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HEAVY METALS CONCENTRATION AND SOURCES IN SOME CREEKS AT OBIO AKPOR AND PORT HARCOURT, RIVERS STATE, NIGERIA

Onwualu-John, J. N.
Department of Geology
University of Port Harcourt, Port Harcourt, Nigeria
josephine.onwualu@uniport.edu.ng

&

Offodile, O. P.
Department of Geology
Federal University of Technology,
Owerri, Nigeria

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Abstract

Heavy metals concentrations in some creeks at Obio Akpor and Port Harcourt local government area were studied in order to know the levels of their concentrations and sources. Field study were done and water samples were collected from the creeks. Field report shows that anthropogenic factors are major source of heavy metals in the creeks than the geogenic factors. Geochemical analysis which was carried out on the water samples revealed the existence of Iron, lead. Copper, Nickel, Manganese, Zinc, Chromium, Cadmium, and Cobalt. These metals occur in all the water samples which were collected at various sample points but they occur in varied quantities. Some of these metals are required for sustainability of man and the environment at a tolerable level but when the tolerable limit is exceeded it becomes hazardous to man and the environment. Iron, copper, manganese, Zinc, Chromium, Cadmium, and Cobalt have average concentrations that are less than World Health Organization (WHO) and Standard Organization of Nigeria (SON) required standard while Lead and Nickel have average concentrations that are higher than WHO and SON standard. The content of the metals in all the samples range between 0.04-0.20mg/l for Iron, Copper 0.01-0.08 mg/l, Manganese 0.05-0.18 mg/l, Zin 0.06- 0.09 mg/l, Chromium < 0.001-0.04 mg/l, Cadmium <0.001-0.012 mg/l, Cobalt < 0.001-0.08 mg/l, Lead 0.06-2.0 mg/l, Nickel 0.02-0.05 mg/l. The heavy elements show increasing order of Ld>Ni>Zn>Mn>Fe>Cu>Cr>Co>Cd. The

intolerable levels of Lead and Nickel in the creeks could be due to sludge from industries, hospital wastes, chemicals carried by floods, and deposition of E–waste into the water.

Keywords: Anthropogenic, Geogenic, Heavy Metals, Creeks.

Introduction

Heavy metals contamination in surface waters are due to anthropogenic factors and geogenic factors. Introduction of heavy metals in waters (surface and underground) causes in homogeneity in the natural state of water (Coyte et al (2019). Amos and Joseph (2016) described heavy metals as pollutants that adulterate the surface water. Heavy metals contaminations have pose lots of challenges in domestic use of water. The adverse effect of the heavy metals contamination in water on humans have resulted to some non-communicable diseases like cancer, Alzheimer's disease, lungs disorder, irritations, diarrhea. The contact of Heavy metals and man play roles in the body chemistry of humans (Vinodhini and Navayanan, 2009. Brackers et al (2013) documented that heavy metals toxicity poses negative effects on the aquatic life.

In order to safeguard the surface water and the underground water from heavy metals contaminations, it becomes crucial that the sources of the heavy metals and their concentrations should be studied. Coode et al, 1997 stated that heavy metals in the surface water can percolate to the underground water. Chukwu et al 2015, mentioned that waste water disposal on the soil cause the soil to have some levels of heavy metals contaminations. The porosity and permeability of the soil enhances the movement of the heavy metals in the soil thereby creating opportunity for the surface water and underground to be contaminated. Kabala and Singh, 2001 detailed about the mobility of the heavy metals in the soil and their implications. The heavy metals on the soil can be washed into the surface water during flooding, when this influx occurs, the heavy metals compound in the water increases. Merian 1991 detailed about the heavy metals compound in the environment. Moslen and Aigberua, 2018 explains the roles of these heavy metals in the surface water. Disposal of organic and inorganic materials into the surface water have also contributed to heavy metal contaminations in the water. Decomposed vegetables have the tendency of emitting heavy metals (Eriyamremu et al, 2005). Some activities that taken place at the banks of the rivers /creeks contributes to contamination of surface waters. Runoff and floods into the surface water contributes to heavy metal contaminations in the surface water.

There were much anthropogenic activities at and around the creeks of the study area. These activities resulted to heavy metal contaminations at the creek.

This research is to ascertain the sources and concentrations of the heavy metals in the creeks at the study area.

Geology of the study area

The study area is within Obio-Akpor local government area and Port Harcourt local government area of Rivers State, Nigeria. The study area is within the Niger Delta Formation (which is made up of the Akata, Agbada and Benin Formation).

The Niger Delta was formed during the separation of South America from Africa as the South Atlantic begins to open in the Jurassic. During this breaking, rifts were formed and rifts sands and shales were deposited.

Benin Formation has thickness of 2,000m (Tuttle *et al*., 2015). Benin Formation is made up of intercalation of sandstones and shales.

Agbada Formation ranges from Eocene- Pliocene. This Formation is made of intercalation of sandstones and shales. The Agbada Formation contain some fossils. It is a hydrocarbon bearing Formation. It has a thickness of about 3500m.

The Akata Formation is Paleocene in age. It is beneath the Agbada Formation. It is made up of Sandy silty shales. The Akata Formation contains some fossils. The thickness range from 6500m-7000meters in some places. It is in a dissolved oxygen depleted environment.

The study area is bounded by the following Latitude and longitude;

Location 1: Creek at Rumuokoro slaughter: N4° 52' 12.68'' E6° 59' 56.34''

Location 2: Creek at Eliozu market/car wash: N4° 51' 34.94'' E7° 1' 31.71''

Location 3: Creek at Artillary bus stop by old Aba road: N4° 50' 27.58'' E7° 1' 54.88''

Location 4: Creek near the Block industry beside filling station by Old Aba road: N4° 50' 14.08'' E7° 2' 10.32''

Location 5: Trans Amadi Creek/ river by Trans Amadi market/slaughter: N4° 48' 57.66'' E7° 2' 51.55''

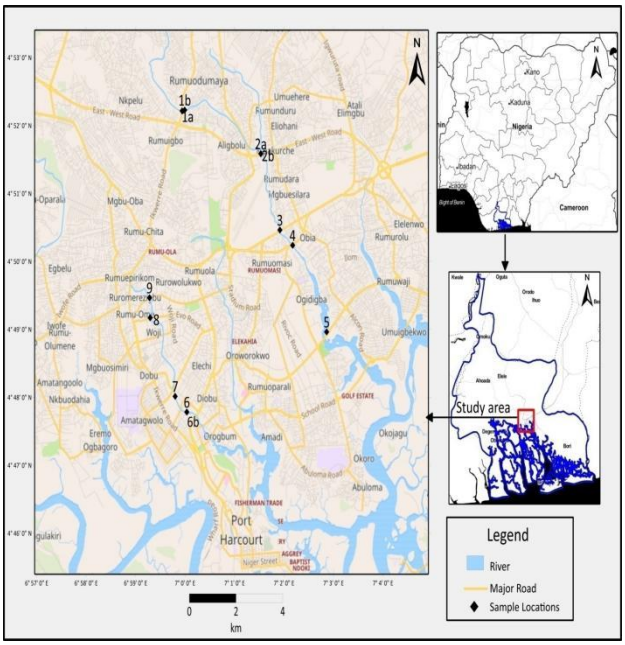

Fig 1: Map of the study area

Methodology

Sampling Techniques

The water samples collected from the study area (plate 1-5) were acidified with Nitric acid and sent to laboratory for heavy metal analysis in order to ascertain the levels of the heavy metals concentrations. Heavy metal analyses were carried out using Atomic Absorption Spectrophotometer (AAS) which involves ASTM D method (Lead-Pb ASTM D 3559), (Iron - Fe ASTM D 1068), (Copper-Cu ASTM D 1688), (Chromium-Cr ASTM D 1687), (Nickel-Ni ASTM D 1886), (Cadmium-Cd ASTM D 3557), (Arsenic-As ASTM D 3972) and (Zinc ASTM D 1691).

Plate 1: Creek at the Rumuokoro slaughter

Plate 2: Eliozu car wash

Plate 3: Creek at Artillery by old aba road

Plate 4: Creek at block industry beside filling station, old Aba road

Plate 5: Creek at Trans Amadi slaughter

Results and Discussions

Field Result

There are much decompositions of waste deposits in and around the creeks which can add to heavy metals concentrations in the surface water when being washed by flooding or high tides. Flooding from contaminated zones into the creek can also affect the creeks by inflow of some heavy metals.

Pelting (skinning/singeing) of animals with fire, using tyres as source of fire is one of the activities that take place at the abattoir of the study area and this process adds toxic heavy metals to the creek near the abattoir. The washing of the ashes of the tyres into the creek also increase the heavy metals concentrations in the surface water.

Leachates from waste at the bank of the creeks are washed into the surface water and this has given rise to the increase of heavy metals in the water. Ogbonna and Ogbuku, 2018 stated that leachate that flow into the rivers contributed to heavy concentrations in the water. Particles dissolution in the river mixes up with the water and in some cases settles in the water to become part of the sediment, thereby altering the chemical content of the water which in one way or the other influence the heavy metals in the water. Ogbonna et al, 2007 stated that decomposition and disintegration of particle in the water increases the heavy metals of the water. Mahboube et al, 2020 describes that water (streams, rivers, creeks) is an excellent tool which can be used to determine heavy metals contaminants. Ogbonna et al, 2019 described contaminants in water as foreign substances.

Fertilizers: Washing away of fertilizers from nearby farms into the creeks contributes to heavy metals influx into the creeks.

Dumping of hospital, hotels and industrial wastes into the creeks makes the creeks to be contaminated with heavy metals. Chapman 1992, Muhammed et al 2014, Eze et al 2016, Ekhaise, El Mountassir et al 2017, Pratibha et al 2014, and Omavwoya, 2008 documented about hospital waste waters being a source of heavy metal contamination in the environment.

Sewage disposals from nearby homes, industries, hospitals contribute to release of heavy metals in the creeks. Washing of oil vessels /barges by industries, in and around the creek also contribute to the source of heavy metals in the creek.

Chemicals from automobiles at car wash very close to the creek can also contribute immensely to the disposal of heavy metals in the creek. Detergents used at car wash also have significant role in release of heavy metals into the creek.

Geogenic nature also contributed to the heavy metal contents in the creeks.

PARAMETERS	SAMPLE LOCATIONS (LC) AND VALUES (mg/l)							
	LC1 Rumuokoro Slaughter	LC2 Eliozu Car wash	LC3 Artillery bus stop by Aba road	LC4 Block industry beside filling station old Aba road	LC5 Trans Amadi Slaughter	Average	WHO	SON
Total Iron	0.203	0.105	0.052	0.043	0.182	0.1222	0.3	1
Lead	1.472	0.131	0.068	0.085	2.099	0.771	0.01	0.01
Copper	0.082	0.031	0.011	0.011	0.196	0.066	1	1
Nickel	0.045	0.059	0.027	0.032	1.098	0.2522	0.02	0.02
Manganese	0.181	0.099	0.062	0.058	0.628	0.205	0.4	0.2
Zinc	0.082	0.091	0.064	0.067	0.850	0.231	5	3
Chromium	<0.001	<0.001	<0.001	<0.001	0.048	<0.001	0.05	0.05
Cadmium	<0.001	<0.001	<0.001	<0.001	0.012	<0.001	0.3	0.3
Cobalt	<0.001	<0.001	<0.001	<0.001	0.081	<0.001	0.05	0.05

Geochemical Result

Discussions

Average concentration of Iron, Copper, Zinc, Chromium, Cadmium, Cobalt in the study area are lower than the WHO and SON recommended standards. These values are not toxic to human. The concentration of Lead is higher than the WHO and SON recommended standards. Lead is so toxic to human and the environment. The average concentration of Nickel is higher than the WHO and SON recommended standard. Average concentration of Manganese is lower than the WHO standard and equivalent to SON recommended standard. Some heavy metals are required by the body at a specific amount which has been stated by WHO and SON but when the tolerable limit is exceeded, it becomes very toxic to the body.

Lead: Large content of lead in the surface water has adverse effect on the aquatic life which man depends. Lead concentrations in the water can get to humans through food chain and contacts. Lead in the body can result to cancer, lungs failure, cardiac attack, blindness and death.

Excessive Nickel in the body can result to weakness of bones, irritation of the respiratory tracks, nausea, pulmonary diseases, brain damage and eventually death.

Conclusion

The sources of heavy metals in the study area is mostly anthropogenic which range from disposal of waste, washing of oil and oil related materials, dissolution of chemicals from industrial wastes, sewage disposal from homes, hospitals, washing away of chemicals(fertilizers) from farms and washing of charcoals from hides and skin into the surface water. Flooding and leaching of mineralized soils is also a resultant factor for released of heavy metals into the creek. Geogenic factors are not eluded as one of the causative factors through which the creeks are being enriched with the heavy metals. Burning of natural and synthetic rubbers at the banks of the creeks contributed to the release of heavy metals into the creek. Corrosion of metals associated with E-waste which are deposited at the creeks and banks of the creeks also resulted in dissemination of heavy metals into the creeks. Awareness of proper waste disposal methods will help to eradicate indiscriminate disposal of waste which is directly and indirectly affecting the geochemical nature of the environment.

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