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MINERAL AND GEOCHEMICAL STUDIES ON SUBSURFACE SEDIMENTS, EL - BURULLUS LAGOON NORTH NILE DELTA, EGYPT.

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ABSTRACT

Geochemical and mineral studies of five cores and 23 bottom sediment samples from El - Burullus lagoon north Nile Delta used various analyses by X - ray diffraction and chemical analysis. From the sedimentary study it was found that El - Burullus lagoon sediments may be derived from the beach and deltaic deposits, poorly to very poorly sediment with silt, very fine sand and clay related to river source and deposited under quit water action. Mineral study indicates the presence of minerals illite, kaolinite, Quartz, K - feldspars,Calcite, Mg - Calcite and Oraganite.

Heavy minerals detected reveal that they are concentrated at the far eastern rim of the lagoon (near Boughaz El Bourg) and gradually decrease westward.

The chemical analyais for major and trace elements indicate that the organic matter may not be related to corbonate skelatal organisms and may affected by the texture of the sediments. Mg / Ca tend to be high near the inlets and decrease in the middle of lagoon. MnO and Fe_2O_3 content seem to be present in very small amount. Na and K oxides content are generaly decrease from east to west.

The trace elements distribution show marked concentration through the lagoon. Its concentration is strongly related to the southern freshwater drainage of the Nile which may affected by pestiside and the industrial activities.

Introduction

El-Burullus lagoon which is the target of the present study occupies an area of about 505km^2. It is situated at the north central part of the Delta between Long.30° 30' and 31° 10'E and Lat. 31° 19' and 31° 36'N (Fig.1).

The Lagoon recieves its water from two main sources, the Mediterranean sea via Boughaz El Bourg by storm action, and rainfall, seeps from adjacent territories. The fresh water flows in from seven drains and Brembal canal.

El-Burullus lagoon had been studied by many authors, among them, Hume, (1925), Zeuner (1954), Shukri (1954) Malaty (1960), Said (1962), El Sedafy (1971), Libosvarsty et al (1972), Darrag (1974), Zazou (1977), Singer (1980), Singer and Stoffers (1980), Beltagy (1985), Selim and Zazou (1987), Nawar (1987), Abdel Moati et al. (1988), Hashm and Hosny (1988), Mahmoud and Beltagy (1987) and Maiyza et al. (1988).

The present work, a mineral and geochemical study is carried out on a set of five core samples and 23 bottom samples collected by the author in June 1989. The identification and distribution of some mineral and chemical components, and their interrelationships are useful as hydrolic tracers indicating origin the lagoon environment.

Core samples 36cm and 95cm long were collected from the bottom of the lagoon using a small local made gravity corer on board of a large boat. The cores were kept in their lined plastic tubes were longitudinally cut into two halves. The samples were taken from one half at 10cm intervals and as every lithologic variation. Samples were dried in an oven at 105^{o}C, whereas the other half was kept for reference.

Thirty one susburface sediment samples representing five cores, 5 samples from core (I), 8 samples from core (II), 4 samples from core (III), 9 samples from core (IV) and 5 samples from core (V) were analyzed. In addition 27 bottom samples were collected to trace the present day sedimentation processes using trace element analysis.

The main mineral and chemical components in cored sediments have been determined quantitavely by X-ray diffraction using CaF_2 as internal standard and by atomic absorption respectively and all the anlalysis were carried out in central laboratory of faculty of science, Menoufia University

Sedimentary study.

The sediment samples were mechanically analysed following the technique of Krumbein and Pettijohn (1938) and their statistical parameters calculated according to the equations proposed by Folk & Ward (1957), (Table 1). The sediment types were deduced using the diagram proposed by Pettijohn et al. (1972), (Fig.2).

The mechanism of transportation was determined using the C-M diagram constructed by Passega (1957) and Passega and Byramijee (1969), (Fig.3).

The obtained data (Table.1) shows that the mean size (average 4.28) exceeds the median diameter (average 4.08) indicating that the subsurface sediments may have been derived from the mediterranian coast where core I sited (Fig.1). However, the median diameter exceeds the mean size in other cores indicating typically lake deposits (shepard, 1973).

The sorting coefficient of the collected samples points to poorly to very poorly sorted sediments which may be related to a river sources (Folk, 1968). The Kurtosis reveals that all the core samples reflect platykurtic to mesokurtic. The skewness at core (I) are skewed toward the fine fractions while in other core samples, they are skewed toward the coarse fractions.

However, C.M diagram reveals that the mechanism of transportation of subsurface sediments depend on suspension and rolling where the majority of samples lies at the category between Md (15-100 micron) and C_1 (1000-20,000 micron).

So, the subsurface sediments of El-Burullus lagoon are poorly to very poorly sorted with silt, very fine sand and clay which deposited by river under quiet water action.

Mineral investigation.

A-X-ray diffraction.

Non clay minerals.

X-ray diffraction analyses indicate that minerals in the bulk samples are represented by varying amounts of carbonates (calcite, Mg-calcite and aragonite), quartz and feldspars that vary in proportion according to location of core and depth of samples (Table 2). It could also be noticed that calcite and aragonite appear only in the top of bottom samples and disappear in subsurface samples with the exception of core (II) where aragonite was not detected. It is also noted that Mg-calcite is not detected in the top of cores I, II and III.

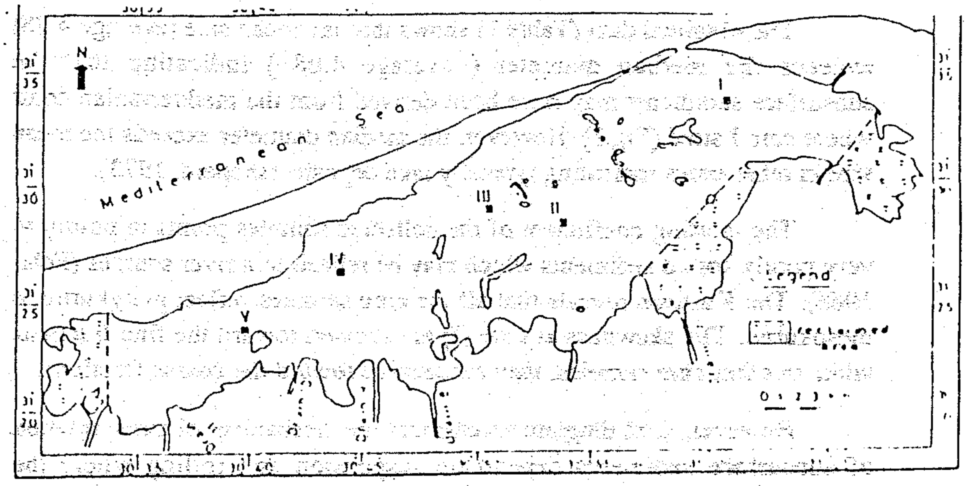

Fig (1): Location map showing the position of the cores.

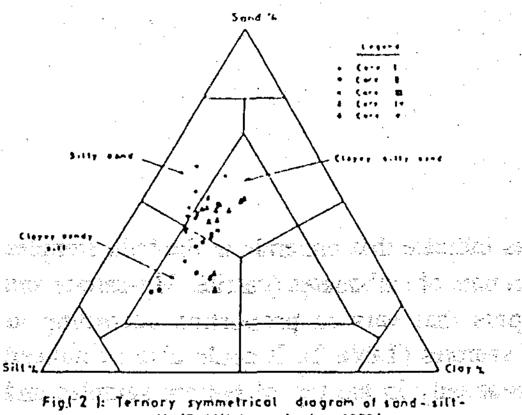

Fig (2): Ternary symmetrical diagram of sand-silt-clay % (Pettijohn et.al , 1972).

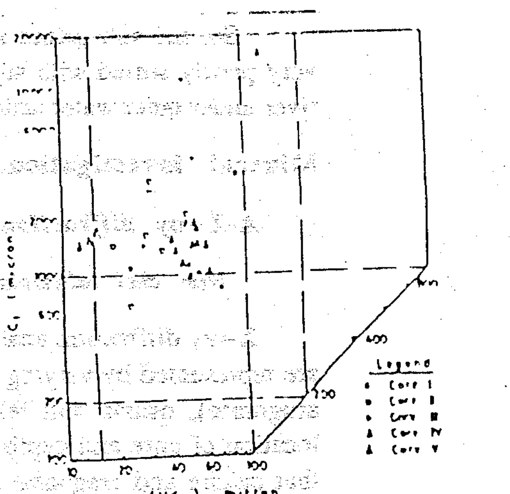

Fig (3) : The interrelation between the first percentile in micron and the median diameter in micron (Passiga and Byramjee , 1969).

Table (1): The data derived from mechanical analysis and statistical parameters of subsurface sediments

Core No	sample No	Thicknes cm	Md	M_z	61	Sk_1	KG	C_1	C_1 in micron	Md	Sand	Silt	Clay	Sediment type
I	1	0.00	3.20	3.70	2.96	0.12	0.78	1.8	3500	9.5	58.30	24.37	17.33	Clayey silty sand
	2	12.50	5.10	4.80	2.74	0.16	0.71	0.5	1425	29	39.81	36.98	23.21	Clayey silty sand
	3	22.50	3.70	3.97	2.07	0.21	1.10	0.3	810	77	60.57	29.77	9.09	silty sand
	4	32.50	4.10	4.52	1.88	0.30	1.00	0.0	1000	58	49.20	37.50	13.30	silty sand
	5	42.50	4.30	4.45	2.28	0.09	0.80	0.1	1075	51	46.30	39.00	14.70	silty sand
	average		4.08	4.28	2.38	0.112	0.87	38	1533	62	50.84	33.52	15.53	
II	1	0	5.10	4.57	2.72	0.23	0.75	0.7	1625	29	38.10	40.70	21.20	Clayey sand, silt
	2	5	0.05	4.47	3.10	0.22	0.68	1.5	2825	31	39.56	38.46	21.98	Clayey sand, silt
	3	15	4.80	4.43	2,87	0.13	0.70	0.4	1325	36	41.40	35.68	22.88	Clayey sand, silt
	4	25	0.50	4.77	2.81	0.15	0.76	1.6	3250	31	36.60	43.34	20.06	Clayey sand, silt
	5	35	5.70	5.30	2.23	0.27	0.86	0.5	1425	19	28.80	47.00	24.30	Clayey sand, silt
	6	45	5.40	5.77	2.19	0.22	1.06	0.6	660	24	23.71	59.03	17.26	Clayey sand silt
	7	55	4.35	4.22	2.79	0.05	0.77	-1.1	2150	29	45.20	39.70	15.10	Clayey sand, silt
	8	60	5.35	5.32	1.75	0.02	1.09	1.8	287.5	24.5	23.27	60.71	15.72	carbonaceous sand
	averge		5.08	4.78	2.55	0.161	0.83	0.425	1287.1	28	34.78	45.57	19.813	
III	1	0	3.50	3.57	2.92	0.03	0.60	1.8	3500	92.5	52.30	35.50	12.20	silty sand
	2	10	4.35	4.05	2.58	0.19	1.09	3.5	1150	49	40.50	44.20	15.30	Clayey sand, silt
	3	20	4.20	4.08	2.93	0.08	0.76	2.1	4300	54	49.30	31.60	19.10	Clayey sand, silt
	4	32.5	5.40	4.67	2.86	0.35	0.73	0.1	1075	24	32.09	48.84	19.07	Clayey sand, silt
	averge		4.36	4.09	2.82	0.148	0.795	1.88	2221.6	54.88	43.55	40.04	18.418	
IV	1	0	3.00	3.28	3.83	0.02	0.83	3.9	1550	125	27.62	17.14	25.52	Clayey silty sand
	2	15	4.20	4.00	2.75	0.08	0.70	0.8	1750	55	47.90	35.30	16.30	Clayey silty sand
	3	25	4.55	4.28	2.83	0.08	0.72	0.4	1325	43	44.00	36.60	19.40	carbonaceous sand
	4	35	4.60	4.33	2.81	0.11	0.67	0.6	1525	41.5	44.70	34.30	21.20	Clayey silty sand
	5	55	4.17	4.01	2.75	0.04	0.73	0.525	1438	55.13	47.25	36.90	15.85	carbonaceous sand
	6	65	4.40	4.20	2.59	0.07	0.77	0.2	1150	47.5	45.88	38.52	15.60	Clayey silty sand
	7	75	4.30	4.37	2.40	0.03	0.69	0.2	970	51.0	45.70	38.40	15.90	Clayey silty sand
	8	85	4.20	4.40	2.64	0.04	0.67	0.9	1875	54.0	48.80	31.30	19.90	carbonaceous sand
	9	95	3.95	4.58	2.18	0.31	0.94	0.0	1000	65.0	5.00	32.90	16.10	carbonaceous sand
	averge		4.15	4.16	2.75	0.00	0.747	0.792	2948.1	59.68	48.07	33.54	18.39	
V	1	0	4.00	4.23	2.80	0.10	0.65	0.55	1450	92.5	50.15	27.75	24.28	Clayey silty sand
	2	7.5	4.35	4.20	2.83	0.07	0.68	0.9	1875	79.0	47.30	33.20	19.50	Clayey silty sand
	3	17.5	6.00	4.93	2.91	0.44	0.9	0.8	1750	15.5	28.27	42.60	29.23	Clayey silty sand
	4	27.5	6.10	5.13	2.70	0.46	0.96	0.6	1525	14.5	27.97	43.22	28.81	Clayey silty sand
	5	37.5	6.30	565	2.65	0.48	1.06	0.5	1425	12.5	24.31	44.99	30.70	Clayey silty sand
	averge		5.35	4.76	2.77	0.27	0.85	0.67	1605	30.8	35.6	37.92	26.48	Clayey silty sand

Table (2): The mineral constituents of bulk sample percentages as calculated from X-ray analysis.

Core	Sample	Thickness	Mineral percentages						
No	No	Cm	illite %	Kaolinite %	Quartz %	K-feldspars %	Calcite %	Mg-calcite %	Aragonite %
I	1	0	9.86	14.37	43.1	5.33	21.63	0.00	3.17
	2	12.5	1.06	17.44	29.81	8.19	0.00	41.44	0.00
	5	42.6	4.22	6.75	22.75	22.75	0.00	32.60	8.16
II	1	0	3.22	21.87	20.26	31.19	21.24	0.00	0.00
	3	15	1.49	38.70	25.31	13.65	18.63	0.00	0.00
	5	35	2.77	7.13	69.77	3.57	0.00	15.02	0.00
	7	55	6.67	25.04	53.42	6.67	0.00	4.36	0.00
	8	60	6.55	4.59	39.72	40.37	0.00	1.35	0.00
III	1	0	2.81	10.14	29.84	20.26	18.46	0.00	15.67
	2	10	1.28	2.56	28.46	25.39	0.00	37.60	0.00
	3	20	2.31	5.19	29.94	8.92	0.00	48.75	0.00
	4	32.5	1.77	15.94	39.30	35.06	0.00	3.60	0.00
IV	1	0	4.49	5.02	36.92	16.15	23.01	4.17	9.72
	4	35	3.17	16.93	61.38	7.93	0.00	3.90	0.00
	6	65	12.35	26.23	38.58	9.26	0.00	3.80	0.00
	7	75	4.98	34.91	34.91	12.47	0.00	4.23	0.00
	8	85	1.52	50.19	22.81	16.73	0.00	1.31	0.00
	9	95	0.19	1.48	71.88	17.41	0.00	1.50	0.00
V	1	0	3.71	44.5	15.58	3.71	6.00	18.76	5.25
	2	7.5	2.32	6.96	38.99	2.32	0.00	46.46	0.00
	3	17.5	2.42	36.40	24.27	24.27	0.00	11.11	0.00

The presence of aragonite in the top of each core only, may be related to that the aragonite is more soluble than calcite and less soluble in shallow sea water than some high-magnesian calcites (Chave, 1954a). However, aragonite exposed to dissolution with depth. The absence of aragonite in core may be due to either complete dissolution of aragonite or to non deposition of skeletal aragonite layers. The distribution of Mg-calcite is related to three factors, mineralogy, physiology and temperature (Pilky and Hower, 1960, Lowenstam, 1961). From data listed in table 2 it can be shown that Mg-calcite contents are detected in all core samples except sample one (at top) in cores No. I, II and III. Also calcite mineral is detected in all bottom samples in all cores and disappeared with depth. It is noted that calcite is not detected in the samples containing Mg-calcite with some expections, this may be due to the inhibiting effect of Mg^{2+} on calcite precipitation (Curl, 1962).

Quartz has an average content that ranges from 24.30% to 44.41%. It show a marked increase in core (IV).

K-feldspar shows a fairly varible content allover the lagoon with a maximum of 40.37%

ii-Clay minerals

Semi-quantitative estimates of clay minerals have been obtained from individual measurements of the area under the peak of (001) reflection.

Subsequently; the relative abundance (%) of the area under each (001)peak was calculated as part of the total area of all (001) reflections measured within each core sample (table 2). clay mineral analyses of 27 samples from five core sediments revealed the presence of kaolinite and illite. It is noted that kaolinite is recorded in a fairly high percentage in most cores except core (III), while illite percentage is fairly less in all cores. Apparent increase in illite content is noticed in some samples.

In general the deposited clays reflect the weathering environment in the source area and early diagenesis. This relationship between weathering condition and deposited clays might also be extended to the depositional environment as observed in El-Burllus lagoon sediments.

The presence of kaolinite in the clay assemblages seems normal since kaolinite forms under warm, wet conditions accompanied by a high leaching rate (Singer 1980). Illite prevails with high abundance in sediments of core (III). Illite could have been either detrital in origin or a product of diagenetic alteration or both. The increase of illite in core (III) may indicate that illite may be partly a praduct of K^+ koolinite which can be easily transformed to illite.

B-Heavy minerals

The heavy minerals are examined at 0.125 and 0.25mm fractions and the identified minerals are opoques, amphibole, mica, pyroxene, garnet, zircon and staurolite (Table 3).

The distribution of heavy minerals reveals thier concentration at the far eastern rim of the logoon (near Boughaz El-Bourg) and gradually decrease westward and not detected in core(II). Core(I)and (III) are characterized by fairly high amount of minerals correlative to the surrounding areas contaning both cores (IV) and (V). The absence of some heavy minerals in subsurface core samples may be either not detected or attributed to mineral decay, alteration and biochemical influnces.

Chemical analyses

Chemical analyses carried aut on the acid soluble part of the sediments for the major and trace elements, the data are plotted at figures (4&5) and listed at table 4.

The organic matter content seems to increase from core(I) to core (IV), while its content decline at core(V).

The major factor affecting the distribution of organic matter is the texture of the sediments, where the fine sediments have similar settling velocity like organic matter [Parker and Selluwood (1983), Trask (1939)].

Phosphorus averages content range from 0.037 to 0.011%. It could be noticed that phosphours concentration (table 4) is not related to organic corbon concentration as it increase with decreasing organic carbon content and increase in water bodies close to the main inlet (Boughaz El Bourg) and decrease toward the south west.

Mg / Ca averages tend to be high at core I and core V (i. e near the inlets) while tend to decrease in cores II and IV. This tendency may be due

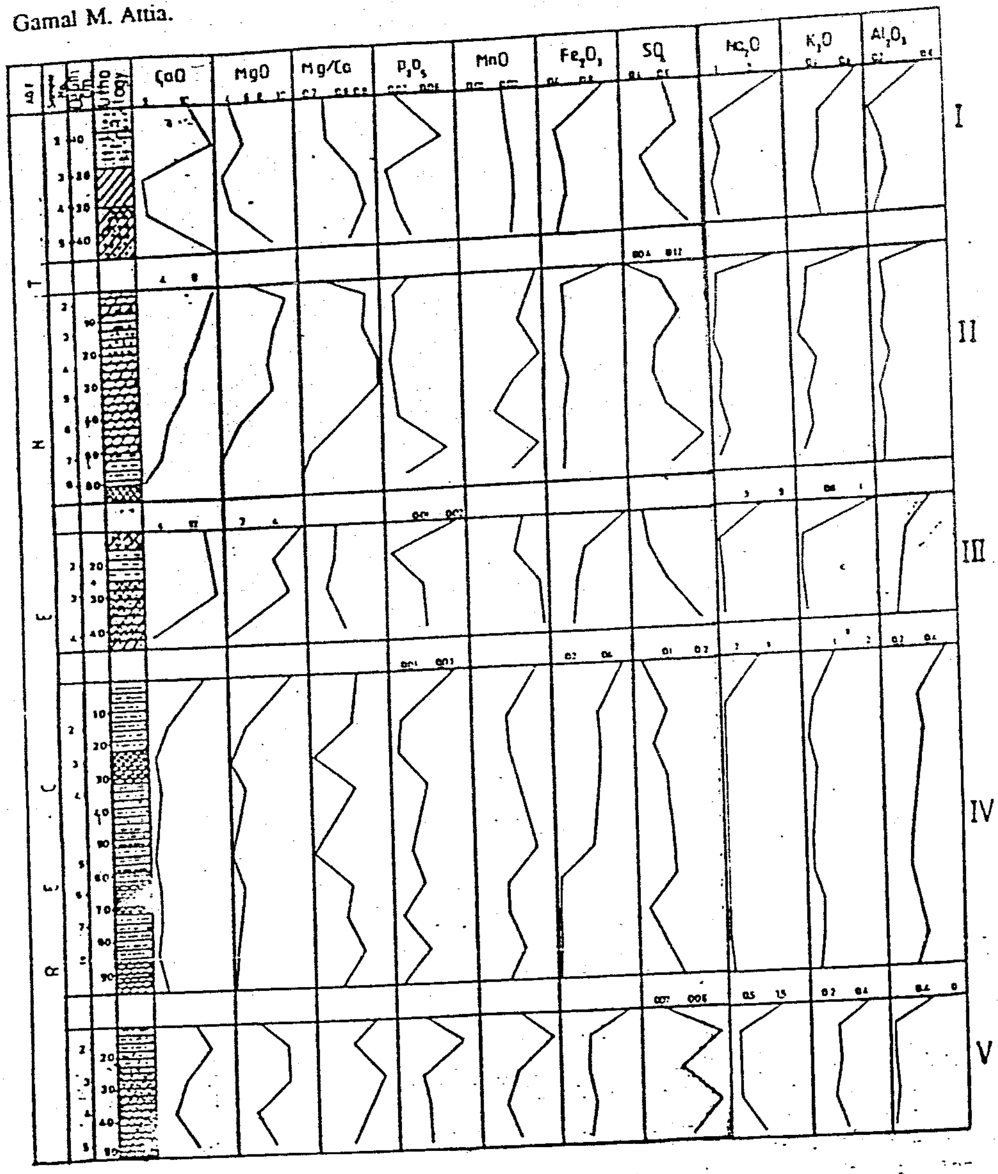

Fig.(4): Major and trace elements distribution through the five core sediments of El Burullus lagoon, Table (3) Heavy minerals percentages of subsurface sediments in El-Burullus Lagoon.

Sample No	Core No.	Thickness cm	Opaques	Amphibols	Mica	pyroxens	Garnet	Zircon	Staurolite	Index figure	wt. %
1	I	0	12.9	28.38	20	3.23	29.03	3.23	3.23	0.0075	0.73
2		12.5	13.51	81.09	-	-	5.41	-	-	0.0034	-
3		22.5	21.74	76.09	-	-	2.17	-	-	0.003	-
4		32.5	9.09	-	-	-	90.9	-	-	0.0028	-
5		42.5	11.43	-	-	-	88.57	-	-	0.0025	
1	II	0	-	-	-	-	-	-	-	-	-
2		5	-	-	-	-	-	-	-	-	-
3		15	-	-	-	-	-	-	-	-	-
4		25	-	-	-	-	-	-	-	-	-
5		35	-	-	-	-	-	-	-	-	-
6		45	peated	-	-	-	-	-	-	-	-
7		55	peated	-	-	-	-	-	-	-	-
8		60	peated	-	-	-	-	-	-	-	-
1	III	0	50	35	15	-	-	-	-	0.0011	0.1086
2		10	-	-	-	-	-	-	-	-	-
3		20	-	50	-	30	-25	20	-	0.0012	-
4		32.5	-	75	-	-	-	-	-	0.003	-
1	IV	0	50	43	-	-	-	5	2	0.0072	0.67
2		15	-	-	-	-	-	-	-	-	-
3		25	-	-	-	-	-	-	-	-	-
4		35	-	-	-	-	-	-	-	-	-
5		55	peated	-	-	-	-	-	-	-	-
6		65	-	-	-	-	-	-	-	-	-
7		75	-	-	-	-	-	-	-	-	-
8		85	peated	-	-	-	-	-	-	-	-
9		95	peated	-	-	-	-	-	-	-	-
1	V	0	47	3.9	3	5.6	5.4	-	-	0.0067	0.661
2		7.5	-	-	-	-	-	-	-	-	-
3		17.5	-	-	-	-	-	-	-	-	-
4		27.5	-	-	-	-	-	-	-	-	-
5		37.5	-	-	-	-	-	-	-	-	-

Table (4) Chemical constituents of subsurface sediments in El-Burullus Lagoon.

Sample	Core No	depth cm	organic carbon	organic matter	CaO %	MgO %	Mg/Ca	P_2O_5 %	MnO %	Fe_2O_3	Na_2O %	K_2O %	Al_2O_3 %	A. I. R
1	I	0	1.475	2.540	11.04	3.81	0.34	0.02	0.01	0.89	0.86	0.90	7.5	52.44
2	I	12.5	1.300	2.240	14.90	5.70	0.38	0.08	0.02	0.39	0.44	0.48	19.5	40.25
3	I	22.5	1.380	2.370	3.94	3.05	0.77	0.01	0.02	0.46	0.84	0.40	01.12	80.37
4	I	32.5	1.050	1.810	4.63	4.06	0.87	0.02	0.02	0.53	0.35	0.32	05.55	73.07
5	I	42.5	1.560	2.680	13.60	9.20	0.67	0.04	0.02	0.42	0.71	0.38	16.81	36.76
			1.353	2.328	9.53	5.251	0.611	0.03	0.02	0.53	0.60	0.50	10.10	56.58
1	II	0	1.295	2.230	10.53	2.951	0.28	0.03	0.02	0.99	0.62	0.03	06.07	55.53
2	II	5	1.300	2.240	9.90	8.20	0.82	0.01	0.02	0.43	0.80	0.32	00.56	57.15
3	II	15	1.210	2.080	8.60	6.70	0.77	0.01	0.02	0.47	0.75	0.29	01.93	61.15
4	II	25	0.930	1.600	6.96	6.07	0.95	0.01	0.02	0.43	0.63	0.19	05.31	78.10
5	II	35	0.970	1.670	6.80	6.50	0.95	0.01	0.02	0.50	0.88	0.42	01.95	76.25
6	II	45	2.160	3.720	4.50	2.40	0.53	0.02	0.01	0.44	0.73	0.19	01.86	76.06
7	II	55	2.120	3.650	3.60	0.40	0.11	0.08	0.02	0.44	0.03	0.34	02.64	84.80
8	II	60	21.250	7.310	1.60	0.00	0.00	0.03	0.02	0.41	0.73	0.23	02.44	85.23
			1.779	3.0625	6.56	4.15	0.55	0.02	0.02	0.51	0.65	2.01	2.85	71.78
1	III	0	1.640	2.820	15.01	5.66	0.37	0.02	0.02	0.84	0.74	0.29	11.10	33.05
2	III	10	2.700	4.640	16.30	3.90	0.35	0.00	0.01	0.59	0.25	0.25	16.37	20.69
3	III	20	2.795	4.810	17.50	4.80	0.27	0.01	0.02	0.55	0.67	0.25	25.20	17.35
4	III	32.5	2.420	4.160	2.30	1.10	0.47	0.01	0.02	0.53	0.80	0.29	2.72	85.79
			2.389	4.108	12.78	3.86	0.36	0.01	0.023	0.62	0.62	0.27	13.83	39.22
1	IV	0	1.430	2.460	13.51	7.62	0.56	0.02	0.02	0.84	0.36	0.03	20.20	30.64
2	IV	15	2.680	4.610	4.02	1.97	0.49	0.01	0.01	0.53	0.52	0.31	10.82	80.04
3	IV	25	5.610	9.650	1.00	-	0.00	0.01	0.01	0.55	0.16	0.21	02.01	87.28
4	IV	35	3.830	6.590	2.25	1.15	0.51	0.02	0.01	0.53	0.35	0.38	06.00	85.42
5	IV	55	3.930	6.760	1.20	-	0	0.01	0.01	0.44	0.22	0.23	05.02	89.71
6	IV	65	5.610	9.650	2.54	1.20	0.47	0.01	0.01	0.01	0.31	0.25	08.72	82.49
7	IV	75	4.920	8.460	2.55	1.08	0.42	0.01	0.01	0.01	0.88	0.48	05.30	83.27
8	IV	85	4.280	7.360	0.84	0.52	0.61	0.02	0.01	0.01	0.84	0.48	02.45	89.25
9	IV	95	4.310	7.410	0.96	0.34	0.35	0.01	0.01	0.01	0.92	0.40	05.82	88.567
			4.067	6.971	3.20	1.54	0.38	0.01	0.01	0.33	0.50	0.31	07.37	79.63
1	V	0	1.450	2.490	9.889	2.56	0.75	0.01	0.01	0.83	0.75	0.77	23.82	37.51
2	V	7.5	1.560	2.840	13.94	6.42	0.46	0.04	0.02	0.35	0.35	0.37	16.71	35.60
3	V	17.5	0.860	1.480	7.890	6.40	0.81	0.01	0.01	0.33	0.38	0.38	28.92	66.11
4	V	27.5	0.800	1.510	4.699	2.90	0.61	0.01	0.01	0.41	0.33	0.30	07.03	82.79
5	V	37.5	0.800	1.370	10.50	4.60	0.43	0.02	0.17	0.36	0.09	0.42	24.56	50.46
			1.110	1.938	9.383	4.57	0.61	0.02	0.01	0.46	0.38	0.45	20.21	70.14

to i) increase of the contribution made by shells and shell fragments of high Mg content in core I and V and that of low Mg content in other cores; ii) difference in the rate of diagenitic processes, probally due to differences in the rate of sedimentation; iii) general changes in the Mg / Ca ratio in the lagoon due to selective and consumption of the two elements by oganisms and iv) the effect of changes in water temperature in different parts of the lagoon (Bathrust, 1971).

The average MnO content ranges from 0.02 to 0.01 percent while Fe_2O_3content ranges from 0.62 to 0.33 percent Fe and Mn oxides seem to be present in very small amount. The low concentration of the two elements reveal the poverty of the source material and / or leaching of these elements, particulary in view of the low content of organic matter.

Na and K oxides are generally decrease from core I to core V (i. e from east to west). The increase of Na and K content in some core samples may be attributed to the absorbance of these elements by clay minerals.

Al_2 O_3contents shows nearly similar values in the core samples and agree with average content of acid insoluble residues where most of the samples composed of clayey silty sand.

Trace elements:

The areal distribution of the trace elements Cu, Pb, Zn, Mn, Ni, and Hg were studied in (23) bottom sediment samples. The samples were collected in such a way as to cover all the lagoon. In addition four samples were collected from Balteem and drainage Nos 11, 6 and 8 aiming to study the deposition of sediments, its sources and its pollutional effects, the data obained are listed in table 5 and plotted in the isochemical maps in figure (5a & 5b).

Copper, lead and zinc contents are relatively high. It could be noted that their distribution increases with feldspar-rich detrital sediments. Consequently, Cu, Pb and Zn are dispersed in the lagoon sediments from different drainage branches and the mediterranean sea inlet under the action of current regeim that runs in south-south east direction (fig. 5a).

Table 5 : Trace elements of bottom sediments and Nile drainages.

sample no.	Cu	pb	Zn	Mn	Ni	Hg
1	0.20	0.05	0.50	1.51	0.47	0.04
2	0.25	0.07	0.57	1.10	0.68	0.34
3	0.18	0.06	0.45	1.25	0.57	0.10
4	0.16	0,03	0.37	0.88	0.51	0.13
5	0.19	0.04	0.48	1.36	0.63	0.14
6	0.17	0.09	0.65	1.73	0.84	0.48
7	0.19	0.08	0.64	1.65	0.84	0.71
8	0.18	0.08	0.64	1.39	1.13	0.07
9	0.17	0.08	0.57	1.30	0.87	0.74
10	0.16	0.07	0.56	1.82	0.81	0.61
11	0.21	0.06	0.62	1.75	1.12	0.84
12	0.19	0.05	0.57	1.26	1.00	0.22
13	0.16	0.08	0.58	1.52	0.94	0.57
14	0.18	0.06	0.55	1.39	0.82	0.58
15	0.22	0.05	0.77	0.95	0.94	0.17
16	0.18	0.06	0.62	1.33	0.55	0.47
17	0.22	0.07	0.75	1.65	0.80	0.00
18	0.16	0.07	0.66	1.32	0.61	0.12
19	0.15	0.10	0.70	1.16	0.71	0.15
20	0.18	0.17	0.84	1.50	0.78	0.60
21	0.20	0.09	0.66	1.79	0.57	0.15
22	0.23	0.10	0.99	1.23	0.83	0.24
23	0.19	o.10	0.87	1.52	0.65	0.31
25	0.22	0.10	0.77	1.29	0.78	0.36
Baltim	0.13	0.10	0.35	0.34	0.06	0.26
ElGhar-bia	0.18	0.11	0.70	1.26	0.24	0.22
Draina-ge no.6	0.02	0.04	0.45	1.73	0.12	0.00
Draina-ge no.8	0.21	0.06	0.53	1.41	0.29	0.00

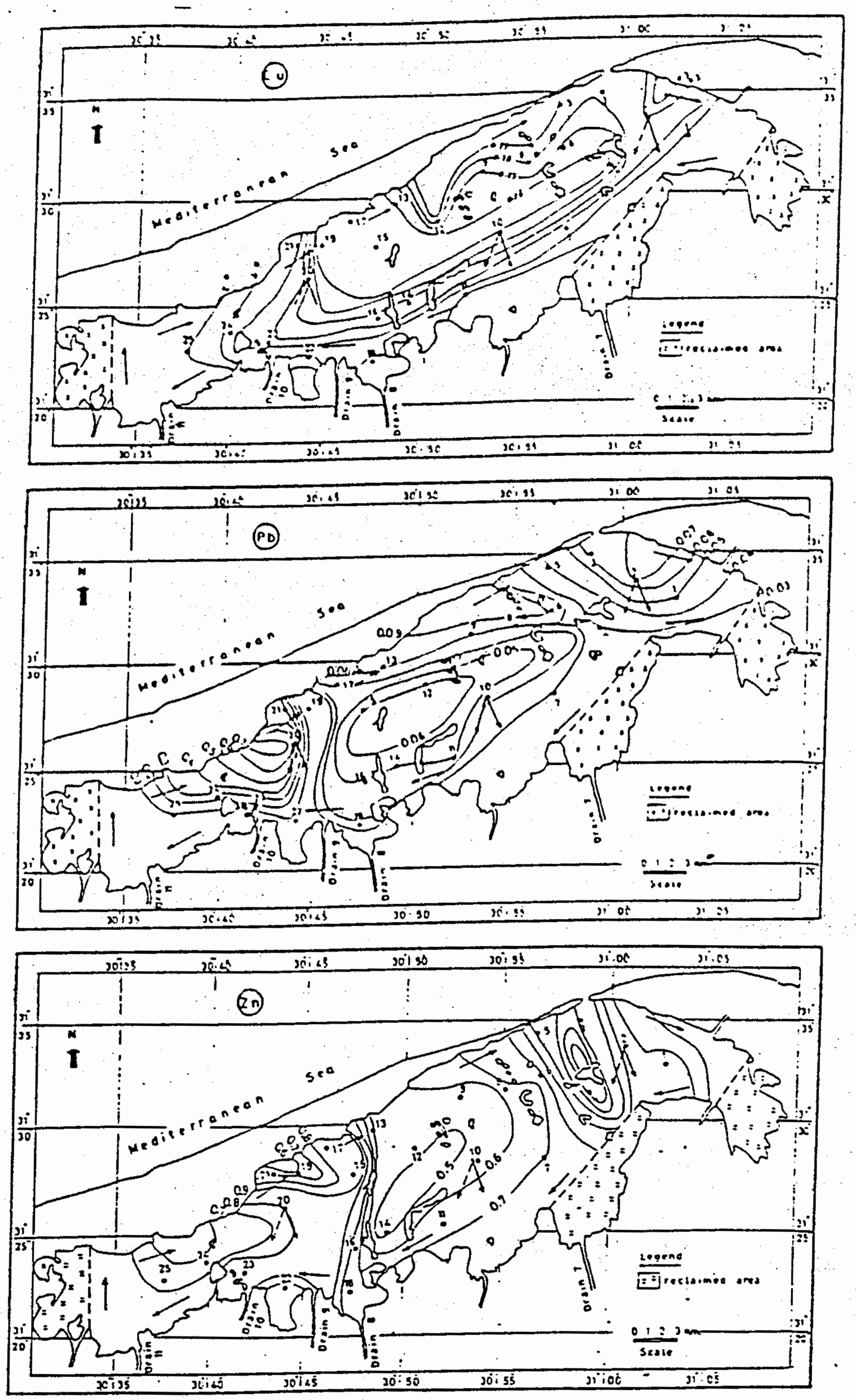

Fig.(5d): Isochemical maps of Cu, Pb and Zn

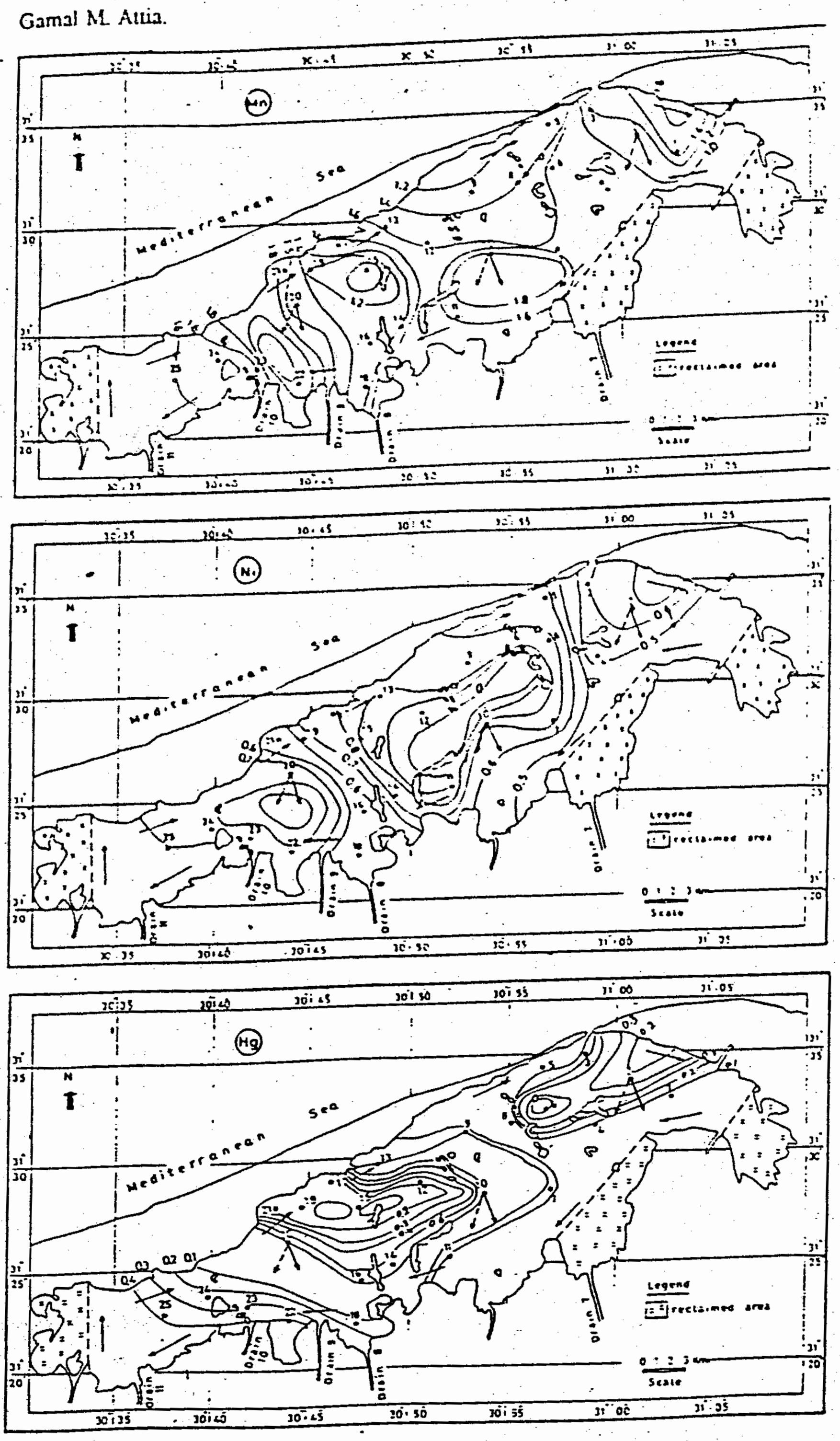

Fig.(5b): Isochemical maps of Mn, Ni and Hg

Manganese and nickel contents as shown in table 5 and figure 5b are distributed through the lagoon sediments showing isochemical centers which decrease towards the rims of the lagoon. The amount of Mn and Ni are affected by the concentration of these elements in the sediments from which they were leached through the different drainage branches.

The distribution of mercury shows a distinct concentration. The isochemical map shows that its concentration increases in the centre and towards the periphery of the lagoon. The relatively high content of Hg may be due to the perculation from the drainage water through dredging and industrial activities.

Conclusion

From the sedimentary study it was found that El Burullus lagoon sediments may be derived from the beach and deltaic deposits poorly to very poorly sediments with silt, very fine sand and clay related to river source and deposited under quit water action. C-M diagram reveals that the mechanism of transportation of sediments depend on suspension and rolling.

Mineral study indicate that carbonate grains are not stable suggesting that recrystallization may be an important diagenetic factor. The increase of Mg-calcite content with decreasing in grain size reflect the alteration of all type of skeletal grains. Kaolinite and illite show a fairly high content in most cores. The deposited clay minerals reflect the weathering environment in the continental source area and the early diagenesis in sea water is minimal. The surrounding sedimentary rocks in the Nile Delat may contribute detrital illite to the lagoon.

Heavy minerals detected reveals that they are concentrated at the far eastern rim of the lagoon (near Boughaz El Bourg) and gradully decrease westward. The conspicous absence of heavy minerals in most cores may regard to mineral decay, alteration and biochemical influences.

The chemical analysis reveals that the organic matter may not be related to carbonate skeletal organisms and may affected by the texture of sediments. Mg / Ca tend to be high near the inlets and decrease in the middle of lagoon. Its variable content may be attribute to the contribution of shells and shell fragments of variable Mg contente, difference in diagenetic processes and changes in water temperature. MnO and Fe_2O_3

content seem to be present in very small amount which may be related to rarity of source material and / or leaching of these elements. Na and k oxides content are generally decrease from east to west.Al_2O_3 content show normal distribution through the Burullus lagoon sediments.

The trace elements distribution reveal that these elements have marked concentration through the lagoon. Its concentration is strongly related to the southern freshwater drainage of the Nile which may affected by pestiside and the industrial activities. Consequently, some controls must be taken on the use of pestisides and the drainage of factories.

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دراسات معدنية وجيوكيميائية للرواسب التحت قاعية للاجون البرلس - شمال دلتا النيل - مصر

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تم عمل الدراسة المعدنية والجيوكيميائية لعدد خمسة كور تحت قاعية وعدد ثلاثة وعشرون عينة قاعية للاجون البرلس بواسطة الأشعة السينية والتحليل الكيميائى وقد أثبتت الدراسات الترسيبية أن لاجون البرلس قد تكونت من رواسب شاطئية ودلتيه وأنها تتكون من رواسب سلتيه ورمليه دقيقة الحجم مع وجود الطين وقد أثبتت هذه الرواسب أنها من مصادر نهرية وترسبت تحت تأثير المياه الهادئة .وقد أثبتت الدراسات المعدنية وجود معادن الأليت والكاولينيت والكوارتز والفلسبار البوتاسى والكالسيت والأراجونيت .

وقد وجد من الدراسة أيضاً أن المعادن الثقيلة تتركز فى الجزء الشرقى من اللاجون وتتناقص تدريجيا ناحية الغرب .

وقد أثبت التحليل الكيميائى أن المواد العضوية قد لا تنتمي إلى الهيكل الجيري للكائنات وقد تكون قد تأثرت بنسيج الرواسب .

وقد وجدت أكاسيد الحديد والمنجنيز بنسب قليلة وأن نسبة أكاسيد الصوديوم والبوتاسيوم تقل بصفة عامة من الشرق إلى الغرب وقد وجد من توزيع العناصر الشحيحة أنها موجودة بتركيزات مختلفة وقد يرجع مصدرها إلى النشاط الزراعى والصناعى الموجود فى منطقة الدلتا وتصل إلى اللاجون عن طريق المصارف المختلفة .