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RECENT BOTTOM SEDIMENTS OF LAKE QARUN, EGYPT.

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ABSTRACT

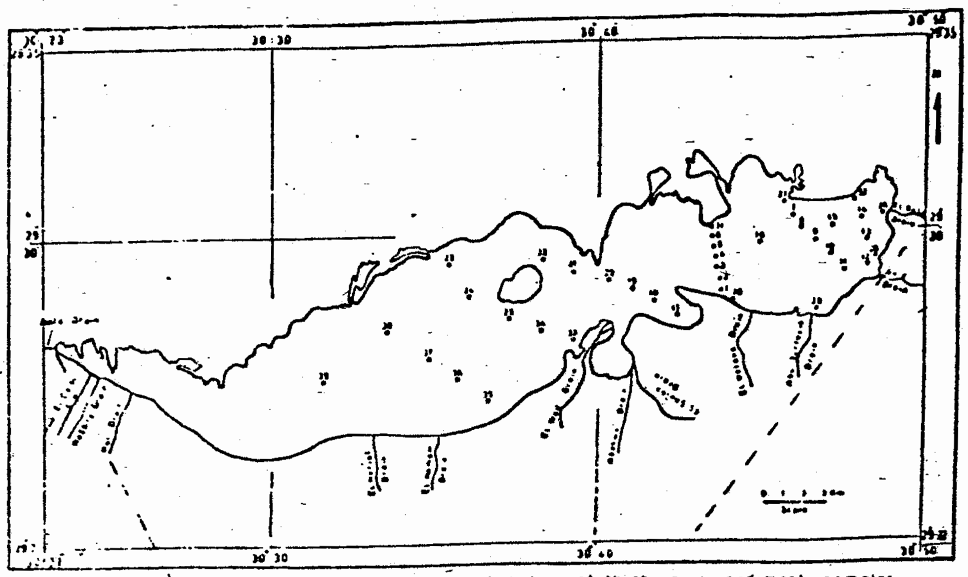
The aim of the present work is to gather sufficient information about the distribution of the Recent bottom Sediments of lake Qarun, and the environmental factors affecting its Sediments. For these purposes 39 grab Sediment samples were collected in addition to some measurements concerning depth, currents and Salinity.

From this work it was found that the texture of the Sediments changes irregularly with respect to shoreline. The depositional environment of the Sediments of lake Qarun are mainly formed under Shallow agitiated marine environment. However, the mechanism of deposition of the Sediments is of polygenetic nature. The factors affecting Sediments distribution are mainly generated currents, bottom configuration, Salinity and Size grade.

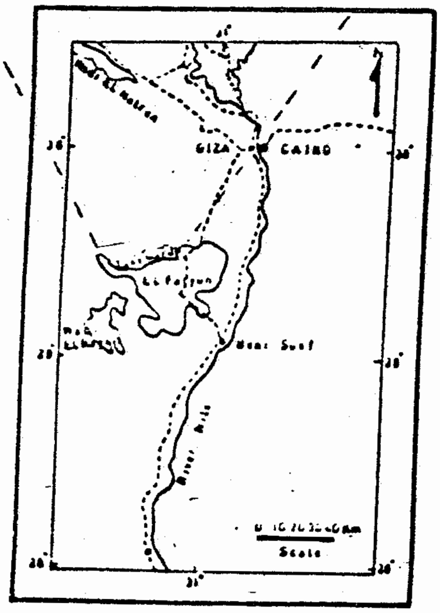
INTRODUCTION

Lake Qarun is irregular closed lacustrine basin, it lies northwest of EL-Faiyum depression. It occupies the lowest portion of this depression at level of -51 m. (Fig.1).

It has an area of about 245 km with surface water-level -43.3 m. It has a maximum width of about 9 km whereas the minimum width is of about 3.4 km. It has a length of about 45 km long, with maximum depth of about 8 m, and located around the Golden horn island.



Fig(2.). Station location map showing the distribution of thirty-nine sediment samples



----Roads

Fig(1): Location map of EL Faiyum depression and its vicinities.

Lake Qarun is topographically divided into two parts, the eastern and western parts. The western part is more deeper than the eastern part. The eastern part of the lake is characterized by the main drains (El-Bats and EL-Wadi drains) where their loads are reached. There is a barrier located nearly in the middle part of the lake which is called Golden horn island and composed mainly from Eocene fissured limestone and marl. (Ansary, 1955).

The area under investigation lies between latitude 29 20 & 29 30 N and longitude 30 23 & 30 50 E.

MATERIAL & METHODS

Thirty-nine grab Sediment samples were, collected by means of small peterson grab from a depth ranging between 0.30 m and 7.20 m. using small motor boat (Fig.2).

Sand fraction of the bottom sediment samples were mechanically analysed using standard set of sieves with mesh openings of 0.50, 0.25, 0.125 and 0.0625 mm, However, the silt & clay (fine fractions), the pipette method was used following the technique described by Krumbien & Pettijohn (1938).

The depth was measured by mechanical lot at each stations. In addition to the measuring the velocity of the wind generated currents . The Salinity was measured in each station using conductivity meter at depth of about 1.5 m. below water level.

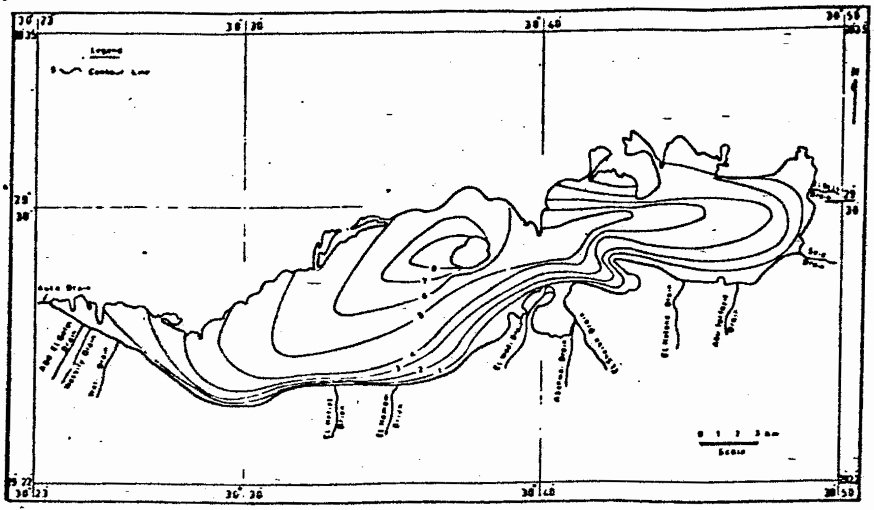


Fig.(3): Depth contour map.

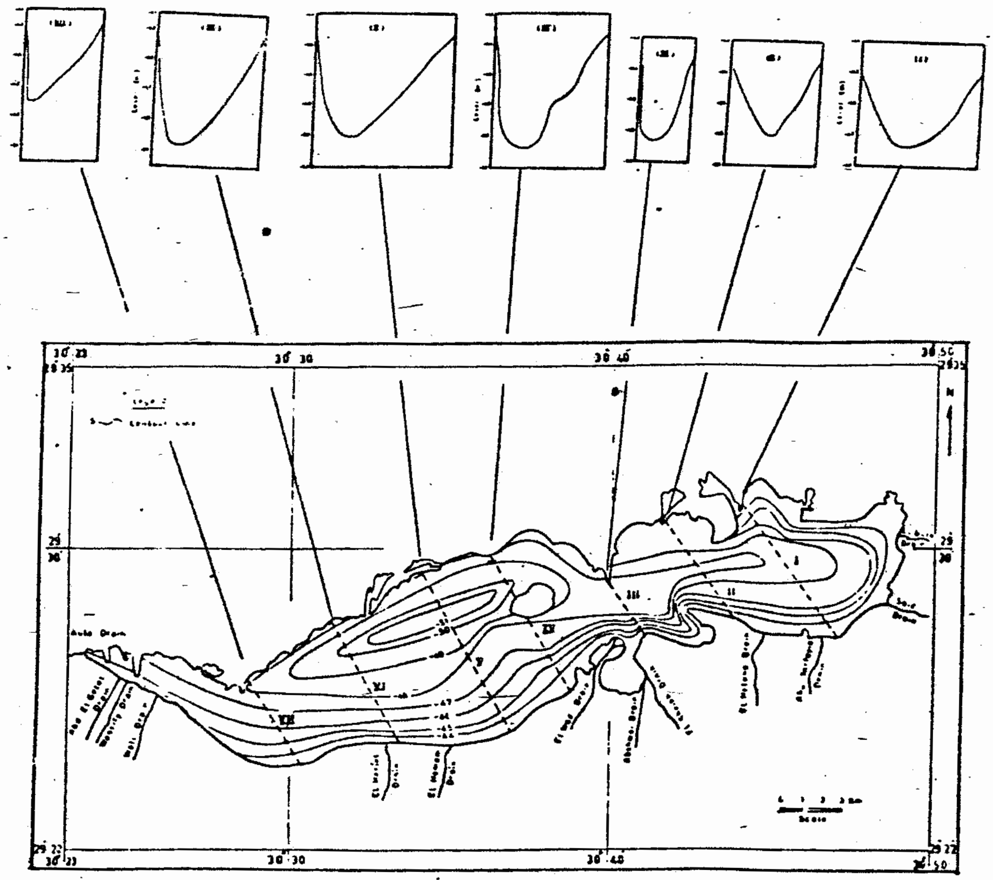


Fig.(4): Bottom configuration of Lake Qarun and the directions of profiles.

THE BOTTOM CONFIGURATION

Lake Qarun is topographically divided into 2 parts, Eastern & Western parts, the western part is more deep than the eastern part. It has a maximum depth of about 8 m. measured around the Golden horn island. The maximum depth recorded in the eastern part is of about 5m. (Fig.3).

In order to show the features that may be associated with the bottom relief, Seven profiles were made perpendicular to the coastline. Three of them are located in the easten portion whereas the other four profiles located in the western portion (Fig.4). From these profiles, it was found that the bottom configuration of the eastern parts from the lake has a shallow basin with broad V shape cross section which is nearly symmetrical. The inclination from the shore to the maximum depth varies between 0.001 to 0.0014 . The depths ranges between 4 to 5 meters recorded in the deeper portions.

The bottom configuration of the western part from the lake has a relatively basin shape like structure which has a relatively steep asymmetrical sides. The northern side slope is very steep relative to the southern side slope.

The maximum depths-recorded in this part ranges between 5.8 to 7.2 m.

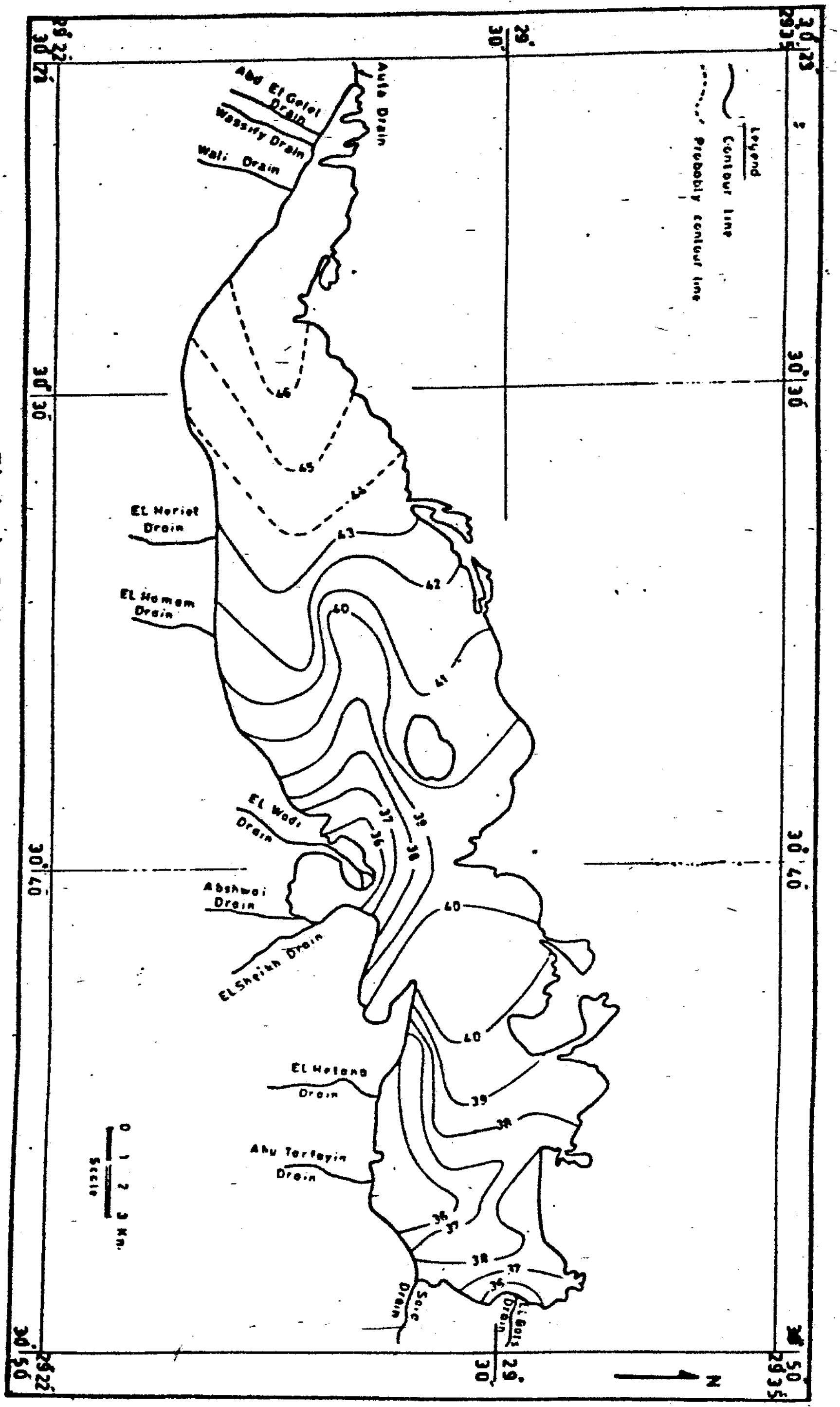


Fig.(5): Salinity distribution map.

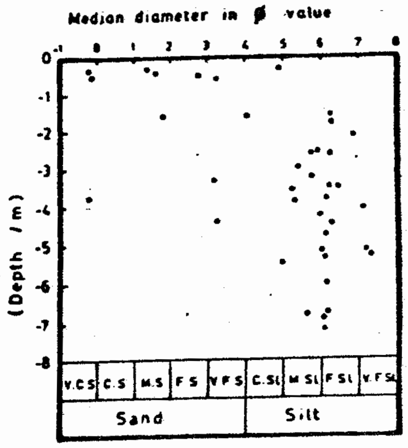


Fig.(6):Interrelation between Median diameter and depth.

Legend
V.C.S Very Coarse Sand
C.S Coarse Sand
M.S Medium Sand
F.S Fine Sand
V.F.S Very Fine Sand
C.Sl Coarse Silt
M.Sl Medium Silt
F.Sl Fine Silt
V.F.Sl Very Fine Silt

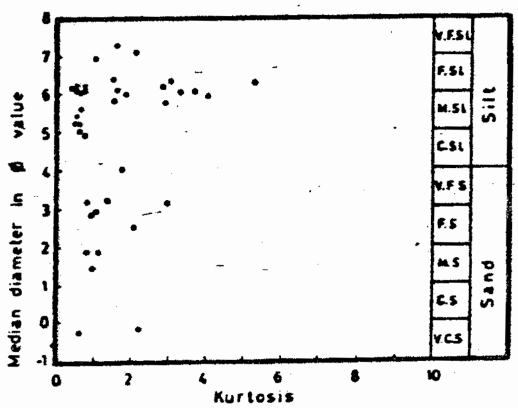


Fig.(7):Interrelation between kurtosis and Median diameter.

Legend
V.F.Sl Very Fine Silt
F.Sl Fine Silt
M.Sl Medium Silt
C.Sl Coarse Silt
V.F.S Very Fine Sand
F.S Fine Sand
M.S Medium Sand
C.S Coarse Sand
V.C.S Very Coarse Sand

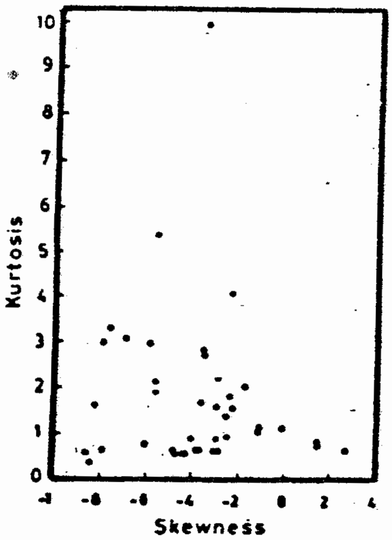


Fig.(8):Interrelation between skewness and kurtosis.

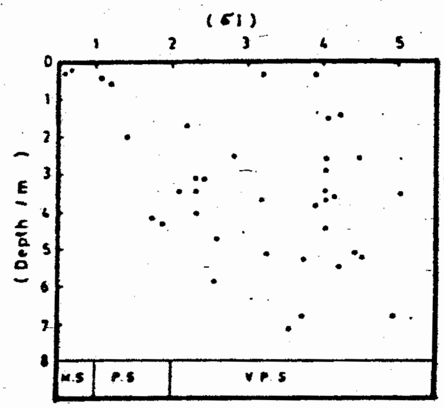


Fig.(9):Interrelation between sorting and depth.

Legend
M.S: Medium Sorting
P.S: Poorly Sorting
V.P.S: Very Poorly Sorting

WATER SALINITY

From Salinity values recorded by conductivity meter at depth of about 1.5 m. below the surface water, a salinity distribution map was made (Fig.5).

From this map, it was found that, the salinity of the eastern part from the lake is relatively low where the outlet of EL-Bats drains is present. The water salinity of this part ranges between 36% 0 and 39% 0 with an average 37.5% 0 whereas the Salinity recorded in the western part from the lake ranges between 36% 0 (near EL-Wadi drain) and 46% at the north western part of the lake, with an average 41% 0.

GRAIN SEZE RELATIONS

From the grain size analysis, the statistical parameters were calculated following the equations described by Folk and ward (1957).

The data derived from mechanical analysis and the calculated statistical parameters are listed in table (1).

From this table, it was found that the sorting values for collected samples ranges from 0.617 to 5.07 with an average 3.032 (very poorly sorted). Their skewness ranges from 0.14 to -0.84. The median diameter (Md) for collected samples ranging from -0.2 0 to 7.3 0 with an average value of 4.84 0. The corresponding mean values (MZ) ranges from - 0.21 0 to

6.7 0 with an average value of 3.76 0 this means that the Median diameter (Md) of the collected samples exceed the means (MZ) represent a typically lake deposits (Shepard, 1971).

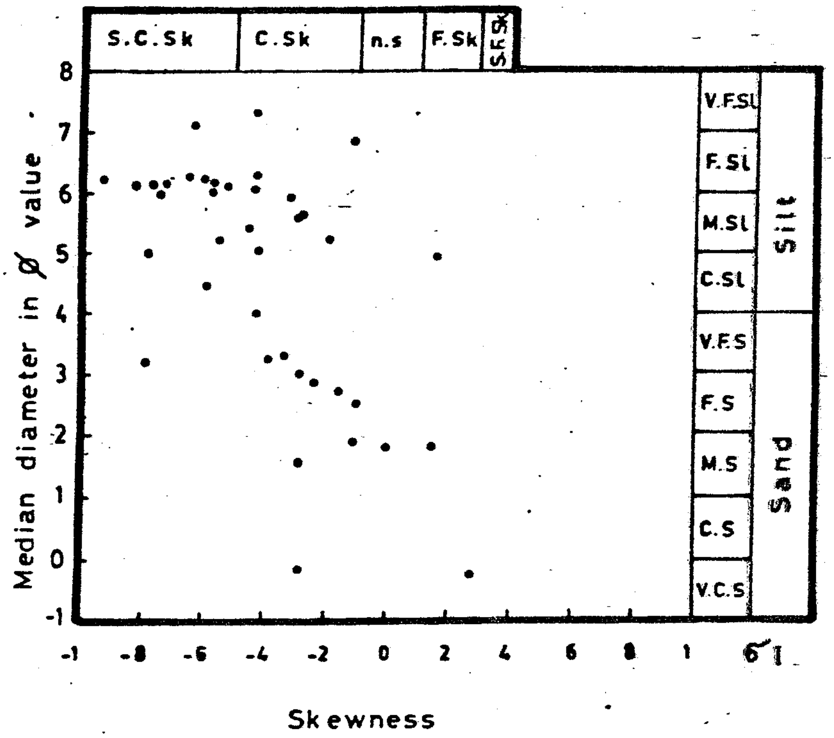
The kurtosis of the collected samples ranges from 0.49 0 to 9.95 0 very platykurtic to very Leptokurtic with an average of 1.821 0.

Interrelation of Statistical parameters:

A Scatter diagrmas were made to find out the interrelation between the statistcial parameters derived from the grain size analysis. These diagrams include the following relations.

a) Median diameter and depth (Fig.6).
b) Kurtosis and Median diameter. (Fig.7).
c) Skewness and Kurtosis. (Fig.8).
d) Sorting and depth (Fig.9).
e) Skewness and Median diameter .(Fig.10).

From these relations, the sediments of lake Qarun controlled mainly by depth, median diameter (Md) and sorting where a distinct relations with depth are noriced, they decrease with increasing depth. No distinct relations were noticed between kurtosis and skewness in one hand and depth with median diameter in the other hand.



Fig(10):Interrelation between skewness and Median diameter.

Legend

Grain size	
V.F.Sl	Very Fine Silt
F.Sl	Fine Silt
M.Sl	Medium Silt
C.Sl	Coarse Silt
V.F.S	Very Fine Sand
F.S	Fine Sand
M.S	Medium Sand
C.S	Coarse Sand
V.C.S	Very Coarse Sand

Skewness	
S.C.Sk	Strongly Coarse Skewness
C.Sk	Coarse Skewness
n.s	Nearly Symmetrical
F.Sk	Fine Skewness
S.F.Sk	Strongly Fine Skewness

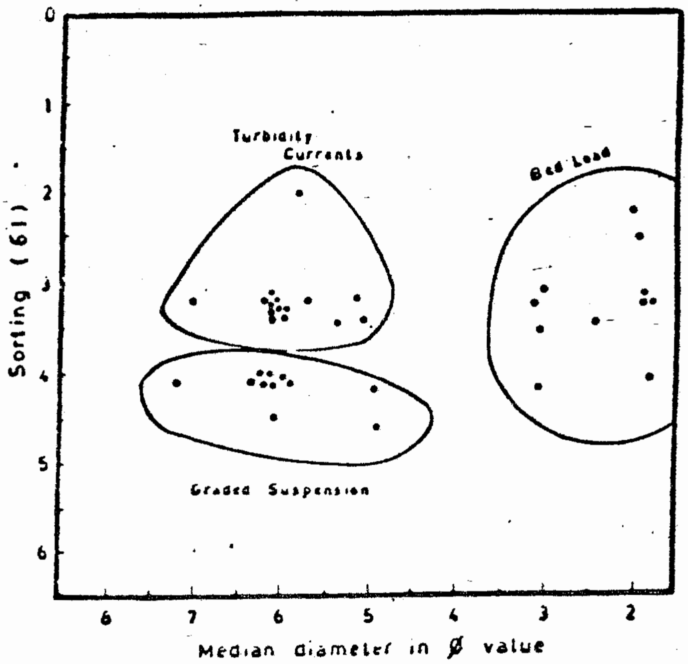


Fig.(11) Mechanism of deposition

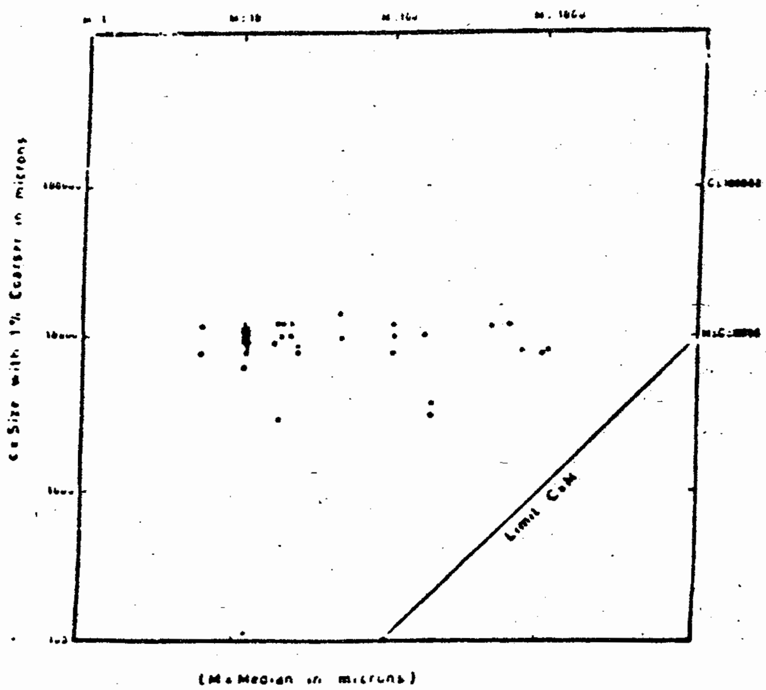


Fig.(12) Passega's C-M diagram with 39 sample values of lake Qarun sediments.

Depositional environments:

The depositional environments had been deduced from the descriminant functions proposed by Sahu (1964).

The application of these functions on the area under investigation reveals that the deposits of lake Qarun are mainly formed under shallow agitated marine environment in addition to eolian deposition, beach deposition and turbidity current environment (Table 2).

The mechanism of deposition:

The median-standard deviation plot stewart (1958). and assega's well known C-M diagram (1957 & 1962) were used to econstruct the mechanism of deposition of sediments.

From the median-standard deviation diagram (Fig.11), it as found that many of the collected samples are affected by eposition from suspension and reworking by currents in ddition to the wave action which was intensive enough to hift the parameters into requested field (i.e.) . The ajority of the samples are of polygenetic nature.

The C-M diagram for the collected samples is shown in ig.(12). This figure is not so specific to indicate single echanism of transportation and deposition of sediments. ossibly, three main processes affected the area, deposition om suspension, traction currents and wave processes. They

Table (1) : Statistical parameters and the data derived from grain size analysis.

Sample No.	Depth (m)	Median (Md)	Mean (MZ)	Sorting (σ_1)	Skewness (SK_1)	Kurtosis (KC)	Shell %	Sand %	Silt %	Clay %	Sediment type
1	1.65	1.8	1,32	4.10	-0.14	0.866	38.19	32.73	19.32	9.76	silty sandy shell
2	3.0	5.4	3.47	4.14	-0.54	0.52	25.62	17.11	51.56	5.22	sandy shelly dilt
3	3.5	6.2	3.70	4.09	-0.58	0.56	30.06	3.92	60.00	5.8	shelly silt
4	4.55	6.3	3.76	4.05	-0.71	3.05	17.06	3.41	70.69	8.59	shelly silt
5	4.80	6.1	2.98	2.67	-0.45	2.87	12.93	3.75	75.54	8.59	shelly silt
6	4.40	5.2	2.9	1.90	-0.35	1.39	12.93	4.8	77.96	4.75	shelly silt
7	2.55	5.9	3.35	4.12	-0.366	4.10	11.84	6.38	75.43	6.35	shelly silt
8	3.8	6.12	3.49	4.09	-0.94	0.58	26.30	3.88	64.30	5.59	shelly silt
9	3.90	5.3	3.17	3.93	-0.56	0.55	26.55	4.51	64.88	4.00	shelly silt
10	3.5	6,29	5.88	2.13	-0.64	5.38	8.69	5.86	79.95	5.96	silt
11	3.20	5.75	5.19	2.33	-0.612	2.97	10.28	8.84	76.59	4.28	shelly silt
12	1.60	6.39	4.13	4.22	-0.37	1.52	16.12	6.17	62.26	15.37	clayey shelly silt
13	2.60	5.8	5.6	4.48	-0.31	1.56	2.45	4.06	86.95	6.55	silt
14	1.60	4.08	4.52	3.2	-0.28	1.79	10.50	37.75	38.81	12.57	clayey shelly silt
15	3.30	3.15	2.05	2.46	-0.80	2.96	14.16	8.26	72.15	5.41	shelly silt
16	4.10	7.1	6.66	2.32	-0.64	2.14	5.47	8.27	81.43	3.60	silt
17	1.80	6.3	6.13	2.21	-0.44	9.95	6.50	4.48	83.53	5.50	silt
18	2.55	6.2	5.2	2.86	-0.6	0.71	11.15	10.17	71.26	5.59	sandy shelly silt
19	5.20	7.3	6.1	3.39	-0.44	1.68	11.39	10.56	55.64	22.42	sandy shelly clayey silt.
20	5.50	5.0	3.13	4.22	-0.43	0.66	24.93	19.02	50.42	5.40	sandy shelly silt
21	5.25	6.1	3.73	4.51	-0.54	0.59	29.92	10.68	48.10	4.30	sandy shelly silt
22	6.85	5.6	4.33	4.96	-0.30	0.61	31.92	9.45	25.48	33.17	silty shelly clay
23	6.0	6.1	4.98	2.58	-0.79	0.69	22.28	14.92	57.72	4.83	sandy shelly silt
24	7.20	6.03	4.28	3.66	-0.45	3.74	2.45	4.06	88.95	6.55	silt
25	3.75	-0.3	0.73	3.2	0.27	0.65	38.80	14.7	26.49	20.38	sandy clayey silty
26	0.4	2.5	1.56	3.47	-0.17	2.09	19.58	61.66	12.28	6.35	silty shelly sand
27	0.34	1.45	1.3	1.05	-0.31	0.99	-	100.0	-	-	sand
28	0.3	4.9	6.02	3.39	0.15	0.77	-	31.22	34.66	34.11	sandy clayey silt
29	0.4	2.85	2.75	1.033	-0.27	0.92	-	94.20	5.80	-	sand
30	0.20	2.9	2.8	0.88	-0.12	1.04	-	93.66	6.00	-	sand
31	0.3	-0.2	-0.21	0.63	-0.29	2.22	-	99.96	-	-	sand
32	0.4	1.8	1.83	0.61	-0.08	1.18	-	99.48	0.53	-	sand
33	0.[illegible]	3.2	2.7	1.46	-0.4	0.81	-	92.92	7.8	-	sand
34	3.63	5.2	4.4	5.07	-0.2	0.58	24.82	16.06	25.96	33.12	sandy shelly silty clay.
35	2.10	6.9	6.7	1.41	-0.13	1.02	-	3.06	83.49	13.45	clayey silt
36	4.25	6.0	3.57	1.74	-0.76	3.31	25.6	4.64	65.41	4.27	shelly silt
37	5.20	6.0	3.7	4.24	-0.58	1.89	24.83	9.20	53.21	10.57	clayey shelly silt
38	6.86	6.1	3.57	3.25	-0.83	1.62	16.97	3.35	79.66	0.15	shelly silt
39	5.37	6.15	3.61	3.70	-0.84	0.49	12.88	1.52	70.57	9.01	shelly silt

Table (2) : Environmental interpretation of the bottom sediments of lake Qarun due to the application of the discriminant functions of Sahu.

Sample No.	Y1	Y2	Y3	Y4	Environment
1	56.980	1187.31	9.19	-	Shallow agitated marine
2	53.90	1180.38	6.751	-	Shallow agitated marine
3	45.20	1156.96	1.42	-	Shallow agitated marine
4	58.26	1180.23	11.56	-	Shallow agitated marine
5	46.89	560.03	1.55	-	Shallow agitated marine
6	9.41	301.9	-2.54	-	Shallow agitated marine
7	57.26	1257.55	11.72	-	Shallow agitated marine
8	53.22	1147.52	13.84	-	Shallow agitated marine
9	48.0	1064.0	9.23	-	Shallow agitated marine
10	13.889	478.125	0.789	-	Shallow agitated marine
11	12.13	481.87	1.279	-	Shallow agitated marine
12	56.67	1256.99	12.71	-	Shallow agitated marine
13	59.8	1429.70	14.49	-	Shallow agitated marine
14	27.92	781.393	1.49	-	Shallow agitated marine
15	25.95	470.06	1.79	-	Shallow agitated marine
16	4.15	488.94	2.63	-	Shallow agitated marine
17	28.08	592.96	0.458	-	Shallow agitated marine
18	15.22	633.97	3.64	-	Shallow agitated marine
19	24.50	829.84	4.78	-	Shallow agitated marine
20	57.68	1223.59	12.06	--	Shallow agitated marine
21	65.23	1395.75	15.20	-	Shallow agitated marine
22	169.189	1690.16	18.49	-	Shallow agitated marine
23	10.64	513.79	3.203	-	Shallow agitated marine
24	46.88	1008.26	8.19	-	Shallow agitated marine
25	38.1	701.18	0.39	-	Shallow agitated marine
26	45.86	851.2	2.99	-	Shallow agitated marine
27	9.66	58.61	-	-	Beach deposition
28	23.75	860.89	8.067	-	Shallow agitated marine
29	-2.45	125.25	-5.56	-	Shallow agitated marine
30	-3.65	-	-	-	Eolian deposition
31	9.71	58.61	-	-	Beach deposition
32	-1.44	73.49	-7.42	7.97	Turbidity current deposition.
33	1.58	196.88	-3.854	-	Shallow agitated marine
34	81.64	1765.02	19.18	-	Shallow agitated marine
35	-13.23	-	-	-	Eolian deposition
36	10.51	301.51	-0.88	-	Shallow agitated marine
37	60.42	1244.77	13.15	-	Shallow agitated marine
38	46.05	994.86	10.45	-	Shallow agitated marine
39	42.71	979.32	10.52	-	Shallow agitated marine

occupy a small field in the diagram and they have some tendency to approach pessega's pattern for sediments transported by traction currents.

So, the mechanism of deposition of lake Qarun sediments is of polygenetic nature.

"THE SEDIMENT DISTRIBUTIONS"

From grain size analysis, a sediment distribution map were constructed based on the percentage of shelly granules, sand, silt and clay following the sediments textural nonenclature put forward by Shepard (1954).

The distributions of shelly granular deposits are concentrated mainly around the Golden horn island, where it reach more than 30% then decrease toward the west and to the east, where it reaches less than 30%. There are actually numerous areas where coarse fraction exist on the outer part of the lake rather than on the inner part (Fig.13). In the eastern part of the lake, the silt fraction is deposited directly in front of El-Bats and EL-Wadi drains, it reaches its maximum percentages (more than 75%) followed by sandy silt area including clayey silt. The silty sand marges into north-east to the south where silty sand and sand are present. While in the western part of the lake, the silt reaches its maximum (more than 75%) at the western side of the lake followed by an areas of clayey silt to sandy silt and shelly silt (Fig. 14). The caly fraction is concentrated directly off the main drains (EL-Bats and EL-Wadi drains), where it reaches more than 20% and gradually surrounded by lesser areas where the clay percentage decreases and reaches its minimum value (Fig. 15).

Generally, the texture of the sediments changes irregularly with respect to shoreline. There are actually many areas where the coarse sediments exist on the outer part of the lake rather than on the inner part. The fine fraction is deposited directly off the main drains and located nearly in the middle part of the lake where, greater depths are reached, So, the distribution of the sediments is conrolled mainly by depth where the particle size of sediments decreases with the increasing depth (Fig. 16), as well as the effect of currents, wind and drainage patterns. The bottom configuration seems to have an effect on the distribution of the sediments. In this respect, the distribution maps show clearly that the fine grained sediments are distributed both in considerable depth as well as in shallow water depth whereas, the coarse sediments occur in the shallow water depth.

The wind and drainage pattern are considered as a chief source of sedimentary materials derived to the lake. In front of the main drains, the finer material in suspension would settle immediately due to the coagulation resulting

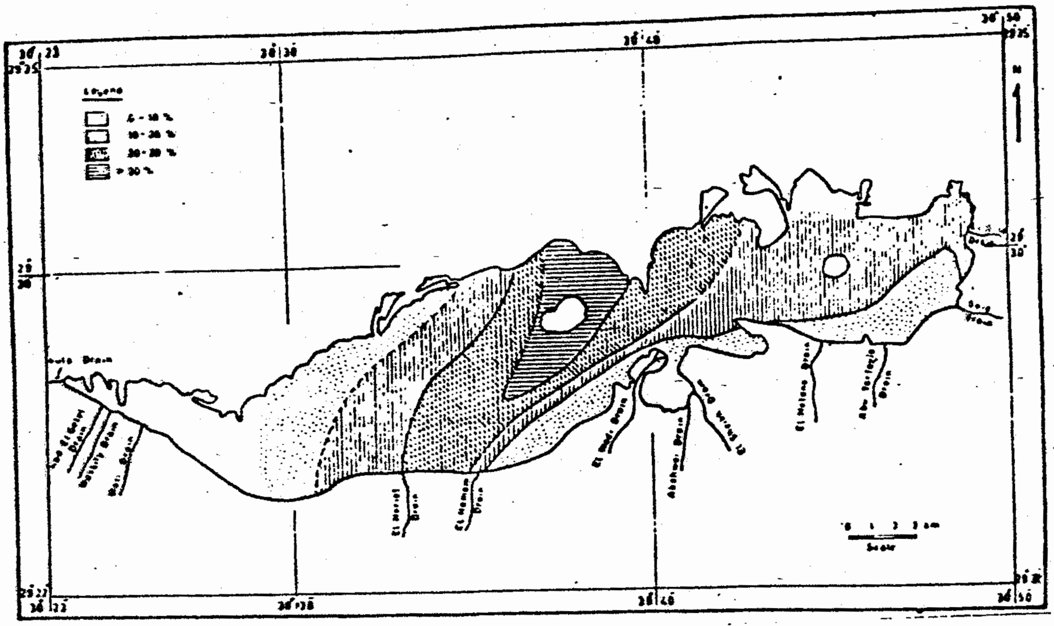


Fig (13) Frequency distribution of shellh granule fraction map.

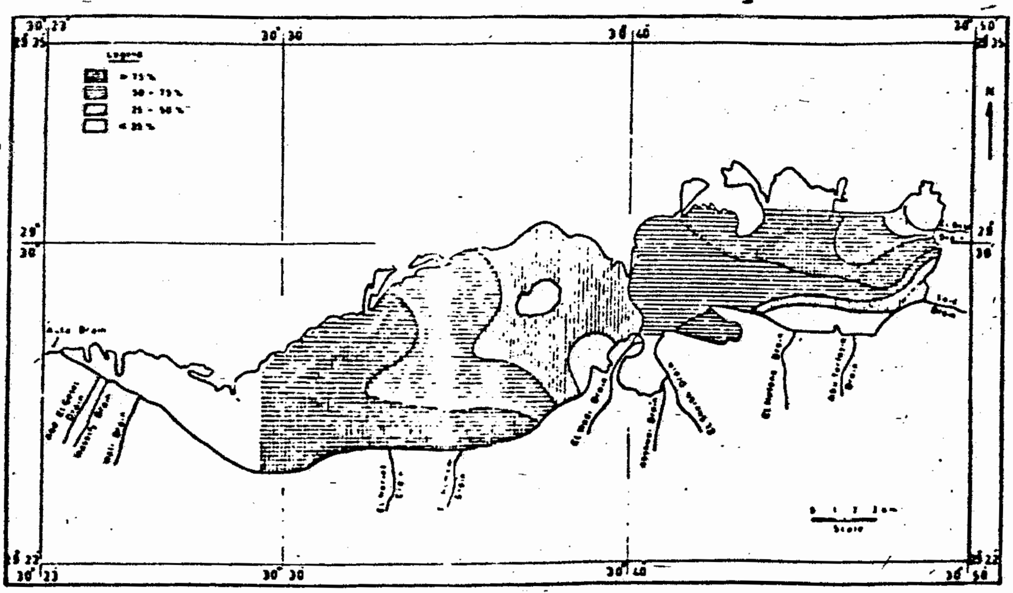


Fig (14) Frequency distribution of silt froction map.

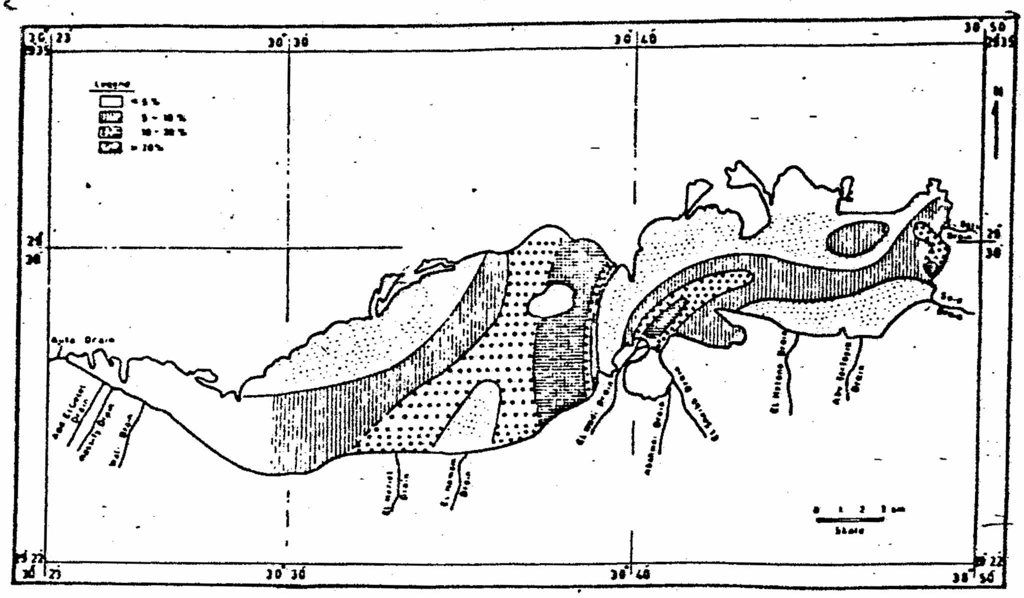
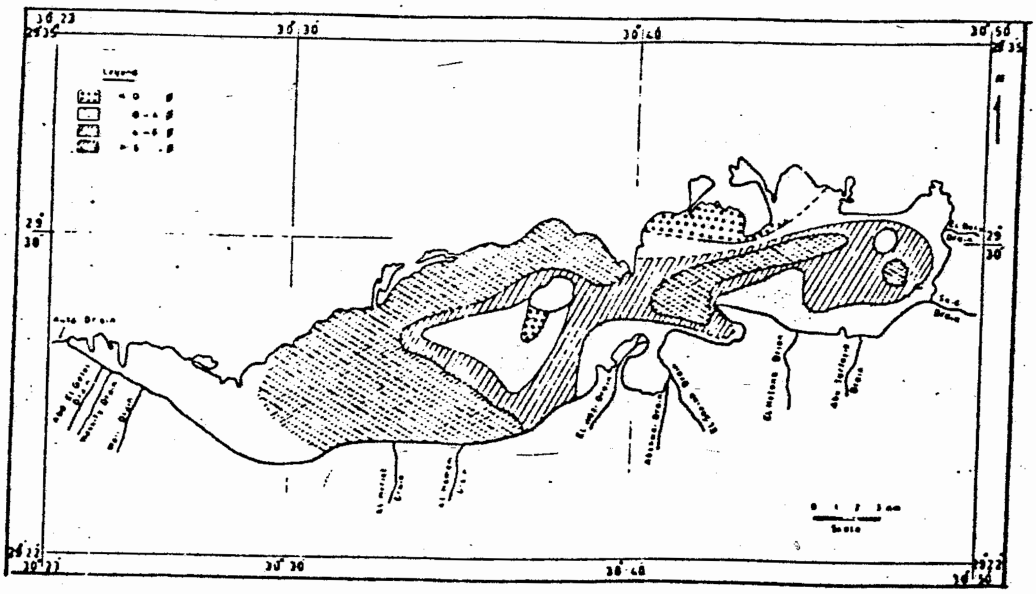


Fig (15) Frequency distribution of clay fraction map.



Fig(16) Median diameter distribution map.

from the mixing of salt and fresh water (Mohamed, 1968). Moereover, the decrease in the velocity of the drainage water with the saline water of the lake results a rapid deposition of the coarse particles and thus, settle rapidly. During surges and intensive turbulence which are prevailing in this lake, the finner particles are however carried in suspension by the generated currents to a distant aeas far from their original area of deposition and then settle down where the velocity of the currents gradually decreases (Mohamed, 1987). This explains the existance of the deposits of finer grain size in places far from the main drains.

The presence of sands on the southern coast would be attributed to the winnowing out of the fine fraction from the bottom deposits by the strong currents estimated by the author with 10-12 cm/sec. Accordingly, the depth at which the fine deposits began to appear marks the place at which agitation of the bottom deposits by winds and waves generated currents ceases (Inman, 1952). This does not mean that the current action is completly lacking beyond this depth but it became weak and incapable of doing much work. The presence of shelly granules at relatively greater depths, (e.g) near the Golden Horn island, indicates that, the environmental conditions such as salinity, depth, and texture of sediments are favourable for their flourishing (Mohamed, 1979).

The sediments composed from muddly shelly gravels and sand are mainly rich in carbonate material. This sediment type may be derived from the coastal areas by erosion, whereas the agents of erosion are here wind and wave that hit the coast obliquely resulting longshore and rip currents (Fig.17). So the currents have a considerable effect on the distribution of the sediments in the present area.

CONCLUSIONS

From the foregoing discussion we arrived to the following conclusion that the Recent bottom sediments of lake Qarun are mainly of polygenetic nature and were deposited under shallow agitated marine environments affected mainly by currents.

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