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Elemental Assay of Gold Ore Matrix from Nigeria Using Proton Induce X-Ray Emission Technique

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A B S T R A C T

The inspiration for this work was the recent underdeveloped growths observed in children in gold mining areas. Observed symptoms in children include: Delay in development, Learning difficulties, Weight Loss, Abdominal pain, Hearing loss, Seizures, Reduced sperm count and Miscarriage or stillbirth in pregnant young girls and boys. These symptoms are largely speculated to be caused by lead poisoning. More so that most of these illnesses are alien to these areas until the advent of gold mining. The rock boulders believed to contained gold are transported to living quarters where they are crushed and gold extracted. Samples are collected from crushing sited and gold extracting areas for analysis. Chosen method of analysis was Proton induced x-ray emission because of its non-sample destruction and not harmful to its immediate environment. Results obtain include the following: Sample E has lead concentration of 50332 ppm as the highest while sample Q has 59 ppm as the least of the samples collected. Therefore it can safely be concluded that lead presence in some samples are way too high for human beings: particularly children and Teens. Lastly, Gold is equally observed to be abundant in some samples: sample P has 10279 ppm of gold.

Keywords: ppm, lead, assay, proton induced x-ray emission technique.

1. INTRODUCTION

Petroleum being the mainstay of Nigerian economy has being having challenges lately: (1) in the international market, (2) disruption and sabotage in oil production due to agitations at areas where exploration are taking place. As if these are not enough headache for the industry, there is the issue of political instability engendered by the socioeconomic problems in the country. These have prompted the government to begin to look for other sources of revenue (foreign exchange) to ameliorate the economy. One of the sources of foreign exchange considered is mining. The mining was of two ways: artisanal and multinational companies.

At artisanal levels, international ethical mining ethos are not observed and so the health issue that came to the fore(DC, 2012). Alien sicknesses that are not common to the areas of mining began to surface. These illnesses were attributed to superstitious believe. Until recently when these illnesses began to be associated with houses and areas where mining and extraction of gold are undertaken. The presence of heavy metals in Gold ores is a severe tread to human health especially at elevated level (Samaila, 2018). This then informed the collection of samples from these areas for elemental analysis. The method of analysis employed was proton induced x-ray emission (PIXE) because of its non-destruct of the samples as well as not harmful to the immediate environs.

2.0 Material and Method

2.1 Material

1. Fourteen geological samples
2. Global Positioning System (GPS)
3. Hillquist thin section machine
4. Chemflex TM
5. GUPIX Software

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2.2 Method

Fourteen samples were collected. They were then prepared to the level they can easily be interrogated by PIXE technique. These preparations include breaking and grinding the boulders, and then mixed thoroughly to attain homogeneity. After thorough mixing of the powdered materials with some binding agent such as chemflex TM, pellets are prepared with a hydraulic press. Fourteen pellets are made and thereafter fastened to the specimen holder (special ladder akin to a slide projector, which enables the analysis of many (100) in sequence). The aluminium foil paper was placed behind the pellets before it was fastened to the special ladder to avoid the masking tape sticking to the pellets. It was then meticulously lowered in to the specimen chamber. Once the specimen was securely placed in the specimen chamber, the chamber is made vacuous by a special vacuum pump affixed to the chamber.

2.3 Theory of PIXE

The formula for calculating concentration [Y (Z)] in PIXE is given as:

$$Y(Z) = \frac{N_{av}\omega_Z b_Z t_Z \epsilon}{A_Z} N_P C_Z \int_{E_2}^{E_1} \sigma z \frac{EyT2\ (E)}{S_M(E)} dE \qquad 2.1$$

Where Np is the number of protons, Nav Avogadro's number, and σz (E) the K-shell ionization cross section for the proton energy E corresponding to depth x. The number of K X-rays in a particular spectral line is then obtained via the fluorescence yield ωk,z and line intensity fraction bk,z.

$$\frac{CZ\ (SP)}{CZ\ (ST)} = \frac{Y_Z\ (SP)}{Y_Z\ (SP)} = \frac{I_{Z_{ST}}}{I_Z\ (ST)} \qquad 2.2$$

Standards are usually single elements or very simple compounds containing the elements of interest or their near neighbours in the chart of nuclides. The merit of this ratio process is its cancellation of instrumental factors such as solid angle, efficiency, and calibration factors for charge integration Aung*et al.,* (2002). This is important given the practical difficulties in obtaining accurate knowledge of the detector's line shape and intrinsic efficiency at the low X-ray energies characteristic of the light elements that are so often the major elements in environmental specimens Sven *et al.,* (1995).

3.0 Results and Discussion

3.1 Quality Control

Table 3.1: nist 1515 (Apple Leaves)

Symbol	Concentration (ppm)	Cert. Values (ppm)
Si	262307.4	
S	1805.3	1800*
Cl	580.7	579
K	16119.4	16100
Ca	15264.0	15260
Ti	21.2	
Mn	54.0	54
Fe	83.0	83
Cu	5.7	5.64
Zn	12.5	12.5
Rb	10.6	10.2
Ba	49.0	49

Table 3.1 shows the results of irradiation carried out on standard (NIST) 1515 (Apple leave). The table contains the analyte, standard and cert. values. The observation from the table reveals that the cert. values of the analyte silicon (Si), Copper (Cu), iron (Fe) and rubidium (Rb) respectively are good, depicting efficacy of the technique. Analyte chlorine (Cl), andzin (Zn) are also present. Observation shows that PIXE is efficient for the analysis.

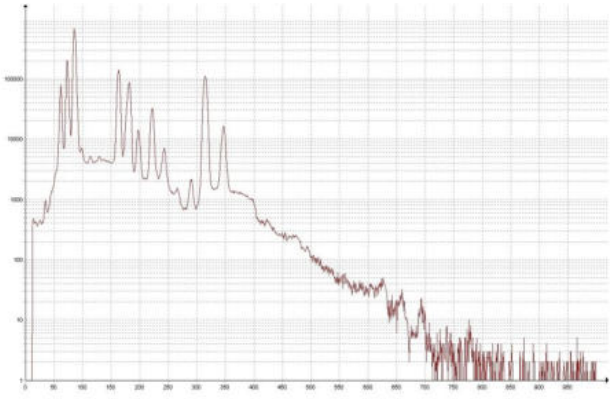

Figure 3.1: Elemental energy peaks spectrum of sample 1.

The horizontal axis depicts transition energy peaks of elements which is unique to an element. Every element has its unique transition energy as a signature only it has. The vertical axis represents the numbers of transitions each element in a particular energy peak has undertaken. The bigger the spike the more the abundance of that element in the sample. The computer software has the energy peak of all elements, hence it can detect the presence of an element and its abundance in a sample.

Table 3.2: Analyte concentration in part per million (ppm) of fourteen samples

Sample	Analyte Conc. in ppm									
	Pb	**Au**	**Zn**	**Ta**	**Ni**	**As**	**Nb**	**Hf**	**Y**	**Sr**
1	46460	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2	15932	BDL	BDL	BDL	7	BDL	BDL	33	BDL	BDL
3	5379	BDL	BDL	174	BDL	BDL	91	BDL	69	86
4	128	1719	133	BDL	BDL	BDL	65	48	82	157
5	50332	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	39
6	656	BDL	172	BDL	BDL	BDL	428	79	115	34
7	11216	BDL	95	BDL	BDL	BDL	BDL	BDL	109	BDL
8	32087	BDL	BDL	205	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	433	BDL	BDL	73	406	BDL	423	105
10	18591	BDL	77	BDL	BDL	BDL	BDL	79	BDL	63
11	40918	BDL	22	BDL	BDL	BDL	BDL	BDL	BDL	61
12	165	533	264	BDL	BDL	BDL	BDL	210	137	546
13	BDL	10279	304	BDL	BDL	BDL	438	228	508	108
14	60	BDL	293	BDL	BDL	BDL	140	98	95	156

BDL = below detection level

From the above table, Table 3.2it is obvious that lead (Pb) is present in the ore matrix in quantity that will be inimical to humans and animals living around that area. It is only in sample 13 that lead is below detection. Keen observation indicated that samples 4, 12 and 13 have presence of gold: In fact sample 13 looks promising because gold concentration is high. Comparing these values with world health organisation (WHO, 2011) that

$\frac{3.5\mu g}{dL} = 0.035ppm$ of lead in the blood in children is harmful.

Conclusion

This work has confirmed the work done by *Bello and Funtua (2012)* in which they observed that Pb is in excess of normal occurrence in some northern Nigeria geological matrix. They observed that even though the gold ore is promising but they do come with concomitant hazard. Sample 9 contain the element arsenal (As). This element is indeed very harmful even in small quantity to human beings.

Reference

Aung, Z. O., Khin T.W., Lam, N., and Sonoko, D. B., (2002). Toposequential variation in soil properties and crop yield from double-cropping paddy rice in Northwest Vietnam

Abdullahi, B., and Funtua I.I. (2012). Characterization of Lead (Pb) poisoning gold ores from N-W Nigeria using PIXE technique. *The IUP India Journal Physics*, vol. 1, ISSN 0974-1380.

DC (Centers for Disease Control and Prevention). Response to the Advisory Committee on Childhood Lead Poisoning Prevention Report, Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. M or b Mortal Wkly Rep MMWR 61:383. 2012. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6120a6.htm

Sven, A. E., John, L. C., Klaus, G. M. (1995). Particle-induced X-ray Emission Spectrometry (PIXE). *Nuclear Science Application,* 133, 65-78.

SAMAILA B. (2018). Trace Element analysis by PIXE in tailings of Gold Ore samples of Maga Mining Area of Danko-Wasagu. *International Journal of Interdisciplinary Research and Innovations.* Vol. 6, Issue 3, pp: (594-597) Available at www.researchpublish.com

WHO (World Health Organization). Safety Evaluation of Certain Food Additives and Contaminants, *Geneva: WHO*. 2011b. Available: http://whqlibdoc.who.int/publications/2011/9789241660648_eng.pd