ASSESSMENT OF METAL CONCENTRATIONS IN LEAD – ZINC MINES AND NEARBY SOILS, PLANT AND WATER IN ABUNI TOWN, AWE LOCAL GOVERNMENT AREA, NASARAWA STATE, NIGERIA

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Abstract

Assessment of metal concentration in Pb–Zn mine, soil, plant (*Frosobis africana*) *and water samples was carried out in Abuni town, Awe local government area of Nasarawa State, Nigeria using XRF and AAS methods. Analytical results showed that the metal concentrations (mg/L) in the water samples had range of ; Pb (0.15–0.25), Zn (6.19–15.69), Ni (0.03–0.04), Cu (0.00–0.01), Mn (0.09–0.13), Cr (0.00–0.02), Ba (0.034–3.05), Al (0.00–0.13), Mo (5.19–19.11), U (1.07–2.08), Co (0.00–0.03), Cd (0.01–0.02) and Ag (0.00–0.01). The mine showed higher concentrations of Pb–Zn minerals in exploitable quantities. These high concentrations of Pb and Zn were due to the geological occurrence of the area .The average concentrations of the metals in the sampled soil varied greatly as one approaches the sampling area with a decrease in concentration in the trend: Fe > Si > Ba > Al > K > Zr > Mn > Cr > Ti > Pb > Zn > Ni while for the plant the trend was: Pb > Zn > Cu > Ni > Mn > As > Fe > Cr > K > Ti > Sr > Ca > Ba > S > Si > Zr. In general, the lowest concentrations of these metals were in the soils than in the plant samples.*

Keywords: *Lead–zinc mineral, soil, mine, Nasarawa, Nigeria.*

INTRODUCTION

Abundant mineral deposits occur in all the components of Nigerian geology. These solid mineral deposits that are of economic significance include Pb, Zn, Fe, Ba, Sn, Nb, Tn, Cu, Ag, etc. all occur in Nasarawa State with the possibility of petroleum occurrence in parts of its sedimentary basin (Obaje *et al.*, 2006). Pb – Zn occur in mineralized zone in the Benue Trough from the southeast through the middle Benue to Zurak in the northeast. The Nigerian Pb – Zn ore of the Benue valley is impregnated in relatively narrow fracture zones in shales and mudstones and to an extent in sandstones. Sulphides of Zn and Pb, locally associated with smaller quantities of Cu, occur in lodes and veins infilling open fractures in the sedimentary formations. The strike of these mineralized fractures is generally north to south or northwest to southeast. They vary from a few meters to over 1½ kilometers in length and from a few centimeters to several meters in width (Ford, 1989). The lodes of these minerals are typically characterized by many large rugs through which water readily circulates and in some cases sympathetic variations in water level over fairly wide areas (up to 5 km) indicate that the fractures are connected along the strike direction between mineralized zones (Ford, 1989).

Soil being an essential component of terrestrial ecosystem supports plant growth and the biogeochemical cycling of nutrients .Taking ride from the surface to the bedrock, several distinct layers or horizons that form the soil profile (ground level, topsoil, subsoil, the weathered material and the bed rock) has been identified (Lentech, 2005). Nigeria with a land area of approximately 950,000 km^{2} ^{is} richly endowed with diverse resources. However, indiscriminate mining by artesinal miners is generally leading to contamination and deterioration of the environment .There are staggering environmental problems manifested in various forms to present a grim of woes as a result of degradation arising from pollution. Heavy metal pollution and the resulting health effect present some of the biggest challenges currently affecting the world (Okoye, 1994). Metal concentrations in soils, plants and water cannot be attributed solely to geological factors alone. Human activities also play a predominant role in polluting the soils, water and plants (Murphy, 1981). Minerals occur in soils in various chemical forms with ranging mobility, bioavailability and toxicity (Shiowatana *et al.*, 2001). The concentrations of metals in the air, soil, water and plant may be increased beyond their natural levels due to mining activities, agricultural, domestic and industrial effluents (Oboh & Edema, 2007). Determination of the total concentrations of heavy metals in the soil, though important in risk assessment of contaminated sites, does not suffice in the prediction of mobility, bioavailability and fate of the heavy metal contaminant in order to assess the potential of environmental impacts (Kabata & Singh, 2001).

A number of approaches have been widely used to estimate the so–called mobile, labile or bioavailability pools of heavy metals in soils. Plant uptake of metals depends significantly on factors such as (i) the concentrations and chemical speciation of the metals in the soil solution (ii) the movement of the metal from the bulk soil to the root by diffusion or convection (iii) metal absorption by the root and (iv) metal translocation within the plant (Bakirdere & Yaman, 2008). The plant uptake of mobile ions present in the soil solution is determined by a combination of the total quantity of that specific ion in the soil and other soil factors such as acidity (pH), cation exchange capacity (CEC) and soil organic matter content (SOM) (Tokalioglu *et al.*, 2006). The most important chemical process affecting the behaviours and bioavailability of metal in soils are those concerned with the adsorption of metals in the solution on solid soil surfaces. Adsorption processes control the free ions and ion complexes in the soil solution and thus exert a major influence on metal uptake by plants. More so, plant species may differ in their need for and tolerance of metal as well as in the physiological mechanism of metal transport and incorporation in tissue (Barber, 1995).

In water, insoluble heavy metals may be bound to small slit metals and other fluvial contaminants in suspension or solution do not simply flow downstream, they are complexed with other compounds, settled to the bottom and ingested by plant and animals or absorbed as sediments (Collison & Shimp, 1972).Heavy metals pollution refers to cases where the contents of these elements in soil and water are higher than the maximum concentration, which has potential harmful effects on vegetation and water sources. The geological nature of a place has a great significance in determining the metal type and its concentration, bioavailability and accumulation in an organism, water or plants which is the product of equilibrium between the concentrations (Turpeinen *et al.*, 2000). It is in realization of the importance of these mineral and their consequences that this work is being carried out to determine the economic viability of these metals in the pb–zn mine for possible exploitation. On the other hand investigating the level of concentration of these metals in soil, plant and water to ascertain the level of pollution and bioavailability of these metals which have economic connotation.

MATERIALS AND METHODS

Study Area

Nigeria lies approximately between latitude 4^0N and 14^0N and between longitude 3^oE and 15^oE. The study area is located in Abuni town, Awe local government area of Nasarawa State north central, Nigeria (Fig. 1) .The town is 90 km north of Lafia the capital of Nasarawa State. It is situated on longitude $08^0\,30'$ east and latitude 08^0 32′ north. The area is accessible through the major road from Abuja – Keffi – Akwanga – Lafia to Awe (Fig. 1).

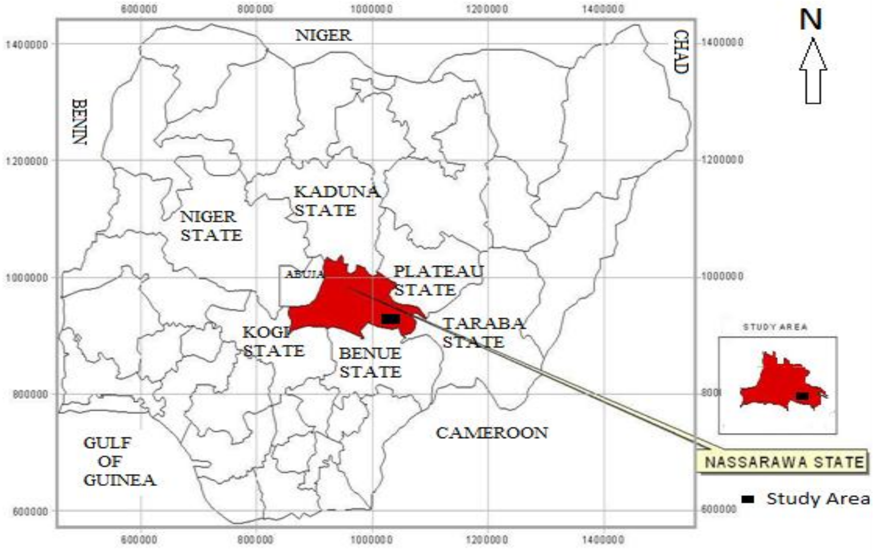

Fig. 1: Map of Nigeria Showing Nasarawa State and Abuni Town

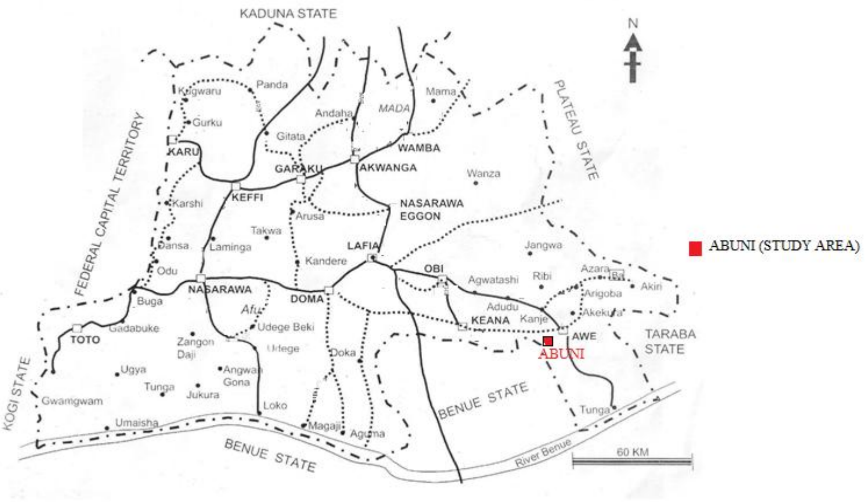

Fig. 2: Map of Nasarawa State Showing Abuni the Sampling Town

Sample Collection

Water samples for this research work were collected from the stream and underground water 200 m north–west from the Pb–Zn mine with a 2.5 L polythene keg. The samples were preserved with 1 mL nitric acid concentration. The soil samples were collected from the mine vicinity. A hole was dug to a 15 cm depth using a chrome–plated trowel. The hole was then cleansed to expose an undisturbed vertical section of the soil. The sampling container (polythene bag) was then opened and the trowel was used to gently scrape the soil vertically beginning at the bottom of the section and moving to the top of the pipe. This method provided a vertical composite sample from each discrete location. The plant root and stem (*Frosobis africana*) was carefully uprooted with cutlass and a digger to ensure that the root and other parts were not damaged and stored in a properly labeled polythene bag. The plant samples were separated into root and stem while the ore samples were collected from the mine with the assistance of miners (Fig. 2).

Sample Preparation

The dried soil, plant and Pb – Zn ore samples 20.0 g were finely ground to pass through a 200 – 250 mm mesh sieve. The samples were then dried in an oven at 105^{o}C for 1 h and cooled. Thereafter, each sample was intimately mixed with a cellulose binder in the ratio of 5:1 respectively and pelletized at a pressure of 10 – 15 tonnes/inch in a pelletizing machine. The palletized samples were stored in desiccators for analysis.

Metal Analysis

Elemental analysis was carried–out using ED–XRFS and AAS. The prepared soils, plant and ore samples were analyzed using energy dispersive x–ray fluorescence spectrometry (ED–XRFS) (mini PAL 4 Model ©, 2005), while the water samples were analyzed for the following metals; Pb, Zn, Ni, Mn, Mo, U, Cu, Cr, Co, Cd, Ba, Al, Ag and As using the Atomic Absorption Spectrophotometer model VCG 210.

RESULTS AND DISCUSSION

The results for metal analysis of Pb–Zn ores, soil, plant and water samples are presented in Tables 1, 2, 3 and 4. This is compared with the normal and critical ranges of metals in soil, plant and the World Health Organization parameters for potable water (Tables 5 and 6). The mine showed higher concentrations of Pb and Zn minerals in exploitable quantities. The average concentrations of the metals in the sampled soil varied greatly as one approaches the sampling area with a decrease in concentration in the trend; Fe > Si > Ba > Al > K > Zr > Mn > Cr > Ti > Pb > Cr > Zn > Si > Ni while for the plant the trend was: Pb > Zn > Cu > Ni > Mn > As > Fe > Cr > K > Ti > Sr > Ca > Ba > S > Si > Zr

Lead concentrations in the samples ranged between 0.00 – 82.47 mg/kg in the ore, 0.05–0.08 mg/kg in soil, 3.21–10.51 mg/kg in the *Frosobis africana* plant and 0.15–0.25 mg/L in the water samples (Tables 1, 2, 3 and 4). The metal was not detected in ABN$_2$–ABN$_5$ (Table 4). Values obtained indicated higher content of Pb metal in the mine which is an indication that the metal is concentrated in exploitable quantities for economic benefit. This may be attributed to the fact that the mine is within the zone and vein of mineralization of the metal. The level of concentration of the metal is comparable with one in Ishiagu, Enyigba, Ameri and Ameka Pb/Zn mineralized areas in Ebonyi State of the Lower Benue Trough of Nigeria (RMRC, 2006). Similarly, a considerably low value for Pb was obtained in the rest of the samples when compared with the critical and normal ranges for the metal in soil (Table 5), though the root and plant stem had more concentrations of the metal than the soils implying bioaccumulation. This may be due to the high absorptive ability and uptake of the metal by the *Frosobis africana* plant. On the other hand, higher concentrations of Pb above the WHO (1993) recommended range were detected in the water samples (Tables 4 and 6). These high values could be due to the geological nature of the area and the mining activities in the area. Pb is a widespread in soil, plant and water contaminant that could enter the soil from many sources. There is suggestive information about the role of Pb in hypertension. It has also been linked to kidney diseases and neurological damage; blindness and brain disorder have also been implicated (Hutton, 1987)

Zinc concentrations ranged from 0.07 – 39.11 mg/kg, 0.01–0.03 mg/kg, 0.08–3.21 mg/kg and 6.19 – 15.69 mg/L for ore, plant, soil and water samples (Tables 1, 2, 3 and 4). The result showed that the mines had higher concentrations of the metal than the rest samples. Zn metal is known to occur in nature as sphalerite (ZnS) in close association with Pb which mainly occur in the form of galena (PbS).The metals are usually mined together due to their strong association of occurrence (Elueze, 1982). The soil samples contained the metal in concentrations within the normal range (Table 5). The low content of the metal in soil could be as a result of its corresponding uptake by the plants within the vicinity leading to its depletion in soil. *Frosobis africana* plant root accumulated more of the metal than the stem (Table 3), which compares well with result reported by Abulude (2003) that plant roots accumulate higher concentrations of metals than the stem and leaves; however, the uptake of heavy metals varies widely depending on the plant specie being studied. Zn content in the water samples (Table 4) was exceedingly higher that the WHO (1993) standard guideline values of 3.0 mg/L (Table 6). The metal is not detrimental to health, but will impart an undesirable taste to drinking water, creates sand like deposits, for these reasons its concentration in drinking water has to be monitored. It can produce a barren area as a result of toxicity to vegetation area; the mobility of Zn in secondary environment is high in oxidizing acid and neutral waters (Worgu, 2000). The high concentration in water could be as a result of its mobility in the sampling media. The concentration of the metal in the sampling media was in the trend: mine > water > soil > plant.

The concentration of Cu varied with the different locations (Tables 1, 2, 3 and 4). Result indicated low concentrations in the mine. Similarly, low concentrations were observed in plant, soil and water samples which did not exceed their respective standard guideline ranges (Table 5 and 6). Copper is specifically adsorbed or ‘fixed’ in soil making it one of the trace metals which moves the least. A higher concentration of copper in the upper horizon of soil is usually an indication of addition from smelters, fertilizer, sewage sludge and other waste (Dragun, 1988). Most soils contain only 20 – 30 mg/kg total copper (Nabulo *et al.*, 2008). It is likely that Cu exists in most soils as $\mathrm{Cu}\,(\mathrm{H_2O})_6^{2+}$ ions adsorbed at mineral surfaces. However, the chemical activity of Cu is not constant and therefore, the plant uptake of Cu are not correlated with either amount in the various pools or the amounts removed by various means (Gilkes, 1981). The low concentrations of the metal obtained in the different sampling area may be due to the precipitation and surface adsorption processes which remove Cu as it is easily bound to Fe and Mn oxides leading to its removal and subsequent low concentrations (Gilkes, 1981). Low levels of copper are essential for maintaining good health while high levels can cause harmful effect such as irritation of the nose, mouth and eyes, nausea, vomiting, diarrhea and stomach cramps (WHO, 1993).

Nickel concentrations were very low in the mine samples with values that ranged from 0.00 – 0.02 mg/kg, 0.01–0.04 mg/kg, and 0.05–0.07 mg/kg for ore, soil and plant samples (Tables 1, 2, and 3). While the water samples (Table 4) showed higher concentration of the metal that exceeded the WHO (1993) standards for potable water of 0.02 mg/L (Table 6). Ni is a siderophike element with good mobility in oxidizing acid reducing environment, but immobile in alkaline pH 6.7 (Levinson, 1980). The concentration of the metals in soil and plant samples were quite low when compared with the normal and critical ranges (Table 5). This suggests that they were poorly available in the sampling media .A small amount of the metal is needed by the body to produce red cells but excessive amounts can become mildly toxic. Short term exposure to Ni is not known to cause any health problem, but long term exposure through consumption from plant, water and other sources can cause decreased body weight, heart and liver damage, and skin irritation (WHO, 1993).

Table 1: Result of metal analysis of mine samples (mg/kg)

Sample	**Elements**																
Location	**Pb**	**Zn**	**Ni**	**Cu**	**Mn**	**As**	**Ba**	**Cr**	**Ti**	**Fe**	**Ca**	**K**	**S**	**Si**	**Al**	**Sr**	**Mg**	**Zr**
ABN$_1$	82.47	0.07	0.02	0.10	0.06	ND	0.34	0.04	0.05	0.68	0.22	ND	ND	ND	ND	ND	ND	ND
ABN$_2$	ND	39.11	0.02	0.14	0.25	ND	ND	ND	0.06	7.27	0.14	0.02	8.89	8.89	0.42	0.06	1.21	ND
Mean	41.2	19.5	0.02	0.12	0.15	ND	0.17	0.02	0.05	3.97	0.18	0.01	4.44	4.44	0.21	0.03	0.60	ND
SD	±8.48	±1.92	±0.02	±0.12	±0.19	ND	±0.07	±0.02	±0.06	±3.98	±0.18	±0.01	±4.45	±4.45	±0.21	±0.03	±O.61	ND
CV%	20.5	9.80	100	100	1.26	ND	2.00	2.00	1.20	100	1.00	100	1.00	1.00	100	1.00	1.00	ND

Where: ABN$_1$ and **ABN$_2$ =** Mines samples; **ND =** Not detected

Table 2: Result of metal analysis of soil samples (mg/kg)

Sample	**Elements**																
Location	**Pb**	**Zn**	**Ni**	**Cu**	**Mn**	**As**	**Ba**	**Cr**	**Ti**	**Fe**	**Ca**	**K**	**S**	**Si**	**Al**	**Sr**	**Mg**	**Zr**
ABN$_3$	ND	0.03	0.04	0.06	0.38	ND	ND	ND	3.36	18.27	0.16	2.00	ND	18.51	8.09	0.03	ND	0.19
ABN$_4$	ND	0.03	0.12	0.05	0.12	ND	ND	0.02	3.95	28.31	1.06	0.47	0.44	12.29	6.51	0.05	ND	0.17
ABN$_5$	ND	0.02	0.04	0.04	0.12	ND	ND	0.09	0.39	23.07	0.78	0.83	ND	15.98	6.23	0.04	ND	0.19
ABN$_6$	0.05	0.01	0.01	0.03	0.26	ND	0.29	0.09	0.57	3.45	0.84	6.99	0.04	26.92	8.46	0.03	ND	0.13
ABN$_7$	0.08	0.02	0.01	0.04	0.05	ND	0.30	0.02	0.56	4.79	1.07	8.28	ND	27.44	8.89	0.04	ND	0.14
Mean	0.02	0.02	0.04	0.04	0.18	ND	0.29	0.07	1.65	15.5	0.78	5.76	0.44	20.2	7.63	0.03	ND	0.16
SD	±0.11	±0.09	±0.18	±0.18	±0.75	ND	±0.30	±0.15	±6.62	±62.3	±3.13	±23.0	±0.44	±80.9	±30.4	±0.16	ND	±0.66
CV%	55.0	45.0	4.50	4.50	41.6	ND	10.3	21.4	40.1	40.1	42.8	39.9	10.4	40.0	39.8	5.33	ND	41.2

Where: ABN$_3$ – ABN$_7$ = Soil samples; **ND =** Not detected

Table 3: Result of metal analysis of plant (*Frosobis africana*) samples (mg/kg)

Sample	**Elements**																	
Location	**Pb**	**Zn**	**Ni**	**Cu**	**Mn**	**As**	**Ba**	**Cr**	**Ti**	**Fe**	**Ca**	**K**	**S**	**Si**	**Al**	**Sr**	**Mg**	**Zr**
ABN$_8$	10.51	2.10	0.05	0.19	0.64	0.40	0.17	0.12	0.89	10.27	11.64	15.60	0.04	7.47	ND	0.37	0.60	0.39
ABN$_9$	3.21	0.88	0.07	0.37	0.22	0.10	0.45	0.15	0.17	1.43	29.23	14.61	0.40	ND	ND	1.01	0.48	0.04
Mean	6.86	1.49	0.06	0.28	0.43	0.25	0.31	0.13	0.53	5.85	20.4	15.3	0.22	3.83	ND	0.69	0.52	0.21
SD	±6.86	±1.49	±0.06	±0.28	±0.43	±0.25	±0.31	±0.14	±0.53	±5.85	±20.5	±14.9	±0.22	±3.64	ND	±0.70	±0.56	±0.22
CV%	10.0	10.1	10.0	10.0	100	100	10.0	1.07	1.01	10.0	10.4	9.70	10.0	9.50	ND	10.1	10.7	10.4

Where: ABN$_8$ and **ABN$_9$ =** Plant (root and stem) samples; **ND =** Not detected

The levels of aluminium, chromium and arsenic determined in all the samples were quite low, As was not detected in most of the samples while Al and Cr were not detected in only few samples (Tables 1, 2, 3 and 4). The concentrations implied that the metals are poorly distributed and may have no health implications to both plant and animals when compared to the values reported by Abulude (2003) and Asia *et al.* (2008) in soils with sewage sludge and effluents. Cr and As are known to have toxic effects. For example high concentrations of these metals in water causes severe respiratory irritation, lung cancer and kidney damages (Lafantaine, 1979).The values for manganese and barium were low and varied considerably among the samples. Mn was detected in all the samples while Ba was not detected in samples ABN_2–ABN_5 (Tables 1, 2, 3 and 4). Ba concentration in the water samples were above the WHO (1993) and EU (1999) standard guidelines for potable water of 0.30 mg/L (Table 6). The metal may have adverse effect on prolong consumption. The levels of Mn obtained compared well with the one obtained by Madu *et al.* (2007) for the analysis of some heavy metals on selected soils in Keffi, Nigeria. High levels of Mn are known to occur in soils rich in iron oxides or hydroxides (Alina *et al.*, 1985).

The concentrations of Ca, K and S in the samples levels were very low except for the plant samples (Table 3) where Ca and K were considerably high. The concentration in the plant (*Frosobis africana*) may be due to the high absorptive capacity for these metals by the plant resulting in their accumulation in both the root and stem. Since plant uptake of metals is affected by the competitive interactions among heavy metals, these appeared to be reduced metal uptake by the plant as the case is in this result. Absorption of metals by plant roots can be both passive (diffusion along concentration gradient) and active (diffusion against the concentration gradient). The type of uptake varies among different metals. Also, absorption mechanism can vary between different metals and metal ions that are absorbed by the same mechanism are likely to compete with each other (Nabulo *et al.*, 2008).

Iron and silicon are the major constituent of virtually all soils (Alina and Henry, 1985). The values obtained for these metals (Tables 1, 2, and 3) indicated their low concentrations within the tolerance limits with only few samples showing significant concentration of the metals (Table 5). The concentrations of these metals are affected by the geological nature of the soil, ore formation and leaching processes. The ubiquitous nature of Fe makes it to be the second largest metal and the fourth element naturally occurring in the environment (McBride, 1994). The values of strontium, zirconium, titanium and magnesium concentrations were low except the soil samples which had varied concentration of Ti in small amount while Mg was not detected in most samples. However, none these metals was detected in the water samples (Tables 1, 2, 3 and 4). A critical assessment of these metals concentration revealed that these concentrations in soils exceeded those of the plant and mines which is an indication of the fact that the soil are reservoirs of metals at the same time acting as end pollution reservoirs arising from different sources (McBride, 1994).

Concentrations of metals in the water samples (Table 4) showed that cadmium and molybdenum values were above the WHO (1993) respective standards of 0.003 mg/L and 0.07 mg/L for potable water (Table 6). Cobalt, silver and uranium were in low concentrations, respectively (Table 4). These metals that have high concentrations could pose severe health risk to their consumers. Heavy metals toxicity is known to pose a severe threat to humans and the environment (WHO, 1993).

Table 4: Results of metal analysis of water samples (mg/L)

Elements	Samples		Mean	SD	CV%
	ABN$_{10}$	**ABN$_{11}$**			
Pb	0.25	0.15	0.20	±0.20	10.0
Zn	15.69	6.19	10.94	±10.9	10.0
Ni	0.03	0.04	0.03	±0.04	13.3
Mn	0.09	0.13	0.11	±0.11	10.0
Mo	5.19	19.11	12.2	±12.1	9.90
U	2.08	1.07	1.57	±1.50	9.50
Cu	ND	0.01	0.01	±0.00	0.00
Cr	0.02	0.02	0.02	±0.22	10.0
Co	0.03	ND	0.03	±0.00	0.00
Cd	0.02	0.01	0.10	±0.22	2.20
Ba	3.05	0.34	1.69	±1.70	10.0
Al	0.13	0.13	0.13	±0.13	10.0
Ag	0.01	ND	0.01	±0.00	0.00
As	ND	ND	ND	ND	ND

Where: ABN$_{10}$ and **ABN$_{11}$ =** Water samples; ND = Not detected

Table 5: Normal and critical range of metals in soil and plant (mg/kg)

Elements	In Soil	Normal Range In Soil	Critical Range In Plant	Normal Range In Plant A	Critical Range In Plant B
Pb	2 – 300	100 – 400	0.2 – 20	30 – 300	NS
Zn	1 – 900	70 – 400	1 – 400	100 – 400	100 – 900
Ni	2 – 750	100	0.02 – 5	10 – 100	8 – 220
Mn	20 – 10000	1500–3000	20–1000	300 – 500	100 – 7000
Cu	2 – 250	60 – 125	5 – 20	20 – 100	5 – 65
As	0.1 – 40	20 – 50	0.02 – 7	5 – 20	1 – 20
Ba	625	NS	NS	NS	NS
Al	10000–300000	NS	NS	NS	NS
Fe	7000 – 550000	NS	NS	NS	NS

NS = Not specified;

Source: Kabata–Pendias & Pendias (1984)

Table 6: World Health Organization parameters of potable water (mg/L)

Elements	WHO
Pb	0.10
Zn	3.00
Ni	0.02
Mn	0.50
Mo	0.07
U	2.40
Cu	2.00
Cr	0.05
Co	NM
Cd	0.003
Ba	0.30
Al	0.20
Ag	NM
As	0.07

Source: WHO (1993)

CONCLUSION

The mine showed higher concentrations of Pb and Zn minerals in exploitable quantities. Pb was not detected in some samples .The average concentrations of the metals in the sampled soil varied greatly as one approaches the sampling area with a decrease in concentration in the trend: Fe Si > Ba > Al > K > Zr > Mn > Cr >Ti > Pb > Zn > Ni while for the *Frosobis africana* plant the trend was: Pb > Zn > Cu > Ni > Mn > As > Fe > Cr > K > Ti > Sr > Ca > Ba > S > Si > Zr. In general, low concentrations of these metals were observed in the soils when compared to that of the plant. This may be due to the uptake of these metals by plant during growth and development as well as vertical leading due to induce infiltration. The level of the metals that lied within the normal range for plants may become significantly high with time and continual consumption of the plant growing around these locations could result in their accumulation in the body of their consumers thereby posing health risk in future .Though a more rigorous mechanistic approach is however, needed to understand the mechanism of absorption of these metals by plant. At present there is no known reported case of metal poisoning arising from the direct consumption of water from Abuni town, Nasarawa State, Nigeria. However, the result obtained is a clear indication that the water sources are under threat as such stricter environmental law is to be observed in this regard and adequate measures taken to prevent this pollution which has a long–term effect on consumers.

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