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Analysis of Pb, AS and Zn Concentration in soil around Ririwai Tin Mine, Kano State, North Western Nigeria

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ABSTRACT: Mining industry in Nigeria provides economic benefits of wealth creation and employment opportunities. However the industry is associated a number of negative challenges among which is the health impact of miners and surrounding communities arising from mining processes. In this study Xrf analytical techniques was used to determined the concentration of Pb, As and Zn in soil around Ririwai Tin mine Kano state Nigeria. The results shows that the mean concentrations of Pb, As and Zn were 113.54±3.92, 6.76±0.34 and 216.89±5.74mg/kg respectively. Zn have the highest concentration across all location followed by Pb while As have the lowest concentrations. The concentrations of Zn and As in the study area were within the worldwide range values in soil of 50-250mg/kg and 1-50mg/kg reported by USEPA for Zn and As respectively. Pb have very high concentration when compared with worldwide average value of 10mg/kg reported by USEPA. Suggesting that there is high deposits of Pb in the area. Therefore all means of ingesting of soil by human and animal around the area should be avoided because of the elevated concentration and the toxicity of Pb.

Keywords: Xrf, Concentration, Heavy Metals, Lead, Arsenic, Zinc, Tin Mine,

INTRODUCTION

Beside the socio-economic benefits of the mining industry in the developing countries such as Nigeria, the industry may be faced with three potential negative effects. The first one is the socio-economic dislocation all ill-prepared mining communities go through at mine closure, which arise from exploitation of a non-regenerative resources [1]). The second and third undesirable aspects arise when non-optimal management of mining operations results in environmental degradation and /or negative health impacts on miners and mining communities. Principal health problems among miners and mining communities from various countries that have been cited by the literature include respiratory disease, neoplasm/cancer, chronic hypertension, mental health and genetic impact [2] . The major cause of these diseases can be attributed to the heavy metal contamination and naturally occurring radioactive materials NORMs [3].

Mining and industrial processing are among the main sources of heavy metal contamination in the environment. Mining activities, through milling operations coupled with grinding, concentrating ores and disposal of tailings, along with mill wastewater provide obvious sources of heavy metal contamination of the environment. It is, therefore, not surprising that the degree and extent of heavy-metal pollution as a result of human activities has been one of the main topics studied in environmental geochemistry. Heavy metals can cause health problems at higher exposures and destroy aquatic organisms when leached into water bodies. Metals contamination in aquatic environmental has received huge concern due to their toxicity, abundance and persistence in the environment and subsequent accumulation in the aquatic habitats.[4].

Heavy metal residues in contaminated habitats may accumulate in microorganisms, aquatic flora and fauna, which in turn may enter the human food chain and result in health problems like the lead poisoning problems that killed more than 400 children in Zamfara State[5] .

Ions such as sodium, potassium, magnesium and calcium are essential to sustain life. Additional metals such as manganese, iron, cobalt, copper, Zinc, chromium, vanadium, selenium and molybdenum are also essential for optimal growth, development and reproduction. These metals function mostly as catalysts for enzymes activity in human bodies but become toxic when their concentration becomes excessive. In addition to the mercury, lead, cadmium, silver aluminum, arsenic and barium [6], Epidemiological studies in recent years have indicated a strong association between the occurrence of several diseases in humans, particularly cardiovascular disease, kidney related disorders, neurocognitive effects and various forms of cancer and the presence of toxic trace metals [7,8].

In this research, the concentrations of Pb, As and Zn in soil samples obtained from ten locations around Ririwai Tin mine in Kano state Nigeria were determined using energy Dispersive X-Ray Fluorescence (EDXRF) Spectrometer model FXL-83358 .

MATERIAL AND METHODS

Ten (10) soil samples were collected at ten different locations around the study area, at 10cm depth using a mechanical digger. The10cm depth was carefully chosen as the appropriate depth to obtain the samples in line with the facts established that these pollutants are highly absorbed to clayed materials and organic matters in the study areas [9]. Fig; 1 shows the map of the study area while Table; 1 shows the locations where samples were collected

The soil samples collected were pretreated by oven drying them at a regulated temperature of 55^0c for 48 hours. After drying, a series of mesh size 35µm was used to remove large undesirable particle sizes The dry test samples were analyzed using the energy dispersive X-ray florescence (EDXRF) FXL-83358 model to determine the concentration of the metals in the soil samples.

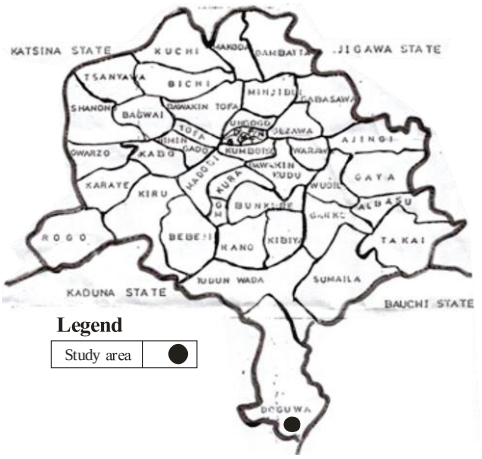

Fig. 1: Map of Kano State Showing the study area

Table 1: Sampling locations

S/No	North	East	Elevation
1	10^0 44′ 35.3″	008^0 45′ 16.4″	856m
2	10^0 44′ 36.7″	008^0 45′ 15.8″	856m
3	10^0 44′ 33.8″	008^0 45′ 17.8″	856m
4	10^0 44′ 32.3″	008^0 45′ 21.0″	858m
5	10^0 44′ 30.3″	008^0 45′ 27.0″	862m
6	10^0 43′ 48.2″	008^0 44′ 57.1″	896m
7	10^0 43′ 49.1″	008^0 44′ 53.4″	894m
8	10^0 43′ 48.5″	008^0 44′ 53.0″	895m
9	10^0 43′ 50.2″	008^0 44′ 58.7″	892m
10	10^0 43′ 49.5″	008^0 44′ 59.2″	894m

RESULTS AND DISCUSSION

Soils collected from the sampling locations were analyzed using Energy Dispersive X-Ray Fluorescence (EDXRF) method. It was found out that the concentrations of the elements varied from one sampling location to another. Inferential statistics and one-way ANOVA were used to compare the concentrations of Pb, As and Zn.

Table 2: Concentration of Pb, As and Zn

		Concentration in mg/kg		
S/No	Sample I.D	Pb	As	Zn
1	Rp1	189.40± 4.76	5.85 ± 0.35	420.55 ± 7.68
2	Rp2	100.24± 3.68	5.20± 0.28	161.78 ± 5.16
3	Rp3	47.75 ± 2.78	5.62± 0.40	57.58 ± 3.62
4	Rp4	65.22 ± 3.06	6.34 ± 0.24	75.04± 3.93
5	Rp5	62.64 ± 2.93	5.94±0.22	60.19± 3.56
6	Rp6	69.71 ± 3.31	7.22 ± 0.55	181.64 ± 5.39
7	Rp7	114.07±4.12	8.55 ± 0.31	188.18± 5.90
8	Rp8	118.10 ± 4.14	8.10 ± 0.31	178.29 ± 5.77
9	Rp9	218.00 ± 5.64	9.16± 0.42	581.34 ± 9.64
10	Rp10	150.30 ± 4.73	5.60 ± 0.35	264.31 ± 6.72
	Mean	**113.54 ± 3.39**	**6.76 ± 0.34**	**216.89 ± 5.74**

Concentration of Pb

The result from Table- 2 showed that the mean concentration of Pb is 113.54 ± 3.92 mg/kg in range between 47.75 to 218.00 mg/kg with standard deviation of 54’21.The concentration of Pb obtained in this study revealed very high values when compared with the world wide average of 10mg/kg reported by USEPA[10] thus suggesting high deposit of Pb in the area

Concentration of As

The concentration of As ranged between 5.20 to 9.16 mg/kg with a mean value of 5.20 ± 0.22 mg/kg with standard deviation of 1.33.The mean value is within 5.00mg/kg world average value and it fall within the world range of 1-50 mg/kg as reported by [10,11].

Concentration of Zn

The mean concentration of Zn is 216.89 ± 5.74 mg/kg between the range of 57.58 to 581.34 mg/kg with standard deviation of 159.12. The mean concentration of Zn in this study is higher than the world wide average value in soil of 1oomk/kg, however the concentration of Zn across all the locations fall within the world wide range of 100 – 500mg/kg reported by USEPA

In the sampling locations Zn was found out to have the highest concentration followed by Pb while As has the lowest concentration shown in Figure- 2.

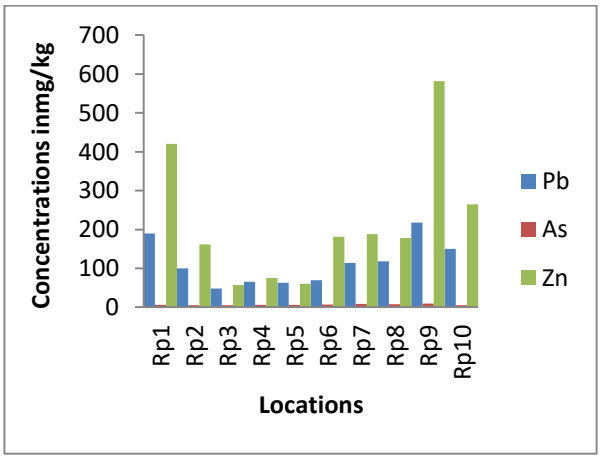

Figure 2: Plot of Concentrations against Locations

Similarly, the ANOVA (0.000> 0.05) showed that there is a significant difference in the relative abundance of the various metals. In other words some metals are more abundant than other in all the locations.

CONCLUSION

Xrf analytical technique was used to determined the concentrations of Pb, As and Zn in soil sample collected around Ririwai. Tin mine in Kano state Nigeria. The results indicated that Zn with mean concentration of 216.89±5.74mg/kg is the highest in all locations followed by Pb with mean concentration of 113.54±3.92mg/kg while As with mean concentration 5.20±0.22mg/kg has the lowest concentrations in all the locations. The concentrations of Zn and As obtained in this study falls within the values of the worldwide concentration ranges of these metals in soil. However, the concentration of Pb obtained in this study is very high when compared with the worldwide average value and range this therefore suggested that there is high deposits of Pb in the soil of the study area. All means of ingesting soil around the area by people and animals should be avoided because of the high toxicity of Pb.

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