Geophysical Investigations of Early Middle-ages Turkic Fortresses.

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Introduction

The studies of states – heirs of the Turkic Khaganate in the early middle-ages is a very important and challenging task. Because of the lack of written sources the key role here is played by archaeological studies. However, for determining the general structure of a site and its planning and for making paleogeographic reconstructions, archaeological studies turn out not to be very effective because of large sizes of sites and fortresses and a vast amount of excavations needed.

Furthermore it is difficult to conserve excavated walls and constructions made of mud brick. Having been in the permanent humidity conditions and exposed to the air the walls begin to peel off and crack. This is why after the excavation mud-brick walls should be conserved in a complicated way and guarded afterwards – tasks which nowadays seem to be impractical.

In such conditions the integral role in the studies of the sites of this historical period belongs to geophysical survey methods because of their efficiency and unobtrusive nature.

This paper examines the potential of integrated geophysical surveys in studies of early middle-ages Turkic fortresses. Conclusions are formed based on the experience of the investigating Semikarakorsk fortress (Russia, Rostov region) and Djankent (Yangikent) fortress (Kazakhstan, Kyzyl-Orda region), fig.1.

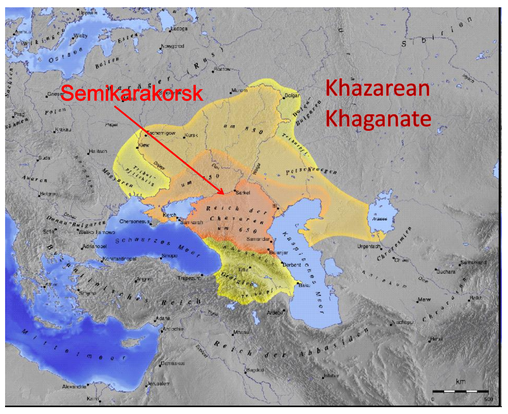

Figure 1. Historical map of Asia in 800 AD (www.WorldHistoryMaps.info) and map of Khasarean Khaganate in different historical periods. Location of Semikarakorsk and Djankent fortresses.

Geophysical investigations of Semikarakorsk fortress

Targets and survey methods

Semikarakorsk fortress (fig. 1) is one of a number of fortresses, erected by the Khazars in VIII – early IX centuries to defend the northern borders of Khaganat. This is the largest of all Khazarian fortresses on the Don river (215 m × 200 m with the citadel 85 m × 80 m). By now only a few percents of the site's territory have been excavated, and because of that a lots of important historical issues are unclarified.

The target of the geophysical survey has been the occupation layer investigation in order to reveal human-induced anomalies, which may improve the general understanding of site structure.

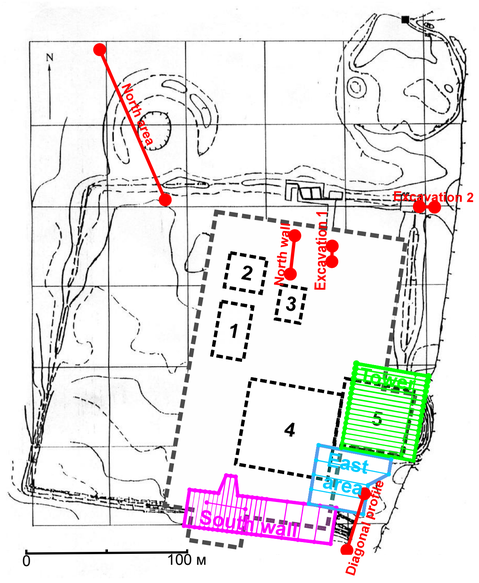

Figure 2. Physical and survey map. The area of magnetic investigations is grey, areas of detailed magnetic investigations are dark grey. Areas of electrical ERT investigations are green (Tower), purple (South wall) and blue (East area), ERT profiles are red (Diagonal profile, North area, North wall and methodological profiles Excavation 1, 2).

As methods of investigation we have used electrical imaging (ERT) and magnetic survey (fig. 2).

The interpretation of the obtained data is based on the results of archaeological excavations of two ERT profiles (fig. 3 - one of them) and on magnetic susceptibility measurements during the excavations and the measurements of the uncovered mud-brick and ceramics samples. Comparison of ERT sections and the results of excavations shows that walls made of mud-brick are characterized by low resistivity values as contrasted with the other occupation layer deposits of the site.

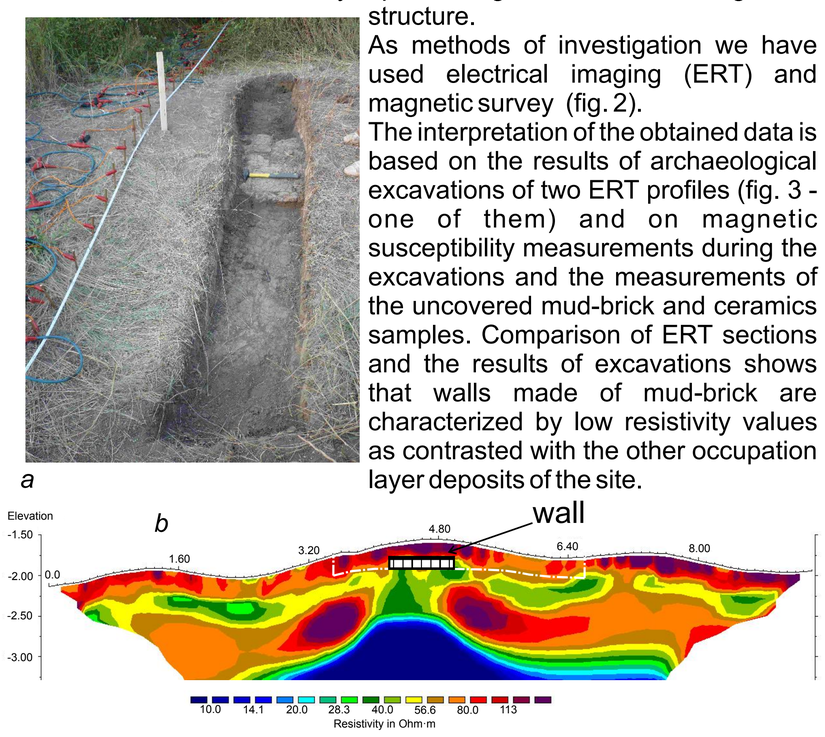

Figure 3. Methodological profile Excavation 1. Geoelectrical (resistivity imaging) cross-section (b) and the mud brick wall position defined by excavations (a). The dashed line represents the borders of excavated volume.

Investigation results

The conducted electrical survey enabled the discovery of the following peculiar features of Semikarakorsk fortress:

1. The hill in the eastern part of the fortress (fig. 4) and the ring structures in the north part of the area outside the fortress seem to have human origin.
2. The raise in the inner central part of the southern wall is an artificial structure and has been constructed for entrance and exit from the fortress.
3. The citadel might have had one more wall.
4. Fortress walls have served as a detention dam.

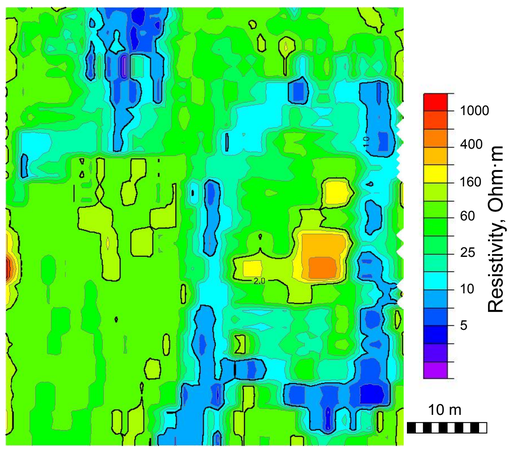

Figure 4. The area Tower (5). Resistivity map at 1 meter depth based on electrical imaging results. Low resistivity values correspond to the walls.

The results of the magnetic survey also turned out to be very informative. They revealed the distinct planning both inside the citadel and in the area between the citadel and the outer wall (fig. 5).

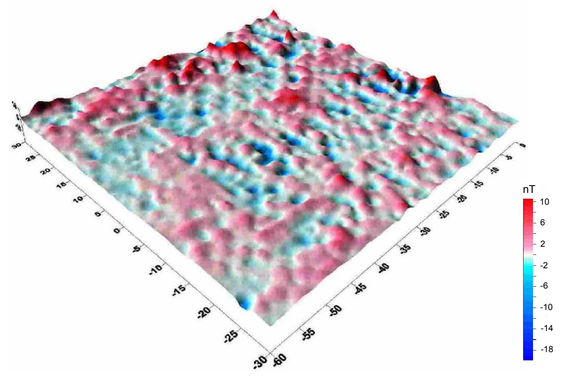

Figure 5. Map of local magnetic anomalies on one of the investigated areas between the citadel and the outer wall. The planning is clearly seen.

According to the current understanding of Khazar Khaganate social development [Flyorov, 2010] the khazars have not passed through sedentarisation (transition from roving life to sedentary life) and so they have not built cities (defined as settlements with distinct planning. Thus if the obtained magnetic data is confirmed by archeological excavation it will be possible to reconsider part of current views on Khazar history.

Magnetic survey also detected two walls in the citadel construction of Semikarakorsk fortress (area 1, fig. 6).

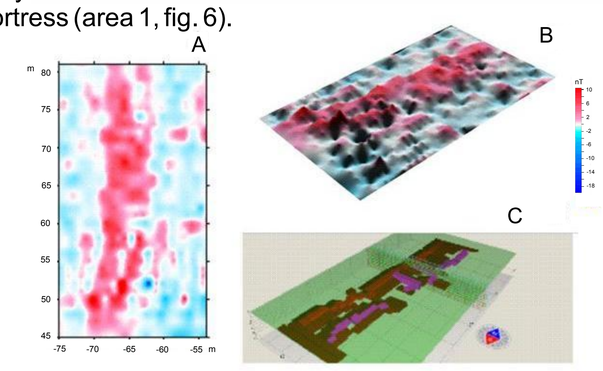

Figure 6. Reconstruction of western citadel wall based on magnetic survey data. A – map of local magnetic anomalies, B – 3D representation of this map, C - 3D model of ruined wall

Geophysical investigations of Djankent site

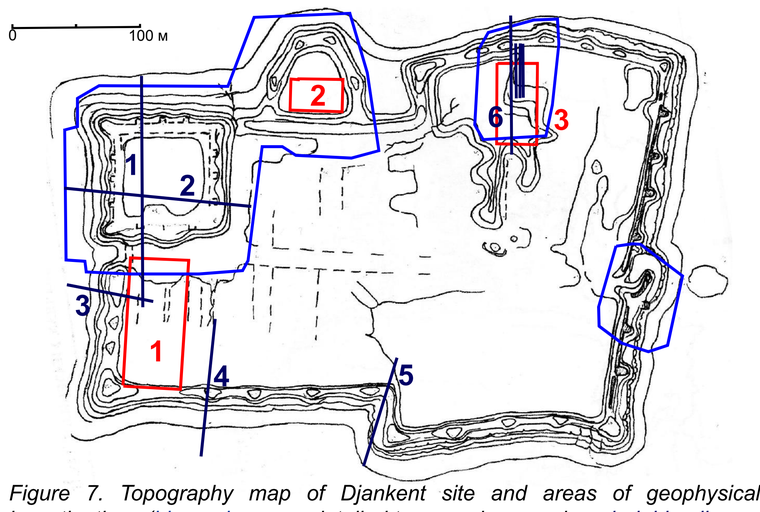

Figure 7. Topography map of Djankent site and areas of geophysical investigations (blue polygons – detailed topography mapping, dark blue lines – resistivity imaging profiles, red polygons –magnetic survey).

Targets and survey methods

Djankent site was was a large trading center on the caravan route from Central Kazakhstan to Horezm and Itil regions. In VIII century it became the capital of the Oguz Yabgu State, the eastern neighbor of Khazarian Khaganate. Having been left in XII century, it is still a splendid sight: arectangular area 250 m × 450 m raised 6 meters meters above the prairie (fig. 7, 8).

Figure 8. ERT measurements, view to the eastern part of the fortress from within.

Much less than 1% of the total area of the site is covered by archeological excavations, and the virgin layer has not been identified clearly. So the main targets of Djankent fortress' investigation are defining the structure and origin (natural or human-induced) of the rise on which the fortress is situated, and the study of several regions of the site, whose functions are still unclear.

To fulfill this task electrical (resistivity imaging) and magnetic surveys were carried out (fig. 7).

Investigation results

The results of ERT enable to make several absolutely new important conclusions concerning Djankent fortress (fig. 9):

1. With a high level of confidence we can say that the rise, on which the fortress is situated, has a human-induced origin. Vast amount of ground has been transported here during the fortress construction. Defining the place where it had been taken from is the problem for future investigations. Nevertheless this material has not been produced in close vicinity to the fortress, because its resistivity differs from the vicinity layer resistivity.

2. One more important feature of Djankent fortress construction has been established: the existence of “platforms”, on which the fortress' walls have been raised. Such technology of construction during this period is known to exist but its application in Djankent is established for the first time.
3. Further archaeological investigations are necessary to explain the clear difference in resistivity of several parts of ground volume surrounding the “platform”.

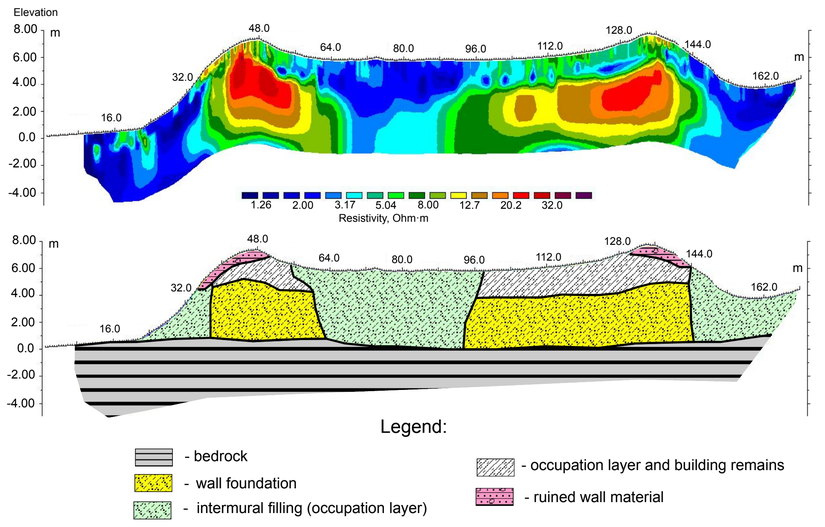

Figure 9. Profile 2 through the citadel. Geoelectrical cross-section (ERT) and its interpretation

The main result of magnetic survey is defining of the planning structure. Figure 8 shows total magnetic field map for one of the investigated blocks overlaid with old topographic map of the site (now the roads in the right part of the picture are not visible). In magnetic survey data the streets can be seen as the negative magnetic field anomalies with amplitude less than 7 nT.

On the basis of magnetic survey data we can say, that the investigated area (fig. 10) was divided into several “blocks” approximately 40 m × 40 m in size, and each block consisted of four yards. The evidence of this is not only the system of linear negative anomalies, which correspond to the streets, but also the aggregate of local anomalies typical for ovens.

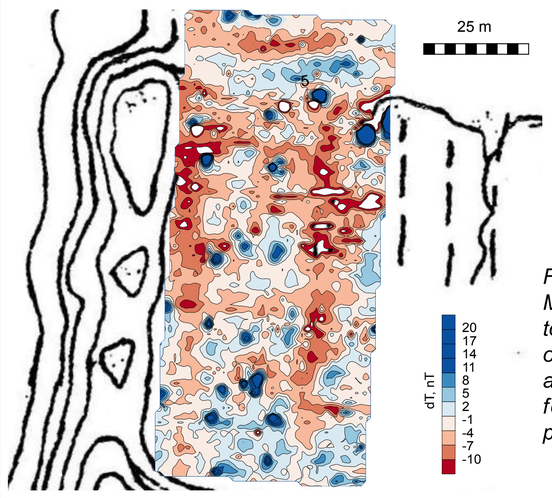

Figure 10. The area 1. Magnetic field and topography map. Streets and ovens can be seen (negative anomalies parallel to the fortress wall and local positive anomalies).

Conclusions

The results of geophysical investigation of two large early middle-ages Turkic fortresses provided fundamentally new information about its structure. The main conclusion concerns the principal applicability of geophysical methods for the investigation of sites made of mud brick, whose physical properties are close to physical properties of the surrounding virgin layer. Our researches widens the scope of positive outcomes of investigations of similar objects – of Ancient Egypt capital Memphis territory [Belova et al., 2005] and Uigur fortress Por-Bajin in Tyva region of Russia [Arzhantseva et al., 2009].

At the present time large-scale excavation of vast sites territories are impracticable for Turck archaeology. That is why geophysical methods of investigation are the optimal way of speedly obtaining reliable information for determining site planning and the occupation layer thickness and for conducting paleogeographic reconstructions.

Acknowledgements

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