Hazards of Heavy Metal Contamination on the Groundwater Around a Municipal Dumpsite in Lagos, Southwestern Nigeria.

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Abstract-- **The presence of heavy metals in water is widespread, affecting hundreds of cities. In high dosages, these heavy metals are highly toxic to human, even deadly. The study was therefore aimed at evaluating the geochemical implication of Heavy metals on the groundwater surrounding a municipal solid waste dumpsite at Olusosun, waste disposal site Lagos. Twenty groundwater samples and a leachate were investigated around the dump site and the samples were acidified with two drops of concentrated nitric acid before it was sent for analysis at the Acme Laboratory Canada. The results revealed dominance of Pb, Fe and, Mn when compared with WHO and SON standard, while all the metals were found high in the leachates. Contamination assessment revealed Fe and Pb to be extremely contaminated in the groundwater, while geoaccumulation factor showed that farther away from the dumpsite contamination reduces. Pb, Mn, Fe are found to be from anthropogenic source and correlated significantly Pb-Cd (0.84), Mn-Pb (0.90), Fe-Cd (0.76) with each other. Thus, Pb, Fe and Mn if not checked could lead to major health problems like tooth discoloration, low mental development and kidney problems on the public.**

Index Term-- **municipal solid waste, dumpsite, environmental pollution contamination**

I. INTRODUCTION

Heavy metal pollution is a problem associated with areas of intensive industry. However, roadways, areas of dumpsites and automobiles now are considered to be one of the largest sources of heavy metals (4; 1; 14; 8; 16). Human existence on earth is almost impossible without the heavy metal. Even though important to mankind exposure to them during production, usage and their uncontrolled discharge into the environment has caused lots of hazards to man, other organisms and the environment itself (17; 6). Different heavy metals used by man are maintained in the ecosystem and several of these have been reported to exhibit toxic effects on lives (10; 3; 9; 13; 19; 7; 2).Over the last three decades there has been increasing global concern over the public health impacts attributed to environmental pollution, in particular, the global burden of disease. The World Health Organization (WHO) estimates that about a quarter of the diseases facing mankind today occur due to prolonged exposure to environmental pollution (18).

Improper management of solid waste is one of the main causes of environmental pollution and degradation in many cities, especially in developing countries. Many of these cities lack solid waste regulations and proper disposal facilities, including for harmful waste. Such waste may be infectious, toxic or radioactive. Municipal waste dumping sites are designated places set aside for waste disposal.

Depending on a city's level of waste management, such waste may be dumped in an uncontrolled manner, segregated for recycling purposes, or simply burnt. Poor waste management poses a great challenge to the well-being of city residents, particularly those living adjacent the dumpsites due to the potential of the waste to pollute water, food sources, land, air and vegetation. The poor disposal and handling of waste thus leads to environmental degradation, destruction of the ecosystem and poses great risks to public health. Therefore the study undertaken on the waste disposal site around Olusosun, Oregun, Ojota area, Lagos state (Fig 1.0) was therefore aimed at evaluating the impact of heavy metals in the groundwater around the waste disposal site, while compared with the leachate (Figure 2.0) and relates them to the attendant environmental problems.

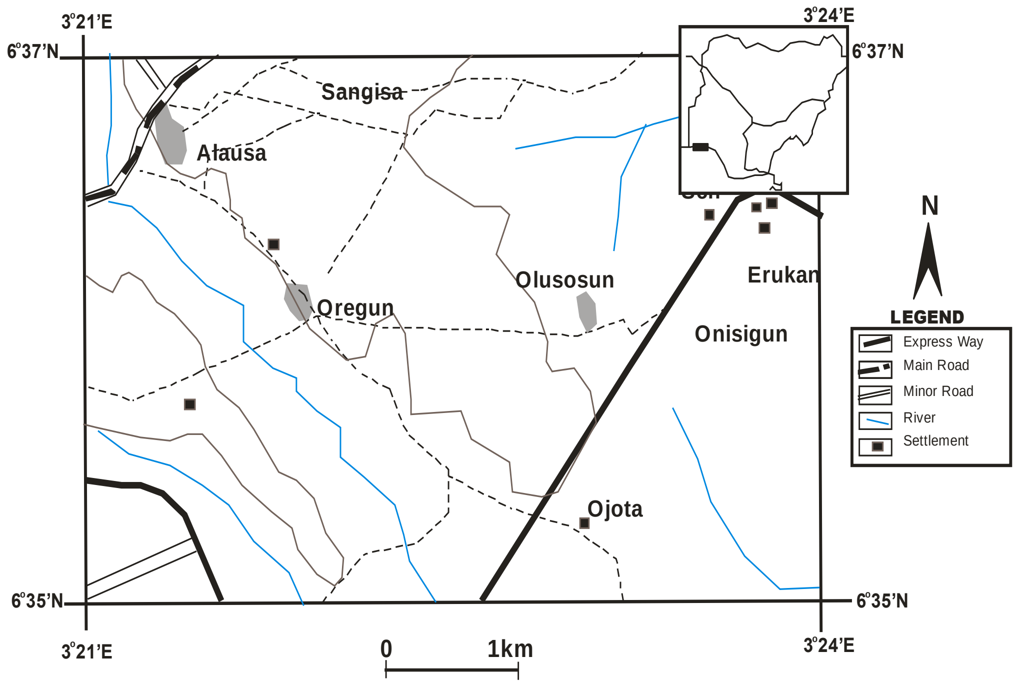

Fig. 1.0. Location of the study area

Fig. 2.0. Leachate found within the dump

II. MATERIALS AND METHODS

Twenty groundwater samples were collected around the waste disposal site into a clean plastic 100ml bottle in order to avoid contamination through the use of reactive or metallic containers, while a leachate was taken directly from the dumpsite, to ascertain the rate of heavy metal contamination on the surrounding groundwater. the samples were acidified with two drops of concentrated nitric acid to prevent the ions from adhering to the surface of the container. Samples were then sent to Acme Laboratories Canada for analysis.

III. RESULTS AND DISCUSSION

Hydro chemical results of the leachate and groundwater (in ppb) revealed different trace metals of Pb, Zn, Cu, Fe, Cd, Mn, Fe. The mean concentration of the metals when compared with (14; 18; 5) standards (Table 1.0), showed that all the metals found in the groundwater of the area were within the standards except Pb, Fe and Cd which confirms the work of Ogundina, et al; 2008; while the metals of leachate was found above in nearly all the metals with the exception of Zn and Ba which was found below the water standards. The result showed that the influx of leachates through the water flow is gradually affecting the groundwater particularly that of Pb, Fe and Cd that is extremely high. Inter-elemental analysis (Table 2.0) of the metals showed a strong and positive correlation with all the metals these revealed that all the metals are from the same source which may be coming from the dumpsite and thus, makes it of anthropogenic in origin. Geochemical evaluation (Figure 3.0 &4.0) shows that there is a higher concentration of the metals at the dumpsite, with decreasing concentration to the NW and SW part of the dumpsite. This implies that the dumpsite is the main source of accumulation of the heavy metals in the study area. Contamination assessment showed that the index of Geoaccumulation (Table 3.0) of Fe in location 1 is Uncontaminated to moderately contaminated i.e 0 < Igeo< 1, location 2 is Heavily to extremely contaminated i.e 4 <Igeo < 5, location 3 and 17 are Extremely contaminated i.e 5< Igeo < 6; Mn in location 2, 10, 12, 15, 18 and 19 are uncontaminated to moderately contaminated i.e 0 < Igeo< 1, location 13 is moderately contaminated and location 17 is heavily contaminated;Pb in location 1 is Uncontaminated to moderately contaminated i.e 0 < Igeo< 1 and 17 is Extremely contaminated. Contamination factor of the study area for heavy metals indicate a low contamination class for all elements, i.e Cf<1, except for Fe and Mn. Fe which has a very high contamination factor i.e 6<Cfi while Mn has a moderate contamination i.e 1<Cfi<6.

Table I
Comparison of the Result with Recommended Standard

Element	Mean	Range	Standard deviation	leachate	W.H.O (2006) ppb	E.P.A (2009) (ppb)	SON (2007) (ppb)
Ba	65.10	14.20-152.37	41.23	336.50	700	2000	700
Cd	0.80	0.09-1.59	0.55	4.40	3	5	-
Cr	1.1	0.5-5.2	1.1	1171.0	50	100	-
Cu	12.0	2.3-41.3	10.4	605.0	2000	1300	1000
Mn	69.51	6.96-184.75	50.25	643.60	400	50	200
Pb	5.8	1.2-26.9	6.3	485.0	10	15	10
Zn	19.6	4.1-73.7	16.0	3777.0	3000	5000	3000
Fe	2019	11-21675	5828	16753	50	300	300

Table II
Correlation of Heavy Metals

	Ba	Cd	Cr	Cu	Fe	Mn	Pb	Zn
Ba	1							
Cd	**0.77**	1						
Cr	**0.84**	**0.85**	1					
Cu	**0.84**	**0.82**	**0.99**	1				
Fe	0.00	0.00	**1.00**	0.49	1			
Mn	**0.92**	**0.84**	**0.94**	**0.94**	**0.52**	**1**		
Pb	**0.83**	**0.84**	**0.99**	**0.99**	**0.76**	**0.90**	**1**	
Zn	**0.84**	**0.83**	**0.99**	**0.99**	**0.51**	**0.90**	**0.99**	1

Table III

Sample locations	Ba	Cd	Cu	Fe	Mn	Pb	Zn
1	-4.67	-1.58	-8.53	**0.14**	-1.33	**0.84**	-9.04
2	-3.35	-1.50	-9.59	**4.90**	**0.84**	-2.64	-9.38
3	-4.25	-2.79	-9.59	**5.59**	-0.45	-	-10.96
4	-3.77	-2.60	-9.83	-5.36	-0.44	-3.32	-10.70
5	-3.89	-4.36	-8.64	-4.29	-3.43	-3.64	-9.04
6	-4.71	-4.57	-6.91	-4.01	-0.69	-0.09	-8.89
7	-5.03	-1.87	-8.76	-1.94	-1.39	-2.18	-9.48
8	-6.21	-5.23	-6.86	-1.58	-2.17	-2.14	-7.73
9	-4.89	-2.51	-6.19	-3.03	-0.91	-1.39	-8.38
10	-4.84	-1.97	-7.53	-4.29	**0.52**	-1.87	-9.48
11	-5.87	-1.83	-9.48	-4.49	-1.40	-2.64	-10.11
12	-2.97	-2.03	-6.52	-	**0.47**	-1.08	-8.97
13	-2.86	-2.18	-5.57	-5.23	**1.30**	-0.34	-7.59
14	-4.65	-1.61	-9.82	-4.82	-0.42	-2.09	-9.29
15	-2.78	-1.65	-8.38	-1.72	**0.96**	-1.71	-8.24
16	-4.60	-3.52	-7.45	-3.86	-0.96	-2.28	-8.70
17(lch.)	-1.64	-0.03	-1.69	**5.21**	**3.10**	**5.01**	-0.99
18	-4.39	-5.49	-7.12	-4.73	**0.70**	-2.09	-8.70
19	-4.02	-5.64	-6.51	-4.64	**0.29**	-2.06	-9.12
20(ctrl)	-3.74	-5.36	-7.14	-2.66	-1.37	-2.77	-6.67

Geoaccumulation Indices of Heavy Metals In The Study Area

Lch-Leachate:Ctrl-Control

Table IV
Contamination factors of the elements in the study area.

Elements	Contamination factor
Ba	0.093
Cd	0.267
Cu	0.009
Fe	**6.730**
Mn	**1.390**
Pb	0.580
Zn	0.004

Cdeg=11.662

CONCLUSION

The geochemical analysis of the metals reveals that Pb, Mn and Fe have values above the recommended standards, while virtually all the elements are from the same anthropogenic source from the inter-elemental analysis, while the contamination assessment showed Fe to have contaminated the waters most. Quality of the water in the study area could be termed contaminated and unhealthy for consumption. Thus, the effect of Fe and Pb to man could lead to delays in physical and mental development and slight deficit in attention span and learning abilities in infants and children; Kidney problems and high blood pressure in adults. While Fe and Mn that was high in the groundwater cause cosmetic effects such as skin or tooth discoloration or aesthetic effect such as taste, odor, or color in drinking water which may also lead to nausea, vomiting, diarrhea, as well as blood clotting and if exceeding high in human system threatens life.

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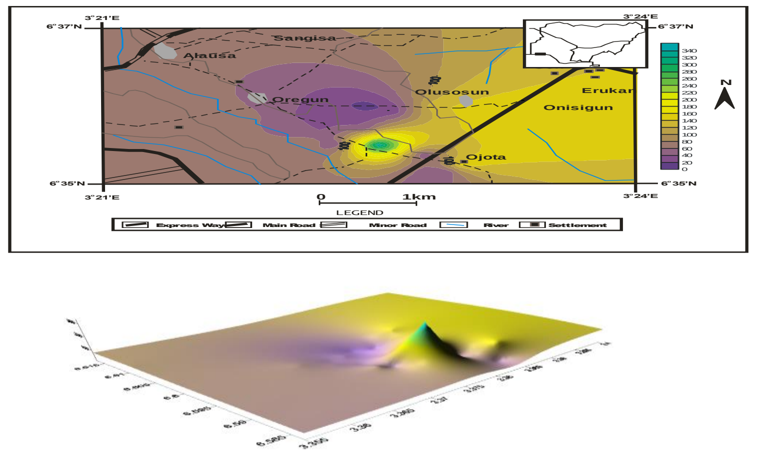
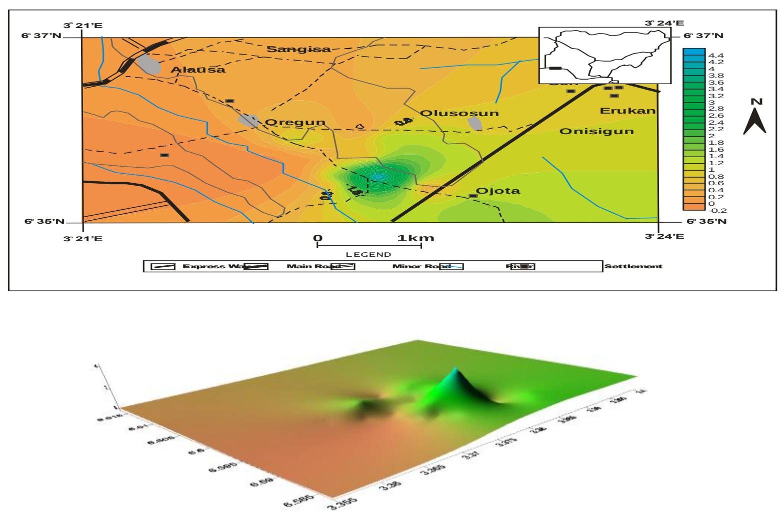
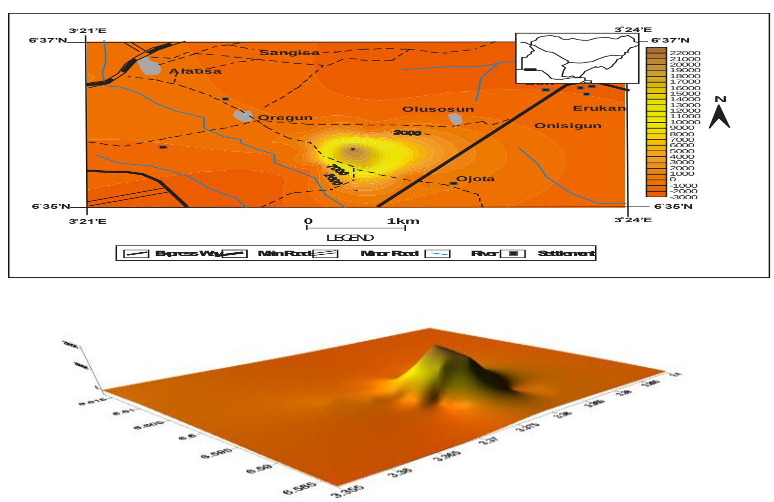


Ba

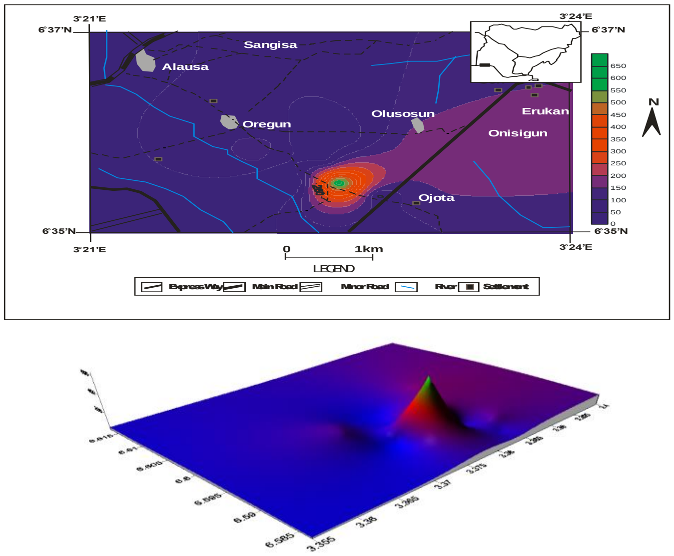


Cd

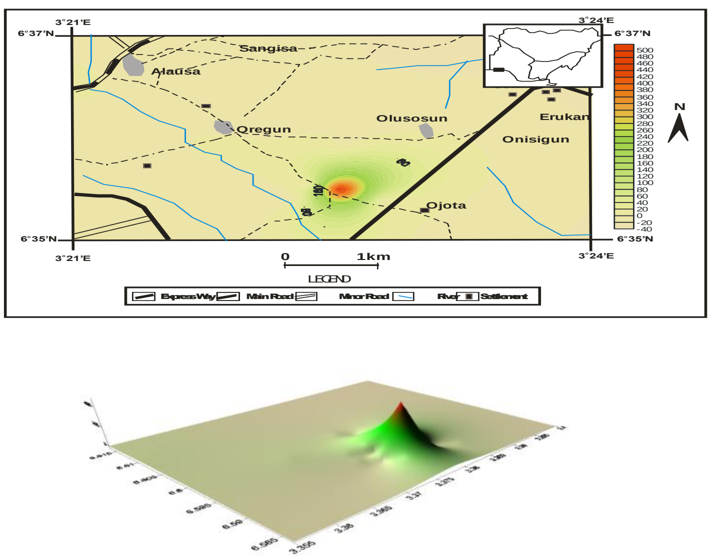


Fe

Fig. 3.0. Geochemical map showing the concentration in the sampled area



Mn



Pb

Fig. 4.0. Geochemical map showing the concentration in the sampled area

Picture showing some part in the dumpsite

Picture showing activities going on in the dumpsite arena