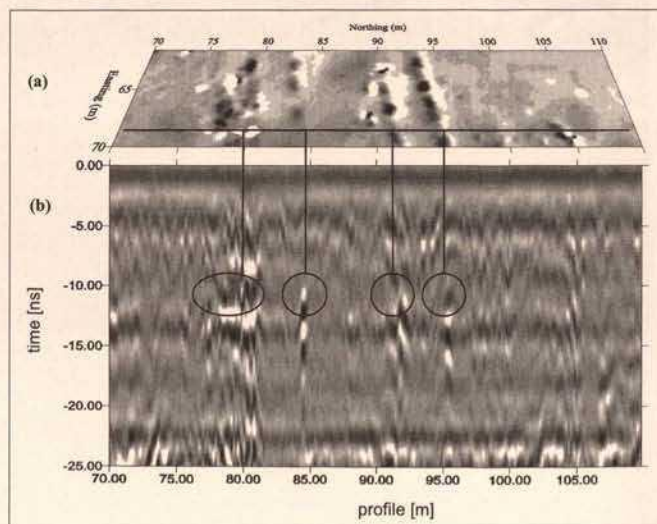


Interpretation Enhancement of Archaeometric Investigations due to Joint Interpretation of Geophysical Fields

Because of different limitations, e. g. time, instrumental or economic limitations, only single-method geophysical investigations are carried out in many cases. However, a single method is often limited by the capability of the utilized physical principles to display certain archaeological patterns. Therefore, an integrated geophysical investigation technique should be applied to overcome this problem. At Kalø peninsula (Jutland, DK) an integrated geophysical prospecting was carried out to detect different subsurface targets related to the old medieval castle and its surroundings. To locate houses and the position of different defense structures, four different areas were investigated using geomagnetic prospecting, ground penetrating radar (GPR), geoelectrical profiling and surveying. By means of combined geomagnetic and GPR measurements the situation at the first entrance to the peninsula was investigated. To correct the GPR data for topographic effects, the topographic map was refined by dense surveying. Because geoelectrical profiling has generally a lower resolution than the other two methods, it was applied as a first prospecting method to find the continuation of the ancient road outside the forecourt. Afterwards, anomaly regions found by this method were studied in detail using GPR and geomagnetic prospecting. The data revealed the distribution of old farm houses in the forecourt and the position of the ancient road leading from the entrance of the forecourt up to the castle. A 3D-image of the urban plan of the area under study is finally presented.

Fig. 1. Joint interpretation of total magnetic field data (a) and GPR data (b) on a profile crossing the remains of an ancient building. From the GPR time section a depth to the top of the remaining foundation of about 50 cm was estimated. Depth estimates of 45–50 cm, obtained by means of inverse modelling and from logarithmic power spectra of geomagnetic data, were in good coincidence with the former results



N. Kozhevnikov

Barun-Kahl : History of Purely Geophysical Discovery of the Oldest Iron Age Site at the Western Shore of Lake Baikal

Some years ago, very slowly decaying transient signals were measured during TEM survey over metamorphic crystalline rocks in the mouth of the Barun-Khal valley which is situated in the vicinity of village Chernorud, at the western shore of Lake Baikal. Being converted to apparent resistivity, these transients resulted in values of about 2–5 Ohm meter. Since both in-field and laboratory DC resistivity measurements didn't indicate any conductive rocks evidence within the TEM anomaly area, the TEM results seemed to be confusing.

To elucidate the cause of the slowly decaying transients, parent rock and soil samples were studied in the laboratory using: 1) microscopic examination; 2) small coil TEM measurements;

3) hysteresis and thermomagnetic analyses. It turned out that anomalous in-field measured transients were caused by the relaxation of magnetization of extremely fine ferri -and/or ferromagnetic particles concentrated in the near-surface layer. The origin of these particles for a long time remained a mystery.

In 1996, the third-year students of the Irkutsk Technical University that had in the vicinity of Chernorud their training in field geophysics, found a gopher's burrow. Among the soil thrown out of the burrow, many slags and charcoal fragments were found, which suggested an ancient metallurgical activity. The slags were electrically nonconductive. Examination of slags with chemical, X-ray diffraction and SEM analyses has revealed

that they consist predominately of a silica matrix and dispersed within it ultrafine particles of metallic iron, magnetite, phalaitite, and wuestite. Being placed into a small coil, the slags produced slowly decaying transients caused by magnetic viscosity effects. By chemical and mineral composition the Chernorud site's slags proved to be identical to those which are known to have been formed during yielding iron in ancient bloomery furnaces.

The total magnetic field measurements carried out along two lines intersecting at the above gopher's burrow have indicated a positive magnetic field anomaly with amplitude of 50 nT, and 25–30 m in diameter. A reconnaissance excavation carried out to a depth of 0.8 m over the 1 m by 2 m area centred at the gopher's burrow resulted in discovery of slags, charcoal, porous iron, and baked clays. In 1997, the excavation area and depth were increased up to 3 m by 4 m, and 1 m, respectively. This time, remains of a bloomery furnace, some pottery sherds and other artefacts were found.

In 1998, magnetometry data were collected over a rectangular, 200 m by 150 m area centred at the excavation. Magnetic field measurements were taken at 2 m intervals along parallel profiles spaced by 4 m. The magnetic field contour and surface maps exhibited two positive isometrically-shaped anomalies connected via a narrow "cross connection". Unfortunately, the gopher's burrow and excavation fell just within the "cross connection" rather than within one of the main anomalies. The following excavations are planned to be taken in central parts of the above anomalies.

Radiocarbon dating of three charcoal fragments sampled during the excavation from different depth intervals has given ages of 1915 ± 35 , 2050 ± 35 , and 2180 ± 30 . These results make it apparent that the Iron Age at the western shore of Lake Baikal started about 700–900 years earlier is generally appreciated. Note that anomalous transients were measured over an area of no less than 15 ha. This suggests that iron yielding in the Barunkal valley was performed on a large scale.

R. Krivánek

Contribution of Caesium Magnetometer Prospection to Archaeological Projects in Bohemia

The first pioneer magnetometric measuring on archaeological sites in Czechoslovakia were realized in the late 60's. The various kinds of proton magnetometers and also methodologies of archaeomagnetic prospection were applied on different types of Czech, Moravian and Slovakian archaeological sites and in particular features for more than 25 years. By present eyes of archaeogeophysicists it has been the time of many very good results of small magnetic surveys which were mostly aimed at the individual interest of archaeologists and their archaeological excavations. Geophysics in archaeology has been often observed and also used during that time only as a service prospection method of archaeology. Another more intensive application of geophysics before rescue archaeological activities and excavations started in this country in the beginning of 90's. Since that time it has been more real to start also another aimed cooperation of geophysics within other methods of archaeological prospection and also archaeological research. Archaeomagnetic methods were than more systematically connected, for example into the project of aerial prospection and its verification, project of surveys of abandoned medieval glass-working sites or into the landscape reconstruction project within application of intensive field walking methods. ... Due to this intensive individual cooperation and putting geophysics into the Department of Landscape Archaeology of Institute of Archaeology in Prague then could Bohemia start the new era of more systematic archaeological and also archaeogeophysical projects based on the use of proton magnetometers and fluxgate gradiometers. The new ar-

chaeological project "Settlement areas of prehistoric Bohemia" (Gojda et al. 1997-2002, Institute of Archaeology Prague) offers new ways of wide and intensive cooperation of non-destructive archaeological methods (aerial prospection, geophysical prospection, landscape reconstruction, systematic field walking survey all together with GPS, GIS) for the systematic study and prospection of chosen intensively settled and used prehistoric areas/landscapes. The results on the poster demonstrate the new scales of use of modern caesium magnetometers for the study of the whole archaeological sites (atypically fortified prehistoric settlement sites, ploughed burial-mound areas) and connection of results with other archaeological methods. Another new archaeogeophysical project under the Ministry of Culture "The identification of destroyed fortifications and inner structure of settlement of hillforts" (Krivánek 1999–2000, Institute of Archaeology Prague) documents another application of caesium magnetometers for the detailed prospection of larger areas of abandoned hillforts which could bring new archaeological view on site, but also could help for better and more precise protection of whole archaeological monuments. Only the first year of experience with caesium magnetometer prospection has shown that for the Bohemian archaeogeophysics a new era of unexpected and many times impossible applications of method on large areas of sites as in detailed scale of individual types of features. Other cooperations of various archaeological and geophysical methods are also planned in Bohemia in some future interdisciplinary projects.