

DISTRIBUTION OF MUD PHOSPHATES IN THE COCHIN BACKWATER

Z. A. ANSARI AND M. D. RAJAGOPAL

National Institute of Oceanography, Dona Paula, Goa (India)

ABSTRACT

Distribution of total phosphate, adsorbed phosphate and interstitial phosphate was studied for a period of one year in the Cochin Backwater. The concentration of total phosphate showed a wide variation from 258 to 1320 $\mu\text{g/gm}$ of mud. It was high during the monsoon and low in the pre- and post-monsoon periods. During the period when the total phosphate was low the concentration of interstitial and adsorbed phosphate was high. The maximum value for the interstitial phosphate was 26.6 $\mu\text{g/gm}$ while for the adsorbed phosphate it was 41.5 $\mu\text{g/gm}$. Adsorbed phosphate was generally higher than interstitial phosphate at all stations. Fine sediments of silt and clay showed a higher content of phosphate than the coarse sandy sediment. The total phosphate concentration revealed a decreasing trend from marine to estuarine zone. Seasonal trend in the ratio of adsorbed and interstitial phosphate seems to be related to the influence of land runoff and freshwater flow into the estuary.

INTRODUCTION

The importance of mud nutrients, especially phosphate content which has a strong bearing on the organic production of the water above has been shown by earlier workers (Mortimer, 1941; Stephenson, 1949; Rochford, 1951). Although the Cochin Backwater has been studied fairly intensively during the past several years (Qasim *et. al*, 1969; Sankaranarayanan and Qasim, 1969), little has been done on the distribution of the different fractions of phosphorus in the sediment and its relation with the overlying water. The present communication deals with the distribution of phosphate in the mud and its exchange between the mud and the overlying water. The concentration

of mud phosphate in relation to the texture of the sediment is also given.

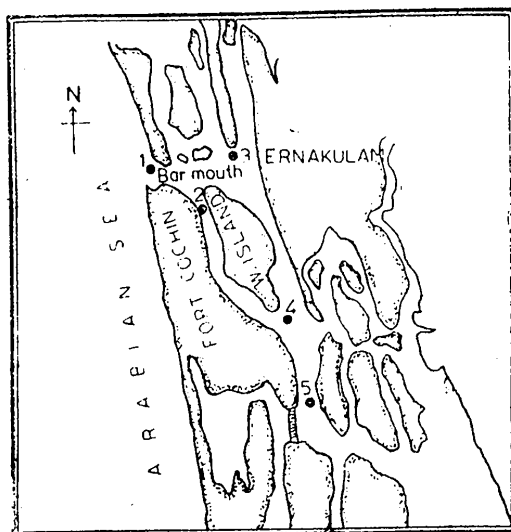


Fig. 1. Location of stations in the Cochin Backwater.

MATERIALS AND METHODS

Fig. 1 shows the sampling stations in the backwater selected for the study. Mud samples were collected at monthly intervals for a period of one year, commencing from January to December 1973 using a van Veen grab. The overlying water was collected with the help of a Nansen bottle for the estimation of inorganic phosphate. The mud phosphate was determined using the method of Rochford (1951). For fractional analysis, the substratum was sieved and the components such as sand, silt and clay were separated and then pipetted as given by Krumbin and Pettijohn (1938).

RESULTS AND DISCUSSION

Based on the texture, the substratum

was divided into sandy, silty-sandy, silty-clayey and clayey-sandy. Table 1 shows the percentage composition of sand, silt and clay along with the different fractions of phosphate in the substratum at each station. At station 1, the main component of the substratum was sand. At station 2 and 3 the substratum was found to be predominantly composed of silt and clay. The substratum at stations 4 and 5, was mainly sandy with a very low percentage of silt and clay. From Table I it is clear that the fine grain substratum holds a high concentration of phosphate which agrees with the findings of Balasubrahmanyam (1961) in the Vellar estuary and Murty and Veerayya (1972) in the Vembanad lake.

TABLE I

*Percentage of the three different fractions of mud phosphates in the sediment
(Average values of one year data)*

St. No.	Depth (m)	Inter- stitial	Adsorbed	Total	Sediment			Sedi- ment type
		P %	P %	P %	Sand %	Silt %	Clay %	
1	11.5	0.0015	0.0018	0.0716	64.48	22.62	11.90	Silty sand
2	8.0	0.0015	0.0021	0.0873	13.50	36.92	49.58	Silty clay
3	4.5	0.0018	0.0024	0.0878	1.82	42.87	55.31	Silty clay
4	5.5	0.0011	0.0016	0.0563	59.54	11.23	29.23	Clayey sand
5	4.0	0.0009	0.0014	0.0426	64.28	24.55	10.97	Silty sand

Fig. 2 shows the seasonal changes in the concentration of inorganic phosphate in the water overlying the mud. From November to February low values were recorded. However, with the onset of monsoon the inorganic phosphate content increased. As the monsoon advanced, the concentration decreased. The values varied from 0.22 to 2.90 $\mu\text{g-at/l}$. The increase in the concentration

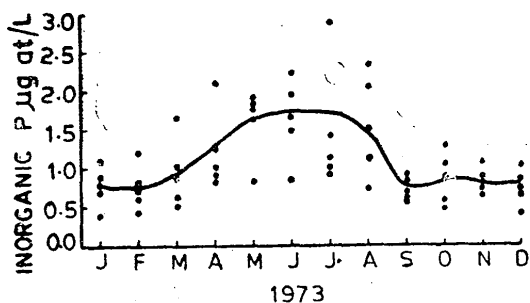


Fig. 2 Seasonal cycle in the inorganic phosphate in the water overlying the sediment.

of phosphate in the overlying water occurred when there was a decrease in the concentration of both interstitial and adsorbed phosphate in the mud. This may probably be attributed to the effect of turbulence and low pH (7.2-7.4), observed during the monsoon months. Miller (1952) has reported that the release of phosphate from the sediment into the overlying water is brought about when there is reduction in pH.

Seasonal variation of the three different forms of phosphate is shown in Fig. 3. It can be seen from the figure that the lowest value for interstitial and adsorbed phosphate occurred during the monsoon period. Maximum value (26.6 $\mu\text{g/gm}$) for the interstitial phosphate was recorded at Station 1, while the maximum value for adsorbed

phosphate was recorded at Station 3 (41.5 $\mu\text{g/gm}$). The high concentration of interstitial phosphate at Station 1 might be related to the texture of the substratum which is mainly silty sand and which favours a higher interstitial phosphate concentration (Rochford, 1951). Similarly the highest values of adsorbed phosphate observed at Stations 3, is also related to the texture of the sediment which mainly contains silt and clay. This confirms the observation made earlier by Jitts (1959).

In the present study, the values of adsorbed phosphate were always higher than that of the interstitial phosphate at all the stations except in February when low values of adsorbed phosphate were observed at stations 1, 2 and 3. The concentration of total phosphate showed a decreasing trend during the pre-monsoon period and higher values were recorded during the monsoon period. The values declined when the fresh water flow was reduced towards the end of monsoon. Stations 1, 2 and 3 recorded a high concentration of total phosphate. The lowest concentration (258 $\mu\text{g/gm}$) was recorded at Station 5.

From Fig. 3 it is seen that the maximum release of phosphate takes place during the monsoon period. Stephenson (1949) under laboratory conditions found an enrichment of water with phosphorus when the estuarine mud was agitated. Seshappa (1953) and Seshappa and Jayaraman (1956) have reported that intense agitation of mud during the monsoon months might give a leaching effect which may help in the release of phosphate from the mud to the overlying water. The above statement seems valid

for the observed low values of interstitial and adsorbed phosphate during the monsoon period. The permeability of

results in the retention of large quantities of phosphate in the mud interstices, while the overlying water has a low concentration of phosphate.

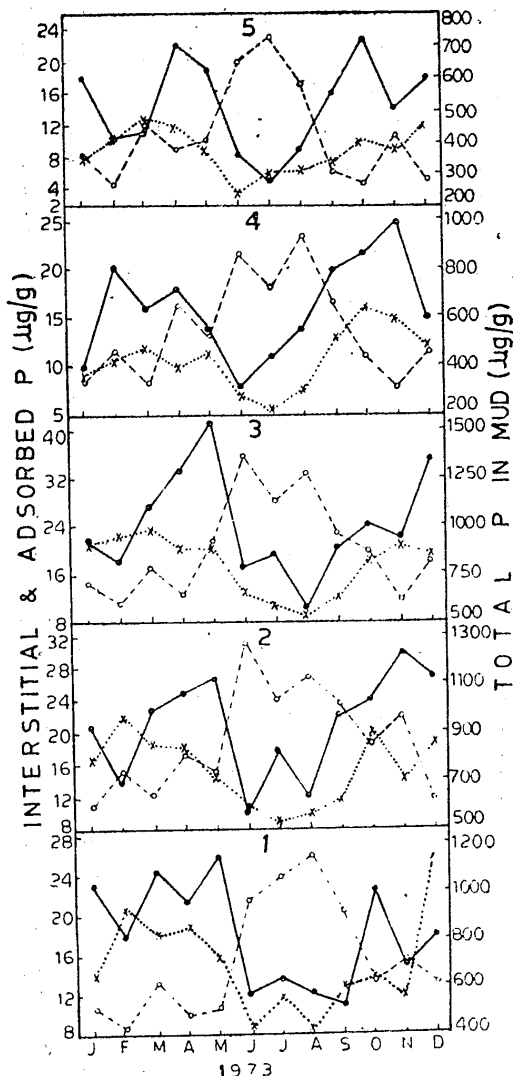


Fig. 3 Monthly distribution of three different fractions of mud phosphate at stations 1-5. (x x interstitial P; o - - - - - o adsorbed P; o ———— o total P)

the mud plays an important role in storing the phosphate in the mud interstices. During the pre- and post-monsoon periods the mud permeability is very low because of high silt content which

During the monsoon period, large quantity of allochthonous phosphate finds its way into the estuary which is probably responsible for its high values in the inshore waters. Stations 1, 2 and 3 showed high values of total phosphate which may be due to the transport of sediment from the upper reaches of the estuary. The differences observed in the concentration at these stations (Stations 1-5) might be related to the textural characteristics and physico-chemical changes of the sediment at different localities as suggested by Reddy and Sankaranarayanan (1972).

An examination of the ratios of adsorbed and interstitial phosphate at Stations 1 and 5 (Fig. 4), which differ in their environmental conditions, would

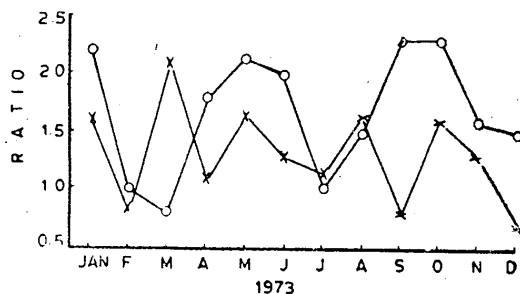


Fig. 4 Seasonal variations in the ratio of adsorbed and interstitial phosphate (x x Station 1; o ———— o Station 5)

reveal that values greater than 1 at both the stations indicate that adsorbed phosphate is greater than interstitial phosphate. The relatively higher values at Station 1, which has proximity to

Ansari & Rajagopal : Mud phosphates in Cochin backwater

the marine zone shows a greater retention of absorbed phosphate. encouragement. Thanks are also due to Shri C. V. G. Reddy, for suggesting improvements and to the Ministry of Education & Social Welfare, Government of India, for awarding a Senior Research Scholarship, during the tenure of which this work was carried out.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. S. Z. Qasim, Director, National Institute of Oceanography, Goa, for guidance and

REFERENCES

- Balasubrahmanyam, K., 1961. Studies in the ecology of Vellar estuary-2. Phosphates in the bottom sediment. *J. Zool. Soc. India*, **13** : 166-169.
- Jitts, H. R., 1959. The adsorption of phosphate by estuarine bottom deposits. *Aust. J. mar. Freshwat. Res.*, **10** : 7-21.
- Krumbien, W. C. and F. J. Pettijohn, 1938. *Manual of Sedimentary Petrography*, Appleton Century Crofts, New York. 549 pp.
- Miller, S. M., 1952. Phosphorus exchange in a subtropical marine basin. *Bull. mar. Sci. Gulf and Caribbean*, **1** : 257-265.
- Mortimer, C. H., 1941. The exchange of dissolved substances between mud and water in lakes. Part I. *J. Ecol.*, **29** : 280-329.
- Murty, P. S. N. and M. Veerayya, 1972. Studies on the sediments of Vembanad lake, Kerala State. Part II - Distribution of phosphorus. *Indian J. mar. Sci.*, **1** : 106-115.
- Qasim, S. Z., S. Wellershaus, P. M. A. Bhattathiri and S. A. H. Abidi, 1969. Organic production in a Tropical estuary. *Proc. Indian Acad. Sci.*, **69B** : 51-94.
- Reddy, C. V. G. and V. N. Sankaranarayanan, 1972. Phosphate regenerative activity in the mud of a tropical estuary. *Indian J. mar. Sci.*, **1** : 57-60.
- Rochford, D. J., 1951. Studies in the Australian estuarine hydrology- 1. Introductory and comparative features. *Aust. J. mar. Freshwat. Res.*, **2** : 1-116.
- Sankaranarayanan, V. N. and S. Z. Qasim, 1969. Nutrients of the Cochin Backwater in relation to environmental characteristics. *Mar. Biol.*, **2** : 236-247.
- Seshappa, G., 1953. Phosphate content of mud banks along the Malabar coast. *Nature, London*, **171** : 526-527.
- Seshappa, G. and R. Jayaraman, 1956. Observation on the compositions of bottom muds in relation to phosphate cycle in the inshore waters of Malabar coast. *Proc. Indian Acad. Sci.*, **43B** : 288-301.
- Stephenson, W., 1949. Certain effects of agitation upon the release of Phosphate from the mud. *J. mar. biol. Ass. U. K.*, **28** : 371-380.