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Evaluation of Heavy Metals in Sediments of River Ethiope, Delta State, Nigeria

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Abstract: *This study presents concentration levels of Fe, Mn, Cu, Cr. Cd Ni, V and Pb in sediments of River Ethiope. The levels fell within the following ranges (mgkg^{-1}), 0.21-0.46 for Mn, 0.84-2.24 for Zn, 0.34-0.60 for Cu, 0.00- 0.11 for Cd, 0.005-0.49 for Ni, 0.00-0.05 for V and 0.27— 0.72 for Pb. Cr was not detected in any of the samples. The observed concentrations of the metals are mainly due to anthropogenic effects. There seems to be no imminent danger to the living organisms in the environment since the low levels observed do not pose any environmental contamination risk. Three correlation levels were observed. In group 1, Cr, Zn, Ni and V strongly correlated with each other. In group 2, Fe, Zn; Mn. Cu and Ni displayed positive correlation at different levels with each other while in group 3, Pb and Cd did not correlate with any of the metals. The levels reported have an abundance ratio in order Zn> Pb > Cu > Mn > Ni > Cr.*
Key Words: *Environmental pollution, heavy metals, River Ethiope, sediments.*

I. Introduction

Sediments are components of our environment that serve as repositories for deleterious chemical species[1] because of anthropogenic wastes discharged into water bodies[2]. They conserve important environmental information and are increasingly recognized as both carriers and possible source of contaminants in aquatic system[3].

Studies have shown that many water bodies in Nigeria contain various levels of heavy metal pollutants[4,5,6,7]. Metals dissolved in soil solution, surface and interstitial waters and those adsorbed to the sediment by cation exchange process are usually readily available to aquatic and benthic organisms as well as plants[8].

The behaviour and biological impact of heavy metals pollutants in aquatic systems is governed by factors such as adsorption, desorption, sedimentation-resuspension, filtration, complexation, precipitation-solubilization, biological uptake and excretion[9,10].

River Ethiope is used extensively for recreational and occupational activities such a fishing, swimming, washing, bathing and other domestic purposes. Since the river passes through many towns and villages, some unfriendly activities such as dumping of waste from consumer products by local residents along the banks of the river may lead to contamination and pollution of the water body. In addition, during the rainy season, Ethiope River overflows its bank annually and as such carry all the domestic wastes into the river along with runoffs from rains.

The objectives of this study were to establish the presence and levels of heavy metals in the river sediments and to identify the sources of these metal pollutants. The results of this study will provide useful information, about the pollution status of the river.

II. Materials and Methods

Study Area

River Ethiope (latitude 6°00 - 6°30N and longitude 5°00 - 6°OOE) is a clear oligoinic fresh water river which took its source from Umuaja in Ukwuani Local Government Area of Delta State flows westward for about 10km before it discharges into Benin River at Sapele. The substratum consists mainly of sand and is vegetated in the non-tidal zone and mainly muddy sediments in the tidal area[11]. The river stretches from Umuaja through Obiaruku, Abraka, Eku, Aghalokpe, Mosoga down to Sapele.

Sampling

Sediment samples were collected at five sites along the stretch of the river in March and July representing dry and rainy seasons respectively. Sampling points were centred mainly on the towns along the river course. The samples were air-dried at room temperature and subsequently kept for 1 hour in an oven at 100°C. The dried sediments were ground in a porcelain mortar with a pestle and sieved to particle size of 200mm.

Sample Preparation

1 .0g of each of the samples was digested with a mixture of hydrofluoric, nitric, perchloric and sulphuric (HF -$HN0_3$ - $HCIO_4$ -H_2S0_4) acids. The clear digest was diluted to 50cm^3 with distilled deionized water. The sample solutions were analyzed for the metals using air-acetylene flame atomic absorption spectrophotometer (AAS) (Perkin Elmer A3 100) fitted with D_2 background correction device.

III. Results and Discussion

The results of heavy metals concentrations (in $mgkg^{-1}$ dry weight) from the sediment samples in the five sampling sites for dry and wet seasons together with their mean values are presented on table 1.

Table 1: Concentration levels (mgkgt) of Zn, Pb, Fe, Ni. Mn, Cu, Cr. Cd and V in sediments of River Ethiope.

Key

Parameter	U_1	U_2	Mean	O_1	O_2	Mean X	Abk_1	Abk_2	Means X	A_1	A_2	Mean X	S_1	S_2	Mean X	World Aver. Level in ppm
Zn	1.02	0.80	0.91	2.04	2.08	2.06	1.52	1.41	1.47	0.97	1.00	0.84	2.25	2.23	2.24	-
Pb	0.45	0.39	0.42	0.66	0.62	0.64	0.68	0.63	0.66	0.24	0.29	0.27	0.74	0.69	0.72	100
Fe	2.30	2.30	0.30	4.50	0.40	0.40	4.90	4.95	4.93	3.75	3.74	3.745	3.40	3.60	3.50	38000
Ni	0.00	0.01	0.005	0.52	0.45	0.45	0.39	0.64	0.52	0.75	0.40	0.55	0.84	0.63	0.74	40
Mn	0.41	0.35	0.38	0.52	0.40	0.40	0.34	0.25	0.30	0.70	0.30	0.40	0.25	0.16	0.21	850
Cu	0.44	0.34	034	0.44	0.44	0.44	0.45	0.43	0.44	0.50	0.37	0.38	0.61	0.59	0.60	20
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100
Cd	0.01	0.00	0.05	0.13	0.11	0.11	0.00 12	0.00 12	0.0 012	0.00 12	0.0 01	0.0 01	0.00 20	0.0 030	0.0 025	0.06
v	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.005	100

U_1 Umuaja dry season
U_2 Umuaja rainy season
O Obiaruku dry season
0_2 Obiaruku rainy season
Abk_1 Abraka dry season
Abk_2 Abraka rainy season
A_1. Agholokpe dry season
A_2 Agholokpe rainy season .
S_1 Sapele dry season
S_2 Sapele rainy season

The mean concentration of Zn in the sediment samples analysed in this study generally exceeded those of Pb, Ni, Mn, Cu, Cd and V. Highest mean concentration of Zn was found in sediment collected from Sapele axes of the Ethiope river (2.24 $mgkg^{-1}$). This may be attributed to the industrial nature of Sapele. However, this mean concentration of zinc obtained was lower than the mean values recorded for sediments from gutter road side in Warri[12], for Ase River sediments[13], for Kubanni dam sediments containing high levels of heavy metals[14], in Kaduna Street soils[15], but higher than the levels observed in soils around some oil-spill and gas flaring zones in Delta State, Nigeria[16]. Zinc is widely used in industries to make dye, paint, rubber, wood preservatives and ointments. Plants and animals require zinc for normal growth. At high concentration, zinc is very toxic, its toxicity being caused by interactions in plant uptake of other essential elements like phosphorus and iron[17].

Pb concentration was also higher in Sapele area (0.72$mgkg^{-1}$) compared to other portions of the study area. This could be as a result of the greater amount of hydrocarbon fuels that come out of vehicle exhaust in

Sapele area. This relatively low level of Pb concentration also exceeds the level reported[6]. Toxic concentrations of Pb can accumulate in bone marrow where red blood corpuscles formation occurs[18].

The average concentration of Fe in the river sediments was found to be highest in sediment sample collected from Abraka area (4.93 mg/kg^{-1}) followed by the Umuaja end of the catchments (2.30 mg/kg). The concentration of Fe to an extent is usually determined by the nature of soils along the river course[19] which is eventually leached into the river system and its sediments. Cu levels recorded were generally low (0.34-0.59 mg/kg). The extremely low levels of Ni and Mn which ranged between 0.005 — 0.74 mg/kg and 0.21 — 0.46 mg/kg respectively are relatively lower than the respective values in the world standard for Ni and Mn respectively. The average levels of Cd and V were very negligible. Cr was not detected in any of the samples.

Table 2: Elements correlation coefficient of results

	Fe	Mn	Zn	Cu	Cr	Cd	Ni	V	Pb
Fe	1	0.060	0.014	0.40	-0.17	-0.06	-0.19	-0.01	0.01
Mn		1	0.44	0.48	0.20	0.29	0.31	0.32	0.30
Zn		++	1	0.42	0.66	0.05	0.44	0.50	-0.02
Cu	++	++	++	I	0.19	0.04	0.26	0.50	0.45
Cr			+++		1	0.23	0.63	0.67	0.02
Cd.					.	1	0.17	0.28	0.16
Ni			++		+++		1	0.58	0.07
V			+++	+++	+++		+++	1	
Pb				++				++	1

\+ Correlation is significant at the 0.05 levels (2-tailed)
++ Correlation is significant at the 0.01 levels (2-tailed)

The nine heavy metals were grouped according to correlation levels (Table 2). In group 1, the elements Cr. Zn, Ni and V strongly correlated with each other. Fe, Zn, Mn, Cu and Ni in group 2, displayed positive correlations of different levels with one another. In group 3, Cd did not correlate with Cu. Elements of group I have similar ionic radii and exhibit similar chemical behaviour during sediment formation[20]. Cd appeared slightly evenly distributed but showed no correlation with other metals.

IV. Conclusion

Generally the results obtained in this study showed low levels of heavy metal accumulation in the sediments of River Ethiope. This does not pose any threat to the aquatic life. Based on the overall pollution status of River Ethiope observed from the study, recreational and occupational activities in the river can therefore be encouraged.

References

[1] A.G. Korcharyan, E.V. Venitsianove, N.S. Safronova, and E.P. Serenkaya, Seasonal variation in the forms of heavy metals occurrence in the Water . 2003, 4: 404-412..
[2] C.K. Jain, Metal fractionation study on bed sediments of River Yamuna. India. *Water Res.*. 2005, 38: 569-578.
[3] B. Gumgum, and G. Ozturk, Chemical speciation of heavy metals in the Tigris River sediment. *Chem. Spec. Bioavail* . 2001, *13: 25-29.*
[4] S.E. Kakulu, O. Osibanjo, and S.O. Ajayi, Trace metals contents of fish and shell fishes of the Niger Delta Area of Nigeria. *Environ. Inter.* 1987, 13: 247-251.
[5] B.C.O. Okoye, Heavy metals and organisms in the Lagos lagoon. *Inter. Studies* 1991, *37: 285-295.*
[6] T.P. Fugeyin, Heavy metals concentrations in water, sediment and fish species of.Ikpoba reservoir, Benin City. *Ph.D Thesis University of Benin, Benin City, Nigeria* 1994, *167.*
[7] O. Idodo-Umeh, Pollution assessment of 0.omoro water bodies using physical, chemical and biological indices. *Ph.D Thesis* University of Benin, Beam City, Nigeria. 2002, P485.
[8] M. Horsfall, and A.I. Spiff, Speciation and b availability of heavy metals in sediments of Diobis River. Port Harcourt, Nigeria. *Euro. J. Sci. Res.* 2005, 6(3): 20-36.
[9] D.R. Turner, *The chemistry of metal pollutants in water*. In: Harrison, R.M. (ed). Pollution: causes, effects and control. U.S. Geological Survey Circular 1013.1981, 613**.**
[10] D.S. Orhor, Soil chemistry. Russian Translation Series 92. Balkema Publishers, USA. 1992, 5-6.
[11] R.B. Ikomi, The biology of the African Leaf Polycentropsis Abbreviata Boulenger, 1901, in the River Ethiope, Nigeria Acta I Chihyologica et piscaloria 1996, 26: 1-3.

[12] S.H.O. Egboh, G.E. Nwajei, and E.O. Adaikpoh, Selected heavy metals concentrations in sediments from major roads and gutters in Warri, Delta State, Nigeria. *Nig. J. Sci. Environ.* 2000, 2: 105-111.
[13] C.M.A. Iwegbue, M.O. Eghwrudje, G.E. Nwajei, and S.H.O Egboh, Chemical speciation of heavy metals in the Ase River sediments, Niger Delta, Nigeria. *Chem. Spec. Bioavail.* 2007, 19(13): 119-129.
[14] B.W. Tukura, J.A. Kagbu, and C.E. Gimba, Effects of p11 and total organic carbon (TOC) on the distribution of trace metals in Kubanni Dam sediments, Zaria, Nigeria. *Sci. World J.* 2007, 2(3): 1-6.
[15] V.O. Ajibola, and I. Ozigis, Partitioning of some heavy metals in Kaduna street Soils. *J. Chem. Soc. Nig.* 2005, 30(1): 62-66.
[16] E. Osabohien, and O.B. Otuya, Heavy metals in soils, tubers and leaves of cassava plants grown around some oil-spill and gas flaring zones in Delta State, Nigeria. *Euro. J. Sci. Res.* 2006, 13(1): 53-57.
[17] P.R. Harrison, W.R. Matson, and Ehester, Effects of Cd, Pb and Hg in living organisms. *J. Atoms Environ.* 1974, 5:613.
[18] B.J. Alloway, *The origin of heavy metals in soils*. In: Alloway B.J. (ed) Heavy metals in soils. Blackie, Glasgow and London 1990, 29-30.
[19] A.O. Ekakitie, The potentials of Warn and Ethiope Rivers towards the establishment of fish ponds in *Abraka. J. Agric.* 1991, 1: 70-74.
[20] A. Kabata-Pendias, and H. Pendias, Trace elements in soils and plants. CRS Press. Boca Raton, Florida. 1992.