Bronze Age Körös Off-Tell Archaeology (BAKOTA): Geophysical Investigations at Békés 103, Hungary

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The BAKOTA Project

Initiated in 2006, the BAKOTA project aims to understand how travel and participation in trade networks affected sociocultural change and the emergence of social inequality in later European prehistory. Békés 103 is located in Eastern Hungary on an old meander of the Kettős Körös, downstream of the old Fehér and Fekete river confluence and contains a Bronze Age cemetery (Areas B and C) and a related settlement region (Area A), both of which were most intensively used between ca. 1600 and 1200 BC.

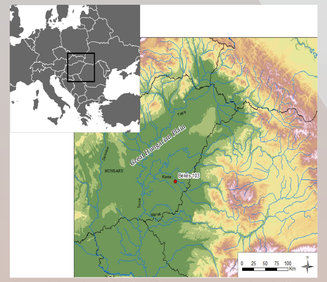

Figure 1. Location of Békés 103. Image created by Paul Duffy (2016)

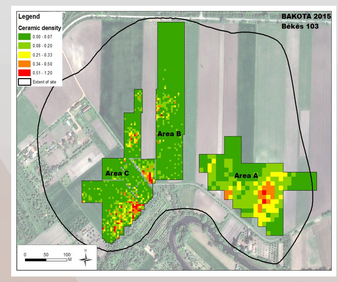

Figure 2. Ceramic density from surface collection at Békés 103. Image created by Paul Duffy (2016)

Non-Invasive Methods

Non-invasive or weakly-invasive surveying methods are often employed to produce images of features below the earth's surface without or prior to excavation.

- The geophysical prospection methods (non-invasive) employed in the latest phase (III) of geophysical investigations at Békés 103 included measurements of vertical magnetic gradient (nT/m) and soil resistance (Ohms) with instruments provided by the GeoSat Research Lab of the Institute for Mediterranean Studies, Foundation of Research & Technology, Hellas (F.O.R.T.H.). (Figures 3&4)
- The weakly-invasive methods employed at Békés 103 in phase III included surface collection, shovel testing, and geochemical coring.

Figure 3. Geoscan FM256 - Fluxgate Gradiometer and the Bartington Instruments Grad601

Figure 4. Geoscan Research Resistivity Meter-85

Our Purpose

Through analysis of non-invasive and weakly invasive prospection methods we expect to find a correlation between the results of surface collection data, excavation, and a specific range of values from each of the soil resistivity and magnetic techniques used in the three phases of geophysical investigations under the BAKOTA project. This information may be used to designate areas for excavation of human cremation urn burials moving forward.

In The Field

A Real-Time-Kinetic GPS unit was used to establish a precise grid of 20 x 20 meter squares in the areas targeted for survey. We worked on one grid at a time in groups of three with one individual walking along parallel transects 1m and 0.5m apart for the soil resistance and magnetometry methods correspondingly. Sampling was 1x1m for soil resistance and 0.5x0.125m for magnetometry.

Photo Credit: Dylan Kelly

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Incorporating Mortuary Data

In order to build a signature archive for mortuary features we created a table of contexts that included both text and graphic information about the excavation results of all the human burials found at Békés 103 and the corresponding geophysical signatures (Figure 5). We calculated the average values for both the resistivity and magnetic data and established a range of values for the different sectors surveyed - areas B and C (Figure 6). Furthermore, we compared the number of vessels associated with each grave to corresponding geophysical signatures for both methods (Figures 7 & 8).

HB number	Excavation Results	Geophysical Signature	Values +/- MAG nT/m RES Ohms	Ceramics number per m²	Bones number per m²	Description of features (based on the field notes)	Dimensions of the feature / HB (meters)		
							Length (W-E)	Width (N-S)	Depth
HB 2		MAG  RES 	MAG -2,0/-0,9 RES 14,1/14,4	0,60	0,08	Type: urn cremation Pit's visibility: N? Fill type: hard/friable, dark Number of vessels: 3 Metal present: – Partly destroyed by a rodent burrow. Badly disturbed by plowing.	0,96	0,84	0,07

Figure 5. Example from table of contexts. *Dziechciarz and Kelly 2015*

		Range min	Average min	Average max	Range max
Mag B	*nT/m*	-3	-0,48	0,85	2,8
Mag C		-0,7	0,22	1,1	2,4
Res	*Ohms*	14	14,26	14,67	14,7

Figure 6. Békés 103. Ranges and averages of the geophysical values based on the measurements related to the urn cremation human burials excavated since 2011.

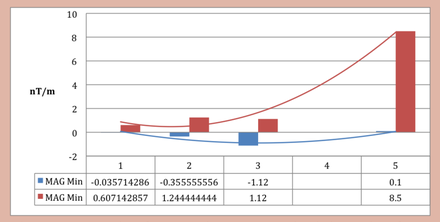

Figure 7. Average value of magnetic data as associated with the number of ceramic vessels within the burials at Békés 103.

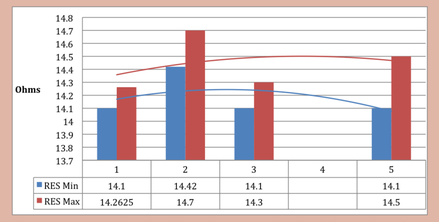

Figure 8. Average value of resistivity data as associated with the number of ceramic vessels within the burials at Békés 103.

Analysis

The magnetic and resistivity data was imported into ArcGIS software and combined with the data from the previous two phases of geophysical investigations at Békés 103. We adjusted the color scales of the images to highlight the values that fell within our calculated average ranges (Figure 6) and used the dimensions of the anomalies that fell within those ranges to identify potential urn burials (Figures 9&10 yellow/blue squares). Then we examined the original data (without adjusted color scales) to see which of our suggestions still met the dimensional criteria and designated those that did as our final suggestions (Figures 9&10 red/green triangles).

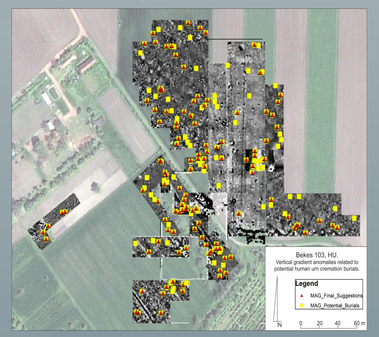

Figure 9. Békés 103. Preliminary and final suggestions for excavation targets based on vertical gradient measurements.

Figure 10. Békés 103. Preliminary and final suggestions for excavation targets based on soil resistivity measurements.

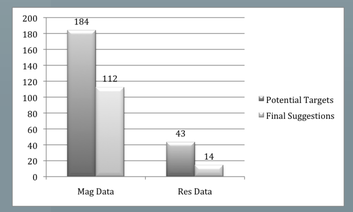

Figure 11. Békés 103, area B. Number of excavation targets based on the previously calculated ranges and average values of geophysical signatures.

Conclusion

Disturbance from agricultural practices like deep plowing made geophysical study very challenging at Békés 103. We identified 126 potential targets for future excavations. We showed the superiority of magnetic methods over resistivity methods in geophysical studies of this nature through the visible trend shown between the number of vessels and the corresponding magnetic signatures (figure 7) and the lack of such a trend with the resistivity data (figure 8). The superiority of magnetic methods is further shown by the comparison between the number of potential burials identified with each method (Figure 9). We also created an archive of geophysical signatures that can be further developed and built upon as more data becomes available. It is our hope that this archive can be used to establish a framework for future investigations of this nature.

References

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