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Measurement of Environmental Radioactivity in Mining Dumpsites in JOS Metropolis, Plateau State, Nigeria

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Abstract
The annual activity concentrations of radiation exposure dose rate from dumpsites in the area of Tin Mining companies in Jos metropolis were measured using a portable radiation meter (Scientific Rad G-10). The activity concentration of radiation exposure dose rate obtained in area through radiation meter revealed that the dumpsites record mean annual radiation dose rate of 4220.54+48.44 $\mu Sv / yr$ *in 2019. This mean value is higher than the average natural radiation in some cities in Nigeria and the Nigeria mean terrestrial annual effective dose equivalent of 0.29mSv/yr; (1990) recommended terrestrial dose to the public (1mSv/yr) and UNSCEAR standard of 2.4mSv/yr. Due to high radiation dose rate in the area, radiation related illness is likely to be public found among the inhabitant of Jos City. Environmental radioactivity sensitization programme is therefore recommended to create awareness on the possible health effects and to provide information that will assist/guide radiation protection scientist and environmental/radioactive waste managers on the appropriate waste management strategies.*

Keyword: *Mining terrestrial, Dose rates, Health &Environmental Effect.*

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I. Introduction

IT is a known fact that radiation is present everywhere on the surface of the earth and has been in existence since the formation of the earth (Avwiri, 2014). In addition, day to day human activities in the environmental, which produce different forms of radiations, have made the flora and fauna (most especially man) to be exposed to these radiations (Avwiri, 2014). Most radiation in the world is caused naturally through cosmic and terrestrial sources. Most of human exposure to natural radiation comes from radon in the rocks and soil.

The establishment of tin mining companies in the early 1980's in Nigeria contributed immensely in the development of states endowed with solid minerals. The companies generated revenue for the various state Government as well as the Federal Government. They also provided employment for the inhabitants of the immediate environment for the nation at large.

The occurrence of cassiterite and columbite in Plateau state brought intense minning activities in the early growth and development of Jos city (Sombo, 2016). However, tin minning has caused extensive environmental degradation. Amongst these are uncontrolled tailing heaps, increase in the number of mine ponds, dams and devasted landscape (Sombo, 2016). The tailing (Industrial waste) heaps contain minerals like magnetite, Zircon, ilmenite, Manozite, silicates, theorite and amethyst etc. (Ngyang, 2002). Zircon and theorite present in the tailing (waste) contain radon and thorium, which are hazardous to human health. Radon gas a radium daughter, also it's produced natural gas also enhanced through the animal processing seeps out of its ores into the atmosphere or into ground water and can accumulate within dwellings. It has a short half life of four (4) days and decays into other solid particulate radium series radioactive nuclides. When these particulates are inhaled they remain lodge in the lungs causing continued exposure. The more the radiation dose a person receives, the greater the chance of developing radiation related health effects like cancer, Leukemia, eye cataracts, erithemia, hematological depression and incidence of chromosome aberrations (Ovwiri and Ononugba, 2012).

Geology of the Study Area

The use of the tailings for baking and frying as well as for plastering of houses by the inhabitants of Jos Plateau could result in exposure to radiation from naturally occurring radioactive materials within these tailings (waste) and can contaminated soil in the vicinity of the dumpsites (Sombo, 2016).

This work seeks to assess the annual radiation dose rate enumerating from dumpsites from dumpsites within Jos city in order to profer appropriate control measures aimed at avoiding the outbreaks of radiation related sickness or illments.

Study Area

Jos is a city in the Middle Belt of Nigeria. The city has a population of about 900,000 residents based on the 2006 census. Popularly called "J-Town", it is the administrative capital and largest city of Plateau State. The city is located on the Jos Plateau at about 1,238 metres or 4,062 feet above sea level.During British colonial rule, Jos was an important centre for tin mining and is the trading hub of the state as commercial activities are steadily increasing.

II. Methodology

Radiation dose rate from 10 dumpsites in the vicinity of tin minning area of Jos Plateau were measures with the aid of portable radiation meter (Scientific Rad G-10) held at about 1m above sea level. Ten readings were taken per sampling site and the average values for the respective sites were obtained from the repeated readings to account for error.

III. Results and Discussion

Table 1: Annual Dose Equivalent rate from Dumpsite in Jos Metropolis

Site Code	Sites	Dose Equivalent ($\mu Sv/yr$)
A	A.M Dumpsite Ltd. Dadi Kowa	6571.87± 13.7
B	Guman Minning Co. Ltd. Utan Rd. Jos	8813.40±552
C	D.Gyang Co. Ltd. Utan Rd. Jos	2509.61±43.5
D	Colmin Mining Co. Ltd. Jos	2836.85±90.1
E	D.K Ejin Koren Nig. Ltd. Jos	5133.53±47.9
F	Climi Mines Ltd. Jos	1192.34± 37.8
G	Eze walu Nig. Ltd. Bukuru	3491.30±43.9
H	Dambo Mines Ltd. Gindi Akwati	811.80±11.6
I	Geo Mineral & Resources Ltd. Bukuru	3489.02±72.7
J	Don Chyke Miner Ltd. Bukuru	7354.82±68.0

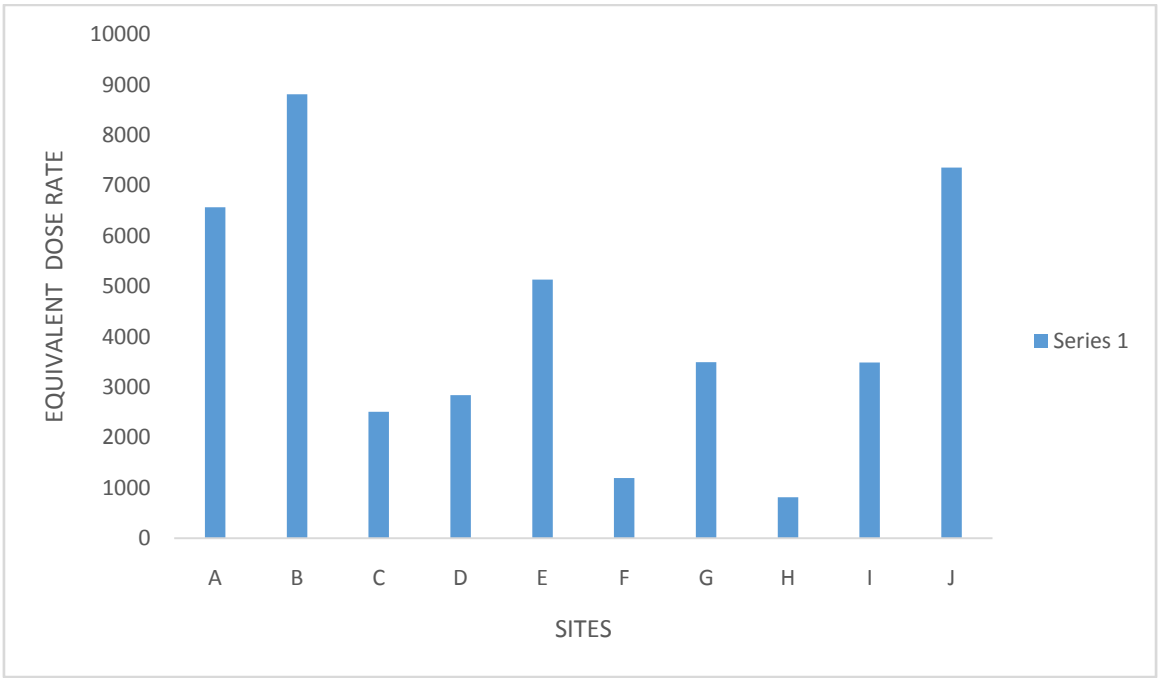

Fig. 1.: Graph of Annual Equivalent Dose Rate Vs Dumping sites

Table 2: Natural Radiation in some Nigerian cities

City	Dose equivalent ($\mu Sv/yr$)
Lagos	943.2 ± 35.9
Ijebu-Ode	1279.0 ± 14.0
Ibadan	1146.9 ± 20.1
Akwa	946.0 ± 42.7

Benin City	1249.8 ± 78.8
Owerri	1009.8 ± 28.1
Port Harcourt	1073.6 ± 39.1
Enugu	1026.6 ± 148.6

(Agba & Sadiq, 2014.)

IV. Result And Discussion

The mean annual exposure dose rates at the various dumpsites in the vicinity of mining companies in Plateau State are reported in table 1 and in fig. 1 reveal high annual radiation exposure of 8813.40 ± 55.3, 7354.82±68.0, 5133.53± 47.9, 3491.30± 43.9 and 3489.02± 72.7 $\mu Sv/yr$ for dumpsites within the vicinity of Guman Mining Company, minor metals and minerals Ltd, Don Chyke Miner Ltd., D.K Ejin Koren Nig. Ltd. Jos, Eze Walu Nig. Ltd. Bukuru and Geo Mineral & Resources Ltd. Bukuru respectively the presence of traces of Uranium, Pottassium and Thorium (^{235}U, ^{238}U, ^{40}K and ^{232}Th) which are usually present in the upper granite crust of Jos Plateau may also contributed significantly in addition to the size and concentration of radionuclides in the tailing (dumpsites). The lowest annual dose rates of 811.80±11.6 and 1192.34±37.8 $\mu Sv/yr$ from the vicinity of Dambo mines Ltd and Climi mines Ltd Jos respectively.

The mean annual dose rates from the dumpsites were compared with the natural radiation level of eight cities in southern Nigeria reported by Ramli *et al.,* (2014) (table 2). It was found that the are annual dose rates from the dumpsites were higher than the natural radiation dose equivalent of the eight cities; the UNSCEAR recommended limit of 2400$\mu Sv/yr$; the Nigeria average annual dose rate of 24.6 $\mu Sv/yr$, 24.5 $\mu Sv/yr$ and 98.0 $\mu Sv/yr$ reported. Obed *et al.,* (2005). Odunaike *et al.,* (2008); and the ICRP (1990) limit of 100 $\mu Sv/yr$. The Uranium, potassium and thorium series are emitters of gamma and beta radiations (Glowaik, 1980). Some radiations present little external hazard, since it is unable to penetrate the dead skin layers. However, if ingested can cause internal ionization. This can lead to cell damage, cell death or development of cancer (Jozannov-Stankov, 2003), Russel & Bradley, 2007; UNSCEAR, 1993 and AAMP, 1992). Radiation exposure from very high background radiation areas (VHBRA) is predominantly from Radon gas. Buildings from areas with high radiation dose rate should be well ventilated to reduce the risk of radiation related diseases.

The estimation of exposures to ionizing radiation is an important goal of regulatory authorities and radiation pollute scientists. The data generates in environmental radioactivity assessments/monitoring provide base line values of exposure to radiation in an environment where mining activities are carried out and may be useful for authorities in the implementation of radiation protection standards for the general population in the country (Agba and Sadiq, 2011; Ibrahim *et al.,* 2013).

V. Conclusion

The study determined the annual dose rate from main waste dumpsites in the neighborhood of mining companies in Jos-Plateau State. The annual dose rate ranges from 811.80±11.6 $\mu Sv/yr$ to 8813.40± 55.2 $\mu Sv/yr$. The average annual dose rate from the dumpsites is above the ICRP, (1990) of 100 $\mu Sv/yr$, UNSCEAR safety limits of 2400 $\mu Sv/yr$ and Nigeria average annual dose rate 98.0 $\mu Sv/yr$ reported by Obed *et al.,* (2005) and Odunaike *et al.,* (2005). The average equivalent dose rates for all the dumpsites have been measured using radiation meter (Rad G-10). Based on these findings, the potential risk posed by wastes in most of the studied dumpsites to the environment (human, plants and animals) is higher except for few locations where the risk due to radiation is significant and may be increasing with time. Therefore, it is recommended that as a matter of urgently the inhabitants and workers (miners) should avoid using the tailings for building and household projects so as to avoid the risk associated of radiation exposure

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