

Towards an integrated remote-sensing strategy for revealing the urban details of the Hellenistic-Roman city of Demetrias, central Greece

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INTRODUCTION

The ancient city of Demetrias is located on a small promontory on the Pagasetic Gulf just south of the modern city of Volos. It was established by the Macedonian king Demetrios in 294 BC and became the royal residence of the Antigonid dynasty of Macedonian kings. The city flourished as a political center and as a stronghold for the Macedonian naval fleet. After the Romans defeated the Macedonians in 168 BC, a prolonged state of decline befell the city, but it continued to be inhabited until the 6th century AD. Organized along the lines of the Macedonian kingdom cities, Demetrias was a major strategic settlement in the region, as attested by its large extent, the expansive fortification walls that enclose a large area in the region, and its monumental architecture. A reconstruction of the city plan of Demetrias has been produced based on past excavations of the 1960s and 1970s by D. Theocharis and a group of German archaeologists (Milojčić 1974; Milojčić and Theocharis 1976; 1978; Milojčić *et al.* 1980; Einwanger 1981; Bakhuizen *et al.* 1987).

GEOPHYSICAL APPROACHES

Previous geophysical work in the area covered the region of the ancient theater which is well preserved (Sarris *et al.* 2013). The aim of our current research involved an expansion of investigation to other sections of the site and the creation of a best-practices approach to geophysical prospection.

High-resolution multispectral satellite images were employed together with excavation plans in order to reconstruct the layout and plan of the city. Based on this, various segments of the city were explored, via magnetic, soil resistance, electromagnetic (EM) and ground penetrating radar (GPR) techniques. In total, about 10 ha of the ancient city were covered, out of which about 5 ha was new coverage without overlap from the different methodologies. Depending on the accessibility of the areas and the vegetation, measurements of the magnetic field were carried out by both Bartington G601 (with sampling of 1 m x 12.5 cm) and a multi-sensor SENSYS Mag-

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Fig. 1. Superposition of the GPR Noggin Plus 250MHz 0.8 m depth slice on the magnetic data acquired from the area to the south of the Hellenistic Palace of Demetrias. Data were overlaid onto a World-View 2 satellite image. The Hellenistic palace is shown in the upper right corner of the image

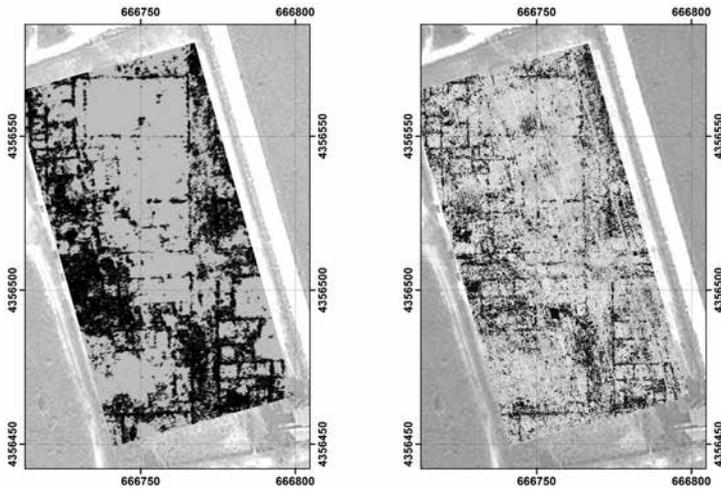


Fig. 2. Demetrias, area of the soccer field. Left: Depth slice of 0.8 m from the Noggin Plus 250MHz GPR unit. Right: Depth slice of 0.8 m from the MALÀ Imaging Radar Array 400MHz GPR unit. Dark colours indicate the most intense reflectors

netometer MX system consisting of eight fluxgate gradiometers (with sampling of about 0.5 m x 10 cm) and a GPS rover unit. A single channel Sensors and Software NOGGIN Plus-Smart Cart system with a 250 MHz antenna and a MALÅ Imaging Radar Array with nine 400MHz antennas were widely employed within a number of flat sections, especially parking lots and soccer fields. Spatial sampling resolution was 0.5 m x 2.5 cm and 10 cm x 8 cm correspondingly for the above GPR units. Soil conductivity and magnetic susceptibility information were acquired via a GEM-2 multi-frequency and a CMD multi-coils spacing electro-magnetometer units (with sampling of 1 m x 1 m). Small sections were also investigated through a twin-probe-array Geoscan RM85 resistivity meter.

MAPPING OF THE URBAN STRUCTURE OF THE ANCIENT CITY

Due to recent activities in the area, deposition of modern debris increased levels of noise for magnetic measurements and vegetation density prevented the implementation of all techniques, especially GPR. Multiple techniques were implemented however in the better preserved areas. The geophysical results through the amalgamation of the various techniques have been extremely revealing in confirming the accuracy of the German city plan, providing evidence for new streets not included on the plan and identifying clusters of subsurface buildings, both large public and smaller private structures, with great clarity.

Despite the surface distribution of metal and garbage debris, a number of linear anomalies became apparent from both magnetics and GPR to the west and south of the central excavated site, where the Hellenistic palace complex and agora are located (Fig. 1). Most notable is the group of structures located to the south of the palace, which consists of square and rectilinear rooms of various dimensions and long corridors. The western boundary of the complex is clearly defined by a north–south wall identified in GPR and to a lesser extent with magnetics. The structural remains continue further to the west with a similar density, in contrast to any significant features found within the agora itself.

An even higher density of structural remains was found in the region east of the agora and southeast of the Hellenistic palace. Almost all methods (EM, magnetics and GPR) applied in the specific area where a dirt soccer field is presently located produced comparable outcomes with the most clarity and details resulting from the higher-resolution GPR surveys (Fig. 2). The data indicate that the region could have been a dense residential and commercial quarter of the ancient city, where structures were confined in blocks of about 50 m x 100 m and crossed by N–S and E–W streets of about 8.2 m in width. Within the city blocks, structural complexes seem to consist of various clusters of rooms and corridors with or without open yards. This kind of architectural arrangement is typical of Hellenistic and Roman urban houses with courtyards or gardens in the back and shared partition walls between houses (Rumscheid 1998; Zanker 1998).

Moving away (~400 m) from the center of the city and close to the modern shoreline in the northern region of Demetrias, geophysical data discovered the ruins of a large buried structure following the same alignment as the rest of the city plan. The structure consists of a semicircular (20–25 m radius) western half that is connected to a rectilinear (about 45 m in length) complex with individual rooms (Fig. 3). The semicircular exterior of the building has a corresponding semicircular feature 7–8 m inside. The southern end of the rectilinear complex

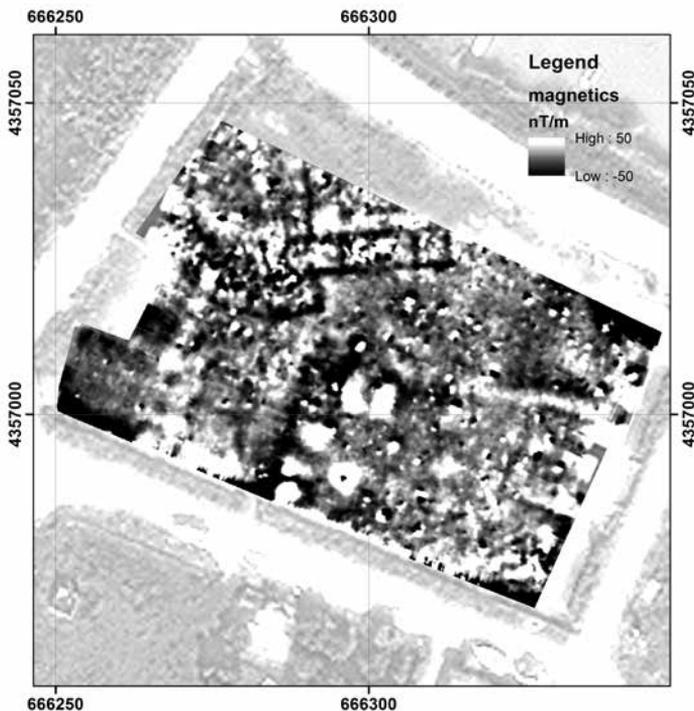


Fig. 3. Results of the SENSYS magnetic prospection from a field close to the shoreline

is subdivided into four rooms. The western room appears to have an apsidal end. North of these rooms, a large square area (courtyard?) appears in the geophysical data. The plan of the particular monument is suggestive either of a small theater with an attached portico or of a covered odeion, although a bath complex cannot be ruled out.

Overall, geophysical survey in Demetrias was more than revealing. It confirmed sections of the older German plan, identified various new features, blocks and roads, provided accurate details of the internal structural planning of the city blocks, and indicated the expansion of the city plan in areas that were completely unexplored. The resulting maps have contributed significantly to an understanding of the usage of the urban space in the Hellenistic and Roman periods, allowing comparisons with other similar cities in the Greek mainland.

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