GIAP Journals
Green Chemistry & Technology Letters
Vol 2, No 2, March 2016, pg. 91-94
eISSN: 2455-3611, DoI: 10.18510/gctl.2016.228

DISTRIBUTION OF ORGANIC CARBON, PHOSPHORUS AND NITROGEN IN THE SEDIMENTS OF MANAKUDY ESTUARY

A. Jeena Pearl
Assistant Professor in Chemistry Scott Christian College, Nagercoil-3, Tamil Nadu, India
jeenapearl@rediffmail.com

Article History: Received on 20th September 2015, Revised on 30th October 2015, Published on 20th March 2016

Abstract

Estuary is a transition zone between land and sea as well as freshwater and salt water. In the estuary, the water carrying agricultural, industrial and domestic wastes are deposited as sediment. Distribution of organic carbon, total phosphorus and total nitrogen in the sediments of Manakudy estuary has been studied. Based on their nature, five stations have been earmarked for sampling. The C/N ratio of these sediments is very high compared to the sediments from Mandovi estuary goa.

Key words: Organic Carbon, Nitrogen, Phosphorus, Sediment, Estuary

INTRODUCTION

The mixing point of river and the sea forms the estuary. Estuarine wetlands protect water quality by filtering pollutants and sediment and serve as buffers that protect adjacent land areas from flooding and erosion (Kate Johnson, 2003) Estuarine sediments and waters are characterized by specific and complex physical, chemical and microbiological properties. These properties depend and interact with each other and collectively constitute a unique environment to the organism. Thus Estuary is one of the productive wetland ecosystems.

The study of sediments represents a useful tool for determining the actual state of environment and pollution of a water body.

Estuaries are often contaminated with a range of organic and inorganic contaminants. Sources of environmental contaminants to the coastal system are numerous. They enter the estuarine system through different pathways mainly rivers. Contaminated sediments may be directly toxic to aquatic life or through bioaccumulation. The biomagnifications can cause long term chronic effects (Swartz et al., 1985)

Organic carbon in riverine and estuarine sediments is controlled mostly by the rate of organic to inorganic constituents, primary productivity, composition and texture of the sediments. Organic carbon plays a major role in the distribution and retention of trace elements in the sediments. Study of organic carbon in the sediments is of potential significance for a proper understanding of its flow in an ecosystem.

Organic carbon may inhibit the accumulation of contaminants through chemical binding to organic carbon that renders contaminants relatively unavailable for uptake. Organic carbon may also enhance the uptake and accumulation of contaminants into biota (Curtis, 1996).

Oxygen is the most important oxidant for respiration of organic matter. Its concentration and distribution among sediments is critical for organic carbon decomposition and recycling of nitrogen and phosphorus (David et al., 2006). Nitrogen and Phosphorus are present in organic and inorganic forms. Phosphorus and Nitrogen can also be bound by bacteria and it is important to consider living microscopic benthos as part of the sediment structure (Pettijohn, 1926). 70-80% of phosphorus in the faeces of animals derived from the non-absorbable form of phosphorus in food. The major part of the excreted phosphorus remains in the soil, affecting the chemistry of sediments (Rankama and Sahama 1950).

STUDY AREA

The tail end of Pazhayar River merges with the Arabian Sea at Manakudy. Manakudy estuary is situated about 8 kilometers north west of cape comorin falling with in the latitude $8^0 4^1$ and $8^0\ 21^1$ N and longitude $77^0 26^1$ and $77^0 30^1$ E. The climate of the region is grately influenced by both the south – west and north-east monsoons. Khondalites, Charnockite and the river and marine aluviam are the geological formations observed in these study area.

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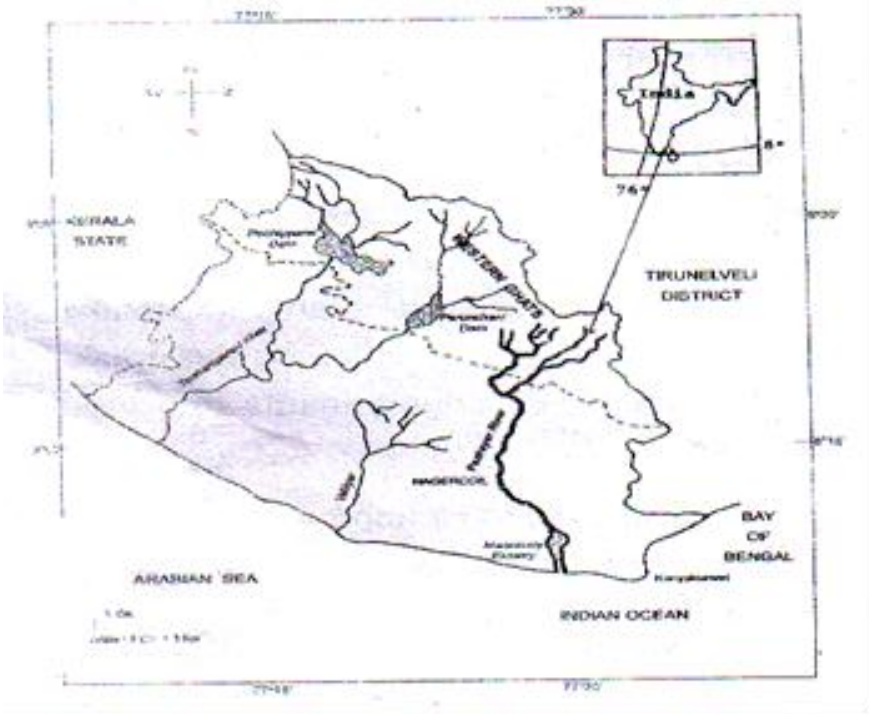

MATERIALS AND METHODS

Sediment samples were collected from five different stations from estuarine mouth bed to river basin. The collected samples were initially air dried and finally powdered using agate motor. Percentage of organic carbon was determined by titration method of Walkley Black (1934) as well as Elwakeel and Riley (1957). Nitrogen was estimated by kjeldhal method (Technicon Industrial System, 1973). Phosphorus was estimated by ammonium phospho molybdate method (APHA, 1998).

RESULTS AND DISCUSSION

Organic Carbon

From the results, the Organic carbon ranges between 0.18 and 0.72% with the mean value of 0.44%. The maximum value was observed in station III (S15) and the minimum value was observed in station I(SI). Low content of organic carbon is attributed to low bioproductivity and active hydrodynamics. Moreover, the bottom are unable to accumulate organic matter supplied from the water mass. The Higher percentage of organic carbon can be attributed to the influx of land runoff containing considerable amounts of terrigenous organic matter. The organic carbon is highly positively correlated with nitrogen revealing that the accumulated fine sediments are nitrogeneous organic matter.

Nitrogen

The Nitrogen ranges between 280 and 840 ppm with the mean value of 524 ppm. Maximum value was recorded in station III and the minimum value was recorded in station I. Generally nitrogen increases towards the estuary similar to organic carbon. Under Mandovi river estuarine condition, Nasnolkar et al., (1996) have indicated a strong correlation existing between nitrogen and phosphorus, an inference of their common source. There is lesser correlation between nitrogen and phosphorus. It implies that nitrogen and phosphorus do not occur from a common source though the occurrence of both these elements is controlled by lithology of the sediments.

The total phosphorus and organic carbon are not correlated which implies that organic phosphorus is enriched in the sediments. Since the organic carbon and nitrogen bear a direct relationship, the C/N ratio is highly revealing. Low C/N ratio in areas of high organic carbon and nitrogen is indicative of organic matter preservation in clayey sediments due to adsorption of organic compounds in the clay mineral (Muller, 1977).

According to Ruediger stein et al., (1994), the relatively high organic carbon is caused by the supply of terrigenous organic matter as indicated by high C/N ratio. However Faganeli et al., (1991) have established that C/N ratio could not be used as index of organic

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matter source, since there is more of organic nitrogen preservation than the sedimentary organic matter. According to Meybeck (1982), under esuarine conditions during post-monsoon a decreasing C/N ratio is indicative of retention of nitrogen and increase of respiration of carbon. In contrast, the post – monsoon sediments of Tambraparni estuarine sediments follow an increasing trend (Vetharoy, 2002).

In Manakudy estuarine sediments low C/N ratio (3.3) may be due to lack of suspended matter in the estuary. The higher C/N ratio (10.7) is due to terrigenous organic matter enriched with residual of mangrove grasses which contain high contents of lignin and cellulose. The CN ratio of these sediments is very high compared to the sediments from Mandovi estuary Goa (Nasnolkar et al., 1996). Organic carbon content in Amazon estuarine sediments is higher (0.2-167%) with nitrogen ranging from traces to 0.05% and the C/N ratio increasing to 11.8 (Artemyev, 1996).

Phosphorus

In the present study, the phosphorus content ranges between 250 – 510 ppm with the mean value of 291 ppm. Maximum value was observed in station IV and the Minimum value was observed in station I. Higher concentration of phosphorus is due to the larger supply of terrigenous material by the river, organic productivity and agricultural waste discharge from the paddy fields of the region. But in urbanized estuaries high phosphate levels are reported near the freshwater end (Shorp et al., 1982 ; Fox et al., 1986). Low concentration of phosphorus is due to the process of flocculation and the changes in salinity. Changes in salinity is caused by the draining of bitterns from the nearby saltpans.

Table 1: Distribution of C,N, P in the sediments of Manakudy

No	OC	N	P	C/N
1.	0.18	280	250	6.428
2.	0.24	280	250	8.571
3.	0.29	420	300	3.320
4.	0.29	420	340	3.320
5.	0.30	420	340	7.142
6.	0.36	420	300	8.571
7.	0.36	420	340	0.047
8.	0.41	420	300	8.571
9.	0.41	560	380	9.761
10.	0.57	840	430	9.464
11.	0.57	840	430	10.178
12.	0.68	700	430	8.095
13.	0.69	840	380	9.857
14.	0.71	840	340	8.452
15.	0.72	700	300	8.571
16.	0.60	700	380	8.571
17.	0.53	560	430	8.142
18.	0.51	560	470	7.571
19.	0.41	420	510	9.107
20.	0.36	420	470	7.321
21.	0.38	520	510	8.571
22.	0.45	520	430	9.047
23.	0.45	280	430	8.653
24.	0.30	280	340	10.714
25.	0.32	420	300	7.619

CONCLUSION

Based on the analytical works, the organic carbon is highly positively correlated with nitrogen (r = 0. 95) revealing that the accumulated fine sediments are nitrogenous organic matter. The total phosphorus and organic carbon are not correlated which implies that organic phosphorus is enriched in the sediments. Since the organic carbon and nitrogen bear a direct relationship. The C/N ratio is highly revealing.

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