CHAPTER I

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The present work is essentially concerned with the interpretation of the available gravity and magnetic data in the area under study which lies in the Northern part of the Western Desert, between latitudes $29^{\circ}\ 0\bar{0}$ & $31^{\circ}\ 3\bar{0}$ N and longitudes $27^{\circ}\ 0\bar{0}$ & $30^{\circ}\ 0\bar{0}$ E,and covering a surface area of about 65000 Km^2,Fig.(1)

Recently,strong attention has been given to the geological and geophysical implications of the Egyptian Western Desert, regarding the expected petroleum occurrences in the western part of Egypt , as a potential source of oil. Also, a special emphasis is directed to the predictable accumulations of the ground water. Therefore, the present study is mainly devoted to the evaluation of the subsurface structure and solving some of the geological problems that are most interesting to both geologists and geophysicists. The study had been carried out using:-

a- The Bouguer anomaly map, compiled by the General Petroleum Company (G.P.C,1986) with Scale 1 : 500,000 and contour interval 2 milligal.

b- The Aeromagnetic map,compiled by G.P.C.,(1986) with Scale 1: 500,000 and contour interval 25 gammas.

c- More than 70 boreholes drilled in the study area by the different oil companies that worked or still working in the Western Desert of Egypt, Fig.(2).

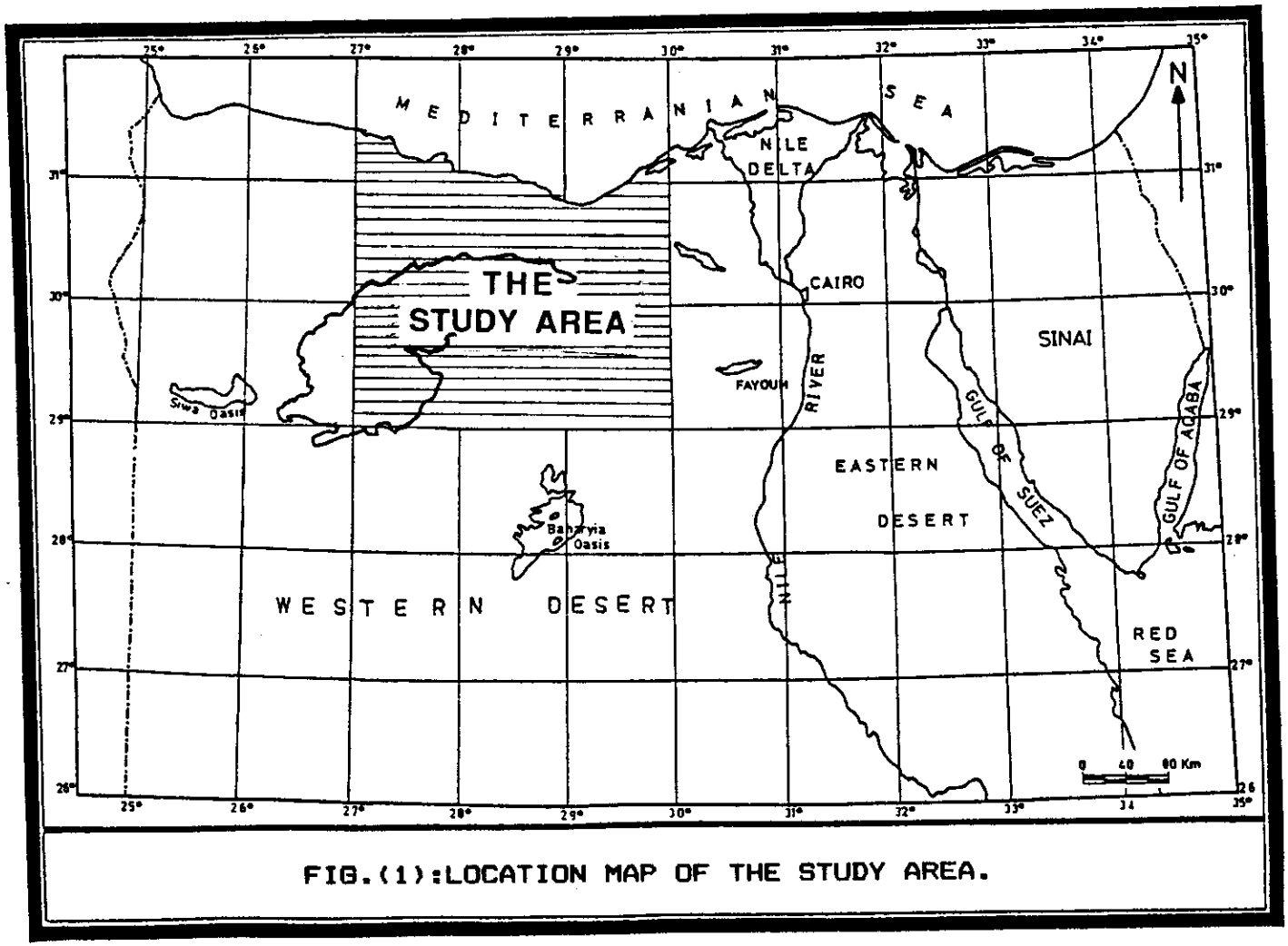

FIG.(1):LOCATION MAP OF THE STUDY AREA.

d- Maps representing the surface and subsurface geology and structural geology of the area under study.

e- Most of the techniques in this worke were operated on an IBM/AT computer with total RAM 1.2 M.B. Six programs have been designed to handle the different operations including data entry, computational histograms ,diagrams , probability methods,mapping involved in the different techniques.This done to cover the different conditions which may affect the validity of parameter estimation. Then , the resulted values are weighted to choose the proper value which is the least affected by any other parameter.

I. 1- PREVIOUS GEOPHYSICAL WORK.

Due to the importance of the northern Western Desert as an area of high petroleum possiblities different petroleum companies (General Petroleum Co., Pan American Petroleum Co., Phillips Petroleum Co., and others) worked in different parts of this Egyptain province, covering it by frequent geophysical surveys including gravimetric, seismic reflection, seismic refraction, aeromagnetic and well logging studies. The activity of these petroleum companies has led to the discover of many oil fields as Abu Charadig, Abu Sennan, Razak, Alamin, Meleiha.....etc.

These productive oil fields throw a considerable amount of light about the petroleum potentialities of the Northern Western Desert Province and gave the hope for a good future to the hydrocarbon exploration and prospection.

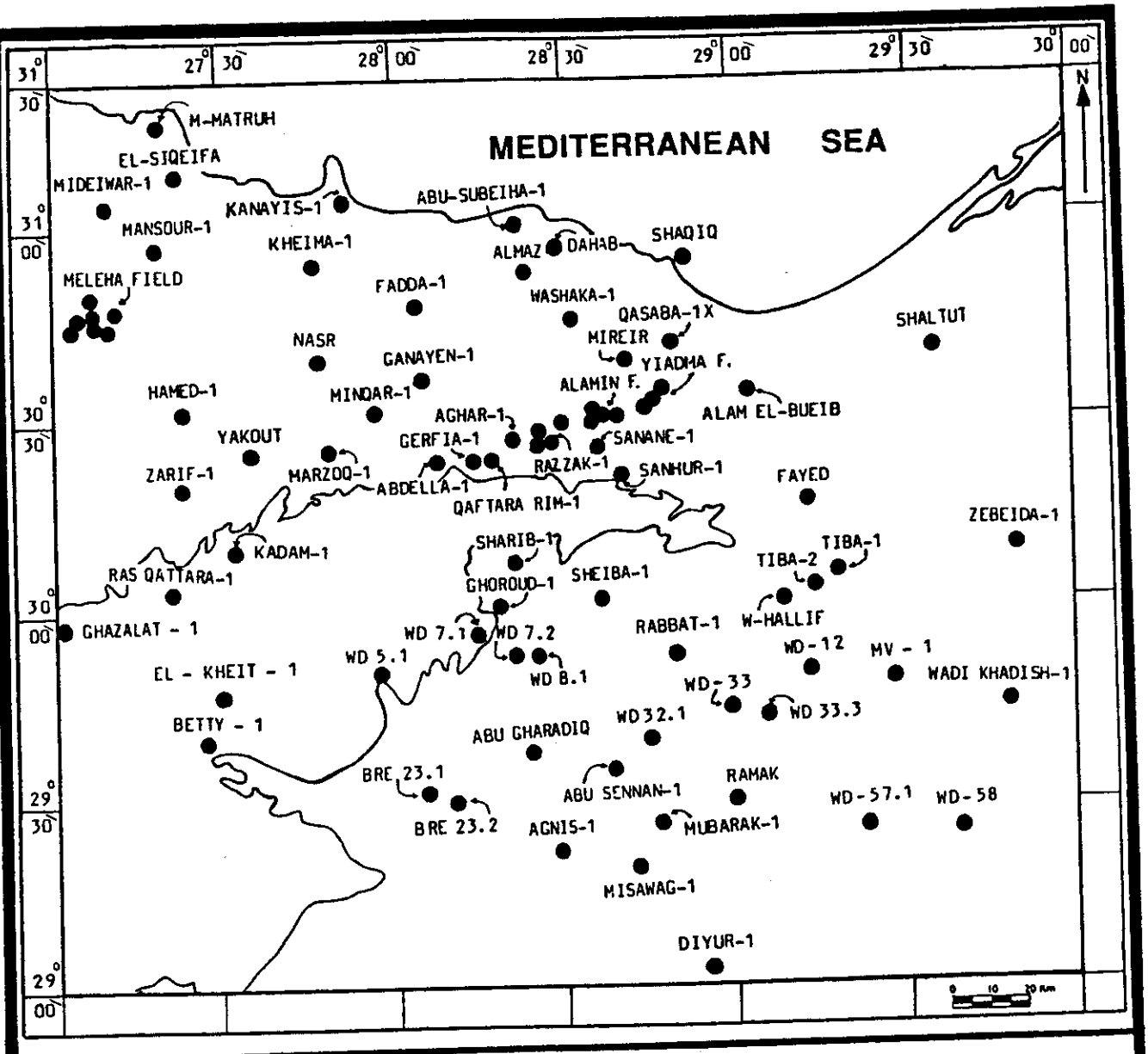

FIG.(2): WELL-LOCATION MAP OF THE STUDY AREA.

Morever,since the forties till 1958, Sahara petroleum Company conducted a reconnaissance geological and geophysical surveys for the Northern Western Desert ended by drilling of some scattered explorating wells as Yiadma, Alamin, Meleha Fields. Since 1964, a regional seismic program has been carried out by philips and Pan American Companies,in which philips explored the tract north of latitude 30° $0\bar{0}$ and Zarif, Kadam and Ras Qattara wells while Pan American explored the tract south of latitude 30° $0\bar{0}$ and drilled Betty and EL-Kheit wells. In 1968,the Russian experts of the petroleum industry held the contract 1501 for the western part of the Northern Western Desert in an extensive program and drilled most, if not all, the wells located in the Western part of Northern Western Desert. In 1976 Shell Winning N.V. prospected the west of the investigated area and drilled a number of wells as Yakout, Kadam-1, Betty-1,Zarif-1 .....etc.

The General petroleum company(G.P.C) participated in the Western Desert exploration ampaign since 1969 . G.P.C. efforts were concentrated mainly in Siwa area at first. Currently , G.P.C activities are devoted mainly to Abu Sennan area, where successful oil and gas discoveries were claimed by company since 1981, the discovery date of the G.P.T. field.

Since 1974, several international oil companies as Shell, British petroleum , Chevron, Braspetro, Murphy, Phonex, Agypetco, Amoco and Phillips have conducted exploration efforts in the study area.

Also Intensive geophysical studies have been carried out on different parts by different authers on the Western Desert, Riad, (1977); Sayed (1977) ; EL-Melegy (1978); Riad et.al (1978,1979) ; Darwish (1979); Riad et.al (1982); Awad et.al (1983); Sharaf, (1984); Abu EL.Ata (1987) ; Sharaf et.al (1989, 1990);Zahra (1990); Helaly, (1990); and many others (1990) used the Bouguer anomaly maps in determing the fault systems and shear zones in the different parts of the North Western Desert. From their studies , the following may be concluded:-

a- Gravity anomalies can help in detecting shear movements when favourable structural conditions exist.

b- Two sets of shear zones have been recognized:-

i- The first set of shear zones trending in N-W direction. It is probably represents the suez right - lateral shearing supposed to exist according to Moddy's model (Halsey and Gardner,1975). This shear direction was reported in the Gulf of suez area (Health, 1975) and in north Egypt on the basis of gravity data (Riad, 1977). Faults of NW - SE direction were reported by EL - Shazly et.al, (1976) to be strike slip faults of right lateral type.

ii- The second set of shear zones strike in NE direction. It is believed that this set represnts the Aqaba shear direction.

iii- Fifty eight shear zones are recognized in North Egypt. The right lateral shear zones are mostly N-W ,whereas the left-lateral zones are mostly N-E.(Riad et.al,1983).

iv- The detected fault system and shear zones show that stress fields were probably acting on North Egypt . A meridional strees field acting in N-S direction since late-Cretaceous times , is believed to be due to the drifting of African continent,and the collision between the African and European plates.The second field is the modified equatorial one acting since the Oliogocene times and is due to the Red Sea rifting. The direction of the principal stress axis is prependicular to the spreading center of the Red Sea (N 55^{o} E).

v- The effect of both fields is felt in all zones of North Egypt, but their intensity differs from zones to another. Refai et.al (1973); Sayed,(1977); Riad et.al, (1978);Riad,et.al,(1979); Tealeb,(1979);Mesheref et.al, (1979,1980); Abu EL-Ata,(1981,1984); Nakhla,(1982); Mesheref,(1982); Abd EL-Rahman et.al,(1984); Abd EL-Fattah et.al,(1984); Zante,(1984); Dennis,(1984); EL-Sirafe, (1978); Abu EL-Ata et.al,(1985); Sultan et.al, (1988); Mesheref,(1988);Ahmed et.al,(1989);Abu EL-Ata, (1989); Zahra,(1990); Sharaf et.al, (1990) identified the main tectonic trends and constructed tectonic maps for the basement surface in different areas in the North Western Desert from the avalable geophysical data.

As a result of these studies the following conclusions could be achieved:-

a)- In the northern part of Egypt there are five basement tectonic trends, namely :- E-W (N 85° E, N 85° W Mediterranea); N 45° W (Suez trend), N 25° E (Aqaba trend); N 55° E (Qattara or Syrian Arc trend) and the N-S (East Africa trend)

b)- There are a wide spectrum around the Suez trend characterizing the sedimentary cover . All basement trends are recorded in the sedimentary cover which indicate the control of basement tectonics on the overlying sediments.

c)- North Egypt may be subdivided into the following five tectonic zones; Gulf of suez, Baharya, North Sinai, Qattara Depression and Northwest of Western Desert. (Raid et.al. 1973).

Mesheref and EL-Sheikh,(1973);Bakrah,(1981,1990);Youssif and EL-Khashab, (1982); Ibrahim (1981, 1986); mades a correlation between the surface and subsurface structural features for the different areas in the North Western Desert.

Riad (1969); Refai,(1973);Sayed (1977);Darwish (1979);Tealeb and Abdel Hady, (1979); Riad et.al (1981); Zahra (1990); Sharaf et.al (1990) used the avaliable Bouguer anomaly maps to point out the following :-

a- Across the Northern Western Desert of Egypt as a whole, there is an abnormal increase of gravity field from south north.

b- They evaluate a northward decrease in crustal thickness.

c- The thickness of the earth's crust changes regulary,which reaches its maximum value (more than 35 Km) at the south and southeastern parts,and reaches its minimum value (Less than 25 Km) at the most north and north western parts of the North Western Desert.

EL-Gamili,(1968); Bayoumi & EL-Gamili,(1969,1970)); Bayoumi , and Sabri (1970); Bayoumi and Awad, (1972), Khalil and Mofty (1972); Refia et.al,(1973,1975); Bayumi, et.al (1974); Awad, (1975);Othman ,(1975);Sharaf,(1980);El Khashab, et. al (1982) Mahmoud et al (1982) Sharaf et.al (1990); Zahra (1990); Helaly (1990); evaluated the subsurface structural featuers and threw lights on the fault systems and their vertical continuation in different parts of the Northern Western Desert. Results of their studies show the following points:-

a- Depth to basement surface in the different areas ranges from about 500 meters in the southern parts,and about 4.5 Km. in the northern parts. Local uplifts and basins,that are considered as anticlinal and faulted steps,were presented in the different areas.

b- The Northern part of the Western Desert is structurally characterized by different systems of dislocation zones. The major trend paterns of such zones coinicide well with the deformation trends of the Mediterranean,Gulf of Suez and Gulf of Aqaba. These possibily result from the tectonic activities affecting the earth's crust during both the Pre-Cambrian and Post-Cretaceous periods.

c- Lithological variations not only within the sedimentary section but also within the basement complex it self can be also outlined from the analysis of gravity data of different areas in the northern Western Desert.

I.2- THE AIM OF THE PRESENT WORK.

The aim of the present work can be summarized in the geophysical evaluation of the available potential field data represented by the Bouguer gravity map and the total areomagnetic map of the area under study. This is for determining the possible structural features disturbing the Basement Complex, as well as the overling sedimentary section.

Such geophysical evaluation includes some of the treatment and resolution techniques by which the possible subsurface hidden features can be revealed. The results of these techniques have to be presented in a number of profiles, diagrams and maps that can be interpreted for identifying the characteristics of the subsurface implications, throught the estimation of the physical parameters of the concealed inferences.

The Bauguer anomalies were analysed into residual and downward continuation anomalies. As a result of the qualitative studies a tectonic maps representing fault systems present in the area were interperted from these anomalies and at different levels. Further statistical analysis and tests were carried out for the whole area and using grid unit areas in classes of 10^{o} of arc. The predominant tectonic directions were

detected. Besides , aeromagnetic data were investigated and used to adjust the subsurface geological interpretation.

Some of the parameters controlling the geologic conditions of the area as well as the prevailing structers were computed through the qualitative interpretation of the gravity and magnetic data. It were devoted to:-

a)-Determination of the type,dip angle and throw of the faultes which complicate the structure of the area.

b)-Determination of the intrusive bodies which have the shape of dike - like structures of infinite length or limited parrallel epipedoidal prisms of varying dips, widths,lengths and depths of burial of the top and bottom surfaces.

c)-Determination of the depth to the top of the basement complex as this gives a good control on the thickness variations of the total sedimentary section in the area. Moreover,a prices knowledge of the attitude and relief of the basement surface usual leads to the detection of any local structueres of economic value that might be hidden within the thickness range of the sedimentary section.

d)-Determination of the possible lithological variation within the basement complex itself.

e)-Also, the changes in the magnetic susceptibility of the basment rocks have to judged,in order to integrate the various lithologic effects in addition to the structural ones.

f)-Studying the geological and geotectonic activity affecting the area both laterally and with depth. This was achieved by constructing the geological structure maps of the different geological times and the tectonic structure maps interpreted from the gravity data at different levels.