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Distributions of Cu, Ni and Cr Concentrations in Soil Around Tin Mine Located in Ririwai, Kano State, North Western Nigeria

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ABSTRACT

Mining and mineral processing 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 on miners and surrounding communities arising from mining processes. In this study Xrf analytical techniques was used to determined the concentration of Cu, Ni and Cr in soil around Ririwai Tin mine Kano state Nigeria. The results shows that the mean concentrations of Cu, Ni and Cr were 48.79 ±4.83mg/kg, 21.67±1.23mg/kg and 63.78 ±6.83mg/kg respectively. Cr have the highest concentration across all location followed by Cu while Ni have the lowest concentrations. The concentrations of Cr in the study area were lower than the worldwide range values in soil of 100-500 mg/kg reported by USEPA for Cr. The concentration of Ni is within the worldwide range of 1-50 mg/kg. Cu have very high concentration when compared with worldwide average value of 30mg/kg reported by USEPA. Suggesting that there is high deposits of Cu in the area. Therefore all means of ingesting soil by human and animal around the area should be avoided because of the elevated concentration and the toxicity of Cu which could course health hazards.

Keywords : Xrf, Concentration, Heavy Metals, Cu, Ni, Cr, Tin Mine

I. INTRODUCTION

In African commercial scale mining provides important benefits in terms of exports/foreign exchange earnings and tax receipt to nineteen African countries [1]. 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 [2]. 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 [3]. The major cause of these disease can be attributed to the heavy metal contamination and naturally occurring radioactive materials [4].

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.

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 distributions of Cu, Ni and Cr concentrations in soil samples obtained from ten locations around Ririwai Tin mine in Kano state Nigeria were investigated using energy Dispersive X-Ray Fluorescence (EDXRF) Spectrometer model FXL-83358 .

II. METHODS AND MATERIAL

Ten (10) soil samples were collected at ten different locations around the study area at 10cm depth using a mechanical digger. The 10cm 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].

Figure 1 shows the Topographic 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

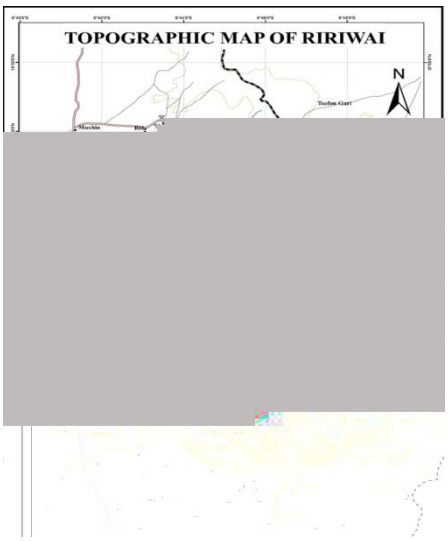

Figure 1. Topographic map of the study area

Table1. Sampling Locations

	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

III. 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 Cu, Ni and Cr.

Table 2. Concentrations of Cu, Ni, Cr in mg/kg

		Concentration in mg/kg		
S/no.	Sample Id	Cu	Ni	Cr
1	Rp1	34.23 ± 4.46	19.02 ± 0.61	87.49 ± 7.14
2	Rp2	35.92 ± 4.50	22.13 ± 0.59	98.90 ± 6.79
3	Rp3	43.11 ± 4.54	10.43 ± 0.50	66.00 ± 5.80
4	Rp4	35.11 ± 4.41	22.20 ± 0.58	58.92 ± 6.52
5	Rp5	28.13 ± 4.15	11.23 ± 0.50	62.08 ± 5.92
6	Rp6	42.71 ± 4.63	15.75 ± 0.58	59.66 ± 6.09
7	Rp7	49.98 ± 5.07	24.84 ± 0.70	38.57 ± 7.71
8	Rp8	43.24 ± 4.93	27.69 ± 0.72	35.01 ± 7.89
9	Rp9	98.66 ± 6.06	36.59 ± 0.73	85.13 ± 7.57
10	Rp10	76.77 ± 5.56	26.83 ± 6.78	45.99 ± 6.86
	Mean	**48.79 ± 4.83**	**21.67 ± 1.23**	**63.78 ± 6.83**

The result from Table- 2 showed that the mean concentration of Cu is 48.79 ± 4.83 mg/kg in range between 28.13 to 98.66 mg/kg with standard deviation of 20.88.The concentration of Cu obtained in this study revealed higher values when compared with the world wide average of 30mg/kg reported by USEPA[10].

The concentration of Ni ranged between 10.43 to 36.59 mg/kg with a mean value of 21.67 ± 1.23 mg/kg with standard deviation of 7.57.The mean value is less than 40.00mg/kg world average value and it fall within the world range of 1-50 mg/kg as reported by [10,11].

The mean concentration of Cr is 63.78 ± 6.83 mg/kg and between the range of 35.01 to 63.78 mg/kg with standard deviation of 20.19. The mean concentration of Cr in this study is les than the world wide average value in soil of 1oomk/kg, however the concentration of Cr across all the locations fall below the world wide range of 100 – 500mg/kg reported by USEPA

In some sampling locations Cu was found out to have the highest concentration while in some Cr concentration is higher ,however Ni has the lowest concentration in all locations as shown in Figure- 2.

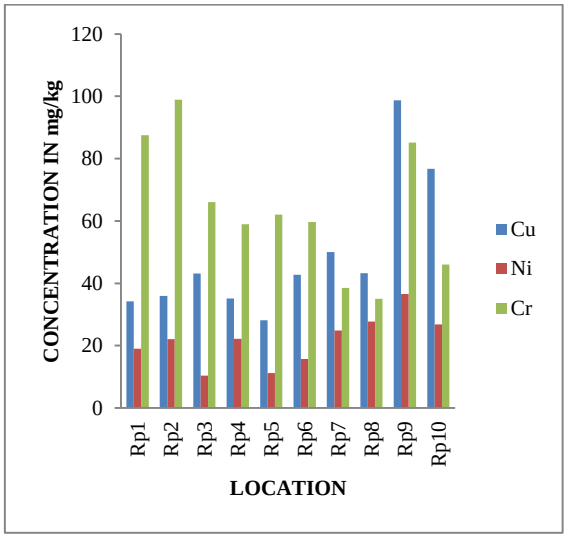

Figure 2. Plot Of Concentration Against Location

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.

IV. CONCLUSION

Xrf analytical technique was used to determined the concentrations of Cu, Ni and Cr in soil sample collected around Ririwai. Tin mine in Kano State Nigeria. The results indicated that Cu, Ni and Cr have mean concentration of 48.79± 4.83mg/kg, 21.67±1.23mg/kg and 63.78±6.83mg/kg respectively. In most locations the concentrations of Cr is higher than that of Cu and Ni, Cr concentration in this work is generally lower than the worldwide range of 100 – 500mg/kg reported by USEPA . The concentration of Ni is the lowest amongst the three metals in all locations and it is within the range of 1-50 mg/kg worldwide range. The concentration of Cu in the samples analysed has higher concentrations than worldwide mean value of 30mg/kg. This therefore shows that the concentration of Cu in soil in the study area could course health harzards when ingested by people or animals.

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