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Geophysical Measurements for Upraising the Geological Model at the Katakolo Peninsula

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Introduction

In this work we present the results of the geophysical survey that took place in 2018 at the Katakolo peninsula aiming into obtaining supplementary information regarding the subsurface geological configuration of the wider Katakolo peninsula.

The post-alpine rocks of the Katakolo area are part of the wider Pyrgos basin. The Pyrgos basin is a first order tectonic graben that is bounded to the north and to the east by the Erymanthos and Tropaia horsts, and to the south by the Lapithas horst. In the Katakolo peninsula, two basic formations crop out: 1) The lower fine grain Vounargos formation and 2) The Katakolo calcarenitic formation. The contact between these two is designated by an angular unconformity that is visible at the western part of the peninsula. The Katakolo formation crops out in the whole peninsula covering large areas on top of the Vounargos fine grain formation. It is in general a strong calcarenitic to calciruditic member that dips towards the west in the northern and western part of the peninsula and towards the south in the southern part reaching its highest onshore width near the western coastline. The Katakolo formation was subjected to weathering processes that generated a weathering brown/red clayey mantle <2m thick. In some areas the Katakolo formation is locally absent and the Vounargos formation is topped by a thick (>3m) younger fluvial deposits.

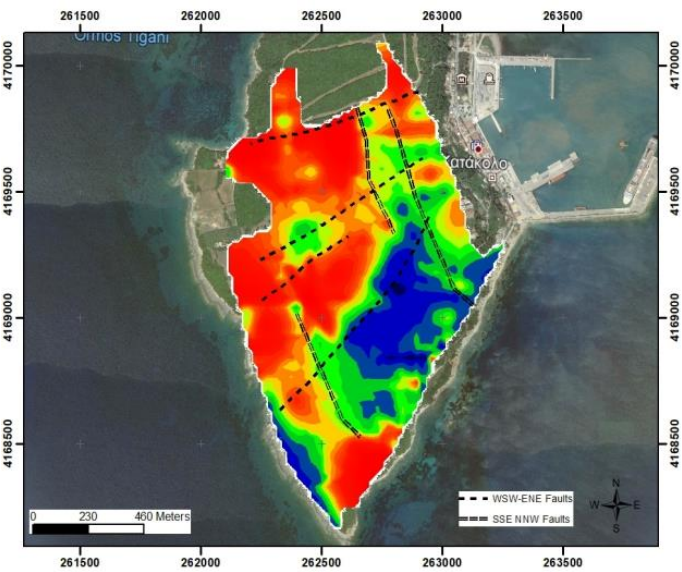
The main aim of the geophysical survey was to determine the thickness of the top Katakolo formation and to investigate the possible existence of salt diapir below the wider Katakolo peninsula area up to a depth of 500m. The technique of electrical resistivity tomography was applied over the entire Katakolo Peninsula to map the subsurface at depths up to 250m in order to locate geoelectrical units and discontinuities and then correlate them with the geological/geotectonic setting of the area. Additionally, a large number of Transient Electromagnetic (TEM) method soundings were collected and interpreted in an attempt to map the deeper geoelectrical structure (i.e. up to 500m depth) of the peninsula and locate possible diapir intrusions.

Figure 1. The location of the ERT lines and the TEM centers.

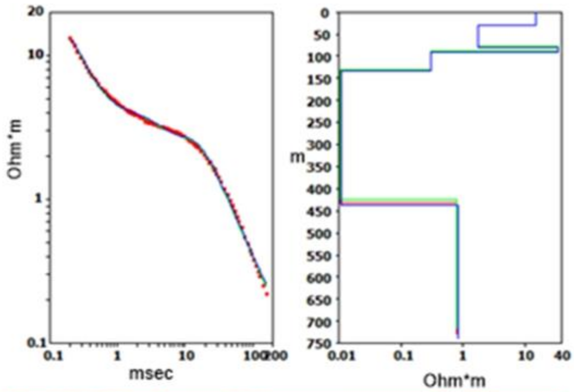
Geophysical Measurements

A total of 9 long ERT lines (total length of 9450m) were measured: lines K51-K512 are distributed all over at the Katakolo peninsula. The exact location of the lines is depicted in Fig. 1. All ERT lines had a 50m electrode separation and a typical length of 1000m (21 electrodes) while some lines were longer and they are the result of the merging of two 1000m roll-along lines. Data were obtained using the multiple gradient and the dipole-dipole electrode arrays and were inverted using standard 2D inversion software (Kim, 2017). The inversion results were extracted from all 2D lines and every inversion point was georeferenced to its actual coordinates. Georeferenced inversion data were combined into a single interpolated 3D grid from which slices for specific elevations were extracted. A typical geoelectrical colored map slice for the elevation of z=-10m is shown in Fig.2a using a rainbow color scale (blue-low, red-high). Areas of high resistivity (red) correspond to the Katakolo formation which is thicker at the NW part of the peninsula. Further clear lateral geoelectrical variations can be seen which can be correlated to WSW-ENE and SSE-NNW tectonic lines which are also depicted in Fig.2a.

A total of 34 TEM soundings were conducted at the area of investigation. The location of the soundings is shown in Fig.1. Typical loop sizes used were 100x100 m and sometimes 50x50 in certain “noisy” areas. The delay time reached 500 msec in noise free areas, such as the southern tip of the peninsula. The data were inverted with a 1D scheme assuming models of 3 to 5 layers, with the Terra software developed by Karmis (2004). A typical TEM sounding and its interpretation is shown in Fig2b. The sounding TA2 was conducted at the southern part of the peninsula. Loop size is 120x120 m and the induced current was 4.7 Amps. The interpreted geoelectrical layer model is also shown at the bottom of in Fig.2b. The top layer with resistivity of 14 Ohm-m is underlain by conductive layers of low resistivity values, reaching sea-water resistivity. There is no indication of large resistivity formation (i.e. possible diaper intrusion) up to a depth exceeding 432 m.



(a)



Resistivity Ohm*m	Thickness m	Depth m
15	31	31
1.7	48	79
34	10	89
3	43	132
1	300	432
0.8		

(b)

Figure 2. (a) Geoelctrical depth slice at the elevation of Z=-10m. (b) Typical TEM sounding curve (TA2) and its interpretation.

Concluding Remarks

By inspecting the individual and combined inversion results of the long ERT lines it is evident that there is clear distinction in view of resistivities of the top geological Katakolo formation. The formation appears to be generally more resistive and it is geoelectrically heterogeneous and at parts appears to be quite resistive (resistivities > 100 Ohm-m). The thickness of this formation ranges from few meters to 2-3-decades of meters but is on average 10m. The Katakolon formation is followed by deeper formations which are generally more conductive to moderately resistive and are probably related to clays, sandy clays and maybe sandstones. The combined depth slices and 3D views of all lines illustrate clearly that the thickness of the Katakolo formation is limited at the south-eastern and south parts of the peninsula but it increases significantly towards north-west. The particular change in thickness seems to be also related to the existence of tectonic lines.

The general pattern of all TEM soundings is the succession of a resistive layer as overburden with thickness of 20 to 30 m, followed by a conductive formation with resistivity values 2 to 10 Ohm*m. This is probably attributed to silty clayey deposits with sand intercalations in places. At larger depths, the formations are becoming very conductive with resistivity values below 1 Ohm*m indicating sea water intrusion. There is no evidence of a salt diapir intrusion in the whole area of investigation. This result applies for the first approximately 500 m of depth, within which the results are considered as reliable.

References

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