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The Swiss IAW-EurAsia Project on Urban Development and Land Use in Gonur Depe (Turkmenistan)

A geo-magnetic survey

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Abstract: The Institute for Archaeological Sciences (IAW) of Bern University and the company GGH Solutions in Geosciences undertook a large-scale magnetometer survey of the city of Gonur Depe in south-east Turkmenistan in 2014 and 2015. This was done within the framework of a Swiss-Russian project to analyse urban development and land use in Gonur Depe, and was headed by Bern University in cooperation with the Russian Academy of Sciences, Moscow, the funding being provided by the Society for the Exploration of EurAsia. An area of 257,712 sq m was scanned in and around Gonur Depe. Numerous urban elements can be identified in the magnetogram, such as parts of the city wall, a ditch, water basins, high-temperature areas like kilns and ovens, mud-brick buildings, and tombs belonging to the necropolis. Hence important additional information has been revealed concerning the urban layout. This will help to define and select future fields of excavation.

Keywords: Gonur Depe, GIS, magnetometry, necropolis, kilns.

Резюме: Институт Археологических Наук (IAW) Бернского Университета и компания “GGH Solutions in Geosciences” предприняли крупномасштабное магнитометрическое исследование города Гонур-Депе на юго-востоке Туркменистана в 2014 и 2015 годах. Исследование было проведено в рамках швейцарско-российского проекта по изучению городского развития и эксплуатации территории на Гонур-Депе, возглавляемого Бернским Университетом в сотрудничестве с Российской Академией Наук, г. Москва, и финансируемого организацией “EurAsia Society”. Была просканирована территория площадью 257,712 кв. м. внутри Гонур-Депе и вокруг него. На магнитограмме можно выделить многочисленные признаки городской цивилизации, такие как части городской стены, ров, водоемы, высокотемпературные области — печи и очаги, кирпичные здания и могилы, относящиеся к некрополю. В результате была получена дополнительная важная информация о городской планировке. Это поможет определить и выбрать участки для будущих раскопок.

Ключевые слова: Гонур-Депе, GIS, магнитометрия, некрополь, печи.



Fig. 1: Fluxgate-Magnetometer mounted on a portable rack, Gonur Depe (photo C. Hübner).

1 Introduction

The Bronze Age settlement of Gonur Depe has been excavated by the Russian archaeologists Victor Sarianidi and Nadezhda Dubova over the past 40 years.¹ The site is situated in the historical region of Margiana, 70 km north of modern Mary in south-east Turkmenistan. It lies at the margins of the alluvial inland fan of the Murgab River in the southern part of the Karakum Desert. Here, on the lower slopes of the fan, the deposits are dominated by fine sands, silts and muds, so it is no wonder that almost all the architecture was made of mud bricks.

The settlement consists of two complexes, Gonur North, at the centre of which is a huge building inside the so-called *kremlin*, and Gonur South, with a similar but significantly smaller structure, called the *temenos*.

The Russian excavations have revealed huge parts of the entire settlement, providing an impressive insight into the layout of the ancient city. However, some areas still remained unexcavated, leaving open several questions, such as the exact limits of the settlement. Hence the project initiated by the Institute of Archaeological Sciences (IAW) of Bern University, and funded by the Society for the Exploration of Eurasia, was intended to gather further information, first on the extension of the settled area, and second on the functional structure of the ancient city. The method used was geomagnetic prospection, which was executed by GGH-Solutions in Geosciences,

Freiburg (Germany).² The work, which was made possible through the kind invitation of Professor Doctor Nadezhda Dubova, was based on a cooperation agreement between the Margiana Expedition of the Russian Academy of Sciences and the University of Bern.

2 Geomagnetic survey

At the centre of Gonur North is the *kremlin*, a square fortified complex approximately 120 × 120 m, consisting of the palace and several adjacent buildings. It was surrounded by other public buildings, presumably temples, inside another enclosing wall.³ Together, they form a square “inner” city with a side width of 175 m. This inner city was situated in an extensive urban settlement with domestic areas, water basins, royal tombs and open spaces, and was encircled by another wall with an irregular outline. The oval-shaped town had a maximum diameter of about 450 m. To the west of the outer city wall, an extensive necropolis was discovered and completely excavated. About 200 m south of Gonur North, another square structure similar in size and layout to the *kremlin* was exposed, so-called Gonur South.

The major objective of the project Urban Development and Land Use in Gonur Depe was to prospect the unexcavated areas of Gonur Depe with the help of non-invasive research methods, preferably

1 On the excavations in Gonur Depe, see DUBOVA in this volume; on the Swiss IAW-SLSA project, see WINKELMANN 2014 and 2015.

2 Two campaigns have been undertaken so far: from 15 to 27 September 2014, and from 22 April to 1 May 2015, led by Christian Hübner and Klaus Kurz. The project is directed by Mirko Novák, and Sylvia Winkelmann is field director.

3 See DUBOVA in this volume.



Fig. 2: Magnetogram of Gonur Depe North and the *temenos*; area 257,712 sq m; Förster gradiometer; measuring grid: 0.5 x 0.2 m; dynamic range [± 5 nT] combined with World Imagery, Sources: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.



Fig. 3: Three excavated kilns outside the outer city wall to the south-east of Gonur Nord (photo C. Hübner).

a magnetic survey. This method, which guaranteed the fast acquisition of data, is suited to capturing remains like high-temperature areas, mud-brick walls, ditches, pits and tombs. The magnetic survey was carried out in September 2014 and April 2015, over an area measuring 257,712 sq m. Four Fluxgate gradiometer probes con 650 with a Ferex 4.032 data logger, mounted on a portable rack, were carried by one person along survey profiles, with a sampling interval of 0.20 m inline and 0.50 m cross-line (Fig. 1).

The datasets were processed with the software magtools⁴ and presented in the Geographic Information System ArcMap by ESRI as a greyscale image. Created using a high-precision DGPS System, the magnetogram and the topographical maps made by the Russian team were transformed into the UTM coordinate system 41N. This means that the results can be synchronised with the satellite image within GIS (Fig. 2).

The magnetic prospection of Gonur North was carried out in areas inside and outside the outer (“third”) fortification wall and in the vicinity of Gonur South. Unfortunately, some other areas were covered by the dump of the former excavations, rising up to 8 m in height and making a survey impossible, or preventing the creation of clear images. Numerous linear elements, visible in the magnetogram, were caused by mechanical removal of dump over the past 40 years.

However, the results were more than satisfying, for prominent magnetic anomalies were discovered in all prospected areas.

West of the palace, two linear structures were detected. The western one has a length of 130 m and runs exactly along the assumed line of the expected third city wall (and seems to mark the border of settlement in the west of Gonur Depe North during period II.). The eastern one has a length of 112 m and is identical with a moat excavated in the Swiss team’s Trench A.⁵ East of this ditch, the anomalies refer to mud-brick architecture and high-temperature spots that indicate furnaces or ovens. The elements belong to structures excavated by the Russian team further to the east. West of the ditch, narrow, restricted positive anomalies can be observed which can be identified with tombs and pits of a newly found cemetery existing additionally to the huge necropolis further west. The centre of the cemetery is situated 200 m west of the ancient town and was excavated by the Russian team.⁶

To the south and west of the palace, outside the “second” city wall, magnetic anomalies indicate the existence of water basins similar to those already excavated by the Russian team. The great southern basin is limited by linear elements.

Other prominent anomalies are located 30 m south of the royal tombs. They are related to burned mud-brick structures and high-temperature spots. Numerous magnetic dipole and multipole anomalies

4 GIESE/GRUBERT/HÜBNER 2007.

5 Excavations carried out by the University of Bern within the framework of a Swiss project, Excavations in Gonur Depe, and funded by the Swiss-Liechtenstein Foundation for Archaeological Research Abroad (SLSA), have proved the existence of this ditch, which was filled completely with ash and refuse. Its function, however, remains still unclear.

6 SARIANIDI 2007.

lies like these result from the thermoremanent magnetisation of clay and muds by kilns, fireplaces and ovens.⁷ They have ash layers in parts up to 1 m thick. Most of these anomalies appear between the second and third city wall. In addition, a concentration of kilns can be seen outside the south-eastern alignment of the “third” city wall, indicating a workshop area (Fig. 3).

Furthermore, a prominent circle structure was detected in the magnetic survey south of the *kremlin* between the second and third city wall. The object with a diameter of 7 m was sounded by the Russian team. It could be identified as a further and well preserved circular altar.

North of Gonur South, multipole anomalies identified further high-temperature areas. The predominant positive anomalies west and east of this field are caused by two modern fields for ceramic studies, arranged by the Russian team in the past decades. More anomalies related to high-temperature area and pits were detected 130 m west of Gonur South. Here, a high accumulation of pottery sherds covers the surface.

Finally, another concentration of numerous contiguous multipole anomalies is located 70 m south of Gonur South, situated in the centre of a wide mound with a diameter of 120 m. The anomalies cover an area of 20 × 50 m and again indicate high-temperature areas like fireplaces. In two soundings opened by the Russian team several years ago, thick layers of ash have been exposed. On the same mound, several linear structures, presumably mud-brick walls, are visible. All indications are that this area was a workshop quarter.

3 Urban implementations

In total, 549 anomalies of pits or tombs and 111 high-temperature spots were discovered in the survey, distributed over almost all areas surrounding the “inner city”, both inside and outside the “third” city wall. The enormous quantity of ceramics found, together with the absence of metal slag, suggests ceramic production rather than metallurgy. Depending on the weak susceptibility contrast between the soil and mud-brick material, only in a few areas of the site were mud-brick walls detected, mainly in undisturbed fields like those east of the *kremlin* and around Gonur South.

The magnetic survey has revealed some extramural occupation areas. One such settlement is situated 150 m north-north-east of Gonur North and was partly excavated by the Russian team. They belong to a small settlement outside of the third city wall with remains of a street-system and some graves. The settlement is in total 100 × 30 m. North of it, at a

distance of 100 m, some spots of positive anomalies were observed. In between Gonur North and South, as well as to the east and west of Gonur North, the magnetogram does not reveal striking anomalies. In the magnetogram, geological structures of river channels are visible, as well as traces of the modern path network, and agriculture features (Fig. 4).

How can all this data be interpreted in respect of urban development and land use?

First of all, it seems obvious that the ancient settlement shows a very thorough town-planning concept, with a concentric structure of the settlement sectors. Another characteristic feature is a functional distinction between the official quarters inside the *kremlin* and the “inner city”. The dwelling quarters were situated both inside and outside the enclosed area, showing that the primary function of the outer (“third”) city wall was symbolic, its role being to segregate rather than to provide a real military fortification, as has already been observed by the Russian excavators.⁸ Of high interest are the satellite settlements located at a considerable distance from the main site.

Some traces of irrigation channels have been detected in the magnetic survey, between Gonur North and South, and east of Gonur North. Such channels, similar to those discovered by the Russian excavations,⁹ presumably became necessary when the Murghab River started to dry out. It seems likely that the moat excavated in the Swiss Trench A and identified in the magnetic survey west of the *kremlin* was originally constructed as a water channel for irrigation, being the first approved example inside the city wall. However, this channel’s primary function was abandoned shortly after construction and it was re-used for other, as yet unknown, purposes. When it was exposed, it was completely filled with ash and settlement debris. As the Swiss excavations have revealed, it was later re-used for a small cemetery during Period III. West of the second city wall, a water basin was detected, presumably also part of the water-supply system.

The high quantity of anomalies indicating high-temperature workshop areas is surprising. As mentioned above, it is unclear so far whether all kilns served for pottery production, or at least partly also for metallurgy. For the latter conjecture, no supplementary indicators – like metal slag at the surface – have been found. However, one important consequence is that obviously more pottery was produced in Gonur than required for internal consumption. Hence we can conjecture that the city was a production centre, at least for parts of the Murghab delta, if not the entire BMAC (Bactria-Margiana Archaeological Complex). This question must be

7 LE BORGNE 1960.

8 DUBOVA in this volume.

9 DUBOVA in this volume.

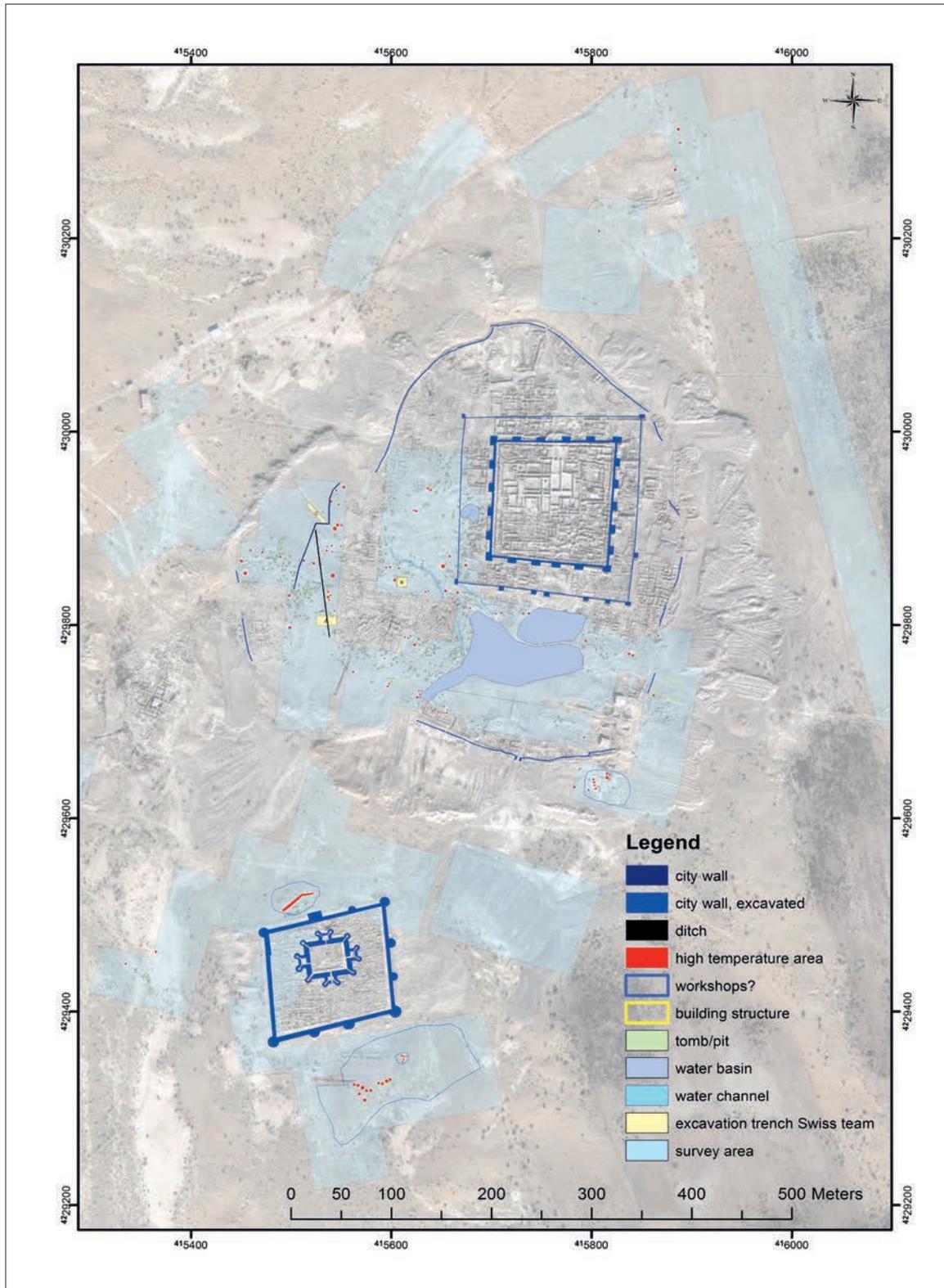


Fig. 4: Archaeological interpretation of the magnetogram, combined with the city map of the Russian team and World Imagery, sources: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

resolved by detailed typological and archaeometric studies on BMAC pottery in general.

Another even more interesting consequence of the survey is the fact that a number of artisans and craftsmen must have lived in or around Gonur. And if this is the case, other specialised professions have to be expected among the inhabitants of ancient Gonur, including their families. We have to assume that Gonur was not only a “city of kings and gods”¹⁰ but of “ordinary” people as well.

Further investigation has to test these suppositions. Beside the Russian excavations, a continuation of the Swiss research is intended, both in respect of further geophysical prospections and remote sensing, and also archaeological excavations. The latter will focus on fine-tuning the stratigraphy, but also on exploring some dwelling quarters to gain more information on the “ordinary” people among the inhabitants of Gonur Depe.

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10 SARIANIDI 2005.