Preservation of reactive organic phosphorus in shelf sediments west of the Nile Delta, off Alexandria

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Phosphorus is one of the nutrients limiting growth in natural waters. Contrary to the open ocean, phosphorus cycling in estuaries and coastal sea areas is influenced by river input in both dissolved and particulate form, contributions of sewage and the intensive contact of water masses with the underlaying sediments. Thus, phosphorus in shallow sea areas is subject to both biological and physicochemical controls (BALZER, 1986). Phosphorus in the sediment may be found in pore water adsorbed to particles, bound to calcium, chemisorbed by ironoxyhydroxides, and contained in organics (KROM and BERNER, 1981; BLAZER, 1986). MEYBECK (1982) estimated that phosphate content of river waters already has been increased globally by a factor of three ; the additional load, however, is distributed unevenly over the world and may reach a multiple of this factor in highly polluted areas.

The present study aims to study the levels of organic, inorganic and total phosphorus in the shelf sediments of Alexandria region. Subsequently, the amount of buried phosphorus will be quantified.

The area of study locates west of the Nile delta. This area received, but little amount of the Nile load. Salinity varies from 37.77 ‰ to 38.83 ‰. Dissolved oxygen ranges from 5.28 ml/l to 6.00 ml/l in surface water, decreases with water depth and ranges 4.95 ml/l to 5.56 ml/l near the bottom. This area is not comprehensively studied, as most of the studies were carried out off the Nile delta. The investigated area covers the innershelf off and west of Alexandria region. It extends from Abu Qir in the east to Marakia in the west. Depth ranges between 10 m and 30 m (Figure 1). Seven sediments samples were collected either by a peterson grab sampler or by Scuba diving. For the determination of total and inorganic phosphorus, the method described by ASPILA *et al* . (1976) was used. The organic phosphorus was obtained by substraction.

Results and Discussion

Results obtained for total phosphorus (TP), inorganic phosphorus (IP), and organic phosphorus (OP) are displayed in figure 2. The organic phosphorus makes up about 20.9% $\pm$ 3.72% of the total phosphorus, varies between 15.7% and 27.1%. It has a mean concentration of 6.9 $\pm$ 3.37 µmole/g. It is clear that TP varies from station to another, however the relative percentage of IP to OP are almost constant. The maximum concentrations of OP and IP are found to be in Abu Qir station and Sidi Kirer deep station. EL-SABROUTI *et al.* (1990) mentioned that Abu Qir innershelf area is rich in OP. This station are covered with fine sediments, brought from the Rosetta branch (prior to 1965), by the westerly current. Accordingly lower porosity should be obtained for this fine materials, hence prevent the penetration of oxic water from the water-sediment interface. Thus the increasing percentage of OP on TP might be a combined effect of higher accumulation rate in this area and lower degradation efficiency in more anoxic sediments. In Agami station, the low values of TP, IP and OP may account for the type of sediments in this area, which is mainly carbonate sand (83% of the sediments in this area are carbonate, DOWIDAR *et al.*, 1990). According to EMELYANOV and SHINKUS (1986), the average content of phosphorus in the Mediterranean Sea is 0.05% in carbonate materials, compare to 0.5% in organic detritus and 0.1% in siliceous materials. The variation of OP/TP ratio may account for 1. A respective amount of IP is released from the degradation of organic matter which lead to increased of IP, and hence, low OP/TO ratio. 2. Upward migration of IP from anoxic sediment column to the top oxidized sediments layers. This upward flux may contribute significantly to the enrichment of phosphorus in the top layers, 3. Increasing the annual input to the sediment due to man's influence. Phosphorus is intricately involved with main productivity, so it is reasonable to suppose that phosphorus removal might occur by burial of OP in association with organic matter in sediments. We can estimate the burial rate of OP in sediments from the P/C ratio and the pre-agriculture burial rate of organic carbon (OC). The pre-agriculture burial rate of OC was estimated to be 0.99 x 10^{-6} mole-C cm^{-2} y^{-1} (FROELICH *et al.*, 1982). Taking the average P/C ratio obtained during the present study as 1.591 x 10^{-2} and the value of OC burial, we can calculate an OP burial rate of about 1.58 x 10^{-9} mole-P cm^{-2} y^{-1}. This value is considerably low compare the hemipelagic sediments (4 x 10^{-9}) mole-P cm^{-2} y^{-1}, FROELICH *et al.*, 1982). This may be interpreted as reflecting fractional regeneration of OP from OC during oxidation of organic matter during deposition as well as in marine sediments. OP/OC ratio obtained during the present study are almost less than that of Redfield ratio (9.4 x 10^{-3}), sometimes it is only 30% of Redfield ratio. From this it is concluded that part of the reactive OP fraction of the plankton has been preferentially lost (relative to carbon) before burial, both in the water column and in the top few mm of the sediments.

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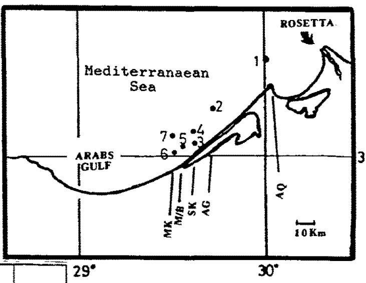

Fig. 1 Area of study and location of samples.
1 = Abu Qir 23 m (AQ),
2 = Agami 30 m (AG),
3 and 4 = Sidi Kirer 10 and 20 m (SK1, SK2),
5 = Marakai/Burg el Arab 10 m (M/B),
6 and 7 = Marakai 10 and 20 m (MK1, MK2).

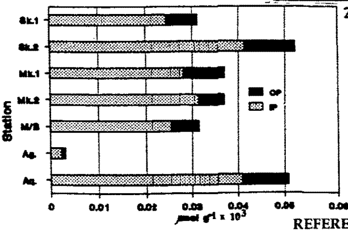

Fig. 2. - Concentrations of Inorganic Phosphorus and Organic Phosphorus in stations sampled.

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