The earth crust of the Levant

Rybakov Michael (*), Geophysical Institute of Israel, Ben-Avraham Zvi, Tel-Aviv University, Israel

Abstract

Potential field and petrophysical data have been collected for the Levant region with a particular emphasis on Israel (Fig. 1). Spatial database includes Free Air and Bouguer gravity, aero- and satellite magnetics, geoid and topography data. An initial crust model compiled by the Cornel University team (basement and Moho grids) was adopted via Internet. Our data sets allowed developing a more detailed picture of the Earth Crust of the region now hidden beneath sedimentary cover and the Mediterranean Sea. We developed a 3-D crustal model interpreting the gravity and magnetic data and using as constrains deep well information (density logs, thickness of layers) and seismological, seismic reflection and refraction data.

The tectonic and magmatic evolution of the region were elucidated in detail as a result of the interpretation of the potential field data sets in conjunction with the paleontologically (sediments) and radiologically (magmatics) dated markers.

Analysis of the improved 3-D crustal model (Fig. 2) allowed to confirm:

- Existence a transition zone between oceanic and continental crusts;
- Existence of a fossil Mesozoic margin. The weakness zone corresponding to the margin served also as a magma chamber for the Jurassic basic volcanic rocks
- 105km sinistral shift along the Dead Sea Transform (DST).

New observations are as follow:

- Patterns of the geoid undulations and satellite magnetic anomalies suggest for a long life sub global lineament transverse to Mediterranean (Tethys).
- High gravity values extend from Mediterranean eastward on land to the DST. Assuming the density difference existed before initiation of the DST motion, we suggest that the development of the DST used the eastern boundary of the dense block (Sinai - Levant subplate) as a zone of weakness.
- The DST has broken up the crust and made it easier to uplift the low-density eastern block. That explains an apparent topographic asymmetry across the DST.
- The segmented internal structure of the DST is apparently correlated with transverse faults on western side. These prerift weakness zones define the location of the sedimentary basins and en-echelon fault pattern.
- Analysis of the magnetic map suggests an apparent offset of the magnetic anomalies about of 80-90 km along an arcuate line coinciding with the Gulf of Suez. Restoring this offset and the DST offset significantly simplifies the regional magnetic pattern. We speculate that the Suez left-lateral offset reflects an ancient shear zone. Extending this assumption south one can achieve a good alignment of the Precambrian ophiolites belts located on the both sides of the Red Sea. This means that the opening of the Red Sea was influenced by the shear zone as precursor. The lineament may be interpreted as the early Mesozoic transverse and transform fault within the Tethys.

This study is also the methodological example of how improved understanding of subsurface geology can be obtained using integrated interpretation in other complicated geological regions.

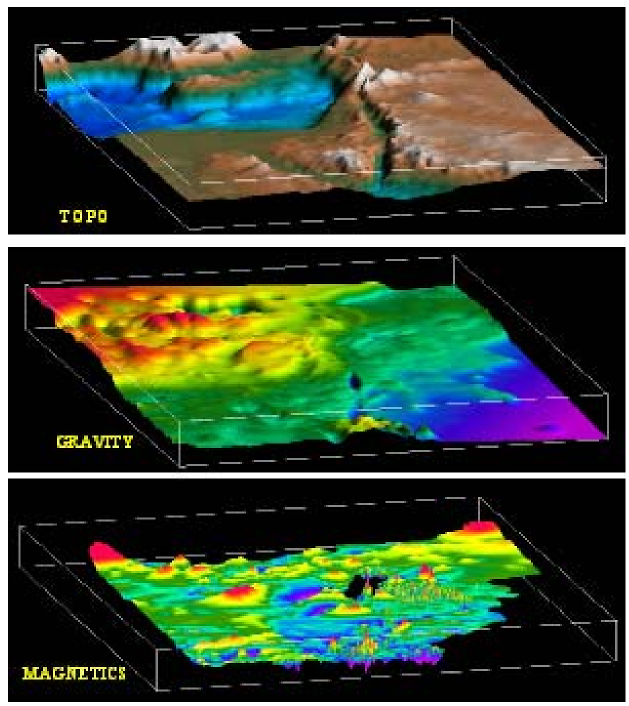

Fig. 1. Topography and potential fields of the Levant.

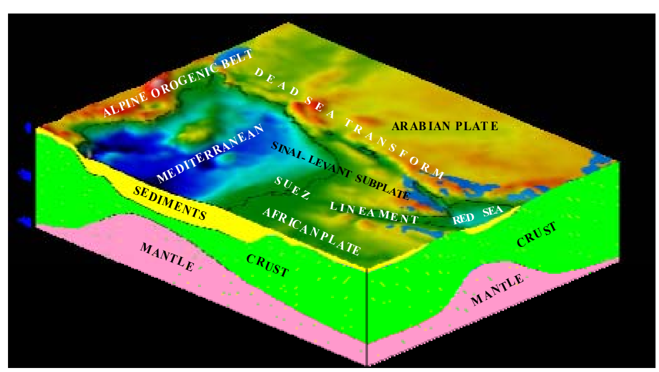

Fig. 2. 3-D crustal model of the Levant.