

*Henning Zöllner – Burkart Ullrich – Renate Rolle – Sergey Makhortykh – Michai Orlyuk*

## Results of Geophysical Prospection in the Scythian Settlement of Belsk (Bol'šoe Belskoe Gorodišče)

*Abstract:* Since 2002, as part of joint Ukrainian-German archaeological expeditions to the Belsk hillfort and kurgan cemeteries, geophysical prospection methods have been used to investigate the large-scale area of interest on this unique site. It was possible to demonstrate the effectiveness of geomagnetic investigations in precisely locating and identifying archaeological structures. One of the most significant results of these recent studies is that geomagnetic data also provides evidence for the kurgans' containing the graves of the ascendant class of Scythian society. With the help of geomagnetic surveys, kurgans could be detected that are invisible because of surface unconformities. Saltpetre production in the 17<sup>th</sup> and 18<sup>th</sup> centuries may explain why nearly all kurgans found were almost totally destroyed. Here too our hypotheses were supported by geophysical data, as geomagnetic anomalies were detected that were most likely caused by fireplaces and other sources from this time.

### *The Hillfort of Belsk – the City of Gelonus*

With an overall length of about 35 km and an enclosed area of more than 40 km<sup>2</sup>, the hillfort of Belsk is probably the largest and most impressive fortified settlement from the Early Iron Age in Europe. It is situated in the eastern Ukraine around 100 km west of the town Kharkov.

Scythians founded the settlement between 700 and 400 BC. Experts are generally agreed that the Belsk hillfort coincides with the ancient settlement of Gelonus mentioned by Herodotus (see for instance SRAMKO 1987). According to Herodotus, Gelonus was a large town in the heart of Scythia. He describes the city as being bordered by two 30-fur-long long wooden walls forming an acute angle. He also mentions numerous altars. Furthermore, he characterizes the inhabitants as Geloni, people of mixed Greek and Budini blood, speaking the Scythian language. In the 5<sup>th</sup> century BC, the Persian army under Darius reached Gelonus (in his assault on Scythia) and burned it to the ground. The populace was said to have abandoned the city before the Persian advance (HERODOT 4, 123).

The ramparts of Belsk form an irregularly-shaped triangle enclosing a plateau that is cut by streams and loess channels. Two fortifications (Vostochnoye and Zapadnoye), covering areas of 85 ha and 95 ha, are located in the western and in the eastern part of the Belsk hillfort, respectively. They were built to control and secure the vast river valleys. To this day, relicts of the historic ramparts with heights between

7.5–9 m, as well as ditches up to 6m deep, can be found.

Well-situated strategically at the border of steppe and forest-steppe, the Belsk fortification was the political, trade, religious and industrial centre of the Scythian tribal unions. Archaeological findings of craft workshops and a large amount of imported Greek pottery (amphora, black-lacquered ware, etc.) from the 5<sup>th</sup> and 4<sup>th</sup> century BC confirm that theory.

The significance of the site at Belsk Goridišče is so obvious that it is presumed to have been a former royal residence of the Scythian Empire. Belsk was built at the same time as the Greek city-states were colonizing the coastal areas of the Black Sea and the Scythian military campaigns to the Middle East were about to cease. As Scythian rulers tended to imitate the kings of Assyria and Urartu, the construction of such extraordinary and spacious complexes like the Belsk Goridišče is most likely the result of contact between Eastern European culture and the Middle East. Outside of the settlement, several large necropoleis are located close to the ramparts (Skorobor, Pereshepino).

### *History of Investigation*

The Belsk settlement has been variously investigated for approximately 100 years. The earliest archaeological discoveries of 1906 are associated with V. A. Gorodtsov, who conducted the first sci-



Fig. 1. Geomagnetic prospection (profile distance 1 m) at the Belsk settlement; in the back the rampart of the Zapadnoye goridišče (oil rigs in the back).

entific excavation and attributed it to the Scythian period.

From 1960 to 1980, the Belsk hillfort has been the subject of several investigations by the University of Kharkiv. Detailed studies of living and working quarters were conducted in the Vostochnoye fortification whereas other parts of the Belsk settlement were barely included in former research work. In the 1990s, a joint Ukrainian-German archaeological research team started to explore the Belsk hillfort on a larger scale. Since 2002, geomagnetic prospection, kite aerial photography and topographic measurements have been carried out to support the archaeological investigations.

### *Technical Realization*

For the geomagnetic prospection, an array of five Förster fluxgate magnetometers was used (Fig. 1). The magnetometer measures the gradient of the vertical component of the earth's magnetic field. The general profile distance was 40 cm; due to the very large investigation area the sensor spacing was at times extended up to 1 m in horizontal direction. This meant the data resolution increased, but areas up to 5 ha could be covered in a single day. A reflectorless Leica total-station took topographic measurements. For the aerial photography, a four-megapixel digital camera was used and the pictures referenced later on.

### *The Area of the Necropoleis*

The necropoleis of the Belsk settlement had been an important aspect of past investigations in this area. Therefore it was all the more remarkable that no large kurgans had so far been identified by relief anomalies. Inside the kurgan necropoleis of Skorobor and Marchenki, the remains of so-called "maidans" – mysterious kurgan-shaped earth-constructions – were found, which had caught the attention of many researchers already. New geomagnetic data indicates that these "maidans" correspond with the remains of destroyed kurgans and that these kurgans were of a significant size.

In the Marchenki necropolis (kurgan groups "fifth and eighth fields"), for example, the remains of four kurgans were found, each surrounded by a ditch with diameters between 50–60 m. The magnetic map in Fig. 2 shows an example of a clearly visible ditch surrounding a kurgan. The underlayed topographic map is 10 times super-elevated. Only through the super-elevation can the typical shape of the "maidan" be recognized.

In the Skorobor necropoleis, another kurgan of even greater size was located, again surrounded by a ditch with a diameter of approximately 100 m. Taking into account that the ditches are usually at a distance of 0.5–6 m from the base of the burial mounds, and considering the strict correspondence between ditch diameter and the status of those buried in upper-class Scythian society, it is highly likely that more of these Early Scythian elite kurgans are still hidden in the outskirts of the Belsk hillfort. These elite kurgans were built to stand out against the landscape and the smaller kurgans. Undoubtedly, the construction of such monuments required significant labour and resources. The most important result of the geophysical investigation is thus not only the confirmation of the Belsk hillfort as the largest fortified settlement of the Scythian epoch in Europe, but also the verification that large kurgans, classified as royal kurgans, exist surrounding it. In addition, the results of investigation demonstrate the advanced social stratification of Scythian society in the study area and testify to the importance of Belsk as the centre of political authority in the Scythian epoch.

### *The Zapadnoye Fortification*

Another important result of the geophysical investigation at Belsk hillfort is the discovery of 18 groups

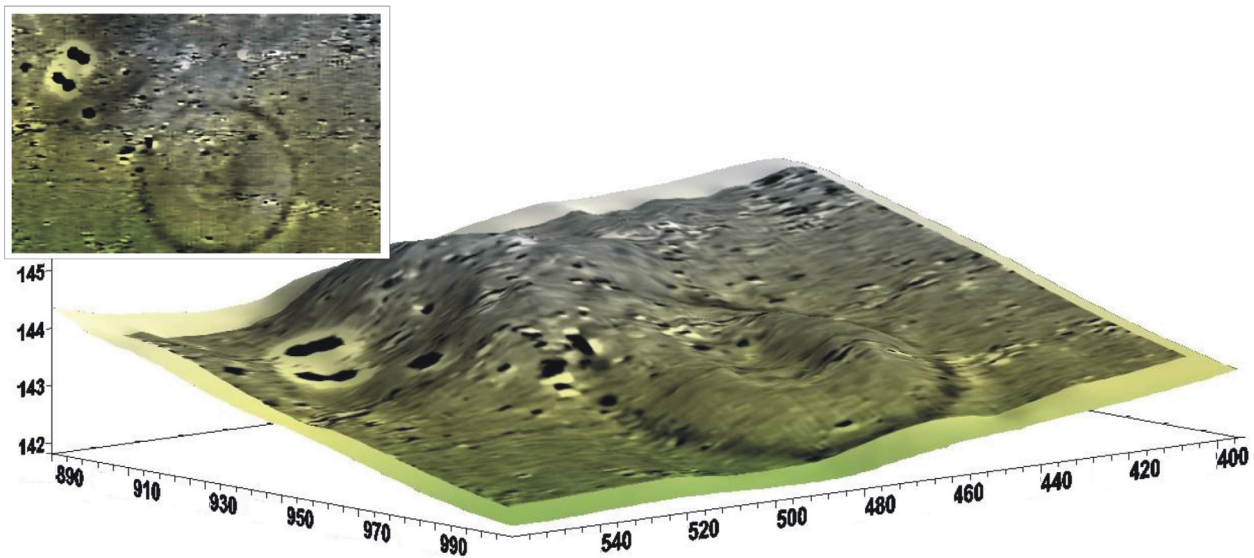


Fig. 2. Kurgan N° 5. Topography (10× super-elevated) with overlaid magnetic map ( $\pm 3\text{nT}$ ).

of extended-dumbbell-shaped anomalies in the Zapadnoye fortification. These patterns are arranged in rows close to the defensive wall. Fig. 3 shows the positions of the anomalies in the geomagnetic map (left) and in a bird's eye view over the Zapadnoye fortification (right).

One of these anomaly groups was excavated during the expeditions of 2005 and 2006 and three furnaces were discovered. A large pit in the ground served as the floor for these furnaces. Their walls were coated with a thick layer of yellow clay, as

were the floors. Similar anomalies were found close to the remains of the large kurgans in Marchenki and Skorobor necropoleis (Fig. 2).

The anomalies close to the destroyed kurgans correlate with deep pits in the defensive walls of the Zapadnoye fortification and probably have a similar origin: saltpetre production in historic times. The Polish historian O. Jablunovski reported that the Polish people extracted saltpetre in Skorobor in 1613 using the soil from ancient burial mounds.

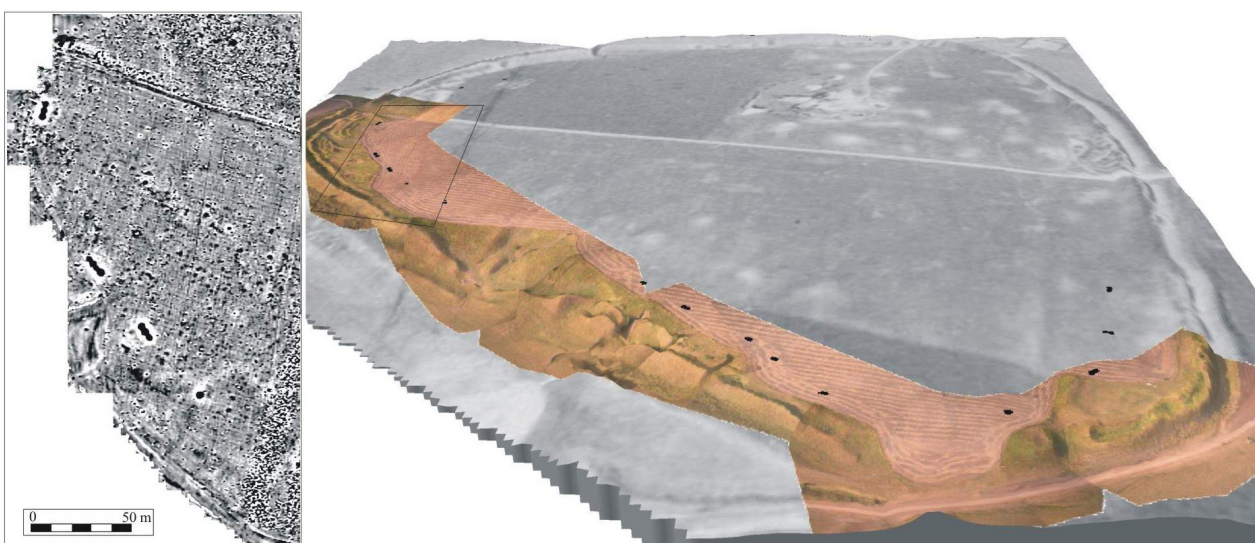


Fig. 3. Left: Section of the geomagnetic map ( $\pm 3\text{nT}$ ). Its location is also shown as a black square in the terrain model to the right. Right: View over the Zapadnoye fortification. Orthogonal kite aerial photographs overlay a digital terrain model (east-west extension approximately 1 km). Furnaces are marked in black and represent the results of geomagnetic interpretation.



Throughout the 17<sup>th</sup> and 18<sup>th</sup> centuries, saltpetre production was very common in the Poltava region. Almost every province (uyezd) controlled a large number of saltpetre fabrication sites until the beginning of the 19<sup>th</sup> century. In 1858, about 2800 workers extracted an amount of 64,000 poods (1050 tonnes) of saltpetre in 75 saltpetre production sites, using it mainly for gunpowder production. Saltpetre accumulates in the rich chernozem humus and is derived from organic residues. Natural deposits in the Belsk region – the Eastern Ukraine is one of the largest chernozem areas in the world – and an additional enrichment of organic materials in the burial mounds made the Belsk hillfort area to one of the most important centres of saltpetre production in Eastern Europe.

### *Conclusion*

The research of the Ukrainian-German cooperation has set new trends for studying the Bol'shoe Belskoe Gorodišče, closely connected with one of the most advanced regions of the Scythian world in the 7<sup>th</sup>–5<sup>th</sup> centuries BC – the middle Vorskla basin. The absence of large kurgan findings in the Belsk settlement area led to geophysical investigations being made. With the help of geomagnetic prospection these kurgans could be found and shown as footprints in the geomagnetic data. There are clear hints that these kurgans were destroyed systematically in the 17<sup>th</sup> and 18<sup>th</sup> centuries, when people settled the land for saltpetre production.

### *Acknowledgements*

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*Henning Zöllner  
Burkart Ullrich*

*Eastern Atlas  
Geophysical Prospecting  
Grosse Hamburger Str. 17  
10115 Berlin  
Germany  
[hzoellner@eastern-atlas.de](mailto:hzoellner@eastern-atlas.de)*

*Renate Rolle*

*University of Hamburg  
Institute of Archaeology  
Edmund-Siemers-Allee 1  
20146 Hamburg  
Germany*

*Sergey Makhortykh*

*Academy of Sciences of the Ukraine  
Department of Archaeology  
12 Geroiiv Stalingradu ul.  
Kiev  
Ukraine*

*Michail Orlyuk*

*Academy of Sciences of the Ukraine  
S.I. Subbotin Institute of Geophysics  
Kiev  
Ukraine*