CHAPTER VII

SUMMARY AND CONCLUSIONS

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The present thesis is mainly devoted to study and interpret the Bouguer anomaly and total intensity areomagnetic data of an area lies in the northern part of the Western Desert of Egypt. The area under study lies between Latitudes $29^{\circ}00$ N and 31° N and Longitudes 27° 00 E and 30° 00 E covering a surface area about 65000 Km^2. On the surface the area covered by Cretaceous, Tertiary and Quaternary sediments which show in its great part, gentle dips towards the North and Northwest.

The sedimentary section has different thickness at different parts. The stratigraphic column is generally thick and includes most of the sedimentary succession from Recent to Precambrian basement complex, this clairfied from the study of the bore holes in the study area.

Separation of the residual anomalies is done on the Bouguer data using Griffin's method, where the residual anomalies reflected clearly the shallow-seated causitive effects, especially those of the structural features. In addition, downward continuation of gravity field is also applied using Constantimescu 's method to six different levels taken at regular intervals of 1.25, 2.5, 3.75, 5, 6.25, and 7.5 Kilometers.

Linear anomalies of high gradient, great areal extent and different trends were separated between the uplifted and downfaulted blocks. The study of these linear anomalies in terms of their direction, mean length, and mean number were interpreted every 10° around the North.

Most of the observed anomalous features obtained from the analysis of Bouguer, residual and downward continuation as well as the magnetic intensity are generally connected with deep seated and shallow structural conditions, which are responsible for the formation of the major and relatively minor fault trends. Therefore, the study of linear anomalies of the Bouguer map, in terms of number and length percentage, indicate possible five fault trend directions indicated during the evolution of the area. These regional tectonic trends can be arranged as the following:N 55°E (Qattara),N 85°E ,N 85°W (E-W or Mediterrnean), N 25° E (Aqaba), N 25°W (East Africa) and N 45°W (Suez) trends.

The predominent directions deduced from the residual anomaly map are N 55° E (Qattara), the E - W (Mediterrnean), the N 25° E (Aqaba), the N 35° W (Suez) and N 15° W (N-S or East Africa) trends. Also, the systems of faulting dissecting the hole sedimentary column and the basement surface, as well as those interventing the depth ranges 1.25, 2.5, 3.75, 5, 6.25 and 7.5 Km. are defined with respect to their trends. Most of the major faults have their effect downward to more the six Kms. These major trends, as interpreted from the different levels of downward continuation maps are following:N 55°E (Qattara), N 85°E, N 85°W (E-W or Mediterrnean),N 25°E (Aqaba),N 25°W (East Africa) and N 45°W (Suez) trends.

The graphical-numerical technique was applied directly to the different levels of downward anomaly maps of the area under study. Based on anomaly maps and morphological characteristics, the study area was divided into six relatively homogeneous

sectors. From these data the relatively frequency distributions were computed and plotted, for the six sectors, as rose diagram. Eash sector has its characteristics major trends these trends show differences in the dominant trends.

Also, the density distribution of fault system was expressed as iso-fracture contour maps. The density distribution for length and number of faults are more or less similar. They show an increasing in the southern and eastern parts of the study area.

The Bouguer anomaly map was interpreted in forms of:-

a- Evaluation of the types of cauastive bodies using normalized relation figures;

b- determination of the parameters of the faults and dykes using Hilbert-transform techniques,analytical signal and geometrical functions of the interpreted structures.

Analysis and interpretation according to these methods and techniques led to the following conclusion:-

1- The computed normalized relation figures along profiles indicate that the anomalies along profiles from F(1) to F(76) are fault structures while those along profiles from D(1)to D(32) are dyke structures.

2- Hilbert transform techniques indicates that the evoluted parameters of the faults are:-

   a- The depths to the upper surface (t) vary from 1.14 to 3.88 Km.

   b- The depths to the lower surface (T) vary from 2.18 to 5.53 Km.

c- The dip angle (α) are vary from $21^{o}\ \bar{9}$ to $90^{o}\ 0\bar{0}$ degree.

d- The density contrast (ρ) between the basement rocks and the overling sedimentry rocks are vary from 0.14 to 0.33 gm/cm^{3}, table (22).

3- The maximum amplitude and the horizontal gradient method indicate that:-

a- The depths to the upper surface (t) vary from 2.42 to 4.91 Km.

b- The depths to the lower surface (T) vary from 2.49 to 5.72 Km.

c- The dip angle (α) are vary from $37^{o}\ 2\bar{0}$ to $88^{o}\ \bar{6}0$ degree.

4- Saha's method used for determining the parameters of the vertical faults besides the other mentioned methods and the resultes are shown in table (21) where the depth to the upper surface range from 1.90 to 3.47 Km., the depth to the lower surface range from 2.60 to 4.55 Km.,the dip angle vary from $86^{o}\ 1\bar{0}$ to 88^{o} degree and the density contrast (ρ) range from 0.11 to 0.23 gm/cm^{3}.

5- Inclined and vertical dyke parameters were evaluated using different methods such as Hilbert transform technique method. The evaluated parameters are mainly dips, widths, depths to upper and lower surface and density contrast. These methods indicate that the depth to top of these dykes are vary from 1.46 to 3.30 Km.,the depth to bottom vary from 2.37 to 4.64 Km.,the dip angle vary from $41^{o}\ 2\bar{6}$ to $90^{o}\ 0\bar{0}$ degree,the widths of these dykes are vary from 1.10 to 2.88 Km.and the

density contrast are vary from 0.14 to 0.26 gm/cm^3, tables (22 and 23).

6- Spectral analysis techniques and Bott & Smith method clarify that the average depth to the top of basement complex ranges from 1.40 to 4.66 Km. in the northern part of the study area while in the southern part this range differs from 2.15 to 4.30 Km.

On the other hand, the total intensity areomagnetic map of the study area were qualitatively interpreted, where the linear anomalies in terms of number and length percentage indicate possible five regional tectonic trends. They are :- N 55° E (Qattara), N 85°E, N 85° W (Mediterrnean), N 25° E (Aqaba), N 25°W (East Africa) and the N 45° W (Suez) trends. The quantitave interpretation of the areomagnetic anomalies was carried out; where:-

1- The study profile were taken at the same location of that in the Bouguer gravity map locations, and tested by several methods.
2- The computed normalized relation figures along profiles MF (1) to MF (80) are fault structures while those along profiles MD (1) to MD (28) are dyke structures.
3- Powell's, Durantny's, Koulomzine, Complex gradient, Amplitude of the analytical signal and the geometrical function of (Ln.) and (ψ) contribution techniques were applied along 118 profiles, they indicate that the anomalies along 80

profiles are fault structures and anomalies along 28 profiles are dyke structures. The evaluted parameters were listed in tables (30 to 33).

4- The parameters of the interpreted dykes indicated that the depth to the top are vary from 1.11 to 3.86 Km., the depth to the bottom vary from 2.12 to 5.93 Km., the density comtrast vary from 0.21 to 0.26 gm/cm^3, the dip angle vary from 28 38 to 90 00 degree and the width of the dykes vary from 1.11 to 3.11 Km.

5- Magnetic fault parameters indicate that the depth to top are vary from 2.31 to 5.32 Km., the dip angle ranges from 25 00 to 90 00 degree and the density contrast vary from 0.20 to 0.23 gm/cm^3.

6- The magnetic susceptibility of these basement rocks were calculated. It indicates that the type of the basement of the study area is granitic or rhyolitic of lower susceptibility dissected by intruding dykes of more basic nature and higher susceptibility; ranging from 0.00043 to 0.000648 S.I.

7- Spectral analysis and Peter's techniques used for estimating the average magnetic depths to the top of the basement complex.

The basement relief and tectonic maps of the study area were constructed, and show that:-

1- The thickness of the sedimentary rocks ranges from 1.41 in the southeastern part of the study area to 3.70 Km. in the northern part of the study area.

2- The basement surface of the study area is characterized by the presence of major uplifted zone localized at different parts such as: Rabat-1, Mubarak-1,E. Mubarak-1, southwest of Betty-1 and south of Agnes-1 and minor uplifted zones scattered at different parts.

3- The major downfaulted blocks (basin) localized at south-western portion of the area, Abu Gharadige basin, south of WD 7-1 well , southwest to WD 8-1 well, western portion of Ramak -1 well, S W Mubarak-1 well, Diyure -1, Zebeida-1 major structural low and south of WD 32-1 well

4- The major uplifted and downfaulted blocks are separated by linear anomalies with different trends, areal extension and horizontal gradients.

The calculated thickness values of the sedimentary sections (basement depth) in the study area, have different values ranging between 1.5 Km. in the southern part to about 4.5 Km. in the northern portion of the study area. These calculations are in a good agreement with the actual values of drilling.

The correlation between trends deduced from Bouguer, residual, downward continuation anomalies and the trends obtained from Landsat images and field investigation show a good agreement with each other,excepted some differences in the regonality of the different trends, that refer to different phases of tectonic activity.

Also, the statistical analysis of the Bouguer, residual, downward and magnetic anomalies reveals that there are two major trends, namely N-E and N-W that are parellel to the directions of the Suez trend and Aqaba (and/or Syrian arc) trends respectively. It can concluded that the depth of the maximum number of anomalies representing the N-E trend is less deeper than that representing the N-W trend. This leads to the conclusion that the tectonic phase, responsible for the formation of the N-W structural trend is older than that responsible for the formation of the structural pattern having the N-E trend. Such a tectonic phases are probabaly due to the rejuvenation of the tectonic activities occurs in the Precambrian. Generally, the results are in agreement, but the order of predominance is different. This is probabaly due to the fact that faults detected from gravity anomalies and magnetic are mainly due to basement structures that are not allways transmitted through the overlying sedimentary cover. Also, not all the lineaments on the landsat images have necessarily a structural significance.

The detcted fault systems are interpreted to be mainly to N-S meridional stress resulting from the interaction between the European and African Plates which started in the Pre-Cambrian time and rejuvenated during the Hercynian (Pre-Carboniferous), Laramide (Late-Cretaceous) and Alpine (Late-Tertiary) orogenies.