INSTITUT ZA OCEANOGRAFIJU I RIBARSTVO — SPLIT
SFR JUGOSLAVIJA

No. 56 BILJEŠKE - NOTES 1984.

A preliminary study on the bottom sediments of Lake Nasser

Preliminarna studija sedimenata dna jezera Nasser

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Sediment samples were collected from Lake Nasser and the end of Lake Nubia and subjected to some physico-chemical investigations. The density of wet mud showed generally an inverse relation with water content. The variation of water of the sediments coincided with their nature and type. The samples characterized by low water content contain high amounts of allochthonous material and vice-versa. The minimum amount of dry matter was associated with minimum amounts of organic, calcareous and allochthonous materials. The maximum amount of dry matter, on the other hand, was accompanied by maximum amounts of calcareous substances, allochthonous materials and diatom-silica. The amounts of each of the different sediment components deposited on one m^2 wet mud gave remarkable variations. The quantitative distribution of these components in the sediment samples was found to depend mainly upon certain factors which were discussed.

INTRODUCTION

The Nile is the only major river which is fully controlled and utilized. Several barrages and dams were constructed along this river in Egypt in order to regulate and control the flood waters. In spite of these barrages and dams still huge amounts of the fertile Nile water used to flow annually into the Mediteranean Sea during the flood period. For this reason, the High Dam was constructed south of Aswan to make use of the reserved Nile water, particularly for irrigation and elecrtic energy. The filling of the reservoir started in May 1964 forming a lake which is considered as the second largest man-made lake in the world. Its volume increased successively to reach, as expected, its full capacity of 180 m above sea level in 1980. In this year, the lake took an alongated shape of about 500 km long (350 km in Egypt and 150 km in Sudan). The part of this lake in Egypt constitutes Lake Nasser, while its other part in Sudan was given the name of Lake Nubia. The surface area of the whole reservoir reached 6276 km^2 and the total volume was 157 km^3 in 1980. The lake has 175 side appendages known locally as »Khors«, each one may be considered as a small separate lake (Fig. 1).

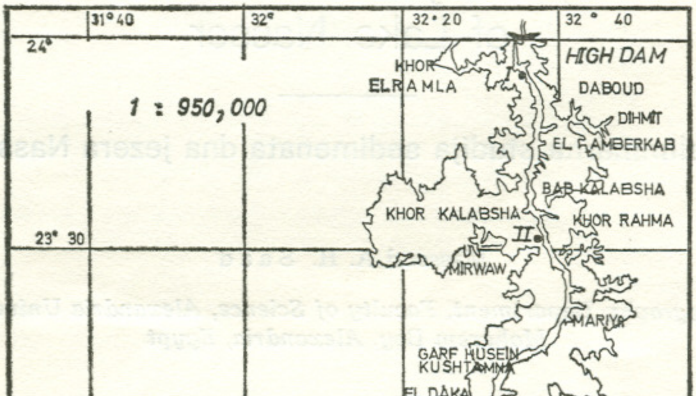

Fig. 1. Lake Nasser and position of stations.

The seasonal and regional variations of some physico-chemical conditions of the Lake Nasser were studied by Nessim (1972). Also, a limnological investigation was carried out by the author at the end of this lake near the High Dam (Saad, 1980). Some physical characteristics of Lake Nasser were examined by Sharaf El-Din and El-Shahawy (1980). The present work is a preliminary study on the bottom lake sediments in order to gain some information on their nature and composition. A further detailed study on the chemistry of this lake sediments should be carried out in order to throw more light on the fertility of this important and interesting lake.

MATERIAL AND METHODS

A modified Ekman-bottom sampler was used to collect seven sediment samples from the reservoir. Six stations were selected in Lake Nasser (I—VI) and one station (VII) in Lake Nubia near its end (Fig. 1). The density of wet mud was determined on the same day of collection, using a pyknometer. The density of dry mud was calculated from the wet density and the water content (Saad, 1970). The amount of water was determined by drying the wet samples in an oven at 105°C. The organic matter was estimated by igniting about 500 mg dry mud in a Muffel furnace at 525°C for 4—5 hours (Ungemach, 1960). The HCl-soluble and insoluble parts of the sediments were determined by adding 12.5% HCl to the remaining inorganic fractions of the deposits in conical flasks which were heated for one hour on an electric plate. Filtration was carried out using ashless filter paper. The dissolved parts of the sediments were considered as calcareous substances and undissolved parts as allochthonous materials plus diatom shells. The method described by Mullin and Riley (1955) and modified by Tessenow (1964) was used for the photometric determination of the carbonate-soluble (diatom)-silica.

RESULTS AND DISCUSSION

The values are represented as weight percentages of dry mud in order to compare the percentage distribution of different constituents of the lake sediments at selected stations (Table 1). These values were also calculated in kg per m^2 wet mud in order to give a good idea about the quantitative distribution of these constituents on the lake bottom. The silica content was calculated in g per m^2, due to its low value (Table 2).

Table 1. Percentages of some constituents of Lake Nasser sediments.

Stations	Water	Dry matter	Organic matter	Calc. substances	Alloch. materials	Si	SiO_2
I	72.51	27.49	15.74+	33.38	49.80	1.08	2.31
II	68.98	31.02	14.15	26.58	58.06	1.20	2.57
III	37.08—	62.92+	6.36—	25.36—	67.35+	0.93	1.99
IV	80.44+	19.56—	13.20	36.58	48.67	1.55+	3.32+
V	56.35	43.65	12.33	39.40+	47.26—	1.01	2.16
VI	74.33	25.67	12.64	37.50	48.75	1.11	2.38
VII	53.72	46.28	12.72	25.44	61.04	0.80—	1.71—
Average percentages	63.34	36.66	12.45	32.03	54.42	1.10	2.35

N.B.: The maximum percentages are designated by (+) and the minimum by (—).

Table 2. Density of the wet and dry mud, as well as the amounts of some constituents deposited on the bottom of Lake Nasser

Stations	Density (g/cm³) Wet mud	Dry mud	Water kg/m²	Dry matter kg/m²	Org. matter kg/m²	Calc. substances kg/m²	Alloch. Materials kg/m²	Si kg/m²
I	1.24	3.40	9.0	3.4	0.5	1.1	1.66	40
II	1.28	3.33	8.8	4.0	0.6	1.1	2.35	50
III	1.45+	1.98	5.4—	9.1+	0.6	2.3+	6.12+	80+
IV	1.18	4.60+	9.5+	2.3—	0.3—	0.8—	1.16—	40
V	1.14—	1.39—	6.4	5.0	0.6	2.0	2.35	50
VI	1.20	2.82	8.9	3.1	0.4	1.2	1.47	30—
VII	1.43	2.36	7.7	6.6	0.8+	1.7	4.05	50
Average amounts	1.27	2.84	8.0	4.8	0.5	1.5	2.74	49

N. B.: The maximum amounts are designated by (+) and the minimum by (—).

The density of wet mud ranged from 1.14—1.45 g/cm³ at stations V and III respectively, with an average of 1.27 g/cm³. The density of dry mud varied from 1.39—4.60 g/cm³ at stations V and IV respectively, with an average of 2.84 g/cm³. The wet density showed generally an inverse relation with water content. The maximum density of wet mud found close to the middle of Lake Nasser (station III) was associated with the minimum water content and the maximum value of dry matter. Also, the markedly high value of wet density of 1.43 g/cm³ obtained at the end of Lake Nubia (station VII) was associated with a low water content and a high value of dry matter. On the other hand, relatively low value of wet density recorded at station IV was accompanied with the maximum water content and minimum value of dry matter.

The percentages of water showed a remarkably wide range of variations, fluctuating between 37.08 and 80.44%, with an average of 63.34%. The amounts of water obtained in one m² ranged from 5.4—9.5 kg, with an average of 8.0 kg. The variation of water content of the lake sediments coincided with their nature and type. The samples characterized by low water content contain high amounts of allochthonous materials and vice-versa. The minimum amount of water was associated with the maximum amount of allochthonous materials and maximum amount of water was accompanied with the minimum amount of these materials. Accordingly, an inverse relation existed between the amounts of water and allochthonous materials. The dry matter gave a considerable wide range of variations for both percentages and amounts. The percentages ranged from 19.56—62.92%, with an average of 36.66%. The amounts deposited on one m² varied from 2.3—9.1 kg, with an average of 4.8 kg. The minimum amount of dry matter was associated with minimum amounts of organic matter, calcareous substances and allochthonous materials. On the other hand, the maximum amount of dry matter was accompanied by maximum amounts of calcareous substances, allochthonous materials and diatom-silica.

The organic matter showed a remarkable wide range of variations for both percentages and amounts. The percentages of organic matter varied from 6.36—15.74% at stations III and I respectively, with an average of 12.45%. The amounts, on the other hand, fluctuated between 0.3 and 0.8 kg/m^2 at stations IV and VII respectively, with an average of 0.5 kg/m^2. Relatively higher amounts of organic matter found at certain stations are attributed principally to the increase in the quantities of autochthonous organic matter produced at these locations, besides the relative increase in the amounts of allochthonous organic matter transported by the Nile.

The percentages of calcareous substances ranged from 25.36—39.40% at stations III and V respectively ,with an average of 32.03%. The amounts of these substances deposited on one m^2 varied markedly from 0.8—2.3 kg at stations IV and III respectively, with an average of 1.5 kg. Relatively higher amounts of calcareous substances found in some sediment samples are due mainly to the abundance of calcareous shells and shell fragments in these samples (El-Wakeel, 1964; Saad, 1974). The lower amounts of calcareous substances obtained from the rest of samples coincided with the relative decrease in the amounts of calcareous shells and fragments in these samples (Saad, 1976a).

The percentages of allochthonous materials fluctuated between 47.26 and 67.35% at stations V and III respectively, with an average of 54.42%. The amounts of these materials deposited on one m^2 varied considerably from 1.16—6.12 kg at stations IV and III respectively, with an average of 2.74 kg. The amount of allochthonous materials obtained at station VII, selected at the end of Lake Nubia was markedly high (4.05 kg/m^2). The allochthonous materials enter the lake mainly via Nile water. Besides, a considerable part of these materials, in the form of fine mineral particles, is carried away from the lake sides by the effect of the prevailing wind to settle on the lake bottom. The allochthonous materials, distributed on the lake bottom by water currents, may cover the autochthonous organic sediments or mix with them. Accordingly, the exchange of material between the sediments and the free water is reduced under this condition (Ohle, 1960, 1962, 1964; Ungemach, 1960; Saad, 1970).

The SiO_2-percentages ranged from 1.71—3.32% at stations VII and IV respectively with an average of 2.35%. The amounts of diatom-silica varied markedly from 30—80 g Si/m^2 at stations VI and III respectively; with an average of 49 g Si/m^2. Relative decrease is attributed to the corresponding decrease in the density of diatom frustules in these samples. On the other hand, the increase in the silica amounts observed in the rest of samples reflects the richnesse of these samples with diatom shells (Saad, 1971, 1972, 1976a, 1976b).

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Received: September 6, 1983

PRELIMINARNA STUDIJA SEDIMENATA DNA JEZERA NASSER

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KRATKI SADRŽAJ

Iznose se preliminarni rezultati sedimentoloških istraživanja na dnu jezera Nasser (6 postaja), dok je sedma postaja na jezeru Nubija blizu njegovog završetka, sve uzduž toka rijeke Nil.

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