Geochemical and Chemical-Physical Characterization of a Polluted Mud Flat in the Venice Lagoon

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The continual discharge of pollutants in a semi-enclosed body of water as the Venice Lagoon, induces the formation of dystrophic states and causes accumulation of toxic species in water and sediment, particularly in the areas with little tide exchange.

To evaluate in detail the causes of degradation in these areas and to advance solutions to restore it, the study of the environmental conditions can not leave out a multi-parameters analysis of "tracer" variables that permit to establish the availability of nutrients and heavy metals in the sediment to surface water and the biosphere.

On this basis, a study was made on the chemical and physical characteristics of a mud flat inside the Venice Lagoon, that is subject to intense growths of macroalgae, predominantly Ulva Rigida. In the last year, in fact, the Venice Lagoon has been particularly afflicted by eutrophication manifestations, at the point of making it necessary to mechanically remove macroalgae during the summer period, to limit the degradation of water and air quality.

The mud flat studied covers a surface area of about 1.5 Km^2; its mean tide is 50 cm, with mean excursion of about ± 30 cm. Analyses were made on the first 50 cm of sediment. During the period between May 1988 and November 1989, four samplings of sediment cores were taken, using a "syringe-type" corer, hand-made in plexiglass; it allows to extract undisturbed samples with 5 cm diameter. On the collected samples, redox potential E_H, grain-size distributions and heavy metal (Cr, Cu, Fe, Mn, Ni, Pb, Zn) concentration measurements were performed; the latter for both in the total content and through the application of a selective extraction technique. Further - during two field measurements - the current evolution through the channels delimiting the mud flat was observed in response to tides of quadrature and syzygies, utilizing data acquired by self-recording current meters immersed simultaneously in four places.

For the E_H measurement a methodology was set-up that permits to obtain representative values of the oxidation-reduction condition in situ from samples practically undisturbed [1].

Instead, the cores to analyse grain-size distribution and heavy metals content were immediatly subdivided into ten 5 cm-long cylinders. Grain-size determination was made with a laser-beam particle analyzer [2] (Microtrac mod.7995), obtaining the particles percentage distribution in fifteen dimensional classes of diameter, from 0.7 to 125 μm. Heavy metals were determined in the total content (cold 1N HCl) and for their presence in five geochemical phases [3], [4] corresponding to these metal fractions: extractable, associated with carbonates, bound to Fe and Mn oxides, associated with the organic matter and sulphides, and finally the non-lattice-held residual (obtained for difference).

In the surface layer (the top 5 cm) all measurements made on the samples coming from the nine measurement-sites chosen in the mud flat indicate the existence ot three sectors with different characteristics. One is, in fact, able to distinguish a very reduced zone with greater presence of fine grains and heavy metals, where there is the greatest growth of algae in the mud flat. Next, a oxidated zone with a greater presence of larger diameters, poor or no accumulation of heavy metals and scarce algae presence. Finally, a third zone with intermediate characteristics.

As a general rule, the E_H values decrease along the cores till about 15 cm depth, indicating more reduced conditions in the deeper layers with respect to the surface layers. The upper 15 cm thick-layer has varying redox characteristics, which are sensitive to the hydrodinamycal and hydrological conditions of the overlaying water, since it is involved in the water interaction processes and bacterial activity. On the contrary, sediment deeper than 15 cm definitely gives negative E_H values, which are about equal and constant in all the nine sampling-points in the mud flat ($\approx$-170 mV). With the depth, either a general but slight increase of particles with smaller diameters and a remarkable decrease of heavy metal contents (total and fractionated), in the deeper layers with respect to the surface layers. Only Mn does not follow this trend.

Utilizing statistical correlation techniques [5],[6], the existing relations between the three measured variables at the same depth in the mud flat and along the sediment column were finally emphasized. In particular a strong, positive correlation among total heavy metal, the redox condition intensity and particles percentage in the diameter range $10<\phi<40$ μm is evidenced for the sediment surface layer. Further, the correlation coefficient r values together with heavy metal present in the five extracted geochemical phases permit the formulation of an interpretative picture of the dependence of heavy metal speciation on the intrinsic sediment characteristics.

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Studies on the Bottom Deposits of the Egyptian Lakes

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SUMMARY:- Sediment samples were collected from six Egyptian lakes and subjected to some physico-chemical investigations. Variable amounts of organic matter, calcareous substances, allochthonous materials and diatom-silica were deposited on the bottom of the Egyptian lakes. The distribution of these components in the Egyptian lake sediments was found to depend upon certain factors which were discussed.

Lake Manzalah, Lake Brollus, Lake Edku, Lake Mariut and the Nozha Hydrodrome are situated at the north of the Nile Delta, whereas Lake Qarun is found in Upper Egypt southwest of Cairo. The first three lakes are connected to the Mediterranean Sea and hence their chlorosity varies according to locality and season. All these lakes receive huge amounts of drainage waters, except the Hydrodrome which feeds from the Nile water. The present work was undertaken to study the nature and composition of sediments collected from these lakes and to compare the results from each lake with those of the others, since each lake has its own limnological characteristics. Sediment samples were collected from three different localities in each lake. The samples of each lake were mixed to form a composite, which was subjected to some physical and chemical investigations.

The external events have a remarkable effects on the nature, composition and distribution of the Egyptian lake sediments (Saad and Arlt, 1977, Saad, 1978). The allochthonous mineral materials entering into the Egyptian lakes mainly with drainage and sea waters, as well as by the influence of the prevailing wind are distributed by water currents throughout most of the lakes. The recent allochthonous sediments cover the autochthonous organic sediments or mix with them. Consequently the exchange of elements between the sediments and the upper free water is greatly reduced (Saad, 1984).

The maximum density of wet mud found in Lake Edku sediments coincided with the maximum value of dry matter and the minimum value of water content. This reflects the large quantities of allochthonous minerogenic materials entering into this lake via drainage and sea waters, giving the maximum value. However, the sediments of Lake Mariut showed the opposite trend; being soft due to the influence of heavy pollution (Saad, 1972).

Variable amounts of organic matter were deposited on the bottom of the Egyptian lakes. The great amounts of organic matter found in the sediments of Lake Brollus and Lake Qarun are due mainly to the increase in the amounts of allochthonous supply and autochthonous production of organic matter. In spite of the influence of organic pollution on Lake Mariut, the organic content in its sediments was relatively low , due to the high intensity of decomposition of organic matter (Saad,1972).

The bottoms of the Egyptian lakes are characterized by accumulation of shells and shell fragments of calcareous organisms (Saad, 1978). The increase in the amounts of calcareous substances in the sediments of Lake Brollus, Lake Edku and Lake Qarun is due to the abundance of these shells (Saad and Arlt, 1977, Saad,1984).

Diatomaceous silica were deposited in variable amounts on the bottom of the Egyptian lakes. The maximum value of diatom-silica found in Lake Qarun sediments reflects the richness of these sediments with diatom shells (Saad, 1976, 1984). However, the minimum amount found in Lake Mariut coincided with the scarcity of diatom frustules in the sediments of this lake.

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