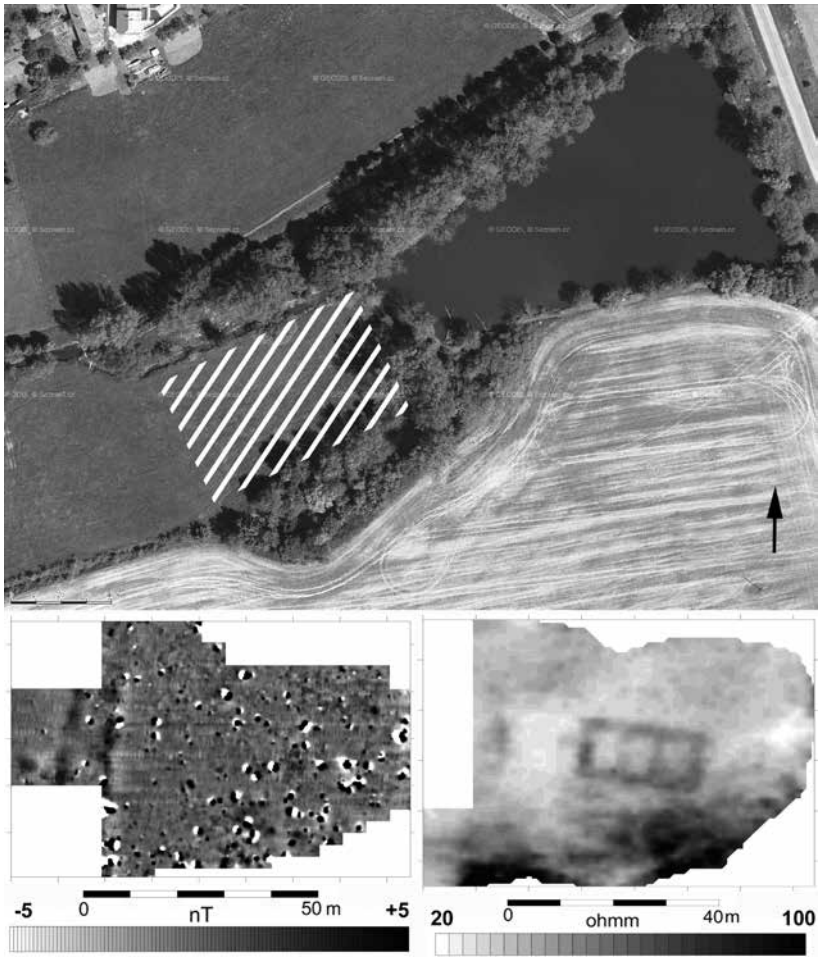

Fig. 2. Neumětely, district Beroun. Aerial image of the site with extinct stronghold (top) and the results of magnetic (bottom left) and resisitivity (bottom right) surveys (source: *http://www.mapy.cz*; surveyed area approx. 0.3 ha; geophysical survey, R. Křivánek 2014)

dense river network played an important role in the selection of a suitable area for settlement. Dramatic and repeated changes in water flows and land use have resulted in parts of settled areas being currently situated in repeatedly flooded areas, making geophysical prospection, not to mention archaeological investigation, hardly easy. Changes of ground water level, variability of sediments, soil erosion and variable accumulation processes can affect significantly the results of geophysical methods. A combination of geophysical methods is essential (without guaranteeing success).

A geophysical survey of an extinct medieval stronghold near Neumětely in central Bohemia (14th/15th century AD) provides an example of efficient combining of three methods (mag-

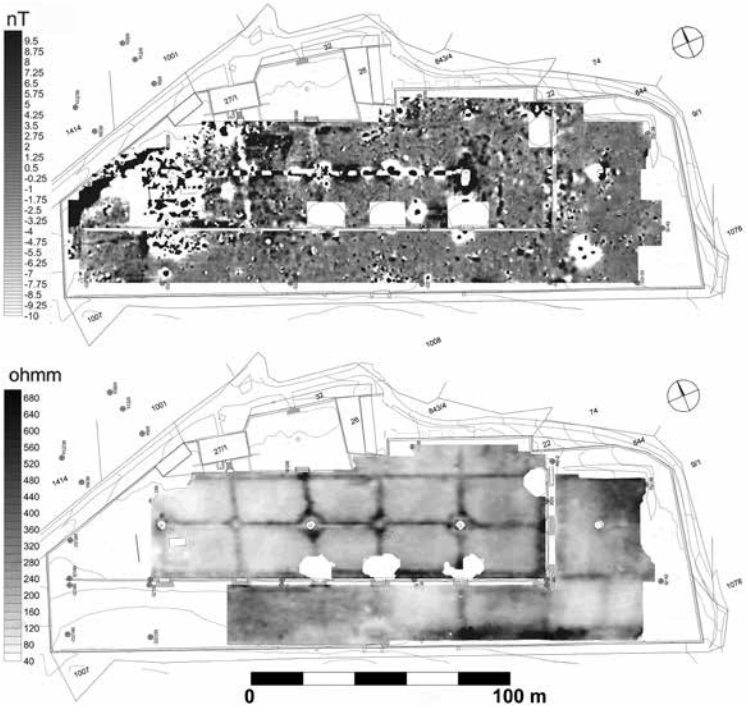

Fig. 3. Breda castle near Lemberk, district Liberec. Combination of a new plan of the gardens and the results of, respectively, magnetic (top) and resistivity (bottom) surveys (source: National Heritage Institute in Liberec; surveyed area approx. 1.15 ha; geophysical survey, R. Křivánek 2014)

netometry, resistivity, GPR). The stronghold was situated originally on an island set in a lake; later the site changed to a promontory jutting from the bank. A magnetic survey helped to identify the original water channel or ditch, but resistivity measurements isolated the subsurface remains of a structured building and the position of another site of stone collapse (Fig. 2). GPR profiles across the identified building verified the limited thickness and shallow depth of the preserved remains of the stronghold.

Geophysical survey of castle parks and gardens

There are several examples from the Czech Republic of the application of geophysical methods in the exploration of castles, but little survey work has been done on castle parks and gardens. In recent years, it has been possible to broaden the experience by cooperation with some departments of the National Heritage Institute. Different geophysical techniques had to be used to satisfy the different heritage goals.

The abandoned Breda castle gardens near the Lemberk castle in north Bohemia (second half of the 17th century–end of WWII) offers an excellent opportunity to observe the different possibilities and results of the applied geophysical methods (magnetometry, resistivity, GPR).

The magnetic survey results have confirmed the existence of a water distribution system with remains of fountains, but in the northern part it was possible to identify only high magnetic contamination with metals (modern greenhouse destruction). The resistivity survey results surprisingly revealed elements of an abandoned castle garden, the high resistivity anomalies being evidence for an extinct system of garden roads, and the low resistivity anomalies for former flower beds (Fig. 3). Some of the identified situations were probed in recent years for the purpose of verification (National Heritage Institute in Liberec, Tišerová). The profile GPR measurements were carried out during archaeological investigations to verify the depth of metal water distribution pipes, as well as the presence of other extinct buildings or subsurface remains in the castle garden.

CONCLUSION

Geophysical methods are used in the long-term for monitoring settlements, enclosures, hillforts, burial cemeteries or production areas, especially in open (mainly agricultural) land. There is a much greater variety of different types of archaeological situations or anthropic activities, as well as the specific conditions of their preservation in the landscape. Some of these specific activities can also be identified in the geophysical results, but one should be aware of a potentially greater margin for error. The application of a single geophysical method may and/or may not achieve the desired result. The success of the prospection grows when combining several appropriate methods and techniques adequate to current conditions on the ground and the expected type of the surveyed situation. In all the examples of geophysical measurements, it was important to choose a suitable period in the course of a year for specific survey methods (the quality of the results of some geophysical methods was dependent on climatic factors, vegetation, moisture conditions on site). Among the positive applications of prospection methods one should mention cases of surveys under difficult ground conditions, in terms of both geology and ground relief and cover, e.g., mined areas with changed landscape, forested areas with specific production activity, sites situated on geologically complex bedrock or on differently sloped terrain). Geophysical methods in archaeology may still turn out to have a broader application than currently used.

REFERENCES

Křivánek, R. 2014. Geophysical survey on the grounds of the Hussite siege camp in the foregrounds of Nový hrad in Prague-Kunratice. *Archeologické rozhledy* 66/4: 633-650.

Kypta, J. and Podliska, J. 2014. The Hussite field camp from the siege of Nový hrad at Kunratice (1420/1421). Surface survey and a comparison with parallel sites. *Archeologické rozhledy* 66/4: 609-632.