Diatomaceous silica of the sediments in four Brackish-water Egyptian Lakes

by

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Introduction

The fisheries economy of Egypt depends greatly on the brackish-water lakes situated in the North of the Delta of the Nile. So far we know only preliminary few limnological investigations were made on these shallow Delta lakes.

The aim of the present investigation is to estimate the amounts of diatomaceous silica found in the sediments of four Delta lakes. The diatomaceous silica reflects the quantitative distribution of diatoms in the Delta lakes at the time of deposition. According to SALAH [1961], the diatoms were generally dominant, usually forming more than 80 % in lake Edku and 70 % in lake Mariut of the total phytoplankton crop. Since diatoms constitute the major group of phytoplankton, they can be approximately considered as a measure of the biological productivity of the lakes.

The four brackish-water lakes which are considered in the present study are: lake Manzalah, lake Edku, lake Mariut and Nozha-Hydrodrome (Fig. 1). Lake Manzalah which is situated at the east

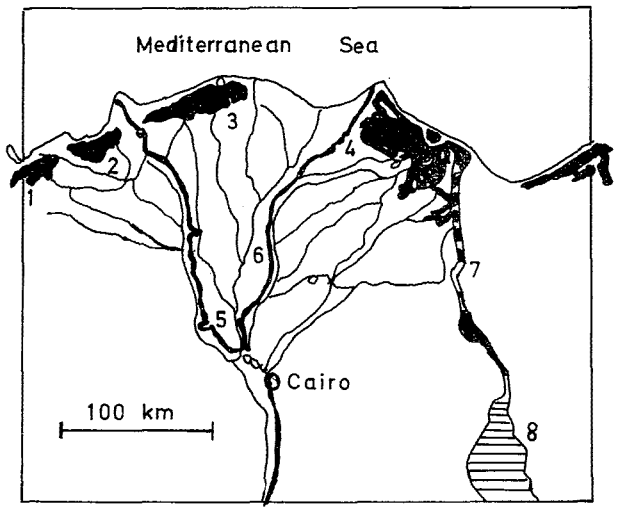

FIG. 1. — The Nile with Delta lakes.
1) Lake Mariut and Hydrodrome.
2) Lake Edku.
3) Lake Burollus.
4) Lake Manzalah.
5) Rosetta Branch.
6) Damietta Branch.
7) Suez Canal.
8) Red Sea.

side of Damietta branch of the Nile, is the largest of the Nile Delta lakes. Its area is about 350,000 feddans (one feddan is equivalent to 4200 m^2). Its average depth may not exceed one meter — This lake is connected with the Mediterranean sea, the Suez Canal and Damietta branch of the Nile. At its southern border, several drains pour into it. The chlorosity varies to 0.77 and 11.67 g/l [EL-WAKEEL & WAHBY, 1970].

Rapp. Comm. int. Mer Médit., **21**, 3, pp. 121-123, 1 fig. (1972).

The other three Delta lakes in question lie on the west side of the Rosetta - Nile branch. The area of lake Edku reaches about 30,000 feddans. Its water depth varies between 50 and 150 cm. It has also a connection with the Mediterranean sea. Drainage water is discharged into the lake. Like lake Manzalah, the salinity varies according to locality and seasons. It fluctuates from less than 0.5 °/oo. to about 18 °/oo [*NASR et al.*, 1963].

Lake Mariut is smaller than lake Edku with a total area of about 20,000 feddans. A large area of this lake was dried for agriculture. Its water depth varies between 90 and 150 cm. The chlorosity of this lake water fluctuates between 1.09 and 2.63 g/l. Drainage water pours also into this lake.

In 1939, the Nozha-Hydrodrome was separated artificially from lake Mariut. The Hydrodrome lies on the eastern side of the mother lake. It receives only unmodified Nile water. Its area reaches about 1200 feddans, with an average depth of 350 cm. Like lake Mariut it has no connection witht he sea. The average chlorosity of the Hydrodrome is less than that of lake Mariut. This is mainly due to its continuous supply with fresh Nile water. According to BANOUB & WAHBY [1960], the surface water chlorosity varies between 1.05 and 1.74 g/l.

Materials and Methods

Bottom deposits were collected from the Delta lakes by means of a modified EKMAN — bottom sampler. Three stations from each lake were selected at different localities. Station II in each lake was always taken from the centre of the corresponding lake.

PENNINGTON [1943] has estimated the diatomaceous silica by counting the diatoms in a measured volume of fresh sediments. He has calculated the percentage of diatomaceous silica from the data of percentage frequency for each species and the total number of diatoms per mg dry weight of sediment. The application of such a method for the determination of diatomaceous silica in the Egyptian lake sediments seems to be very difficult, due to the nature of these sediments. Microscopic investigation of these sediments shows the abundance of minerogenic matters which make the identification and counting of diatoms shells difficult. On the other hand, the identification of the brocken diatoms shells is very difficult. In addition, this method of counting is tedious and not a practical one, since it consumes much time.

Diatomaceous silica is better determined by means of a chemical method. The method used by MULLIN & RILEY [1955] for the photometric determination of silica in sea water was slightly modified by TESSENOW [1964] to be applied in lakes. The wet mud was dried at 105° C in an oven and the diatoms shells were dissolved in a solution of sodium carbonate by heating on a water bath [ZÜLLIG, 1956]. The carbonate — soluble (diatom) — silica was determined and calculated as per cent of the dry mud.

In case of mineral sediments, which contain low values of diatoms frustules, a small error which is not very important appears. This method is very good to be used by the autochthonous sediments, which are rich in diatoms shells. By mineral sediments, it gives only a maximal value of diatomaceous silica. By applying this restricted method, the quartz which is found in the sediments is not dissolved in solution.

Results and Discussions

The amounts of carbonate-soluble (diatom) — silica vary in the different stations of the four lakes (table 1). The maximum value of diatom — silica (0.66 %) in lake Manzalah is found in station I. The minimum value of silica (0.47 %) is found in station II, which was taken from lake Manzalah centre. Station III in lake Edku gives the highest value of diatom-silica found in all stations sampled (1.38 %). In lake Mariut, the maximum and minimum values of diatomaceous silica reach 0.98 % and 0.80 % in stations I and III, respectively. The maximum value of silica observed in Nozha-Hydrodrome (0.89 %) is found in station II, which was taken from the lake centre. The minimum value (0.59 %) is recorded from station III in the Hydrodrome.

Generally, the high amounts of diatomaceous silica found in the bottom deposits of the four lakes reflect the richness of these deposits with diatoms frustules. The low amounts of diatom-silica on the other hand are found in sediments poor in diatoms shells. The poverty of these sediments with diatoms frustules is mainly due to their nature and composition. Such sediments are rich in minerogenic matters which destroy the diatoms shells [SAAD, 1970]. The minumum value of diatom-silica in the four lakes (0.32 %) is found in lake Edku at station I, which was taken near the lake-sea connection, where the deposits are sandy mixed with plant detritus.

Table 1. Percentage of the carbonate - soluble (diatom) - silica per dry mud.

Lake	Stations	Si%	Lake	Stations	Si %
Hydrodrome	I	0.75	Edku	I	0.32
	II	0.89		II	0.71
	III	0.59		III	1.38
Mariut	I	0.98	Manzalah	I	0.66
	II	0.56		II	0.47
	III	0.80		III	0.55

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