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ARTICLE

EVALUATING HEAVY METALS FROM DIFFERENT WATER BODIES IN CHAVARA

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Abstract

Sediment samples were collected from four pond systems in Chavara during pre-monsoon, monsoon and post-monsoon seasons. The concentrations of Al, Li, Fe and Ni were determined using inductively coupled plasma-mass spectrometry (ICP-MS) for the assessment of sediment characteristics from the water systems. From the results, it was observed that pre-monsoon season had the highest concentrations of the metals in the sediment system. The results of this study specifies that the sediment was of polluted with some heavy metals. The pollutants are appeared to be in related to the widespread industrial discharge raised from the excavating and treating of related beach sand elements from the shores through the nearby processing units.
Keywords: inductively coupled plasma-mass spectrometry, beach sand, Chavara

Introduction

Aquatic ecosystems near to the urban area are under stress due to the industrial discharges. Heavy metal accumulation in water bodies is a serious global environmental issue. Metals like Al, Li Ni, have no role in any physiological activities and hence when present in trace level will be shown extreme toxic nature (Kar et al., 2008). The most important reason for the presence heavy metal in water could be due to the mining and weathering of beach sands (Karbassi et al., 2008). Suspended sediment particles act as a sink, which absorbs various chemical pollutants from water, and lower their concentration in water (Wang et al., 2016). Hence by analyzing the sediments, the pollution intensity of aquatic ecosystems can be correctly monitered (Hu et al., 2012). Metals are considered the strongest ecological lethal substance because of its non-biodegradable nature (Singh et al., 2013a).

Materials and Methods

Study Area and Sampling sites

The study sites were located in Panmana panchayath in Kollam district, Kerala, India.4 sampling sites (S1 to S4) were selected for this study. The area chosen in Chavara is profoundly a contaminated location.

Sample collection

The sediment samples were collected from the four sampling stations during the pre-monsoon, monsoon and Post-monsoon for a period of two years from January 2014 to December 2016. Sediment samples were collected using the stainless steel Eckman grab. Collected sediments were immediately transferred to plastic containers and transported to the laboratory for further analysis using Atomic Absorption Spectroscopy -AAS (Perkin Elmer-A Analyst 300) (APHA, 2012).

Statistical analysis

The data obtained from heavy metal analysis were subjected to statistical analysis using SPSS (version 19.0) package. The statistical significance of heavy metal in sediment between sites wise, seasons wise were studied by Two Way ANOVA.

Results

In the present study, the different station wise mean value for Al (mg kg^{-1}) ranged between 1.2 to 188.8 (Table1). In pre-monsoon, the highest value for Al (mg kg-1) was 188.8 (S4) and lowest in S1 (1.2). In the monsoon period, the highest value was in S4 (150.6) and the smallest value was observed in S1 (1.2). In the post-monsoon period, S4 (171) confirms the highest value and least for S1 (1.9). This variation of Al (mg kg^{-1}) values among different site (F= 241.39) is significant at 0.01 level. Thus there is the significant main effect of site on Al (mg kg^{-1}) on different sediment samples. This means that overall when ignoring the influence of season; the site has a significant influence on Al (mg kg^{-1}) of sediment systems.

It can also be observed that the main effect of season on Al (mg kg^{-1}) is not statistically significant at 0.01 level (P

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Table 1. Comparison of Aluminium (mg kg^{-1}) based on season and sites from sediment samples of different water systems in Chavara (Mean ± S E)

Site	Pre-monsoon	Monsoon	Post-monsoon
Site 1	2.5 ± 0.05	1.2 ± 0.01	1.9 ± 0.02
Site 2	11.3 ± 0.03	9.3 ± 0.02	10.2 ± 0.04
Site 3	19.7 ± 0.01	15.6 ± 0.02	17.8 ± 0.02
Site 4	188.8 ± 0.05	150.6 ± 0.01	171 ± 0.01

Table 2. Comparison of Lithium (mg kg^{-1}) based on season and sites from sediment samples of different water systems in Chavara (Mean ± S E)

Site	Pre-monsoon	Monsoon	Post-monsoon
Site 1	0.028 ± 0.8	0± 0.0	0.01± 0.0
Site 2	0.04 ±1.0	.002 ± 0.0	0.01± 0.0
Site 3	.054±0.91	.006 ± 0	0.02 ± 0.0
Site 4	0.098±0.96	.008 ± 0	0.04 ± 0.0

Table 3. Comparison of Nickel (mg kg^{-1}) based on season and sites from sediment samples of different water systems in Chavara (Mean ± S E)

Site	Pre-monsoon	Monsoon	Post-monsoon
Site 1	0.98 ± 0.27	0.56 ± 0.19	0.79 ± 1.0
Site 2	1.62± 0.5	1.2 ± 0.63	1.54 ± 0.16
Site 3	2.34 ± 0.5	1.35 ± 0.27	2.14 ± 0.57
Site 4	3.62 ± 0.57	2.25 ± 0.53	3.23 ± 0.48

Table 4. Comparison of Iron (mg kg^{-1}) based on season and sites from sediment samples of different water systems in Chavara (Mean ± S E)

Site	Pre-monsoon	Monsoon	Post-monsoon
Site 1	213 ± 3.1	186 ± 2.0	201 ± 3
Site 2	635± 3.1	546 ± 1.0	619 ± 1.5
Site 3	713 ± 4.1	689 ± 2.3	698 ± 2
Site 4	171.1 ± 2.6	163± 2	162 ± 1

>0.01). Al was found to be high summer followed by post-monsoon and least in monsoon.

In the present study, the different station wise mean value for Li (mg kg^{-1}) ranged between 0 to 0.09 (Table 2). In pre-monsoon, monsoon and post-monsoon period the highest value for Li was in (S4) and lowest in S1. This variation of Li (mg kg^{-1}) values among different site is not significant at 0.01 level. Thus there is no significant main effect of site on Li (mg kg^{-1}) on different sediment samples.

It can also be observed that the main effect of site on Li (mg kg-1) of sediment is statistically significant at P less than 0.01 level. Li (mg kg^{-1}) was found to be high pre monsoon followed by post-monsoon and least in monsoon. This variation of in Li (mg kg-1) in different seasons were statistically significant at P less than 0.01 level, when ignoring the influence of site on Li (mg kg^{-1}) (Tables 2).

In the present study the different station wise mean value for Ni (mg kg^{-1}) ranged between 0.56 to 3.62 (Table 3). In pre monsoon, monsoon and post-monsoon highest value for Ni (mg kg^{-1}) was (S4) and lowest in S1. This variation of Ni (mg kg^{-1}) values among different site is significant at P less than 0.01 level. Thus there is significant main effect of site on Ni on different sediment samples.

It can also been observe that the main effect of season on Ni of sediment is statistically significant at 0.01 level. Ni was found to be high in pre-monsoon and least in monsoon and post-monsoon. This season wise variation in Ni is statistically significant at 0.01 level, when ignoring the influence of site on Ni.

In the present study the different station wise mean value for Fe (mg kg^{-1}) ranged between 186 to 713 mg kg^{-1} (Table 4). In pre-monsoon, monsoon and post-monsoon the highest value for Fe (mg kg^{-1}) was S3 and lowest in S4. Variation of Fe (mg kg^{-1}) values among different site is significant at 0.01 level. Thus there is significant main effect of site on Fe (mg kg^{-1}) on different sediment samples. This means that overall, when ignoring influence of season; site has significant influence on Fe (mg kg^{-1}) of sediment systems.

It can also been observed that the main effect of season on Fe (mg kg^{-1}) of sediment is statistically significant at 0.01 level. Fe (mg kg^{-1}) was found to be high pre-monsoon and least in monsoon and post-monsoon. This season wise variation in Fe is statistically significant at P less than 0.01 level, when ignoring the influence of site on Fe.

Discussion

In this stud study, the Al concentration was found to be within the permissible limit of the sediment quality guideline value of Canada (23000 mg kg^{-1} in Pre-industrial sediment). Alvarez, (2005) studied the Al concentration in different soil samples from spain. Among the metal ions, the concentration of Iron and Nickel exceeds the permissible limit of EPA /WHO SQG standards. According to FAO/WHO (1984), the permissible level of Ni in sediment was one mg kg^{-1}. In all the sites the Fe value was found to be very high when compared with FAO/WHO values. Hence it is clear that all the sites were polluted with Fe ions and this could be due to the presence of Fe-containing waste discharge from the nearby industrial unit. High concentration of Fe (26.9–71.8 kg^{-1}) was reported by Mekonnen et al., (2013) from the sediment of river in Ethiopia. Lithium (Li) is the lightest metal and occurs primarily in stable minerals and salts. Concentrations of Li in surface water are typically <0.04 mg kg^{-1} but can be elevated in contaminated streams (Lynn, 2003). In all the sites the Li value was found to be in lower concentration in the sediment samples analysed. Because of the general lack of information concerning the toxicity of Li in sediment samples, this work analysed the toxicity level of Li in different water bodies

Conclusion

It can be concluded that sediment analysis is suitable for quantitative assessment of heavy metal pollution. The sediment pollution in this area is caused by deposition of heavy metal particles from industrial waste discharging units. Our results demonstrated that the pollution of this water bodies by surface water transport result in accumulating these metals in sediment result in polluting these area. Thus studying the metal content in sediments can be considered as an excellent metal pollution markers for understanding the heavy metal pollution aspects of an aquatic ecosystem. Sediment analysis thus can be considered as non-destructive tool for assessment of heavy metals pollution in these areas.

References

1. Karbassi AR, Monavari SM, Nabi Bidhendi GR, Nouri J, Nematpour K (2008) Metal pollution assessment of sediment and water in the Shur River. Environ Monit Assess 147(1–3):107–116.
2. Kar D, Sur P, Mandal SK, Saha T, Kole RK (2008) Assessment of heavy metal pollution in surface water. Int J Envir Sci Technol 5(1):119–124.
3. HU Ying, Shihua QI , Chenxi WU, Yanping KE, Jing CHEN, Wei CHEN, Xiangyi GONG, (2012). Preliminary assessment of heavy metal contamination in surface water and sediments from Honghu Lake, East Central China. Front. Earth Sci. 6(1): 39–47. DOI 10.1007/s11707-012-0309-z.
4. Wang,Y .,Wei,Y., Guo,P., Pan,J., Wu, Q. and Liu,N. (2016). Distribution variation of heavy metals in maricultural sediments and their enrichment, ecological risk and possible source—A case study from Zhelin bay in Southern China. Marine Pollution Bulletin. 101:930–937.
5. Singh H, Yadav S, Singh BK, Dubey B, Tripathi K, Srivastava V, Shukla DN (2013a) Assessment of geochemical environment from study of River sediments in the middle stretch of River Ganga at Ghazipur, Buxar and Ballia area'. Proc Natl Acad Sci India Sect B Biol Sci 83(3):371–384. doi:10.1007/s40011-0120134-x.
6. Mekonnen, K. N. Ambushe, A. A.. Chandravanshi, B. S Abshiro, M. R. du Plessis, A. McCrindle, R. I., Assessment of the concentration of Cr, Mn and Fe in sediment using laser-induced breakdown spectroscopy, Bull. Chem. Soc. Ethiop. 2013, 27(1), 1-13.
7. Lynn Adams Kszos, John J. Beauchamp, Arthur J. Stewart, Toxicity of Lithium to Three Freshwater Organisms and the Antagonistic Effect of Sodium, Ecotoxicology, 2003, 12, 5, pp 427–437.