

## ABSTRACT

The southeastern Mediterranean Sea and the northern section of Egypt constitutes one of the most complex tectonic areas in the Mediterranean. This study is an attempt to achieve a better understanding of tectonics, and geodynamical processes along a complex tectonization region. These include crustal structure, thickness of sediments, transition between oceanic and continental crust and regional integrated model of the gravity field observed. A wide range of field work from the geophysical data has been acquired and used in this study with respect to the gravity and magnetic data as well as the results of deep seismic soundings. A comparison between the marine gravity data and the gravity data derived from satellite altimetry was made to ensure that the marine gravity data compiled from different marine surveys were compatible. Furthermore, a successful attempt was made to understand the behaviour of the tectonic activity and regional stress pattern distribution within the area investigated by using the seismicity data.

◆ The geographic setting and geology of the study area show that the Eastern Mediterranean region includes a short segment of the convergence boundary between Africa and Eurasia. Subduction in this segment is along two very small Arcs, the Hellenic and Cyprean Arcs. Moreover, the study area has remarkably prominent morphogeologic features such as East Mediterranean Ridge, Herodotus Abyssal Plain, Levantine Basin, Eratosthenes Seamount, Nile Delta and Sinai Peninsula. At the base of the continental slope off Egyptian coast and eastern Libya, the shape and size of bathymetric depressions strongly suggested that they originated from an active eastern Mediterranean transcurrent fault system (EMTS). Additionally, there is a few major fault systems trending NE-SW and NW-SE, i.e. the Suez rift and faults from Arabian plate, extend into southeastern Mediterranean Sea. It reflects activation of the Dead Sea faults (DSF) and the Levant-Aqaba transform plate boundary.

◆ A qualitative interpretation of the observed potential anomalies revealed that the Free-Air anomalies are generally negative. The Bouguer anomalies are predominantly positive as might be expected for an oceanic area. A series of high magnetic anomalies around the Cyprean Arc, runs from the Antalya Basin across Cyprus to the coast of Arabian plate. It coincides with a large positive Bouguer gravity anomaly suggesting that the ophiolites in Cyprus, in southern Turkey and northwest Arabian plate have a common base, and that ophiolites probably exist around the whole Cyprean Arc.

The regional gravity anomaly field values in the study area generally decrease towards the E-W and SE directions. This behaviour trends reflect the effect of the transition from oceanic crust to the continental crust of the Eastern Mediterranean towards the Arabian plate. The re-

gional magnetic anomaly field in the study area on the other hand is dominant in NW- SE trends and increases towards the north, which may reflect the shallow depth of the basement rocks in this direction. The residual gravity and magnetic anomalies reflect the effect of the difference in density between the crystalline or igneous crust and the sediments, the variation of the basement geometry and also the effect of the bathymetric and topographic features.

The orientation of the Free-Air anomalies in the study area indicated that the isostatic equilibrium is far from being achieved. The absence of a large Bouguer anomaly associated with the extreme relief indicates that the area is, as could be expected, not isostatically compensated by local variations in the crustal or mantle structure.

The satellite data shows only minor deviations in some partial regions of the area investigated such as at Levant basin and nearest Rhodes basin, and differences between the satellite and the shipboard data are also small in some regions. These occurred mostly near to land. Furthermore, some strong deviations in some regions are spatially correlated with bathymetric depth and geological structures can be also obvious.

♦ Seismic profile results indicated that the thickness and velocity values of the crystalline unit under the Levant Basin are similar to the values determined for a normal oceanic crust. The seismic results of the Western Desert of Egypt showed that the Egyptian coast is underlain by a continental crust covered by 4-6 km thick sedimentary layer. The crust is about 26 km thick below the Mediterranean Sea.

♦ A quantitative interpretation of the Free-Air gravity field was undertaken by developing two and three-dimensional gravity modelling. The results show that the measured gravity field of the two and three-dimensional gravity models can be satisfied when using the structural layer boundaries of the given seismic studies. The transition of the oceanic-continental crust occurs near the coast of Israel, the Moho lies at a depth of about 32 km beneath Cyprus, and at a depth of about 27 km at the coast of Israel. The deep parts of the Levantine Basin is covered by about 13 km of thick sediments. The Moho depth varies from about 26 km beneath the Eratosthenes Seamount to about 23 km under the Levant Basin. The depth to the basement lies at about 6 km beneath the Egyptian coast. However, the thickness of the sedimentary layer increases towards the East Mediterranean Ridge. The basement depth varies from about 9 km at the Egyptian coast to about 13 km in the Herodotus Abyssal Plain and beneath the East Mediterranean Ridge.

The continental African plate extends to nearly 40 to 100 km offshore the Egyptian coast and has an abrupt transition to an oceanic crust. It seems that the proposed extends reflects the effect of an active EMTS and the main tectonic elements in this area, which are occurring on

the boundary between continental and oceanic crust units. Moreover, the crustal structure of the Levant Basin is significantly different from that of the adjacent land. The gravity modelling results identify the continental-oceanic crust transition at Levant Basin.

The average thickness of the mantle layer of the gravity model is 27 km towards the Egyptian coast. Moreover, there are strong lateral undulations in the average thickness of the mantle layer ranging from about 10 to 22 km towards Cretan Island Arc. This may reflect the effect of the main driving force for the opening of the Cretan Sea.

◆ The seismicity study of the area under investigation shows that most of the active seismicity is concentrated along and around the main tectonic and geological structural of the investigated area such as the Hellenic and Cyprean Arcs. There are also some activity areas along the trends of the Gulf of Aqaba- Dead Sea-Levant transform, and the Gulf of Suez-Cairo-Alexandria || northern Egypt ||. Additionally, the average P-axes orientations are in good agreement with plate tectonic framework and are broadly consistent with the absolute plate motion of African and its collision with Eurasian plates.