# Gravity Interpretation of Concession 6, Sirt Basin, Libya

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This study covers concession 6 in Sirt basin. It's located approximately between latitudes 28° 50' to 30° and longitudes 19°30' to 20°. The study involves interpreting gravity to delineate structures and faults. It also helps locate major structures within the study area.

Gravity is very important for studying the subsurface structures. The Libyan Petroleum Institute (LPI) assembled a total of 8871 gravity values. These values cover an area that is 186km long and 96km wide. We gathered the gravity data on spaced irregular grids. The smallest grid spacing was 500m. The largest was approximately 1km.

The high gravity anomaly shows up on the Bouguer gravity map. It is not always limited to the platform structures. For example, low gravity expression represents the Zaltan Platform. Also, the low gravity anomaly isn't always limited to the trough structures. A high gravity anomaly represents the Ajdabiya Trough, for example. The Bouguer gravity map shows prominent NW-SE and N-NW trends. The residual gravity map exhibits a dominant NW-SE trend.

The application of the total horizontal gradient methods used to analyze gravity data. This clarified the subsurface structures of the study area. High gradient values delineate NNE-SSW and NW-SE trends. A strong N-S lineament occurs over the southern part of the study area. It is well indicated by the horizontal derivative. This study's horizontal derivative provides valuable information about the rift structures.

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**Hisham Nouri** **Omar Emhemed**

**الملخص:**

تغطي هذه الدراسة الامتياز رقم 6 في حوض سرت. تقع تقريبًا بين خطوط العرض 28° 50' إلى 30° وخطي الطول 19°30' إلى 20°. تتضمن الدراسة تفسير الجاذبية لتحديد التركيب الجيولوجية والفوالق. كما أنه يساعد في تحديد التركيب الجيولوجية الرئيسية داخل منطقة الدراسة.

تعتبر طرق الجاذبية مهمة جداً في تحديد التراكيب الجيولوجية التحت سطحية ، البيانات الجاذبية التي تم استخدامها في هذه الدراسة هي 8871 قيمة و التي وفرها معهد النفط الليبي وتغطي مساحة بطول 186 كم وعرض 96 كم تم جمع بيانات على مسافات غير منتظمة، وكان أصغر مسافة في الشبكة 500 متر وأكبرها حوالي 1 كم.

في الخرائط الجاذبية بوجير لا يقتصر التعبير عن الشواذ الجاذبية العالية دائماً علي التراكيب العالية (Platform) علي سبيل المثال، يمثل تعبير الجاذبية المنخفضة علي Zaltan Platform كما أن شذوذ الجاذبية المنخفضة لا يقتصر دائمًا على التركيب المنخفضة. على سبيل المثال، يمثل شذوذ الجاذبية العالية فوق Ajdabiya Trough كما تظهر خريطة بوجير اتجاهات الفوالق وهوNW-SEوN-NW كما تظهر خريطة الجاذبية المتبقية اتجاهاً سائدا هو NW-SE.

أن تطبيق التدرج الأفقي الكلي المستخدم لتحليل بيانات الجاذبية يوضح التراكيب الجيولوجية تحت سطحية لمنطقة الدراسة. تم تحديد قيم التدرج العالية اتجاهات NNE-SSW وNW-SE. ويحدث خط N-S قوي في الجزء الجنوبي من منطقة الدراسة. كما توفر تطبيق المشتق الأفقي معلومات قيمه حول التركيب و الصدوع في منطقة الدراسة.

## 1. Intraduction .

The area involved in this study is Concession 6, which is located in the central part of the Sirt Basin in Libya. It covers a total surface area of approximately Eight thousand and five hundred square kilometers. The concession 6 composed of several major structural elements such as Maradah Trough in southwest, Zaltan Platform in center and eastern part of the concession, Wadayat Trough and Al Jahamah Platform in the north. The Zaltan Platform is the largest and most important structural feature in the concession; it contains most of the Libyan's oil and gas fields (BenSaleh, 1974). This study used gravity data provided by Libyan Petroleum Institute (LPI).The total of 8871gravity data pints were collected by LPI used in this study,. The main purpose of this study is gravity interpretation data in order to understand the tectonic evolution better and construct a new tectonic map for the concession.Through the uses of the Osis Montaj Geosoft software, Bouguer, regional, residual maps were created, and upward continuation technique was applied on the gravity data in order to separate regional anomaly form the Bouguer gravity map.

## 2. Location of study area

Concession 6 covers an area of approximately eight thousand and five hundred square kilometers and is located in the central part of the Sirt Basin, one of the five major geological basins in Libya (Figure 1). Geographically, it is bounded approximately between latitudes from 28° 50' to 30°00 North and longitudes from 19°30' to 20°00 East.

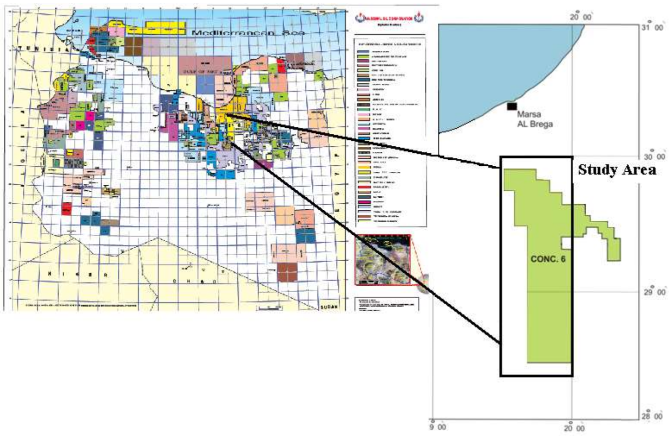

**Figure 1: Location map of the study area (Swei, 2010)**

## 3. Review of Geological Setting of Sirt Basin.

### 3.1 Tectonic and Major Structures of Sirt Basin.

The Sirt Basin covers an area of 600,000 km$^2$ in central of Libya. The basin is characterized by basin fill, which is Mesozoic and Cainozoic in age and by presence of platforms and deep troughs. The main rift phase of the Sirt Basin began in the Cenomanian with the collapse of the Sirt-Tibesti arch. Five major grabens formed (Hun, Zallah, Maradah, Ajdabiya, and Hameimat) which separated by four major platforms (Waddan, Zahrah-Bayda, Zaltan, and Amal-Jalu) as shown in figure 2. These structural features have great significance for the hydrocarbon migration from troughs along faults to platforms where most of the oil fields known.

In the northwest of the basin main structural features orientation was generally northwest-southeast, in eastern part of the basin it is east-west, and in the southwest part it is north-northeast west-southwest, this means that the basin maybe related to a triple junction, but the timing of tectonic activity in the eastern arm is not consistent with a triple junction.

During the Late Cretaceous and Paleocene, a great thickness of shale and subordinate carbonates and evaporates accumulated in the troughs, while a considerably reduced thickness of dominantly shallow marine carbonates was deposited on the platforms (Barr and Weegar, 1972, Gumati and Kanes, 1985, Rider, 1986)

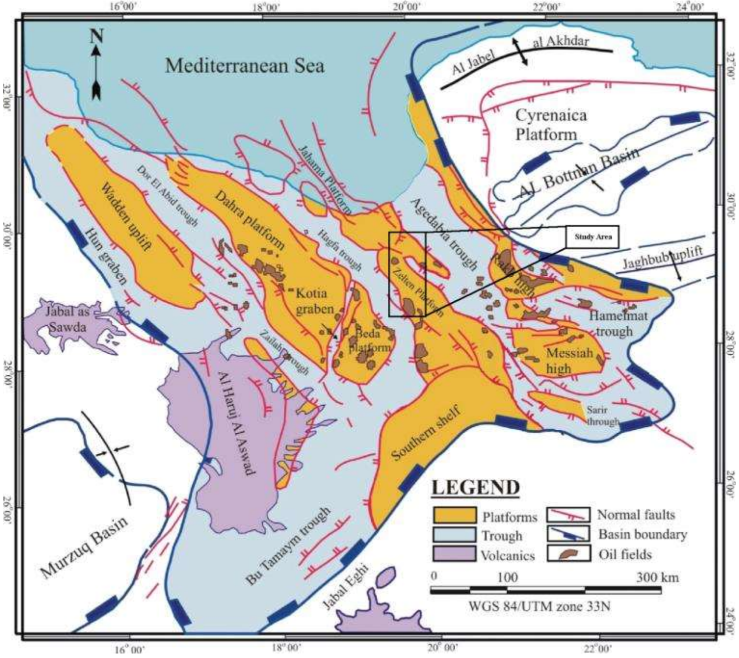

**Figure 2: Tectonic Elements of Sirt basin (Saheel et al., 2010)**

The sedimentary succession of the Sirt Basin reflects its tectonic and structural evolution, that is related to the opening of the Atlantic Ocean and to the convergence of Tethys in Mesozoic and Tertiary times (Gras and Thusu, 1998).

Conant and Goudarzi (1967) and Klitzsch (1970) were the first clearly explained the geological history and major structural elements of the Sirt Basin (figures 3 and 4). Early in geological history, a long period of erosion prevailed throughout North Africa, and by beginning of the Palaeozoic Era of a great part of Libya had been peneplained (Goudarzi, 1980). Precambrian crystalline rocks are exposed in limited and comparatively small area south central Libya, west of Jabal Eghi, in the

Tibisti area, in the southeastern part near border with Sudan and Egypt, at Jabal Al Hasawinah north of Brak, and north of Waw an Namus.

During the Cambro-Ordovician, up to 1000 m of quartzite sandstone were deposited throughout northern Libya (Anketell, 1996). Thinning of the Silurian succession across the Sirt area, together with alkaline magmatism, presaged the uplift of the Tibisti-Sirt arch. during the Hercynian Orogeny (Klitzsch, 1970). Sedimentation continued in the adjacent basins to the east and west, while inversion of the region, together with increased igneous activity, continued during the Devonian to reach a maximum during the Permo-Carboniferous. During the Triassic-Jurassic, eruption of basic lava accompanied post-Hercynian movements. The Sirt Basin area remained a positive element nearly until the Latest Jurassic. The Sirt area gradually submerged, probably for the first time since Early Palaeozoic, as a result of extension that led to the collapse of the pre-existing Sirt arch (Klitzsch, 1970, Bonnefous, 1972, Burk and Dewey, 1974, Goudarzi, 1980). Figure 3 shows major structural elements of Libya, Caledonian-Hercynian and post-Hercynian volcanic, uplifts and basins.

The Sirt basin area experienced stretching and down faulting during Large-scale of subsidence and block faulting began in the latest Jurassic early Cretaceous. The basin underwent reactivation, both in the Late Cretaceous (Van Houten, 1983) and Paleocene time and continued into the Early Eocene (Gumati and Kanes, 1985, Van Der Meer and Cloetingh, 1993). Volcanic activity resumed in post-Eocene time, situated outside the Cretaceous rift at the western side of the Sirt Basin (Guiraud and Bellion, 1995, Wilson et al., 1998). These volcanic generally episodes are believed to have been concurrent with movements along deep-seated fractures (major basement fault zones), more likely re-activated during the Alpine Orogeny (Goudarzi, 1980).

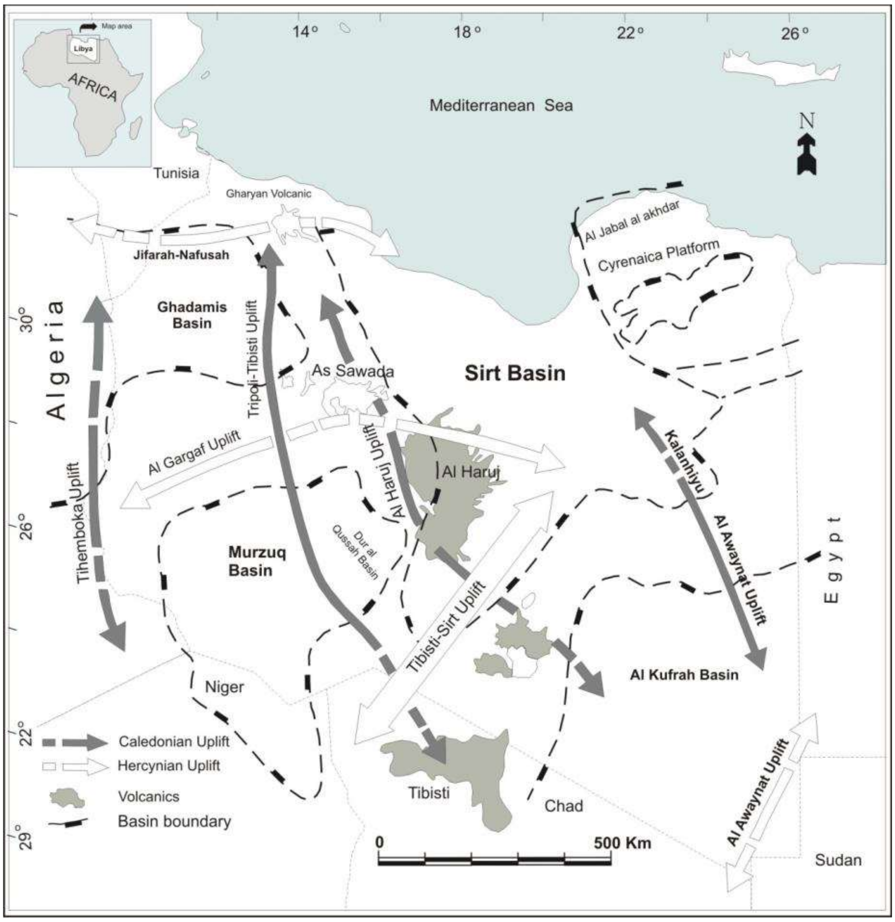

**Figure 3: Major structural elements of Libya, Caledonian-Hercynian and post-Hercynian volcanic, uplifts and basins.(Swei, 2010)**

The rifting in the Sirt Basin took place along a weak zone between two African subplates during the Early Cretaceous (Burk and Dewey, 1974) as result of extension that led to the collapse of the pre-existing Sirt arch (Figure 3). This event is attributed to the drift of the African Plate, which moved north central Libya over a fixed mantle hotspot during the Early Cretaceous (Van Houten, 1983).

Subsidence of the Sirt Basin reached a climax during the Paleocene Eocene according to Gumati and Kanes (1985), corresponding to a period of major crustal extension and reactivation of faults. Anketell (1996) mentioned that the Sirt Basin developed due to inter- and intra-plate movements as resulting of the relative motion of the American, African and Eurasian plates during the opening on the Atlantic Ocean and development of the Mediterranean on the foreland of the African Plate.

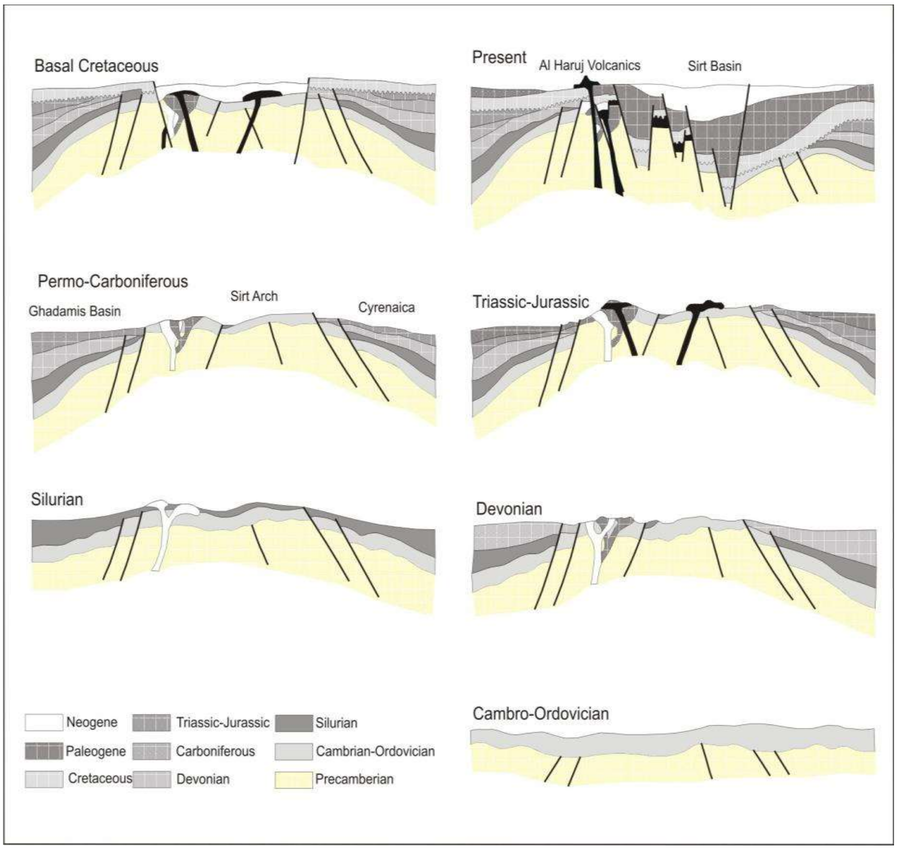

**Figure 4: Structural development (E-W) of the Sirt Basin from the Lower Palaeozoic to the present time (Swei, 2010).**

### 3.2 Geological Background of Concession 6

The Zaltan Platform is the largest and most important structural feature in the Concession 6. This platform and the rest of the Sirt basin was broad regional high, which was tectonically active during Paleozoic time. However, due to Hercynian orogeny at the close of the

Paleozoic and the subsequent erosion, a complete Paleozoic section was not preserved. All that are known to remain of the Paleozoic deposits in Concession 6 are the Cabro-Ordovician Gargaf Quartzites (BenSaleh, 1974).

The subsequent subsidence of the Sirt basin high in the lower Gretaceous created a series of northwest-southeast trending horsts and grabens giving the basin a complicated structural configuration. Rapid fault growth continued during Senonian Soona Shale deposition with shallow shelfal Waha facies being deposited on the Platform margins and highs. Faults also continued during Zmam deposition but growth was much less severe than in Senonian time. During Zmam deposition Waha skeletal limestones and sendstones continues to deposition on the platform highs and margins with micritic to argillaceous limestons being deposted in the deep on water around the Zaltan Ridge, in the Hagfa Trough, and in the Sirt Basin Deap. Following the Zmam period, the Zaltan Reef started to grow on the western margin of the platform. The basin, around the carbonate reefs finally filled with the Early Paleocene Heira shales with transgressed and covered the remnants of the hercynian topography, forming the seal for the reservoir rooks of the Waha-Bahi and Gargaf Formation (BenSaleh, 1974).

### 3.2.1 The Zaltan platform.

The Zaltan Platform is one of the most important tectonic units of the Sirt basin. It covers an area approximately over 4000km2. The largest and most important oil and gas fields are located on the Zaltan Platform (Fraser, 1967). The Zaltan Platform is separated from Al Jahamah Platform in the north by a right-lateral wrench fault. The high productivity of the Zaltan Platform is probably related to its adjacent and deep Ajdabiya Trough, where huge quantities of hydrocarbon have been generated in Sirt and Hagfa Shale. The most significant difference between the Al Jahamah Platform and Zaltan Platform is that the Al Jahamah Platform was emergent during the Danian (Hallett and Clark-Lowes, 2002).

### 3.2.2 The Jahaama Platform.

The most significant difference between the Jahamah Platform and the Zaltan Platform is that the Jahamah Platform was emergent during the Danian. The southwestern margin of the Al Jahamah Platform is faulted facing both the Maradah Trough and the Wadayat Trough(Hallett and Clark-Lowes, 2002).

### 3.2.3 The Wadayat Trough.

The Wadayat Trough extends southeast wards linking the Ajdabiya Trough and it is flanked to the north by Assumud Ridge, which forms the eastern part of the Al Jahamah Platform (Hallett and Clark-Lowes, 2002).

### 3.2.4 The Maradah Trough.

The Maradah Trough Sometimes called Al Hagfah Trough is a deep fault bounded graben extending for almost 400km and width from 10 to 40km. The deepest part of the trough is adjacent to the Al Jahamah Platform and it shallows to both north and south. Gravity map of the northern Maradah Trough presented by El Batroukh and Zentani in 1980 indicated that total sedimentary column of 3600 to 4600m overlying basement. The faulted trough margins are very clear with NW-SE and N-S orientation. They identified several structurs within the trough which interpreted as deep horsts (Hallett and Clark-Lowes, 2002).

### 3.2.5 The Ajdabiya Tough.

The Ajdabiya Trough is the most important part of the Sirt Basin and is responsible for about 60% of all the oil found in Sirt basin. The trough is the largest, deepest and most important source kitchen in Libya. Subsidence in the trough has been rapid and continuous since Cretaceous and continued to the present day (Hallett and Clark-Lowes, 2002).

## 4. Objective of study.

The objectives of this research in the following:

First, to carry out a gravity interpretation of 6 six. This interpretation will use data provided by LPI in Libya. It will use Geosoft software. 6.4, 2007).

Second, create a new Bouguer gravity anomaly map and Tectonic map of Concession 6 of Sirt basin, Libya. Use Geosoft, version... 6.4, 2007).

Thirdly, to investigate the subsurface geological structure of the concession six, the result from residual, regional, and Bouguer anomalies, and the Total horizontal derivative map will help investigate the subsurface geologic structure of the Concession 6.

Finally, compare the result from gravity interpretation with the geological information. This helps explain the relationship between the surface and subsurface structures.

## 5. Gravity Method.

The gravity method is a non-destructive geophysical technique that measure variations in the earth's gravitational field caused by differences in the density of sub-surface rocks. Gravity methods have been used most extensively in the search for oil and gas particularly in the twentieth century, while such methods are still employed widely in hydrocarbon exploration. In addition, it has found many applications in engineering, environmental and geothermal studies including locating voids, faults, buried stream valleys, water table levels and geothermal heat sources. Gravity anomalies reflect lateral change in density caused by structures or changes in lithology. The Gravity anomalies reflect the differences between observed and predicted gravity value and usually contain a regional effect (Dobrin, 1988, Telford et al., 1990) generally, igneous and metamorphic rocks are denser than sedimentary rocks. The success of the gravity method depends on the different earth materials having different bulk densities, which produce variations in the measured gravitational field. These variations can be interpreted by a variety of analytical and computers methods to determine the depth, geometry and density that causes the gravity field variations. The gravity data is processed to remove all quantifiable disturbing effects to get Bouguer gravity anomalies by applying some corrections to data such as latitude, free air, Bouguer and terrain corrections.

### 5.1 Gravity Interpretation.

After remove all quantifiable disturbing effects from the gravity data to get the Bouguer anomaly, the interpretation problem usually is finding the mass distribution responsible for the residual anomaly. Usually the Bouguer gravity anomaly map contains anomalies come from several sources. The regional anomalies are log wavelength anomalies due to deep density contrast. They are very important for understanding large scale structures of the Earth's crust, such as mountain, oceanic ridges and subduction zones. While, the short wavelength anomalies are due to shallow anomalies, which called residual, anomalies and they may be interest for commercial exploration. Geological knowledge is essential for interpreting the residual anomalies, short wavelength anomalies may be due to near-surface mineralized bodies. In sedimentary basin, short or intermediate wavelength anomalies may arise from structures related to reservoirs for petroleum or natural gas. The separation of anomalies of regional and residual is important step in the interpretation of gravity map. There are several methods that used to separate the regional and residual such as graphical, polynomial fitting, upward continuation and wavelength filtering. For this study, upward continuation technique used to separate regional gravity map from Bouguer map figure (5) show the polynomial fitting of separating of residual gravity from regional trend (Lowrie, 2007).

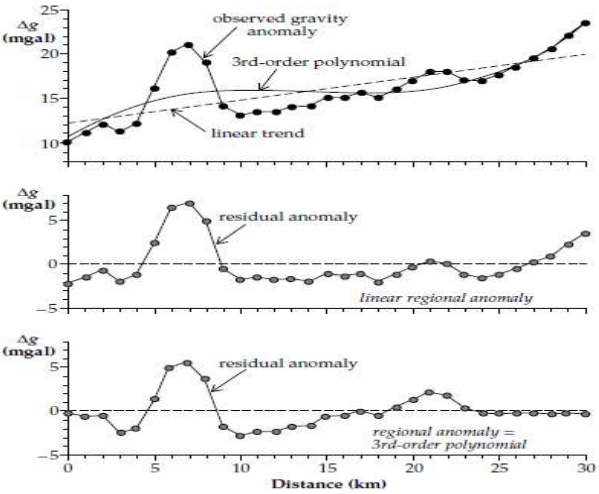

**Figure 5: Representation of the regional trend by a smooth polynomial curve fitted to observed gravity profile (Lowrie, 2007)**

### 5.1.1 Gravity Data.

The gravity survey carried out in Concession 6 of Sirt basin Libya in 2006, the 8871 gravity data points collected by LPI, which covered an area of length of 186 km and width of 96 km figure (6) shows the distribution of gravity stations on Concession 6. Nominally, the survey lines laid out orthogonal to each other to cover all the rectangular area. The gravity data were gathered with an irregularly spacing due to the topography of area and difficulties to access to some point of the survey. The grid spacing was various from 500 meters to approximately 1km.

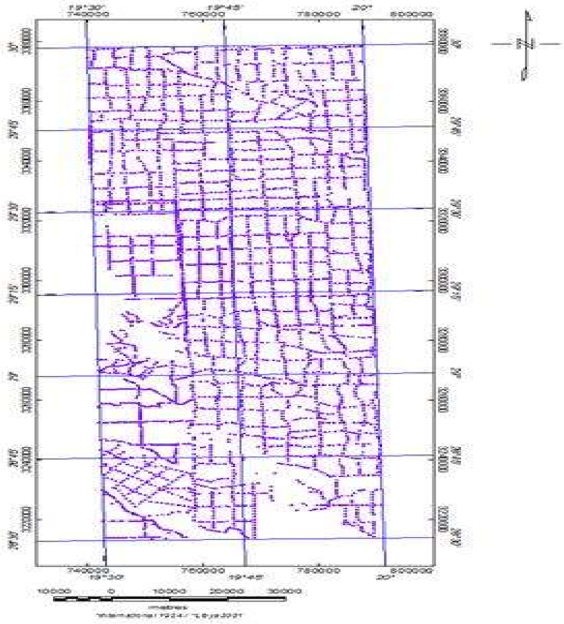

**Figure 6: Gravity station location map in concession six in Sirt basin Libya**

## 5.1.2 Bouguer Gravity Map.

The Bouguer gravity map are usually smoother Due to the small variations in density and the gravity field changes less rapidly in space field. This makes the interpretation of the gravity maps easier Bouguer anomaly should contain information about the subsurface density after the Free Air and Bouguer corrections applied to the data. A map of the Bouguer anomaly gives a good impression of subsurface density Low (negative) values of Bouguer anomaly indicate lower density beneath the measurement point and vice versa.

the geological structure of the Sirt basin is characterized by a series of troughs and platforms separated by block faults. This separation is expressed on the Bouguer gravity map by steep gradient, which related to the faults.

The Bouguer gravity map expression within the concession figure (7) is varying from high gravity anomaly expression in the northern part (Ajdabiya Trough and Aljahamah Platform) with the maximum value 9.4 mGal to low gravity anomaly expression in the Maradah

Trough with minimum value -32 mGal. The Zaltan Platform is characterized by the short wavelength anomaly within platform, which represented for near surface structural features, which related to the short wavelength. The Ajdabiya Trough and AlJahamah Platform are characterized by high gravity anomalies, which are revealed deep structural features that related to the mantle. Most of the northern and central part of the concession, the structural features (Ajdabiya Trough, Zaltan Platform, Maradah Trough and and Aljahamah Platform) are characterized by NW-SE trend direction, which related to the Late Cretaceous rift that affect the entire of the Sirt basin.

In the Bouguer gravity map, the high gravity anomaly expression is not always restricted to the platform structures, such as the Zaltan platform is represented by low gravity, which related to the structural features within the platform that caused of the gravity disturbance from high-density rocks to low-density rocks. And also, the low gravity anomaly is not always restricted to the trough structures, such as northern part of Ajdabiya trough is characterized by high gravity anomaly which related to lower crustal deep features that caused by mantle upwelling that caused thinning the continental crust beneath the northern part of Ajdabiya trough.

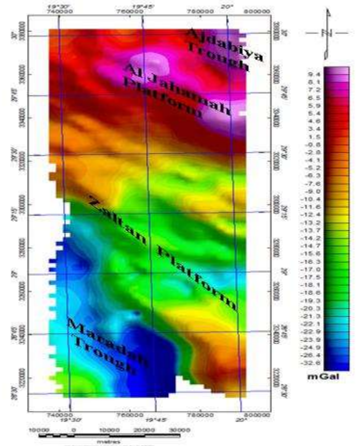

Figure 7: Bouguer gravity anomaly map of concession 6 Sirt Basin" Grid cell size = 2000 m"

### 5.1.3 Upward Continuation for Gravity Data.

In order to achieve our objective of define the major structural elements within the study area and understanding its deep structure, the regional map has to be removed from Bouguer gravity map. As we define before the regional refers to sources with deep origins, and the residual refers to fields created by shallow to intermediate sources.

Separating the regional map and residual map resulting from local mass distribution from the Bouguer map can be difficult task. To separate out the regional map from the Bouguer map, we apply an upward continuation filter to estimate the regional map. The upward continuation of potential field is a form of low-pass filtering. It permits the viewing of potential filed at different levels over an anomaly source and acts a standard separation filter for potential field data (Hughes et al, 1947; Henderson, 1949; Robinson, 1970; Jacobsen, 1987). It enhances long wavelength signal by attenuating higher frequency signals due to shallow sources without producing any side effects that require additional correction. Then to produce residual map reflecting shallow features, we carefully selected an upward continuation level that reflected the regional map and then simply subtracted the corresponding gird from the Bouguer map.

#### 5.1.3.1 Regional Gravity Map.

The interesting anomalies on the gravity map frequently are masked by deep structures, which have low frequencies. The regional effects correspond to low frequencies; the removed of the regional anomaly in gravity is more serious problem than in other geophysics methods. As describing the regional as the effect of large-scale deep structures it must be considered in terms of the scale of the survey. It would be also defining the regional, as the effects of in which were, are not interested.

The low-pass filter is applied to the Bouguer gravity map in order to enhance the deep seated features from the gravity data to produce the regional gravity map (upward continuation) with used different various of cutoff-wave numbers 10, 15, 20, 25, 50, 75 km to obtain the regional gravity anomalies figure (8), which related to deep structures (low frequencies). This filter was applied in frequency domain by using the Fast Fourier Transform (FFT) technique in

Geosoft package software. All the upward continuation maps were examined and compared until there is no longer any noticeable change among the subsequence upward continuation maps. At this point, an upward continuation is defined, and the grid is selected. Finally, 25 km was considered as cut-off to be used for the low pass filter, which will reject the entire wavelength that less than 25 km and pass the wavelength that more than 25 km.

The regional gravity anomaly map of the concession 6 as shown in figure (9 ), the long wavelength gravity anomaly with 25km low pass filter shows the northern part of Ajdabiya trough is still characterized by long wavelength gravity anomaly expression (high gravity values) which interpreted as that related to the deep structures due to the mantle process below the lithosphere.

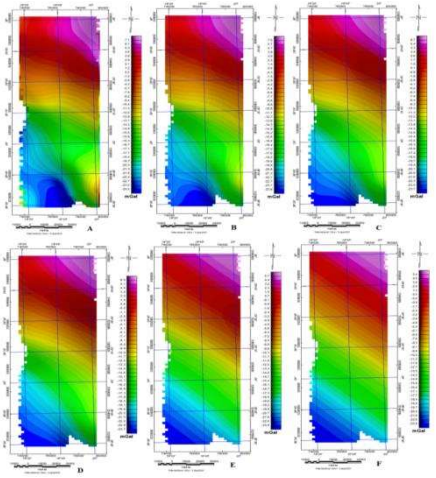

**Figure 8: Various upward continuation anomaly maps of the Bouguer gravity, upward continued to A- 10 km, B- 15 km C- 20 km, D-25 km, E- 50 km and F- 75km.**

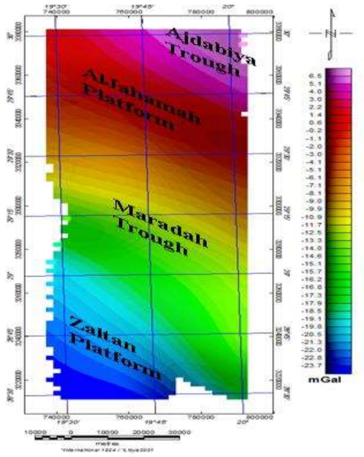

**Figure 9: Regional gravity anomaly map with low pass filter (cutoff 25 km).**

### 5.1.3.2 Residual Gravity Map.

Residual gravity map corresponds to short wavelength fields of shallow bodies. As mentioned before, the residual gravity map figure (10) was the result of simple subtracting of the low pass anomaly map, which is the regional anomaly map, from the Bouguer gravity map. The residual gravity map showed anomaly ranges from -10.9 to 10.4 mGal. The distribution of anomalies is similar to the Bouguer anomaly map.

The residual gravity map of the concession 6 was characterized by positive anomaly in the northern part dominant NW-SE trend which reveals anomalies over Wadayet trough, and also the trends in southern and central were orientation NW-SE trending anomalies. A strong N-S trend was in the southern part of the study area, which reflects to the Hagfa trough (Maradah Trough).

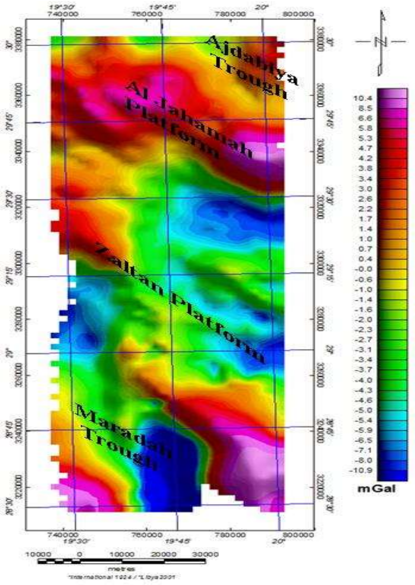

**Figure 10: Residual Gravity map of concession 6 Sirt bain" generated by subtracted an upward continuation of 25 km cutoff from the Bouguer gravity map"**

### 5.1.4 Total Horizontal Derivative .

Total horizontal derivative method was used extensively to locate boundaries of density contrast from gravity and magnetic data. This can be estimated by Phillips et al (1998). The amplitude of the horizontal gradient Cordell and Grauch (1987) is expressed as

$$G(x, y) = \left[\left(\frac{\partial g}{\partial x}\right)^2 + \left(\frac{\partial g}{\partial y}\right)^2\right]^{1/2} \qquad \ldots\ldots\ldots\ldots 1$$

Where:

$(\partial g/\partial x)$ and ( $\partial g/\ \partial y$) are the horizontal derivatives of the gravity field in the x and y directions.

The total horizontal gradient of gravity data is calculated using Fast Fourier Transform (FFT). Grauch and Cordell (1987) discussed the limitations of the horizontal gradient magnitude for gravity data. They concluded the horizontal gradient magnitude maxima can be offset from a position directly over the boundaries, if the boundaries are not near-vertical and close to each other.

This method had the effect of highlighting high gradient areas which for example might occur at faults boundaries that useful for delineating structures trends. In the concession 6, the map of total horizontal gravity gradient, anomalies were observed throughout the area, some geologic faults are confirmed and others are delineated figure (11). The map showed a strong horizontal gradient on the southern and northeastern parts of concession 6. On the north and northeastern parts of the concession 6 showed NW-SE strong gradient, and also on southern part showed N-S and NW-SE trends. On the central part illustrated many short anomalies that NW-SE orientation.

All the result which gotten from gravity data were compared with the geological information in order to explain the relationship between the surface and subsurface structures. This comparison of the estimated faults extracted from the geological map, total horizontal derivative from gravity showed relative agreement with the subsurface structures some geologic faults are confirmed with previous tectonic geological map and others are delineated figure (11).

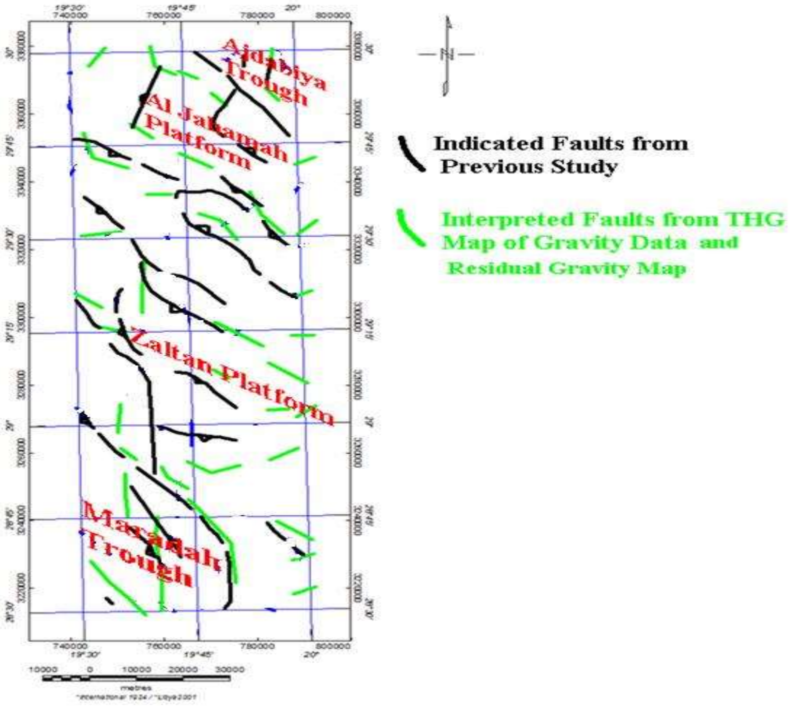

**Figure 11:** The Total horizontal gradient map of the Bouguer gravity map. Black lines indicate the faults from previous studies, and the green lines show the interpreted faults from the horizontal gradient filter,

## 6. Results.

The results obtained from separating the regional and local anomalies from the Bouguer anomaly map are as follows.

The Zaltan Platform exhibits low gravity. In contrast, the northern part of Ajdabiya Trough exhibits high gravity. Both Ajdabiya Trough and AlJahamah Platform have high gravity anomalies. The maximum value is 9.4 mGal. which related to the deep structural features. The Zaltan Platform and Maradah Trough (Hagfa Trough) have a low gravity anomaly. The minimum is -32 mGal.

Most of the gravity anomalies were in good accordance with the structural features. The concession included locations in the northern and central part. These features include Ajdabiya Trough, Zaltan Platform, Maradah Trough, and AlJahamah Platform. The Late Cretaceous rift affected the entire Sirt basin. It characterizes them with a NW-SE trend direction. The northern part of the Ajdabiya Trough still shows a long wavelength gravity anomaly. It has high gravity values. This may be due to deep seated structures related to the mantle.

The residual gravity map of the study area shows NW-SE trending structural features. It also shows strong N-S trending in the southern part of the study area. This reflects the Maradah Trough.

The horizontal gradient delineated subsurface faults that have no evidence on the surface. Geological mapping would not discover them. Scientists confirm some geological faults and delineate others.

## 7. Conclusions.

In general, the gravity field recorded at the Earth's surface is the collective effect of sources at different levels. The sources are from the surface downward up to the Moho.

The initial interpretation of the subsurface structures from the Bouguer anomaly map will not be accurate. This is because the Bouguer anomaly is a collection of local and regional anomalies.

The results show deep and shallow structures after separating local and regional anomalies from the Bouguer anomaly.

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