Studia Antiqua et Archaeologica 31(2): 184 - 192
DOI: 10.47743/saa-2025-31-2-1

From Surface to Subsurface: Mapping the Chalcolithic Cucuteni Settlement of Muntenii de Jos (Eastern Romania) Using Remote Sensing Techniques

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Abstract. *While the site of Muntenii de Jos* – La Biserică *(Vaslui County) was first documented in 1910 based on surface finds, archaeological investigations were limited to a single field walk in 1976 that vaguely dated the settlement. In 2025, our team initiated a comprehensive non-invasive research project to map the planimetry, function, and chronology of this archaeological site. The investigation integrated guided drone flights for obtaining an orthomosaic, and a Digital Surface Model (DSM), while also conducting a detailed magnetometer survey using a 5-sensor gradiometer. Fieldwalking confirmed the site's relative chronology to the Cucuteni A-B phase (4050-3800 BC). The combination of aerial and geophysical data within a GIS environment provided us with a high-resolution subsurface map of the settlement's organization, which will prove vital for its future research and preservation.*

Rezumat. *Deși situl de la Muntenii de Jos* – La Biserică *(județul Vaslui) a fost documentat pentru prima dată în 1910 pe baza descoperirilor de suprafață, investigațiile arheologice s-au limitat la o singură cercetare de teren în 1976. În 2025, echipa noastră a inițiat un proiect amplu de cercetare non-invazivă a obiectivului arheologic pentru a stabili planimetria, funcționalitatea și cronologia acestui sit. Investigația a integrat efectuarea de zboruri ghidate în vederea obținerii unui ortofotoplan și a unui model numeric al suprafeței, alături de prospectarea magnetometrică detaliată folosind un gradiometru cu 5 senzori. Cercetarea de suprafață a confirmat cronologia relativă a sitului, databil în faza Cucuteni A-B (4050-3800 BC). Combinarea datelor aeriene și geofizice într-un mediu GIS oferă o hartă de înaltă rezoluție a organizării așezării, care se va dovedi esențială pentru cercetările viitoare și pentru conservarea sitului arheologic în cauză.*

Keywords: Cucuteni culture, A-B phase, UAV, magnetometer survey.

Archaeological background

The Cucuteni-Trypillia cultural complex (Figure 1), flourished in a large part of southeastern Europe during the Chalcolithic period (ca. 5000-3000 BC)[3], intriguing archaeologists and art historians for over a century. While its exquisitely painted ceramics, showcasing remarkable artistic skill and sophistication, are widely recognized as iconic artifacts of the era, the architectural remains of this culture offer an equally compelling (albeit often dramatically fragmented) glimpse into their lives. These remains often exhibit vitrification, a process where the clay of the walls and floors has been transformed into a glassy material due to extreme heat. Within these fire-ravaged structures, archaeologists have unearthed invaluable evidence not only of daily life, but also tantalizing hints of the Cucuteni-Trypillia people's spiritual beliefs and practices.

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[3] LAZAROVICI/LAZAROVICI/ȚURCANU 2009, 17; URSULESCU 2022, 19.

Figure 1. The Chalcolithic archaeological cultures of Southeastern Europe, and the main archaeological sites investigated (©Ștefan Caliniuc).

The first mention of the archaeological site from Muntenii de Jos (Vaslui county) was made in 1910, belonging to C. Moisil[4]. Subsequently, the information was confirmed by a field investigation conducted by Ghenuță Coman and Ion Baum. Their findings indicated that on the promontory of the interfluvial hill—specifically located on the northeastern edge of the village of Muntenii de Jos, approximately 200 m north of the church—archaeological remains were uncovered. These included flint blades and a significant quantity of ceramic fragments featuring a distinctive three-color (tricrom) painting style, all definitively associated with the renowned Cucuteni Culture[5].

So far, the archaeological research conducted at the Cucuteni site known as Muntenii de Jos – *La biserică* (Figure 2-3), was limited to a single fieldwalk conducted in 1976 that vaguely dated the site. In 2025, our team decided to further investigate the site using modern non-invasive methods, in order to better understand the planimetry and functionality of the site. Besides fieldwalks, we also performed a magnetometer survey, along with guided drone flights, the purpose of the latter being to obtain an orthomosaic and a digital surface model of the site.

[4] MOISIL 1910, 173.
[5] COMAN 1980, 183.

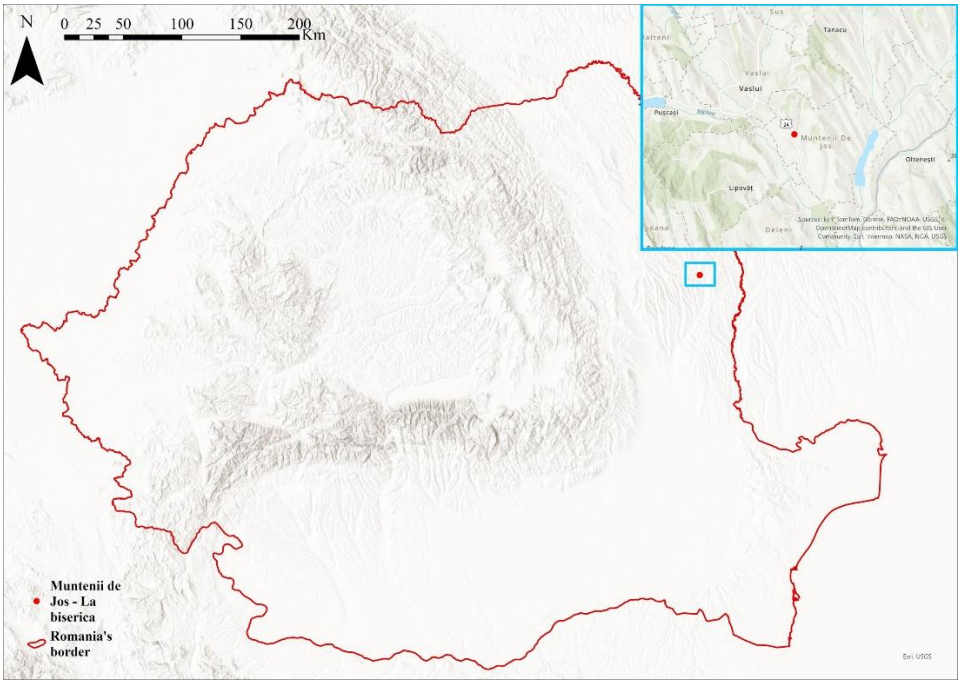

Figure 2. Localization of the archaeological site of Muntenii de Jos – *La biserică*.

Figure 3. Muntenii de Jos – *La biserică* archaeological site. The aerial image of the site, view from the south.

The non-invasive research (2025)

The first stage of our non-invasive research approach consisted of taking oblique and vertical aerial photographs using a DJI Air 2S drone (Figure 4), with the aim of obtaining an overall characterization of the researched area, highlighting its landscape features. Guided flights were also performed, in order to obtain a detailed DSM (Digital Surface Model), as well as a high-resolution orthomosaic (Figure 5). The flight covered an area of 11 hectares, at an altitude of 50m maintaining a 75% overlap between photographs. A number of 8 ground points were recorded using a Leica RTK system in order to better georeference the results.

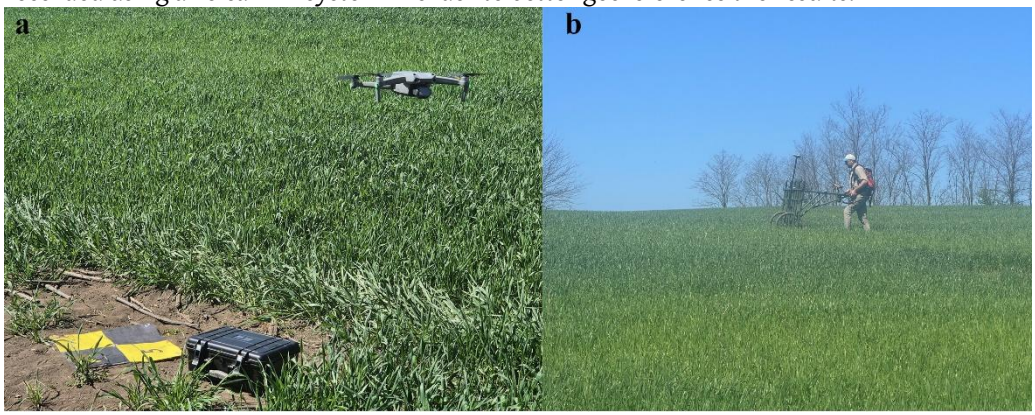

Figure 4. **a**- DJI Air 2S drone, and ground point; **b**- Five probe Sensys MXPDA magnetometer system.

The location of the settlement is clearly strategic: the inhabitants selected this area due to its topographic position, namely a promontory that offers excellent visibility and is naturally protected by steep slopes. This choice indicates a clear emphasis on defense and advantageous sightlines.

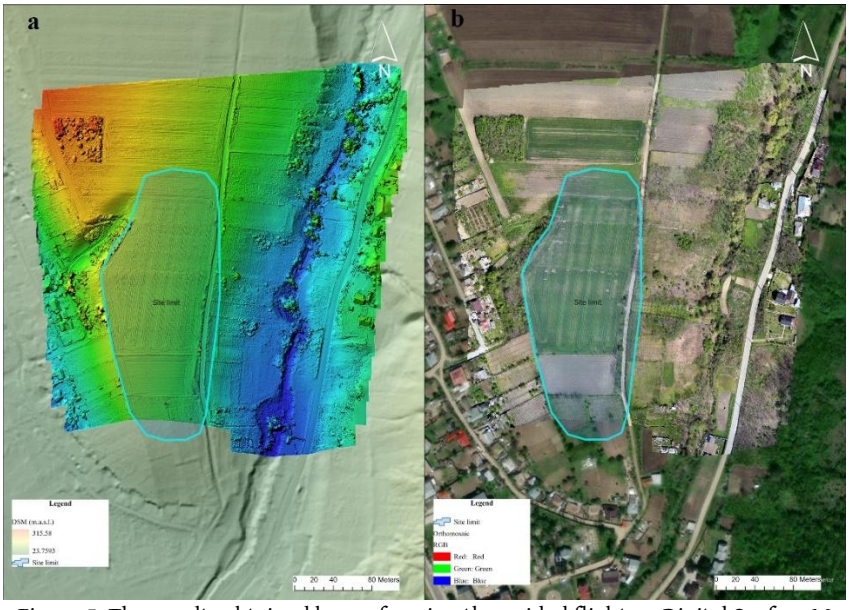

Figure 5. The results obtained by performing the guided flight. **a**- Digital Surface Model; **b**- Orthomosaic.

The following step in our workflow involved performing magnetometer measurements, which were carried out using a 5-sensor gradiometer, produced by the Sensys company. The sample interval was set at 0.5 m, and data acquisition was performed using a GNSS device, mounted on the instrument cart and linked via a radio connection to a fixed base station. This configuration offers the possibility of covering large areas, as gridding of the zones is not necessary. The data were processed using the software provided by the manufacturer (DLMGPS, Magneto-Arch), as well as other specific programs (QGIS Archaeological Geophysical Toolbox), all the results being integrated into a GIS project. The fundamental principle on which the method is based is related to the presence of weakly magnetized iron oxides in the soil. The degree of soil magnetization is known as magnetic susceptibility and is determined by the quantity of oxides present in the soil, especially hematite and magnetite[6]. Since the instrument responds very well to changes that occur when a material is burned at a high enough temperature to modify its magnetic properties, it is primarily used for identifying well-burnt structures in the soil, but it can also be used in detecting anomalies, such as ditches and pits, which we often find in archaeological sites. It has proven to be very effective in investigating the Cucuteni settlements due to the fact that almost all of the dwellings in a Cucuteni settlement are burned to the point of vitrification[7].

Despite this constraint, our team successfully investigated a substantial portion of the site, which was sufficient to clearly delineate the northern boundary of the settlement (Figure 6).

Overall, the archaeological site is heavily impacted by ongoing agricultural work, which likely complicates the interpretation of some shallow anomalies. Nevertheless, the resulting magnetic map successfully revealed a lot of subsurface features. These include evidence of various distinct dwellings, along with various pits and magnetic *markers* indicative of possible pottery kilns. However, it should be mentioned that we do not benefit from a clear contrast as in many other cases, possibly due to the disturbance of the archaeological context, which makes it difficult to specify an exact number of dwellings. Also, the anomalies are not compact, which may suggest the absence of platforms or incomplete burning.

The site's micro-topography, as well as the surrounding environment provide natural and anthropic boundaries, as follows:

- Western Boundary: This side is clearly and naturally delineated by a steep slope.
- Eastern Boundary: The extent here is compromised by a modern road, where residual fragments of dwellings could only be identified within the road's embankment (Figure 7).
- Southern Boundary: This area suffers from significant modern interference, being directly affected by modern constructions, including houses and assorted annexes.

During our fieldwalk, we managed to gather a lot of pottery sherds, some of which preserved the original painting, fragments from loom weights and flint blades (Figure 8). The ceramics seem to chronologically pinpoint the settlement in the A-B phase (4050-3800 BC[8]) of the Cucuteni culture. This chronological stage marks an important transition: while the pottery from the earlier Cucuteni A phase is often characterized by bichrome (two-color) painted decoration, the Cucuteni A-B phase marks the appearance or increased popularity of trichrome (three-color) painted ceramics, often using white, black/brown, and red, combined in complex

[6] GAFFNEY/GATER 2003, 37.
[7] ASĂNDULESEI *et alii* 2024: ASĂNDULESEI 2017.
[8] URSULESCU 2022.

spiral and meander patterns. The decorative style of the A-B phase often refines the intricate geometric patterns seen in the preceding phase.

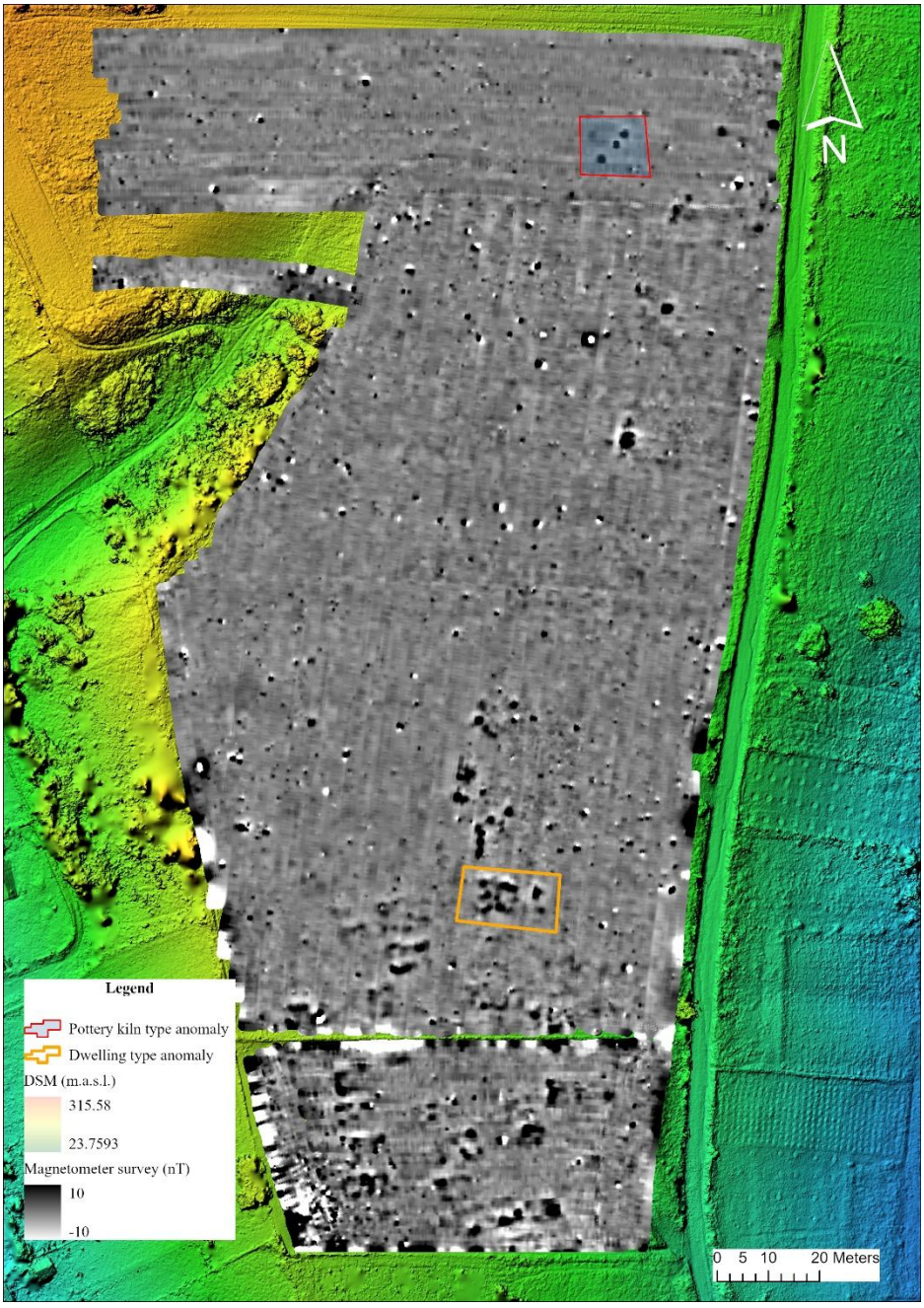

Figure 6. The magnetic map of the settlement from Muntenii de Jos – *La biserică.*

While the setup was ideal for large-scale coverage, the survey faced practical limitations on the ground. A complete magnetic map of the entire archaeological area was unfortunately not possible due to the presence of various modern constructions that obstructed access.

Figure 7. The remains of a dwelling visible in the embankment of the road (the eastern limit of the settlement).

Preliminary conclusions

The 2025 non-invasive research at the site of Muntenii de Jos – *La biserică* successfully transcended the limitations of the previous, minimal archaeological work. By employing a strategic combination of drone-guided aerial imaging (orthomosaics and DSMs), fieldwalking, and a large-scale magnetometry survey, the investigation has fundamentally redefined the understanding of this settlement.

The strategic location of the settlement, on a promontory naturally protected by steep slopes, was reaffirmed, emphasizing the inhabitants' focus on defense and excellent visibility. Furthermore, the ceramic materials identified, particularly the characteristic trichrome painted sherds, has allowed for a more precise chronological attribution of the settlement, within the Cucuteni A-B phase (4050-3800 BC).

Most significantly, the magnetometry survey, despite being hampered by modern constructions, proved highly effective due to the burnt nature of the Cucuteni dwellings. The survey successfully delineated the northern boundary and revealed a rich array of subsurface features, including the magnetic anomalies belonging to multiple structures, along with various pits and potential pottery kilns. These findings offer the first comprehensive planimetry of the site.

In spite of the ongoing challenges posed by modern constructions and agricultural impacts affecting the eastern and southern boundaries, the 2025 research has provided crucial data that lays the groundwork for all future research. The non-invasive methods not only confirmed the long-known presence of a Cucuteni settlement but also provided a detailed map of its extent and internal structure, transforming a vaguely dated reference into a tangible archaeological resource.

All of the data presented in this article was also included in our online database ArchaeoPortal and can be viewed in a GIS environment for free[9].

[9] https://arcg.is/vP4vq (accesed 28.10.2025).

Figure 8. The archaeological material discovered during fieldwalk.

Acknowledgements

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS – UEFISCDI, project number PN-IV-P1-PCE-2023-0040, within PNCDI IV.

References

ASĂNDULESEI A. 2017. *Inside a Cucuteni Settlement: Remote Sensing Techniques for Documenting an Unexplored Eneolithic Site from North-Eastern Romania*. Remote Sensing, Special Issue: Archaeological Prospecting and Remote Sensing, 9/41.

ASĂNDULESEI A., TENCARIU F.A., MIREA D.A., PÎRNĂU R.G., BALAUR R.Ș. 2024. Back to the roots. Ablest prospection techniques for rediscovering the Chalcolithic settlement of Cucuteni – Cetățuie, Romania: a short retrospective, novel recent data, prospects for the future. In: C. Cuenca-Garcia, A. Asăndulesei, K. Lowe (eds.) 2024. *World Archaeo-Geophysics. Integrated minimally invasive approaches using country-based examples*. One World Archaeology Series, Springer, Cham.

BOGHIAN, D. 2006. Unele considerații asupra fazei A-B în contextul civilizației cucuteniene. In: N. Ursulescu, C.-M. Lazarovici (eds.), *Cucuteni 120 – valori universale. Lucrările Simpozionului Național, Iași, 30 septembrie 2004*, 163-180. Iași.

COMAN, G. 1980. *Statornicie, continuitate. Repertoriul arheologic al Județului Vaslui*, București.

GAFFNEY, C., GATER, J. 2003. *Revealing the Buried Past. Geophysics for Archaeologists*, Gloucesternshire.

LAZAROVICI, C.-M., LAZAROVICI, G.-C., ŢURCANU, S. 2009. *Cucuteni. A Great Civilization of the Prehistoric World*, Iaşi.

MOISIL, C. 1910. Privire asupra antichităților preistorice din România, *Buletinul Comisiunii Monumentelor Istorice* III, 115-117.

URSULESCU, N. 2022. *Civilizația Cucuteni şi ariile culturale învecinate. O retrospectivă bibliografică*, Editura Universității „Alexandru Ioan Cuza" din Iași, Iași.