HEAVY METALS IN SUSPENDED MATTERS AND SEDIMENTS FROM A CONFINED LAGOON ON THE NORTH AFRICAN COAST, EGYPT

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Lake Mariut is one of four shallow brackish lagoons or "lakes" along Egyptian Mediterranean coast line. The lake, may be considered as a reservoir of depths range between 50 and 150 cm and receives drainage water from Qalaa drain at its south eastern side mixed with various pollutants. It also receives at its north and north eastern sides waste waters of domestic and industrial origins respectively. Within the frame work of the UNESCO's Meeting of the Experts of the Southern Mediterranean Lagoons in 1979, the present work is concerned with determination of the current pollution levels by heavy metals in lake Mariut. In this paper, surface suspended matters collected bimonthly for over a year from eight stations (Fig. 1), were analysed for Cu, Zn, Fe and Mn[1]. These analysis were also commenced on surfacial sediments[2] sampled from these stations. Water samples for determination of dissolved oxygen or hydrogen sulphides were also collected. The regional average values of the studied elements are shown in table I. On the basis of the levels of those elements, the lake can be classified into two zones. One which is containing the high values of the metals in both phases, the septic zone. The water of this zone shows also high concentrations of these metals in the dissolved forms[3]. This study implies that the stabilization of these forms is attained by formation of dissolved organo - metallic complexes. This water is less oxygenated and sometimes, it turned to anoxic water bearing hydrogen sulphide. The other, at the western side of the lake, contains the lower levels of the metals and it is always in oxic conditions. The lake is polluted with these metals in comparison with those in a neighbouring lake, receiving no direct any anthropogenic inputs. On the base of the present work, the 540,000 cubic meter of water discharged daily from the lake to the sea via Umum drain contains 3.3, 7.7, 62.5 and 22.7 tonnes of Cu, Zn, Fe and Mn respectively. The effect of the disposal of the industrial wastes on the suspended metal concentrations can be seen easily in Fig. 2.

References :

1) Abdullah, M. and L. Royle (1974), J. Mar. Biol. Ass. U.K., 54 : 581.
2) Smith, J.D. et al., (1981), Aust. J. Mar. Fresh Water Res. 32 : 151.
3) Saad, M. et al., (1981), Water, Air and Soil Poll. 24 : 27.

Table I. Regional average values of the metals in the suspended matters and in the sediments as well as values of dissolved oxygen/hydrogen sulphides in lake Mariut.

Station	Cu	Zn	Fe	Mn	$O_2/(H_2S)$	Cu	Zn	Fe	Mn
	mg/g				ml/l	mg/g			
	Suspended Matters					Sediments			
Lake proper :									
I	2.630 +	2.810 +	11.83	7.32 +	3.3 (2.7)	0.130	0.383	4.38	1.33 +
II	0.920	1.600	12.73 +	3.86	5.1 (0.8)	0.152	0.386	6.35 +	1.09
V	0.712	1.220	2.71 -	2.96	4.4 (1.1)	0.139	0.331 -	4.02	0.60
VI	0.821	1.480	3.76	2.35	1.8 (7.6)	0.274 +	0.811 +	5.95	0.39
Mean	1.271	1.780	7.76	4.12	3.6 (3.1)	0.173	0.478	5.18	0.85
(S.D.)	(0.910)	(0.710)	(5.25)	(2.22)	1.4 (3.1)	(0.067)	(0.224)	(1.15)	(0.43)
III	0.355	0.790	8.39	2.37	10.4 (None)	0.060 -	0.390	2.67 -	0.38 -
IV	0.335	0.610 -	4.45	2.08 -	5.4 (None)	0.108	0.555	4.95	0.59
Mean	0.345	0.700	6.42	2.23	7.9 (None)	0.084 +	0.473	3.81	0.48
Draine :									
Qalaa VIII	0.537 -	1.020 -	5.94 -	2.33 -	1.4 (9.8)	0.166 +	0.356 +	3.49 +	0.43 +
Umum VII	0.575 +	1.030 +	9.05 +	4.02 +	6.5 (None)	0.117 -	0.169 -	1.27 -	0.25 -

S.D = Standard deviation. The minimum average values are designated by (-) and the maximum by (+).

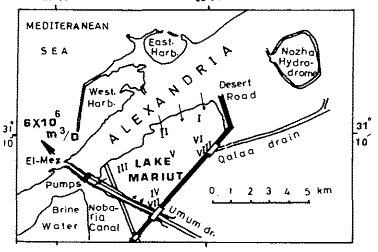

Fig. 1 - Lake Mariut - position of sampling stations.

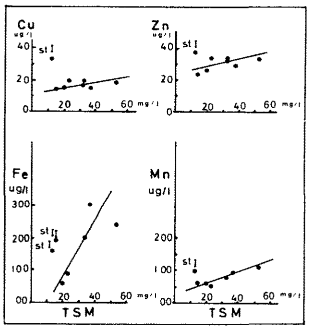

Fig. 2 - Relationships between total suspended matters (TSM) and suspended metals in lake Mariut

HYDROLOGY AND NUTRIENT SALTS IN THE MESSOLONGHI LAGOON

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Summary

The seasonal variation of temperature, salinity, dissolved oxygen, nutrients and chlorophyll a were studied at 16 stations in the eutrophic Messolonghi Lagoon in Western Greece during 1983-1984. The examined parameters were analysed by the methods of Strickland & Parsons (1968). In Table 1 are shown the seasonal mean values of the parameters in each section of the lagoon.

The study of the physical parameters of the Messolonghi Lagoon during an annual cycle indicates two periods, one from June to October, when the waters are hot (21-26 °C) and salty, and the other one from December to March, corresponding to a high reduction in salinity and low temperatures (13-20 °C). The range of salinity in the lagoon varied between 12 ‰ to 60 ‰ and it can be cosidered mixopolyhaline. These variations depended both on the coming of sea water in summer as a result of south winds and evaporation in cycles following the tides, together with the winter rains. The concentration of dissolved oxygen varied with the season. From December to March, the oxygen saturation exceeded 75 %. This was due to the contribution of oxygen rich fresh water and wind stirring. From June to October, the degree of oxygen saturation diminished in the whole of the lagoon and exceeded 60%. The almost permanent state of under-saturation of the water mass indicates that this lagoon has a long turn over time. This is particularly the case at the bottom of station 16, which is deeper and where total anoxic conditions prevail the whole year.

The concentration of nutrients were higher than those usually observed in the Mediterranean Sea. During the annual cycle, the mean contents of nutrients showed two minima, one in June and another one in October, corresponding to two phytoplankton blooms. The June and October chlorophyll a peaks corroborated the existence of these blooms. The level of nutrients were higher at station 3, point of discharge of the city effluents and in A. Because of the high concentration of nutrients red tide tends to occur in the lagoon and the worsening of the environmental conditions is shown by the fish production drop.

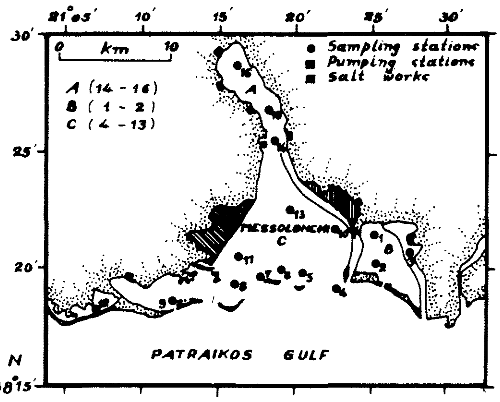

TABLE I

Average surface values of the physical and chemical parameters in the stations of the areas A, B, C.

Parameters	Area A				Area B				Area C				Station S_3			
	June 83	Oct. 83	Dec. 83	Mars 84	June 83	Oct. 83	Dec. 83	Mars 84	June 83	Oct. 83	Dec. 83	Mars 84	June 83	Oct. 83	Dec. 83	Mars 84
Temperature (°C)	24.9	22.7	12.8	15.5	21.6	25.0	13.2	18.9	26.6	22.5	13.5	17.4	21.0	22.0	13.2	18.1
Salinity (‰)	16.5	17.0	16.9	13.6	40.6	47.4	32.2	31.3	41.1	46.2	28.6	33.8	22.9	35.2	24.0	17.7
D.O. (mg/l)	6.6	6.1	8.0	6.5	6.5	6.5	9.5	7.0	6.1	6.8	8.0	7.2	5.0	6.8	8.0	6.5
D.O. (%)	88	79	84	71	93	103	116	91	96	103	92	92	64	96	89	87
NH_4-N (µM)	1.34	1.40	3.26	2.90	0.64	0.08	1.06	1.05	0.47	0.18	2.82	1.60	0.74	2.04	11.16	12.26
NO_2-N (µM)	0.12	0.06	0.45	0.80	0.11	0.05	0.21	0.13	0.09	0.04	0.15	0.17	0.11	0.09	10.28	3.05
NO_3-N (µM)	0.32	0.27	3.46	8.88	0.20	0.18	1.37	0.57	0.21	0.24	1.72	0.27	0.17	0.34	3.44	10.17
ΣN (µM)	1.78	1.73	7.17	12.58	0.95	0.31	2.64	1.75	0.77	0.46	4.69	2.04	1.02	2.47	24.88	25.48
PO_4-P (µM)	0.29	0.17	0.26	0.48	0.14	0.06	0.11	0.18	0.19	0.06	0.41	0.38	0.77	0.28	2.93	0.69
ΣN :P (atoms)	6.1	10.2	27.6	26.2	6.8	5.2	24.0	9.7	4.1	7.7	11.4	5.4	1.3	8.8	8.5	36.9
S_1O_4-S_1 (µM)	37.60	9.88	3.63	15.26	16.00	10.76	4.26	3.02	29.66	7.28	5.18	2.28	17.78	14.50	76.67	20.90
Cll a (mg/m³)	2.06	2.49	5.50	0.74	1.85	7.20	0.63	0.42	1.09	3.96	0.59	0.20	4.73	21.00	9.70	0.54