

# CONTRIBUTION OF GEOPHYSICAL MEASUREMENTS FOR SURVEY AND PROTECTION OF HILLFORTS

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### ABSTRACT:

Paper describes the present new way and possibility of application of non-destructive geophysical method for survey of the whole hillforts in Czech republic. Remains of archaeological activities on hillforts are very often non-preserved on the surface of present remodeled terrains. The results of quick and very efficient magnetometric measurements applied in large scale of ha could contribute to new documentation of important archaeological monuments where it is possible to recognize also various subsurface archaeological situations. Chosen examples from finished or present archaeological projects should present efficiency of geophysical surveys and use of these results as in archaeology as for better evidence and adequate protection of landscape of hillforts as archaeological monument.

## 1. INTRODUCTION

The hillfort is one from the most common and typical archaeological monuments in landscape of many european countries. Very common it is also use of important, strategic or dominant sites in more prehistoric (neolithic, eneolithic, bronze age, iron age, roman) or early medieval periods. Various types of these fortified centres of settlement have very often specific or strategic location, characteristic land use, typical shape, dimensions or orientation of site respecting terrain situation. According to the practical use of particular parts of site we can also suppose more different anthropogenous activities inside and outside of hillfort (settlement, production, burial cemetery areas,...). At present time approx. 340 hillforts in Czech republic are included and protected as archaeological monument, but the final no. of hillforts will be very probably even much higher. Large dimensions of hillforts (varying in czech archeology between 0,X ha and more than 100 ha) and the real (financial, personal or time) possibilities of archaeological research does not offer to have a detailed information about more than only smaller part of only some chosen sites. For more complexed information about the whole hillfort – potential archaeological monument it is necessary to combine precise results of archeological excavations (if there are any) within results of archaeological non-destructive survey methods (aerial or geophysical survey) which we can use for identification and mapping of the main only in subsurface preserved archaeological situation in scale of the whole site. The result of aerial prospection it is possible to use for preliminary new or quantitative evidence and documentation of hillforts. The result of geophysical measurements it is possible also to use for qualitative documentation and more precise separation of hillforts and also for identification of particular archaeological situations and features (Křivánek 2000). Experiences from new archaeological projects in Bohemia showed the most efficient ways of survey of new discovered or previous known or excavated hillforts.

## 2. EXAMPLES OF RESULTS IN PROJECTS

The first complexed non-destructive (including geophysical) surveys of hillforts were carried out in the archaeological project "Settlement Pattern of Prehistoric Bohemia" (Gojda et al. 1997-2002, Grant Agency of the Czech Republic -

404/97/K024). Subsequent application of area magnetometric surveys by 2 Cs-magnetometers (gradient variant of Smartmag SM-4g, Scintrex, Canada) together with systematic field walking survey and GPS measurement (Trimble Pathfinder TDC1, USA) contribute to identification of the surface unpreserved remnants of fortification systems and another activities on arable areas of new discovered or proved hillforts by aerial photography (Gojda 2000; Křivánek 1999, 2002). Geophysical (mainly magnetometric) surveys were focussed to verification of new results of aerial prospection and to more precise identification of subsurface remains of fortification of hillforts.



Figure 1. Magnetometric survey of hillfort Bosyně (2,5 ha). Very important loss of origin archaeological terrains in agricultural regions we could document on abandoned and

ploughed out prehistoric and Early medieval hillforts near Vepřek and Bosyně, both in district Mělník. The example of results of systematic magnetometric survey (approx. 2.5 ha) of Early medieval/Iron age hillfort near Bosyně (Křivánek 2003) we can use as for separation of the whole fortified site as for identification of different subsurface archaeological situations (fig. 1). Magnetometric survey on very long and narrow headland separate different transverse systems of fortification (outer single ditch, inner ploughed out main fortification system ditch-rampart-ditch) and also very probable entrance to the hillfort. Inside of fortified area were then identified groups with larger subrectangular sunken settlement features approx. 5x3 m (probable houses), smaller sunken features (probable pits) and relics of line of ploughed out probable perimeter fortification.



Figure 2. Large area magnetometric survey of hillfort Přistoupim (11 ha).

The first systematically implemented geophysical surveys of hillforts applicable for needs of archaeology and also better protection of archeological monuments were carried out in the archaeogeophysical project "Identification of destroyed fortifications and internal structures of settlement of hillforts" (Křivánek 1999-2000, Grant Agency of Ministry of Culture of the Czech Republic - PK99P04OPP007). The results of application of similar geophysical survey methods on areas of previous known and documented hillforts showed we can use geophysical data as another independent base map for exact separation of fortified archaeological site. The example of large area magnetometric survey (approx. 11 ha) of Early medieval hillfort Přistoupim, district Kolín (Křivánek 2001) confirmed presence of many various surface invisible archaeological situations, their different state of subsurface preservation depending on intensity of ploughing and landscape changes (fig. 2). Magnetometric survey in outer part of Slavic hillfort changed previous archaeological ideas about the real extent (fortified approx. 20 ha) and structure of site. New non-destructive results showed hillfort had 3 different fortified parts, but outer fortifications, remains of

another larger features and inner settlement are not visible at present time on the surface and they were damaged by ploughing of site.

Different way of use of geophysical measurements represents the project "Prehistoric hillfort Plešivec" (Korený-Křivánek-Kuna 2001-2004, Grant Agency of Ministry of Culture of the Czech republic – PK01P04OPP011) where combination of non-destructive and destructive methods (magnetometric survey, field surface survey, GPS, small archaeological trenches and test pits) should help to systematic study of important prehistoric hillfort endangered by illegal use of metal detectors. Particular use of geophysical survey methods on choosen strategic or important and endangered areas (gates, platforms, communications,...) of very large forested Bronze age/Iron age hillfort (approx. 100 ha) it is here combined also with detailed metal detector survey and verification of all modern destructions of surface (illegal pits, afforestation, ...).

The scientific aim of the newest project "The geophysical surveys in archaeologically non-excavated areas of Czech oppids" (Křivánek et al. 2003-2007, Grant Agency of Academy of Sciences of the Czech republic – A8002301) is in complexed area geophysical survey of choosen parts of 5 large and very important bohemian La Tène hillforts – oppids: Závist, district Praha-Západ, Stradonice, district Beroun, Třisov, district Český Krumlov, Hrazany, district Příbram and Nevězice, district Písek). The extensive and also intensive systematic non-destructive survey methods of project should bring a lot of new archeological information about the structures and intensity of use of different areas of large celtic oppids outside of limited areas of previous archaeological excavations. The example of new magnetometric survey in outer forested part of oppidum Závist represents one from the first results of project where we can demonstrate a new identified only subsurface remains of another (previous unknown, only supposed) gate in outer systems of rampart-ditch fortification of oppidum (fig. 3). Two short parallel across ditches in place of interrupted perimeter ditch fortification identified place of abandoned entrance, probably in poor quality of (only subsurface) preservation.

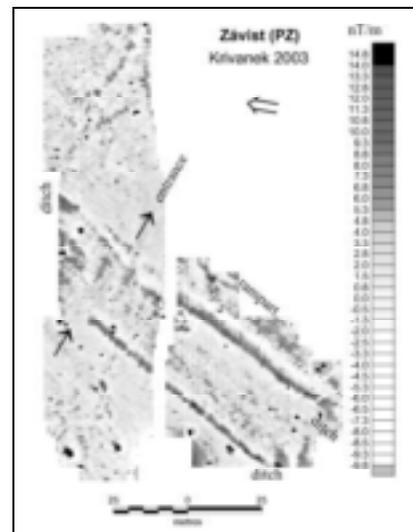


Figure 3. Magnetometric survey in outer forested part of oppidum Závist (approx. 1 ha).

### 3. CONCLUSION

Geophysical (mainly magnetometric) surveys of large inner and also outer areas of hillforts show new method of documentation and mapping of abandoned prehistoric and Early medieval fortified sites. The identification of subsurface only preserved archaeological situation by geophysical methods within cooperation of archaeologist (aerial prospection, field walking survey, eventually trenches) should be used for new area assessment of extent and structure of these protected important archaeological monuments. The same geophysical results it is possible to use as in scale of the whole sites as in more detailed scale of particular features where we can identify and separate more different subsurface archaeological situations. Quick and (in comparison with destructive archaeological methods) non-expensive wide area geophysical surveys could bring a new view on the real anthropogenous activities of the whole sites including the information about the present state of preservation of archaeological situations beneath the soil.

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