RADIOLOGICAL ASSESMENT OF MINING ACTIVITIES IN SOME PARTS OF OYO STATE, SOUTHWESTERN NIGERIA

A PRESENTATION AT THE

NINTH INTERNATIONAL SYMPOSIUM ON NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM IX)

BY:

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INTRODUCTION

- Radiation is the process in which energetic matter travels through vacuum. Radiation is commonly used in reference to ionizing radiation, also called ionization, while non ionizing radiation is used in reference to radio waves and visible light.
- In the area of mining, occupational radiation exposure of miners and populations living where they mine are specific concern. Miners are exposed to airborne radon (^{222}Rn), thoron (^{220}Rn) and their short-lived decay products, long-lived radionuclides in ore dust, and to external gamma and beta radiation (Shittu *et al.*, 2015).

INTRODUCTION CONTD

- The radiation exposure of the population living in the neighborhood may result from: (i) leached activity which may be directly ingested through drinking water or may indirectly enter the food chain by uptake through vegetation, fish, milk and meat, (ii) an enhanced external radiation background in the area, and (iii) higher radon levels due to ground emanation.
- In Nigeria, there is a general lack of information regarding fluxes and doses from the non-nuclear industries. Therefore, this research was necessitated to measure the radionuclides in minning sites.

RESEARCH OBJECTIVES

The purpose of this study is to:

- (i) estimate the activity concentration in the soil found in the mining sites.
- (ii) assess radiological hazard parameters due to mining activities in some part of Oyo State, Southwestern Nigeria

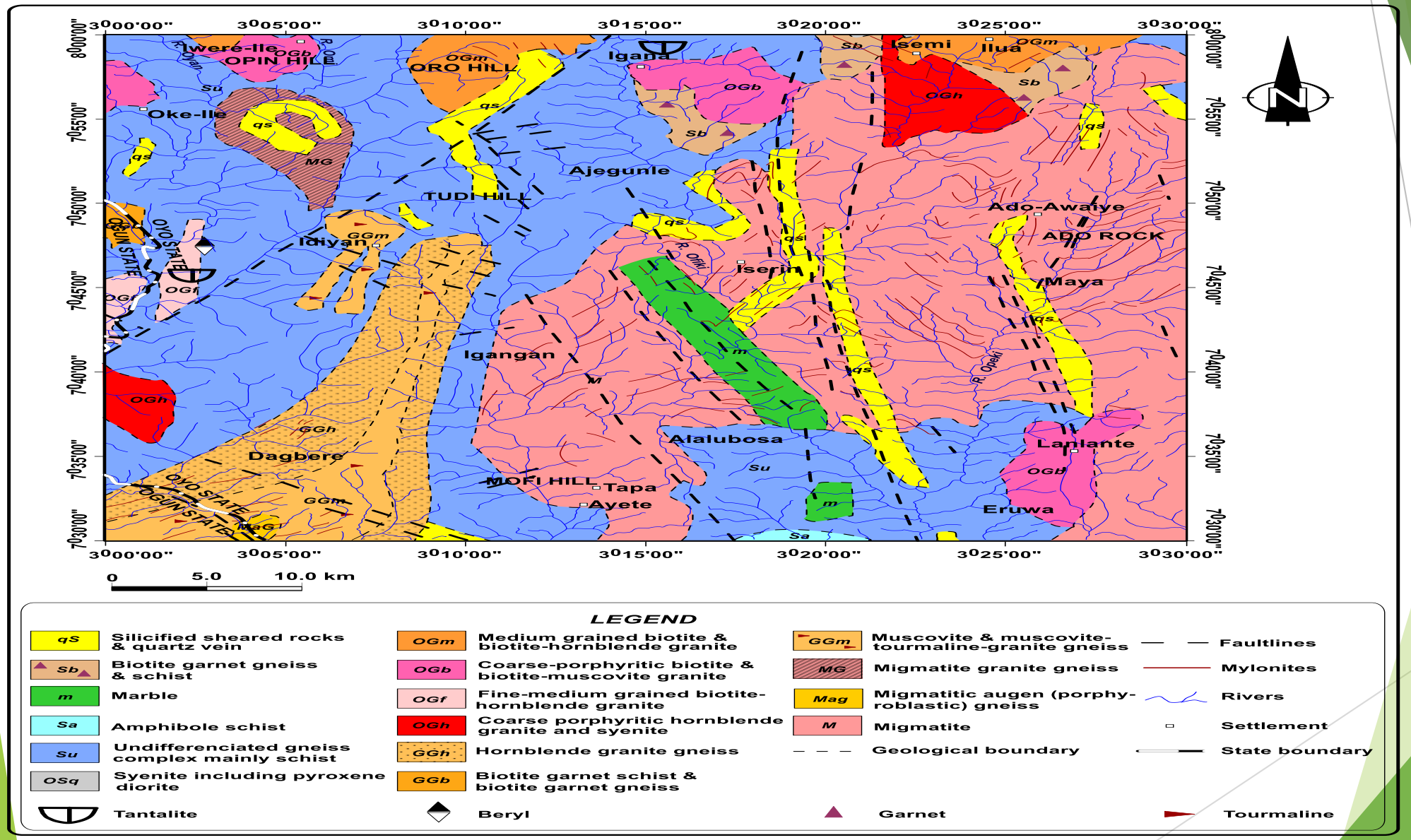
Materials and Methodology

Location and geology of study area

The study area covers three Local Government Area of Oyo state, south western Nigeria and it is located within iwajowa, ibarapa north, ibarapa south. Oyo state is bounded in the West by Benin Republic, in the South by Ogun state, in the North by Kwara and Osun State and in the East by Osun/ Ondo state. It occupies a total land area of 10 km^2 with latitude between 7^0 30N and 8^0 00N and longitude between $3^0$2'24"E and $3^0$2'28"E. The area is almost divided into two parts by the River Oyan which flows throughout the map area from north to south forming the major drainage of the area.

Oyo state is located in the southwestern part of Nigeria and is underlain by three lithological units of the crystalline basement complex which belongs to the Precambrian Basement Complex and is noted to be endowed minerals which are the precious metals, semi-precious metals and gemstones such as tantalite, beryl and tourmaline. Also industrial minerals and building aggregates such as sillimanite, clay, talc, granites, sand and gravels abound in the state

MAP OF THE STUDY AREA



Sample collection and Preparation

- A total of 20 soil samples collected from the mining sites were collected from the study area and analyzed. Samples were collected from 4 mining sites with five samples per pit at a depth of about 50-100cm with the coordinate recorded with the aid of global positioning system(GPS). 200g of each samples was air dried to remove moisture for a week, after which it was pulverized into fine powder for greater surface area using a mini mortar and pestle and sieved with a 2mm mesh to achieve homogeneity. The prepared samples were sealed in a plastic container for 28 days to achieve secular equilibrium

Sample analysis

- Soil samples were subjected to spectrometric analysis using a thallium activated Sodium iodide NaI(TI) detector connected to ORTEC 456 amplifier. Canberra vertical high purity 2″×2″ detector was connected to a computer program MAESTRO window that matched gamma energies to a library of possible isotopes. The cylindrical plastic containers holding the samples were put to sit on the high geometry 7.6 cm x 7.6 cm NaI(TI) detector. The detector was shielded by 15cm thick lead on all sides and 10cm thick on top. The energy resolution of 2.0 kev and relative efficiency of 33% at 1.33Mev was achieved in the system with the counting time of 10,800 seconds to reduce statistical uncertainty.

Table 4: Activity Concentration of naturally occurring radionuclides and Radium equivalents

S/Nfvs	SAMPLE CODE	K(Bq/kg)	Ra (Bq/kg)	Th(Bq/kg)	Raeq(Bq/kg)
1	ABUISE1B	540.69±12.12	BDL	113.37±19.24	203.75
2	ABUISE2B	606.44±7.30	2.81±1.11	BDL	49.511
3	ABUISE4A	147.14±14.98	20.87±2.32	112.39±8.47	192.92
4	ABUISE4B	610.31±8.48	BDL	68.51±12.03	144.96
5	ABUISE3A	599.67±6.57	BDL	121.17±10.45	219.44
6	AIYETE1	449.80±14.81	BDL	BDL	34.63
7	AIYETE2	456.56±11.08	BDL	28.53±2.34	75.95
8	ABUISE3B	266.08±23.09	BDL	BDL	20.48
9	AKOYA1	498.14±7.62	15.87±2.04	56.81±5.28	144.67
10	AKOYA2	503.94±6.57	BDL	BDL	39.31
11	AKOYA3	259.31±9.01	6.27±1.22	256.71±25.20	393.34
12	AKOYA4	391.78±8.72	4.73±1.18	47.06±5.20	102.20
13	IWERE1	136.509±35.19	BDL	BDL	10.51
14	IWERE2	272.849±12.25	BDL	31.18±1.56	26.45
15	IWERE3	159.716±13.70	BDL	71.43±3.55	114.45
16	IWERE4	208.063±11.25	BDL	BDL	16.02
	MEAN	381.69	3.16	56.70	111.20
	UNSCEAR	400	30	35	370

Table 5: Radiological parameter values for External Hazard index, Internal, Hazard Index, Representative Gamma Index and Excess Life Cancer Risk

S/N	SAMPLE CODES	External Hazard index	Internal Hazard Index	Representative Gamma Index	Excess Life Cancer Risk
1	ABUISE1B	0.55	0.55	1.49	1.20
2	ABUISE2B	0.13	0.14	0.42	0.33
3	ABUISE4A	0.52	0.57	1.36	1.09
4	ABUISE4B	0.39	0.39	1.09	0.87
5	ABUISE3B	0.59	0.62	1.61	1.30
6	AIYETE1	0.09	0.09	0.29	0.23
7	AIYETE2	0.20	0.20	0.58	0.47
8	ABUISE3B	0.05	0.05	0.17	0.14
9	AKOYA1	0.36	0.40	1.00	0.80
10	AKOYA2	0.10	0.10	0.33	0.26
11	AKOYA3	0.16	0.17	2.78	2.25
12	AKOYA4	0.27	0.28	0.76	0.61
13	IWERE1	0.02	0.02	0.09	0.07
14	IWERE2	0.07	0.07	0.21	0.17
15	IWERE3	0.30	0.30	0.82	0.66
16	IWERE4	0.04	0.04	0.13	0.10
	MEAN	0.24	0.25	0.82	0.65
	UNSCEAR	1.00	1.00	1.00	1.00

Table 6:Radiological parameter value for Absorbed Dose Rate, Annual Effective Dose and Annual effective dose.

	SAMPLE CODE	D ($nGyhr^{-1}$)	AEDE ($mSvyr^{-1}$)	AGDE ($mSvy^{-1}$)
1	ABUISE1B	98.30	0.34	643.66
2	ABUISE2B	27.27	0.09	199.12
3	ABUISE4A	89.64	0.31	580.51
4	ABUISE4B	71.59	0.25	478.02
5	ABUISE3A	106.00	0.37	694.79
6	AIYETE1	19.34	0.06	141.23
7	AIYETE2	38.52	0.13	262.63
8	ABUISE3B	11.44	0.04	83.54
9	AKOYA1	65.810	0.23	442.96
10	AKOYA2	21.88	0.07	159.81
11	AKOYA3	83.77	0.64	173.87
12	AKOYA4	50.02	0.17	234.37
13	IWERE1	5.86	0.02	42.86
14	IWERE2	14.21	0.04	101.73
15	IWERE3	54.16	0.18	348.76
16	IWERE4	8.94	0.03	65.33
	MEAN	47.92	0.18	297.07
	UNSCEAR	55.00	0.46	300

Result and Discussion

- Activity concentration of potassium-40 ranges between 136.50±35.19 Bq/kg to 610±8.48 Bq/kg with a mean value of 381.69 ±12.53 Bq/kg .
- Radium ranges between BDL and 20.87±2.32 Bq/kg with an average value of 3.16.18±1.91 while the values of thorium is between BDL and 256.71±25.20 with a mean value of 56.70±8.78 Bq/kg.
- The result obtained shows that the mean value of potassium is lower than the standard value of 400 Bq/kg.
- The average value of radium is lower than the world standard of 30 Bq/kg while the thorium mean value is higher than the standard value of 35Bq/kg.
- Radiological parameters measured is below the world average value.

Radionuclides indices

- The absorbed dose rates due to the terrestrial gamma rays are in the range of 5.86 to 217.48 $nGyh^{-1}$ with an average value of 58.06 $nGyh^{-1}$. The mean value is higher than the world average value of 55 $nGyh^{-1}$(UNSCEAR, 2000).
- The annual effective doses are in the range of 0.02 to 0.76 $mSvyr^{-1}$ with an average of 0.078 $mSvyr^{-1}$ for the soil samples and from 0.09 to 0.11 $mSvyr^{-1}$ with an average value of 0.20 $mSvyr^{-1}$ which are significantly lower than the world average value of 0.460 $mSvyr^{-1}$ (UNSCEAR, 2000).
- The annual Gonadal dose equivalent values range between 42.86 and 1173.87 $mSvyr^{-1}$ with a mean value of 385.82 $mSvyr^{-1}$.The mean value is higher than the recommended value of 300 $mSvyr^{-1}$(UNSCEAR, 2000). The external radiation hazard index ranged from 0.02 to 1.06 with an average value of 0.32 while internal hazard index ranged between 0.02 and 1.07 with an average value of 0.33.

Conclusion

- From the results obtained, the Activity concentration of radionuclides of naturally occurring radionuclides shows that the study area is within the permissible values of radionuclides
- Radiological parameters measured are also within the permissible limit. These results can serve as a baseline values for further studies in the study area

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