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Pre-excavation studies of prehistoric cave sites by magnetic prospecting

Sonia Itkis. (1), Zinovii Matskevich (), and Tengiz Meshveliani ()

(1) Israel (sofia.itkis@012.net.il),Ben-Gurion University of the Negev, Beer Sheva, POB 81405, Iarael, (2) Israel Antiquites Authority, (3) The National Museum of Georgia

Detailed magnetic survey was performed for caves study in Israel (1995-1996) within the framework of the Beit Shemesh Regional Project (Judean Shephelah). The experience accumulated in Israel we applied later (2010) in two Georgian prehistoric cave sites: Cherula and Kotias-Klde. The magnetic method is based on the contrast in magnetic properties between a target object (e.g., buried archaeological feature) and the host medium (i.e, the surrounding bedrock and soil). The feasibility of the magnetic method for cave revealing was evaluated by magnetic susceptibility (κ) measurements of surrounding soil and rocks, and archaeological features: stones making up the walls, ceramic fragments and cave fill. According to data obtained, the κ of soil within caves (cave fill) is higher than that of surrounding soil. The enhancement of cave fill κ occurs because processes associated with human habitation: repeated heating and accumulation of organic debris. Both these processes provide good conditions for the conversion of the iron oxide found within the soil to a strongly ferromagnetic form (Mullins, 1977; Maher, 1986; Dalan and Banerjee, 1998, Itkis and Eppelbaum, 1999; Itkis, 2003) The presence of highly magnetic ceramics in caves also enhances magnetic contrast between practically non-magnetic bed rock (chalk in Ramat Beit Shemesh Site (Israel) and limestone (Georgian sites) and the cave fill, increasing the potential of the magnetic method to reveal caves (Itkis, 2011).

Based on magnetic survey results, an excavation revealed a cave with a large amount of well preserved pottery and finds typical of the Early Bronze Age.

Both studied cave sites in Georgia were located in Chiatura region of Imeretia province.

Cherula site is a karstic rockshelter with a single chamber, ca 100 sq. m. The site was briefly tested in 1970s'. The area excavated in 2010 went to the depth of 60 cm below the present day surface; the limestone bedrock was not reached. The excavation revealed stratified Eneolithic deposits (ca. fifth millennium BC), rich in pottery and other material culture remains. Charcoal and animal bones are in good state of preservation that increases the importance of the site. In addition, a built stone wall crossing the excavation area in west-east direction was found in association with an Eneolithic living surface. Magnetic study covers practically whole area of the chamber (about 60 sq. m.) was made adjacent to the excavated area. Soil κ values change in the wide interval of 20 to 140 units SI x 10-5.Nevetheless, the highest κ values 100 to 140 units SI are concentrated in limited area adjacent to the large high intensity (up to 50 nT) positive magnetic anomaly. The latter is limited by two narrow linear negative anomalies of NW-SE and SW-NE orientations which probably indicate location of limestone walls .

Excavations in the Kotias-Klde site were conducted in 2004-2006 under direction of O. Bar-Yosef, A. Belfer-Cohen and T. Meshveliani, with participation of the present author. A sequence including Upper Paleolithic, Mesolithic, Neolithic and Eneolithic layers was revealed. Magnetic investigations were performed both in the cave and outside. We will discuss the results obtained in the cave which was tested by excavation.. The survey revealed a large positive magnetic anomaly of square configuration approximately 2.5 by 2.5 meters. There is a dense correlation between T and κ anomalies. The pattern of the T anomaly, its configuration and intensity allows one to suppose that its source is so-called "firing feature", probably, hearth or fireplace. According to preliminary evaluation, the source is buried at the depth of 0.5-0.7 m.

Following the magnetic survey, a test trench of 3 sq. m. was opened in the location of positive anomaly. The trench reached depth of 80 cm below the present surface. The stratigraphic sequence exposed in the trench includes two main strata, dated on the basis of typological properties of the associated lithic material to Mesolithic and Early Neolithic periods. The upper layer is ca 50 cm thick, consists of fine grey silt with few pebbles and includes numerous bones and lithic implements. In this layer two circular dense concentrations of charcoal, possibly fireplaces were discovered.

Conclusions

1. The results of magnetic survey obtained in prehistoric cave sites in Israel and Georgia show the high efficiency of the magnetic method for revealing and detailed characterization of caves.

2. The presence of organic materials, e.g. bones, charcoals and ceramics in caves enhances magnetic contrast between non-magnetic bedrock and the cave's fill, increasing the potential of the magnetic method.

3. Revealing enhanced magnetization of soil within studied caves allowed us to develop an approach to reliable interpretation of magnetic data in studied areas

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