Integrated Application of Geophysical Methods in Archeological Research

Almaty 2016
It is one of the priorities of the modern archeology to study cultural heritage objects without destroying their structure and integrity. Modern geophysical (GP) hardware and software solutions make it possible to use non-invasive methods of diagnosis of historical monuments. The methods are successfully used by many scientists in the UK, Europe, Russia, Egypt and Mexico.

In Kazakhstan, 2500-year-old monuments of world heritage were found in the Valley of the Saka kings. The archeologists are busy excavating ancient cities, settlements, forts and burial mounds. Those are painstaking, lengthy and costly activities often leading to ruining the integrity of the monuments.

The proposed research methods and their results will enable the scientists working for the Research Institute of Archeology, museums and the users of natural resources to more efficiently use their human and financial resources in planning and carrying out the archeological research.
Problems to be Solved by KAPE LLP

With the use of modern geophysical equipment, shallow geophysical methods and software, we are capable to accomplish a wide range of tasks in archeology:

- Determining a rough structure, features and size of the burial place;
- Tracking underground tunnels, brick reservoirs, buried urban canals, buildings and masonry;
- Assessing volumes of archeological excavation work;
- Detection of voids, decompressions and man-made structures;
- Producing geoelectrical sections of archeological sites;
- Producing 2D and 3D maps of burial places;
- Significant decrease in the volume of unproductive search activities, saving time and material costs.
Archeological research site

- Burial monuments are the most common type of archeological sites in Europe and Asia.

- The site is situated 60 kilometers east of the Almaty city. Site coordinates: 43°31'19.9"N and 77°49'23.1"E. Research activities were conducted on June 10, 2016.

- The burial mound external characteristics and size refer it to the Saka era.

- The burial mound has a regular rounded shape. The mound diameter is 40 meters, the height is more than 3 meters. At-a-glance, there are no decays, no funnel or failure at the top.
The Use of Radar in Archeology

The results of work carried out by KAPE specialists.
The archeological research activities were conducted at Saka era burial monuments near the Almaty city.

Georadar scanning of a burial mound

Scheme of GPR profiles on the mound
The upper layer of the burial mound is surveyed at the depth of 1.3 m.

GPR Survey picture shows a stone ring along the burial mound boundary.

The mound is visible above the ground. Mound dimensions: ≈ 40 m from East to West, ≈ 30 m from North to South.

At the north end, one can see an entrance or a corridor 10 m in width, and 4–5 m in length.
Electric Exploration in Archeology

The results of work of archeologists and geophysicists of the Institute of Archaeology and Ethnography of the Russian Academy of Science Siberian Branch and the Institute of Petroleum Geology and Geophysics of the Russian Academy of Science Siberian Branch.

**Burial mound Pogorelka-2** in Novosibirsk Region.

A map of apparent resistivity distribution (on the left) and 3D model prepared basing on the results of 3D electron tomography (on the right).
In 2011, burial mound No.13 was surveyed by joint Russian and German expedition of the Institute of Archeology and Ethnography of the Russian Academy of Science Siberian Branch and the Eurasian Branch of the German archeological and Historical Institute.

Dig results show that the magnetometric data mapping (on the left) is very clear match to planigraphic location of burial niches (on the right)
The results of work carried out by KAPE specialists. Saka tribe burial mounds were studied near the Almaty city. Burial mound survey carried out with the use of electric exploration method.
The results of work carried out by KAPE specialists. Saka tribe burial mounds were surveyed near the Almaty city.

Geoelectric cross-sections show surface layers of the mound, as well as those located below the modern layer. A 0.3-0.4 m thick stone layer. Obviously, it is a crepidoma turning into a stone cover. Next upper layer is a stony loam. Next goes a well fixed denser layer, over which the stones are laid. Stone layers are also visible in the crepidoma and the stone cover.
Electromagnetic Profiling Method Used in Archeology

The results of work carried out by KAPE specialists. The survey was conducted at a saka tribe burial mound found in Almaty region.
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- Map of burial mound electric conductivity shows presence of oval-square–shape object. The object contours are similar to those visible at georadar section.
- The object is made of stone or covered by thick stony layer. It is oval in the middle with a corridor in its northern section.
- It is probably some kind of a room filled by sandy loam. We can see a contour of the filled part.
- Judging from its size, this room is neither a grave pit nor a looter access hole.
The results of completed surveys show that the use of geophysical methods without disturbing the structure of an archeological monument allows the following:

- Accurate planning of future dig sites showing the structure element locations;
- Identifying the structure, features and size of an archeological object/burial mound;
- Detailed study of the inner structure of an archeological monument;
- Layer-by-layer study of burial mounds without disturbing the soil upper level and the object itself;
- Estimating an approximate volume of earthwork to be carried out during excavation;
- Geophysical methods application enormously reduces the volume and cost of earthwork and archeological survey duration.
Geophysical Equipment
Used by KAPE LLC in Archeological Surveys

Georadar system «MALA Geoscience»

Seismic exploration system «Lakolkpit XM-3»

Electromagnetic scanner GSSI EMP-400

Electric exploration station «SKALA-48»
THANK YOU FOR YOUR ATTENTION!