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Methodology of 3-D combined modeling of magnetic and gravity fields in the Eastern Mediterranean

L.V. Eppelbaum

Dept. of Geophysics and Planetary Sciences, Tel Aviv University, Tel Aviv, Israel
(levap@post.tau.ac.il/Fax: +972 3 6409282)

Difficulties of 3-D combined modeling of magnetic and gravity fields in the Eastern Mediterranean are caused by two main reasons: (1) great variability of geological medium and (2) disturbing effect of oblique (inclination of magnetization vector in the Eastern Mediterranean is about 42-48^o) as well as wide distribution of inversely magnetized geological associations. The functional methodology of combined magnetic and gravity field modeling consists of application of the sophisticated software, employment of the results of reliable inverse problem solution, multilevel potential field observations and as much as possible utilization of all available geological-geophysical information (petrophysical, geological and drilling data, results of seismic, thermal and magnetotelluric investigations, etc.).

3-D combined modeling of magnetic and gravity fields was carried out by the use of the GSFC (Geological Space Field Calculation) program which was developed for solving a direct 3-D gravity and magnetic prospecting problem under complex geological conditions (Khesin *et al*. 1996). This program has been designed for computing of gravity field (Bouguer, free-air or observed value anomalies), components of magnetic field ΔZ, ΔX, ΔY and total magnetic field ΔT as well as second derivatives of the gravitational potential under conditions of rugged relief and arbitrary direction of the magnetization vector. The basic algorithm realized in the GSFC program, is the solution of the direct 3-D problem of gravity and magnetic prospecting for horizontal polygonal prism limited in the strike direction. In the developed algorithm integration over a volume is realized on the surface limiting the anomalous body.

Forward 3D combined modeling of magnetic and gravity fields was successfully applied in the Eastern Mediterranean for revealing of oceanic type Earth's crust offshore

Israel (Ben-Avraham et al., 2002). In Israel, the modern magnetic and gravity field examination allowed to re-interpret some hardly identified geological structures (Eppelbaum, 1996; Eppelbaum et al., 2004a, 2004b, 2005, 2006) and develop improved Moho and Curie maps (Eppelbaum et al., 2004c; Eppelbaum and Pilchin, 2006).

Developed procedures for removing various noises, target indication, inverse problem solution and 3D modeling of magnetic field (Khesin et al., 1996; Eppelbaum et al., 2001; 2003) have been applied at almost twenty archaeological sites in Israel (Eppelbaum, 2005; Eppelbaum et al., 2000, 2001, 2003, etc.). Subsequent excavations successfully confirmed the obtained interpretation results.

Multilevel potential field observations may significantly improve the qualitative and quantitative geophysical data examination and even to obtain principally new results utilized in physical-geological models (Eppelbaum et al., 2000; Eppelbaum, 2005). Reducing of secondary effect of magnetic variations magnetoactive objects is realized using special methodology of magnetic data acquisition (Eppelbaum and Mishne, 1995). A special interpretation scheme for analysis of low-intensive temporary magnetic variations is used for classification of anomalous targets (Finkelstein and Eppelbaum, 1997).

Integration of 3D gravity-magnetic modeling with advanced seismic multifocusing technology (Berkovitch et al., 2004) allows broadening the horizons of geophysical examination.

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