GIS AND THE EXCAVATION OF THE EARLY MEDIEVAL CENTRE IN POHANSKO, CZECH REPUBLIC

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The Department of Archaeology at University in Brno has fully incorporated GIS into the processing of major excavation at Pohansko, a fortress dating to the 9th century AD. Archaeological research at the site has been underway since 1958 and has uncovered a wealth of artefacts providing insight into Early Medieval society and culture.
In 1995, Department of Archaeology first began applying GIS technology at the Pohansko site. Since then, the researchers have digitised the archived excavation data, incorporated new information and initiated complex analysis projects with the GIS. In 2002 was published the fully digital catalogue, based on GIS technology.
At the present day processing of the intra site spatial analysis by the using of the combination of GIS and multivariate statistics (PCA) continues. Geospatial technology enables not only to store and retrieve a variety of data types instantly, but also to spatially correlate relationships between artefacts and their discovered locations in the fort to better understand how tools and ceramics were used in daily life or rituals.
Application of GIS technology at the Pohansko excavation was awarded by the "2002 GeoMedia Best Practices Award" for GIS implementation within researches and education from Intergraph Mapping and GIS Solutions.

POHANSKO NEAR BRECLAV - EARLY MEDIEVAL CENTER IN CENTRAL EUROPE

The archaeological complex of Pohansko south of the town of Breclav is one of the most important and thoroughly investigated early medieval centers in Central Europe. Built in the ninth century, Pohansko is a sprawling fortress in the southeast corner of the Czech Republic. Archaeological research at the site has been underway since 1958 and has uncovered a wealth of artifacts providing insight into early medieval society and culture. In that time, 140,731 square meters have been excavated, uncovering 1,346 settlement features, 872 graves with skeletal remains, 55 cremations and thousands of post holes. More than 200,000 artifacts have been inventoried from the excavations here. The interdisciplinary research carried out here has been closely associated with a number of academic institutions, first and foremost the Institute of Archaeology and Museology of the Faculty of Arts of Masaryk University in Brno. The results of the scholarly research of three generations of scholars have been published in seven monographs and more than one hundred scholarly articles (a summary of work up to 1995 is in Vigniatová 1996:264-266). For example both Czech and foreign scholars have documented processes at Pohansko, a model early medieval centre that occurred at the historical moment of the birth of a new social order and the creation of the first state-level political organizations. The results of research at Pohansko are also often used as the basis for analogy in the interpretation of other important early medieval centers (among the most recent Fagan 1996).

The fort's impressive ramparts were constructed of stone, dirt and wood to a depth of 6 meters and to a similar height. The total length of the rampart is two kilometers and delimits an area of 28 hectares. Among the most exciting and significant recent discoveries is the court of a local magnate comprising palace, church and cemetery. Extending over a one-hectare rectangular area, the court served as a meeting place for the elite of the Great Moravian society, many of whom were buried in the cemetery. The latter has yielded 407 graves containing swords, axes, spurs, gold and silver pieces and Byzantine-Oriental jewellery. An analogy to this settlement structure can be seen in the Carolingian-Ottonian palatine, which German researchers have called a "palatium" (palace). The feudal court at Pohansko was not isolated. Located nearby was a settlement of craftsmen, which is known as "Lesni skola" [tree nursery] portion of the site, whose tools and grave artifacts offer an intriguing insight into the activities of the various classes of this mediaeval society. A residential area with an entirely different character was found in the outer ward areas.

HISTORY OF GIS PROJECT POHAN

Upon its introduction in 1995, GIS was initially employed to digitize the numerous sketches, plans and drawings resulting from over 45 years of onsite work at Pohansko (Kucera and Machácek 2001, 2003). In addition, researchers applied database techniques to organize and catalogue information relating to tons of artifacts and thousands of photographs. The original GIS laboratory included MicroStation for digitizing and GIS software MGE PC for analysis. Attributes were maintained in a Dbase IV database running under Microsoft DOS. By 1997, this system was upgraded to an Intergraph TD 30 Windows NT workstation, with data migrated to an Intergraph MGE 5.0 GIS and Microsoft SQL Server 6.0. In
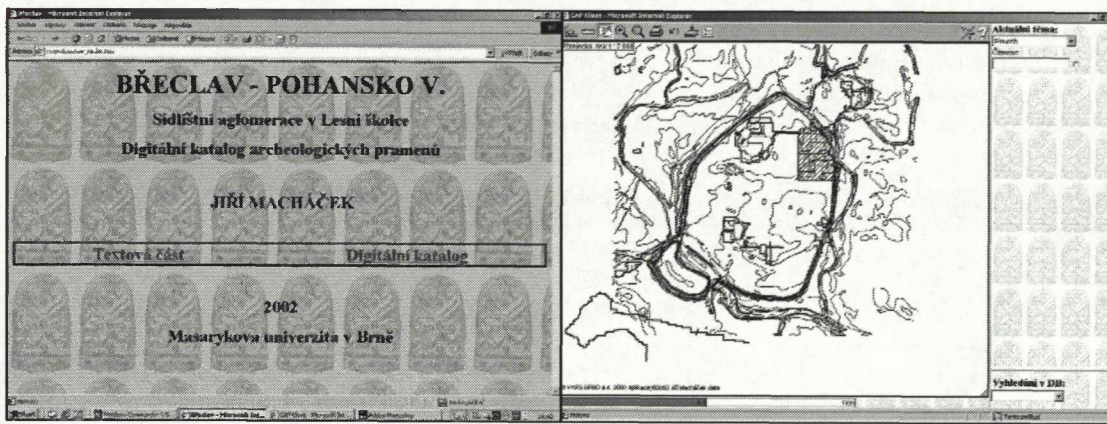
Figure 1 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Title page
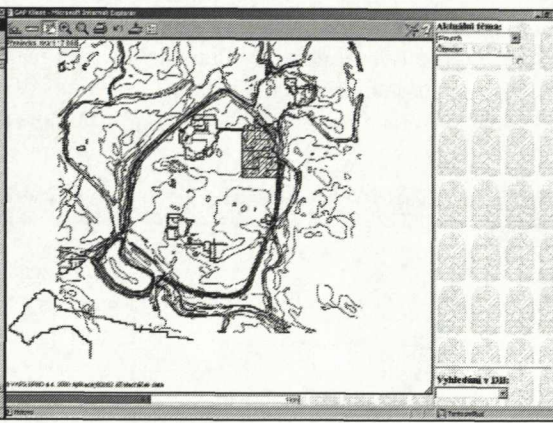

Figure 2 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Overall map

Information used in the project was in the form of existing drawings and written and photographic documentation. Drawings were primarily in a 1:20 scale on millimeter-grid paper. The documentation presents the substratum, or more precisely the excavated artifact-bearing strata, structures in the fill of semi-subterranean settlement features and graves and their negative remaining (cuts) after excavation. Written documentation is in the form of handwritten research journals and artifact reports. Detailed photographic documentation, generally on black-and-white film, was also prepared in the field. The first step in the creating a GIS for the Pohansko fortification was the digitizing of these analog data. This occurred at three levels:

2002, the Institute of Archaeology became a Team GeoMedia Registered Research Laboratory and, under Intergraph's guidance, once again upgraded its resources.

GeoMedia Professional 5.0 now serves as the main tool for data integration and analysis. Microsoft Access is the primary repository for graphical and non-graphical data, while MicroStation remains the digitizing platform for vector maps and plans.

Researchers now incorporate new information and initiate complex analysis projects with the GIS solution. They use GeoMedia Professional during this phase of data collection to establish relationships between attributes and graphical data files and to perform quality control on the data inputs. GeoMedia also validates the connectivity and geometry of the spatial maps, sketches, and drawings. A critical advantage of the GeoMedia software is that relationships between data sets can be maintained despite the fact that data is stored in a variety of raster and vector formats in different databases. At any given time, Pohansko researchers are managing attributes in Access, vectors in MicroStation, and archived data in MGE. All of these data sets are accessible for analysis and integration in GeoMedia. The geospatial data management solution at the Pohansko site enables researchers not only to store, query and retrieve a variety of data types instantly, but also to spatially correlate relationships between artifacts and their discovery locations to better understand how they were used in daily life or special rituals.

DIGITAL CATALOGUE OF EXCAVATION IN POHANSKO

One of the most important applications of GIS at Pohansko is the digitalization of the catalogue for the Lesni skolka (Machácek 2002), where excavations were carried out over seventeen seasons between 1961 and 1991. The total area uncovered at the Lesni skola is approximately 1.9 ha. The primary excavation units, which were documented with drawings, photographs and written records, were individual settlement features, graves and postholes. A new phase of comprehensive analysis and publication of the large residential agglomeration at the Lesni skola began in 1995. The phase of research involves the use of the most modern technology including geographic information systems (GIS), which were used in the project with the working title of POHAN.

- transfer of field documentation into a database format using the MS Access program,
- manual vector digitizing of field maps using the MicroStation program,
- scanning the large photographic archive.

This heterogeneous data was then integrated into a unified data model, which is now maintained using the GeoMedia Professional program. This product of the firm Intergraph is based on an object-oriented approach to both graphic and non-graphic data saved in a unified data warehouse using a standard database format (Microsoft Access). Graphic and spatial data in the POHAN project is primarily based on vector models, where areas (polygons) and lines are represented. It is possible to add to these aerial views representing transformed and localized screens. Non-graphic data are saved in the database in the form of alphanumeric or numeric records or hypertext links to external files (screened pictures). The reasoning behind this data model was to present the most complete presentation of the complicated reality ascertained by archaeological research at Pohansko. All other applications are derived from this data model.

The basic properties of archaeological features are their geographic location and topology. For the POHAN project, features are located in terms of the Czech Republic's S-JTSK system of coordinates. Each type of features is depicted with its own color and line type. Significant features contain a record of its non-graphic attributes. Features are divided into several categories that have been derived from the existing Lesni skolka research documentation and logical subdivisions:

Overall site map: a detailed contour map depicting streams and buildings. Also depicted are areas that have been archaeologically explored, with the field season also being indicated.

Surface: depicts the situation prior to the beginning of research following the removal of the overburden. Within the Surface category, non-graphic database information is described in 5-by-5-meter grids that form the base of archaeological research at Pohansko.
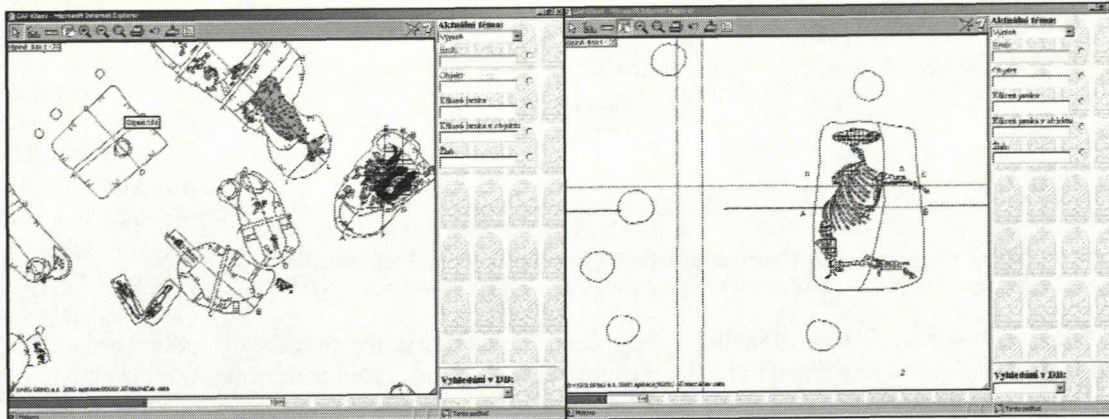
which were derived from the original handwritten documentation and descriptions of the terrain, and formalized descriptions of artifacts from Lesni skola that were made by several authors during the second half of the 1990s. These also include drawings and recent digital photographs.

Figure 3 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Section of excavation, scale 1:75

Figure 4 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Section of excavation, scale 1:25

PRESENTATION OF ARCHAEOLOGICAL DATA IN DIGITAL CATALOGUE

The digital catalog for Lesni skola contains e.q. 7052 vector polygons for stones, 9372 vector polygons for bones, 847 vector polygons for clay daubs, 954 vector polygons with non-graphic attributes for postholes, 285 vector polygons with non-graphic attributes for settlement features, 80 vector polygons for graves or 2419 terrain monochrome photos, 1502 color digital photos of non-ceramic artifacts, 642 drawings of ceramic fragments in relational databases and so on.

Fill: contains documentation of the archaeological situation (generally on a 1:20 scale), recording structures and artifacts (deposits) in the fill of settlement features and graves, including profiles left for checking fill artifacts. Non-graphic database records exist for objects that represent individual categories of archaeological features such as settlement features, postholes, graves and palisade ditches.

Cuts: presents visualizations of the archaeological situation in the final stages of field research after the complete removal of all fills and control profiles. This documents the negative form (cuts) remaining after the excavation of settlement features, graves, postholes and palisade ditches. The database records contain the same features as in the Fill category.

Cut-graves, Cut-postholes, Cut- settlement features, Cut-palisade ditch: are logical categories logically derived from the category Cuts. This subdivided category is designed to aid the user in orienting in the complicated archaeological situation as it exists at Lesni skola.

A significant advantage of this approach is new possibilities for publishing scientific information. For these purposes, GeoMedia was used to generate raster graphics from the data Warehouse, HTML pages and the Microsoft Access database. The transformation (data migration) was carried out using VARS GAP technology in 2001 and 2002. Data in this new format allows the use of GIS applications in a Web browser environment without being permanently connected to the Web and map servers by using CDs, local hard disks or local computer networks. The digitized catalog of archaeological research at Lesni skola was published on CD (Macháček 2002), making it available to the widest possible range of experts (Fig.1). The program allows the drawing of graphic

Recent: intrusions into the substrate that has been interpreted by the authors as modern anthropogenic features.

Non-graphic data, which are presented in a relational format accompanying features, are derived from a variety of sources. These include database tables,
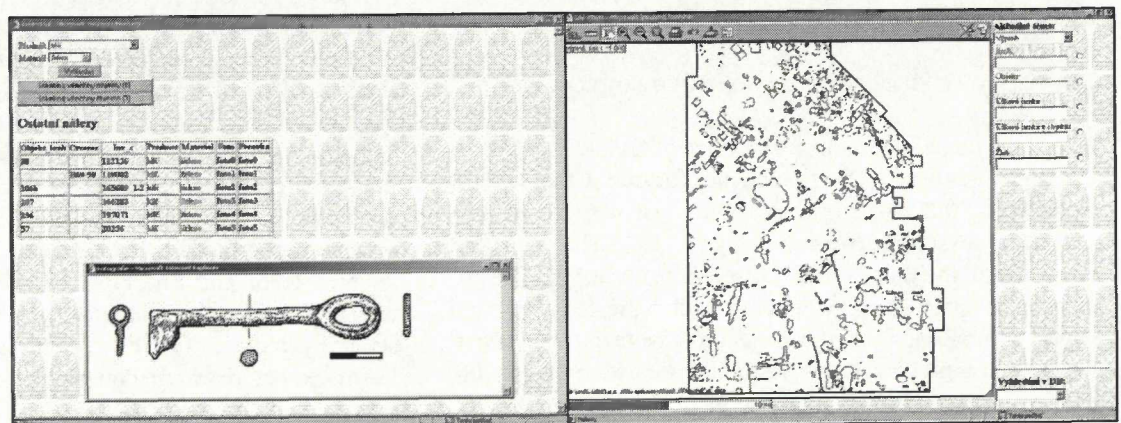

Figure 5 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Printout of database table resulting from a selection of all keys found at Lesni skola

Figure 6 Breclav-Pohansko V. Digital Catalog of Archaeological Sources. Localization of selected features in the map window using arrows

objects in scales ranging from 1:7,000 to 1:25 (Fig.2 - 4). Information from a number of interconnected database tables can be called up interactively for important features by clicking on them. On some tables, hypertext links are marked in bold that allow the calling up of additional relevant information. These are primarily raster drawings (ink drawings, scanned and digitized drawings, etc.) and detailed object descriptions. This data appears in a new window. It is also possible in this application to search for information in the database tables of non-graphic attributes using a variety of criteria (Fig.5). Features that match the search criteria can be depicted on the map using an arrow (Fig.6).

The application of GIS technology at Pohansko earned Masaryk University the 2002 GeoMedia Best Practices Award for GIS implementation within education from Intergraph Mapping and Geospatial Solutions. This annual award is presented to the educational institution that has implemented a groundbreaking application of GeoMedia technology in the classroom and research.

References

FAGAN, B.M., 1996. The Oxford Companion to Archaeology. Oxford.

KUCERA, M. and MACHÁCEK, J., 2001. Räumliche Analysen der archäologischen Daten von Pohansko bei Breclav/Lundenburg mit Hilfe des GIS. In Archäologie und Computer 2000, Workshop 5. Wien. FORSCHUNGSGESELL-SCHAFT WIENER STADTARCHÄOLOGIE:44-61.

KUCERA, M. and MACHÁCEK, J., 2003. Back to the Future. Geo-Connexion, volume 2, issue 1:48-50.

MACHÁCEK, J., 2002. Breclav - Pohansko V. Sídlištní aglo-merace v Lesní školce. Digitální katalog archeologických pra-menu. Brno.

VIGNATIOVÁ, J., 1996. Zum Stand der Erforschung des Burgwalls Breclav-Pohansko. In Stana, C. and Polácek, L. (eds.), Frühmittelalterliche Machtzentren in Mitteleuropa - mehrjährige Grabungen und ihre Auswertung, Brno:261-266.