The structure of the burial mounds in the Eastern Hallstatt areas: a geophysical approach

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Abstract
Prospecting ploughed-out/erased burial mounds is an important part of the Early Iron Age sites research. A complex use of geophysical methods in forested areas is effective also in the case of tracing the construction of burial mounds. Burial mounds that appear similar on the DSM have relevant differences in their construction.

Keywords
burial mounds; Eastern Hallstatt culture; ERT; GPR; magnetometer prospection

Introduction

In the Early Iron Age (EIA), fortified hilltop settlements and (extensive) tumulus fields began to appear in the broader eastern Alpine region, also referred to as the eastern Hallstatt area. This is considered a fundamental and large-scale landscape transformation, creating site-complexes of more than 100 ha. As the main research focus was usually on the burial chambers and the riches they contained, only traditional fieldwork strategies (mainly excavations) were employed. In contrast, only little data was collected on the complete burial mound construction and especially on the areas between the individual barrows and the possible further sites in the area. Basic questions, like how many settlements and necropolises are in these site agglomerations, where are the borders of the site complexes, what are the limits of the single sites in it, what are the typical constructions of the burial mounds, often remain unanswered to this day.

Within the framework of a Hungarian-Slovenian project starting in 2020-2021, the two case study EIA site complexes of Süttő (HU) and Poštela (SLO) have been further investigated. Both have a long history of traditional research, but we tried to investigate them from a landscape archaeological perspective (Czajlik et al. 2019; Teržan and Črešnar 2021; for previous similar researches: von der Osten-Woldenburg 2011; Lindinger 2020). A more detailed prospection of the sites is important to analyse the similarities/differences in land use of the site complexes, which are situated in different geographical position within the Eastern Hallstatt Circle. As the fortified settlements on both site complexes are better examined, we now turn our focus on necropolises. At Süttő, out of the four known groups of burial mounds, three are mapped by magnetometer measurements. The fourth group is actually in a thicket bush, making it impossible to carry out geophysical investigation. At Poštela, the two distinct groups of burial mounds at the Habakuk-plateau are mapped geophysically, the measurements of the third group at Pivola is almost finished.

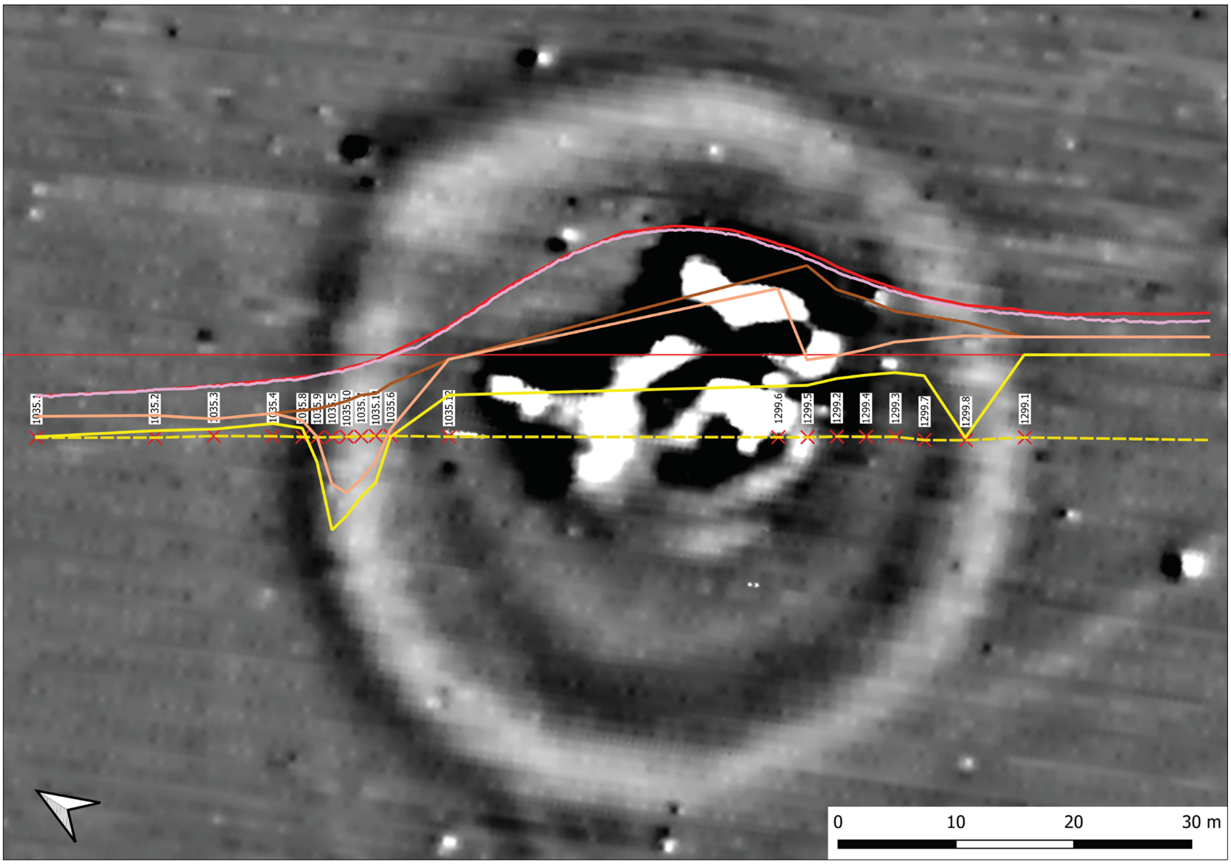

Fig. 1: Süttő – Sáncföldek (Komárom-Esztergom county, N Hungary): Magnetometer mapping and archaeological geomorphological coring results of tumulus 2 (in tumulus group "E"). Magnetic survey was carried out with GSM-19W Overhauser magnetometers in rover mode, positioning with Trimble Geo 7X GPS. The measured points are 0.5 m in-line, the distance between the lines is 0.75 m. The cross-profile is based on 20 shallow (1.1-2.75 m) boreholes in the original and anthropogenic disturbed loessy sediment of the Süttő-plateau. The dashed line shows the location of the profile across the tumulus.

Methods

The structure of the known burial mounds at Poštela has been largely preserved thanks to their location in forested areas, while most of the tumuli at Süttő are situated in a heavily cultivated area. On the loess plateau of Süttő - besides the natural erosion - they have been lowered and widened by agricultural planning (The limestone rock from the structures of burial chambers are often on the surface.). The current morphometrical parameters of the tumuli-surface are highly different from the original landforms. This difference is also the key factor in selecting the appropriate geophysical methods and/or a combination of them. At Süttő magnetometer (GSM-19W Overhauser magnetometers in rover mode, positioning with Trimble Geo 7X GPS) prospection was used. The measured points were 0.5 m in-line, the distance between the lines was 0.75 m. At Poštela a combination of magnetometry (Geometrics G-858, gradient mode), GPR (GSSI SIR 3000, 400 MHz) and ERT (ARES) was applied.

At both sites digital surface model (DSM) was developed using airborne laser scanning (ALS) data was developed, in case of Süttő based partly on unmanned aerial vehicle (UAV) photogrammetry. Further methods, such as aerial archaeology, coring and grid sampling were also used.

Results

There is a good correlation between the burial mounds, identified using ALS, and the burial mounds mapped by geophysical investigations (Fig. 1). Some further archaeological features, for example circular ditches were detected using geophysical methods. The circular ditches are typical in Süttő, although some burial mound do not have this structure.

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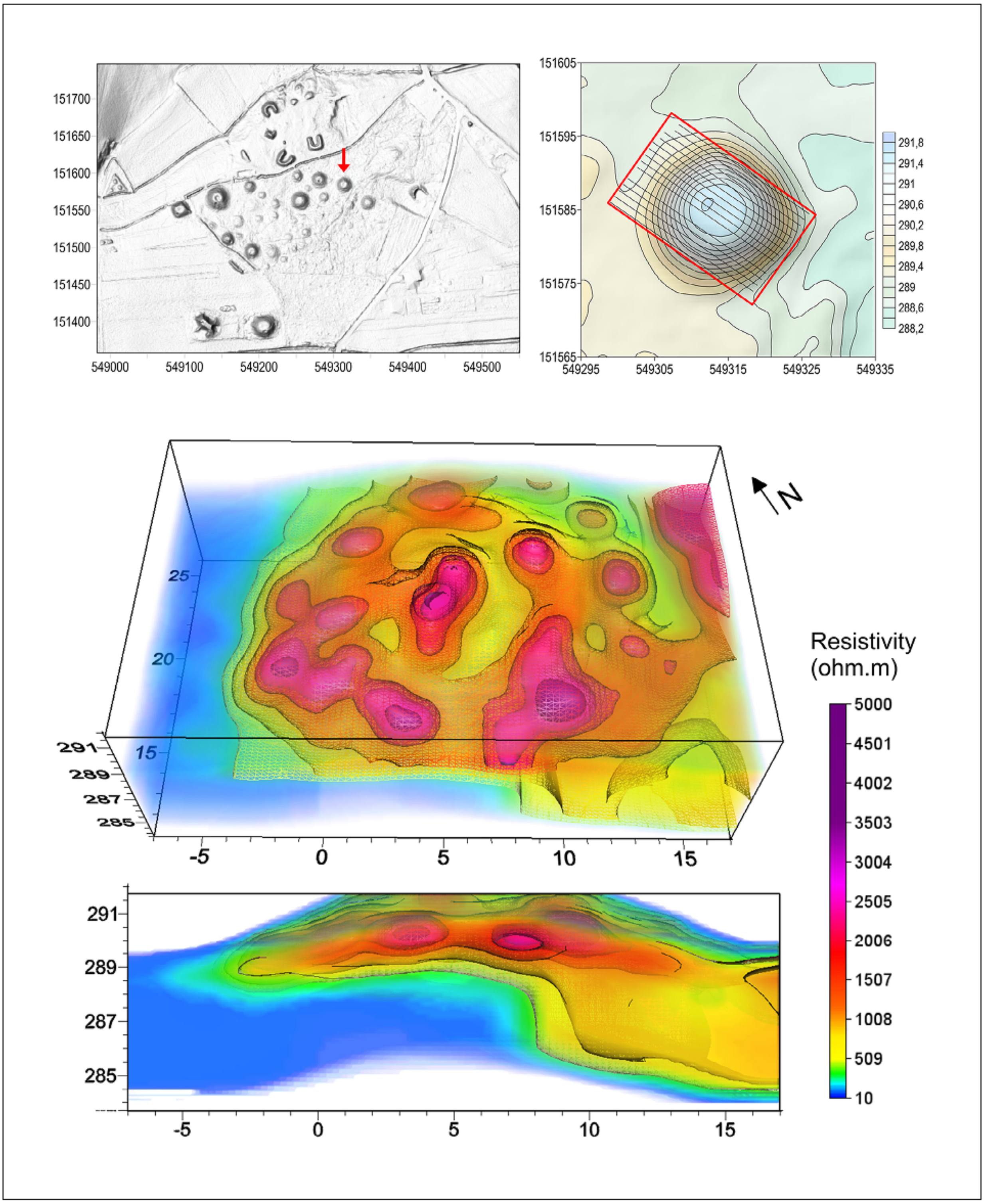

Fig. 2: Pivola (Podravska region, NE Slovenia): 3D electrical resistivity tomography (ERT) inversion model of a prehistoric burial mound at the largest necropolis of the Early Iron Age Poštela hillfort. The resistivity model was obtained from 14 parallel 2D ERT lines (measured with a dipole–dipole electrode configuration, an electrode spacing 0.6 m and a distance of 1 m between lines). The high resistivity anomalies most likely indicate the presence of stone material within the mound (i.e., burial chamber material), as well as partly lower moisture content of the mound. The low resistivity of the ground indicates predominantly clayey material, while the medium resistivity indicates coarse gravelly sediments.

Similarly, at Poštela the burial mounds were also surrounded by ditches, which have only recently been recognized with the help of ALS in geophysics. In both site complexes the bigger mounds have a burial chamber made of stone, which can be absent in the case of the smaller constructions. Lately, at Poštela, near Radvanje, evidence of a barely known group of tumuli emerged thanks to aerial photography.

Discussion

Due to the magnetometer geophysical survey, we can define the limits of the tumulus groups, the exact number of burial mounds, their dimensions, including that of the circular ditches, confirmed by coring. The stone burial chambers appear on the magnetometer maps, but their orientation and form must be defined using a combination of GPR- and ERT-measurements. The latter produced data in 3D, which could prove significant in architectural reconstructions in the future (Fig. 2).

Conclusion

We have the following evidence, collected in the course of the geophysical prospection of the Early Iron Age burial mounds at Poštela and Süttő:

- DSM (ALS/photogrammetry) is an important data set in the background of geophysical mapping.
- The workflow is depending on actual surface coverage and land use.
- In the case of intensive agricultural use, a combination of aerial photography, large surface magnetometer investigation and coring is effective. An important factor is the erosion of the burial mounds.
- In forested areas, a combination of different geophysical methods (GPR, magnetometry and ERT) seems successful.

An important goal of the project is to share our expertise at both site complexes, thus increasing our knowledge of both. We hope to complete the maps of the necropolises and possibly identify the distinct details about tumuli construction that would allow us to perform deeper topographical analyses.

Acknowledgments

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