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The Oil Fields Relation to the Tectonic Boundaries that inferred from Seismic and Gravity Interpretation in Kut-Hai-Fajir and Surrounding Area, Central Iraq

Ahmed S. AL-Banna[1*], Ali .A.M.AL-Zubaidi[2], Falih M. Daim[3]
[1]Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq.
[2]Department of Civil, College of Engineering, University of Wasit, Wasit, Iraq.
[3]Department of Interpretations, Ministry of Oil, Baghdad, Iraq.

Abstract

The seismic reflection and gravity data were used to detect the tectonic boundaries in Kut-Hai-Fajir and surrounding areas, central Iraq. The depth maps of Dammam, Nhr Umr, and Sulaiy, formations were constructed and used to detect some boundareis in the study area. The residual gravity map and Total Horizantal derivative (THDR) also used to detected the tectonic boundaries. It is obtained that most boundaries or faults found in the deep formations; while some of them showen in the shallow fomations. The faults or boundaries obtained from gravity intrpretation mostly coincied with the deepest formation boundaries. Generally, the grvity anomalies conform the morphological feature locations within the depth maps of the formations. Many longitudinal and transverse faults were traced from the seismic and gravity interpretation. It is concluded that the oil fields in the study area lying within certain tectonic zones and coincide with the positive residual gervity anomalies of spacing window of 8 km; mostly near the zero line values. It is believed that the integrated interpretation of residual gravity anomalies with the depth maps of some formations, that inferred from seismic data, gives good results for evaluation of an area for oil exploration.

Keywards: Oil fields , Tectonic, Seismic and gravity, Kut-Fajir, Iraq.

علاقة الحقول النفطية مع الفوالق التكتونية المستنبطة من التفسيرات الزلزالية والجذبية لمنطقة الكوت– الديوانية– الفجر والمناطق المحيطة،وسط العراق

احمد شهاب البناء*[1] ، علي عبد موحي الزبيدي[2] ، فالح مهدي دعيم[3]
[1] قسم علوم الأرض، كلية العلوم، جامعة بغداد، بغداد، العراق.
2قسم الهندسة المدنية، كلية الهندسة، جامعة واسط، واسط، العراق.
[3]دائرة التفسيرات، وزارة النفط، بغداد، العراق

الخلاصة

استخدمت المعطيات الزلزالية والجذبية لتعيين الحدود التكتونية في منطقة الكوت والحي والفجر والمناطق المحيطة بها في وسط العراق. تم بناء الخرائط العمقية لتكوينات الدمام ونهر عمر وسلي والخرائط الجذبية المتبقية لتقييم منطقة الدراسة. تم الاستنتاج بان اكثر الفوالق ظهرت في التكوينات العميقة وبعضها ظهر في التكوينات الضحلة نسبيا. اما الفوالق والحدود التكتونية التي تم تحديدها من المعلومات الجذبية فقد توافقت في اغلب المواقع مع تلك الفواق التي ظهرت في التكوينات العميقة. توافقت معظم الشواذ الجذبية مع الظواهر

*Email: geobanna1955@yahoo.com

المورفولوجية على الخرائط العمقية للتكوينات الجيولوجية. تم تحديد عدة فوالق طولية ومستعرضة في منطقة الدراسة. لوحظ ان الحقول النفطية في منطقة الدراسة توافقت مع عدة انطقة تكتونية ومع الشواذ الجذبية المتبقية الموجبة وقريبا من الخطوط الكنتورية ذات القيمة الصفرية. ومن خلال نتائج الدراسة تاكد الاعتقاد باهمية الدراسات المتكاملة بين الشواذ الجذبية المتبقية والخرائط العمقية لبعض التكوينات في اعطاء نتائج جيدة في اعمال الاستكشافات النفطية.

Introduction

Gravity and seismic reflection methods are used for long time for studying the crust and tectonic boundaries ([1], [2], and [3]).The area of Kut – Hai – Fajir and surrounding area represent part of some studies concerning gravity method.

Al- Banna et al. (2002) [4] evaluated the tectonic situation of southern Iraq using the geological and geophysical information. They divided the area into four major zones, depending on the variation of physical and geological characteristics.

Al-Rawi et al (2009) [5] studied the tectonic trends of an area located at southeast Iraq using directional fan filtering technique for gravity data. They found two main trends these are N-S and NW-SE trends.

Al-Jizani (2016) [6] studied the tectonic boundaries at southern Iraq using potential data. She obtained three main tectonic boundaries, two of these longitudinal while the third one is transverse fault.

In current study the gravity and seismic reflection data were used to detect the main tectonic boundaries and their relation to the oil fields in Kut-Hai-Fajir and surrounding area, Figure- 1.

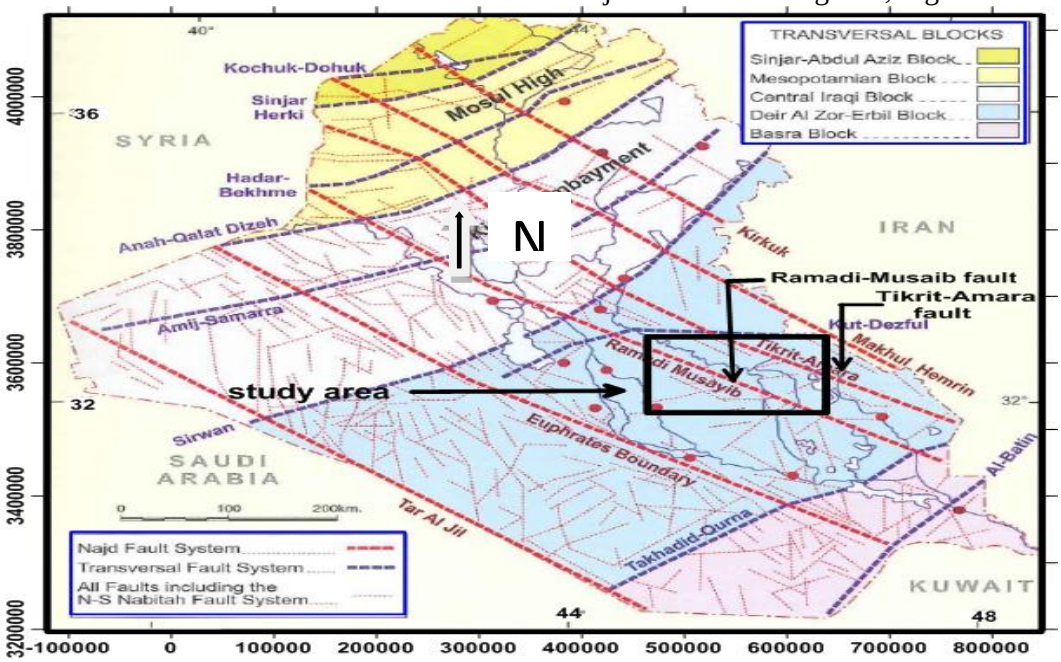

Figure 1- Tectonic map of Iraq showing the location of study area [7]

Geology and tectonic of the study area

Tectonically the study area is a part of the unstable shelf of Iraq [8]. This area characterized by regional dip to the east. The study area contain buired faults and folds trending NW-SE [7]. Many longtudinal (NW-SE) and transverse faults crossing this area diagonally.

The study area covered with Holocene and Pliestocene sediments . The area south of Gharaf river cover by the deposite of marshes and aeolion sand dunes [9].

The stratigraphic column in the study area obtained from Dujila-1 (Du-1) and Dhufria -1 (Dh-1) wells which penetreted to depth of about 4400m. It is found that most formation consist of limestone, sand stone and evaporate rocks.

The most important formation which related with the presence of hydrocarbone, from the deep one to the shallow are Sulaiy, Yamama,Nhr Umr Formations of (lower Cretaceous) they consist of Oolite and hard limestone for Sulaiy and Yamama [10] and [11], Nhr Umr consist of black shale interbeded

with mediam to fine grain sand stone [10]. The shallow formations is Mushrif (Upper Cretaceous) which consists of organic detrial limestone with bed of coral limestone. Dammam Formation (Paleocene) is mainaly of neritic shoal limestone porous, dolomit and chalky limestone [10].

Seismic data of depth maps and interpretation

2D seismic reflection survey were achieved by Oil Exploration Company (OEC). The Two Way Time (TWT) sections were processed by the routine processing techniques using Petrel software version 2013. Many reflectors were identified and picked in the study area.

Three (two way time maps) were constructed for three formations, these are from the shallow to the deeper are Dammam, Nhr Umr, and Sulaiy.

Many wells information including lithology, depth, density and sonic logs were used to build the synthetic seismograms. The average velocity survey of wells and check shots logs were used to draw the average velocity maps of the three considered formations. Figure- 2 shows the seismic lines and well locations of those considered in the present study.

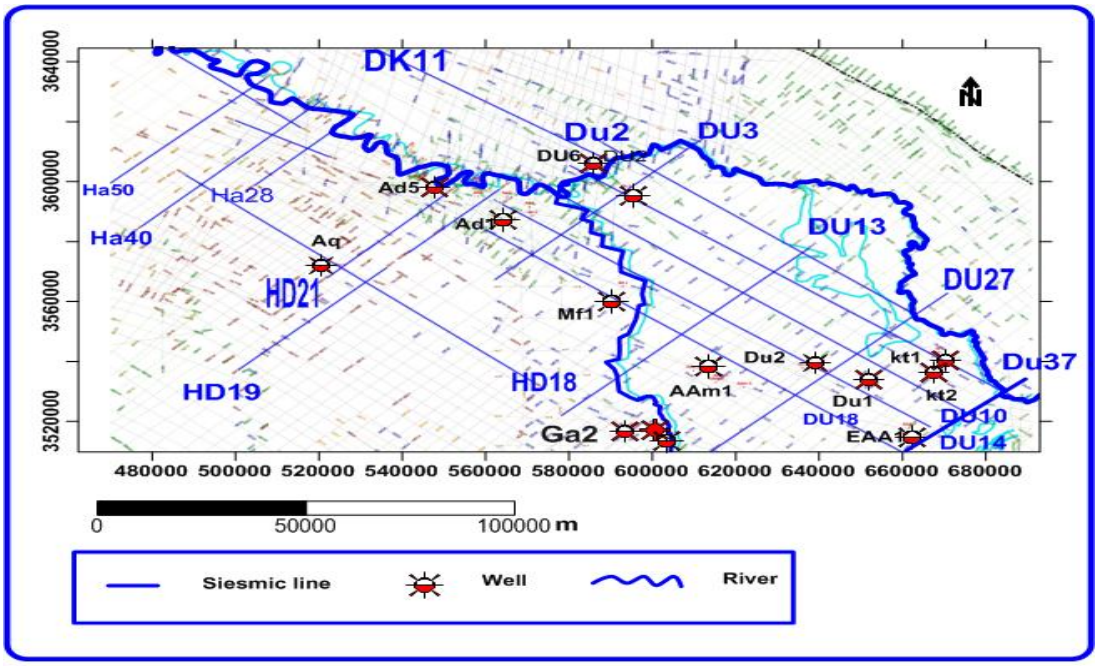

Figure 2-The seismic reflection lines and wells used for seismic interpretation.

The two way time (TWT) and the average velocity maps were used to obtain the depth maps of Dammam, Nhr Umr, and Sulaiy Formations. Figures- (3,4, and 5). These maps were plotted with contour interval of 100m and 200m from the sea level datum.

The depth maps of the three considered formations were studied. The crest and trough features were marked with special colored lines, Figures-(3,4 and 5). Mostly the crest and trough features appeared in the same locations in all depth maps, this may be indicate that these are structural features, so they effect most of the considered formations.

The depth maps shows that most crest and trough axes trending NE-SW. Some axes trending N-S or NW-SE were appeared mostely in Mishrif and Yamama Formations, Figures- (3,4,and 5). Many lines seperated the morphgological features at the depth maps of the considered formations were traced. These lines cosidered as tectonic boundaries, Figures- (3,4 and 5). These boundaries mainly trending NW-SE, NE-SW and some of them nearly E-W.

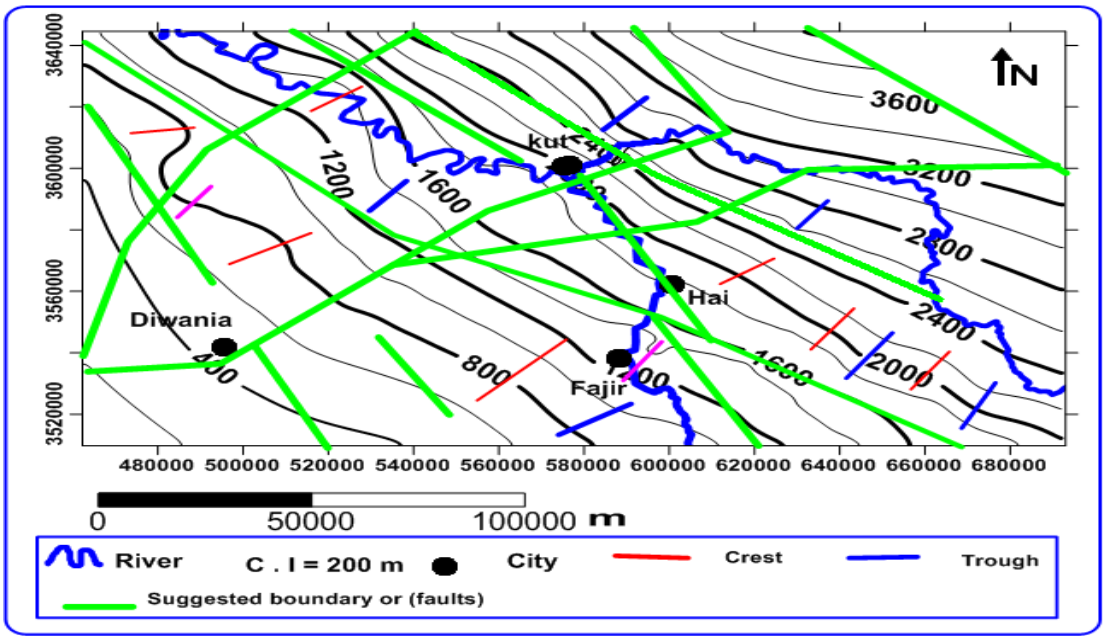

Figure 3- Damam depth map obtained from seismic reflection data, showing the crest and trough features trends.

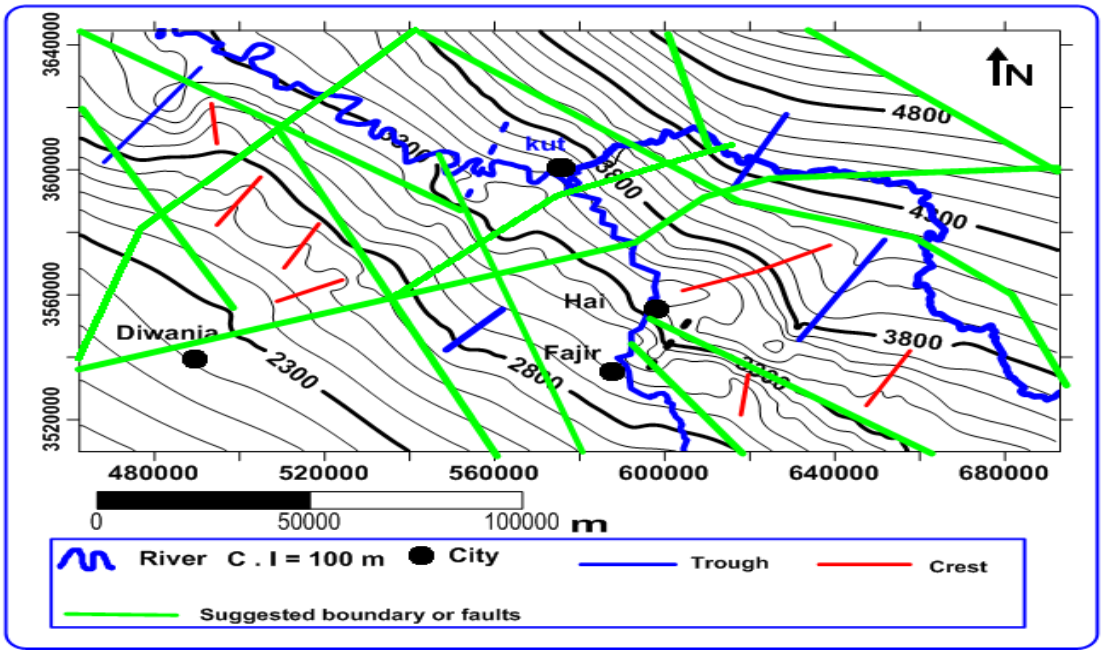

Figure 4- Nhr Umr depth map obtained from seismic reflection data, showing the crest and trough features trends.

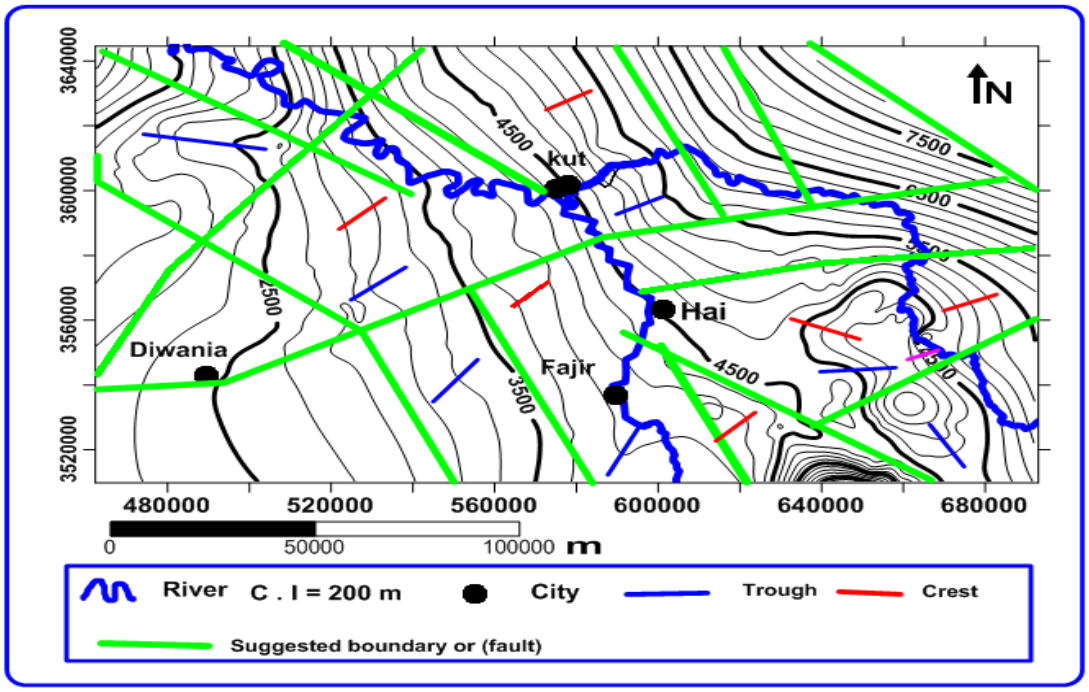

Figure 5- Sulaiy depth map obtained from seismic reflection data, showing the crest and trough features trends.

The gravity data and processing

The Bougure gravity anomaly map of the study area is published by the Geological Survey of Iraq (GEOSURV). This map was processed and unified as a database (OEC,2016). The gravity map digitized at grid (2*2)km. The accuracy of the field measurements range (0.02-0.03)mgl. The Bougure gravity map is plotted with contour interval 1mgl , (Figure- 6). This map shows a variation in contour values from -34mgl at the west to -89mgl at the east. There are many positive and negative anomalies at the gravity map. The first negative anomaly (S) situated at north Diwania city. This anomaly bounded by two positive anomalies one at the north and the other one at the south. There is another negative anomaly lying nothwest Fajir City. The main positive gravity anomaly situated southwest Hai City. East of Gharaf River the gravity values decreas gradually and rapidly by an average gradient of 0.36mgl/km.

The Total horizantl derivative technique (THDR) was used to process the gravity data to obtanied the maximum gradients values and then delineat the faults or main boundaries. The main faults were traced as shown in Figure-7. The main trends of the obtained faults are NW-SE, NE-SW and some faults nearly E-W.

The residual gravity maps were obtained for the study area using spacing windows 8km, Figure- 8. Most residual gravity anomalies axes of spacing window 8km found to be trending NW-SE and some others N-S with little axes NE-SW. It is obtained that the shallow residual gravity anomalies window 8km , mostly trending the same as the Zagrous belt trend. These anomalies may be generated by the collision of Arabian and Iranian plates. Figure- 8.

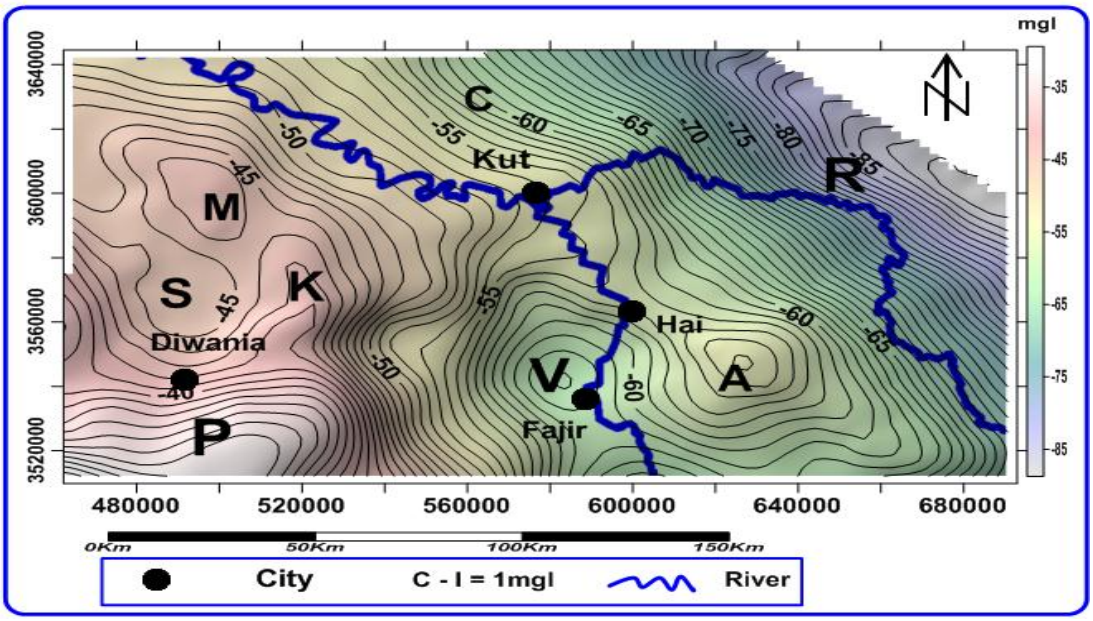

Figure 6- The Bouguer gravity anomalies map of study area showing the main positive and negative anomalies.

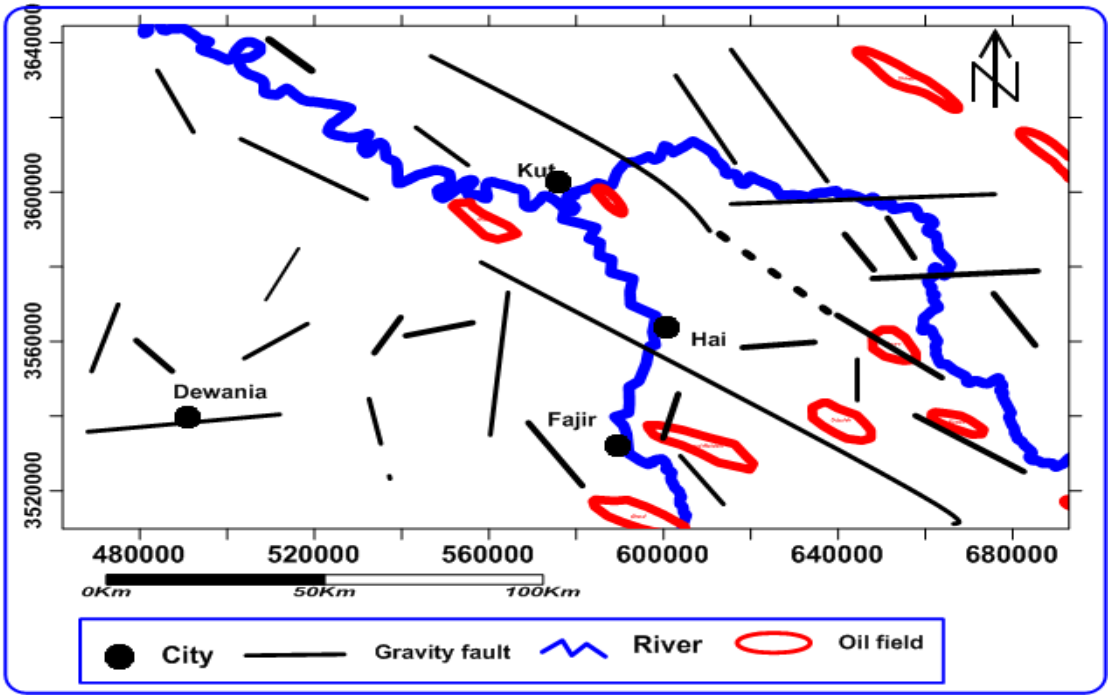

Figure 7- The faults or contacts inferred from gravity data using the Total Horizontal Derivative technique (THDR).

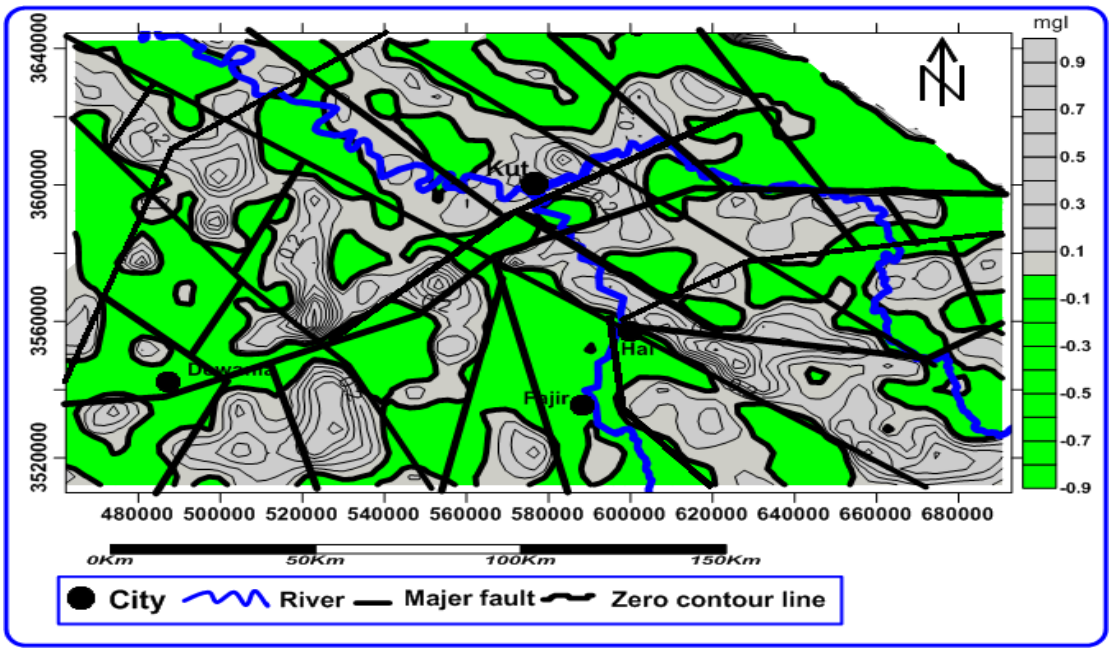

Figure 8- Residual gravity anomaly map (window 8km). Showing the axes of the positive residual anomalies.

The main tectonic boundaries of the study area:

The detection of tectonic boundaries is very important to distinguish the main zones, which have different geophysical and geological characteristic. The gravity interpretation using the Total Horizontal Derivative (THDR) Technique and the residual gravity of spacing window 8 km is used to obtained the tetonic bounadries of the study area. These boundaries have been adjusted by the boundaries traced according to the results obtained from seismic interpretation. These bounadries, confirmed by the variation in the running cannel of Tigris and Garaf Riveres. The obtained tectonic boundary plotted on the residual gravity maps of spacing window 8 km,(Figure- 9). The locations of oil fields were traced on the final tectonic boundaries map. It is concluded from the final map that the oil fields are lying on positive residual gravity anomaly close to the zero lines of residual gravity map within certain tectonic zones**.**

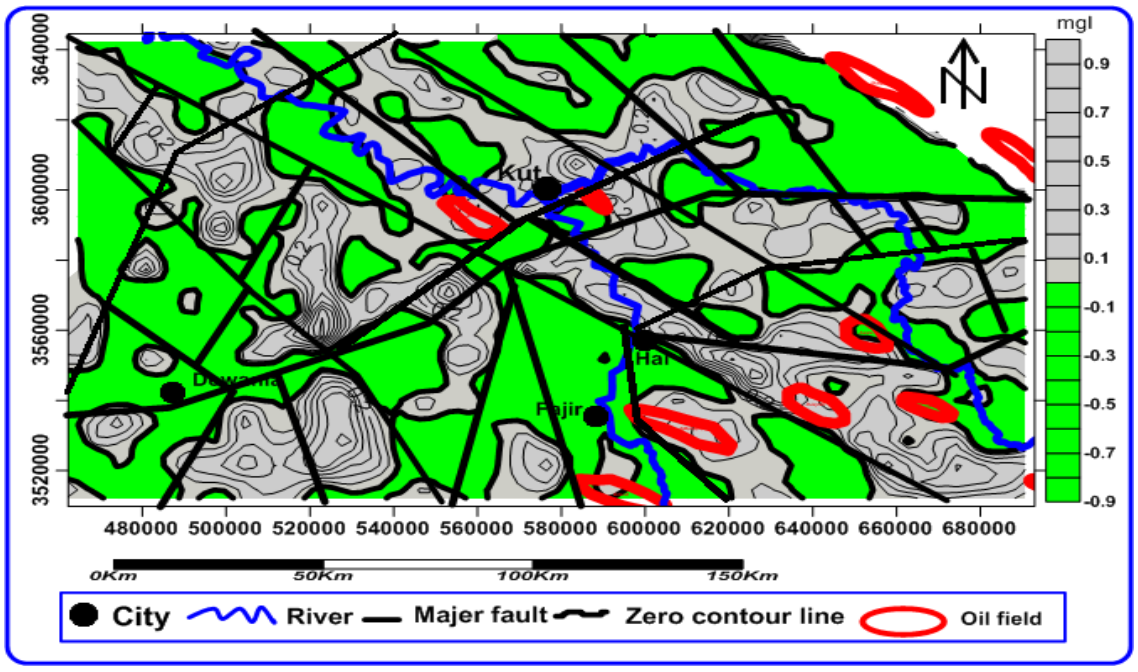

Figure 9- The main tectonic boundaries, zero line of residual gravity anomalies window 8km and oil field locations of the study area.

Conclusions

The residual gravity anomalies of window 8km show that the NW-SE is the main trend of shallow anomalies.It is believed that this anomalies coincide with Zagrous Collision trend and they are created due to this collision. The anomaly features in the depth maps of the three coinsidered formations are confirmed with each others, which indicate that these features are structural and affecting all the formation. Most trends of the axes of the features at the depth maps are NE-SW and some other in NW-SE direction.

It is believed that the difference between the main trends of the residual anomalies and those of the depth maps may be due to th fact that gravity represents the resultant of all formations at the subsurface. On other hand the gravity may be affect by the deeper sources at the same time; the features of depth maps obtained from seismic data have relatively small relation with gravity anomalies.

Many longitudinal and transverse boundaries obtained from gravity and seismic interpretation. It is found that the oil fields in the study area are lying on the positive gravity anomalies of spacing widow of 8 km and nearly close to the zero line of these residual gravity anomalies map.

It is believed that the integration of residual gravity anomalies with depth maps of several formation in a certain area can give very good results for evaluation of an area for oil exploration.

Acknowlegement

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