EUROPEAN ASSOCIATION OF ARCHAEOLOGISTS 20TH ANNUAL MEETING
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Habitation Patterns of the Neolithic Agricultural Villages in Eastern Thessaly (Greece) Through Remote Sensing Applications

A. Sarris, J.C. Donati, G. Cantoro, C. Cuenca-Garcia, T. Kalaycı, F.-X. Simon; M. Manataki, K. Vouzaxakis, V. Rondiri, K. Almatzi, D. Efstathiou, P. Arachoviti, E. Stamelou

Laboratory of Geophysical – Satellite Remote Sensing and Archaeo-environment
Institute for Mediterranean Studies
Foundation for Research and Technology, Hellas (I.M.S.-F.O.R.T.H.)
Rethymno, Crete, Greece
&
13th Ephorate of Prehistoric and Classical Antiquities - Hellenic Ministry of Culture and Sports

GeoSat ReSeArch
Lab of Geophysical-Satellite Remote Sensing and Archaeoenvironment

FORTH
Institute for Mediterranean Studies

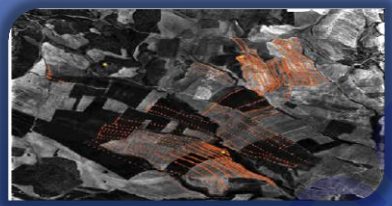
Ευρωπαϊκή Ένωση
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗ
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ
ΕΣΠΑ 2007-2013
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

Chronology of Research in Neolithic Thessaly

1901-1903: Excavations at Sesklo and Dimini
1908: Excavations at Zerelia

1960-1977: Trial Excavations at several neolithic sites by D.R. Theocharis and Vl. Milojcic
1977-1979: Excavations at Dimini by G. Hourmouziades

1984: Halstead's catalogue of prehistoric sites in Thessaly, based on a survey made by French
1992: Gallis' catalogue of sites in E. Thessaly.



1990-present: Field survey in Almiros plain 13th EPCA & the Netherland Institute at Athens
1990-2005: Rescue excavations (national road, Lake Karla)

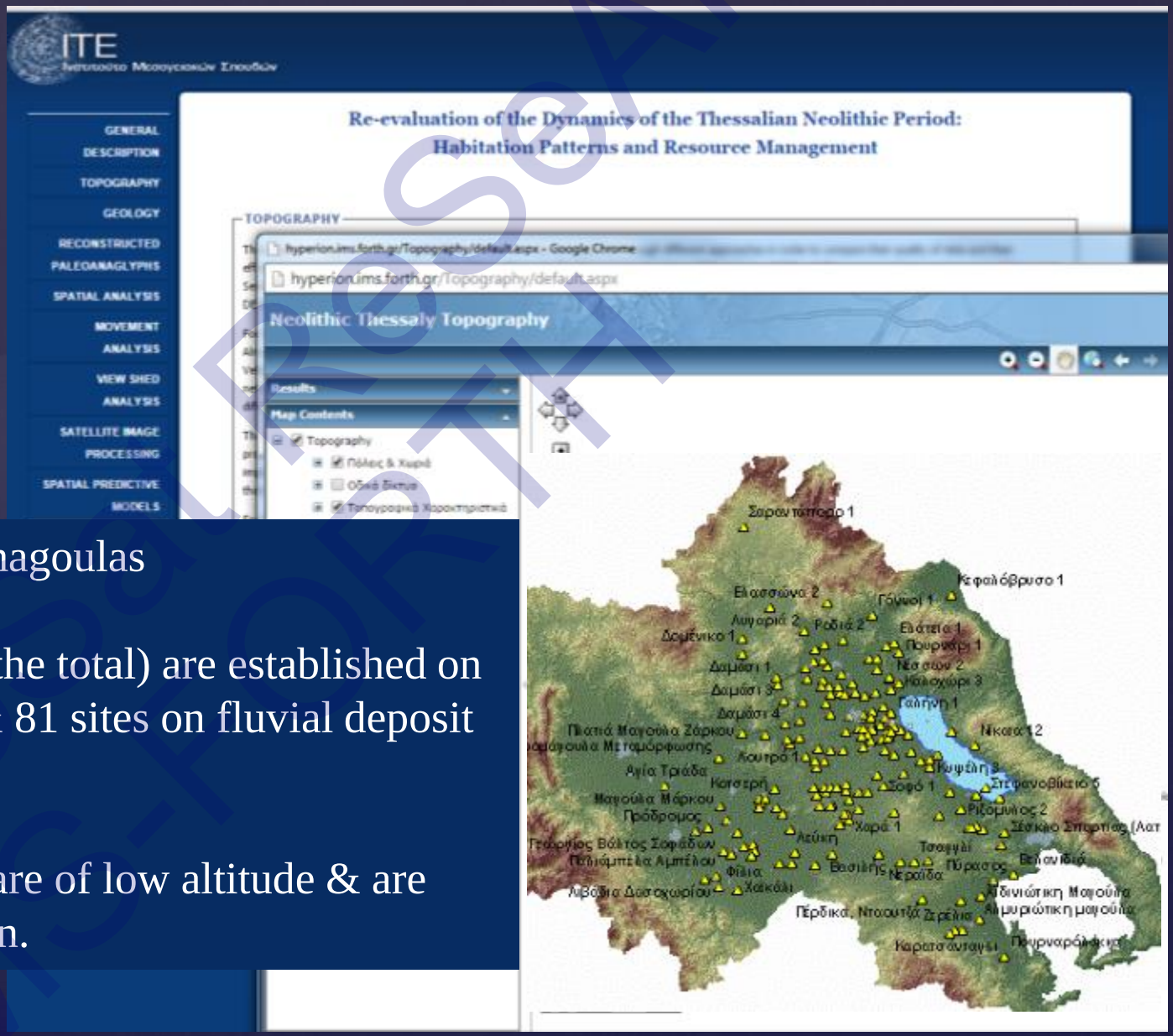
2005-present: Extensive satellite R.S. & geophysical survey by GeoSat ReSeArch Lab of IMS (FORTH). PENED (2005-2007), INSTAP (2006-2010), ARISTEIA (2013-2015)

Status of knowledge of the Neolithic Landscape in Thessaly

Registration and mapping of Neolithic settlements in Thessaly
& GIS analyses for

the management of the natural landscape
&
site distribution patterns among ecological and topographic zones of Thessaly.

http://neolithicthessaly.ims.forth.gr/



- 342 documented magoulas
- 181 sites (53% of the total) are established on alluvial deposits & 81 sites on fluvial deposit areas.
- These formations are of low altitude & are ideal for cultivation.

Habitation Patterns of the Neolithic Agricultural Villages in Eastern Thessaly (Greece) Through Remote Sensing Applications

This paper presents the preliminary results of a multi-year geophysical and remote sensing fieldwork campaign to study the physical landscape and social dynamics of Neolithic settlements within the coastal hinterlands of eastern Thessaly (Greece).

IGEAN (Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly) project, is implemented under the "ARISTEIA" Action of the "Operational Programme Education And Lifelong Learning" and is co-funded by the European Social Fund (ESF) and National Resources (2013-2015).

AIMS: Application of non-destructive, remote sensing techniques to explore multiple settlements & extract new archaeological data on an extensive scale, to analyze the broader characteristics of Neolithic habitation in Thessaly.

The project has been successful in documenting the diachronic development of Neolithic sites from core habitation mounds (≤ 1 hectare) to large, sprawling communities several hectares in size.

Area of interest

Methodologies – Multi-magnetometer Techniques

Sensorik & Systemtechnologie (SENSYS) MX Compact system

8 multi-channel measurement system Equipped with FGM600 fluxgate gradiometers separated by 0.25-0.5m & connected to a DGPS navigation system

Ideal for large-scale scanning

Bartington single sensor unit also in use in thick vegetation areas

Methodologies – Electromagnetic Techniques

GEM2 - Geophex

CMD Mini explorer– GF Instruments

Depth of investigation

	GEM2		CMD Mini explorer			
Electrical conductivity	HCP	2.5 m	HCP	0.5 m	1 m	2 m
			VCP	0.3 m	0.7 m	1.3 m
Magnetic susceptibility	HCP	1.7 m	HCP	0.2 m	0.5 m	1 m
			VCP	0.3 m	0.7 m	1.3 m

Ideal for large-scale scanning

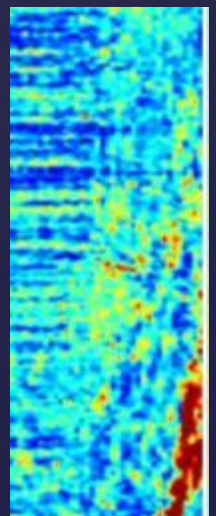
Methodologies – Ground Penetrating Radar (GPR)

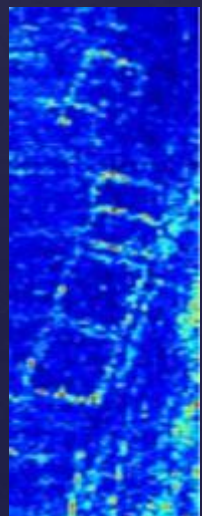
8 channels MALA MIRA GPR,
400 MHz antennas
Sampling 10 x 2.5 cm

Sensors & Software
Noggin Plus System with 250 MHz antennas
Sampling 50 x 2.5 cm

Penetration Depth ~2.5m

Before and after processing





Methodologies – Soil Resistance Techniques

Geoscan Research RM85 resistance meter

Twin Probe array of electrodes with spacing a=1m

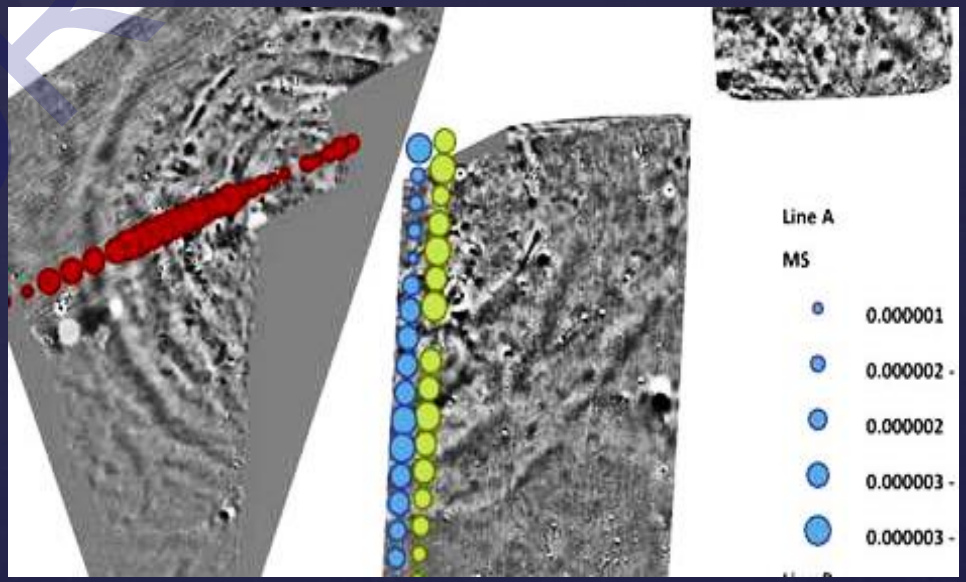
Penetration Depth ~1.5m

Methodologies – Magnetic Susceptibility Measurements

Coring and soil analysis in the Lab.

Bartington MS2B Double Frequency sensor

Low & High Frequency susceptibility & Frequency dependent susceptibility

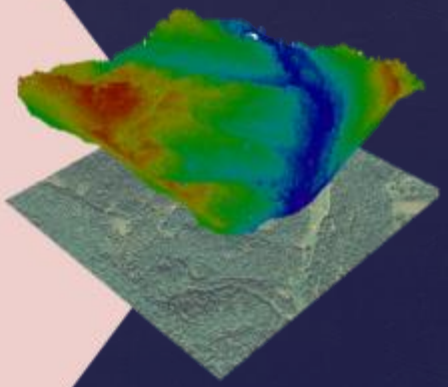


Methodologies – Aerial Photography

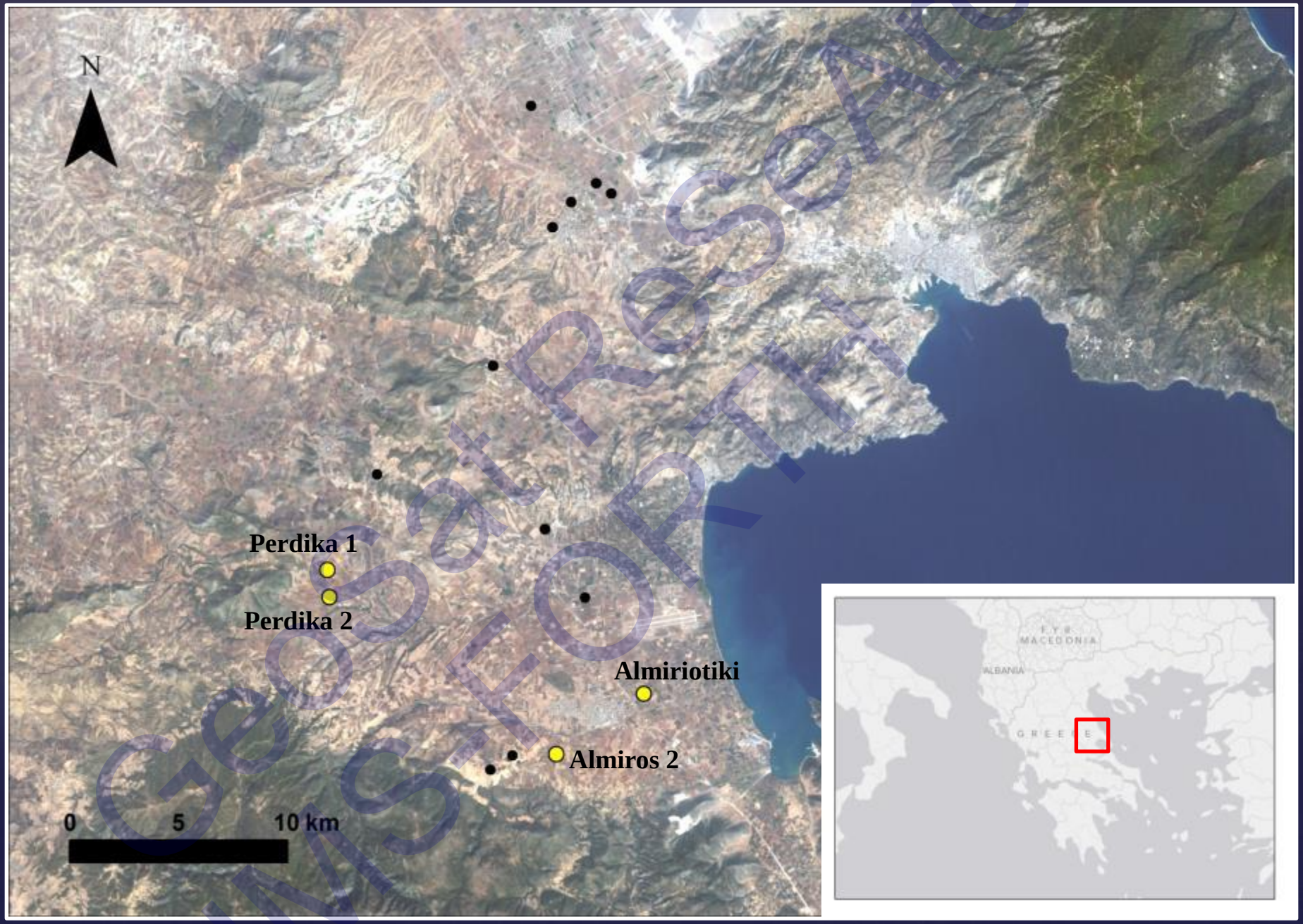
Quadrocopter DroidWorx CX4

- DJI navigation, viewpoint and failsafe
- Average altitude 100-200 m above surface
- Autonomy ~13-15min with camera load

- Canon S100 w/ GPS (or similar)
- Low budget to limit failure costs
- Canon: CHDK hacking system for intervallometer
- Mainly mounted for ortho-view with 2D stabilizing gimbal



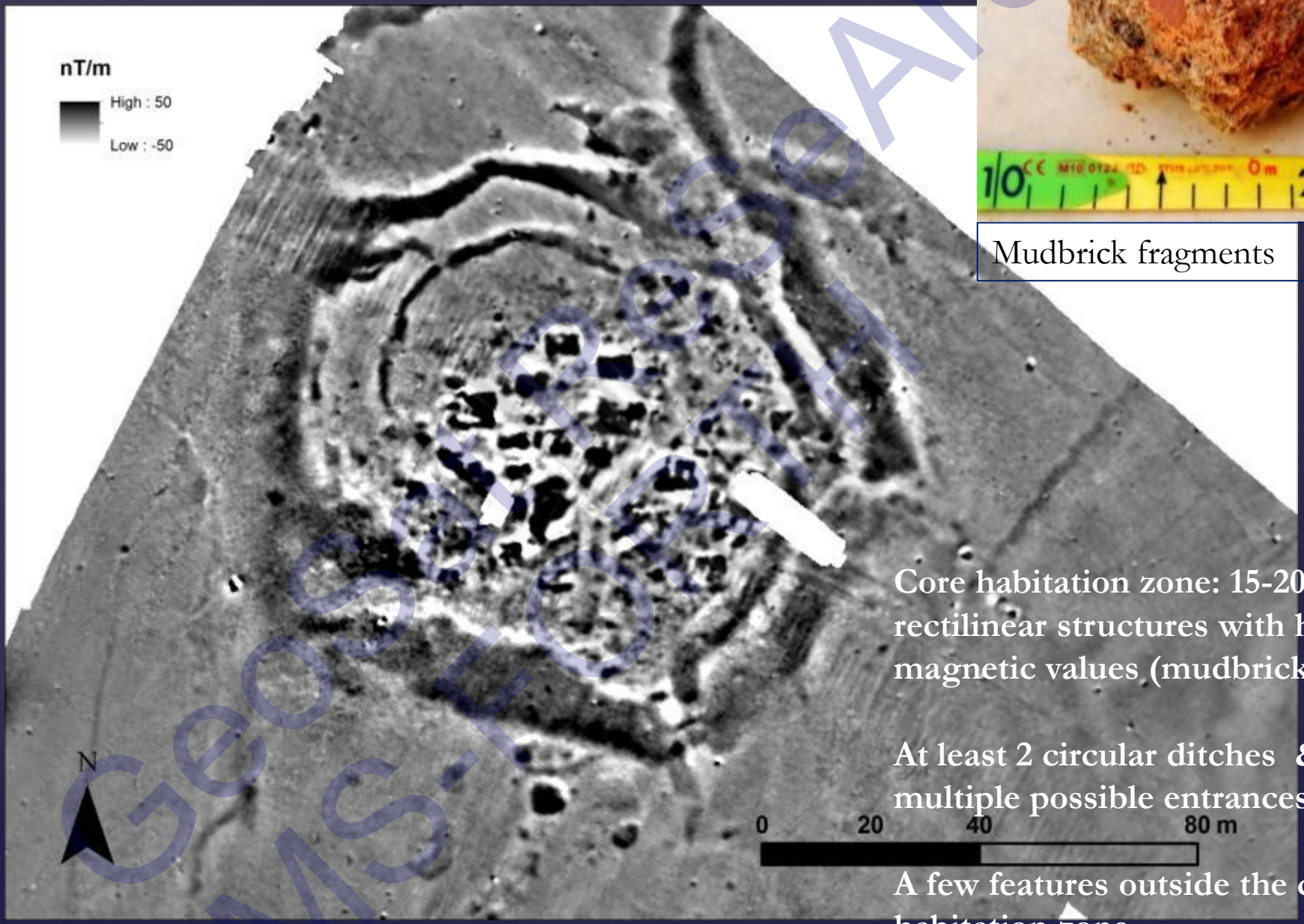
SITE	COVERAGE (in hectares)			
	Magnetics	EM	GPR	UAV
1. Almiriotiki	8.42	7.75	1.28	20.84
2. Almiros 2	6.60	2.39	0.37	7.31
3. Bakalis	0.45	0.36	0.29	-
4. Belitsi	1.32	1.78	0.37	11.74
5. Eleutherochori	-	0.18	0.18	-
6. Kamara	0.88	1.06	0.10	-
7. Karatsangliou	2.96	1.20	0.37	13.22
8. Karatsantagli	2.71	0.58	0.20	12.38
9. Kastro Kokkinas	1.08	0.72	0.09	-
10. Nikonanou	2.91	1.37	-	-
11. Mati	3.33	2.40	0.32	-
12. Perdika 1	5.19	2.32	0.44	-
13. Perdika 2	3.90	2.21	0.32	-
14. Rizomilos 2	10.48	3.16	0.36	-
15. Visviki	5.12	-	1.90	-
16. Zerelia	4.83	1.88	0.72	33.88
TOTAL (<5 weeks fieldwork)	**60.18**	**29.36**	**7.31**	**99.37**



Almiros 2

Early Neolithic – Middle Neolithic

Almiros 2 – Magnetics



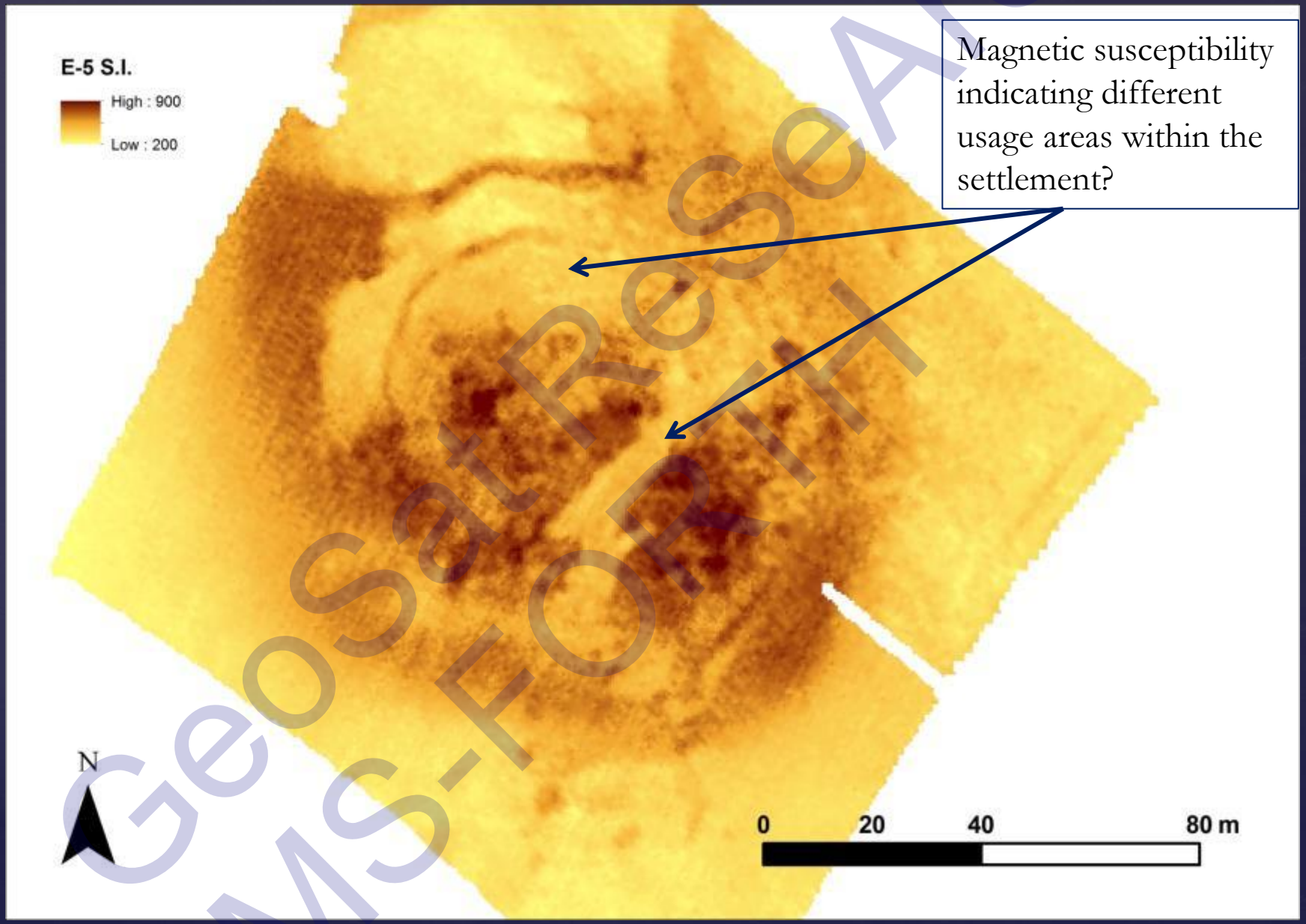
Mudbrick fragments

Core habitation zone: 15-20 rectilinear structures with high magnetic values (mudbrick?)

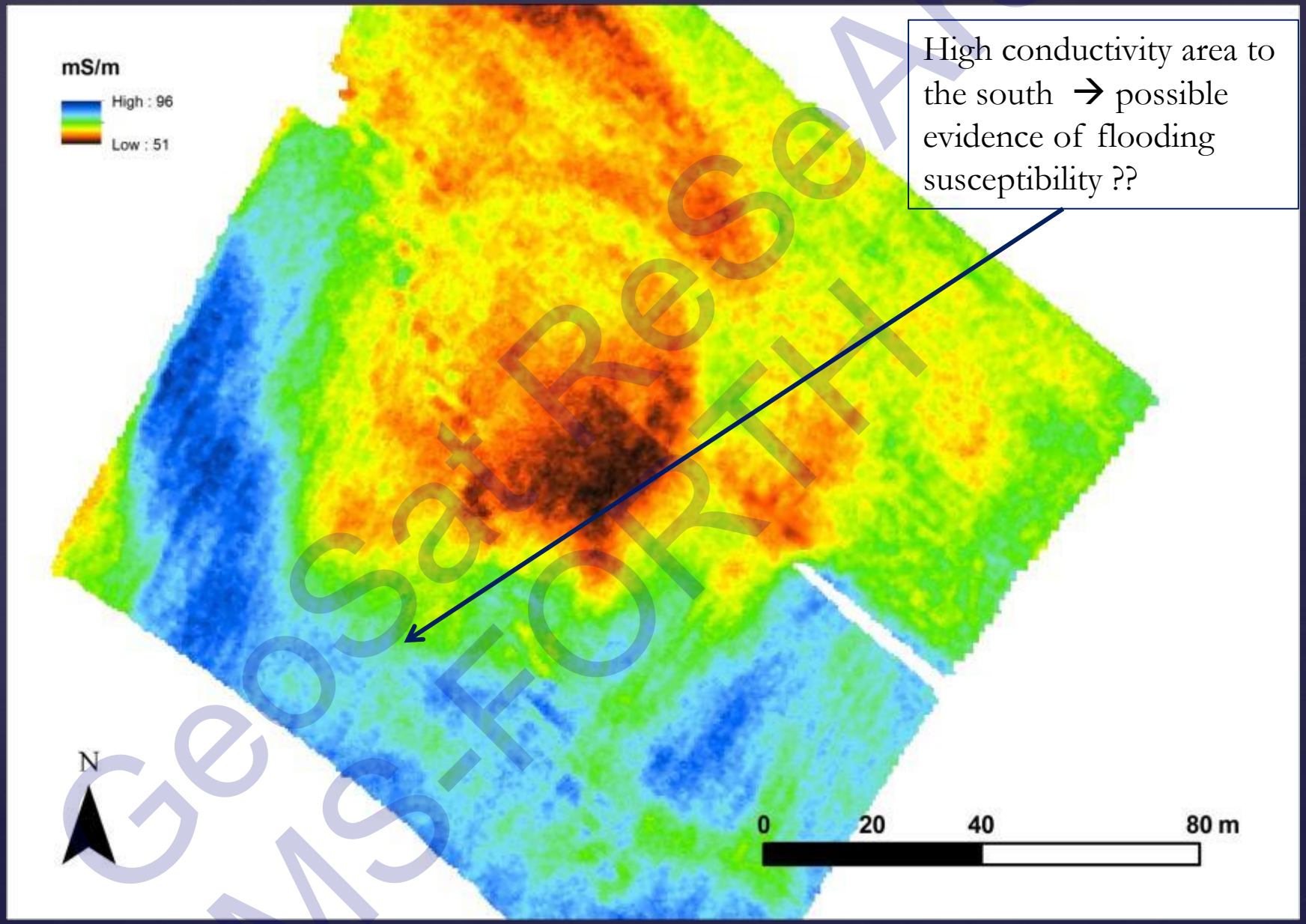
At least 2 circular ditches & multiple possible entrances

A few features outside the core habitation zone

Almiros 2 – EM Susceptibility (HCP for 0-1.7 m depth)



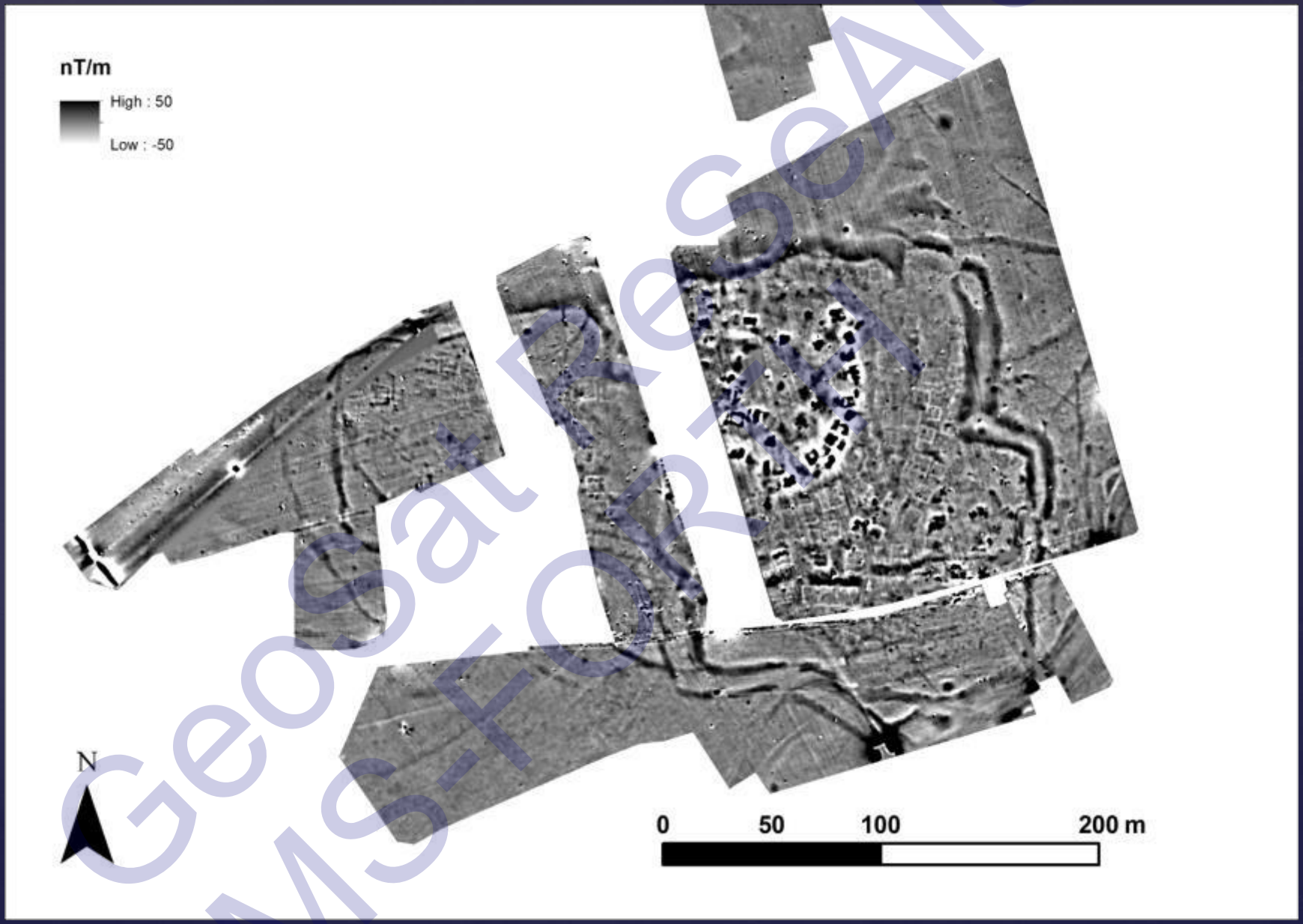
Almiros 2 – EM Conductivity (HCP for 0-2.5 m depth)



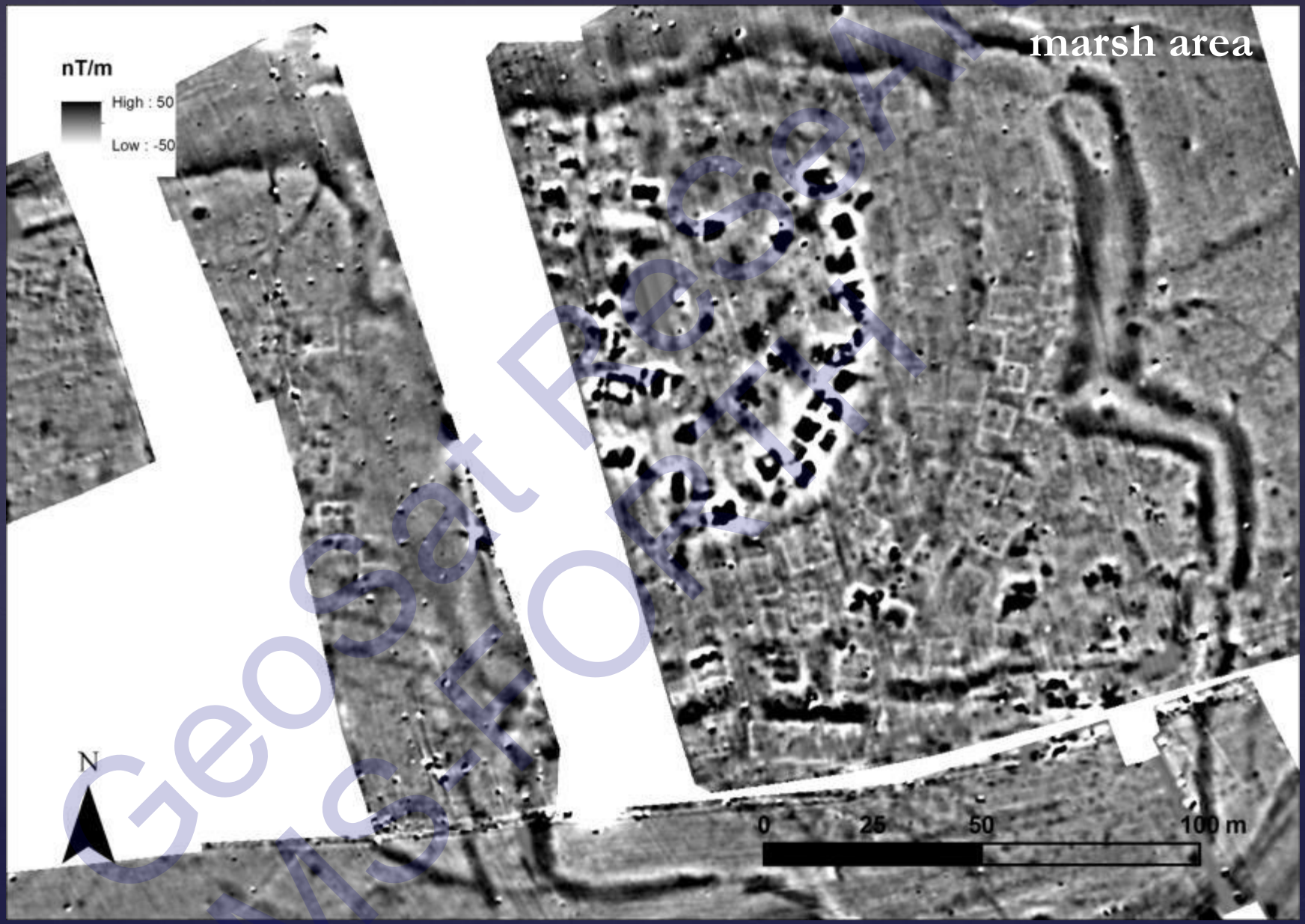
Magoula Almiriotiki

Early Neolithic – Late Bronze Age

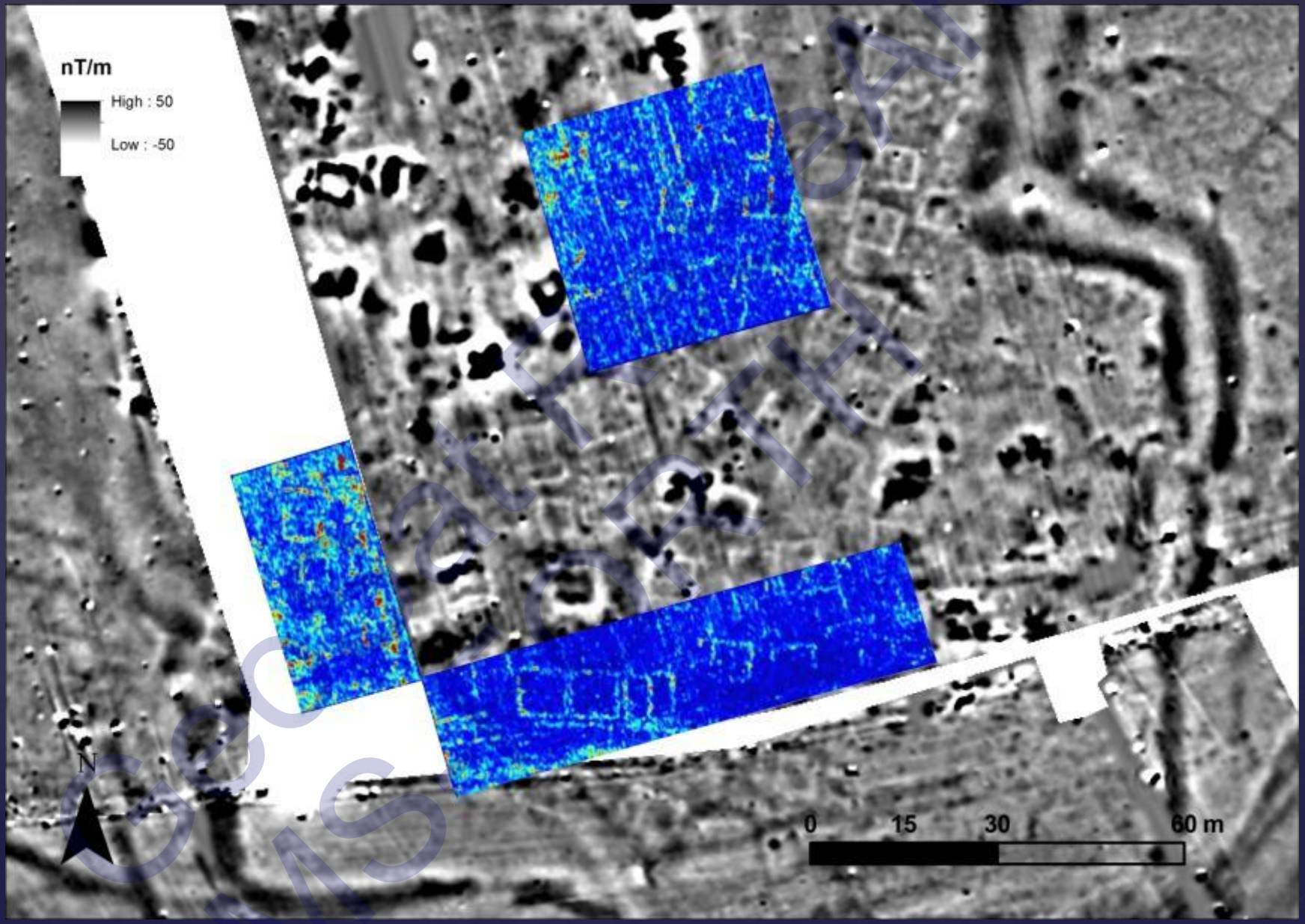
Magoula Almiriotiki – Magnetics



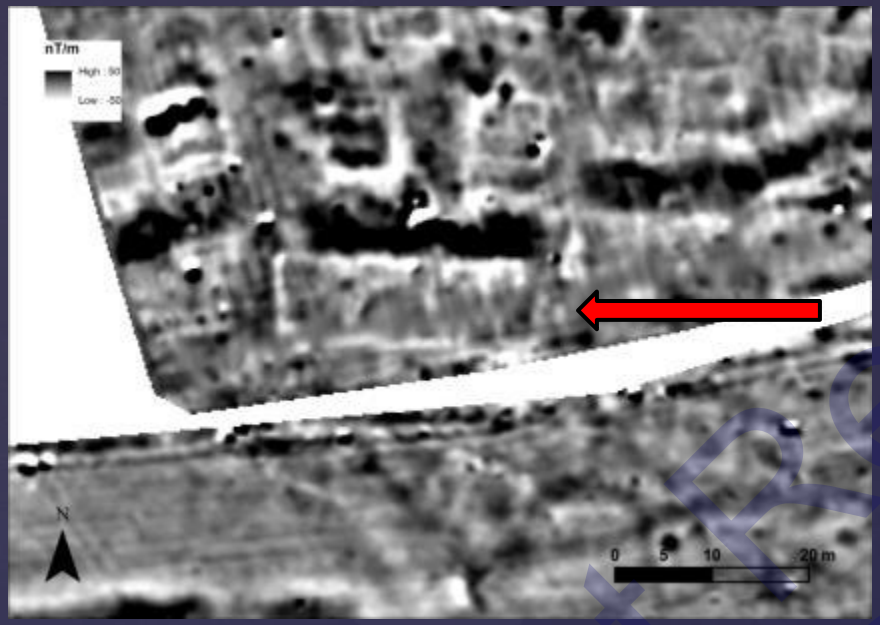
Magoula Almiriotiki – Magnetics



Magoula Almiriotiki – GPR (depth 0.7-0.8 m)

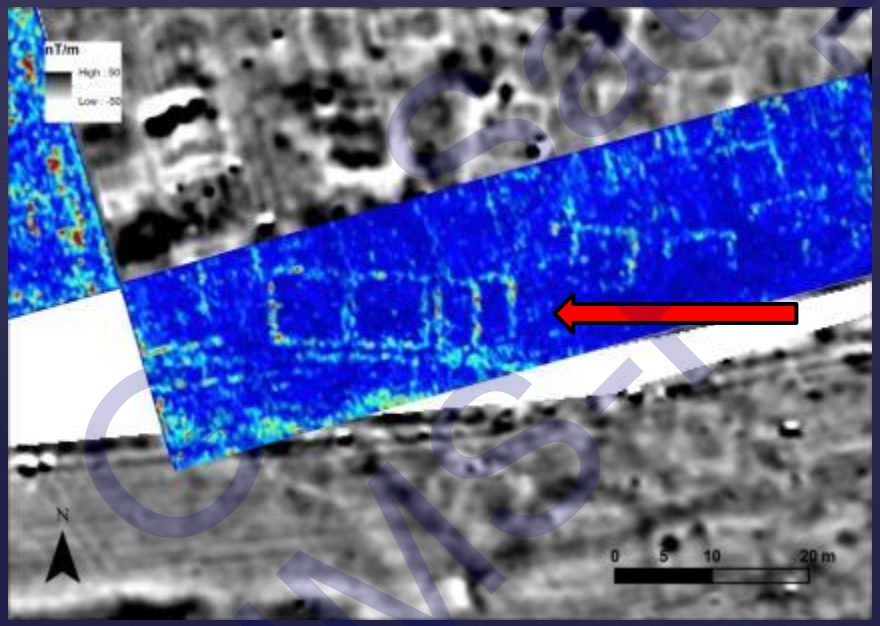


Magoula Almiriotiki – Details of Structures



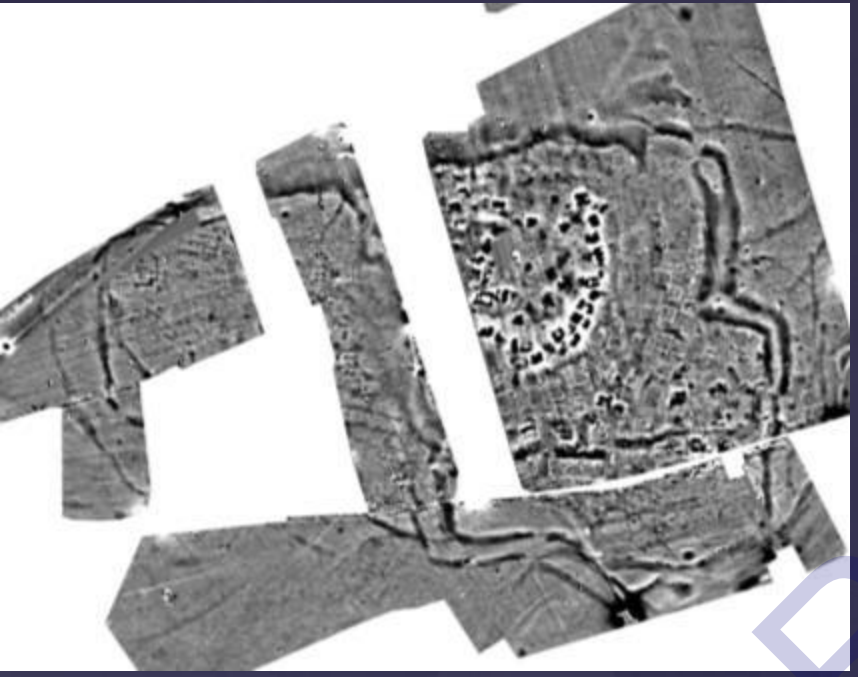
- Low magnetic value probably indicates that the structure(s) has stone foundations

- Rectilinear form 38 m by 10 m.



- In GPR, the structure appears to be formed from three separate structures built side by side.

- Internal wall divisions are present



Magoula Almiriotiki
Early Neolithic – Late Bronze Age

- Extensive settlement built around a core habitation zone on the highest topographic level

- 60+ rectilinear structures

- Structures on the top have high magnetic values and are probably built in mudbrick

- Structures with low magnetic values have 2-3 rooms

- Large “megaron” structure may be three structures built side-by-side

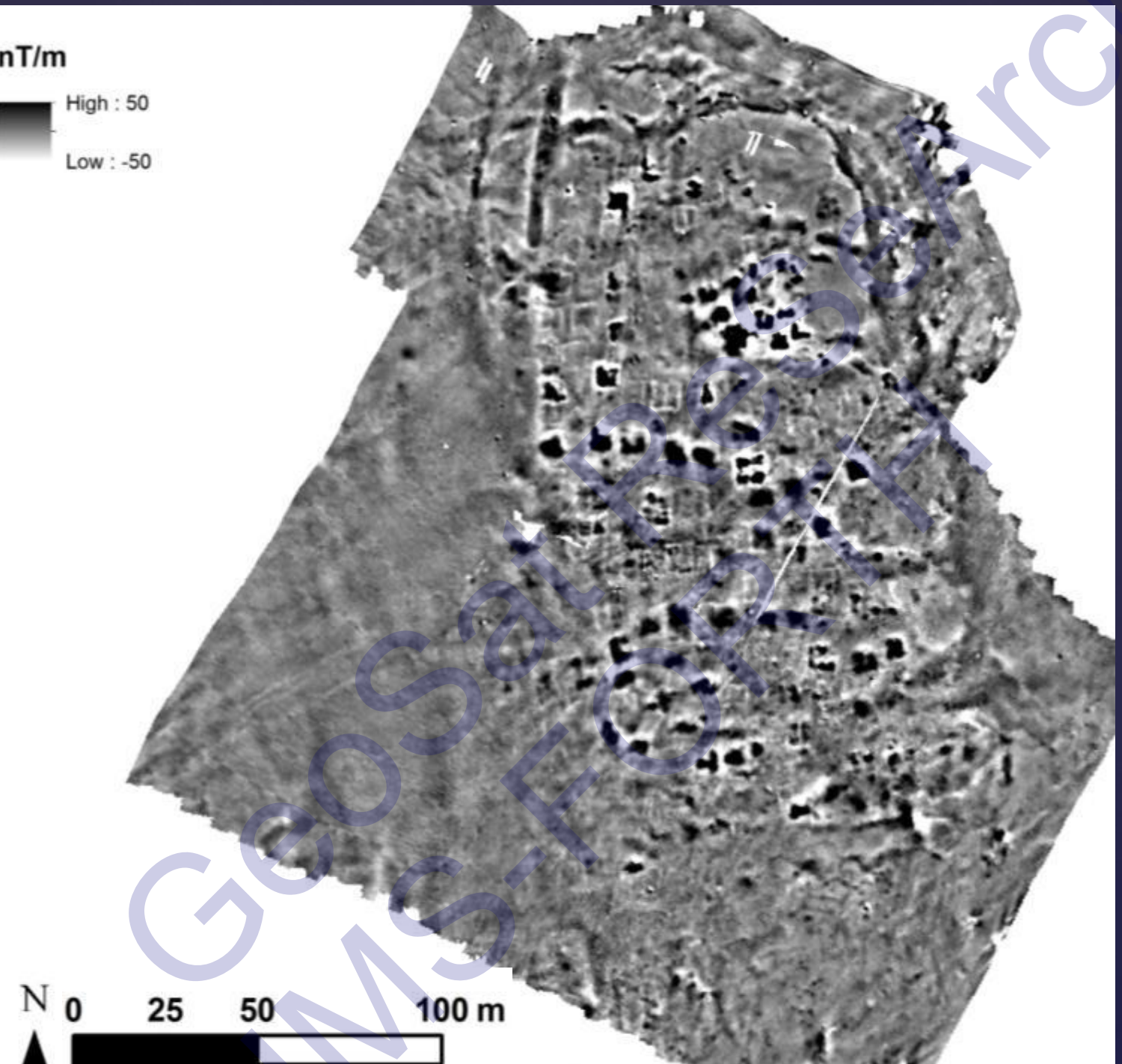
- Extensive network of ditches (at times double) surround the settlement

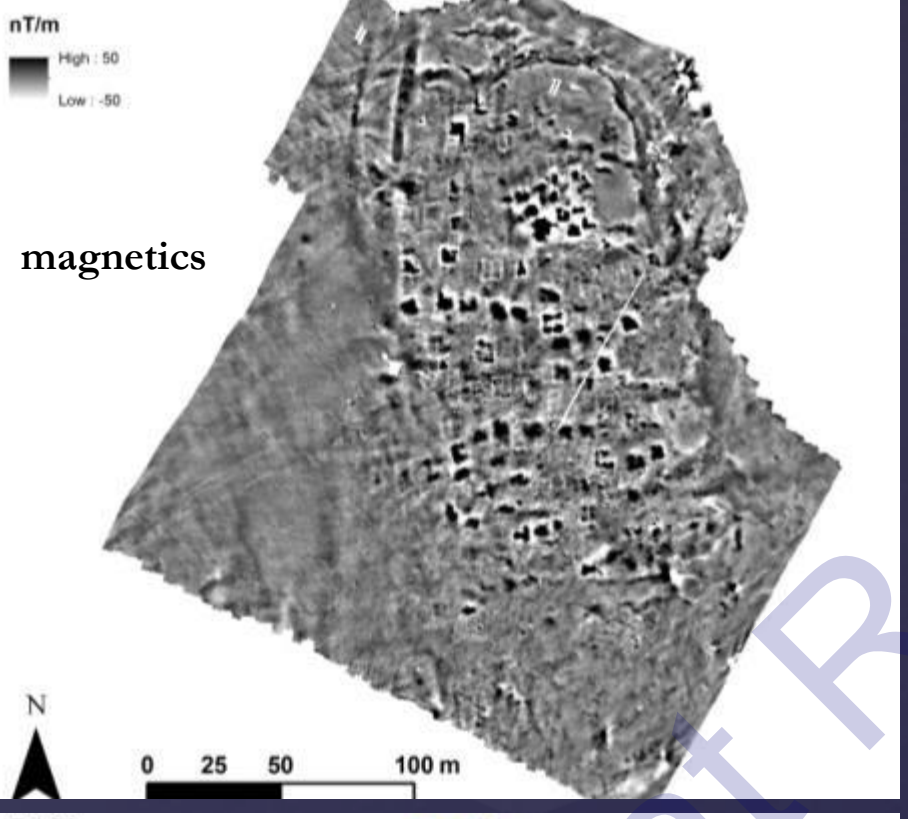
Perdika 1

Early Neolithic – Middle Bronze Age

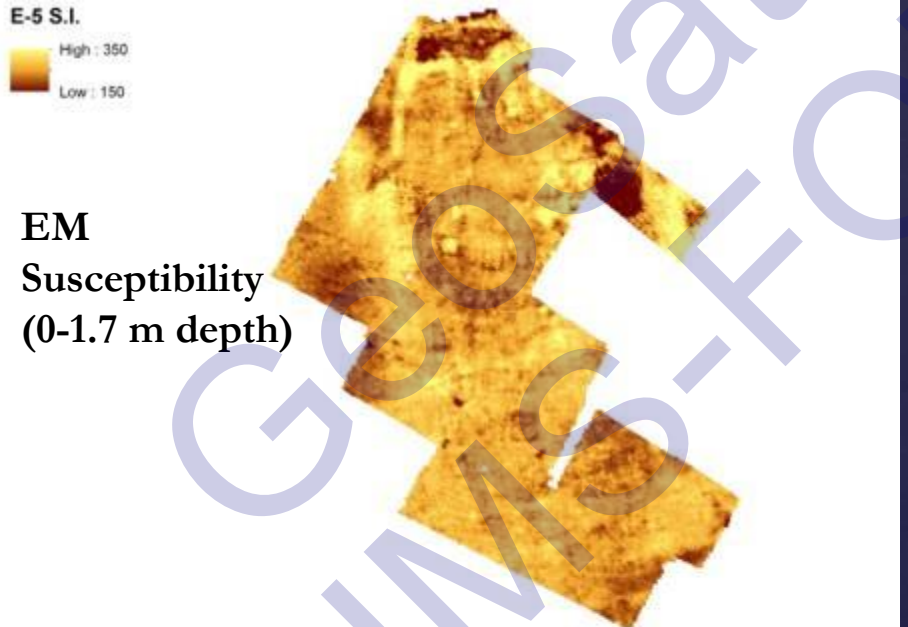
Perdika 1

Magnetics





magnetics



EM Susceptibility (0-1.7 m depth)

Perdika 1
Early Neolithic – Middle Bronze Age

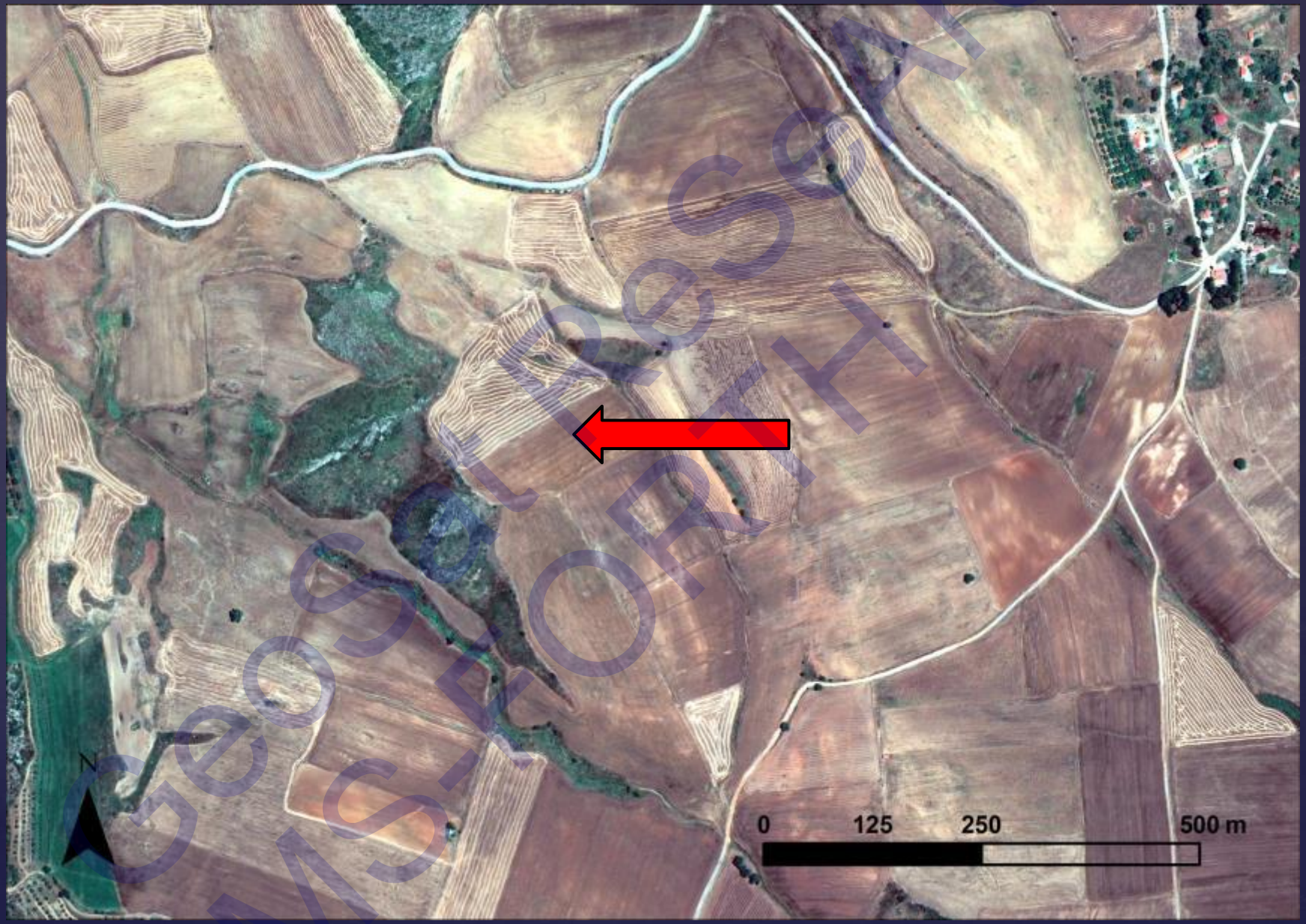
- Extensive settlement (>200x100m) that greatly expands beyond a core habitation zone on the highest level

- 50+ rectilinear structures

- The majority of structures have high magnetic values (mudbrick), but others have low magnetic values (stone) with 2-3 rooms (similar to Almiriotiki)

- Ditches and or walls preserved on the northern side of the settlement

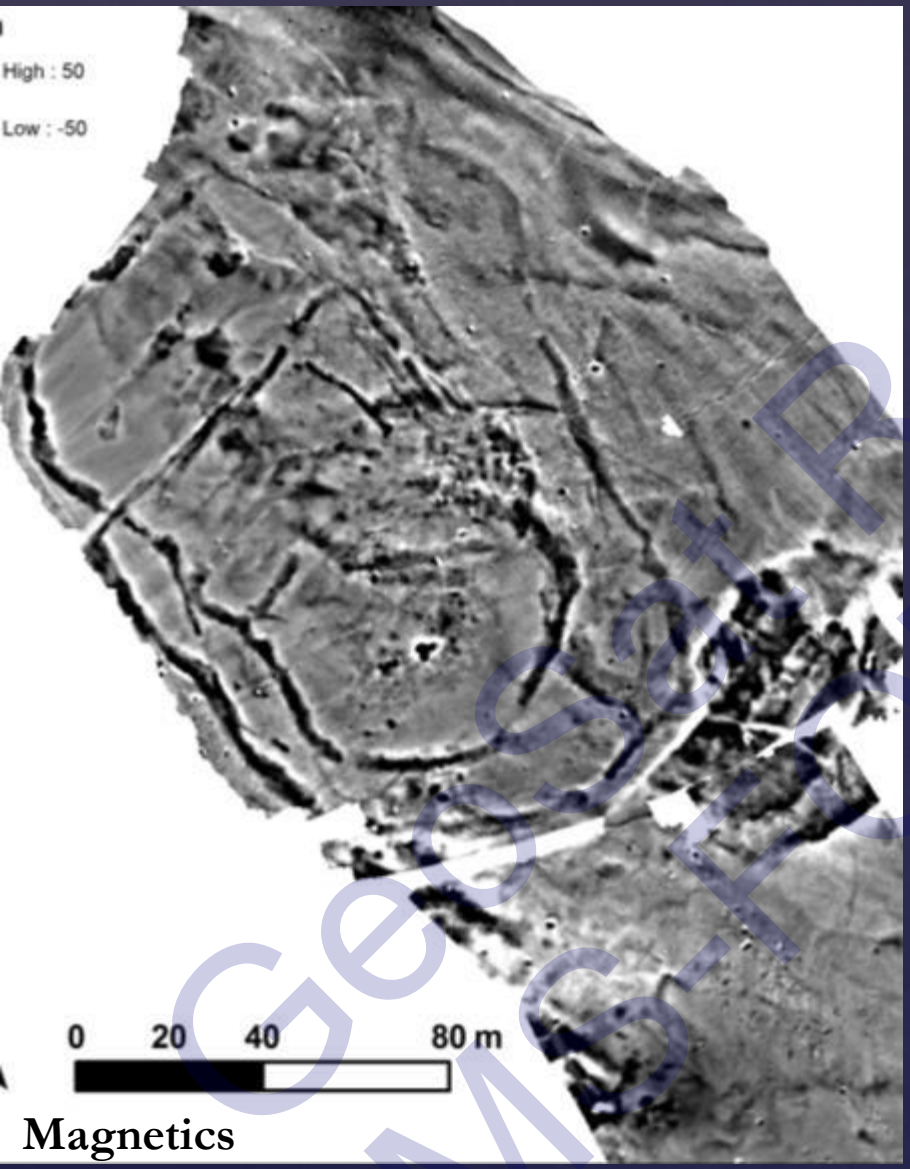
Perdika 2 Early Neolithic – Middle Neolithic



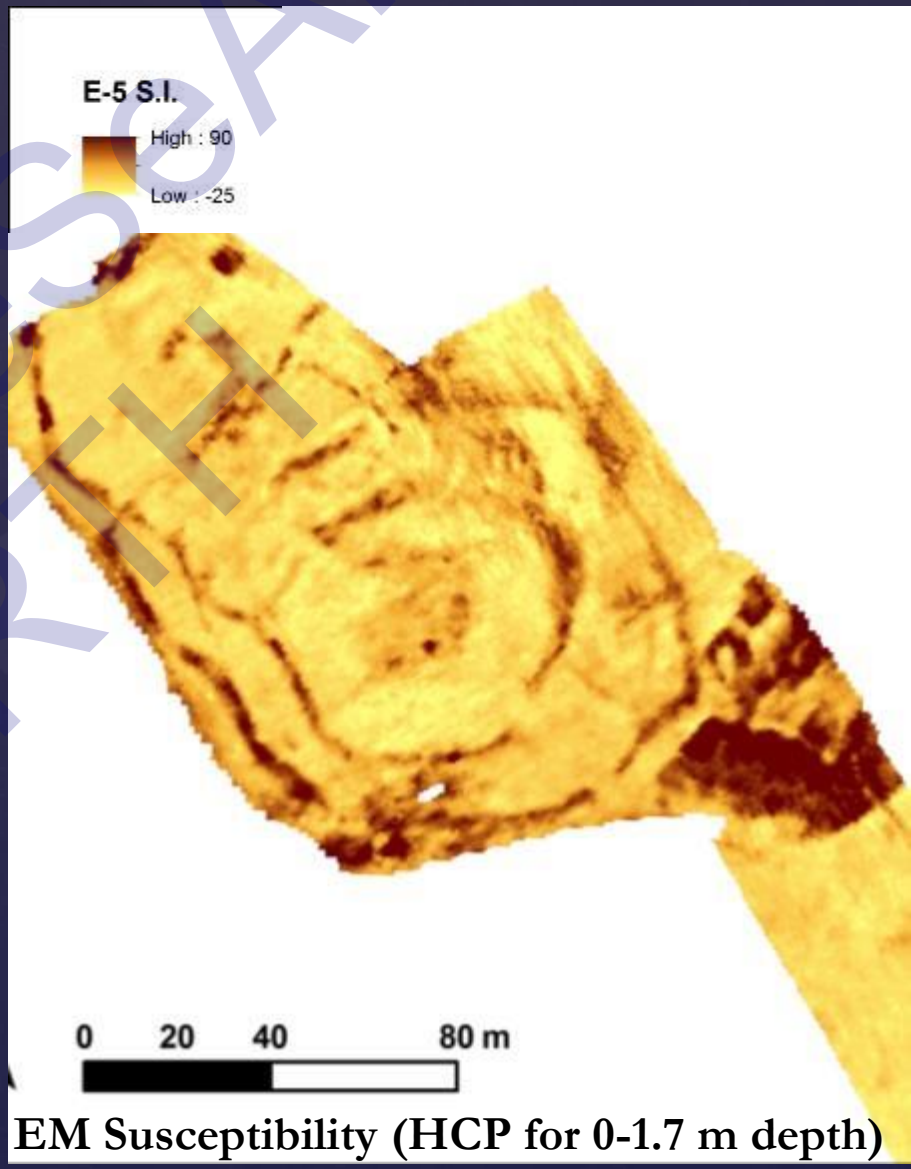
Perdika 2

Perdika 2

- Extensive network of ditches built on a natural hilltop
- A sequence of openings that gave access into the settlement
- Little evidence for individual structures (some have high magnetic values)

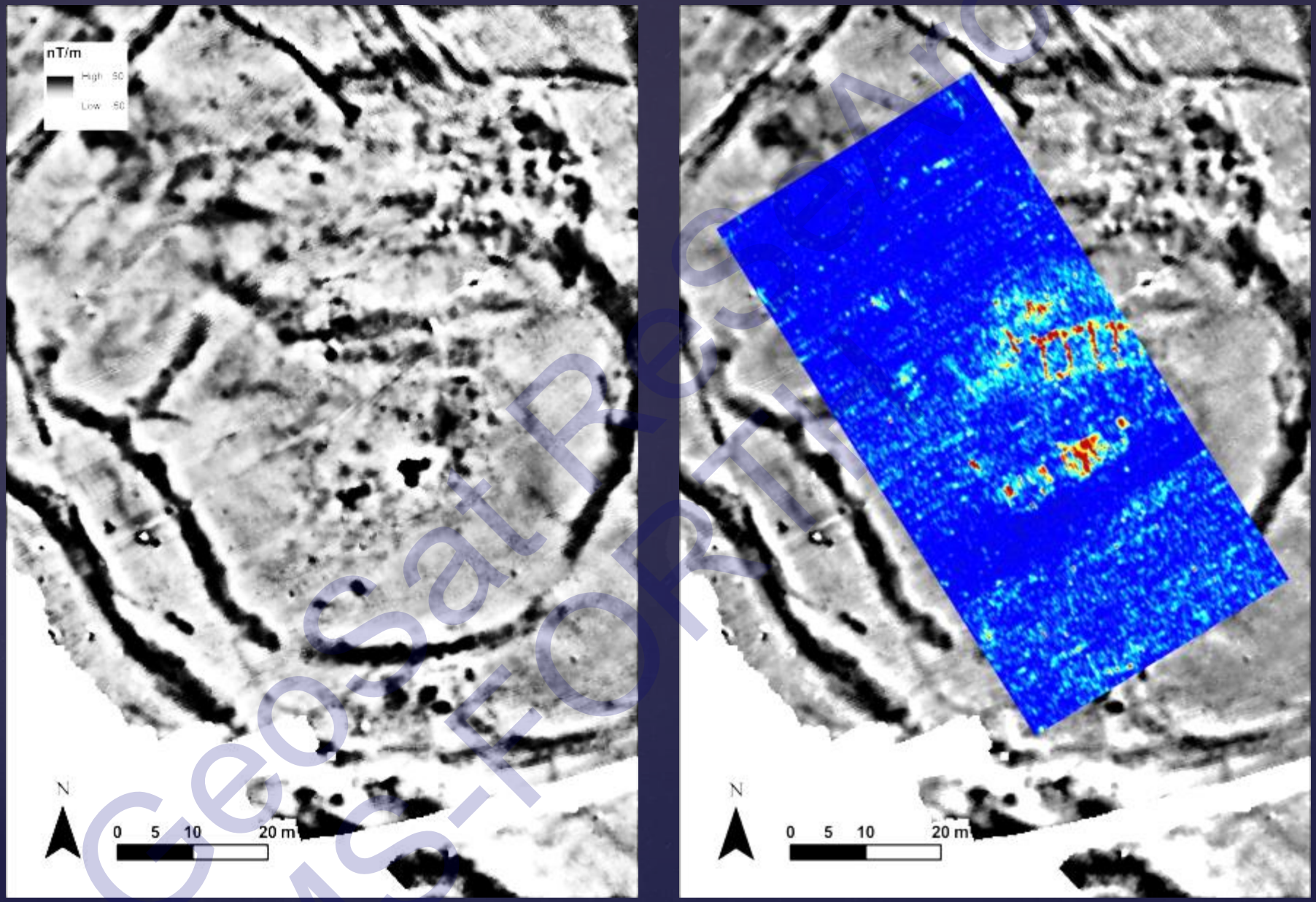


Magnetics



EM Susceptibility (HCP for 0-1.7 m depth)

Perdika 2 – Magnetics (left) and GPR 0.7-0.8 m depth (right)

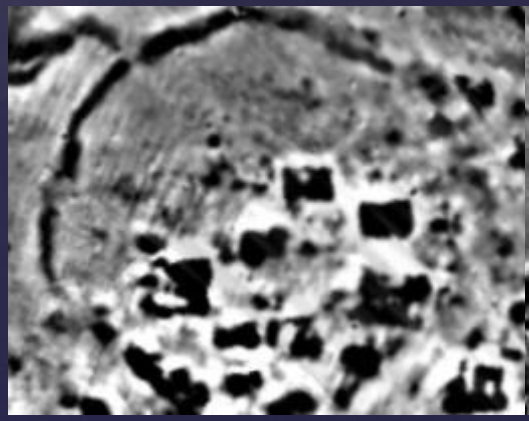


- Large rectilinear structures with low magnetic value (stone structures?) were identified with GPR

Concluding Remarks

- **Successful Employment of Geophysical and Satellite remote sensing techniques** – Importance of using an arsenal of various approaches **(manifold geophysics)**

- **Conceptualize a landscape of variation: Similar and divergent characteristics of settlements in planning and structural materials**)
  - Dimension of settlements and structures
  - Internal organization of the structures, clusters of structures
  - open/unbuilt spaces, pits, a.o.
  - burnt and unburnt structures / mudbrick & stone structures?
  - Corridors and entrances
  - Existence of enclosures (ditches/fortifications)



- Existence of ditches in terms to the surrounding geomorphologic features (e.g. proximity to palaeochannels).

- Implications regarding the sustainable population, the study the spatial context and organization – intra site, local and regional level, the chronological continuation of habitation, persistency in occupation, etc.

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