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SEISMIC REFLECTION AND REFRACTION IMAGING OF THE ANCIENT ITANOS PORT, CRETE, GREECE

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Shallow reflection and refraction seismic studies were carried out in Itanos, an accient port in Eastern Crete close to the unique in Europe Vai Palm Forest, in an effort to locate Itanos harbor. The area of the archaeological site does not exceed 16000 square meters. Archaeological excatavions cover only 1% of the archaeological site. Most of the relies of the buildings are seen in the region between the two acropolis of the city. Itanos is marked mainly from three periods: geometric, roman and late christian, while the periods of original occupation and abandonment are not known.

The application of the seismic methods in archaeological problems is limited, mainly due to difficulties associated with the very shallow depth of archaeological targets (Vafidis et al., 1995). Seismic reflection applications with investigation depths about 3*6 km are sparse due to resolution limits of the method (Miller et al., 1989). Other difficulties encountered are related with the separation of the signal from noise for shallow reflectors (at depths less than 20m) and the facts that the amplitude of the reflections can be smaller than that of coherent noise (Karastathis and Papamarinopoulus, 1997). Nowadays, there is a tendency in archaeological prospecting to combine the conventional geophysical methods (magnetic and resistivity mapping) with high-resolution techniques like ground penetrating radar, electrical tomography and seismics.

Seismic refraction is especially sutied for the investigation pf seismic interfaces in shallow depths. Eight seismic refraction profiles have been selected with total length of 580 m and geophone spacing 2 m. the resonance frequency of the geophones was 14Hz. The hammer and the seisgun (Betsy) produced seismic waves. For most seismic lines five shots were selected: one in the middle, two near shots at the edges of the lines and two far shots. The travel time curves were used in the calculation of the model velocities and depths to the interfaces. tHe top layer with average velocity of 550m/s has an average thickness of 1 m, the second layer shows an average velocity of 1780 m/s, is dipping to the East and corresponds to colluvium. The deeper layer shows an increased average velocity of 2790 m/s and it is attributed to the basement (phyllites-quartzites) or to an eroded layer on top of the basement. This interpretation is subject to verification from a shallow hole. Figure 1 illustrates the top of the basement interface as well as the thickness of the overburden that consists of recently deposited sediments.

The high-resolution reflection survey has been conducted with the use Betsy (seisgun source) and 100 Hz receivers. The record length was set to 100 ms and the sampling interval was 0.1 ms. There were 24 active channels. The geometry was off-end with a 7m offset and 0.5M geophone spacing. The fold of the reflection survey was 600% and the total length of the seismic reflection survey was 83m.

First, we have performed walk-away tests in order to distinguished signal and to select the parameters such as optimum offset window. Initially the geophone spacing was set to 2m and the offset to 4m, 28m and 52m. For the second test the geophone spacing was set to 0.5m and the offset to 4m, 16m, 28m, 40m, 52m, 64m, 76m and 88m. In the roll along technique, the switch rolled the geophones along the seismic line in subsequent whose shot spacing is 1m. The geometry parameters were selected in order to amp the shallow reflections from the subsurface (depths approximately less than 30-35m). The recorded data were processed with the 2D-Promax software. The main processes for the reflection data included transformation from SEG-2 to SEG-Y format, geometry setting of the experiment, trace muting, AGC, deconvolution, F-K filtering, velocity analysis, NMO and stacking.

From the comparison of the stacked seismic section with the seismic model from the refraction experiment, we observe that the first reflector (two way time 30ms) corresponds to the interface at depths of about 30m. From the three dimensional seismic model (fig 1.) it is suggested that the survey area includes the port of the ancient city. The maximum depth is reached at the eastern part of the surveyed area indicating the position of the part entrance. This case study showed that the seismic reflection and refraction methods are useful in archaeological prospection. Further work is necessary to improve this proposed model and provide additional information regarding the inner details of the ancient port.

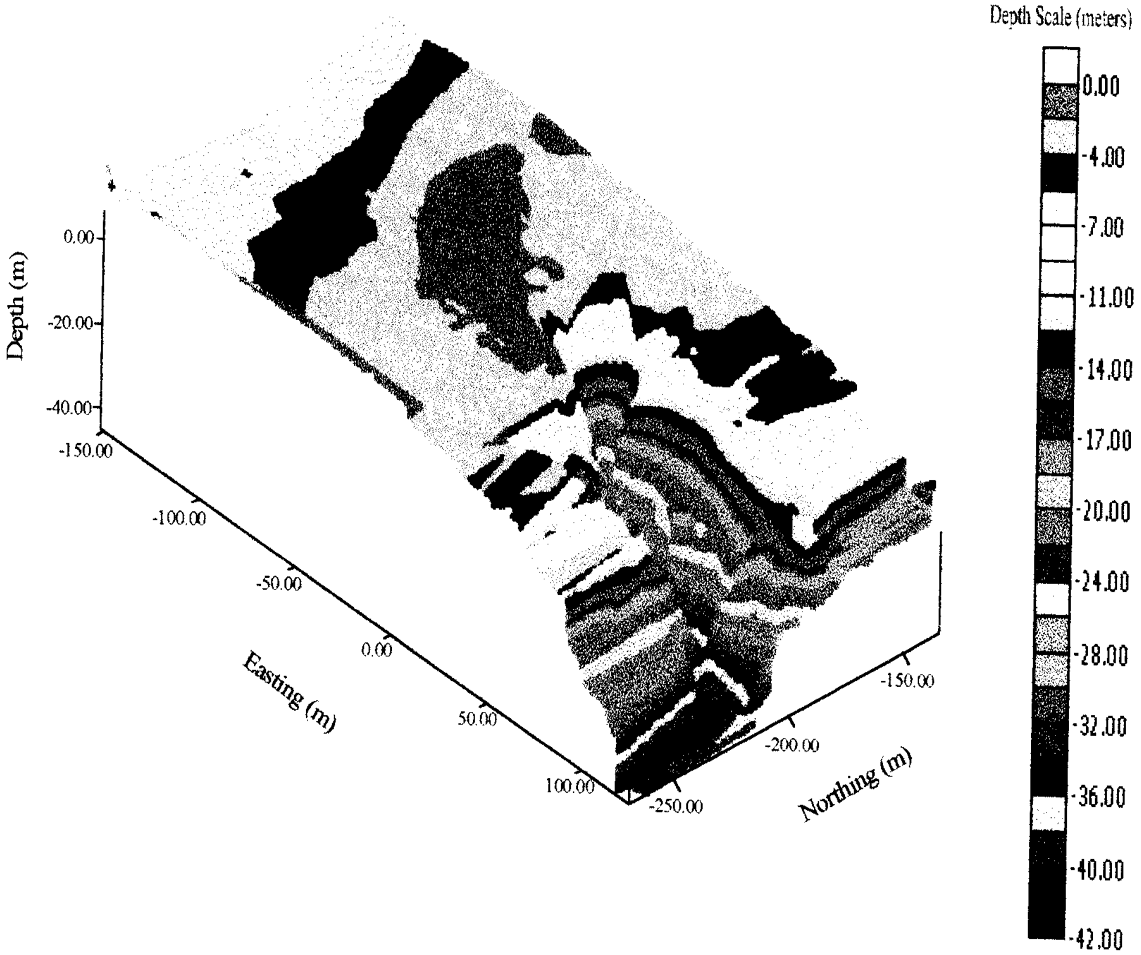

Figure 1. Three-dimensional representation of the top of the basement in the area south of the acropolis deduced from the seismic refraction experiments in Itanos.

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