

IDENTIFICATION OF EUTROPHICATION IN PALLIKARANAI WETLAND, CHENNAI

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Abstract: The present paper studies about the identifying the status of eutrophication in Pallikaranai wetland, Chennai. In order to understand the biological availability of phosphorous, it is always essential to estimate various phosphorous fractions. In the present study, the determination of phosphorous in several chemical fractions of sediments from the Pallikaranai wetland to establish level of phosphorous as inorganic, organic, non-apatite inorganic or as apatite phosphorous fraction. The results show that non-apatite phosphorous is the dominant form of phosphorous in the Pallikaranai wetland sediments accounting for >50% of the total phosphorous.

Keywords: Eutrophication, phosphorous fraction, biological availability, apatite, non-apatite inorganic phosphorous, Pallikaranai wetland.

1. INTRODUCTION

Eutrophication can be defined as the natural aging of lakes or stream brought on by nutrient enrichment. The increasing amount of nutrients favours the over growth algae and weeds leads to eutrophication. Present study aims in understanding eutrophication of Pallikaranai wetland using sediment geochemistry. The work is carried out by studying phosphorous fractionation. The influence of silicon in phosphorous release is also carried out by studying silicate concentration water sediment column.

The Pallikaranai wetland is a freshwater swamp in the Chennai city of Tamil Nadu, India. It is located near the bay of Bengal, which is about 20 km from the south of the city centre, and has a geographical area of 80 square km.

Pallikaranai marshland is the one of the few and the last remaining wetland in Southern India. It is a deep low-lying area which is surrounded by all the aquatic grass species, water-logged depressions and marsh which is connected to 31 different water bodies, all of which release surplus water into the marsh throughout the monsoons. It has a catchment area of 235 square km that includes the urban sprawls of Velachery, Pallikaranai and Navalur.

This wetland area is being assaulted by different factors, ruining its natural condition. The water is dirtied by untreated sewage and industrial effluents.

2. LITERATURE SURVEY

The study of different types of lakes involved in eutrophication. This study evaluates the result of phosphorous which is the key player in biochemical reaction. P locked up in bedrocks, soils, and sediments is not directly available to organisms. The main sources of P in lakes are external point and non point sources such as rain fall, runoff, and soil leaching, industrial and municipal effluents.

Most methods attempt to separate at least three of the fractions. For this purpose, various reagents are used and different experimental conditions are applied. As a result, the fractions obtained are operationally defined and the data depend on the experimental conditions. This leads to lack of comparability of results between laboratories.

3. MATERIAL AND METHODS

3.1 STUDY AREA

Pallikaranai is the marshland is located along the Coromandel Coast south of the Adyar Estuary. It is surrounded by the expressway of Old Mahabalipuram Road and the residential areas of Perungudi, Siruseri, Pallikaranai, Madipakkam, Velachery and Taramani. It has a catchment of 235 square km (91 sq mi) that includes the urban sprawls of Velachery, Pallikaranai and Navalur.

3.2 LOCATION OF SEDIMENT SAMPLES

The sampling was done on the Pallikaranai wetland sediments during Dec 2017. The surface samples were collected from the surface of the lake is detailed below in table(1). The top surface sediment sample was taken from 6 places surrounding the lake i.e., 6 fractions were studied.

Sample no	Latitude	Longitude
PA_SED 1	12.9465	76.6235
PA_SED 2	12.9572	80.2146
PA_SED 3	12.9496	76.6936
PA_SED 4	12.9492	80.2157
PA_SED 5	12.9501	80.2209
PA_SED 6	12.950	80.2244

Table 1. Sampling location details

The 6 samples were collected and placed in the air sealed bags. The locations where the samples are collected is marked in the given figure(1)



Figure 1. location of the samples

3.3 METHODOLOGY

The surface samples which is collected in air tight sealing bags. After transporting the samples to the laboratory the samples are oven dried. The method of sequential extraction for the fractionation of phosphorous was SMT which was used to study the samples, The SMT (Ruban et. al, 2001) is done by which fractionates the inorganic, organic, apatite and non-apatite phosphorous in the sediments is detailed in the given below fig(1).

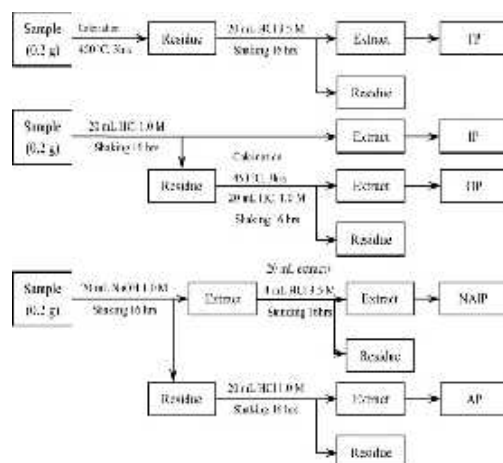


Figure 2. SMT Protocol of Sequential Extraction

3.4 ANALYTICAL TECHNIQUES FOR PHOSPHOROUS FRACTIONS

1 g of sediment was used for analyzing SMT method. Chemicals of supra pure grade or excel grade was used for analyzing the samples. The samples were shaken using rotary shaker and filtered after centrifuging the samples. The residue was used for the next step of the procedure and the extractant is stored in the polypropylene bottles.

3.4.1 PHOSPHORUS

Phosphorus can occur almost as phosphates in both the natural and in waste waters. These are varied as ortho phosphate, condensed phosphate (pyro-meta, and other poly phosphates), and organically bound phosphates. They occur in solutions in particles or detritus, or in the bodies of aquatic organisms. The extractants were analysed by ascorbic method in spectrophotometer.

The combined reagent is prepared by mixing the below reagents in the following proportions for 100 ml of the combined reagent: 50 ml 5 NH_2SO_4 , 5 ml potassium antimonyltartarate solution, 15 ml ammonium molybdate and 30 ml ascorbic acid solution. Mix after addition of each reagent. Let all reagent reach room temperature before they are mixed in the order given. If the formation turbidity occurs in the combined reagent, shake it and let stand for few minutes

until they disappear before proceeding. The reagent is stable for 4 hrs. the sample is tested using spectrophotometer.

3.4.2 SILICA

Two analytical methods were used to determine the concentration of dissolved Si. Atomic adsorption spectrophotometry (AAS) at a wavelength of 251.6 nm was used to determine the concentration of Si in the interstitial water and other sediment extracts in articles I - V. Spectrophotometrically at 815 nm using the blue ammonium molybdate reaction according to Mullin and Riley (1966) as described by University of Lund (1988). The relative merits of the methods and possible sources of error are described in detail by e.g. Babko and Pilipenko (1974) and Hallmark et al. (1982). Although both P and Si may interfere in the spectrophotometric analysis of the other element (e.g. Hallmark et al. 1982), P concentration in this study were too low relative to the concentration of Si for P to interfere with the analysis of Si. The interference of Si in the P analysis was corrected for (IV).

The silica is analysed by taking 25 ml sample adding 0.5 ml 1+1 HCL solution, adding 1 ml ammonium molybdate reagent and mix them thoroughly and let them stand for 5 to 10 minutes. Add again 1 ml of oxalic acid solution and make it ready to read the color after 2 minutes and before 15 minutes by using spectrophotometer.

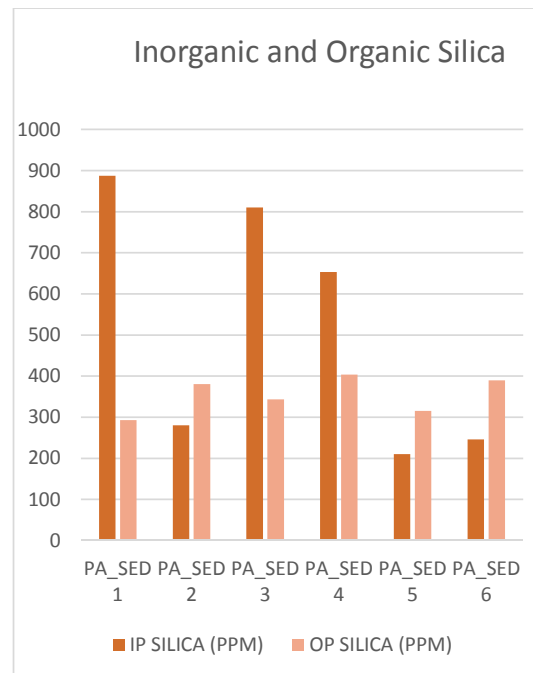
4. RESULT AND DISCUSSION

4.1 Concentration of silica in different fractions of Pallikaranai wetland Sediment

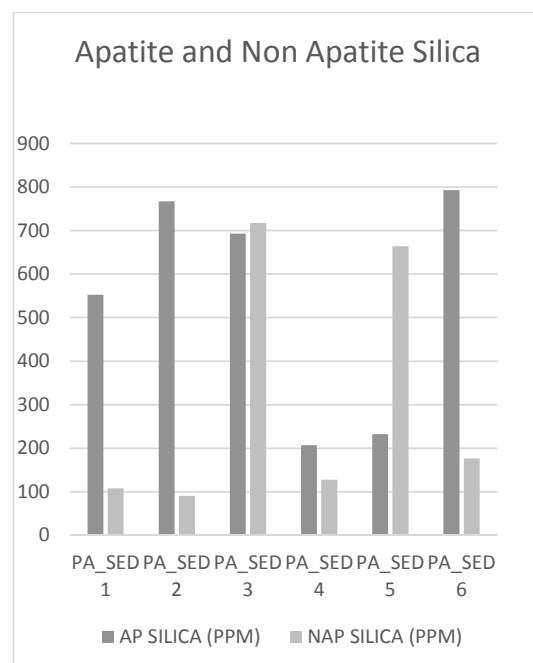
Inorganic Organic Apatite Non apatite

IP SILICA (PPM)	OP SILICA (PPM)	AP SILICA (PPM)	NAP SILICA (PPM)
887.5516	292.7167	552.8932	108.0424
280.4731	380.4625	767.1562	90.6973
810.0088	343.7317	692.6743	717.1615
652.8826	403.9294	207.0115	127.4281
210.0724	315.1633	232.519	664.1059
245.7829	389.6452	792.6637	176.4025

Table 2: concentration of silica in different fractions



graph 1: inorganic and organic silica



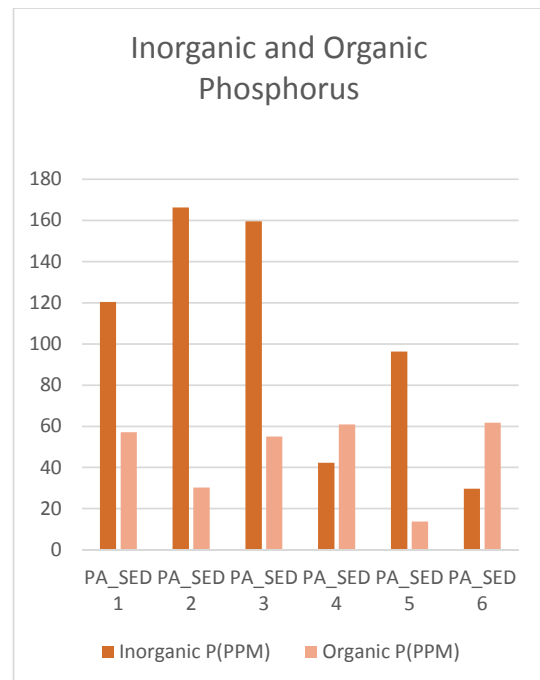
graph2: apatite and non apatite silica

4.2 Concentration of Phosphorus in different fractions of Pallikaranai wetland:

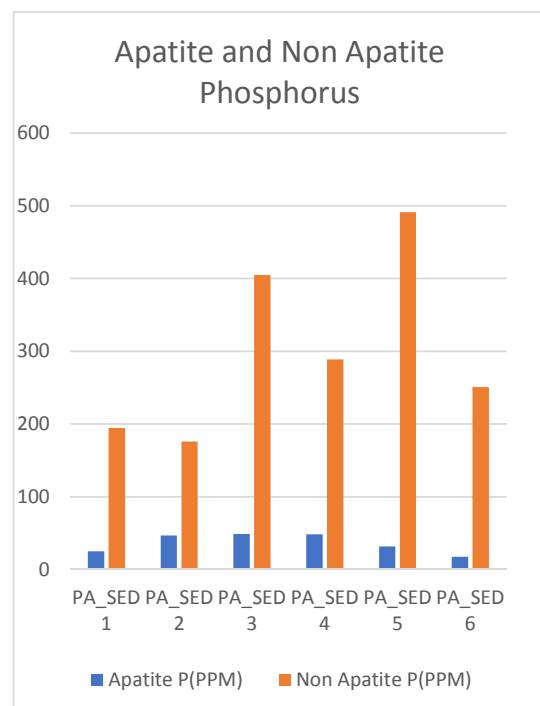
Inorganic Organic Apatite Nonapatite

Inorganic P(PPM)	Organic P(PPM)	Apatite P(PPM)	Non Apatite P(PPM)
120.3646	57.1158	25.02105	194.5249
166.2929	30.2667	46.72385	175.8499
159.5206	55.0636	48.912872	404.9575
42.2579	60.9329	48.58452	288.6798
96.2718	13.6913	31.70175	491.314
29.6574	61.7128	17.58261	250.6731

Table 3: concentration of phosphorous in different fractions



graph3: inorganic and organic phosphorous



graph4: apatite and non apatite phosphorous

PHOSPHOROUS FRACTIONATION:

The result of this wetland from the above graphs and datas shows the dominant phosphorous fractionation concentration (>50%) as the non apatite phosphorous fraction. The high concentration of the non apatite fraction indicates it is the exchangeable fraction. As this phosphorous in mobile nature plays the important role in the eutrophication in wetland in which the dissolution of iron/metal bound complexes at high anoxic condition. i.e when the dissolved oxygen is low, the release of phosphorus takes place (Rydin 2000; Pardo et al. 2003) which in turn is adsorbed onto sediment particles leading to increasing amount of concentration in exchangeable fraction, making phosphorous available for algae and plants in the wetland.

INORGANIC SI ADDITIONS ON THE DISTRIBUTION OF P:

The result shows that the silica has the capable of influencing the labile P in the surface sediment under the laboratory conditions. The phosphorous in apatite inorganic fraction and inorganic fraction clearly shows that it is affected by the silica concentration in the sediments. The phosphorus which is precipitated as non apatite form does react with silica and thus it is involved in exchange process, whereas the inorganic and organic silica showing a negative correlation results in release from phosphorous from the sediments.

5. CONCLUSION

The study indicates that the concentration of Phosphorous in the sediments are high using the method SMT, one of the method used in this study, is proved to be good for studying the different fractions of phosphorous in the sediments of the study area. The high concentration in the loosely bound fraction and the Fe bound fraction indicates presence of high amount of bioavailable phosphorous in the Pallikaranai Lake. The high amount of phosphorous in the Pallikaranai wetland indicates that the possibility of high production of aquatic biota. As the study indicates the high availability of phosphorous for the growth of the

organisms, the lake can be termed as eutrophic lake or considered to be forwarding towards the eutrophication. Hence, necessary step should be taken to reduce the phosphorous input to save the lake from eutrophication.

6. REFERENCES

- [1] R.p.vijayvergia,, "A case study of highly eutrophicated lake udaisagar,udaipur(raj.), India with regards to its nutrients enrichment and emerging consequences" Proceeding of Taal2007: The 12th World Lake Conference: 1557-1560.
- [2]P. Purushothaman& G. J. Chakrapani, "Phosphorus biogeochemistry in sediments of high altitude lakes, Kumaun Himalayas, India"Arabian Journal of Geosciences 8 (2015): 701-709.
- [3] ShouliangHuo, Fenguezan, Beidou Xi, Quingqin Li &Jingtianzhang, "Phosphorous fractionation in different trophic sediments of lakes from different regions, China"Journal of Environmental Monitoring13 (2011): 1088-95.
- [4]Changyou Wang, Yong Zhangb, Hongli Li, R. John Morrisonc, "Sequential extraction procedures for the determination of phosphorus forms in sediment"Limnology 14 (2013): 147-157.
- [5] Xiao-e Yang, Xiang Wu, Hu-lin Hao,and Zhen-li He,"Mechanisms and assessment of water eutrophication"Journal of Zhejiang University SCIENCE B 9 (2008): 197-209.
- [6] Shilpa, Dr. Shakti Kumar Arora, "A Study of Eutrophication Phenomenon of a Lake of a Modern City of India" International Journal Of Engineering Research And Technology(IJERT) 5 (2016): 470-473.
- [7]Keith Hendry, Hugh Sambrook, Chris Underwood, Rachel Waterfall & Adrian Williams,"Eutrophication of Tamar Lakes (1975–2003): a case study of land-useimpacts, potential solutions and fundamental issues for the Water Framework Directive"Water and Environment Journal 20(2006):159 – 168.

- [8] Marcos Callisto, Joseline Molozzi and José LucenaEtham Barbosa“Eutrophication of Lakes”Eutrophication: Causes, Consequences and Control(2014): 55-71.
- [9] Cenk Gürevin, Ali Erturk, Meric Albay, “Predicting the effects of sediment based internal nutrient loads on eutrophication in Küçükçekmece Lagoon for rehabilitation planning”International Journal of Sediment Research 32 (2017): 527-554.
- [10] Zhaokui Ni, Shengrui Wang, Yuemin Wang(2016), “Characteristics of bioavailable organic phosphorus in sediment and its contribution to lake eutrophication in China”Environmental Pollution219 (2016): 537-544.
- [11]Hemant Pathak and DeepakPathak, “Eutrophication: Impact of Excess Nutrient Status in Lake Water Ecosystem”Journal of Environmental & Analytical Toxicology 2 (2012): 2-5.
- [12] H. Karibasappa, H. B. Aravinda and S. Manjappa (2009), “A study on eutrophication level in hosur townlakes”Nature Environment and Pollution Technology 8 (2009):297-300.
- [13]L.Serrano, M.Reina, X.D.Quintana, S.Romo, C.Olmo, J.M.Soria, S.Blanco, C.Fernandez-Alaez, M.Fernandez-Alaez, M.C.Caria,S.Bagella, T.Kaletka, M.Patzig (2017) “A new tool for the assessment of severe anthropogenic eutrophication in small shallow”Ecological Indicators76 (2017): 324-334.

