

Results of geophysical methods in the study of the ancient settlement Dalvarzintepa (Uzbekistan)

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Abstract

The purpose of the study was to use a variety of geophysical techniques to uncover the shape, size, internal structure, and contour of archaeological artifacts buried beneath the surface. Magnetic prospecting, electrical resistivity tomography, and ground penetrating radar were the three main geophysics techniques. Various abnormalities are clearly traced on the maps created from the processing results of all methods in the form of figures with different lengths and forms. Archaeologists were able to identify the most important excavation sites using geophysical study.

Keywords

ancient settlement; anomaly; archaeological prospection; geophysics; processing of data

Introduction

The given abstract represents the results of geophysical measurements using magnetic prospecting, ground penetrating radar (GPR) and electrical resistivity tomography (ERT) methods in the study of the ancient settlement of Dalvarzintepa (Fig. 1).

The settlement is situated in Republic of Uzbekistan's southern region. It was one of the Kushan kingdom's significant trade and artisan centers in the third and fourth

century (Pugachenkova 1975). 47 hectares make up the entire area. Typically, the settlement's surface is flat. However, extensive erosion over many years has led in numerous areas of the surface subsiding. The findings of employing a set of geophysical techniques discovered by looking into a site in the northwest of Dalverzintepa are shown further down.

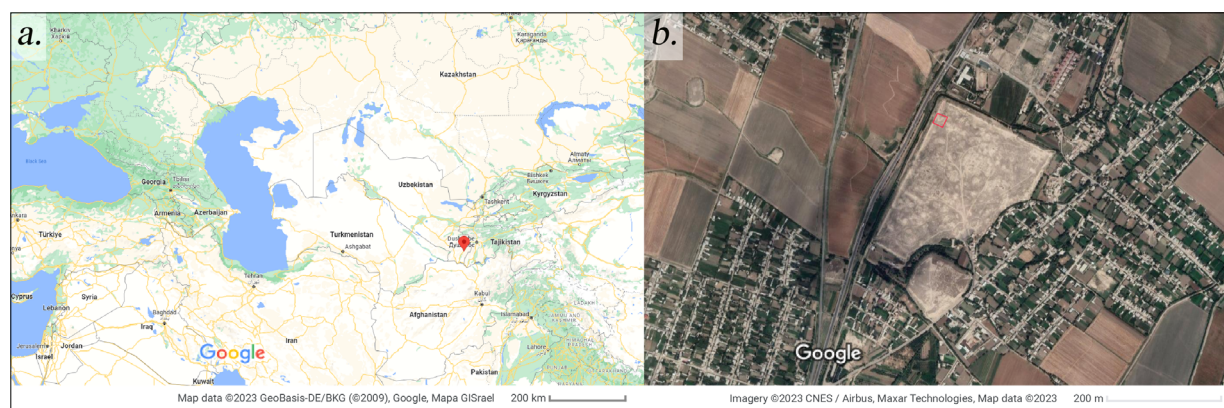


Fig. 1: Location of ancient settlement Dalvarzintepa. a) Google Earth image of the site. b). The area of interest is visible inside the red square.

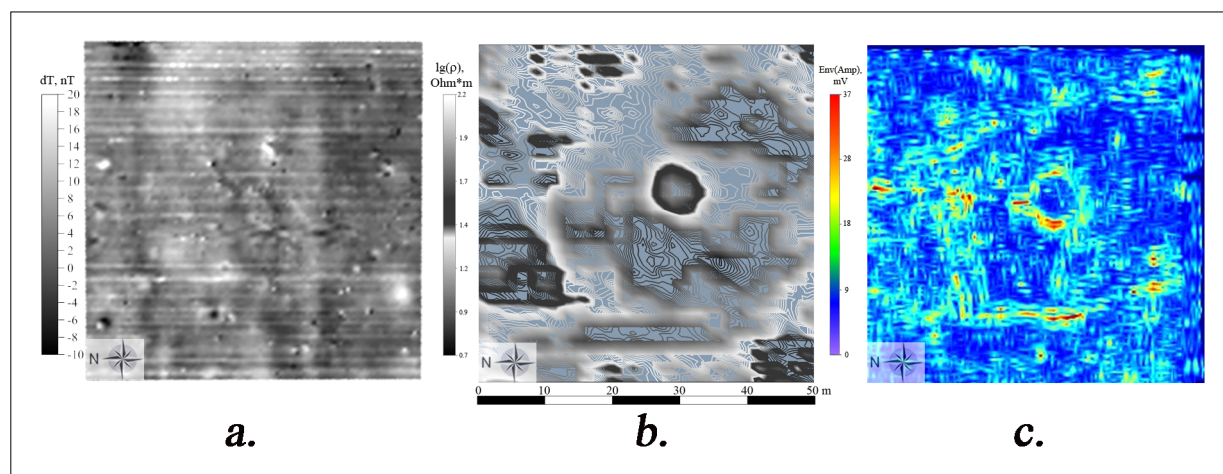


Fig. 2: Maps of geophysical anomalies within the research square obtained from the data of: a) magnetic survey, b) ERT (cut at an interval of 1-1.25 meters), c) GPR (cut at an interval of 1-1.25 meters).

Materials and methods

A proton magnetometer Geometrics 856AX (USA) was used to conduct magnetic surveys. Using 72 electrodes and a multichannel georesistivitymeter M.A.E. X612-EM72 (Italy), electrical exploration work was conducted. A 100 MHz antenna of Sensors and Software equipment (Canada) were used for the GPR.

Two sensors were used in a micromagnetic survey, and one magnetometer was connected to both of them via a beeper. A unique design was created in order to measure simultaneously along two profiles at the 50 cm distance between the sensors.

The number of electrodes was 72, the distance between them was 1 m, and ERT measurements were performed on 26 profiles with a step of 2 m. It made use of the Dipole-Dipole protocol.

Grid profiles were used to conduct the GPR measurements. The measurement network was made up of parallel profiles that were spaced 1 m apart in both the longitudinal and transverse dimensions. 100 MHz was the central frequency of the antenna.

Results

Maps of magnetic anomalies, sections and slices of resistivity over the area, as well as deep slices in accordance with GPR data were created as a result of field geophysical research and processing of the material obtained (Fig. 2).

Figure 2 illustrates how clearly anomalies are seen that describe specific items which are located at depth and covered by cover deposits. These anomalies are distinguished from others by a particular geometric feature, such as angularity, length, or roundness. Such anomalous manifestations may be related to certain ancient artifacts, such as structures or objects that were used for crucial activities in the past. An abnormality in the shape of a circle piqued everyone's interest. After conducting geophysical measurements in 5x5 m squares with 1 m broad edges, archaeological excavations within the research site were begun (Fig. 3).

The outcomes of archaeological digs in squares No. 7, 8, 10, and 11 confirmed an anomaly in the shape of a circle (Fig. 3c). Figure 3a demonstrates how the layer's thickness grows in the area of squares 8 and 11 close to the center edge. The walls are also clearly evident spatially and hypsometrically in Figures 3b and 3c, in plan and in section, and coincide with the anomalies discovered by using geophysical data.

Discussion

An efficient solution has been demonstrated to be an integrated area of geophysical research that uses magnetic prospecting, ERT, and GPR to explore ancient sites. Archaeological investigations in numerous locations have led to the confirmation of such a complex of geophysical techniques (Zakirov et al. 2022, Novikov et al. 2020, Hegyi et al. 2021).

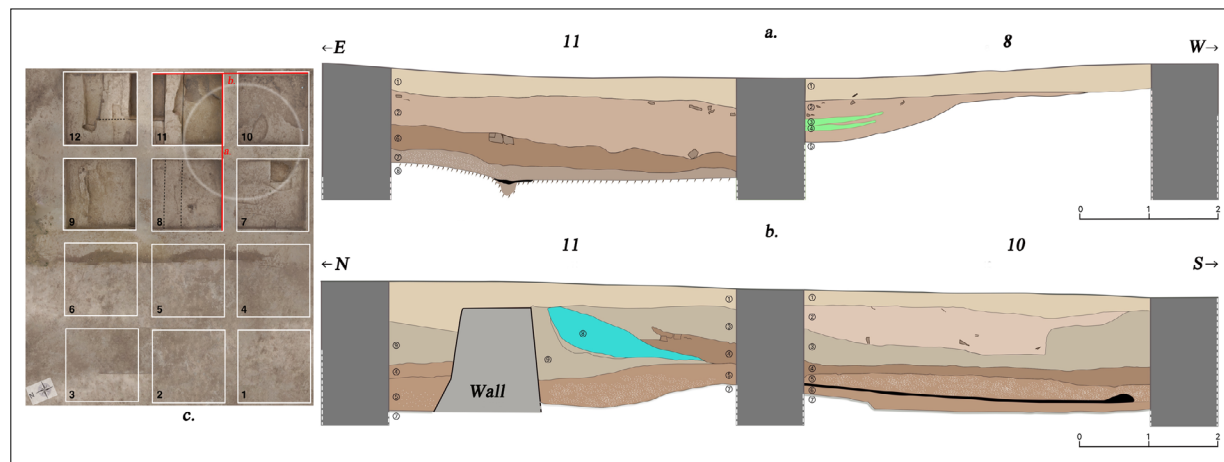


Fig. 3: Results of excavations. a) section of the southern edge. 1 - inflatable layer; 2 - a layer of ash and ashes with a large number of fragments of ceramics and bones; 3 - the remains of a round hearth made of baked clay with pieces of bricks; 4 - remains of a round fired clay hearth; 5 - burnt clay; 6 - a dense layer of a sinter character; 7 - ash layer; 8 - floor 1. b) Section of the eastern edge. 1 - inflatable layer; 2 - soil with ash and ashes, as well as with fragments of ceramics and bricks; 3 - a layer of ash with a large number of ceramics and fragments of bricks; 4 - a dense layer of a sinter character; 5 - burnt layer with ash; 6 - ash layer; 7 - floor 1; 8 - ash layer; 9 - layer of lumpy clay. c) phototopography of the excavation area.

Conclusion

By examining the geophysical data analysis findings, we can draw the conclusion that the techniques employed in this approach to investigate ancient artifacts were highly effective. Based on the findings of the work done, locations for additional non-invasive geophysical analysis of ancient artifacts were identified. █

References

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