

# Investigating the sedimentary fillings of Megalos Peristeres Cave, Rethymno, Crete, through GPR techniques

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## Abstract

The study constitutes the first internal subsurface mapping of a cave environment in Crete. Mapping of the sedimentary deposits of Megalos Peristeres cave indicated the sequence of the fillings within the different chambers of the cave. Suggestions for the existence of anthropogenic residues have been made through the combined study of radargrams and depth slices.

## Keywords

archaeological prospection; Crete; GPR; Megalos Peristeres cave; Rethymno; radargrams

## Introduction

The mountainous terrain of the island of Crete contains a number of caves of different sizes, many of which contain valuable remains of past anthropogenic activity even from the Palaeolithic period as it has been suggested most recently by the Asphendou Cave rock carvings (Strasser et al. 2018). Due to their abrupt geomorphological settings none of them has been mapped through geophysical techniques until now. The cave of Megalos Peristeres, along the rocky northern coastline of Rethymno offered a great opportunity for such investigations aiming towards the definition of preserving strata that could be correlated to past human habitation containing both fossils and stone tools. Such kind of investigations have never been carried out before in the Cretan landscape, while only a few have been conducted worldwide (Weinstein-Evron et al. 2003; Quarto et al. 2007; Zhou et al. 2009; Lowe and Wallis 2020).

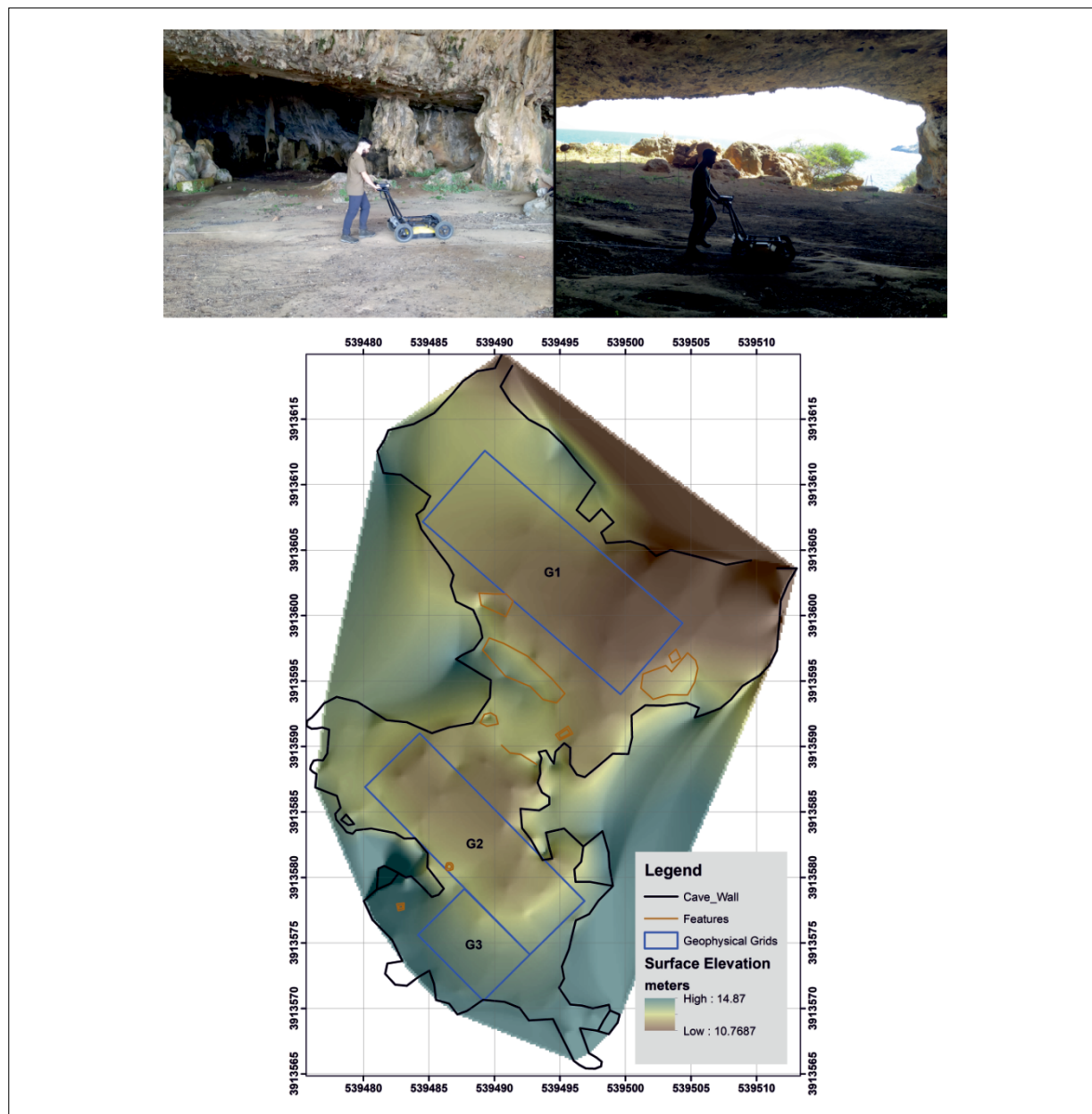
## Materials and methods

The geophysical prospection survey was carried out on July 2021 with the collaboration of the Ephorate of

Palaeoanthropology and Speleology of the Greek Ministry of Culture and Sports (Eleni Stravopodi, Crysanthi Kontaxi and Vassilis Giannopoulos). The detailed mapping of the main two chambers of the cave was accomplished through a Sensors&Software NOGGIN PLUS GPR unit carrying a 250 MHz antenna with a high resolution sampling (5 cm along parallel GPR transects 50 cm apart). The choice of the antenna was determined by the fact that the purpose of the survey was two-fold, namely to map the medium depth bedrock and to map the stratification of the sediment infill. Three grids (G1, G2 and G3) having a total area of about 283 square meters were covered (Fig. 1).

## Results and discussion

Processing of the GPR data was carried out following the pipeline described by Sarris (2020). The transects that derived from GPR were processed using GFP Edit4 and EKKO Project 2 by Sensors & Software. The processes that were applied aimed to remove noise from the data and to enhance the signal's information that will lead to a better



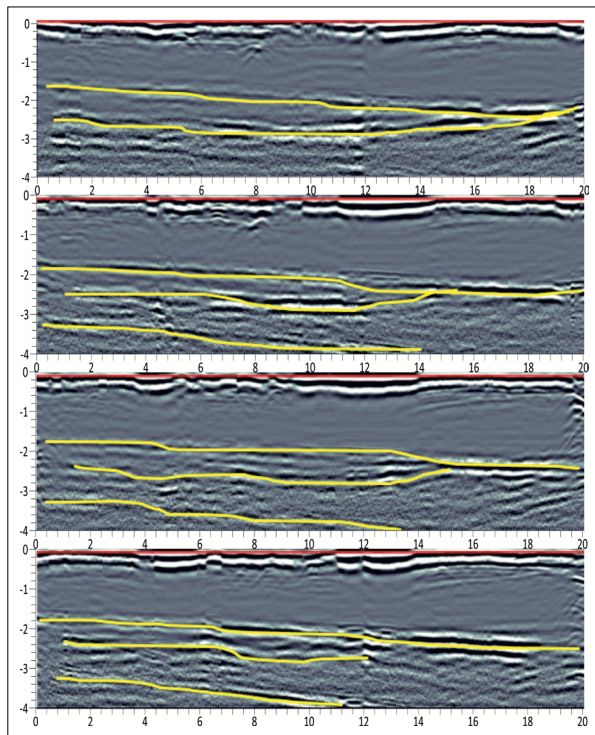
**Fig. 1:** Top: Details of the GPR surveying within the Megalos Peristeres cave. Bottom: Layout of the geophysical grids. G1 is located to the entrance of the cave, whereas G2 and G3 are located towards the interior chamber of it.

representation of the subsoil. Processing was divided into two stages: the first dealt with the application of correction and enhancement filters separately on every survey line, while the second stage involved the extraction of slices in accordance to depth and the creation of a sub-surface 3D model.

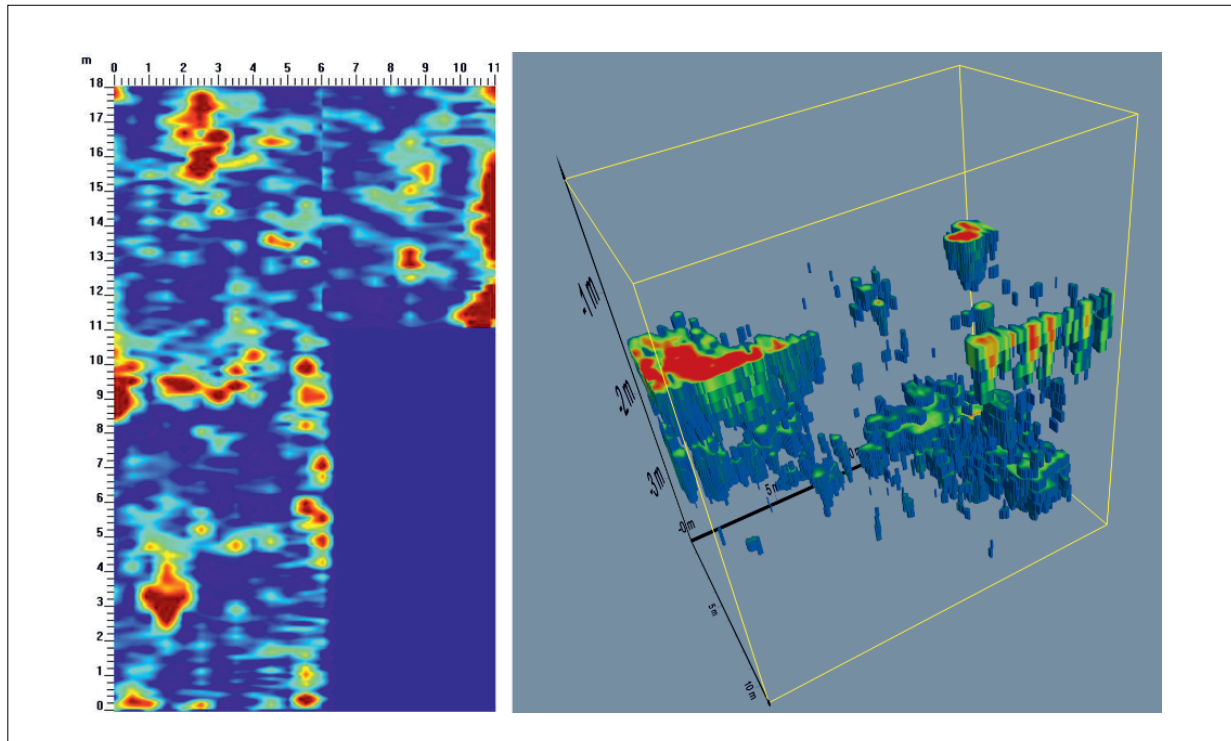
The presentation of the data was made through 1) Radargrams (B-Scans), representing the reflectors along each transect, 2) Depth slices (C-scans), representing the

amplitude of the reflectors with increasing depth from the surface and 3) in the case of Grids 2 and 3, 3D volumetric representations of the reflectors. The most important information resulting from the B-scans is related to the different stratigraphic layers and the deposits within the cave. The most representative depth slices and radargrams were rectified and fused in a GIS environment (ArcGIS).

In Grid 1, located close to the entrance and the north section of the cave, an upper layer has been recognized



**Fig. 2:** Indicative radargrams showing the different subsurface strata from Grid 1. The yellow lines were drawn manually to indicate the direction of the underground strata.




**Fig. 3:** Left: Depth slice of 90-100 cm from Grids 2 and 3, indicating some linear features that may correspond to past anthropogenic residues, most probably of the latest historical occupation of the cave. The most intensive reflectors may indicate the existence of stone foundations. Right: 3D surface render of the GPR signals from Grids 2 and 3. The 3D surface rendering was useful to indicate the differentiation of the underground strata below the different chambers.

having a small downward inclination from NW (~ 1.5-2 m below the surface) to SE (2-2.5 m below the surface) (Fig. 2). This layer is almost flat without any significant microtopographic variations. A second layer expands about 3.5-4 m below the surface, rising towards the NS and SE boundaries of Grid 1, reaching a depth of about 2.5-3 m below the surface. Both layers exhibit a rising trend towards the central section of the grid. The corresponding C-scans of Grid 1 indicated a cluster of strong reflectors (most probably related to rock outcrops) to appear at a depth of about 1.5 m from the NW section of the grid dropping down gradually to a depth of about 2.5-2.6 m toward the SE section of the grid (Depth slices of 150-160 cm to 260-270 cm). A large isolated reflector persists at the north central section of the grid.

The picture is changing as we move towards the interior chamber of the cave. The radargrams for Grids 2 and 3 indicate a well-shaped underground layer, that reaches a depth of about 2.5 m at the center of Grid 2. The layer starts at about 1 m below the surface towards the NW and goes up to a depth of about 1.8 m towards the SE. The particular layer starts dipping as we move to the south, reaching a depth of about 3 m towards the central SE part of Grid 2. The deep part of this layer continues towards the south in Grid 3 and then starts rising as we reach the south wall of the cave. This is also confirmed by the depth slices of 80-100 cm, which also indicate a few linear anomalies that may be related to anthropogenic structural remains (Fig. 3).

## Conclusion

GPR measurements at the Megalos Peristeres cave managed to identify the sedimentary deposits of the cave that expand down to a depth of 4 m below the current surface of it. Within the entrance of the cave, recent deposits missing any significant features expand down to a depth of more than 1.5 m. Most of indications for anthropogenic residues are suggested towards the internal chambers of the cave. Future excavations are planned in 2024 to verify the results of the geophysical prospection. 

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