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LITHOSTRATIGRAPHY AND ENVIRONMENTS OF THE QUATERNARY SEDIMENTS IN EL-SADAT AREA AND ITS VICINITIES, WEST NILE DELTA, EGYPT

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ABSTRACT

The essential purposes of this study is to establish the stratigraphical conditions of Quaternary deposits from El-Sadat area, western part of Nile Delta. This study is concerned mainly with geomorphology, lithostratigraphy and depositional environments which are also discussed.

The Quaternary sediments composed mainly of gravels, sands with thin clay intercalations. To detect the environmental conditions of these sediments, it is necessary to study the basins of sedimentation of the studied area as to assigned, the grain size analysis which carried out for 91 representative samples. This study indicates beach, shallow agitated marine and deltaic environments.

INTRODUCTION

El-Sadat area lies in the western part of the Nile Delta of Egypt. It bounded by Longitude 30° 19\ - 30° 40\ E and Latitude 30° 15\ - 30° 34\ N, (Fig. 1). The surface and subsurface studies for the stratigraphy of Quaternary deposits in the Nile Delta as a whole were occured by several authors of whome Blanckenhorn (1921), Hume (1925), Said (1962), Shata (1955-1957), Shata et al. (1962), Sallouma (1974) and Abd El-Baki (1983).

The essential purpose of this study is to establishing the stratigraphical conditions of the Quaternary deposits exist in the area under study, geomorphology, lithostratigraphy and depositional environments are also discussed.

Geomorphology :

Little informations about the geomorphology of the area under study are considered by different authors of whom SandFord and Arkel (1939), El-Shazly et al (1975), Sand (1975) and Shata et al (1978).

The area is characterized by gentle topography and low relief rarely exceeding + 100 m, (Fig.2). On the basis of the geological configuration, the area can be distinguished into the following geomorphologic units, (Fig. 3).

- The alluvial plains.
- The tablelands.
- The structural plains.

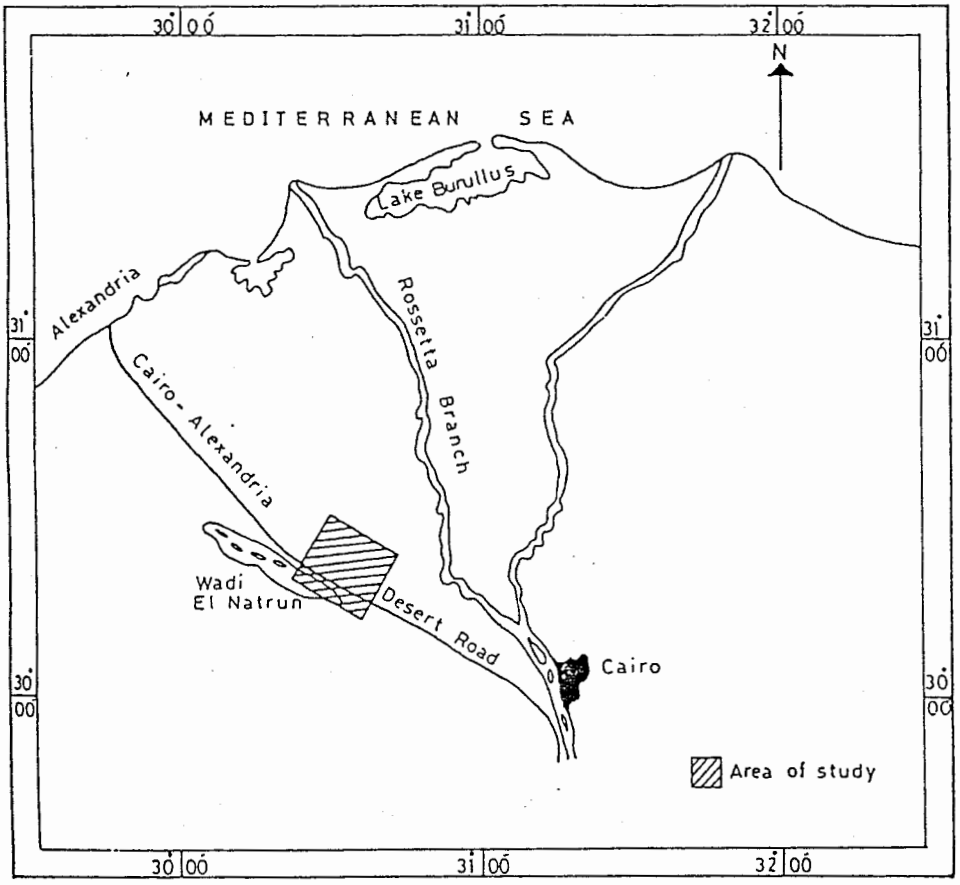
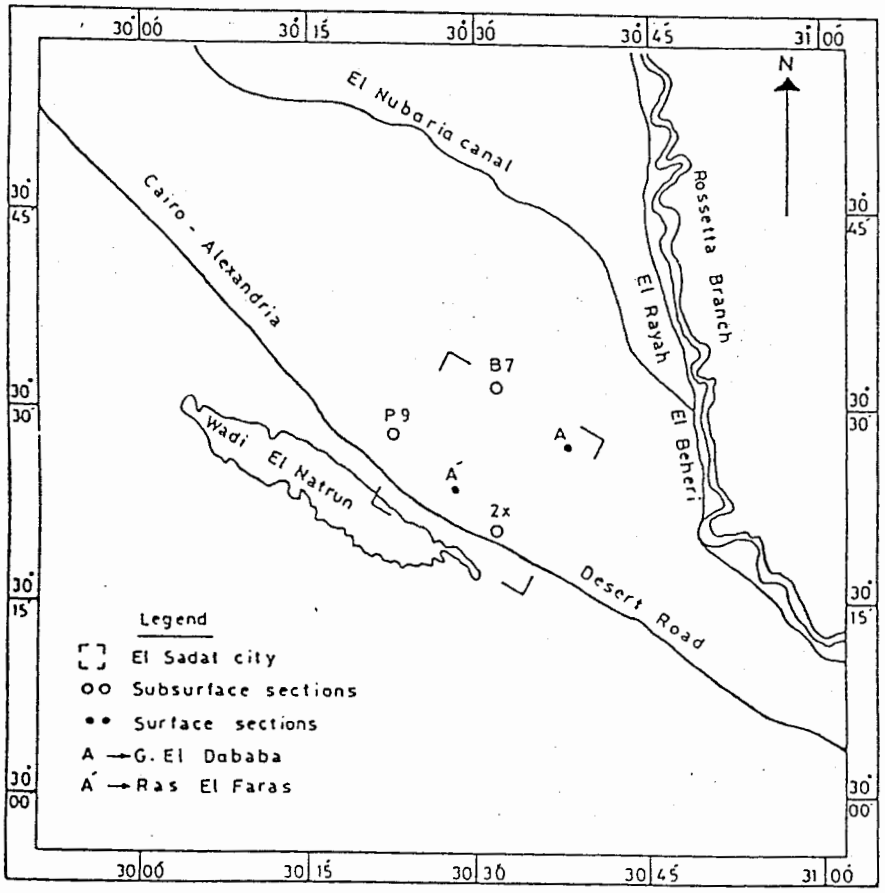


Fig (1) Location map

20 0 20 40 Km
Scale



Fig(2): Location map of the examined sections.

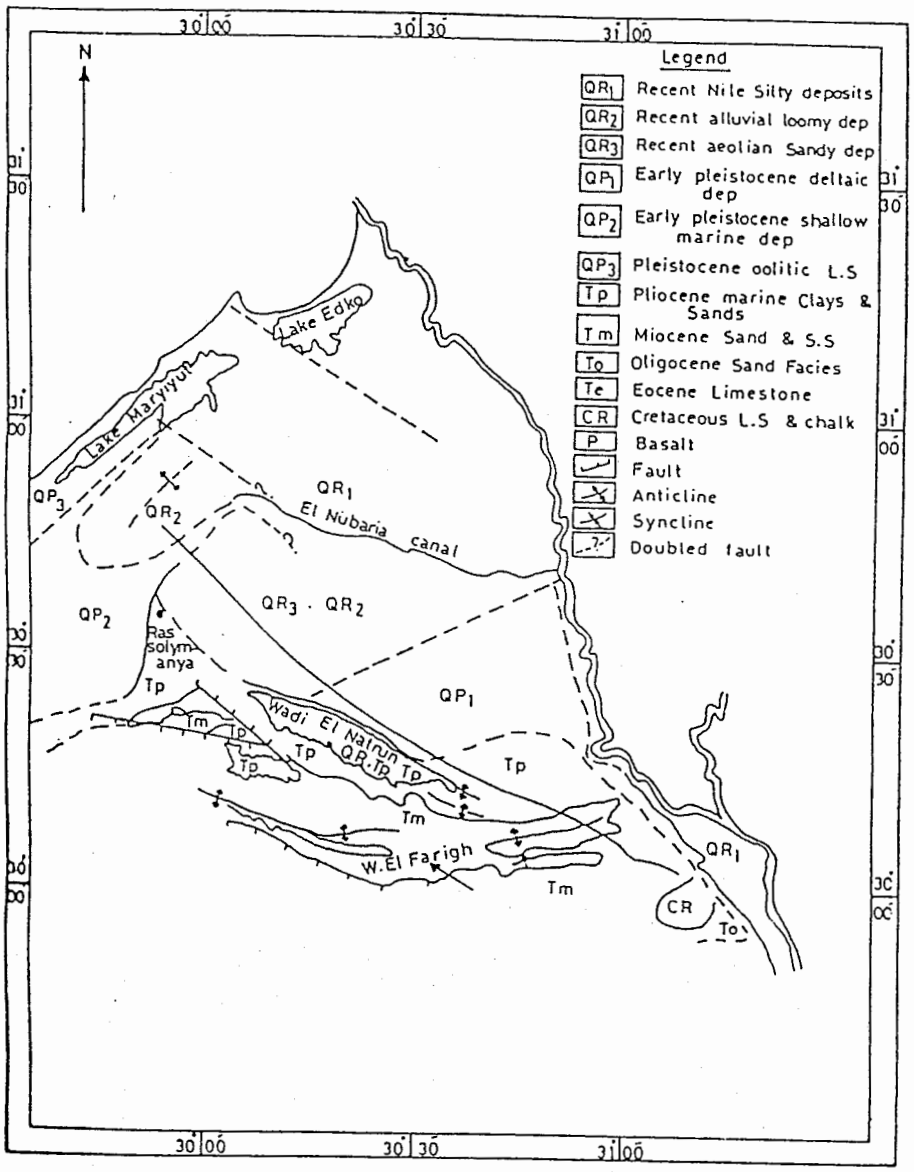


Fig.(3): Regional geological map
(After Shata, 1961)

1. The alluvial plains :

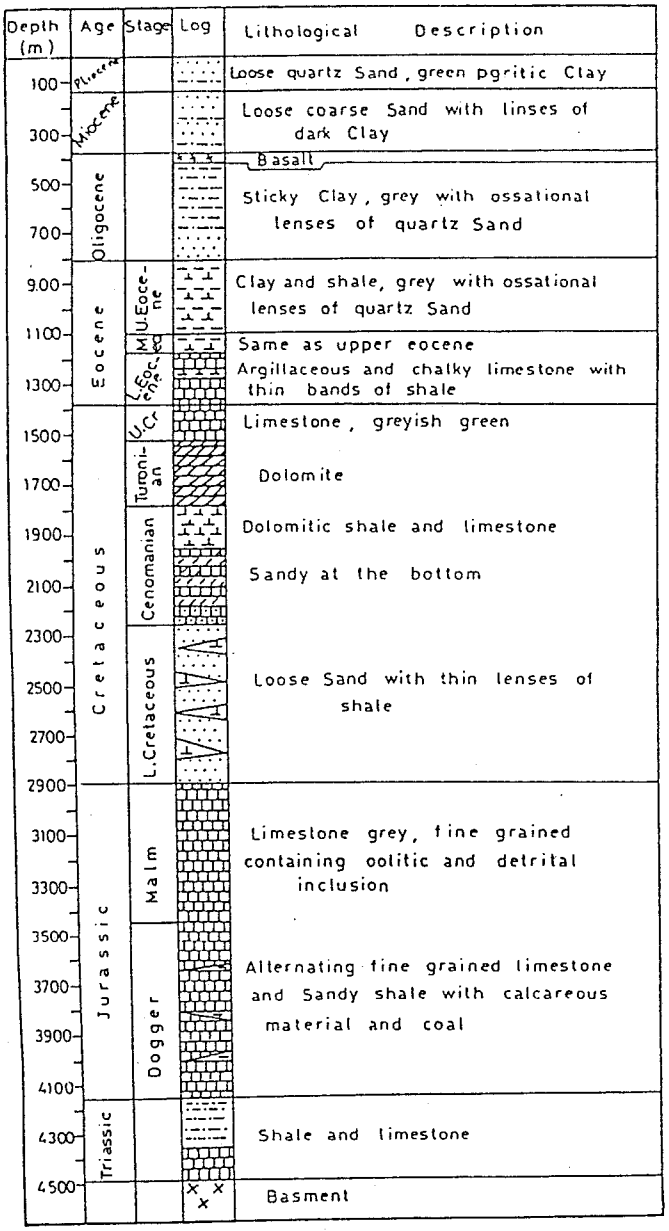
This geomorphic unit constitute one of the most important land features in the area under study. These plains differentiated into; young alluvial plains and old alluvial plains. The first plains includes a portion of the fertile land of the Nile Delta. The surface is partically flat with its altitude ranging from +30m to +20m. and slopes in the northward direction. The old alluvial plains lies south of the young alluvial plains occupying the flat area lying between Wadi El-Natrun and the Rosseta branch of the Nile. El-Sadat city lies within these plains. Some isolated hillocks are noted within these plains as G. Dababa (+43m), G. El-Tabani (+40m), G. Munsif (+61m) and Ras El-Faras (+55m). Several shallow drainage patterns dissect the old alluvial plains, (Fig.4) these old drainage patterns reflect the arid climatic conditions within the studied area.

2. The tablelands :

This geomorphic unit could be differentiated into :

A. Maryut tablelands :

This unit lies west and north of the old alluvial plains and extending wes tward to the Qattara area. It is build up of hard, chalky and detrital limestone slopes to the north and to the south forming two inland ridges, the northern one is "Khashm El-Eish" ridge where as the southern one is Alam Shaltut ridge.



Fig(4): Log of Wadi El Natrun test well No. 1
(After Abd El Baki, 1983)

Ground elevation : -16.46 m Latitude : 30° 23' 27.00" N
Total depth : 4069 m Longitude : 30° 18' 31.00" E

B. El-Hadid tablelands:

These table lands lie immediately to the west of Wadi El-Natrun depression with elevation of about +180m. It is underlain by ferrigenous sandstone and conglomeritic limestone. These table lands are mainly covered with a blanket of dark brown gravels with silicified wood remains.

3. The structural plains :

This unit occupies the area to the south of the old alluvial plains consisting of a number of alternating depressions and ridges. The depressions represented by Wadi El-Natrun depression (-23m), Wadi El-Farigh (-4m).

These depressions are discussed as young morphotectonic features of Late Tertiary and Quaternary time (El-Fayoumy, 1964) where chemical weathering had played an important role in their formation. The structural ridges alternate with the depression areas including G. El-Hadid ridge (+180m), El-Quantara - El-Washiks ridge (+180m) and G. Abu Roash ridge (+200m). Such ridges exist as positive land feature and Owe much of their existence both to the structural and to the lithological factors. Most of these ridge are covered by a gravelly blanket derived mainly from both sedimentary and igneous which exist to the east.

Lithostratigraphy :

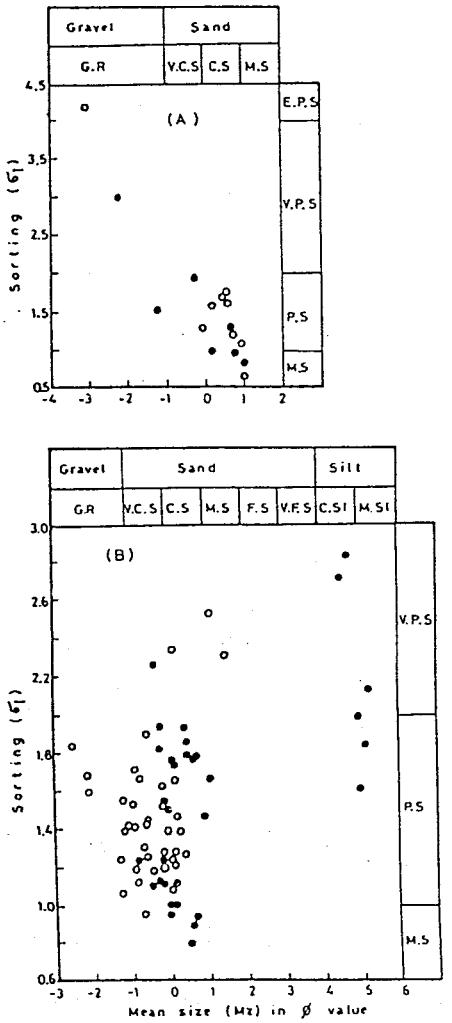
The sedimentary rocks which outcrops onland around the area of study ranges in age from Late Tertiary to Quaternary.

The subsurfacce sedimentary succession attains a thickness of about 4000m and rest directly upon the basment rocks, (Fig. 5).

The area under study mainly covered by Quaternary sedimentss. These rocks are mainly represented by the Pleistocene sediments. These sediments are detected in both surface and subsurface, (Fig. 6) representes the location map of surface sections and subsurface water wells selected to study the Quaternary sediments in the area under consideration (Fig 5, 7 & 8) represent the surface geological section while represents the subsurface geological cross section across the area under study. From these Figures it is noticed that : the pleistocene sediments are mainly represented by the following rock types from base to top :

1. Aeolian Sand accumulation :

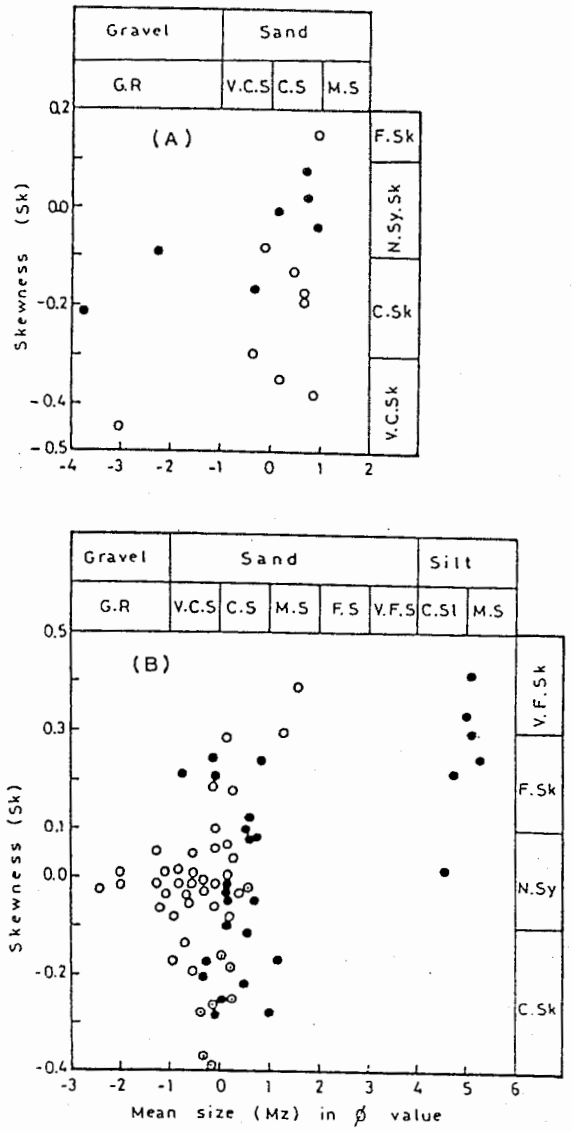
Well distributed allover the area under study in the surfacce and subsurface composed mainly of fine to medium grained, moderately sorted Sandstone. These deposits represents the dry periods that prevailed in the area under study at different Quaternary times forming sand dunes and sand sheets. In the subsurface, the thickness is generally increase from NW to SE direction with highest thickness of about 18-30m, pale yellow coloured.



Fig(5): Relationship between Mean size and Sorting.

Legend

M.S : Medium sorting
P.S : Poorly sorting
V.P.S : Very poorly sorting
E.P.S : Extremly poorly sorting



Fig(6): Relationship between Mean size and Skewness.

Legend

V.C.Sk : Very coarse skewness
C.Sk : Coarse skewness
N.Sy.Sk: Near symmetrical skewness
F.Sk : Fine skewness
V.F.Sk : Very fine skewness

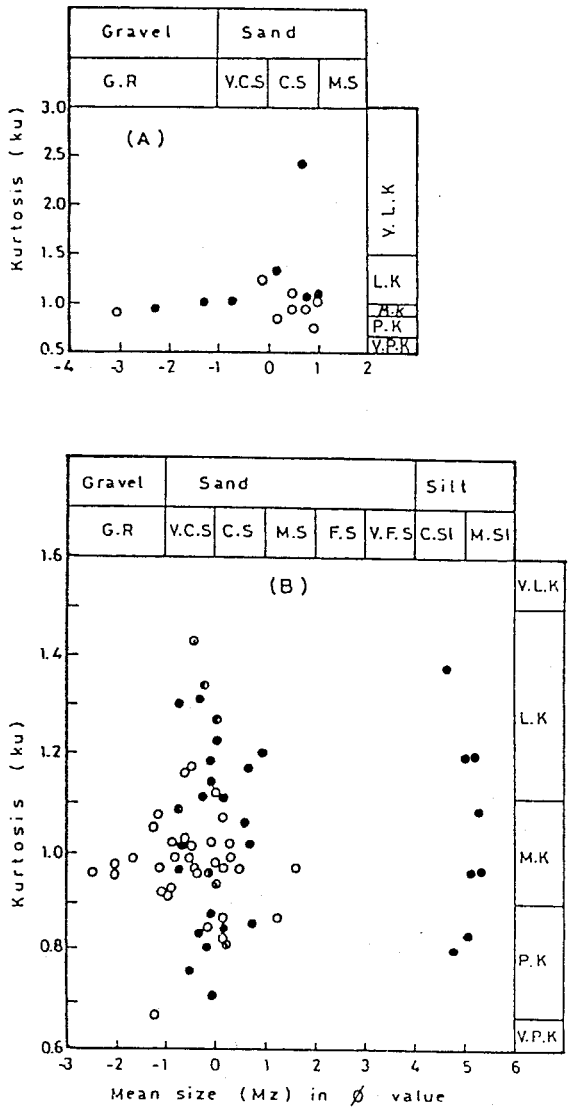


Fig.(7): Relationship between Mean size and Kurtosis.

Legend

V.P.K : Very platykurtic
P.K : Platykurtic
M.K : Mesokurtic
L.K : Leptokurtic
V.L.K : Very leptokurtic

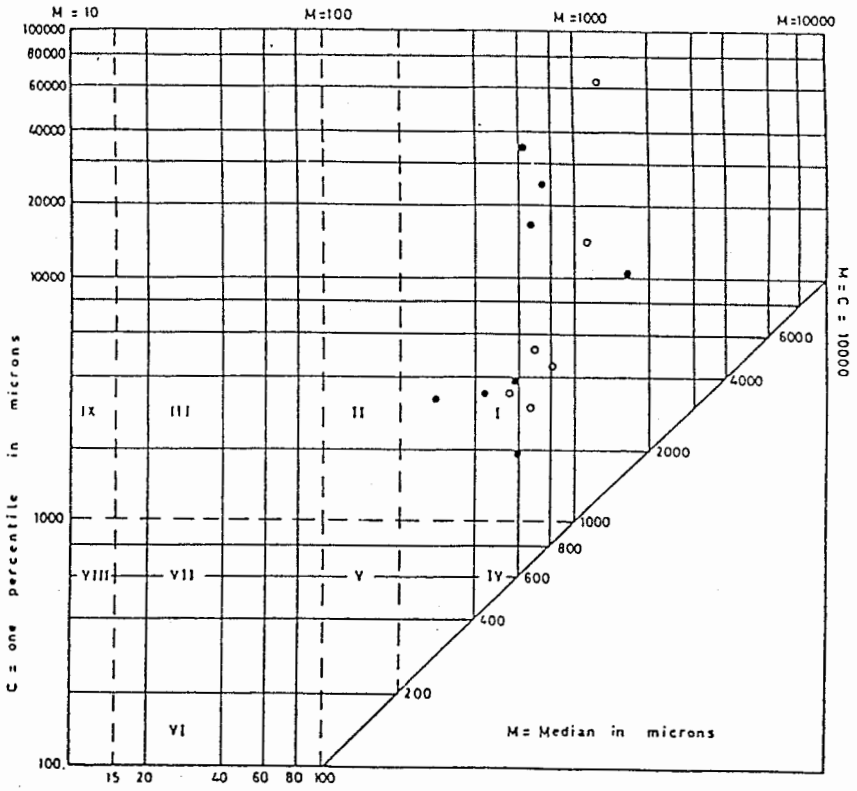


Fig.(8a): C-M diagram of the surface samples.

Legend

●●● ⟶ Samples of Gebel El Dababa section

●●● ⟶ Samples of Ras El Faras section

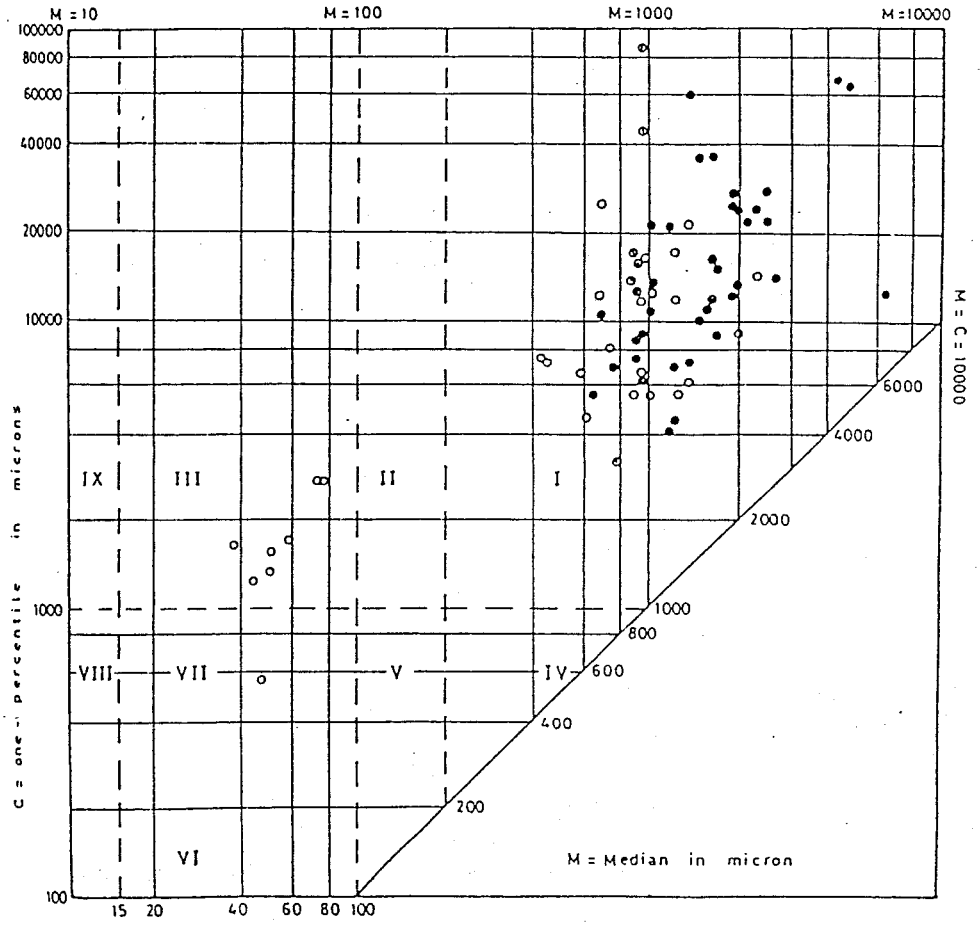


Fig.(8b): C-M diagram of the well samples .

Legend

●●●→ Samples of well No. 2_x

○○○→ Samples of well No. P_9

●○●→ Samples of well No. B_7

2. Lagoonal deposits :

These deposits are distinguished into :

a. Deltaic lagoons :

Reported on the surface and subsurface. Composed of clays and sands. It has a thickness of about 15m.

b. Lagoons of depression areas :

Exposed around the natural lake of Wadi El-Natrun. Composed of quartz Sand with a variable thickness.

3. Alluvial deposits :

Well represented at Abu Mina depression. Composed of Sandy Loam with a thickness of about 2m.

4. Deltaic deposits :

Reported in the vicinity of Rossetta branch, dominate the surface of the old allvial plains. Composed of coarse to medium sand with gravel their thickness ranges from 285m south El-Tahrir to 80m along Cairo - Alexandria desert road.

5. Calcareous crust :

Exposed on the surface of Maryut table lands. Composed of Sandy limestone with a thickness reach to 4m.

The environmental interpretation :

The main purposes of this study is to identify the environmental depositional conditions under which the sediments were deposited and the agents of deposition which were prevailed during the djeposition of the sediments.

To achieve these purposes, grain-size analysis were carried out for 91 representative samples from El-Sadat area distributed as follows:

8 samples from G. El-Dabba; 6 samples from G. Ras El-Faras; 40 samples from well no. 2_X, 28 samples from well no. P_9 and 9 samples from well no. B_7.

The results obtained are represented graphically and some relationships between different grain size parameters. Table (2) shows the values of phi units from cummulative curves of the analysed samples together with the calculated parameters.

Sahu (1964) introduced four discriminant. Functions based on the graphical parameters of Folk and Word (1957) to differentiate aeolian, beach, shallow agitated marine, deltaic and turbidite environments. The four function were calculated (Y_1, Y_2, Y_3,and Y_4) the following results could be noticed :

(Y_1, Y_2, Y_3, Y_4):

1. Surface samples :

Histograms of the examined surface samples show that the frequency distribution of grains in samples of Gebel El-Dabba and Ras El-Faras sections are mostly bimodal indicating mixed sediments of coarse and fine grained.

Surface samples have a sorting coefficient ranging from 1.12 to 1.97 indicating poorly sorted sediments except sample No 4 from Gebel El-Dabba section which is moderately well sorted and samples No 3 and 7 from Ras El-Faras section which are moderately sorted.

The calculated skewness ranges from +0.08 to -0.21 indicating near symmetrical to coarse skewed sediments with the exceptions of sample No 4 from Gebel El-Dabba section which is fine skewed and sample No 5 from Gebel El-Dabba section which is very coarse skewed.

Kurtosis ranges between 0.76 and 1.37 indicating platy to leptokurtic except sample No 4 from Ras El-Faras section which is very leptokurtic.

The calculated percentage of gravel, sand, silt and clay components shows that samples of Gebel El-Dabba and Ras El-Faras sections lie in sand and gravely sand categories.

Y_1 discriminant function of Sahu (1964) indicates beach environment. The values of Y_2 suggest shallow agitated marine environments. The values of Y_3 indicates that the examined samples

are all deltaic except for sample No 4 from Gebel El-Dabba which indicates shallow agitated marine environment. The values of Y_4 support the dominance of turbidity current during the deposition of all the samples studied.

2. Subsurface samples :

Histograms of well samples show that the frequency distribution of grains in samples of well 2_X, Pg and B_7 ranges from unimodal to bimodal indicating uniform sediments.

The samples have a sorting coefficient ranging from 1 to 2.84 indicating poorly to very poorly sorted sediments except sample No 3 at 10 m depth (well 2_X), samples No 20, 27 and 28 at 31, 40 and 41m depth respectively (well Pg) and sample No 1 at 4m depth (well B_7) which are moderately sorted.

The calculated skewness ranges from +0.3 to -0.28 indicating fine to coarse skewed except sample No 25 at 94m depth (well 2_X), samples No 21 and 22 at 32 and 33m depth respectively (well Pg). These samples are very fine skewed. Sample No 1 at 4m depth (well B_7) gives near symmetrical skewed, samples No 3 and 4 at 14 and 20m depth respectively (well B_7) gives very coarse skewed indicating variable environmental depositional conditions.

Kurtosis ranges between 0.57 and 1.43 indicating platy to leptokurtic.

The calculated percentage of gravel, sand and clay components show that samples from well 2_X lie in gravelly sand, sandy gravel and silty sand categories while samples from well Pg lie in sand, gravelly sand and clayey silt categories. Samples from well B_7 lie mostly in gravelly sand category.

Y_1 discriminant function of Sahu (1954) indicates beach environment. Y_2 discriminant function gives a clue that all samples are shallow agitated marine environment. Y_3 indicates deltaic environment with the exceptions of sample No 20 at a depth of 31m from well Pg and sample No 1 at a depth of 4m from well B_7 of shallow agitated marine origin. Y_4 support the dominance of all the samples studied except for one single sample at a depth 33m from well Pg which indicates deltaic origin.

The calculated discriminant functions of the samples being studied (Surface and well samples) suggest that these samples were mainly deposited under beach and deltaic environments. Although shallow agitated marine and turbidity currents have an effect on the deposition of these samples.

Discrimination of sedimentary environments using bivoriate plots of statistical grain size parameters has been employed on recent and ancient sediments (Friedman, 1951, 1957; Stewart, 1958; Folk and Word, 1957; Passega, 1957, 1964; Siemers, 1976; Amaral and Pryor, 1977).

The graphic representation of the relationships between the different grain size parameters of Folk and Word (1957) might be

valuable for revealing the environmental conditions of sedimentation (Zoghloul; Issaw I and El-Sherbini, 1976). A scatter diagrams were made to find out the interrelation between the different statistical parameters derived from grain size analysis. These include the following relations :

1. The Mean Size (Mz) Versus Inclusive Graphic Standard Deviation (6_1)

The relationship between Mz and 6_1 for the examined samples is illustrated by for the examined surface and well samples respectively. The majority of the examined surface samples are very coarse and coarse sand size with few exceptions of gravelly size. In general they are almost poorly sorted with few exceptions. The examined well samples are very coarse and coarse sand size with some exceptions of gravelly and coarse silt size. The samples in general are almost poorly sorted. This may indicate that the sands being examined are possibly Fluviatile immature sediments (Zaghloul et al, 1976). The moderate degree of sorting observed might favour the beach environment of deposition. The plotting points of the examined samples (surface and well samples) appear close to each other, suggested the similarity of environmental conditions of deposition of both well and surface samples.

2. Mean Size (Mz) Versus Skewness (SK_I)

The relationship between Mz and SK_I is used to differentiate between beach and aeolian sands (Mason and Folk, 1958, Friedman, 1951 and Mo'ela and Weiser, 1958). Show the relationship between

Mz and SK_I for both surface samples and well samples. The scatter of the points show that the examined samples are scattered through wide range between negatively and positively skewed suggesting the possible heterogeneous origin of the samples being examined. They might be of beach and fluviatile origins.

3. Mean Size (Mz) Versus Kurtosis (K_G)

Mason and Folk, 1958 used the Graphic Kurtosis to identify the depositional environments. Show the relationship between Mz and K_G for surface samples and well samples. The samples in general appear mesokurtic to platykurtic with somw exceptions of leptokurtic and very leptokurtic. This suggest the possible beach environments.

For a better understanding of the agents of deposition which were prevailing during the deposition of sediments in Sadat area, the Median diameter (M) and the First percentile (\C) of the whole examined samples were plotted on C-M diagram of Passega and Pyromjee (1969). Show the resulting C-M pattern of surface samples and well samples. This figure shows that the examined samples are scattered in a relatively vast area away from line C=M, the samples in general are almost lie in (I) type of the basic C-M diagram with few exceptions of well samples which lie in (III) type of the basic C-M diagram. From the above results it could be concluded that the examined sediments are formed by mixtures of

suspension sediments and rolled coarse grains deposited near their source (Passega and Pyromjee, 1969).

CONCLUSION

El-Sadat area lies in the western part of the Nile Delta of Egypt. The area is characterized by gentle topography and low relief rarely exceeding +60m. The sedimentary rocks cover the area range in age from Late Tertiary to Quaternary. The Quaternary sediments are widely distributed allover the area under study. It maily consists of sands, gravels and thin clay intercalation. All the sedimentalogical parameters such as Bimodality, poor sorting and abnormal skewness and kurtosis values point to a mixed origin of these sediments, indicate beach, shallow agitated marine and deltaic environments.

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دراسة ليثوستراتجرافية وبيئات رواسب الرباعى فى منطقة السادات وما حولها – غرب دلتا النيل

كمال محمد شامة و أحمد جابر شديد

كلية التربية – جامعة القاهرة

الهدف الرئيسى لهذا العمل هو دراسة الظروف الاستراتجرافية لرواسب الرباعى فى منطقة السادات، الجزء الغربى من دلتا النيل، وهذه الدراسة تهتم أساساً بدراسة الجيومورفولوجيا والليثوستراتجرافى والبيئات الترسيبية التى تم دراستها أيضاً.

وتتكون رواسب الرباعى أساساً من الحصى والرمال مع بعض المتداخلات من الطين ولاختبار الظروف البيئية لهذه الرواسب كان من اللازم دراسة أحواض الترسيب للمنطقة المدروسة. كما أفادت دراسات أحجام الحبيبات على ٩١ عينة أدت إلى أن بيئات الترسيب كانت شاطئية إلى بحرية ضحلة وكذلك دلتائية.