



Journal homepage: www.sciencearchives.org

ISSN: 2582-6697



Review Article

<http://dx.doi.org/10.47587/SA.2021.2103>



Assessment of badra oilfield, eastern Iraq utilizing remote sensing and geophysical data

Sa'ad Rasheed Yousif

Department of Geology, Faculty of Science, University of Kufa, Iraq

Corresponding author: saad.aboghnaim@uokufa.edu.iq

Received: Nov 30, 2020 / Revised: Mar 9, 2020/ Accepted: Mar 13, 2020

Abstract

Iraq represents the most diagnostic countries in hydrocarbon in the Middle East. A thick sedimentary succession, robust structures, high individual well productivity, and extensive oil reserves are some of the main characteristics of Iraqi oil fields. Iraq lies within the collided zone between the Arabian Plate that collides with the Persian and Anatolian plates which began after the termination of the Neo-Tethys Ocean in the Miocene. Owing to the trend of Persian and Anatolian plates, Iraq has two systems of faulting; these are the longitudinal faults (Najd system faults) and transversal faults. One of the longitudinal faults is the Makhul-Hemrin fault which extends until the study area. The Badra oilfield was studied by remote sensing imageries and subsurface geophysical maps that relate to seismotectonic of the Mesopotamian Plain of Iraq, and the surface data were correlated in harmony with the subsurface data to better assess the tectonic setting and the development of oilfields.

Keywords Badra Oilfield, Mesopotamian Plain, Remote Sensing, Geophysical Maps

Introduction

The economic utility of Iraq plays a very important role in its relations with nations. It is uniquely placed in world geopolitics due to its rich natural oil resources. The field of oil and gas industry has used remote sensing or earth observation technologies for more than 30 years, including satellite-based earth observation when data became commercially available from the U.S. Landsat and French SPOT programs. Research and earth observation services providers have led to the application of numerous earth observation-based products that are relevant to, or specific to, the oil and gas sector.

Remote sensing imageries offer great promise as a rapid, cost-consuming means of hydrocarbon exploration (Schumacher, 1996).

Seismology is the most effective geophysical prospecting technique. It has an increasing tendency to set the objectives for seismology to determine the internal structure of the subsurface, its physical and geological properties. The study covers Badra oilfield (within Wassit Governorate). It aims to assess the hydrocarbon showers and oilfields in the Mesopotamian Plain of Iraq by comparison the remote

sensing imageries with the available geophysical data, consolidate the scope of hydrocarbon accumulations due to tectonic and structural phenomena, and to integrate the various trends of geological studies participating on the oil fields in the study area.

Location and geomorphology

The oilfield lies within the Mesopotamian Plain of Iraq, where it is reflected a huge aggradational (accumulational) geomorphologic unit, where the fluvial, lacustrine, and Aeolian landforms prevail. The geomorphic units are classified according to origin, geomorphic position, and lithology.

Badra oil field situated in the Wassit Governorate of eastern Iraq. The Iraqi oil field extends about 16km long and six kilometers wide. The field is operated by Gazprom Neff, which also owns 30% stake in the project in partnership with Korean Gas (KOGAS, 22.5%), Petronas (15%), TPAO (7.5%) and Iraqi Oil Exploration Company (OEC, 25%).

Badra contains light crude oil close to Brent blend with API gravity of 34° to 35° and sulfur content of three to four percent. Two wells from five ones are in production at the field under a contract with the Chinese company ZPEC. It is an asymmetrical anticlinal structure embedded in the foreland basin of the Zagros fold and thrust belt, mainly developed

during the Oligo-Miocene. The Badra anticline is trending NW-SE with a steeply dipping SW limb and a more gently dipping NE limb (Fig. 1), where the numbers 1-5 refer to the stages of alluvial fan development. Also, Fouad and Sissakian, 2011 clarify the stages (Fig. 2).

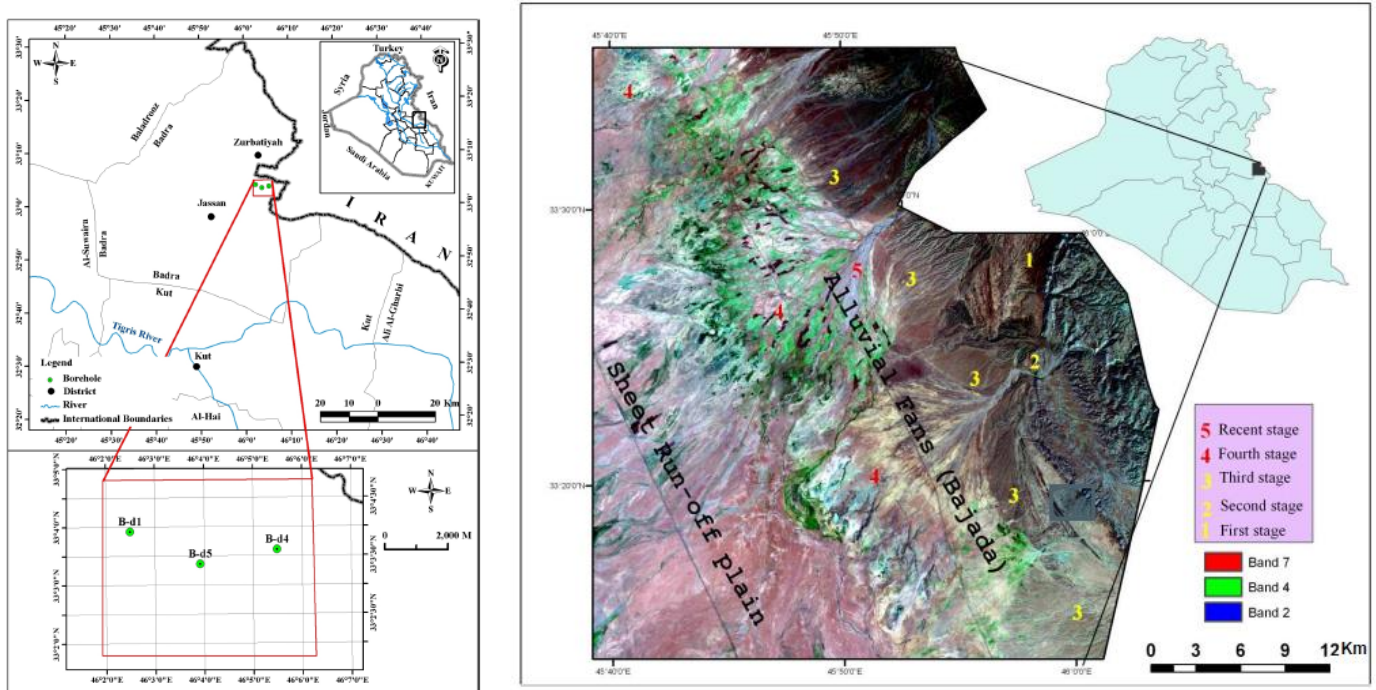


Fig. 1: Location and geomorphology of the study area (after Yacoub, 2011)



Fig. 2: Google Earth image showing complex alluvial fans system, near Badra developed due to continuous subsiding of the Mesopotamia Plain

Geologic Setting of the Study Area

Subsurface phenomena largely differ to the shape of its outer surface, where it is the most distorted and flexible area in Iraq. Two-thirds of Iraq's oil fields are mostly from the Cretaceous period and also contain large water basins in Iraq. The Mesopotamia Plain is a mobile tectonic zone and contains several buried structures including folds, faults, and diapiric structures. Recent tectonic activity is documented

through their effects on the Quaternary lithology and geomorphological landforms, such as abandoned river channels, active and inactive alluvial fans, and topographic expressions of some active subsurface anticlines, altogether indicating neotectonic activity of the plain (Jassim and Goff, 2006).

The mapping of geological expression is illustrated in Fig. 3 and 4).

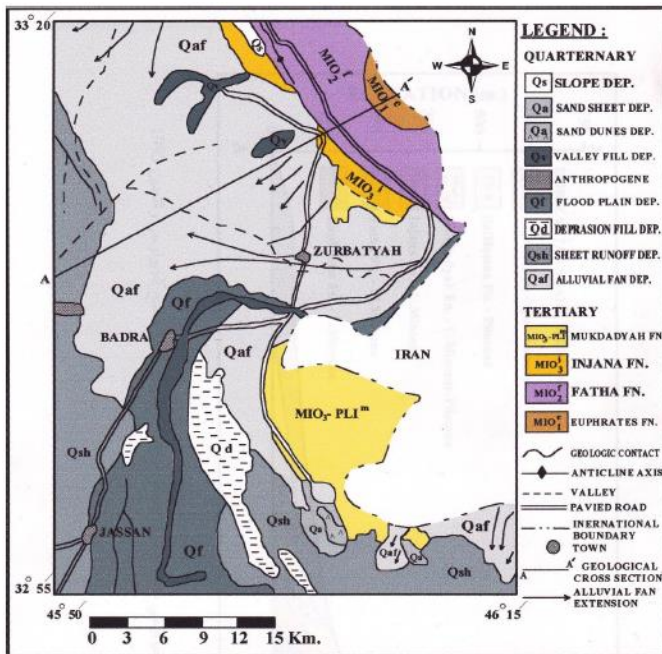


Fig. 3: Geological map of the study area (Geosurv,1993).

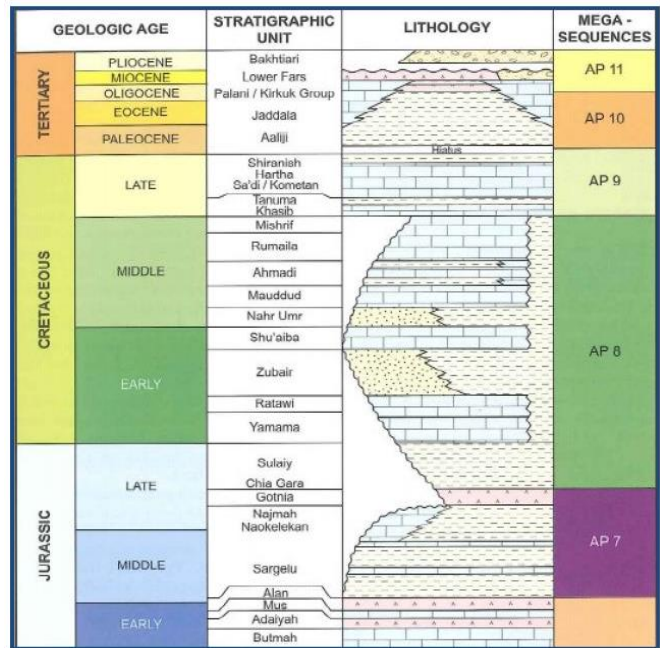


Fig. 4 : Stratigraphic column for Tertiary and Cretaceous in south Iraq, Modified after Verma et al., (2004) and Aqrawi et al., (2010)

Data and Method

To study Badra oilfield, the Landsat image ETM + of P167 R 37 that covered the study area was chosen. After layer stacking (Fig. 5), image subsetting was performed (Fig. 6). Subsetting denotes extracting a portion of the data file into smaller files. In these cases; it is helpful to reduce the size of the image file to include only the area of interest (AOI) to diminish the unnecessary data in the file and speeds up the processing of the small size of data process; and can be important when dealing with multi-band data (ERDAS Field Guide, 2008). The only requirement before the progression is to ensure that all of the inputs are georeferenced of projection UTM, Zone 38, and spheroid name: WGS 84 or that all of the data cover the same geographic area.

Geophysical Processing

From matching the tectonic, epicentral distribution, and lineaments, the following observation is made:

1- The spatial distribution of epicenters is not homogeneous and accordingly, the marked area can be divided into 3 zones, (Fig. 7).

Zone A: It is represented as a non-seismic or very low seismic zone.

Zone B: the spatial distribution in this zone is low to Medium.

Region A and B are characterized by high density and intersections of linear structures.

Zone C: It is the area of severe seismicity because of the nearby convergence between the Arabian plate and the Iranian plate.

Region C is characterized by high density and intersections of linear structures and represents the level of moderate risk level, and its seismic activity is higher than other regions, This is because of the existence of weakness accompanying the activities of interplate region.

Where regional stress is generated as a result of the plate movements that leads to a displacement between the ancient weakness planes due to the seismicity of the plates, (Majeed, 1988).

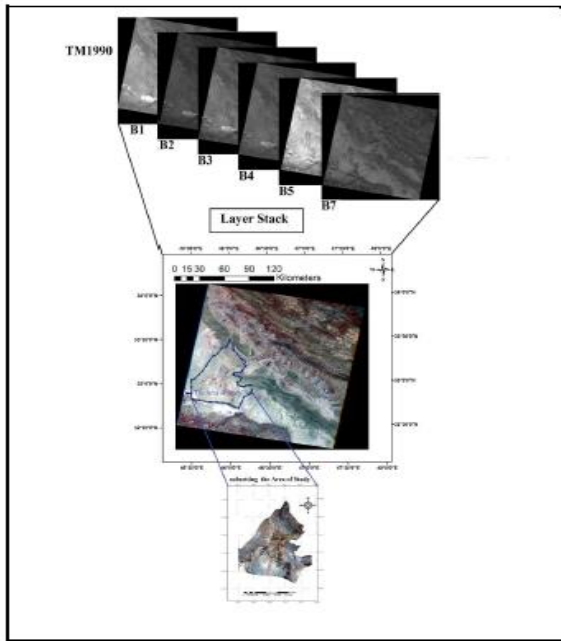


Fig. 5: Layer Stack and subsetting by mask of Badra oilfield

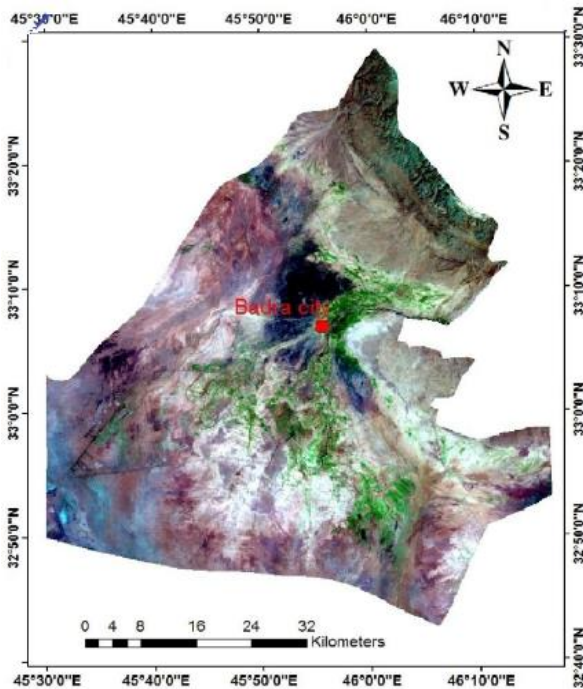


Fig. 6: The final subsetting image of Badra oilfield

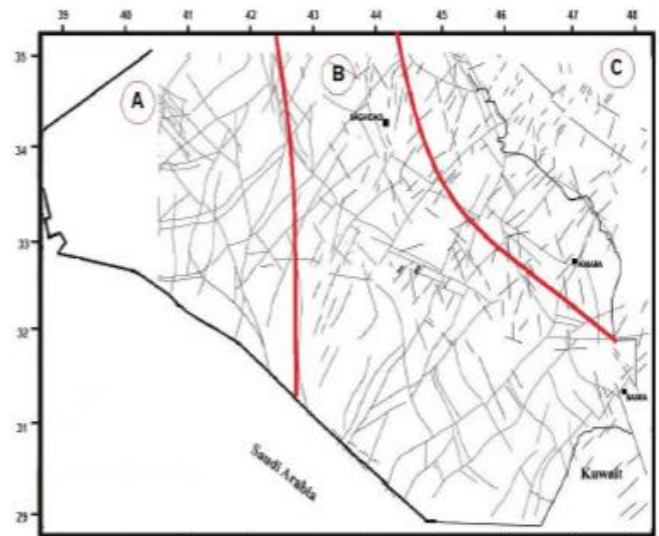


Fig. 7: Lineament map showing the three zones as a result of the relationship between the seismotectonics and lineaments

Accordingly, when the three zones compare with the lineament details and fault types from lineament map has been provided from GEOSURV Iraq, modified by Al-Mashhadani (1986) lineaments, Jasim and Goff (2006), and Hessami et al, (2006). They principally rely on Landsat images, gravity, and magnetic gradients beside a lesser extent seismic data, the following trends that figure (8) illustrates.

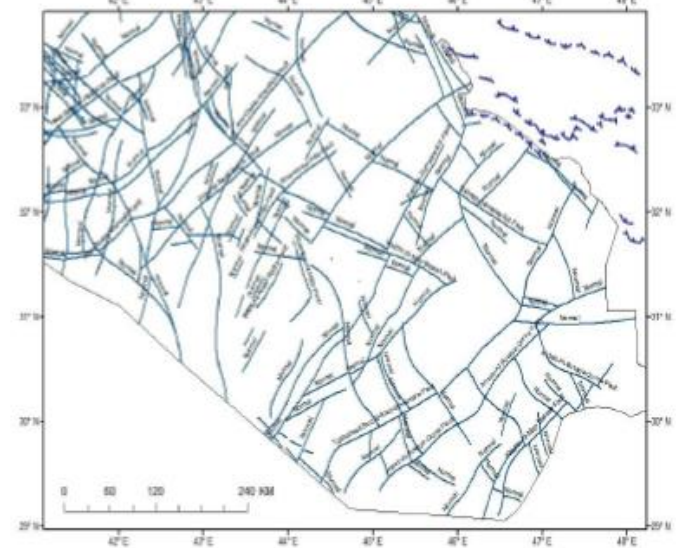


Fig. 8: Fault types adopted from lineament map

Iraq has two systems of faulting; these are transversal faults and longitudinal faults (Najd system faults). One of the longitudinal faults is the Makhul-Hemrin fault, which extends to the study area (Jassim and Goff, 2006).

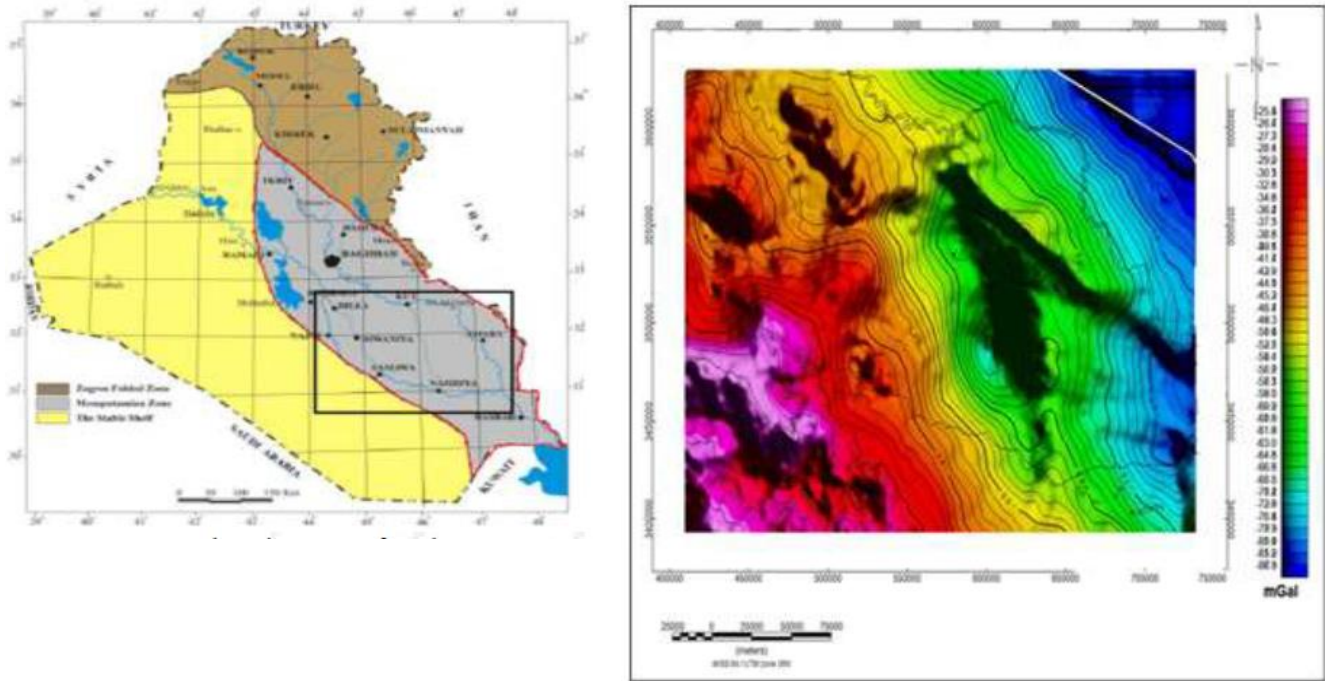


Fig. 9: Bouguer anomaly map

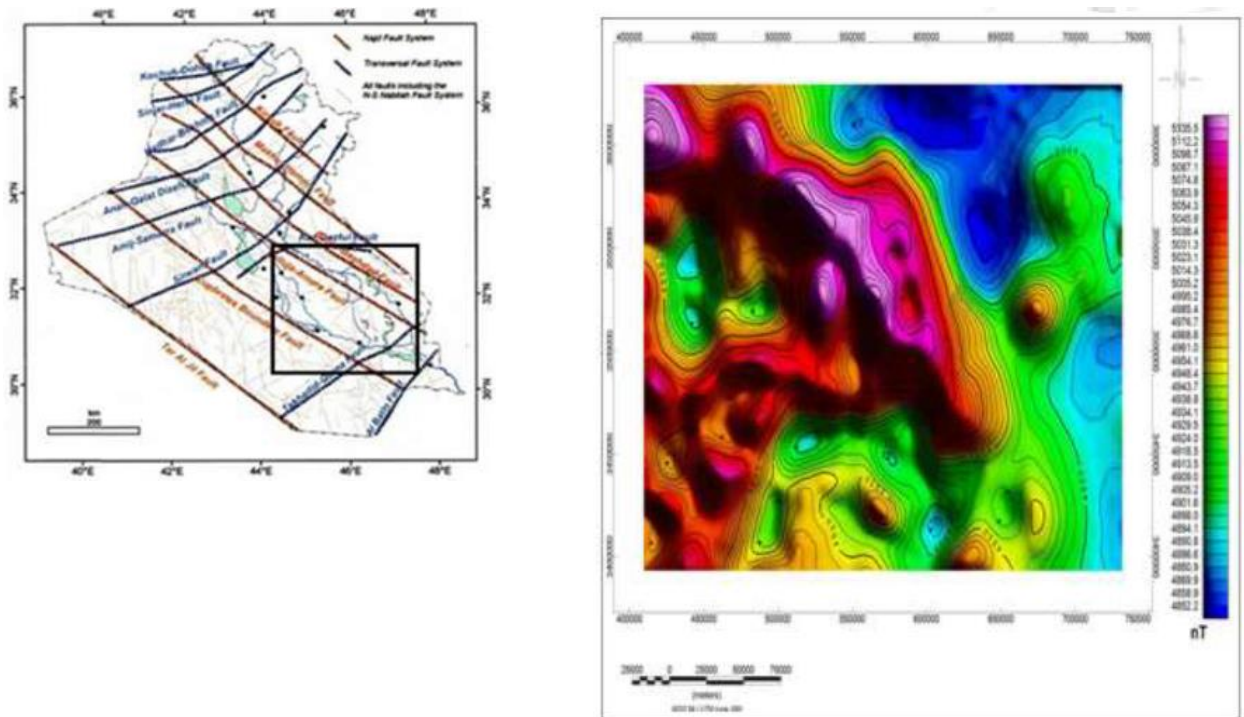


Fig. 10: Reduction to the pole (RTP) magnetic anomaly map

It may be converted and deduce structural surfaces (reflectors) from the above geophysical maps (Fig. 11, 12).

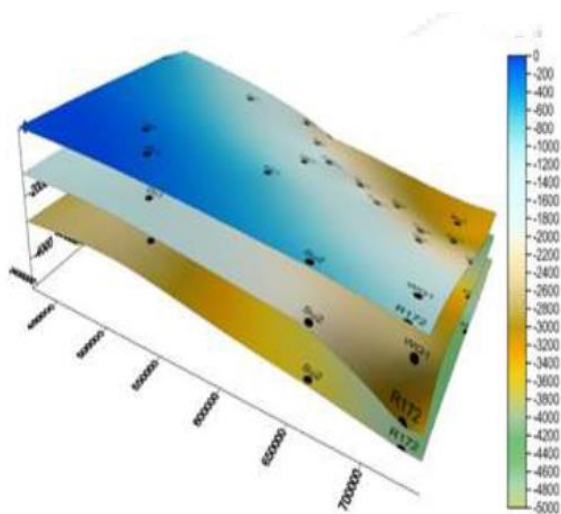


Fig. 11: structural surfaces extracted from gridding of well data from below to above (Tertiary, Cretaceous, and Jurassic)

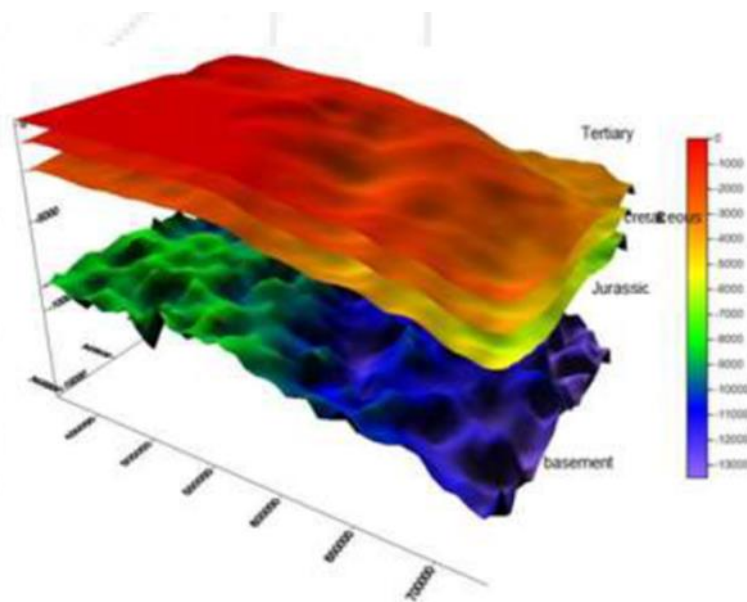


Fig. 12: 3D Gravity inversion result as structural surfaces

Abdulnaby, et. al., 2016 suggested that the Makhul-Hemrin fault is to be subsided into two faults dependent on the seismicity of the study area. These two faults are the Makhul-Hemrin listric fault of non-activity and Badra-Amarah fault. Seismic activity is extending only along the longitudinal area between Badra and Amarah cities.

In the study area, the geophysical gravity and magnetic, the anomalies map denotes that the general description of gravity map of an area characterized by the gradient of gravity value toward the E and NE with an average of decreasing 0.23 mGal per kilometer toward the basin as shown in Figure (9).

The magnetic anomaly map for Mesopotamia was transformed to an RTP map using the same digital interval of the gravity data. The magnetic RTP map (Fig.10) shows that the general gradient of magnetic data is toward the east of the study area but it is different southerly due to the effect of Hormuz Salt (Precambrian age) and lead to less accuracy on depth estimation of sources in the magnetic map (Sabah and Al-Rahim, 2017).

Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

The author declares that the work has consent for publication.

Funding support

The author declares that they have no funding support for this study.

References

- Abdulnaby, W., Mahdi, M., Al-Mohmed, R., & Mahdi, H. H. (2016). seismotectonics of Badra-Amarah fault, Iraq-Iran border. *journal of applied geology and geophysics*, 4-3.
- Al-Mashhadani, A. M. (1986). Paleogeographic evolution of Mesopotamian sedimentary basin during Mesozoic and Cenozoic and relationship with the geological system of Arabia. *Journal of the Geological Society of Iraq*, 19(3), 29-76.
- Aqrawi, A. A., Goff, J. C., Horbury, A. D., & Sadooni, F. N. (2010). *The petroleum geology of Iraq*. Scientific press.
- E. Geological Survey and Mining (Geosurv), 1993: The Geology of Kut Quadrangle NI -38-15 sheet NO.GM -27 Scale 1:250000, State Establishment of Geological Survey and Mining (Geosurv), Baghdad Iraq .18p.
- Fouad, S. F., & Sissakian, V. K. (2011). Tectonic and structural evolution of the Mesopotamia Plain. *Iraqi Bulletin of geology and mining*, (4), 33-46.
- Hessami, K., Nilforoushan, F., & Talbot, C. J. (2006). Active deformation within the Zagros Mountains deduced from GPS measurements. *Journal of the Geological Society*, 163(1), 143-148.
- Jassim, S.Z., Goff, J.C. (2006) Geology of Iraq. DOLIN, Prague, 315p.
- Majeed .N.A. (1988). Study of Lineaments Using Remot Sensing Data and Their Relationship to Seismic Data and Their Relationship to Seismic Activity in Northeastern Iraq. MSc thesis. University of Baghdad. College of science. P 110. (Arabic reference).
- Sabah, L., and Al-Rahim, A. M. (2017). Constrained 3D Gravity Inversion for the Mesopotamia Basin - A Case Study, *International Journal of Science and Research*, 7 (4), 339-345.
- Schumacher, D. (1996) Hydrocarbon-induced alteration of soils and sediments, In: D. Schumacher and M.A. Abrams, eds., Hydrocarbon migration and near surface expression, AAPG Memoir 66, 71-89.

Verma, M. K., Ahlbrandt, T. S., & Al-Gailani, M. (2004). Petroleum reserves and undiscovered resources in the total petroleum systems of Iraq: Reserve growth and production implications. *GeoArabia*, 9(3), 51-74.

Yacoub, S. Y. (2011). Stratigraphy of the Mesopotamia plain. *Iraqi Bulletin of Geology and Mining*, (4), 47-82.

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).



How to cite this article:

Yousif, S.R. (2021). Assessment of badra oilfield, eastern Iraq utilizing remote sensing and geophysical data *Science Archives*, Vol. 2 (1), 14-20.

<http://dx.doi.org/10.47587/SA.2021.2103>