Analysis of the Geomorphological map along Western Coast of The Suez Gulf between Wadi Um Lug and Wadi Malha

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INTRODUCTION

The area studied can be considered as one of the rough landscape in the Gulf of Suez region. The area lies between latitudes 29° 15 - 29° 35 North and longitudes 32° 20 - 32° 35 East Fig. (1) It covers an area of about 305 Km^2.

It is located on the western side of the Gulf of Suez. This area is borderd eastwards by waters of Suez Gulf and westwards by watershed of drainage basins and the scarp of Northern Galala. It also extends from Wadi UM Lug due to Wadi Malha.

The study aims to analyze and determine the most important geomorphological characteristics and controlling factors.

Methods :

The data in this study depended on the following sources :

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- *Data obtained from the topographic and geologic maps.*
- *Data obtained from analysis of geomorphological map and Air photo of the area study.*
- *Climatic Data of the Suez station and the Kattamia station.*
- *Data obtained from field measurement and analysis of morphometric drainage basins.*

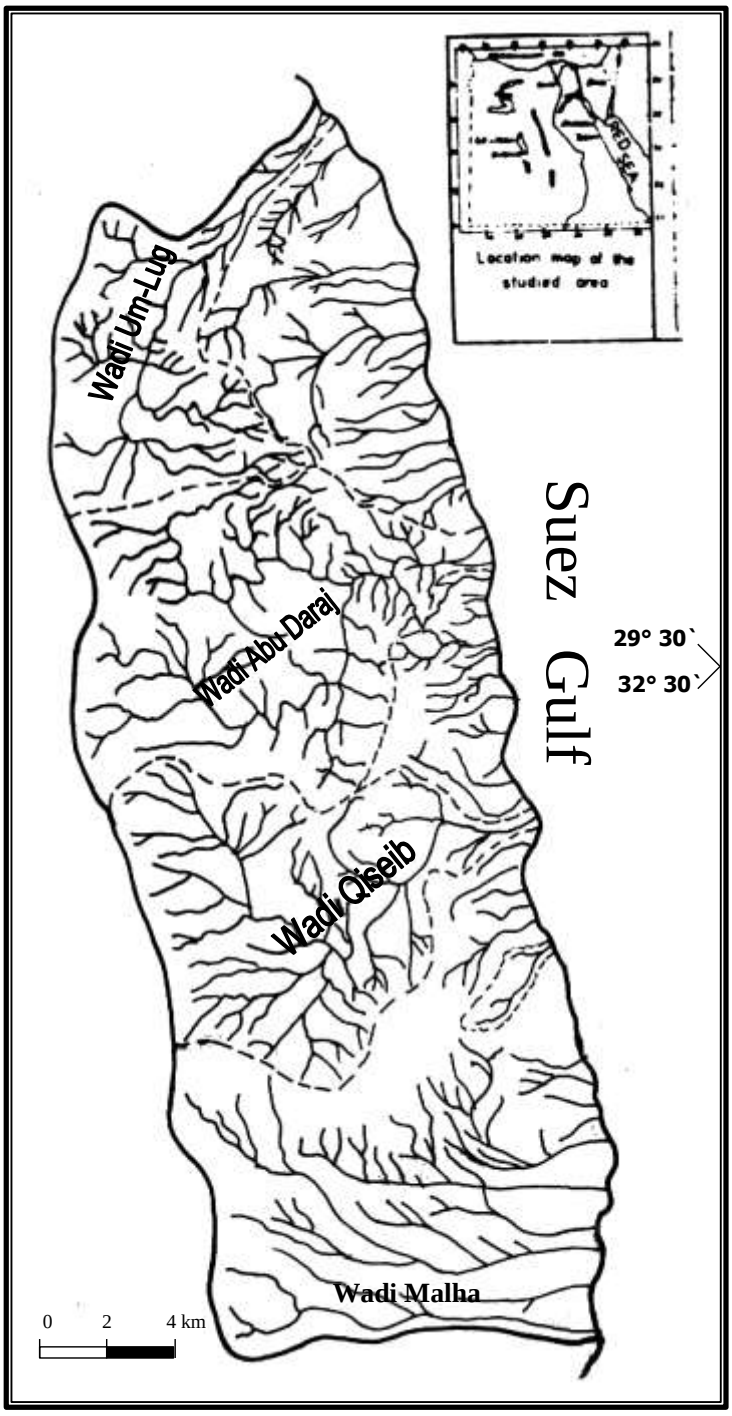

Fig. (1) : Location map of the studied area

Geomorphological Analysis

At the present time, geomorphological mapping is the main research method of geomorphology. Their importance for the further development of geomorphology as a science and its wider practical application is generally recognized.

The aim of analysis of geomorphological mapping Fig. (2) along Western Coast of Suez Gulf between Wadi Um Lug and Wadi Malha is to investigate the morphology, genesis and age of relief. In this study, the following points will be considered :

- The effects of structure.
- Dynamic processes.
- The spatial distribution of the different forms.
- The practical significance of the relief to man geomorphological hazards.

Generally the area can be subdivided geomorphologically into :

- **The Western Scarp.**
- **Hillslopes.**
- **Drainage Basins.**
- **The Coastal strip.**
  - Alluvial Fans.
  - Benches.

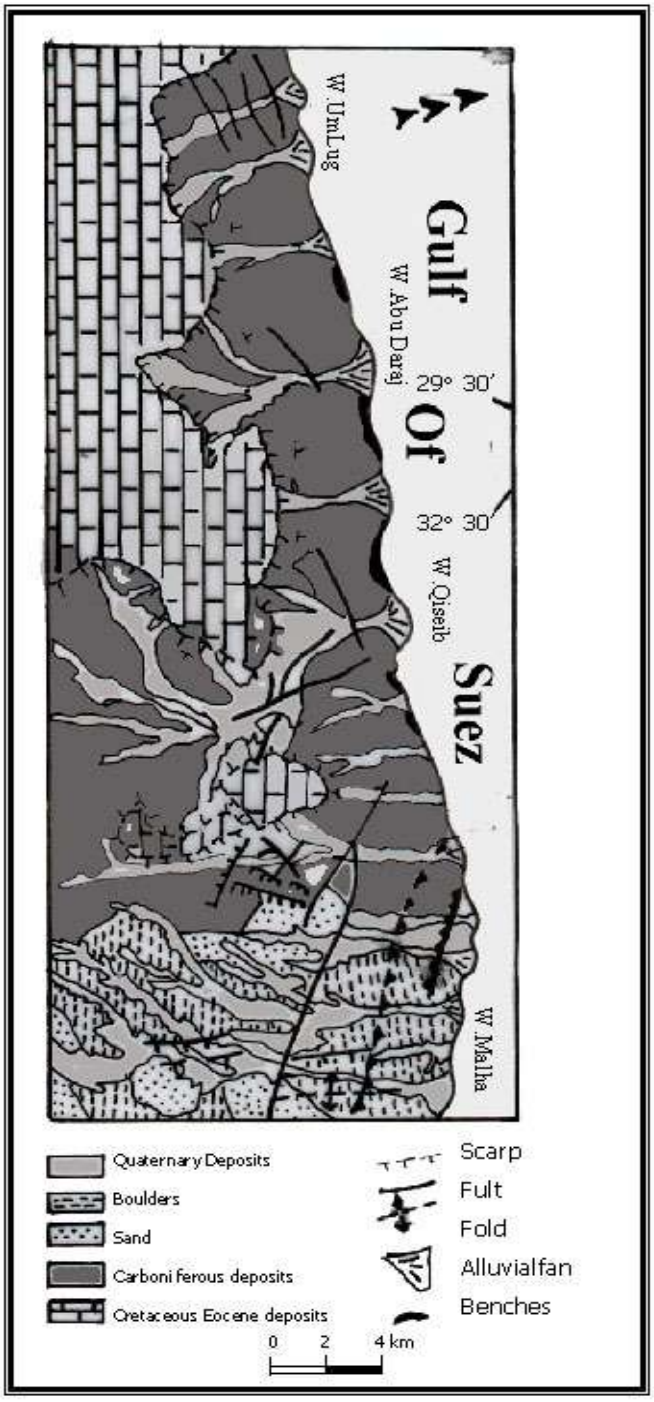

Fig. (2) : Geomorphological map

The Western Scarp :

It extends from Wadi Araba due south to Khashm El-Galala in the North. It is characterized by its cliffy scarp (wall - standing - slope), reaching an elevation of 820 meters above sea level.

It is covered by carbonates upper cretaceous and Middle Eocene rocks with subordinate clastics at its base (Lower cretaceous and cenomanian). (Ahmed F. Kamel, 1997. P 79)

Faults of large extension are observed cutting through the described unit. But chemical weathering plays a minor role.

Hillslopes :

To give a more clear picture of geomorphological characteristic of the studied area, three profiles divided into three units are drawn, based on survey field and elevation points. These profiles is plotted in Fig. (3). The analysis of these profiles and field study showed that :

1. The crest-slope in the upper convex part is a hill, possibly grading on to up land flats. It is composed of the Middle Eocene rocks.
2. The mid-slope is the central, gently curving, or straight (rectilinear) part of a hillslope, possibly interrupted or replaced by cliffs, composed of cretaceous rocks.

Angel of sloops change between 40° - 2°

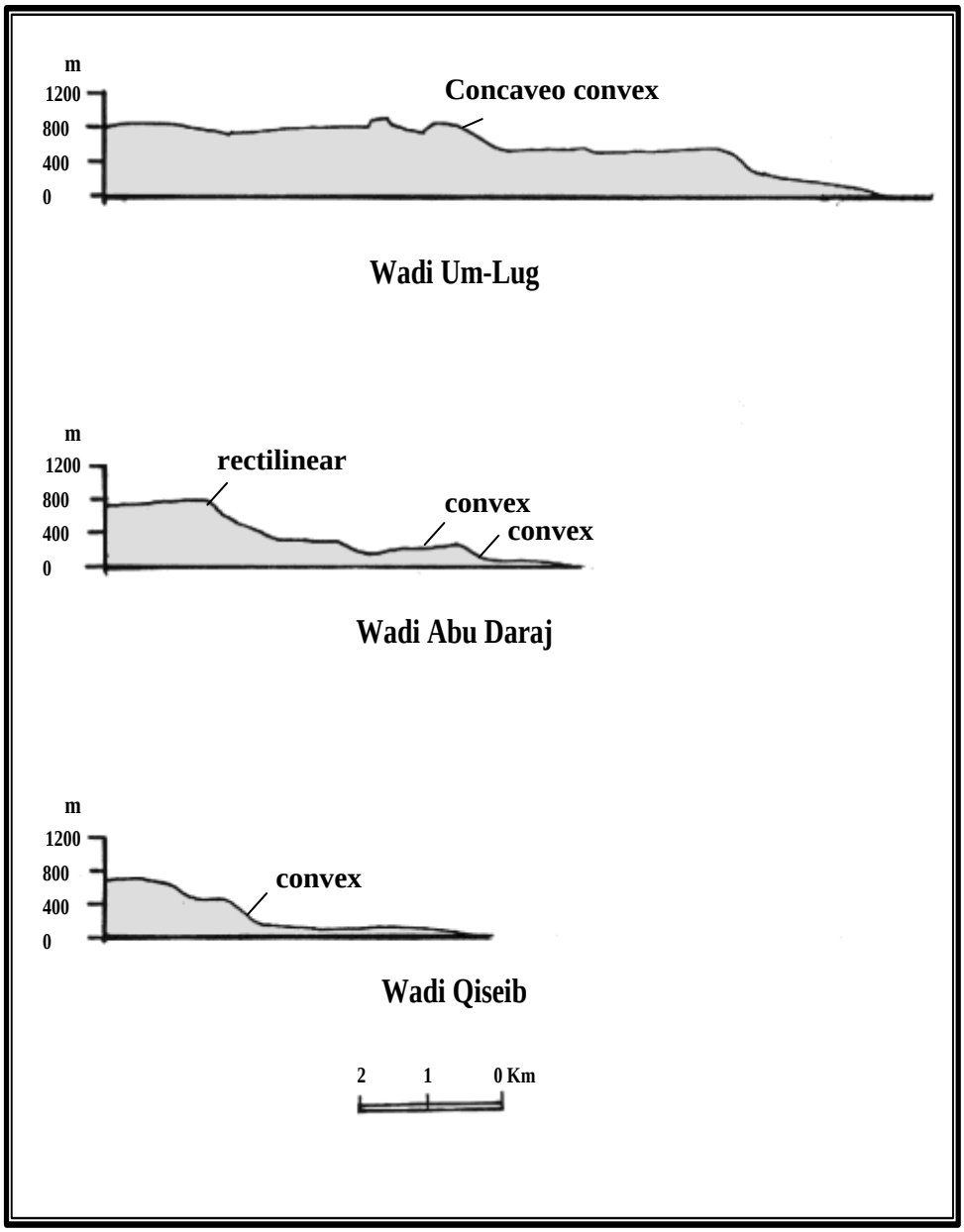

Fig. (3) Topographic Profiles.

3. The Foot-slope is the lower, concave part of a hillslope. It is composed of upper-Paleozoic rocks. Angle sloops are >2°

The change of slope inclination may be abrupt and angular, or it may be smooth. Cliffs and slopes have a Longitudinal geometric form. It attains a width ranging between 3-4.5 kms. In some parts of the area, this unit faces directly the Gulf water.

Drainage Basins :

The Aerial photos show that thirty drainage were involved in the area study. Their geographic location, shape and size of drainage area are located Fig. (1).

The quantitative drainage analysis shows that large extended drainage are exemplified in the area studied by Wadi Um Lug, Wadi Abu Daraj and Qiseib and other unnamed wadis.

The small extended ones e.g. Wadi Um Reiga, Wadi Um Galwat, Wadi Malha and others. Some of large drainage reaches 25 Kms, While the small extended ones average 1.3 Kms. Tribataries are mainly lithologically controlled, While some of main wadi covers are controlled by mega-faults, having east-west direction. Mean bifurcation ratios differ considerably from one basin to another, ranging from 2 to 4.2. It related to lithology, Fracturing and jointing.

1- Angles of Juction :

From Aerial photos, measured the angle of confluence and argimth of orientation as defined by lines joining the mode and head of stream segments. In fact this is the way junction angles are measured in the field. Gut of this measuring, it appeared that average of junction angles between the first and second order varies 60° - 65°degree, meantime the average of angles of junction between the main stream and the other order streams varies 40-45° and varies 85°-90° in the area of rectangular pattern.

It indicates that junction angles are related to gradient and the relif of the basin Wadi Qiseib, Wadi Um Lug and Wadi Um Julauat and to discharge of tributaries involved in Pleistocene period.

2- Drainage Pattern :

The aerial photos show that low drainage orders (1^{st} and 2^{nd}) cutting the Eocene-cretaceous sediments of western scarp. They are dendritic, subdendritic, rectangular and subrectangular types. Fig. (1).

The low orders controlled by the lithologic as well as structural characteristics. While high order and the main drainage courses attain a parallel to sub-parallel pattern, indicating a structural control coinciding with the more or less east-west fault lines.

The drainage pattern in Wadi Um Hamata and Wadi Qiseil is nearly sub-dendritic to rectangular pattern. Wadi Um

Sweillim characterized by sub-dendritic to sub-parallel pattern, and also Wadi Um Lug.

3- Drainage Lineations :

The drainage lineations are plotted on azimuth-frequency diagrams Fig. (4). These show a prominent two sets NE-SW, which is the major one and E-West. The NE-SW set is strucurally controlled by minor faults cutting through different rock units. (El Shazly, E.M., and others, 1980, 1991). The E-W faults dissect paleogenic rocks to the Gulf water.

In Abu Sandug Area, diagram for the east channel order show that it is composed mainly of sets :

- First one trending NE-SW with different angles due to the different trends of features in the area.
- Second one trends N-S and the east one trends E-W.

The structural control can be strongly accepted in this area, the E-W and N-S are observed as separate sets the first time in this locality.

In Abu Daraj area diagram Fig. (4) for the east order in the area show the coincidence between the trends of drainage lineation and structural feature. Both of them trending mainly NE-SW as well as N-S. This shows that they are most probably structurally controlled.

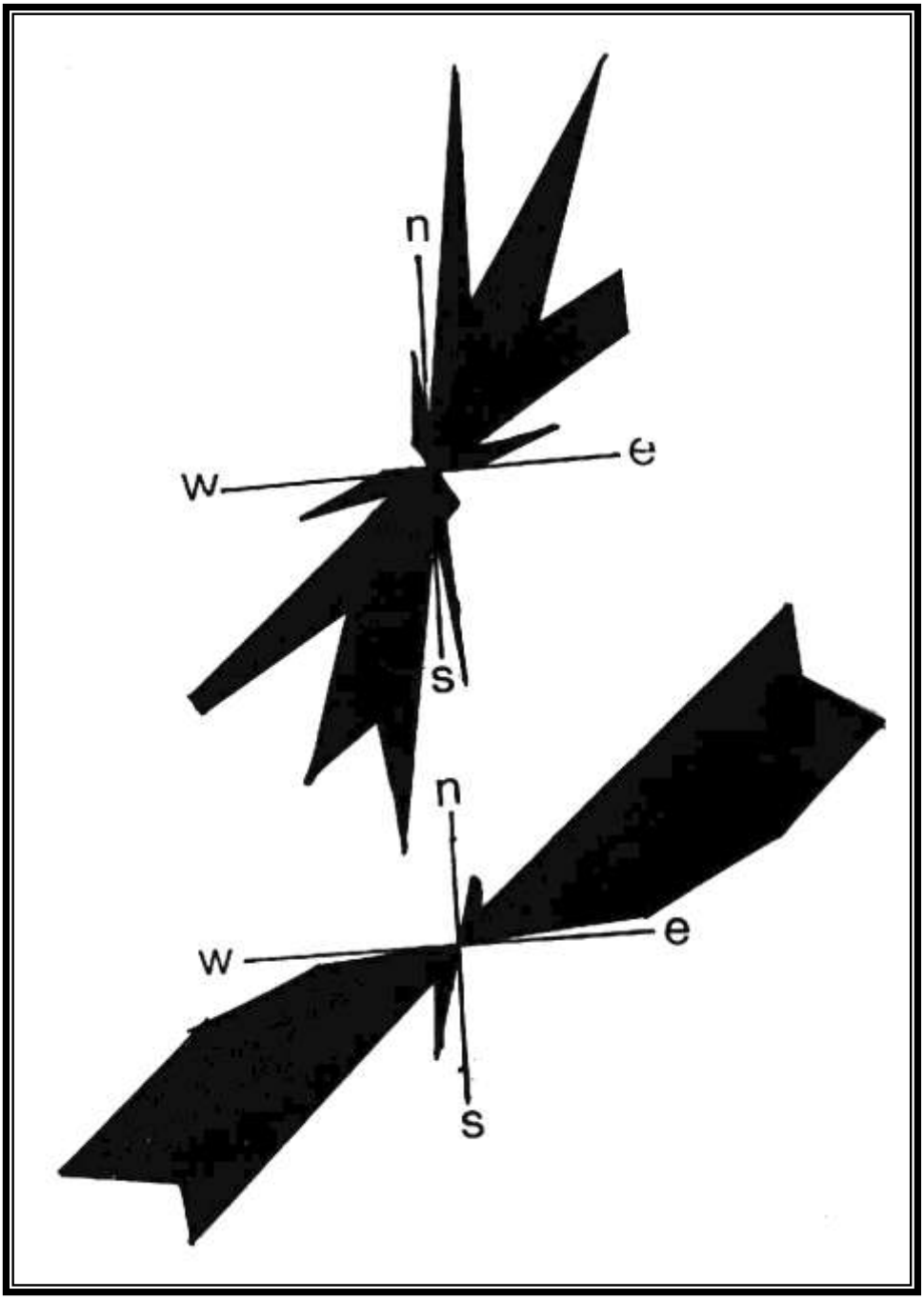

Fig. (4) Azimuth Frequency Diagram of Drainage lineation.

Wadi Um Lug :

Wadi Um Lug occurs in the North part of area study, to the North of Wadi Abu Daraj Basin of Wadi Um Lug covers an area of about 37.12 Km^2. It's main channel extends for about 75 km. It is nearly of an elliptical shape. It is dendritic drainage pattern. The drainage density is 1.68 K/Km^2.

Wadi Abu Daraj :

It occurs between Wadi Um Lug in the North and Wadi Qiseib Abu Daraj covers an area of about 62.72 Km^2. It is nearly to Fan in shape. The drainage density is 2.63 K/Km2. It is dendritic to rectangular drainage pattern.

Wadi Qiseib :

It occurs to south of Wadi Abu Daraj. This basin covers an area of about 51.2 Km^2. Its main channel extends for about 25 Km. It is leaf-like to fan in shape. The drainage density is 7.67 K/Km^2. It is dendritic to rectangular drainage pattern.

Table (1) : Drainage Analysis :

Stream Order	No of Streams			Bifurcation Ratio			Channel Length in KM		
	Wadi Um Lug	Wadi Abu Daraj	Wadi Qisieb	Wadi Um Lug	Wadi Abu Daraj	Wadi Qisieb	Wadi Um Lug	Wadi Abu Daraj	Wadi Qisieb
1	42	77	44				32.9	110	38
2	13	18	18	3.2	4.2	2.4	15.6	31.4	23
3	4	5	5	3.25	3.6	3.6	7.8	13	14.2
4	1	2	1	4	2.5	5	6.2	8.2	10.7
5	-	1	-	-	2	-	-	2.4	
Area of the Basin	37.12	62.72	51.2						
Drainage Density	1.68	2.63	1.67						

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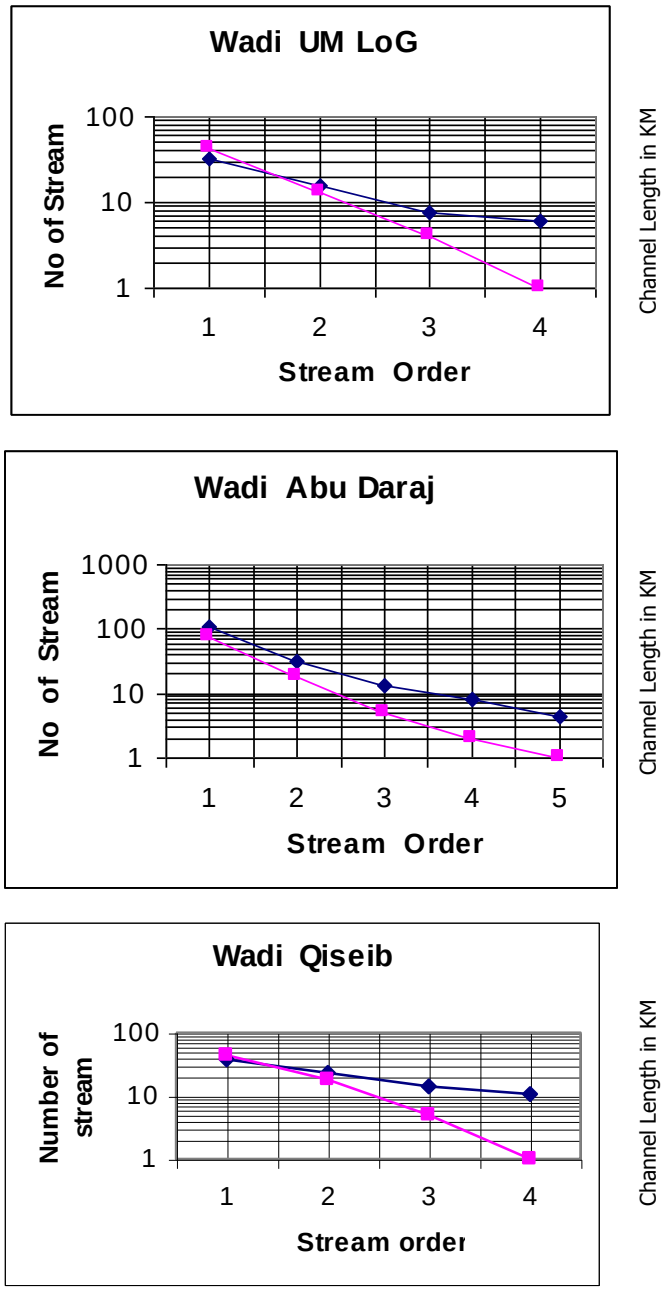

Fig. (5) : The relation between Number of stream and stream order and channel length

The Coastal Strip :

The Coastal strip is bounded eastwards by the waters of the Gulf and westwards by the moderate relief. It attains a very small width in some part of the area. Its maximum width is observed where it fans out towards the Gulf. It reaches a maximum width of 3.5 kms.

It is characterized by boulders, gravels and sands of the Gulf of Suez belonging to the Quaternary.

The recorded thickness of such sediment are 140-235 m. From the East and South, it is bounded by the Gulf of Suez and major E-W Fault scarps of the North Galala Plateau.

Alluvial Fans :

An alluvial fan is a segment of a low cone with its apex at the mouth of a canyon. In area studied alluvial fans are cone-shaped depositional landforms. Contours are arcs of circles concentric on the head of the fan. (Fig. 6)

The field work of the area shows that alluvial fans of Wadi Um Lug, Wadi Abu Daraga, Wadi Qiseib, Wadi Om Galawat and Wadi Malaha form where a high-gradient stream leaves a confining canyon on and discharges directly on to the Floodplain of flat Floor of an intermountain basin.

An alluvial fan of Wadi Um Lug is 1,75 km long and 1,5 km wide. Fan of Wadi Abu Daraj is 1 km long and 1,25km wide. One of the most important landforms in coastal

strip is the alluvial fan of Wadi Qiesb it is 2,25 km long and 2,25 km wide.

Benches

A Bench is a coastal feature formed because of the unequal solubility of various sediments. Benches can be developed on layers of durable sandstone that alternate with beds of readily eroded shale. The downslope flow of spray has sufficient force to remove rock fragments from the most bench surfaces. The most of Benches are due to intensive south Wadi Qiseib and Wadi Abu Daraj bench extend.

The Geomorphic Process

The geomorphic process prevailing is degradation mainly due to the major and minor drainage lines dissecting the area. Resulting from location and the above description, a major fault line activated in Plio-Pliestocene to Recent interval. Occasionaly, landsliding plays, an important part. Large rock masses belonging to area between Bir Abu Sandug and Ra′s Abu Daraj, slide down and sometimes block the Suez-Ras Gharib road, especially in winter times in which precipitation of a few days of heavy rainfall is reported.

There are water-layer weathering more relevant to shore platform erosion, solution of calcareous rock and rock weathering.

Geomorphological Hazards

Studying the geomorphological map Fig. (2), air photo of the area study and field study showed that the main geomorphological hazards are related to precipitation, sediment movement, alluvial fan flooding and sedimentary rocks and earthquake hazards.

(1) Precipitation :

Clinically the area is dominated by the interaction of marine and continental influences, giving rise to steep climatic gradients inland.

The study area receives small amount so rainfall mainly in autumn, winter and spring.

In the Kattamia station, the rainy period starts in December and ends in April with a maximum recorded average value of 3.9 mm in December. The months May through November are dry. The average annual precipitation is 16.5 mm.

In the Suez station, the rainy period starts in November and ends in May with a maximum recorded value of 5 mm. The average annual precipitation is 21.3 mm.

The rainfall was caused by cold northerly air that penetrated southwards along an upper air through associated with a Mediterranean depression moving eastwards across the Sinai Peninsula. The increase in rainfall occurs when the northerly and northwesterly winds strike the major E-W scarp of the North Galala. Maistureladen sir is forced to rise to

higher levels, expansion, cooling and precipitation follows. El-Shaly (1987) estimated the average annual precipitation on the Northern Glala plateau to be 203- mm. The amount of water that precipitated over the catachement area of mentioned drainage basins are 19 mm.

During the time of the study (1994-1997), the area has been subjected to one short heavy rainstorm each year. The duration of each storm ranges between 1-2 hours.

The field work of the area shows more changes for the accumulation of surface runoff draining the highlands to reach the plains.

The catchement areas of the major drainage basins, such as Wadi Um Lug, and Wadi Abu-Darag and made up of limestone belonging to the Middle Eocone. The drainage basins are characterized by steep slopes, deep gorges that cut into the highlands, and lack of soil and vegetation. This configuration helps in controlling the run off and discharge of the floods onto the plain.

(2) Sediment Movement :

Sediment movement on hillslopes is mainly caused by rain drop and overland flow process. The flows generally occur on hillside slopes of greater than 30°. The movement usually originates in a single or multiple head, follows a long narrowing track and spreads out on the lower slopes of the valley. The sediment received from tributary channels with pulsed changes to width and depth in downstream.

The deposits are normally composed of 45-70% sand or coarse clasts. According to change of slope angle down valley from the > 30° hillslopes to 15-20° in the supply channels and 6-8° in the run out areas, the material supplied by the stream, hillside debris flows, and other mass movements accumulate in the main valley track.

(3) Alluvial-Fan Flooding :

Detailed studies of area floods are scarce because they rarely affect man, settlements and research stations are few. Flooding has scared man and despite prodigious efforts to reduce flood damage and loss of life in some areas, the problem remains serious. Flooding on alluvial fans can occur in two principal locations along the margins of the main supply channels, and in the depositional zones beyond the ends of the supply channels.

Floods began in mountain tributaries and were fed into the main valley along alluvial Fan channels. The flows accumulated huge quantities of sediment and deposited much of it within the basin.

(4) Sedimentary Rocks and Earthquake Hazards :

The sedimentary rocks in Suez Gulf region are susceptible to earthquake hazards. The intensity of earthquakes is generally larger over soft rocks.

Mass movement hazards can be considered as an integral part of urbanization, land use and regional planning. Damage caused by disaster events depends largely on the rock mechanics.

The high elevated steep slopes and close fracturing originate debris falls. The massive calcareous rocks are often affected by closely spaced joint sets and subjected to rock falls and block slides. The alternation of sandy and clayey layers is particularly unstable and the high pore pressure on the sandy layers. Quaternary sediment rocks are affected by various types of dangerous mass movements. (Ahmed F. Kamel, 1997 p. 83).

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Fig. 6 : Alluvia fan of Wadi Um Lug

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ANALYSIS OF THE GEOMORPHOLOGICAL MAP ALONG WESTERN COAST OF THE SUEZ GULF BETWEEN WADI UM LUG AND WADI MALHA

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