

EVALUATION OF TRACE METALS IN THE SEDI- MENTS OF RIVER BHADRA NEAR BHADRAVATHI TOWN, KARNATAKA, INDIA

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ABSTRACT

An attempt has been made to evaluate trace metals such as Fe, Mn, Cr, Ni, Zn, Cu,, Pb, Cd. Al and Hg in the Bhadra river bed sediments from four identified stations at monthly intervals for a period of two years from March 1999 to February 2001. The results of the analysis showed that trace metals in the river bed sediments are well within the Shale standards. Trace metals in the order of their relative dominal were in the sequence Fe > Al > Mn > Zn > Pb > Cr > Cu > Ni > Cd > Hg. 58.1 and 72.2 ppm respectively.

INTRODUCTION

Occurrence of elevated level of trace metals especially in the sediments can be a good indication of man-induced pollution and high level of heavy metals can often be attributed to anthropogenic influences rather than natural enrichment of the sediment by geological weathering (Davies *et al.*, 1991). Sediments have the tendency to become the sink component for accumulation of heavy metals and consequently may adversely affect benthic organisms. In the long-term, the contaminated sediments could be a second source of pollution of the overlying water when the environmental conditions to which the sediment is exposed are altered (Nriagu, 1988).

The river Bhadra is a major-Tributary of river Tungabhadra which originates at Gangamoola. A large number of industries such as Visveshwaraiah Iron

and Steel Limited (VISL), Mysore Paper Mills (MPM) etc., located in the vicinity of Bhadravathi town, a fast growing city of Karnataka, discharge their effluents into the river Bliadra and the river also receives considerable amount of municipal and agricultural wastes.

The objective of this paper is to illustrate the levels of sediment contamination by trace metals in the Bhadra River

MATERIALS AND METHOD

The present study was carried out for a period of two years (March 1999 to February 2001). Four sampling stations were identified to represent the different ecological niches along the length of Bhadra River, are shown in **Table-1** and **Figure-1**.

The sampling, preservation, digestion and preparations of samples for the analysis of trace metals in the Bhadra river bed sediments were made as prescribed by Standard Methods of APHA (1992) using Atomic Absorption Spectrophotometer (Perkin Elmer-403). Mercury was estimated by the cold vapour technique (EPA, 1976), in the ECIL make MA500E Mercury Analyzer

RESULTS AND DISCUSSIONS

The results of trace metals in sediments of Bhadra River at different stations is depicted in Table-2.

Iron

Iron is an essential element and is known to be a limiting nutrient factor in fresh water ecosystem (Duce and Tindale, 1991). The iron content present in the sediments primarily as a hydrated oxide and is a part of lithogenic material and thus less mobile. During weathering process iron might also form as ferric oxide coating on clay minerals (Culvert, 1976). In the present study, iron content ranged between 514.7 and 1481.2 µg/g. The maximum concentration was recorded at station-III and minimum at station-I.

Table - 1
Sampling stations

Sl. No.	Sampling station	Location and distance
01	Station-I	Upstream of Bhadravathi town, which receives only agricultural run-off.
02	Station-II	Situated about 2.5 Kms away from station-I, which receives a continuous discharge of industrial effluent from MPM and also municipal waste from the Bhadravathi town.
03	Station-III	Situated 2 Kms away from the station-II, which receives effluent from VISL and municipal waste from the Bhadravathi town.
04	Station-IV	Located about 5 kms away from station-III, which receives only agricultural run-off.

Table - 2
Trace metal concentrations in the sediments of Bhadra river (1999-2001)

Heavy Metal (µg/g)	Sampling Station				Shale* Standards (µg/g)	
	Range/ Mean	Station- 1	Station-II	Station-III	Station-IV	
Fe	Range	272 - 674	704 - 1297	1119-1924	406 - 997	
	Mean	514.7	920.8	1481.2	698.3	46,700
	SD	141.5	162.8	235.7	212.7	
Mn	Range	14.7-29.7	47.1 -92.6	78.5- 142.7	32.3 - 68.5	
	Mean	19.7	67.0	115.4	49.9	850
	SD	3.8	13.58	18.82	9.9	
Cr	Range	4.2-9.5	6.6- 11.2	8.5- 16.4	4.2- 11.3	
	Mean	7.1	9.2	12.1	6.7	90
	SD	1.49	1.27	2.46	1.83	
Ni	Range	1.9-4.0	3.9-6.4	6.2-8.8	2.9-4.7	
	Mean	2.9	5.7	7.2	3.7	68
	SD	0.35	0.62	0.89	0.54	
Zn	Range	11.5-22.0	16.2-25.4	17.6-29.3	17.0-26.4	
	Mean	11.1	20.3	23.9	22.5	95
	SD	2.33	3.0	3.1	2.83	
Cu	Range	5.0-8.5	5.9- 10.6	8.0- 12.4	6.7- 11.9	
	Mean	7.0	8.0	9.7	8.8	45
	SD	0.77	1.06	1.31	1.48	
Pb	Range	1.7-4.1	13.5- 19.6	12.0- 17.7	9.4- 17.5	
	Mean	3.1	17.1	14.7	12.7	20
	SD	0.71	1.60	1.45	1.73	
Cd	Range	0.1 -0.21	0.15-0.29	0.19-0.4	0.14-0.26	
	Mean	0.17	0.23	0.31	0.19	0.3
	SD	0.03	0.04	0.05	0.03	
Al	Range	32.6-82.4	436-812	378 - 686	120-382.7	
	Mean	56.0	615.7	484.8	222.6	—
	SD	15.63	103.97	84.82	68.1	
Hg	Range	ND	0.01 -0.32	ND - 0.07	ND	
	Mean	ND	0.16	0.02	ND	0.4
	SD	0.0	0.09	0.019	0.0	

Note : * - Turikain and Wcdpohl (1961), ND - Not detectable SD - Standard deviation

Manganese : The manganese is an essential element, which does not occur naturally as a metal but is found in various salts and minerals frequently associate with iron compounds. The exchangeable and residual fractions are in dominant phase for manganese in suspended and bed sediments respectively (Chakrapani and Subramanian, 1993). Manganese content varied from 19.7 to 115.4 µg/g. The maximum concentration was reported at station-III.

Chromium : In fresh water, anthropogenically introduced soluble Cr⁶⁺ is removed by reduction of Cr⁶⁺ and subsequent sorption to particulate and sediments (Pfeiffer *et al.*, 1980). The results of present study revealed that chromium content ranged between 7.1 and 12.1 µg/g. The maximum concentration was noticed at station- III.

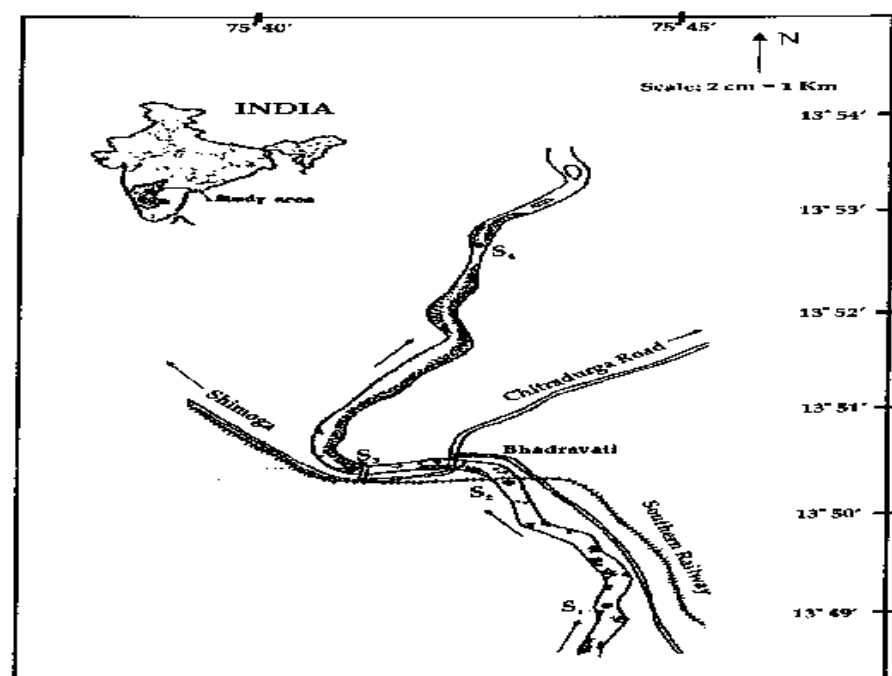


Fig. 1. Sketch map showing the sampling stations along the stretch of the Bhandra river

Nickel : Nickel occurs in natural water as divalent cation with pH range between 5-9 and is almost present only in the form of Ni^{2+} . In the present investigation, nickel concentration varied between 2.9 and 7.2 $\mu\text{g/g}$. The concentration of nickel was maximum at Station-III.

Zinc : Zinc is an important trace element and plays a vital role in the physiological and metabolic processes of many organisms. At higher concentration, it can be toxic to organisms and plays an important role in protein synthesis (Prask and Ploek. 1971). Zinc-is transported mostly in residual, exchangeable and carbonate fraction of sediments (Chakrapani and Subramanian, 1993). In the present study, zinc content ranged from 1 I. I to 23.9 $\mu\text{g/g}$. The concentration of zinc was maximum at station-III and minimum at station-I.

Copper : Copper is highly toxic trace metal posing a great threat to aquatic organisms if present in a level higher than the maximum acceptable toxicant concentration. There is no indication that copper is carcinogenic to humans (Moore and Ramamoorthy. 1984). The results of present study revealed that copper content ranged between 7.0 and 9.7 $\mu\text{g/g}$. The maximum concentration was noticed at station- III.

Lead : It is a serious cumulative body poison and is often found considered as the potential pollutant in drinking water. In the present study, lead concentration varied from 3.1 to 17.1 $\mu\text{g/g}$. The concentration of lead was maximum at station-II and minimum at the station-I

Cadmium : The concentration of cadmium generally encountered in soils and fresh water is reported to vary from 0.03 to 0.3 $\mu\text{g/g}$ and I to 50 $\mu\text{g/l}$ respectively (Alien *et al.*, 1974). In the present investigation, cadmium content ranged from 0.17 to 0.31 $\mu\text{g/g}$. The concentration of cadmium was maximum at station-III and minimum at station-I.

Aluminum : It is well known that acidification causes a strong increase in the mobilization of aluminum from soil profile, leading to remarkably high and even in acidified surface water (Gensermer, 1991). The results of the present study revealed that aluminum content varied from 56.0 to 484.8 $\mu\text{g/g}$. The maximum concentration was found at station-II.

Mercury : The Hg_2^{2+} is non toxic, Hg^{2+} is fairly toxic, because of high affinity for sulphur atoms of amino acids. The most toxic species are organomercurials, particularly CH_3Hg^+ Methylation of mercury takesplace in the activate environment as a result of activities of bacteria, fungi or enzyme (Higgins and Burns, 1975). In the present study, mercury content ranged between ND and 0.16 $\mu\text{g/g}$ and was found only at stations I! and 111 during the entire period of investigation. The maximum (0.16 $\mu\text{g/g}$) concentration was found at station-II

CONCLUSION

Based on the data obtained, it can be concluded that: concentration of trace metals in river bed sediments found to be high at stations II and III. This can be attributed to discharge of industrial effluents and municipal wastes. Geology of river bed and catchments area are also responsible for increasing their concentrations. However, stations I and IV registered relatively low concentration of trace metals, reasons being no discharge of industrial effluents. By and large, trace metals in river bed sediments are well within the limits of shale standards. Trace metals in the order of their relative dominants were observed in the sequence $\text{Fe} > \text{Al} > \text{Mn} > \text{Zn} > \text{Pb} > \text{Cr} > \text{Cu} > \text{Ni} > \text{Cd} > \text{Hg}$.

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