Phosphorus and ammonia release experiments in the sewage-impacted coastal marine sediments of Alexandria, Egypt.

Tarek A. ABOUL-KASSIM[1,2], Naim M. DOWIDAR[2] and Fatma E. EL-NADY[2]

1- Environmental Organic Geochemistry Group, Oregon State University, College of Oceanography, CORVALLIS **(U.S.A.)**
2- Oceanography Dept., Faculty of Science, University of ALEXANDRIA, **(Egypt)**

Introduction

Sorption and desorption of nutrient salts by the sediment particles probably account for about 20-30% of the nutrients turnover in the marine environment (MARTIN, 1970; SEITZINGER, 1987) which play important role in nutrients contribution to the overlying water column. In this paper, our target is to study, experimentally, the amount of phosphorus adsorbed on sediments as well as to measure the sediment bound ammonium-nitrogen characteristic to the marine environment of Alexandria.

Study area

The Eastern Harbour (E.H) of Alexandria is a relatively shallow semi-closed basin, sheltered from the sea by an artificial break-water, leaving two openings through which the exchange of the harbour water and the neritic Mediterranean water take place. About $35.2x10^6$ m^3 of domestic sewage are discharged into the Eastern Harbour of Alexandria through 11 outfalls, distributed along the coast. This quantity is about 2.3 times the water volume of this basin.

Material and Method

Representative bottom sediment samples were collected from 3 stations in the Eastern Harbor. The sediment bound ammonium-nitrogen from each station was mechanically released by centrifugation (3600 RPM) a 1 cc wet sediment sample for ten minutes in 150 ml of ammonia free distilled water (KAMIYAMA *et al.*, 1977). The most suitable sediment to water ratio was found to be 1 cc sediment to 150 cc distilled water (MAHMOUD, 1985). The concentration of ammonia in the supernatant distilled water was measured. The liberation of ammonia-nitrogen from the sediment sample may result from the disruption of the equilibrium between the dissolved form in the interstitial water and adsorbed form on the particles by addition of the distilled water, and a new equilibrium state reached. The results were expressed as ug/lcc/l.

Phosphorus adsorbed on sediments was measured by shaking a 1 cc sediment for one hour with 150 ml of distilled water in an electric shaker. The phosphate released was measured. The results were expressed in ug at/l cc/l. As the desorption of phosphate is a function of pH, the same experiment was carried out using phosphate distilled water of different pH. The range used was 6-9, representing that of the harbor water, to yield maximum adsorption of phosphate for the harbor sediments.

Results and discussion

In the present study, the amount of phosphorus released from 1 cc sediment sample after shaking for one hour at the *in situ* pH, was obtained for different stations (Table 1). It was found that the amount of phosphorus released by shaking were higher than the corresponding *in situ* concentrations in the bottom water. This is obviously due to the strong tendancy of phosphate to be adsorbed in sediments and suspended particles. The *in situ* concentration in near bottom sea water was proportional to the concentration of phosphorus in surficial sediments. The ratio is almost constant (Table 1). This indicates that the distribution of the water column caused by winds and/or vertical mixing processes would increase the concentration of phosphorus in the overlying water column by appreciable amounts even at the same pH.

The equilibrium state between phosphorus adsorbed on the sediment particles and that dissolved in the overlying water seems to be grately governed by the oxidation (Table 1). This indicates that the distribution of the water column caused by winds and/or vertical mixing processes would increase the concentration of phosphorus in the overlying water column by appreciable amounts even at the same pH.

The equilibrium state between phosphorus absorbed on the sediment particles and that dissolved in the overlying water seems to be grately governed by the oxidation state of the bottom sediments. At pH range between 6-8, a complete absorption takes place. According to El-Sayed (1977), an increase in salinity values from 27-39‰ had no significant effect on the desorption processes.

Table 1: Amount of phosphate released by shaking (ug aVcc. sediment), *in situ* concentrations in near bottom sea water, and the ratio between *in situ* concentration and that released from sediments, as well as pH and salinity (‰) for selected stations in the harbor basin

Station	Phosphate released per liter (1)	*in situ* conc. in near shore bottom sea water (2)	Ratio [(2)/(1)]	pH	S‰
I	2.27	1.90	0.84	7.62	38.10
II	2.07	1.65	0.80	7.43	37.98
III	3.33	2.35	0.71	7.12	36.17

Experimentally, it was found that ammonia-nitrogen concentration in bottom waters (in situ) was less than that released from sediments. This negative sediment water gradient favours the release of ammonia-nitrogen to the overlying water. Also, the *in situ* concentration of ammonia near the bottom was inversely proportional to the ambient salinity (Table 2).

Table 2: Amount of ammonia released from sediments by centrifugation versus *in situ* ammonia concentrations (ug at/l) and salinity (‰) for selected stations in the harbor basin.

Station	Ammonia released (1)	*in situ* conc. in near shore bottom sea water (2)	Ratio [(2)/(1)]	pH	S‰
I	11.33	5.39	0.48	7.62	38.10
II	10.00	5.85	0.59	7.43	37.98
III	15.33	9.30	0.61	7.12	36.17

REFERENCES

ABOUL-KASSIM T.A.1987). - Cycles of carbon, nitrogen and phosphorus in the marine environment in Alexandria region. *M.Sc. Thesis*, Oceanography Dept., Fac. of Sci., Alexandria University, Egypt.

EL-SAYED M.A. 1977). - Geochemistry of manganese and iron in the recent shelf sediments of the nile delta in relation to phosphate adsorption. *M.Sc. Thesis*, Fac. of Sci., Alexandria University, Egypt.

KAMIYAMA K., OKUDA S. and KAWAI A.1977. - Studies on the release of ammonium-nitrogen from the bottom sediments in fresh water bodies, I. *Jap. J. Limnol.*, 37, 59-66.

MAHMOUD T.H. 1985. - Phosphorus and nitrogen dynamics in the polluted coastal waters off Alexandria. *Ph.D.Thesis*, Faculty of Science, Alexandria University, Egypt.

MARTIN D.F. 1970. - Marine Chemistry. Theory and applications. Marcel Dekker, Inc., New York, Vol.2.

SEITZINGER P. 1987. - The effect of pH on the release of phosphorus from Potolae river sediments: Final project report. *Annapolis; US-EPA*, 50p.

Flux à l'Interface eau-sédiment Quantification, Réaction et Bilan

Ayed ADDED

Faculté des Sciences de TUNIS **(Tunisie)**

Les flux d'alcalinité, de TCO2, d'azote, et des phosphates calculés à partir des eaux interstitielles et mesurés *in situ* à l'aide de chambres incubatrices dans la Lagune de Ghar El Melh, figurent dans le tableau suivant:

Eléments	Flux (mM/m²/jour)	
	calculés hiver - été	mesurés hiver - été
Oxygène		11,700- 14,000
Alcalinité	0,049 - 0,008	57,600- 0,000
TCO2		5,760- 1,840
Azote	0,160 - 1,230	0,000- 3,920
Phosphates	0,000 - 0,000	0,000- 0,000

A partir des données du tableau nous pouvons tirer les conclusions suivantes:

1) en hiver, l'alcalinité calculée étant supérieure à celle mesurée, indique que la dégradation de la matière organique est forte au niveau de l'interface eau-sédiment.

2) les diminutions des flux d'alcalinité et de TCO2 de l'hiver à l'été suggèrent que la dégradation aérobique de la matière organique diminue en été.

3) en été, le flux d'azote mesuré est supérieur au flux calculé.

4) le fait que les flux d'azote augmentent de l'hiver à l'été signifie que la dégradation de la matière organique passe d'un stade aérobique à un stade anaérobique (en hiver l'azote est sous forme de nitrates et en été il est sous forme d'ammoniaque).

5) l'absence totale de phosphates échangés entre le sédiment et l'eau surnageante (flux nuls) signifie que ceux-ci sont adsorbés sur le sédiment.

En supposant que les flux de TCO2 sont égaux aux taux de dégradation de la matière organique (les précipitations/dissolutions sont négligées car elles sont faibles), les bilans d'alcalinité prenant en compte les taux d'oxygène consommé ont permis de confirmer l'oxydation aérobique de la matière organique en hiver (100% de 02 consommé) et l'oxydation anaérobique en été (0% de 02 sont consommés par la matière organique et 100% de 02 ont servi pour oxyder essentiellement les sulfures solubles).