

Geophysical surveying in Egypt: periodical report for 2021–2022

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Abstract

A magnetic survey of an Old Kingdom necropolis at Abusir near Saqqara yielded data for a reliable reconstruction of its layout. Water management in the hinterland of the Late Antique and Byzantine city at the site of Marea in northern Egypt could be reconstructed based on the results of a magnetic survey. The resistivity method was applied to record stone structures situated below the ground water table at the site of Heliopolis in Cairo.

Keywords

ancient Egypt; Byzantine period; magnetic prospecting; resistivity prospecting; water management research

Introduction

The author resumed geophysical research in Egypt in the spring of 2021, following a two-year break caused by the Covid-19 pandemic. The work that was carried out was part of the research program of the following expeditions: at Abusir, dir. Miroslav Bárta, (Czech Institute of Egyptology, Charles University); at Marea, dir. Tomasz Derda (Faculty of Archaeology, University of Warsaw); at Matariya/Heliopolis, dir. by Dietrich Raue (Leipzig University) and Aiman Ashmawy (Ministry of Tourism and Antiquities of Egypt); and at South Abydos, dir. Josef Wegner (University of Pennsylvania). The surveys continued the author's earlier work at these sites. The sole exception is Abusir, where the work was a follow up to what Roman Křivánek has done and was aimed at verifying the results of Ian Mathieson's survey. Assisting the author in this work were Robert Ryndziejewicz and Konrad Jurkowski.

Methods

Site characteristics and survey objectives determined the choice of geophysical methods: magnetic survey in Abusir, Abydos and Marea, and electrical resistivity in Matariya. A Geoscan Research FM256 fluxgate gradiometer was used for the magnetic prospection, the sampling in this case

being 8 measurements per 1 m², the traverses 0.5 m apart. Electrical resistance of the ground was measured with an ADA-05 resistivity meter (Elmes, Poland) using a twin-probe array, the traversing probes set 2 m apart. Here, the sampling grid was 1 measurement per 1 m².

Results

Abusir

The survey covered an area in the southern part of the site, bordering on Saqqara, in a burial complex from the Third to Sixth Dynasties (Old Kingdom, 2687–2190 BC) explored by the Czechs from the late 20th century. The area had been prospected with geophysical methods by both Ian Mathieson and Roman Křivánek (Herbich 2022). The objective was to investigate the area of the necropolis north of the burial complex. 17 ha were prospected, tracing the extent of the cemetery located at the base of the desert plateau running along the Nile Valley. The plans of most of the tombs could also be reconstructed based on the geophysical results. The tomb layout is typical of Old Kingdom burials. The building material is presumed to be mud brick based on the nature of the anomalies and the amplitude of magnetic values.

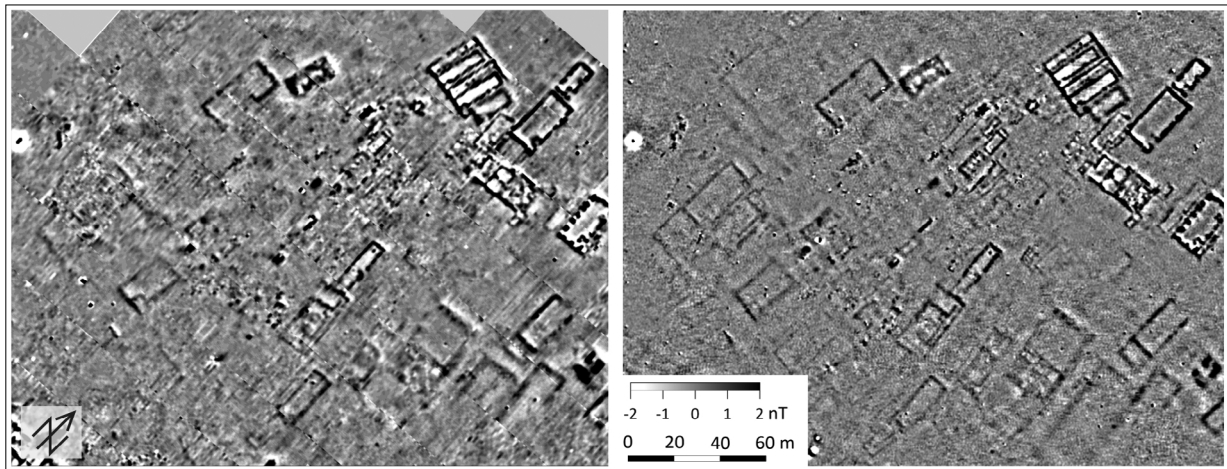


Fig. 1: Abusir. Magnetic maps. Left, results of Ian Mathieson’s team; right, results obtained in 2021.

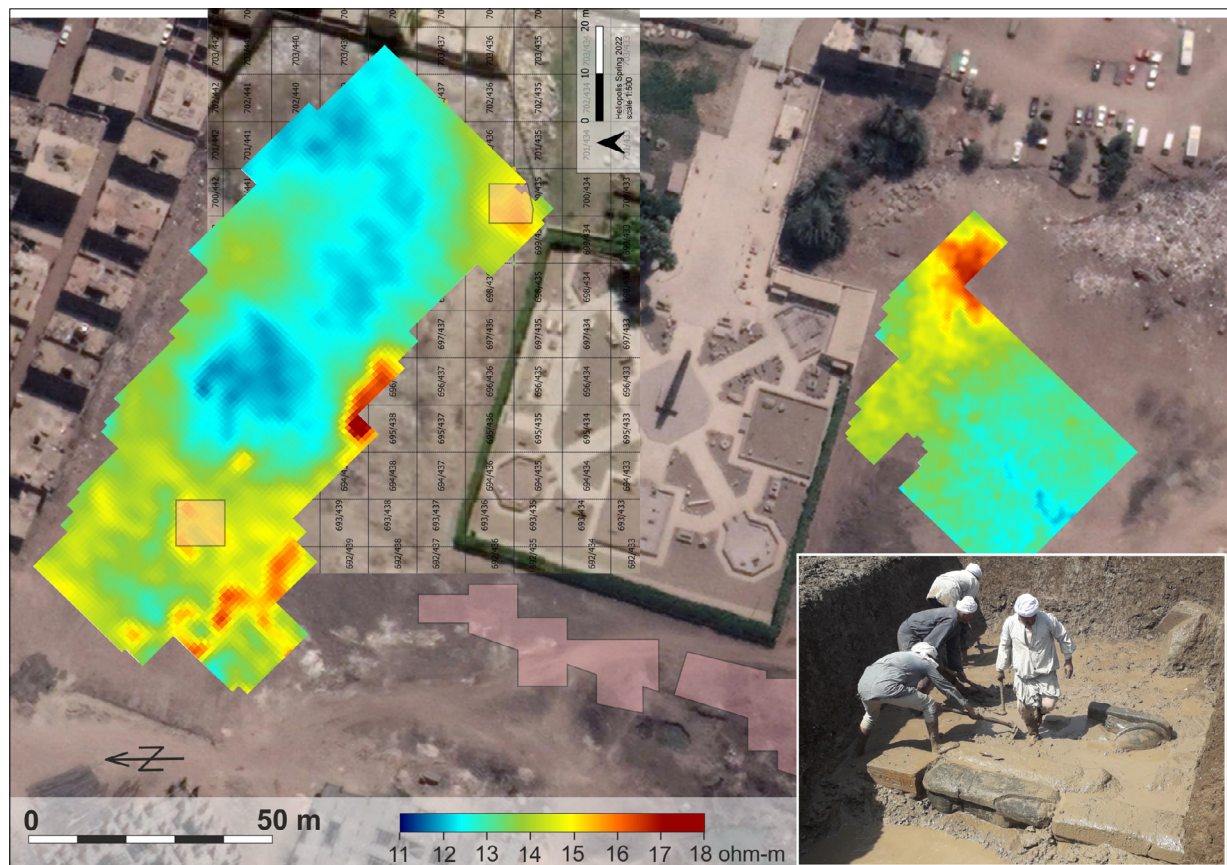


Fig. 2: Matariya. Electrical resistivity map. The excavation area of 2022 and sites where the geophysical results were archaeologically tested marked in transparent pink. Photo shows sphinxes from the New Kingdom during exploration (satellite image: Google Earth, ©2023 Maxar Technologies).

The prospection south of the burial complex aimed to verify the results obtained by Mathieson’s team. These are not very clear in many places because of a loose sampling grid (traverses 1 m apart) which was additionally orien-

ted N-S, the traverses doubling the orientation of most of the tombs. Using the same type of instrument (FM), but applying a denser sampling grid and orienting the traverses at an oblique angle in relation to the tomb orientation

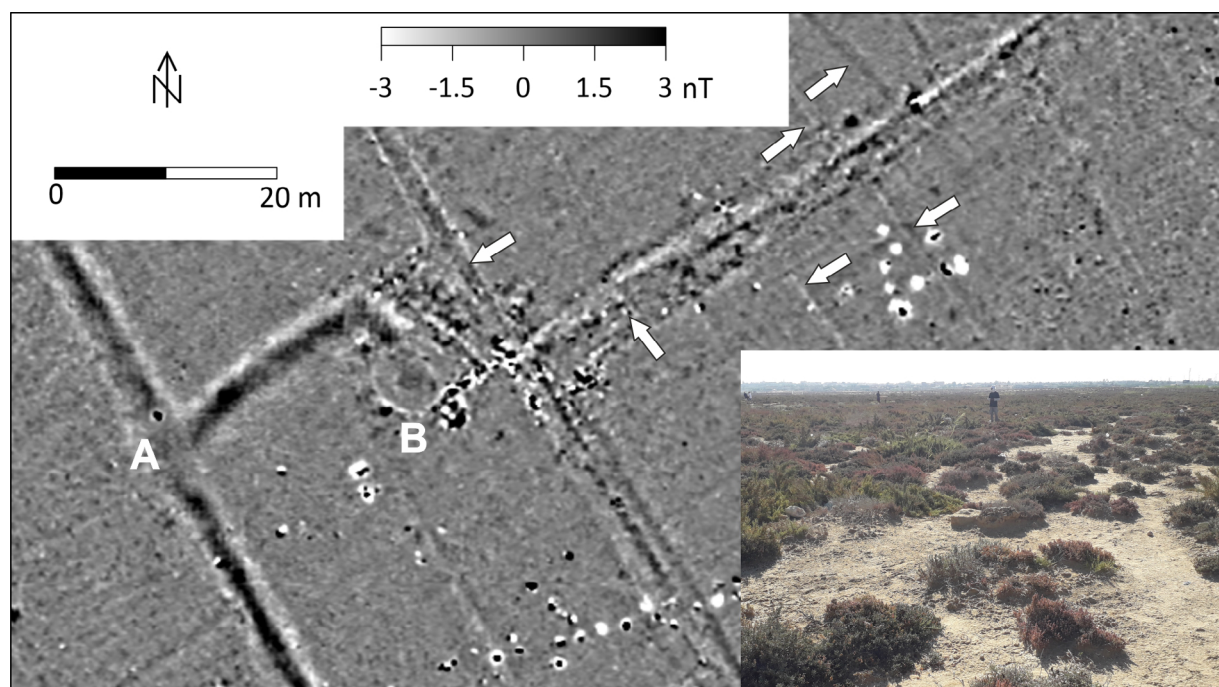


Fig. 3: Marea. Fragment of the magnetic map. A - main channel, B - saqia. Arrows indicate channels distributing water to the fields.

allowed for a much more precise reconstruction of individual tomb plans and revealed the presence of previously unrecognized burials (Fig.1).

Abydos

Work northeast of the burial complex of Senwosret III (1878–1843 BC) was aimed at tracing the remains of burials in this part of the site. A necropolis of unknown rulers of the Second Intermediate Period (c. 1650–1600 BC) had already been mapped by magnetic prospection (Herbich and Wegner 2003; Wegner and Cahail 2015). A series of low amplitude anomalies recorded now could correspond to a Predynastic necropolis mentioned by excavators from the early 20th century; this hypothesis will be tested archaeologically. The survey in another part of the necropolis, discovered south of the mortuary temple and settlement of Senwosret III in 2004, did not uncover any new tombs.

Matariya / Heliopolis

The work at Matariya is a salvage project investigating the area of one of the most important ancient Egyptian temples, the sun temple in Heliopolis, which is now the location of a new urban housing district with full road and commercial infrastructure. The temple, which was destroyed in late antiquity and again in medieval times,

was buried first in alluvia during regular Nile inundations in the past and then under several meters of urban trash. Today, the ruins are found for the most part below the groundwater table. Knowing that limestone, which does not have magnetic properties, was the main building material, the electrical resistivity method of prospection was an obvious choice (Herbich and Ryndziejewicz 2019). The eastern part of the temple was surveyed, supplying data for immediate archaeological testing. A few areas of distinctly higher resistivity values were recorded (Fig. 2). Testing of one of these areas revealed remains of a structure, which turned out to be of modern date.

Marea

Marea was an important urban center in late antiquity and the early Byzantine period (4th–7th centuries AD). Local limestone was the principal building material, with only occasional use of fired brick. Magnetic prospection and a topographic survey carried out over the past ten years have yielded an approximate town plan, point-checked only to a small degree by archaeological excavations ongoing since the mid-20th century (Derda et al. 2021). The general street network and various urban quarters were mapped using a cesium magnetometer and measuring the total magnetic field intensity. The current geophysical pro-

ject tested the efficacy of a fluxgate gradiometer compared to the cesium instrument and extended the prospection to the agricultural hinterland of the city. The FM survey of a test area yielded a somewhat more detailed picture of the architecture compared to the results obtained with a cesium instrument, but not good enough to reconstruct individual house plans as was the case earlier in the industrial part of Marea (Herbich 2005; Pichot 2010). Investigations south of the city have traced the channels distributing water from the lake throughout the town, including the main canal and a saqia waterwheel transferring water to a higher level from where it was channeled directly into the fields (Fig. 3). The results of the project have created the opportunity for a full reconstruction of the water economy in the agricultural hinterland of the town.

Concluding remarks

Magnetometry is still the main method applied in geophysical prospecting in Egypt. GPR has been found recently to be highly effective in prospecting mud-brick architecture in Sudan, especially in areas where the magnetic method is compromised by an extensive presence of pottery and fired brick (Obłuski, Herbich and Ryndziewicz 2022). However, in Egypt, administrative restrictions have limited the application of this method by foreign missions.

A positive outcome noted in some Egyptian academic centers is a close collaboration between geophysicists and archaeologists, taking advantage of current geophysical prospection results (obtained with the magnetic, electrical resistivity and GPR methods) to plan archaeological excavations. ■

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