Chemistry of Lake Burullus
1 - Changes in Nutrients Chemistry between 1970 and 1987

A. ABDEL-MOATI**, A.I. BELTAGY* and M.H. EL-MAMONEY*

* Institute of Oceanography and Fisheries, Kayet Bey, Alexandria (Egypt)
** Department of Oceanography, Faculty of Science, Alexandria University, Alexandria (Egypt)

Nutrient components were measured in Lake Burullus (Fig.1) during the period Jan. - Dec. 1987. The results are compared with other observations reported in the literature.

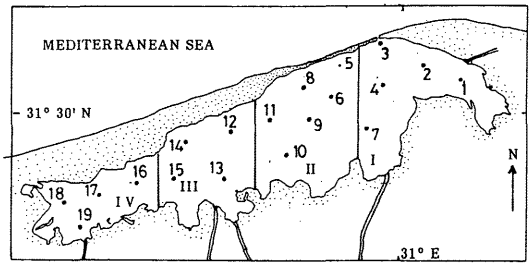

Fig. 1. Location of sampling stations and the 4 subdivisions (basins) of Lake Burullus.

Table 1, summarizes the annual average values of different nutrient components observed for the different regions of the Lake during 1987.

Table 1. Mean values of nutrient salts in Lake Burullus during 1987.

	NO_3	NO_2	NH_3	RPO_4	$RSiO_2$	Ch/a
			ug at/l			mg/m^3
Zone I	1.58	0.46	7.10	1.26	58.6	6.61
Zone II	1.29	0.21	4.18	0.73	54.11	4.31
Zone III	5.20	1.00	6.48	2.32	71.00	10.82
Zone IV	8.15	1.68	5.97	2.13	83.60	4.85

Higher averages observed in zones III and IV reflect the effect of large amounts of drainage water discharging into both zones (> 75 % of the total amount of drain water reaching the Lake). It is worth to mention that this effect was mostly localized to the southern boundaries of the Lake i.e. few kilometers off the outlets. However, the levels of nutrients in the other zones are probably controlled by dynamical conditions between drain water supply and marine water invasion through the Lake openning. Lower concentrations may be also related to consumption of nutrients by aquatic plants which are densily populating these areas.

The average concentration of DIN in the Lake was 10.8 µg at/l constituting about 28% of TN. Ammonia constituted the larger part of DIN (about 55%) followed by NO_3 (36 %) and NO_2 (9 %). However, the dissolved orgainc nitrogen fraction constitutes half of the dissolved nitrogen in the Lake water which in turn represent about 55% of the total nitrogen content.

On the other hand, dissolved phosphorus contributes more than 65% of the total phosphorus content of Lake Burullus. The organic fraction of the dissolved phosphorus (average 1.35 µg at/l) represents between 43 - 57 % of the total dissolved phosphorus (TDP), while particulate phosphorus (average 1.56 µg at/l) constitutes no more than 40% of the total phosphorus content of the Lake water.

The low inorganic N/P ratio i.e. 6.7 : 1 calculated for the Lake water may indicate that nitrogen could be more critical than phosphorus for phytoplankton growth and production in the Lake. Compared with studies on other northern Delta Lakes, Table 2 shows that Lake Burullus followed the highly productive Lake Manzallah in the abundance of nutrients.

Table 2. Mean N/P & Si/P ratios in different Nile Delta lakes.

Locality	L. Idku	L. Manzalah	L. Mariut	L. Burullus	L. Burullus	L.Burullus
				1970-71	1978-79	1987
N/P	2:1	11:1	2.4:1	16:1	17.12:1	7:1
Si/P	132:1	73:1	5.4:1	562:1	114:1	41:1

Signficant changes had taken place in the nutrient chemistry of the Lake since 1970. The levels of nitrogen (mainly nitrate) and silicon have decreased by one and three times since 1970, while on the contrary, the concentration of reactive phosphorus has increased about four times. Not only the levels of these elements have changed, but also their ratios have drastically declined (Table 2). The probable cause of such variations is the increased rate of drainage water entering the Lake draining nearby reclaimed lands. The reduction and complete cessation of rich-silicon Nile water reaching the Lake opposed by the continual invasion of marine water through the Lake - Sea connection. However, these changes were reflected on the present status of phytoplankton population and consequently on the fish yield of the Lake. Recorded data on the average phytoplankton biomass (El-Sherif, personal communication) show a remarkable decline in the total number of species during the last 10 years.

Trace elements status in surficial sediments of Lake Manzalah (Egypt)

A.R. ABDEL-MOATI and N.M. DOWIDAR

Oceanography Department, Faculty of Science, Alexandria (Egypt)

Introduction

Lake Manzalah is the largest of the four Nile Delta lakes in Egypt (surface area about 900 km^2). It provides more than 70% of the total inland fisheries of the country. In view of the increased role of drain water reaching the lake, in the last 20 years, important changes have taken place in the water and bottom sediments quality which needed to be evaluated and documented. The total anuual fresh and drain water inflowing into the lake is 6680×10^6 m^3. 75% of this water is discharged by Hadus (agricultural drain, 50%) and Bahr-El-Baqar (domestic and industrial sewage, anoxic, 25%) which opens into the southern basin of the lake.

Material and Methods

Using a modified Ekman grab, surficial bottom sediments were collected during April 1982 from 25 stations. Additional samples were collected from the mouths of different drains. Exchangeable metals fraction were determined using 1 M NaOAC at pH 8.2 (Gibbs, 1973; 1977) while the residual form was determined according to Tessler et al. (1979). The concentrations of Al, Fe, Mn, Zn, Cu, Cd, Pb, Co and Ni were determined using Model 34000 ICP-emmission spectrometer. The precision and accuracy of the methods were checked against Standard Reference Material 1645 River Sediment from NBS and found satisfactory.

Results

The areal distribution of exchangeable and residual forms of the elements showed a common feature of increasing levels towards the southeastern basin of the lake, the area highly affected by drainage water. Values tend to decrease gradually towards the lake center. This trend matchs with the basinward increase in grain size. The frequency distribution of residual forms showed that >50% of Al, Zn, Cu, Pb & Co felt in the concentrations range 40-50 mg/g, 60-80 µg/g, 20-40 µg/g, 40-60 µg/g and 20-30 µg/g, respectively. On the contrary, the concentrations range of Fe, Mn, Ni & Cd occupied wider scale reflecting high irregularity and patchiness.

The increase in the levels of residual metals at the lake-sea connection is mostly due to coagulation of colloidal species to produce particulate form in the mixed zone, some of which may be lost to the sediments.

The relative abundance of elements as observed from their average concentrations (Table 1) was: Al>Fe>>Mn>Zn>Pb=Ni>Cu>Co>>Cd. The average exchangeable / residual elements percents were insignificant for Al (0.029%) and Fe (0.03%), low for Ni (11.7%), Cu (9.0%) & Co (4.1%) but valuable for Mn (37.3%).

Table 1. Mean residual metals concentrations (µg/g) in Lake Manzalah surficial sediments.

	Al	Fe	Mn	Zn	Pb	Ni	Cu	Co	Cd
NW	38,533	32,267	717	59	54	47	48	22	6.3
L.P.	43,497	36,487	716	67	51	53	42	26	7.5

Discussion

The geochemistry of Lake Manzalah sediments reflect to a great extent several conditions resulting from water inputs and different characteristics of bottom sediments. Generally, all metals are enriched in the area affected by main drains. At the mouth of Bahr-El-Baqar drain the prevailing anaerobic conditions reduces the solubility of reactive metals which are subsequently expected to precipitate as sulphides. This is reflected on the relatively low Cu content of the overlying water and enrichment in sediments. The enrichment of some metals like Co in the sediments of anoxic stations is probably due to their co-precipitation with metals on sulphide sediments.

On the contrary, at the mouth of Hadus agricultural drain, with overlying oxic conditions, high values of residual Fe and Mn were observed. In such waters the solubilities of both metals decreased due to formation of higher oxidation states or lower solubilities of oxides and hydroxides. Many soluble species in water could be scavanged due to oxide formation. This explains the elevated levels of Ni, Cd and Pb in these stations.

Both Fe and Mn are known to be closely associated in their geochemical cycle. This is clear from the positive correlation relating both elements in Lake Manzalah ($r=0.6747$, $p<0.001$). Significantly positive correlations between studied elements in suspended matter and sediments indicate the interaction between both phases. However, the concentrations in suspenssion (µg/g) for all elements were higher than those of sediments indicating the role of suspended matter in carrying these elements to the bottom.

In comparison with 1968 sediments (McComas, 1983), results showed a remarkable increase in the levels of Al, Pb and Cd. Increased water discharge of highly industrialized areas surrounding the lake may explain such elevated levels. Compared with other Nile Delta lakes, Lake Manzalah is generally enriched in nearly all studied elements. However, when matching the average values of differnt elements with those of standard shale, we observed that Cu, Pb, Cd, and Co are highly accumulated in lake sediments and thus could be a source of environmental problems.

References

Gibbs, R.J. (1973). Science, 180: 71-73.
Gibbs, R.J. (1977). Geol. Soc. Amer. Bull., 88: 829-843.
Tessler, A., P.G. Campbell & M. Bison (1979). Analytical Chemistry, 151(1): 844-851.