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Archaeological prospection in Serakhs oasis in Turkmenistan

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Non-invasive surveys in Serakhs oasis in Turkmenistan were carried out within the frame of the "Landscape of Serakhs oasis settlement during the Sassanid period „project financed from Grant No. 203640 of the National Science Centre of Poland. The project aims to reconstruct the archaeological landscape of the oasis at a time when the area was part of the Sassanid Empire (3rd–7th century AD) and to do this it has envisaged comprehensive studies of settlement patterns and collections of ceramic and building materials, as well as frequent coins in order to determine the chronology of the located sites, isolating those with Sassanid-age relevance. Remains of fortified residences of the local landowners can be assumed to be present at most of the sites. Moreover, one can assume the existence of a relationship between the size of the house and its location (in relation to the main irrigation canals), and the status of the owner, to be confirmed by the results of research on individual sites. This research should be based on settlement studies related to the archaeological landscape.

The non-invasive surveys presented in this paper were the preliminary step to identify different architectural structures at the sites. Site selection was determined by the criterion of no archaeological evidence connecting a site with the Muslim period.

Aerial images were obtained with kites and the geophysical survey was carried out using a G858 Magmapper caesium magnetometer. The magnetometer, with two sensors set horizontally (0.5 or 1 m apart) recorded values of the Earth's total magnetic field at 0.125 m intervals along profiles set 0.5 or 1 m apart (depending on the size of sites and expected dimensions of archaeological remains). The pseudo-gradient of the horizontal component of the total vector of the magnetic field was calculated in order to assist in identifying anomalies caused by modern metal artifacts on the surface or at shallow depths. Fieldwork was carried out on six sites, the total area being more than 5 ha, located in a part of the oasis that had not been surveyed archaeologically before.

Aerial images were the first step in the process of documenting the selected sites (Fig. 1). For this purpose a flow-form kite (self-inflating without rigid reinforcing) with a bearing surface of

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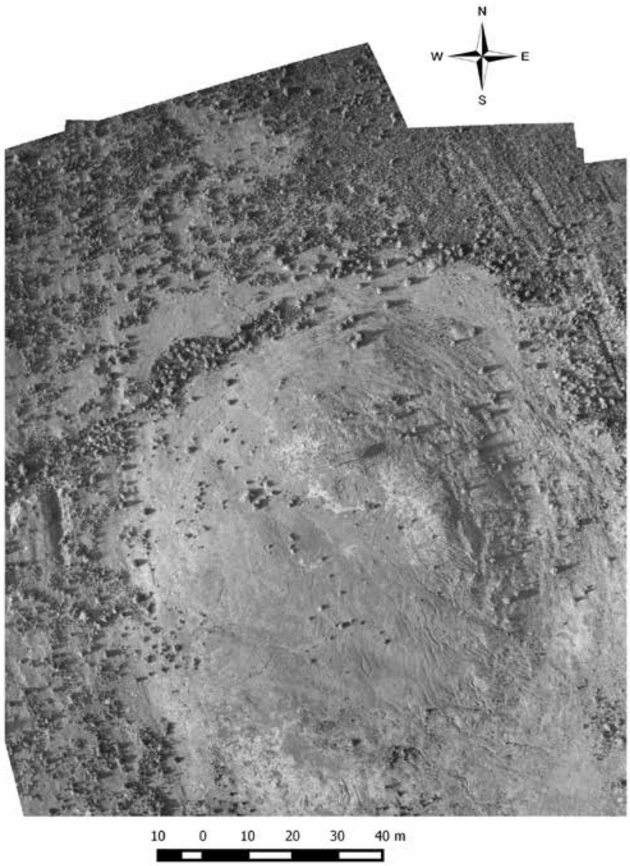

Fig. 1. Orthophotomap of the site Nazar Depe. (scale 1:500)

9-12 m² (depending on the strength and direction of wind) was used. These kites allow lifting Canon 5d mk2 camera with 24 mm and f 2.8 lens. The photographer could monitor the camera view via remote control console. Wireless transmission of data to the console also allowed precise control of the geographical location and determination of the altitude of the camera (with an accuracy of 2 m). The mounting of the camera made it possible to take both vertical and oblique photographs. However, defects in optical lenses and perspective deviations do not make the images suitable for obtaining distances directly. Therefore, photographs were processed with photogrammetric software into orthophotomaps and digital terrain models. Models textured with vertical images were recorded in digital form using, among others, standard 3D file format such as VRML or OBJ, but also as an xyz points cloud. Basic orthophotomaps were prepared as standard GeoTiffs, enabling processing and analysis with different compatible GIS software.

Topographic measurements were taken using a RTK GPS system (Fig. 2). Operating RTK (real time kinematic measurements) mode determines the position of the measured points with an accu-

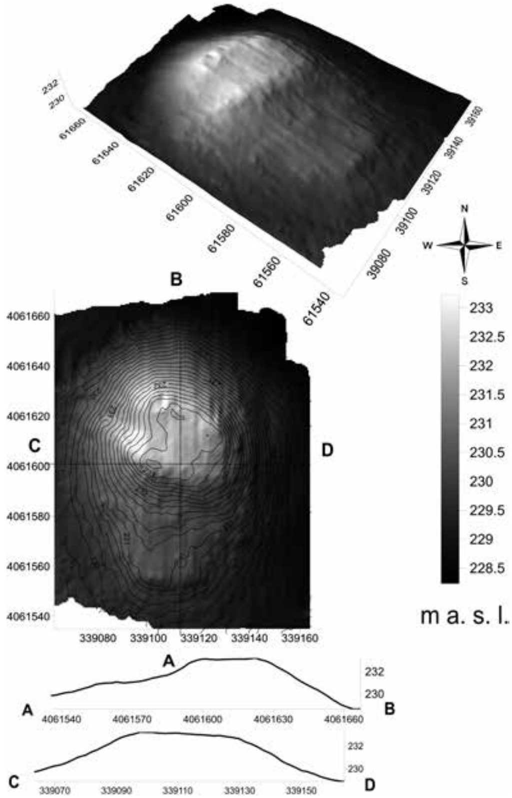

Fig. 2. Site Nazar Depe. Topographical documentation: digital elevation model (top), map of the layers (middle) and cross-sections (bottom)

racy of +/- 3cm (x, y, z). This allows topographic (but also magnetic) surveying without the support of other systems such as orthogonal grids or tape measures when combined with the visualization of the path of travel. The results of topographic measurements were also used for the preparation of orthophotomaps and 3D models of surface microrelief on the surveyed sites. Linking data from magnetic prospection with information about the surface relief not only provided an improved basis for locating archaeological remains, but also allowed a reconstruction of formation leading to a preliminary determination of the depth of features causing the magnetic anomalies.

The recorded total vector value of the magnetic field was in the range of several to tens of nT, the overall range being 49750–49950 nT (Fig. 3). Values depend not only on the state of preservation of the archaeological remains causing anomalies and location of the sites in relation to modern irrigation systems (wells and canals), but also on military installations. The archaeological interpretation could easily discount the latter changes. Remains of outer walls appear to be present on all of the surveyed sites. They are represented by narrow linear anomalies with regular, usually rectangular shapes, identified as internal structural elements. Strong dipolar anomalies on the magnetic maps

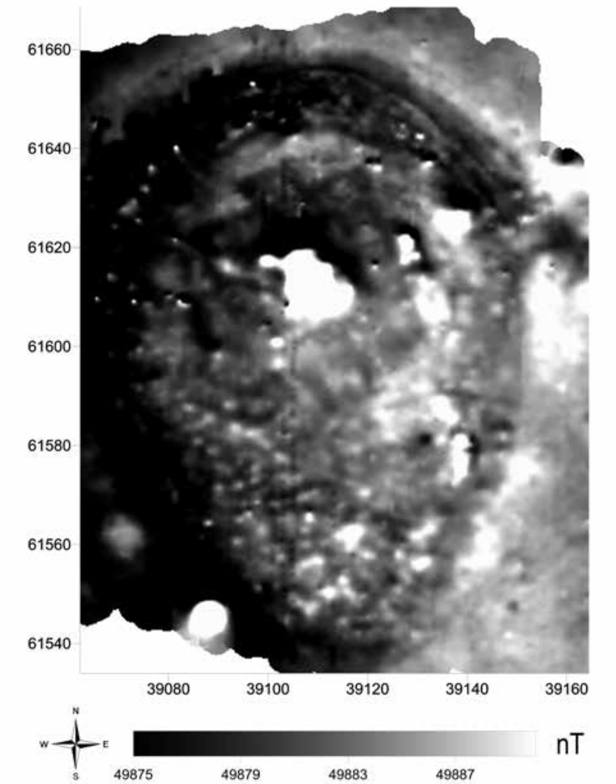

Fig. 3. Nazar Depe. Magnetic survey. Map of changes of intensity of the Earth's magnetic field in the range 49870-49900 nT

are the result of remanence magnetization of heavily burnt features. It is difficult to recognize the sources of such anomalies: they could be caused either by the presence of burnt objects (structures of red brick, furnaces, hearths) or by modern metal artifacts on the surface. Other possible sources include bonfires, usually on the highest points on any given site; it should be kept in mind that goat and sheep herding is a common occupation in Serakhs oasis.

The nature of the anomalies depends also on the state of preservation of the remains. Many features were destroyed already in antiquity and post-depositional processes, such as wind and water erosion on the slopes, would have caused further damages. Wherever Muslim pottery was observed on the surface, one needs to consider a phased stratigraphy as an explanation for the magnetic anomalies.

Naturally, stratigraphy cannot be established based only on the result of non-invasive research and it is even less possible to determine the dating of preserved remains. Potsherds collected from the surface may be helpful in identifying later phases, but the most appropriate solution for a less ambiguous interpretation of data gained through non-invasive methods is to probe selected areas with traditional methods of archaeological excavation.