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Trace Elemental Concentration of Core Sediments in Lake Kolakkudi, Tiruchirappalli District, Amilnadu, India

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***Abstract:-* The aim of this study was to assess the spatial distributions of total trace elements content in the bottom sediments of Kolakkudi lake, along with the comparison of the accuracy and characteristics of trace elements. On the basis of regular measurement grid consisting of 6stations, bottom sediments samples were collected. Twenty four samples of bottom sediment were collected to determine the spatial concentrations of trace elements in the Lake. Mean values of total trace elements content in bottom sediments of Kolakkudi Lake were as follows: Zn – 10.81 ppm, Pb – 3.71 ppm, Cr – 8.94, Cu – 8.77 ppm, Ni – 5.09 ppm and Co – 3.34 ppm. The enrichment degree of the studied metals decreased in the order of Zn>Cr>Cu>Ni>Pb>Co. Trace elements are concentrated along the current trajectory in the inner part of the lake, which has deeper sites and higher percentages of clay particles. The highest concentrations of these elements were found to be in KLKD-6 from the outlet part of the lake. The distributions of trace elements content were classified by means of geochemical criteria. The generated trace elements distributions allowed determining the most contaminated areas, which were mainly central and outlet parts of the Kolakkudi Lake.**

Key words: Trace elements, Bottom sediments

1. INTRODUCTION

Lake sediments and their characterizationfrom viewpoint of trace elementand especially its concentrationsare important ecosystem and environmentalquality assessment indicators exactly inlong-term significance. Trace elements are widespread pollutants of great environmental concern as they are nondegradable, toxic and persistent with serious ecological ramifications on aquatic ecology (Jumbe and Nandini, 2009).Sediments are known to be the ultimate sinks for trace elements discharged into the environment (Yu K C et al, 2001 and Malferrari D et al 2009). Thus, the sediment could be a potential source of heavy metals that will be released into the overlying water via natural and anthropogenic processes (Kelderman P et al ,2007, Leonard T M et al ,2008), where they could have an adverse effect on the drinking water quality and human health. The site of deposition, however, is controlled by physical and chemical processes which are influenced by climatic and seasonal variations. Weather conditions can play an important role in the trace elemental distribution over the lake, especially as a very shallow water system. Wind speeds, rainfalls and other meteorological conditions affect the concentrations of trace elements and suspended particulate matter, especially in the shallow lakes. Understanding the levels, distribution and sources of trace elements in sediments can aid environmental managers and facilitate the supervision of lake water quality, which is always based on the appraisal of sediment quality by sediment quality guides (SQGs) (Pradit et al, 2010).When sediment-trace element concentrations are markedly elevated, simple reconnaissance surveys usually suffice to delineate the spatial distributions of the elements of concern.Due to all the potential problems associated with defining useful average concentrations, it might prove more efficacious to develop a set of sediment-trace element predictive models that incorporate some or all of the geochemical factors, known to affect sedimenttrace element concentrations. Therefore, the objective of this study was to (1) characterize the Trace elements contents and spatialdistribution patterns; (2) to identify the possible sources of Trace elements; thereby enabling ranking and prioritization of sites and metals of concern.

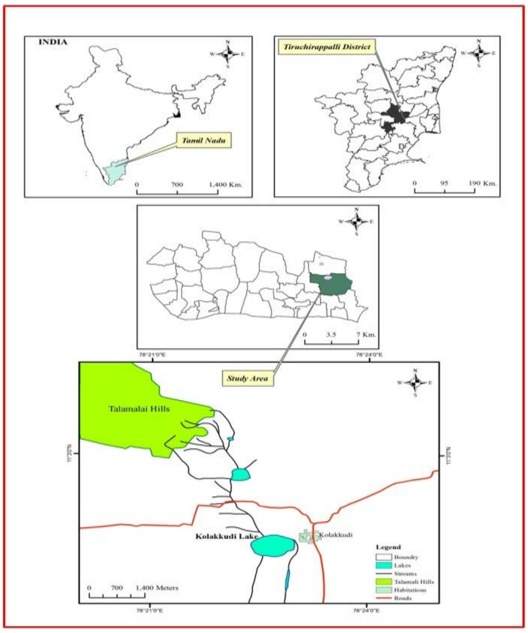
2. MATERIALS AND METHODS

2.1. STUDY AREA AND SAMPLING METHODS

Lake Kolakkudi is usually divided into three parts according to the morphography of the lake (figure 1) namely Inlet part, Central part and Outlet part. The study area Kolakkudi Lake is a part of Granulite terrain of the peninsular shield in the Tiruchirappalli district of Tamilnadu. It lies between Latitude 78^{0}22'37"E' to' Longitude 11^{0}01'19"N (Toposheet 58 I/8).The study area characterized by Alluvial placers. The study area covered 0.60 sq km it forms a part of Musiri taluk, Tiruchirappalli District of the state of Tamil Nadu, India. (Fig.1and Fig.2).

2.2. Sediment sampling

A core sampler equipped with rotatory drill was used to collect subsurface sediments from 6 sites in Lake Kolakkudi August and September of 2015 (figure 1). The sediment cores were carefully collected, after which they were placed in polyethylene bags and kept in a cooler on ice. The samples were then immediately transported to the laboratory and preserved under nitrogen at below 4°C. In addition, subsamples were freeze dried, disaggregated, passed through 0.063 mm mesh sieves and stored at 4°C in the dark before analysis.The sediment samples were then transferred to the laboratory in clean plastic bags. Than all samples kept at -18°C until analysis.



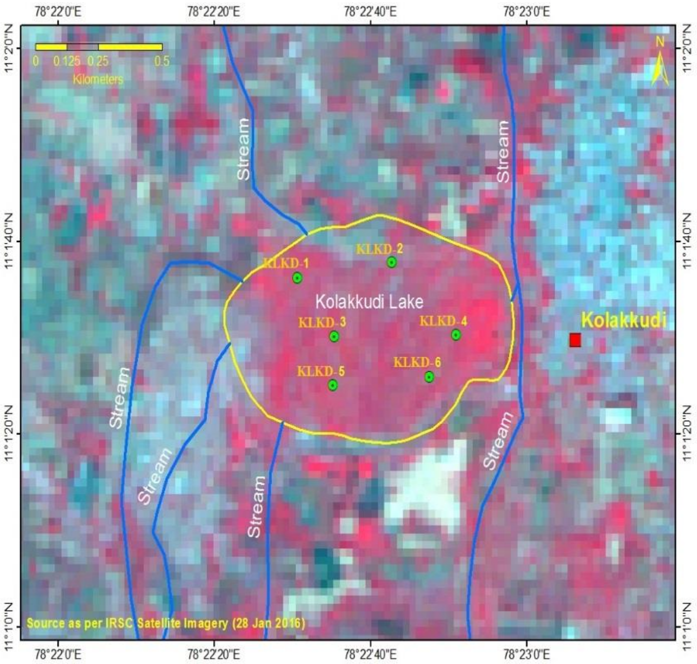


Figure.1. Location of the Study Area

Figure. 2. Satellite image of the Study Area

2.3. Sediment Analysis

In brief, about 0.1250 g dry sediment was weighted into PTFE digestion vessels, in which a mixture of concentrated 3 ml HNO_3 and 4 ml HF were added, and these sealed vessels were heated to a temperature of 180°C for 20 min in a microwave digestion system (Berghof MWS3 Digester). After cooling, these solutions were quantitatively transferred into PTFE beakers, and 0.5 ml of $HClO_4$ added; the mixture was then heated to a temperature of 200°C and maintained there until some residues were left. We then add several milliliters of 1:1 HNO_3 and 1:1 HCl to completely dissolve the residue and made a final 25 ml solution with MilliQ water. The concentrations of Pb, Cd, Cu,Zn, Co and Cr in the samples were then analyzed by ICP-MS. Inductively coupled a mass spectrometry (ICP-MS, Agilent-7500) was used to analyze samples for which metals were present in levels below the detection limit of ICP-MS.

3. RESULTS AND DISCUSSION

3.1. DISTRIBUTION OF TRACE ELEMENTS

Average concentration along with standard deviation of total Zn, Cu, Pb, Cr, Ni, and Co, contents in core sediments are presented in Table 1. The trace elements were also compared with background and toxicological reference values. The average concentration for trace elements in outlet samples was lower than those in center part of the samples, which may be due to excess rise in water level in summer. The standard deviation for Zn, Cu, Pb, Cr, and Ni was higher which reflects the variation in sites to sites. Detailed values designate the presence of higher amount of trace elements in downstream and lower amount in upstream. For Bottom sediment samples collected from the 6 sites of Kolakkudi Lake, the concentrations of trace metals Cr, Cu, Co, Ni, Zn, and Pb, to other sites. For instance, site KLKD-3 records the highest levels of Ni (5.21 ppm), Cr (8.25 ppm), Cu (12.64 ppm), Zn (15.48 ppm and Co (2.88 ppm) and Pb (7.58 ppm).correlations are found between the trace elements (Table.1).For example, Pb is well correlated with Zn and Cu. As shows positive correlations with Cu, Ni and Zn. Correlations also exist between Cr ($r2$ =5.85) and Ni ($r2$ = 14.84), Pb ($r2$ = 1.56), Co ($r2$ = -7.11), Zn ($r2$ = -2.904) and Cu ($r2$ = -7.194).(Figure.3)

Table.1.Mean Concentration of Trace elements in Kolakkudi Lake Sediments
(*All Values in ppm)

Sampling Stations	Longitude	Latitude	Depth (in cm)	Cr	Cu	Co	Ni	Zn	Pb
KLKD-1	78^{0}22'27"	11^{0}1'21"	0-30	7.97	8.34	3.36	5.60	9.86	6.37
			30-60	8.75	8.03	3.73	5.09	8.34	2.63
			60-90	9.95	8.67	3.69	4.76	10.25	2.85
			90-120	10.1	7.73	3.88	5.68	8.47	2.1
KLKD-2	78^{0}22'48"	11^{0}1'23"	0-30	9.49	7.64	3.40	5.43	9.32	4.51
			30-60	10.3	7.28	3.77	5.08	10.29	4.69
			60-90	10.8	7.63	3.74	5.20	8.14	2.44
			90-120	10.7	8.08	3.71	5.13	9.11	4.02
KLKD-3	78^{0}22'31"	11^{0}1'16"	0-30	7.54	12.64	2.88	5.15	13.11	3.43
			30-60	6.53	10.56	2.47	5.60	15.48	8.31
			60-90	6.21	11.23	2.58	5.12	12.68	3.21
			90-120	8.25	12.01	2.34	5.21	13.54	7.58
KLKD-4	78^{0}22'58"	11^{0}1'16"	0-30	8.58	8.18	3.27	5.03	7.95	4.93
			30-60	8.38	6.80	3.08	4.74	8.52	1.31
			60-90	8.51	7.58	3.47	5.26	7.56	3.54
			90-120	8.27	8.62	3.21	4.98	8.02	2.35
KLKD-5	78^{0}22'58"	11^{0}1'13"	0-30	5.48	7.41	2.08	3.71	9.53	3.33
			30-60	9.38	9.44	3.81	4.83	15.33	4.88
			60-90	6.54	7.25	2.54	4.15	11.25	4.25
			90-120	9.21	7.35	3.24	3.24	10.23	3.24
KLKD-6	78^{0}22'30"	11^{0}1'08"	0-30	8.41	9.26	3.34	5.28	13.25	2.01
			30-60	12.56	9.88	4.47	6.43	15.42	1.99
			60-90	11.28	9.29	3.94	5.99	10.22	2.54
			90-120	11.35	9.48	4.25	5.47	13.47	2.58
			Mean Value	**8.94**	**8.77**	**3.34**	**5.09**	**10.81**	**3.71**

However, normalized ratio for Co is higher than 1(this will be valid even after accounting for over estimationof Co) suggesting that it is supplied to sediments from non-lithogenic source (Tarun K. Dalai,et al,2004).The highest concentration of Cr is observed at KLKD-6 depth of 30-60 cm.High averageconcentrations of Ni, Cr in Kolakkudi lake are indicative of mafic orultramafic rocks in the source region. Zn, Cu and in lake might be due to the fine grained natureof the sediments and reducing bottom conditionsproduced by abundant organic matter. (Ahmed F et al 2009). In the study area,Source rock composition strongly controlsSediment composition. In KLKD-2 andKLKD-3 Co were found to havesame concentration in at least two differentdepths respectively.The highest concentration of Cr, occurred at 30-60 cm in KLKD-6; Zn at 30-60 cm in KLKD-3.Pb-Zn-Cu-Ni-Cr suits in Kolakkudi lake sediments implies that these metals have a common source and similar enrichment process (Diallo IM, et al 2016). This might in partexplain the observed vertical variation of thegeochemistry of the Kolakkudi core sediments.However, it could also be attributed to diagenicmodifications and precipitation around the redoxboundaries.(Lee SV et al., 2001, Soto-Jimenez M et al, 2001).Thehighest concentration of Pb occurred at9 0-120 cm in KLKD-3, Zn, Cu is at 90-120 in KLKD-3.The highest concentration of Ni, Co at 30-60 cm in KLKD-6.

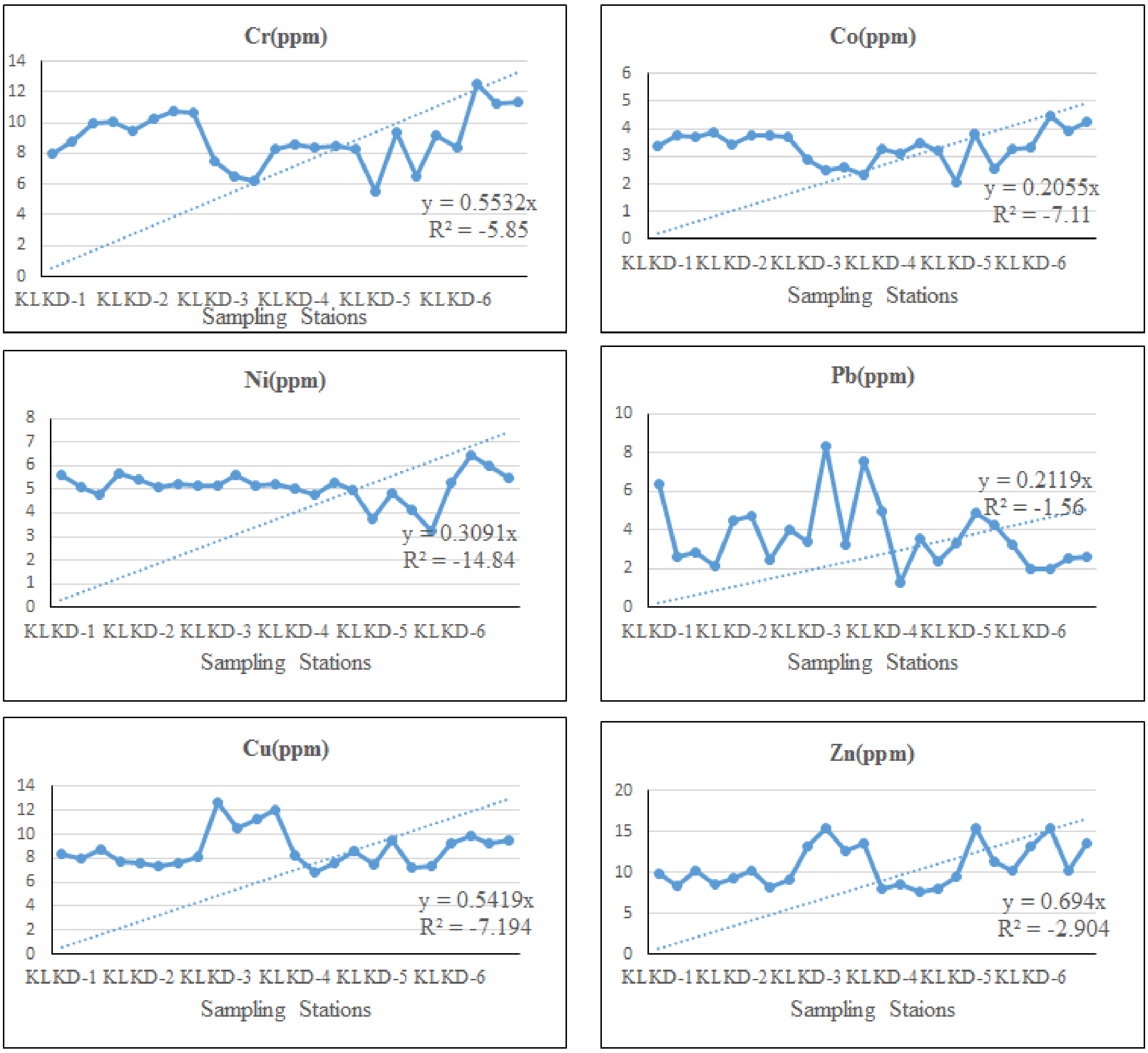


Figure.3. Shows Concentration of trace elements in Kolakkudi Lake Sediments.

4. CONCLUSION

The core Kolakkudi sediment samples havehigher concentrations and Variations were observed on the concentrationsof the analyzed elements at different depths. Theobserved vertical variations might be due todiagenic modifications and precipitation aroundthe redox boundaries. In Study area, thereis a strong Zn correlation which is indicativeof the influence of felsic rocks.The Cu association inlake sediments signifies the existence ofgranitic/Pegmatitic lithology. Pb, Zn, Cu, Ni and Cr in lake sediments are correlated and it indicates thatthese elements have a common source and similar enrichment process. The enrichment of Zn and Cu are mostly geogenicwhile the enrichment of Pb, Cr and Ni are largely anthropogenic.For these reasons the geochemical monitoring of sediments is important in the aim of evaluating the natural content of trace elements in soils, related to parental materials and possible enrichment due to human activities.

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