CHAPTER 1
INTRODUCTION

1. 1. Location and accessibility

The study area represents the central part of the northern Eastern Desert, occupying the area between the northern scarps of the El Galala El Bhariya plateau to the southern scarp of Gabal Ataqa to the north. It is bounded by Lat. 29° 30' - 30° 00' N and Long. 32° 00' - 32° 30' E.

In the northern Eastern Desert, two main paved roads exist and are oriented nearly E-W with some deviations. These roads, from north to south are the Cairo – Suez and the Maadi – Sukhna. The Maadi - Sukhna road connects the Suez - Sukhna paved road along the Gulf of Suez coast.

At the southern part of the study area, there is also a desert track from Helwan through Wadi Garawi, Wadi El- Sheikh, Wadi El – Shuna, then Wadi Ghoweiba, to Ghubet El – Boos on the western side of the Gulf of Suez.

The main mountains in the study area are: Gabal Ataqa, Gabal Kahalyia, Gabal Abou Treifiya, Gabal Akheider and El Galala El Bhariya plateau. The main wadis in the study area downstream into the coastal plain and the Gulf of Suez, these are from north to south, Wadi Hagoul, Wadi Beda, Wadi Akheider, Wadi Hammath and Wadi Ghoweiba (Fig. 1).

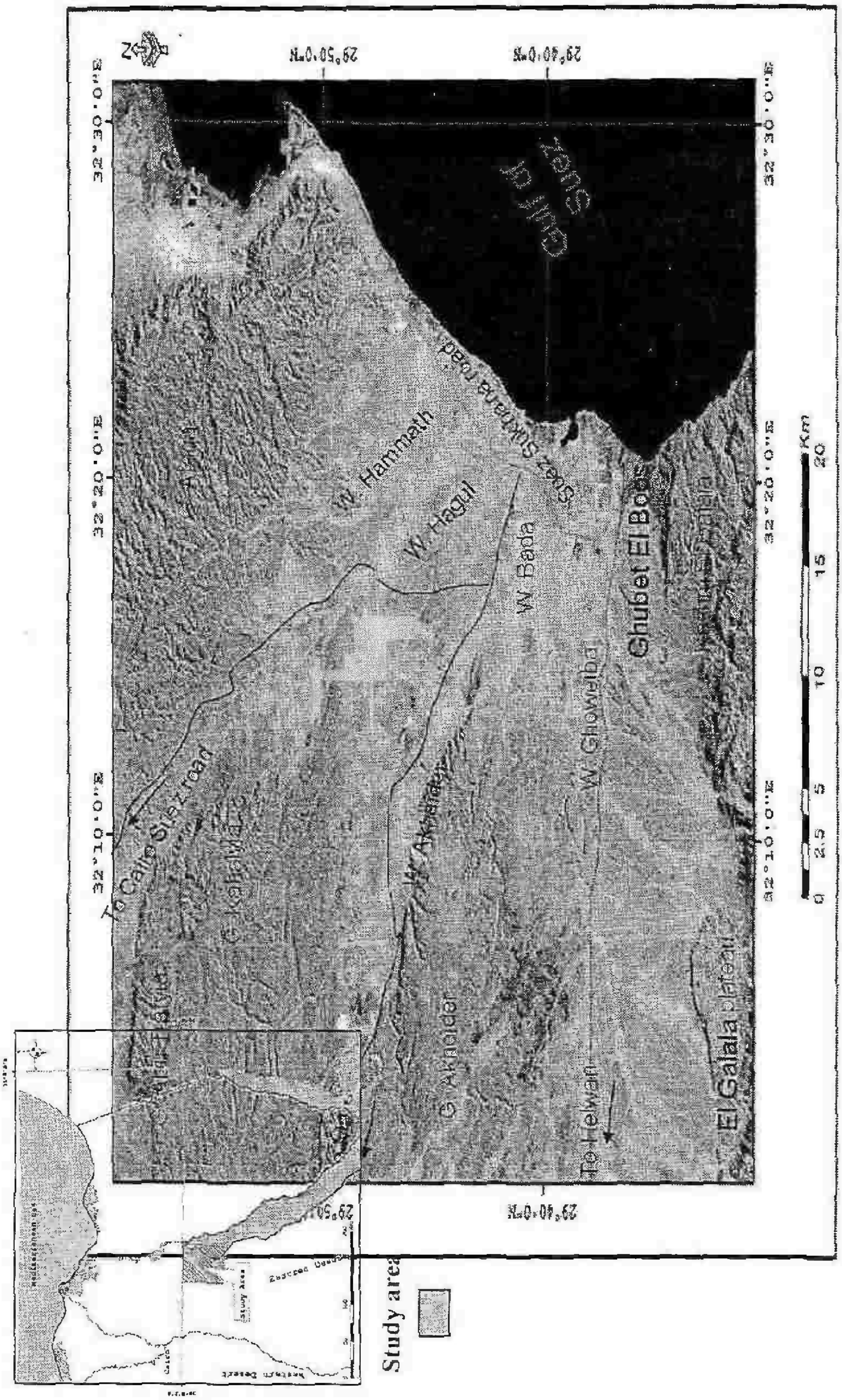

Figure (1): Location map of the study area.

1. 2. Climatic conditions

A hot summer and a warm rainy winter characterize the climatic conditions in the study area. The main meteorological data related to the stations in the studied area.

1.2.1 Temperature: The annual mean of daily temperature ranges between maximum of 25°-30°c and minimum of 10°-20°c.The average monthly temperature reaches its maximum in August and its minimum in January.

1.2.2 Humidity: The annual mean relative humidity grades from 50-60% at the coastal belt to 30-40% further inland into the desert.

1.2.3 Rainfall: The study area receives small amounts of rainfall (25mm/year) mainly in autumn and winter.

1. 3. Previous Work

The previous geologic studies on the investigated area comprise stratigraphic, remote sensing, geophysics and structures.

1.3. 1. Previous stratigraphic study:

Sadek (1926): Studied the area between Gabal Ataqa and El Galala El-Baharyia and sub divided Miocene succession into three units which are designated as M1, M2, and M3. The first (M1) consists of coralline limestone and marls and assigned an Early Miocene age, the second (M2) is dated as Middle Miocene age and composed of interbedded marls, and limstones. The third unit (M3) is highly enriched in sandstones and belongs to the Late Miocene age.

Ismail (1953): Studied the geology of the Wadi Hof area north east Helwan. He subdivided the Upper and Middle Eocene exposures into 4 series as follows, from top to base:

1- Wadi Hof series.

2- El Qurn series.

3- Observatory series

4- Gabal Hof series

Abd El-Hady (1965): Studied the geology of Sadat area. This study revealed the following unconformities: -

1- Middle Eocene - Upper Eocene unconformity.

2- Upper Eocene – Lower Miocene unconformity.

3- Lower Miocene - Middle Miocene unconformity.

Rocks overlying Upper Eocene are grouped into three rock units: Sadat, Hommath and Hagul Formation.

Abdallah and Abd El-Hady (1966): Showed that stratigraphic succession exposed in the Sadat area is subdivided as follows, from top to base:

1- Hagul Formation (Late Miocene)

2- Hommath Formation (Middle Miocene)

3- Sadat Formation (Early Miocene)

4- Upper or Middle Eocene

Cherif (1966): Studied the geology of the Sadat area, south west of Suez. He recognized the different rock units as the following from top to base:

7- Rock unit IV (b)	Calcareous sandstone
6- Rock unit IV	Calcareous sandstone
5- Rock unit III (b)	Calcareous limestone
4- Rock unit III (a)	Coraline limestone

3- Sandstone with pelecypods and Nummulites.

2- Rock unite II Coralline limestone
1- Rock unite I Red clastic beds

Abou-Khadra (1968): Carried out the geology of Gabal Abou-Treifiya area. He stated that rocks exposed at Abou-Treifiya area are sedimentary, igneous and metamorphic origin. The strata range in age from the Lower Middle Eocene (L. Lutetian) to Recent.

Abdallah (1993): Studied the geomorphology of the area between El Galala El Baharyia and Gabal Akheider. He classified the geomorphologic features of the area into seven unites and stated that Northern Eastern Desert comprises plateaux, cuestas, mesas and hills.

Kandil (1996): Studied the geological and sedimentological of Upper Cretaceous rocks of Gabal Um Reseis – Khashm El-Galala stretch. He assumed the stratigraphic sequence in this area is tabulated form base to top as follows:

4- Adabiya Formation (dolostane, Campanian, Mastrichtian)
3- Maghra El-Hadida Formation (dolostone, Turonian Santonian)
2- El-Khashm Formation (dolostone Late Cenomanian).
1-Galala Formation (clays, sandstone and dolostone, Early Cenomanian).

Abu EL – Anwar and El-Gohary (2003): Carried out the petrographical and geochemical studied of Sadat Formation. Petrographically the Sadat Formation consists mainly of two facies type: a) dolomitic calcareous sandstone facies which is the basal horizon and represents the beginning of the Miocene transgression. b) reefal limestone facies which is a back reef deposits and represents the maximum Miocene sea level.

El Attar (2003): Carried out the stratigraphic studies of the Sadat Formation, Sadat area, south Gabal Ataqa using the Echinoid species. The study showed that Sadat Formation referred to the Early-Middle Miocene age. Two main facies, clastics in the lower part and carbonates in the upper part represent it.

1.3.2. Previous work on the application of remote sensing in geology

Several authors discussed the usage of remote sensing application in geology in several ways, the most recent are;

Sultan (1987): Used the Landsat Thematic Mapper TM data for mapping the Meatiq Dome area in the central Eastern Desert of Egypt by using a ratio color composite (Bands 5/1, 5/7, 5/4 , 3/4) combined with field and laboratory reflectance data. Similarly they delimited the major mafic units.

Ahmed (1999): Discussed the environmental status of the coastal zone of Al Sukhna area by using satellite data. This study used as base line environmental information that may be affected after completion of projects in the study area.

Yehia et al (2002): Studying the drainage basins of the Gulf of Suez and assessment of their flash flood hazard. These basins range in area from 3 KM^2 to 3684 KM^2. They are classified into 6 size categories. This study led to the delineation of the hazardous sites along the coastal highways on both sides of the Gulf.

Abou El-Saoud (2006): Used remote sensing data and geographic information system to study the geoenvironmental the new Cairo area. He studied the surface structural depending on lineaments analysis techniques by using the Landsat ETM+

image, which shows that the main structure trends are WNW-ESE and NW-SE.

Hassan et al (2008): Using the remote sensing techniques to discriminate the Oligocene sands and gravels from the surrounding rock units that are exposed near the mouth of Wadi Ghoweiba. The image processing techniques on aster data can be utilized to explore other raw material taking into consideration the special reflectance behavior of rock type or the raw material.

1. 3. 3. Previous geophysical and structural study

The structures between El Galala El Bahariya and the Cairo-Suez road were studied in several works. Some of these studies are mentioned below.

Sadek (1926): In his study on the district between Gabal Ataqa and El Galala El Bahariya, mentioned that there are three fault sets, which are oriented NW, E-W and N-S.

. Sigaev (1959): Divided Egypt into several regions of different structural stages and considered the Cairo-Suez district and the northern part of the Gulf of Suez to belong to the Oligocene-Quaternary structural stage, which is characterized by:

1. Wide development of brittle-structures in the Oligocene-Miocene.

2. Active basaltic extrusion at the end of the Oligocene.

3. Intensive down warping and widening of the Gulf of Suez and Red Sea grabens in the Miocene and Pliocene.

Said (1962): Showed that the Cairo-Suez district, in contradiction to other parts of northern Egypt, is characterized by a number of E-W trending blocks which do not follow the trends of structures of the basins of the unstable shelf to the east and west of the district.

Youssef and Abdel Rahman (1978): Studied the area between Gabal Ataqa and northern Galala and showed that, the area is considered as a huge graben in which there are numerous gently tilted fault blocks. The area has a structural setting resembling that of the Gulf of Suez area.

Abdel Rahman and EL-Etr (1979): Described the western side of the Gulf of Suez as a series of positive and negative fault blocks bounded by ENE faults. The area between Gabal Ataqa and the northern Galala Plateau was called the Wadi Akheider negative block.

EL Ghamry (1985): Studied the Cairo-Suez district and concluded that, the NW oriented faults are well exhibited in the eastern parts of the district whereas the E-W oriented faults are well exhibited in the northern and western parts of the district. The middle part of the district may be equal, affected by both fault trends.

Bandel and Kuss (1987): Differentiated the area between Gabal Ataqa and the Red Sea hills into seven structural blocks. These blocks are the Dakhla Block, the Paul Block, the Anthony Block, the Wadi Araba Block, the Northern Galala Block, the Khashm El Galala Block and the Ataqa Block. A major fault zone bound each block, which was active during different times. They indicated also that the Northern Galala Block consists of two different tectonic units with a minor fault zone between them. It was active before the onset of deposition of the Malha sandstone (Early Cretaceous).

Safei EL-Din (1988): Study the area between Gabal Ataqa and the Northern Galala, showed that there are two main fault sets, which are NW to WNW and E-W. Some faults of the WNW `, E-W elongated fault belts of left-stepped, en echelon, normal faults.

echelon, normal faults. These belts are called, from north to south, Gabal Um Zeita, Gabal El Ramliya, Wadi Akheider and Wadi El Shona. He interpreted these fault belts as right-lateral strike slip movement rejuvenated overlying four deep-seated faults that have the same trends.

According to Moustafa and Abdallah, (1991): There are three fault sets in the central part of the Cairo-Suez district. These fault sets are E-W, NW and NNW. E-W oriented faults and some of the NW oriented faults form five E-W, elongated, left-stepped en echelon fault belts. These fault belts are called, from south to north, Abu Treifiya, Wadi Charaba, south Abu Shurna, Gabal El Qattamiaa and El Nasuri-El Anqabiya.

Abdel- Latif et al (1997): Investigated the structural and lithological impacts on the ground water occurrences along Wadi El Naoora – Wadi Bada area. They carried out the electrical resistivity method for knowing the possibility of ground water occurrence. This study reveals the geological succession in the area includes three units namely from top to bottom as A, B and C, unite (B) saturated with water. Structurally the study area is affected by three faults f1, f2 and f3.

1.4. The present study is divided into two parts:

1- Regional study; comprise the whole area stretched from the north El Galala El Bhariya plateau to the south Gabal Ataqa (Fig. 1).

2- Local detailed study; comprise the area about 224 Km^2. This area enclosed between Lat. 29° 38' - 29° 45' N and Long. 32° 12' -

32° 21' E (Fig. 2).This detailed area is studied geophysical through the geoelectrical resistivity methods. The main purpose of such studies is to reveal the lithological successions in the subsurface and investigated the ground water in the study area.

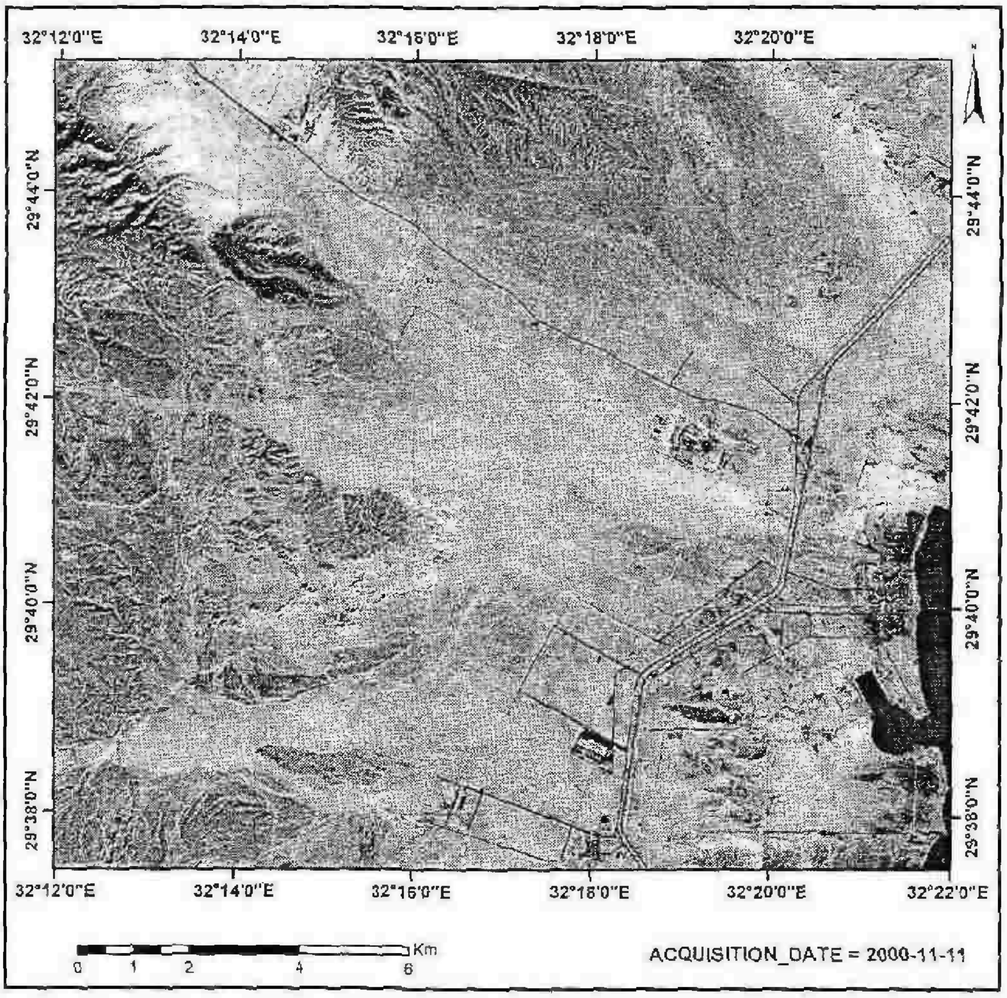

Figure (2): Location map of local study area.

1. 5. The objectives of this study include:

1- Delineation the subsurface structural and subsurface stratigraphic units by using geophysical data which represented by magnetic and electrical data of the study area.
2- Determining the depth to the basement rocks using the magnetic method.
3- Review the relationship between the surface and subsurface structures.
4- Delineation land suitability map.

1.6. Methods of study

To achieve the objectives of the present work, the following steps were followed:

The original data exist as published and unpublished report, maps, ETM+ Landsat images, aerial photographs and field data. The used remotely sensed data are Landsat ETM+ images acquired in 2003.

The Landsat image was subjected to most of the image processing operations such as rectification, radiometric correction, rationing and image enhancement.

The data collected from maps and references have been converted into digital format using Arc GIS software version 9.1 to create layers of information projected to geographic Lat/Long projection and linked with the database. These data are used in GIS environment to be analyzed geologically and geomorphologically.

The airborne geophysical magnetic surveys for the study area were carried out by the Aero-Service Division of the Western Geophysical Company of America in 1984. This survey covered a large segment over the majority of the Egyptian Eastern Desert. The obtained airborne magnetic data were reduced, compiled and finally presented in the form of total intensity magnetic contour map reduced to the pole of a scale 1: 250,000 (Aero-Service, 1984). Magnetic analysis is done starting with the reduction to the magnetic pole technique on the total intensity magnetic map. Then, the separation of the total intensity magnetic map reduced to the pole magnetic into their residual and regional components executed using Geosoft program. The depth to the upper surface of the basement sheet is determined.

In addition, the magnetic modeling carried out through five magnetic profiles crossing the magnetic anomalies from W to E using GM-sys program produced by the Northwest Geophysical Associates Inc. USA (1999) to delineate the shape of the basement surface and the overlying sedimentary cover.

Electrical measurements are carried out in the studied area by the Egyptian Geological Survey and Mining Authority (EGSMA) in (1999) using Schlumberger array. The vertical electrical sounding (VES) measurements are carried out by using Russian electronic compensator, type AE-72. The seventeen vertical electrical soundings (VES) were measured by using Schlumberger configuration of electrode spacing (AB) ranging from 3 to 3000 m.

The quantitative interpretation was carried out by using an analytical method through IPI2WIN program which has been designed by a scientific group in Moscow State University, Russian at 2000. The quantitative interpretation has been applied to determine the thicknesses and true resistivities of the stratigraphic units below each VES station, the final results used for construction the geoelectrical cross-sections which exhibit different geological units represented in the study area.

GIS analysis has been applied to generate a land suitability map of the area depending upon the database which has been available.