Tectono-Geophysical Zonation of the Near and Middle East and Eastern Africa

Lev V. Eppelbaum, and Youri I. Katz

Abstract The region under study is of great interest from many positions: geodynamically (high seismic activity, modern riftogenesis and collision processes), structurally (presence of mosaic block system of continental and oceanic Earth's crust of different age), geophysically (presence of several greatest gravity anomalies and very intricate magnetic pattern) and economically (presence of the main hydrocarbon resources of the world). It is well-known that successive integration and generalization of isolated geophysical-geological features significantly increases reliability and exactness of earlier developed maps and schemes. Regional long-term seismological prognosis, strategy of searching economic deposits and many other important geological-geophysical problems are based mostly on results of combined tectono-geophysical zonation. This paper presents a new tectonic map of the Near and Middle East and Eastern Africa developed on the basis of numerous tectonic, stratigraphic and other sources supported by geophysical data analysis. Examination of satellite derived gravity data by the use of different advanced mathematical methodologies enabled to construct a series of principal new maps (here two examples of these maps are shown) indicating essential properties of Earth's crust and lithosphere of the region. Integrating the novel tectonic map with gravity map and its transforms enabled us to create precursors for development of a new seismological scheme of long-term prognosis for the region under study.

Keywords: integrated analysis, satellite gravity, tectono-geophysical zonation, seismological prognosis

I. Introduction

The region under study is limited by the coordinates (0º – 35.6º north, 30º – 57º east) and presents a giant territory of the Near and Middle East and Eastern (and partially – Northern) Africa. Totally this area covers more than 10 mln. km^2 and its regional geological-geophysical peculiarities were presented in numerous publications, [e.g., 1 – 19]. The main goals of present investigation are following: (1) development of a novel tectonic map of this area (on the basis of careful examination of and generalization of available geological and geophysical data), (2) employment of a new powerful regional geophysical tool – satellite derived gravity data and its transforms for unmasking some buried tectonic and geodynamic peculiarities of the study area, and (3) finding definite relationships between the compiled tectonic map and the gravity field and its transforms.

II. Development of a Novel Tectonic Map for the Regions Under Study

Comprehensive analysis of published sources indicates absence of a common tectonic map for the region under study. Various authors published mainly isolated and uncoordinated maps and schemes of the region. At the same time, such a generalized map is of great necessity for solving different geological-geophysical problems: tectono-geophysical mapping, development of 3D physical-geological models, searching different types of economic deposits and long-term seismological prognosis. Therefore, on the basis of comprehensive analysis of the following main publications: [2] – [5], [8], [9], [12], [14], [18] – [29] (inclusion of all analyzed sources to this work is not possible), a novel tectonic map of the Near and Middle East and Northern-Eastern Africa has been developed (Fig. 1). For the tectonic map compiling a classic method of such maps development [e.g., 16] was applied.

This map is constructed on the basis of historic principle of structural genesis. Such an approach enabled us for the first time to show an interaction of structures of three types: (1) the structure of basement of the African-Arabian platform, (2) structures of this platform northern boundaries (including originally delineated Mesozoic-Cenozoic mobile belts), and (3) active rift systems. Some results obtained for tectonic zonation of oceanic crust [e.g., 8, 27] are omitted due to the comparatively small scale of a tectonic map.

III. Satellite Gravity Data Retracked to the Earth's Surface and Their Importance

It is known that in the 'pre-satellite gravimetry epoch', regional gravity observations (shipborne and airborne) were as a rule non-regular ones, with large 'white spots' areas and different accuracies and methodologies of gravity field observations. Besides this, the most part of the available shipborne and airborne gravity data is characterized by error of gravity field computation > 2 mGals.

The satellite gravity data were obtained from the World Gravity DB as retracked from Geosat and ERS-1 altimetry [30]. A highly positive factor is that these observations were done with regular global 1-minute grids [30] and the error of gravity data computation was estimated at 1-1.5 mGals [31].

The compiled gravity map (by the use of satellite derived

L. V. Eppelbaum is with the Dept. of Geosciences, Faculty of Exact Sciences, Tel Aviv University, Tel Aviv 69978, Israel (phone: +972-3-6405086; fax: +972-3-6409282; e-mail: levap@post.tau.ac.il).

Yu. I. Katz is with the Steinhardt Museum of Natural History & National Research Center, Faculty of Life Sciences, Tel Aviv University, Tel Aviv 69978, Israel (e-mail: kiyour@mail.ru).

data) with main tectonic features (Fig. 2) shows the intricate gravity pattern of the investigated area. The gravity data cannot be related to the conventional type of gravity reduction but can be assumed as close to 'free air' anomalies [8, 31, 32]. At the same time this difference (between the conventional free air anomalies and satellite derive gravity field retracked to the Earth's surface) usually is not significant for marine areas [30, 31] and land areas with relief values close to the mean sea level, but may reach considerable values in the land areas with middle and high-amplitude topography.

Theoretically, free air gravity anomalies are mainly produced by non-uniform density distribution in the Earth's crust and upper mantle and reflect the differences of shape and mass distribution between the real Earth and geodetic ellipsoid [33]. Jin-Yu et al. [34] presented two important items: (1) for the areas with gentle terrains (assuming that width of terrain relief in general more than in ten times exceeds the compensation depth), free air gravity anomalies can be applied for crustal isostatic research and for analysis of significant tectonic movements; (2) recent tectonic events and lithospheric structure have more visible signatures just in the free air field. Concerning item (1) we should note that the region under study (see Fig. 1) basically does not characterized by high relief amplitudes. We completely agree with item (2) and our experience indicates that earlier constructed satellite derived gravity map retracked to the sea and land surfaces of the easternmost Mediterranean [9] reflects practically all main structural-tectonic peculiarities of this area.

Gravity field anomaly behavior shown in Fig. 2 enabled to separate the main types of tectonic structures: (1) stable zones of continental and oceanic crust, and (2) mobile belts. First type is characterized by homogeneous character of gravity field pattern (for instance, see East Arabian Craton in Fig. 2), whereas second type is characterized by mosaic and variable behavior of gravity field (especially, in active rift zones).

It should be noted that 'youngest' mobile structure (Alpine-Himalayan orogenic belt and active rift system of the Red Sea – East Africa) significantly differ from the Mesozoic terrane belt and Neoproterozoic belt in the gravity field pattern (Fig. 2).

IV. Transforms of Satellite Derived Gravity Map

Some examples of satellite derived gravity field transforms were shown in [9, 35 – 37]. For example, computation of first directional derivatives (south-north) of satellite derived gravity field [35] enabled to clearly trace the main tectonic and geophysical peculiarities of the easternmost Mediterranean, especially a boundary between continental and oceanic crust. The use of Marussi tensor and some gravity fields invariants were successfully applied for computation of satellite observed gravity anomaly transforms in different regions of the world [36]. Entropy map derived from the satellite gravity data [9] unmasked some buried tectonic peculiarities of the eastern Mediterranean. An informational approach employed to satellite gravity examination in the South Caspian Basin [37] enabled to obtain new important characteristics about the buried geological targets.

In this investigation two most effective computations (totally 12 different maps were compiled) are presented: multidimensional statistical analysis by the use of sliding window (Fig. 3) and 3D inverse methods (Fig. 4). Application of the multidimensional statistical analysis of satellite derived gravity data enabled not only to delineate geodynamical parameters of the studied region (collision zone at the boundary between the Arabian and Eurasian plates, and active rift zones between the Arabian, Nubian and Somalian plates, etc.), but also to estimate generalized properties of the Earth's crust (Fig. 3). In this map are clearly shown zone of development of the oceanic crust of the Easternmost Mediterranean and the oceanic crust of the Gulf of Aden and eastern (oceanic) part of the Somalian Plate. Besides this, in this map are visibly traced the Arabian and East African active rift zones and collision zone between the Arabian and Eurasian plates.

On the basis of advanced inverse method employment, the map showing most density contrast surface (discontinuity) in the upper mantle was developed (Fig. 4). This map presents an intricate density-tectonic depth pattern of the region. In this map are noticeably recognized such important tectonic features as Afar Triple Junction and collision zone between the Arabian and Eurasian plates. Besides this, we can note increasing of lithospheric thickness in central parts of the Arabian and Somalian lithospheric plates. Both these plates are countered by low-thickness lithospheric zones corresponding to the active rift zones. As indicated in the map, the thick lithospheric zones are associated with collisional zones at the boundaries between cratons and mobile belts.

We suggest that the lowered values in the northern boundaries of the Arabian Plate correspond to subduction zones. The zones of lowered values in the middle of western part of the region correspond to the Neoproterozoic belt where ophiolitic and back-arc complexes with thinned crust [13] are developed.

The depths of contrast density surface (discontinuity) presented in Fig. 4 map were compared with results of seismic, seismological and thermal investigations, where some disturbing objects (slabs) were determined at corresponding depths in separate areas of the region [e.g., 1, 4, 38 – 43]. The comparison shows reasonably good agreement between the values derived from the gravity data from the one hand and from the seismic, seismological and thermal data – on the other.

V. Some Tectono-Geophysical Conclusions

Comparison of the novel tectonic map of the area under study (Fig. 1) and three developed gravity maps (Figs. 2 – 4) enabled to recognize the following regional tectono-geophysical peculiarities: (1) observed gravity (Fig. 2) and transformed fields (Figs. 3 and 4) reflect both structural and geodynamic peculiarities of the region under study, (2) gravity field and its transforms contain patterns reflecting different types of mobile structures (first of all, active rift zones), (3) gravity field transforms clearly trace both (a) main tectonic boundaries, and (b) boundaries (discontinuities) of other ranks; (4) in all three maps (but in Figs. 3-4 – to a greater extent) different types of Earth's crust can be distinguished.

Fig. 3 mostly indicates the tectono-geophysical zonation of the region under study and different types of the Earth's crust, whereas a distribution of contrast density masses in lithosphere is shown in Fig. 4.

All these maps (Figs. 1-4) may be effectively employed for the long-term seismological prognosis. These maps may also be useful sources for development of any kind of physical-geological models and searching various types of economic minerals in the region under study.

Further geophysical data analysis will include computation and examination of airborne magnetics (in the areas where these data are available) (for analysis of magnetic anomalies under conditions of oblique magnetization, rugged terrain relief and unknown level of the normal magnetic field a special interpreting system has been developed [e.g., 44-47]), and satellite derived magnetic data for the region under study.

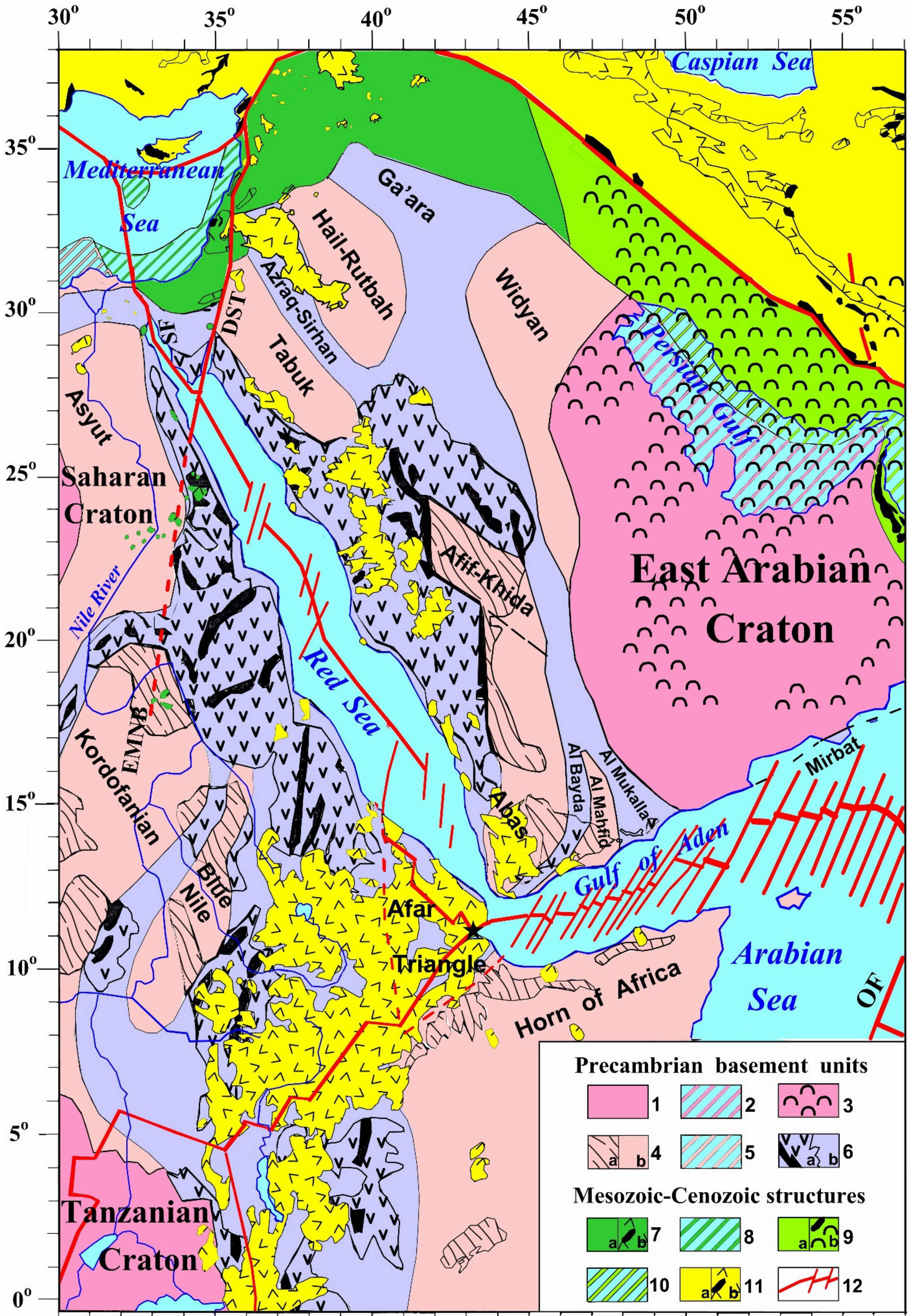

Fig. 1. A novel tectonic map of the region under study.

(1) Archean cratons, (2) submarine continuation of Archean cratons, (3) Upper Precambrian salt basins, (4) Paleo-Mesoproterozoic basement: (a) exposed, (b) buried at the depth, (5) submarine continuation of Paleo-Mesoproterozoic basement, (6) Neoproterozoic belt: (a) exposed with ophiolites, (b) buried at the depth, (7) Early Cretaceous accretional complex: (a) traps and ophiolitic associations, (b) sedimentary rocks, (8) submarine continuation of the Early Cretaceous accretional complex, (9) Late Cretaceous accretional complex: (a) Neoproterozoic salts and Mesozoic ophiolites, (b) sedimentary rocks, (10) submarine continuation of the Late Cretaceous accretional complex, (11) Cenozoic accretional and fault systems: (a) traps and ophiolites, (b) sedimentary rocks, (12) collisional and active rift systems.

EMNB, Eastern Mediterranean-Nubian Belt; SF, Sinai Fault; DST, Dead Sea Transform; OF, Owen Fault

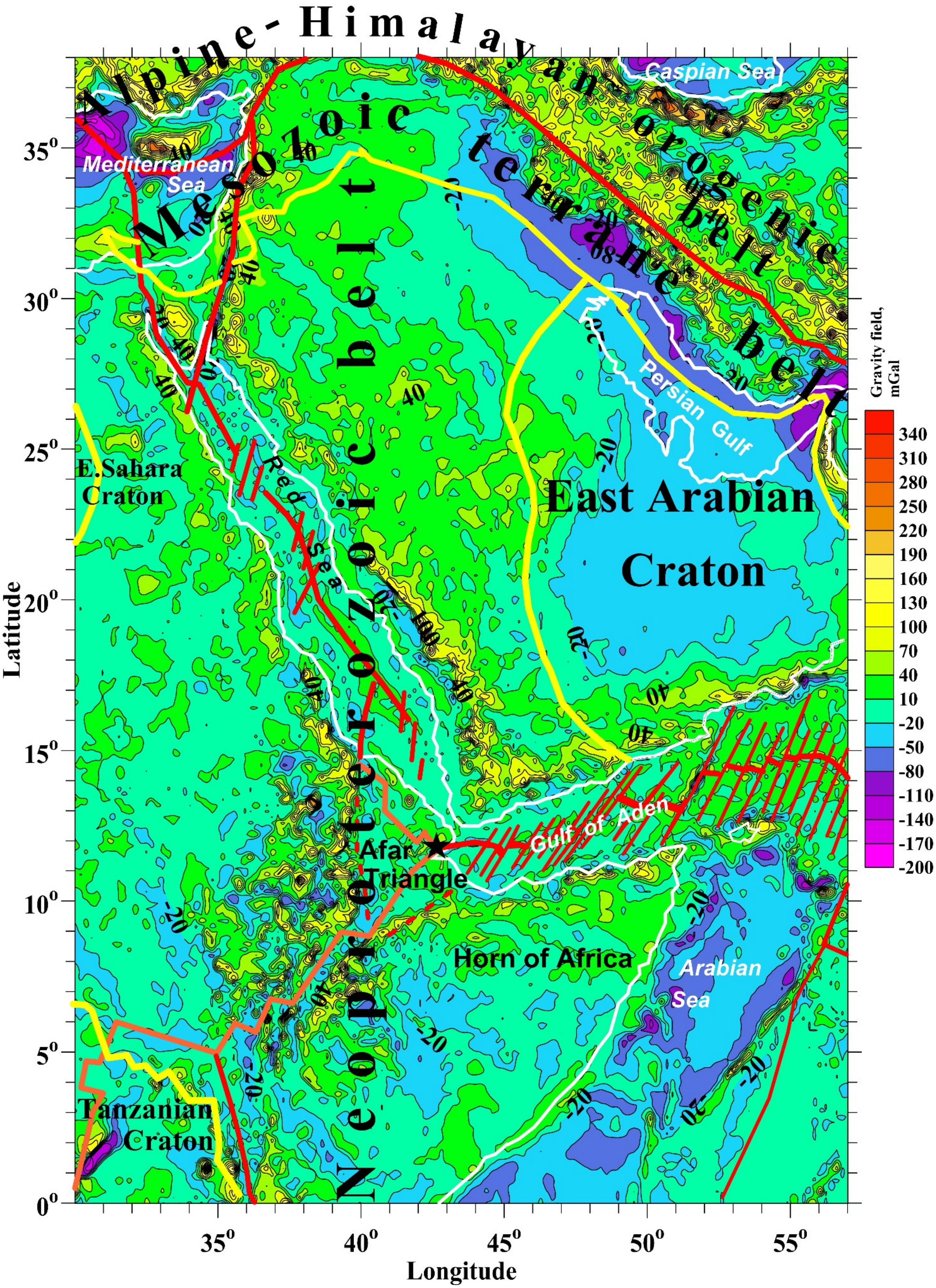

Fig. 2. Satellite derived gravity map retracked to the Earth's surface with general tectonic features (cratons, belts and fault systems). Isoline interval is 30 mGal. Symbol ★ designates position of triangle junction.

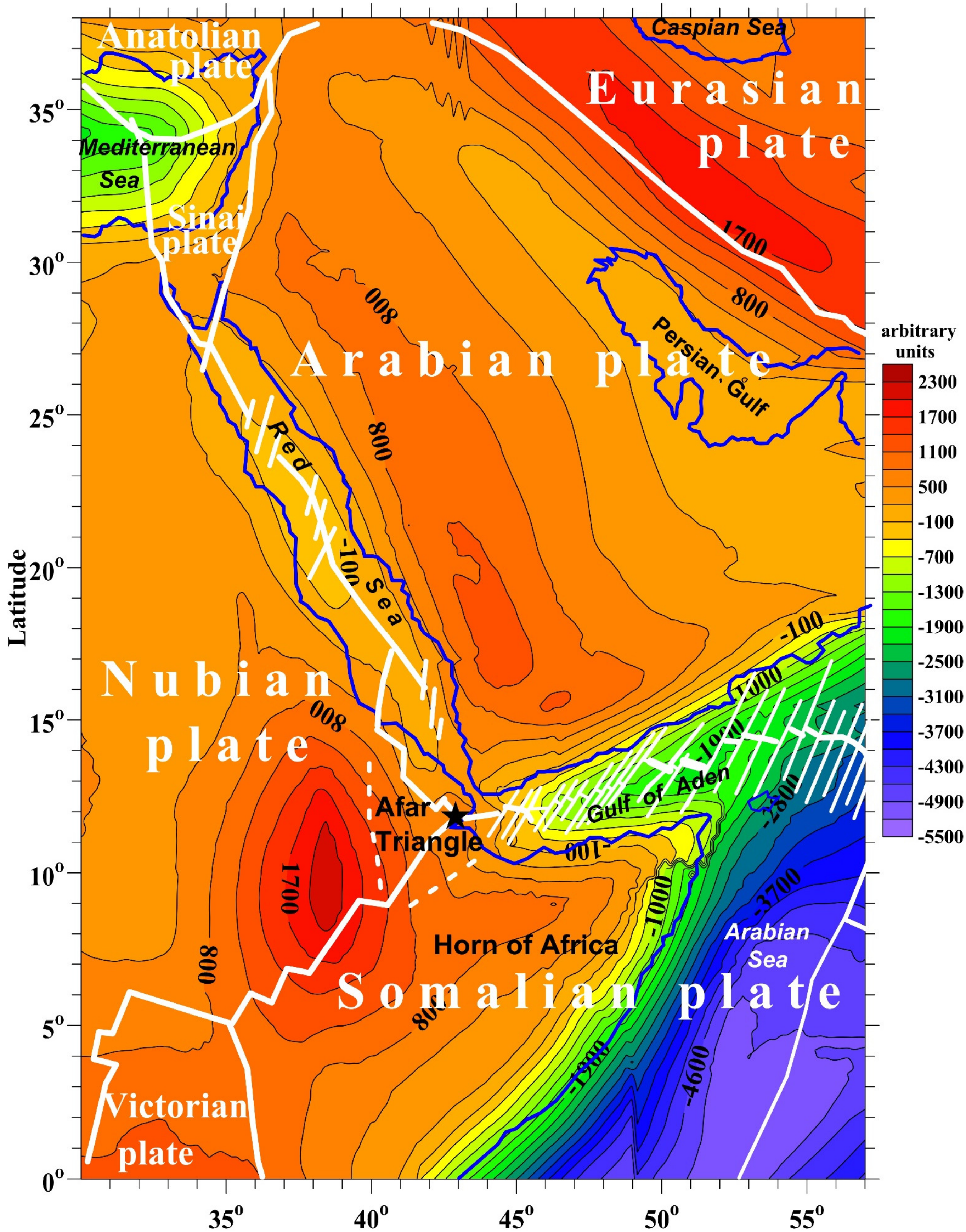

Fig. 3. Comparison of the satellite derived gravity field (see Fig. 2) transformed by the use of multidimensional statistical analysis with plate tectonics.

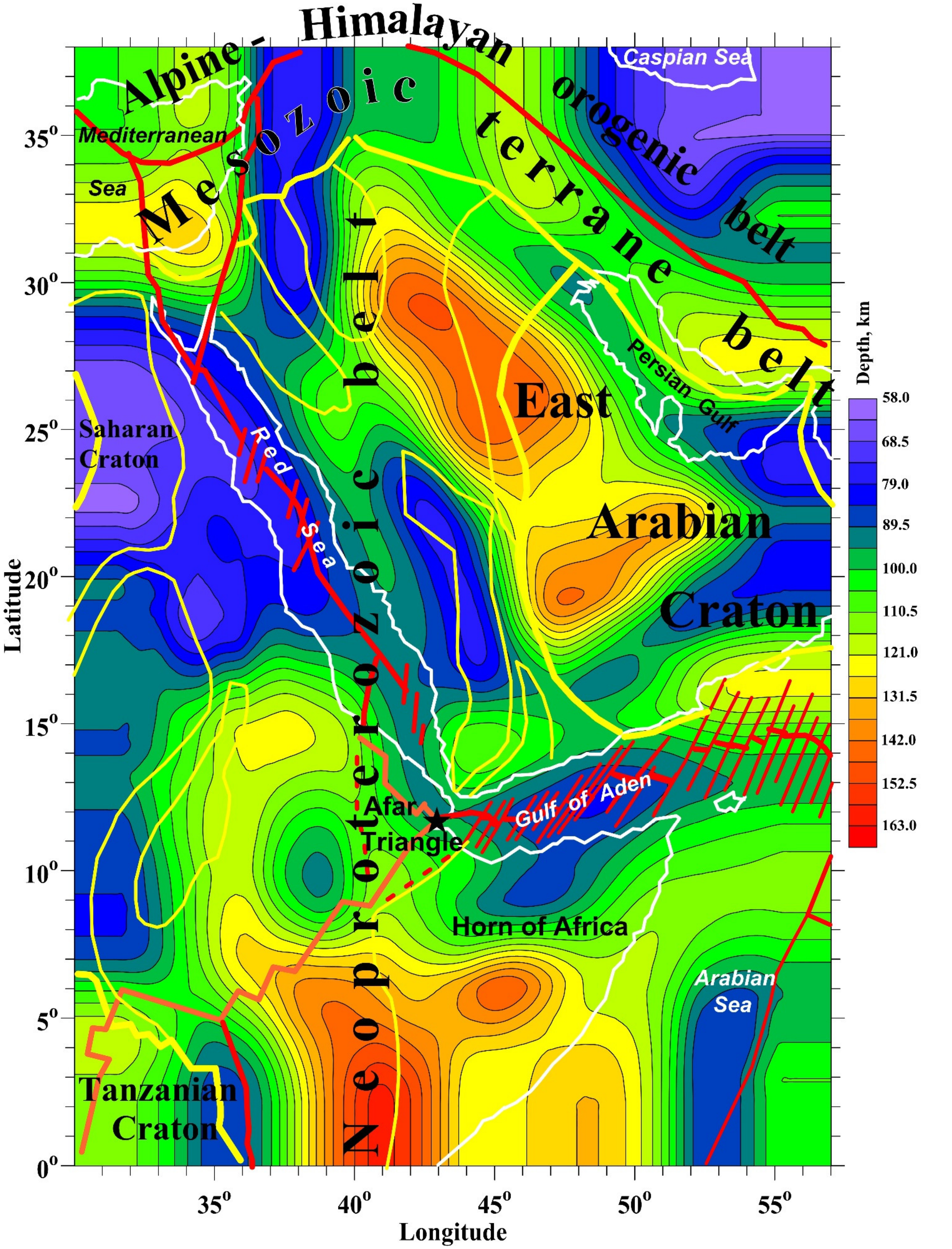

Fig. 4. Comparison of map of contrast density masses distribution in the upper mantle obtained by satellite derived gravity map (see Fig. 2) transformation with major tectonic units drawn from Figs. 1 – 3.

References

[1] I. Jimenez-Munt, R. Sabadini, and A. Gardi, "Active deformation in the Mediterranean from Gibraltar to Anatolia inferred from numerical modeling and geodetic and seismological data", *Jour. of Geophysical Research*, Vol. 108, No. B1, pp. 1-24, doi: 10.1029/2001JB001544, 2006.

[2] P. R. Johnson, and F. H. Kattan, "Lithostratigraphic revision in the Arabian shield: The impacts of geochronology and tectonic analysis", *The Arabian Jour. for Science and Engin*., Vol. 33, No. 1, pp. 3-16, 2008.

[3] P. R. Johnson, F. H. Kattan, and A. M. Al-Saleh, Chapter 4, "Neoproterozoic ophiolites in the Arabian Shield: Field relations and structure", *In*: (T. M. Kusky, Ed.), "Precambrian Ophiolites and Related Rocks), Developments in Precambrian Geology", Vol. 13, pp. 129-162, 2008.

[4] L. Tunini, I. Jimenez-Munt, M. Fernandes, J. Verges, and A. Villasenor, "Lithospheric mantle heterogeneities beneath the Zagros Mountains and the Iranian Plateau: A petrological-geophysical study", *Geophysical Jour. International*, Vol. 200, pp. 596-614, 2015.

[5] K. W. Glennie, M. W. H. Clarke, M. G. A. Boeuf, W. F. H. Pilaar, and B. M. Reinhardt, "Inter-relationship of Makran-Oman Mountains belts of convergence", *In*: (A. H. F. Robertson, M. P. Searle, and A. C. Ries, Eds.), "The Geology and Tectonics of the Oman Region", *Geological Society, London, Special Publications*, Vol. 49, 773-786, 1990.

[6] Z. Ben-Avraham, and A. Ginzburg, "Displaced terranes and crustal evolution of the Levant and the eastern Mediterranean", *Tectonics*, Vol. 9, pp. 613-622, 1990.

[7] Z. Ben-Avraham, A. Ginzburg, J. Makris, and L. Eppelbaum, "Crustal structure of the Levant basin, Eastern Mediterranean", *Tectonophysics*, Vol. 346, pp. 23-43, 2002.

[8] L. V. Eppelbaum, and Yu. I. Katz, "Newly Developed Paleomagnetic Map of the Easternmost Mediterranean Unmasks Geodynamic History of this Region", *Central European Jour. of Geosciences* (*Open Geosciences*), Vol. 7, No. 1, pp. 95-117, 2015.

[9] L. V. Eppelbaum, and Yu. I. Katz, "Eastern Mediterranean: Combined geological-geophysical zonation and paleogeodynamics of the Mesozoic and Cenozoic structural-sedimentation stages", *Marine and Petroleum Geology*, Vol. 65, pp. 198-216, 2015.

[10] J. S. Stacy, B. R. Doe, R. J. Roberts, M. H. Delevaux, J. W. Gramlich, "A lead isotope study of mineralization in the Saudi Arabian shield", *Contrib. Mineral. Petrol*., Vol. 74, pp. 175-188, 1980.

[11] R. Said, (Ed.), *The Geology of Egypt*, AA Balkema/Rotterdam/ Brookfield, 1990.

[12] R. M. Pollastro, "Total petroleum systems of the Paleozoic and Jurassic, Greater Ghawar uplift and adjoining provinces of Central Saudi Arabia and Northern Arabian-Persian Gulf", *U.S. Geological Survey Bulletin*, 2202-H, pp. 1-75, 2003.

[13] R. J. Stern, P. R. Johnson, A. Kroner, B. Yibas, "Neoproterozoic ophiolites of the Arabian-Nubian Shield", *Developments in Precambrian Geology*, Vol. 13, pp. 95-128, 2004.

[14] R. J. Stern, and P. R. Johnson, "Continental lithosphere of the Arabian Plate: A geologic, petrologic, and geophysical synthesis", *Earth-Science Reviews*, Vol. 101, pp. 29-67, 2010.

[15] G. M. Stampfli, C. Hochard, C. Vérard, C. Wilhem, and J. von Raumer, "The formation of Pangea", *Tectonophysics*, Vol. 593, pp. 1-19, 2013.

[16] V. E. Khain, *Tectonics of Continents and Oceans*, Scientific World, Moscow (in Russian), 2001.

[17] A. Robertson, "Development of concepts concerning the genesis and emplacement of Tethyan ophiolites in the Eastern Mediterranean and Oman regions", *Tectonophysics*, Vol. 66, pp. 331-387, 2004.

[18] M. L. Bordenave, "The origin of the Permo-Triassic gas accumulations in the Iranian Zagros foldbelt and contiguous offshore areas: A review of the Paleozoic petroleum system", *Jour. of Petroleum Geology*, Vol. 31, No. 1, pp. 3-42, 2008.

[19] A. S. Alsharhan, and A. E. M. Nairn, *Sedimentary Basins and Petroleum Geology of the Middle East*, Elsevier, Amsterdam – Tokyo, 2004.

[20] J.-L. Lenoir, D. Küster, J.-R. Liegeois, A. Utke, A. Haider, and G. Matheis, "Origin and regional significance of late Precambrian and early Palaeozoic granitoids in the Pan-African belt of Somalia", *Geol Rundsch*, Vol. 83, pp. 624-641, 1994.

[21] V. A. Krasheninnikov, J. K. Hall, F. Hirsch, H. Benjamini, and A. Flexer, (Eds.), *Geological Framework of the Levant*, Volume 1: Cyprus and Syria, Jerusalem, 2005.

[22] J. K. Hall, V. A. Krasheninnikov, F. Hirsch, C. Benjamini, and A. Flexer (Eds.), *Geological framework of the Levant*, Volume II: The Levantine Basin and Israel, Jerusalem, 2005.

[23] H. S. Moghadam, F. Corfu, and R. J. Stern, "U-Pb zircon ages of Late Cretaceous Nain-Dehshir ophiolites, central Iran", *Jour. of the Geological Soc*., London, Vol. 170, pp. 175-184, 2013.

[24] D. S. Stamps, G. Iaffaldano, and E. Calais, "Role of mantle flow in Nubia-Somalia plate divergence", *Geophysical Research Lett*., doi: 10.1002/2014GL062515, pp. 290-296, 2014.

[25] A. Al-Juboury, and A. Al-Hadidy, "Facies and depositional environments of the Devonian-Carboniferous succession of Iraq", *Geological Journal*, Vol. 43, pp. 383-396, 2008.

[26] L. V. Eppelbaum, and Y. I. Katz, "Mineral deposits in Israel: A contemporary view", *In*: (A. Ya'ari, and E. D. Zahavi, Eds.) *Israel: Social, Economic and Political Developments, Nova Science Publishers*, N.Y., USA, pp. 1-41, 2012.

[27] W. Bosworth, P. Huchon, and K. McClay, "The Red Sea and Gulf of Aden Basins". *Jour. of African Earth Sciences*", Vol. 43, pp. 334-378, 2005.

[28] A. A. Muluneh, M. Cuffaro, and C. Dogloni, "Left-lateral transtension along the Ethiopian Rift and constrains on the mantle-reference plate motions", *Tectonophysics*, Vol. 632, pp. 21-31, 2014.

[29] C. R. Scotese, "Late Proterozoic plate tectonics and palaeogeography: a tale of two supercontinents, Rodinia and Pannotia", *Geological Society, London, Special Publications*, Vol. 326, 57-83, 2009.

[30] D. T. Sandwell, and W. H. F. Smith, "Global marine gravity from retracked Geosat and ERS-1 altimetry: Ridge Segmentation versus spreading rate", *Journal of Geophysical Research*, Vol. 114, B01411, doi: 10.1029/2008JB006008, 2009.

[31] D. T. Sandwell, E. Garcia, K. Soofi, P. Wessel, and W. H. F. Smith, "Toward 1 mGal global marine gravity from CryoSat-2, Envisat, and Jason-1", *The Leading Edge*, Vol. 32, No. 8, pp. 892-899, 2013.

[32] O. B. Andersen, P. Knudsen, and P. A. M. Berry, 2009, "The DNSC-08GRA global marine gravity field from double retracked satellite altimetry", *Journal of Geodesy*, Vol. 84, No. 3, pp. 191–199, 2009.

[33] N. P. Grushinsky, *The Theory of the Earth Shape*, Nauka, Moscow (in Russian), 1976.

[34] Y. Jin-Yu, Z. Xun-Hua, Z. Fei-Fei, H. Bo, and T. Zhen-Xing, "Preparation of the free-air gravity anomaly map in the seas of China and adjacent areas using multi-source gravity data and interpretation of the gravity field", *Chinese Journal of Physics*, Vol. 57, No. 6, pp. 872-884, 2014.

[35] L. V. Eppelbaum, and Y. I. Katz, "Key features of seismo-neotectonic pattern of the Eastern Mediterranean", *Izvestiya Acad. Sci. Azerb. Rep., Ser.: Earth Sciences*, No. 3, pp. 29-40, 2012.

[36] J. Klokočník, J. Kostelecký, L. Eppelbaum, and A. Bezděk, "Gravity disturbances, the Marussi tensor, invariants and other functions of the geopotential represented by EGM 2008", *Journal of Earth Science Research*, Vol. 2, No. 3, pp. 88-101, 2014.

[37] L. V. Eppelbaum, "Estimating informational content in geophysical observations on example of searching economic minerals in Azerbaijan", *Izvestiya Acad. Sci. Azerb. Rep., Ser.: Earth Sciences*, Nos. 3-4, pp. 31-40, 2014.

[38] F. Korostelev, C. Basuyau, S. Leroy, C. Tiberi, A. Ahmed, G. W. Stuart, D. Keir, F. Rolandone, F. Al Ganad, K. Khanbari, and L. Boschi, "Crustal and upper mantle structure beneath south-western margin of the Arabian Peninsula from teleseismic tomography", *Geochemistry, Geophysics, Geosystems*, Vol. 15, doi: 10.1002/2014GC005316, pp. 2850-2864, 2014.

[39] A. A. Nyblade, "The upper-mantle low-velocity anomaly beneath Ethiopia, Kenya, and Tanzania: Constraints on the origin of the African superswell in eastern Africa and plate versus plume models of mantle dynamics", *In*: (L. Beccaluva, G. Bianchini, and M. Wilson, Eds.), "Volcanism and Evolution of the African Lithosphere", *The Geol. Society of America Spec. Paper 478*, pp. 1-14, 2011.

[40] Y. Park, A. A. Nyblade, A. J. Rodgers, and A. Al-Amri, "S wave velocity structure of the Arabian Shield upper mantle from Rayleigh wave tomography", *Geochemistry, Geophysics, Geosystems*, Vol. 9, No. 7, doi: 10.1029/2007GC001895, pp. 1-15, 2008.

[41] M. E. Pasyanos, and A. N. Nyblade, "A top to bottom lithospheric study of Africa and Arabia", *Tectonophysics*, Vol. 444, pp. 27-44, 2007.

[42] P. Agard, G. Omrani, L. Jolivet, H. Whitechurch, B. Vrielynck, W. Spakman, P. Monie, B. Meyer, and R. Wortel, "Zagros orogeny: A subduction-dominated process", *Geological Magazine*, Vol. 148, Nos. 5-6, pp. 692-725, 2011.

[43] I. D. Bastow, D. Keir, and E. Daly, "The Ethiopia Afar Geoscientific Experiment (EAGLE): Probing the transition from continental rifting to

incipient seafloor spreading", *In*: (L. Beccaluva, G. Bianchini, and M. Wilson, Eds.), "Volcanism and Evolution of the African Lithosphere", *The Geol. Society of America Spec. Paper 478*, pp. 51-76, 2011.
[44] B.E. Khesin, V.V. Alexeyev, and L.V. Eppelbaum, *Interpretation of Geophysical Fields in Complicated Environments*, *Kluwer Academic Publishers* (*Springer*), ***Ser.: Modern Approaches in Geophysics,*** Boston – Dordrecht – London, 1996.
[45] L. Eppelbaum, Ben-Avraham, Z., and Katz, Y., "Integrated analysis of magnetic, paleomagnetic and K-Ar data in a tectonic complex region: an example from the Sea of Galilee", *Geophysical Research Letters*, Vol. 31, No. 19, L196022004, pp. 1-4, 2004.
[46] L.V. Eppelbaum, and A.R. Mishne, "Unmanned Airborne Magnetic and VLF investigations: Effective Geophysical Methodology of the Near Future", *Positioning*, Vol. 2, No. 3, pp. 112-133, 2011.
[47] L.V. Eppelbaum, "Quantitative interpretation of magnetic anomalies from bodies approximated by thick bed models in complex environments", *Environmental Earth Sciences*, Vol. 74, pp. 5971-5988, 2015.

Lev V. Eppelbaum was born in Tbilisi (Georgia) on 18.05.1959. He received M.Sc. in 1982 from the Azerbaijan Oil&Gas Academy, and PhD in 1989 from the Geoph. Inst. of the Georgian Acad. Sci. and Moscow Mining Acad. During 1991-1992 he had Postdoctoral Studies at the Department of Geophysics, Tel Aviv University (TAU). His main research interests include applied and environmental geophysics, tectonics and geodynamics.

He is author of more than 330 publications including 8 books and 130 articles. The most significant books are 'Interpretation of Geophysical Fields in Complicated Environments' (Kluwer Acad. Publ., 1996), 'Geophysical Studies in the Caucasus' (Springer, 2012) and 'Applied Geothermics' (Springer, 2014). From 1982 to 1990 he worked as a Researcher and Senior Researcher at the Institute of Geophysics in Baku (Southern Branch of the All-Union Geophysical Prospecting Institute). From 1991 to 2005 he occupied positions of Researcher, Senior Researcher and Senior Lecturer at Dept. of Geophysics (TAU); in 2005 he received at this Dept. a position of Principal Research Associate (Associated Professor).

Prof. Lev Eppelbaum is member of Society of Exploration Geophysicists, EuroScience, American Geophysical Union, European Association of Exploration Geophysicists, International Society for Archaeological Prospection, International Association for Promoting Geoethics, EARSeL SIG (remote sensing and archaeology), Society of Mediterranean Geologists and Geophysicists, Israel Geological Society and Prehistoric Society of Israel. He is Assoc. Editor in the "Geophysical Instrumentation, Methods and Data System" and "International Journal of Materials, Methods & Technologies", member of Editorial Board of the "Archaeological Discovery", "Positioning", "International Jour. of Earthquake Engineering", "Open Mineralogical Processing Journal", "Open Petroleum Engineering Journal", "LatinMag Letters", "Stratigraphy and Sedimentology of Oil & Gas Basins", "Izvestiya Azerbaijan Acad. Sci." and Guest Editor of "Advances in Geosciences", "Jour. of Geophysics and Engineering" and "Near-Surface Geophysics". He is a member of the International Commission '*Rotation of the Earth*' and member of the WebmedCentral Ecology Advisory Board.

Youri I. Katz was born in the Trousilovka village of Antoniny district of Kamenetz-Podolsk region (Ukraine) on 02.02.1937. He received M.Sc. (1960) and PhD (1965) from the Kharkov State University (Ukraine) on geology and paleontology.

He is author of about 200 publications including nearly 100 papers and books' chapters. His research interests cover paleontology, stratigraphy, geological mapping, tectonics, historic planetology, geomorphology, Quaternary geology and biogeochemistry.

Youri Katz since 1959 to 1991 occupied positions of Researcher, Lecturer and Assoc. Professor at the Kharkov State University. In 1992 – 2007 he has been worked as Senior Researcher at the Steinhardt Museum of Natural History & National Research Center, Faculty of Life Sciences, Tel Aviv University (Israel). Now he carries out scientific studies at the same Dept. as a retired Professor-Consultant.