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ROCK-BORNE RADIUM EQUIVALENT IN EKITI STATE

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ABSTRACT

The concentrations of natural radionuclides, namely ^{40}K, ^{238}U, and ^{232}Th, in the rocks around Ekiti State, were measured using a highly sensitive γ-ray spectrometric system. Twenty four (24) samples from different towns were analysed and the mean radioactivity concentrations obtained were 719.10, 22.40 and 23.10Bqkg^{-1} for ^{40}K, ^{238}U and ^{232}Th respectively. The mean radium equivalent for the rocks samples is assessed to be 112.48Bqkg^{-1}.This is lower than the minimum standard recommended by Nuclear Energy Agency Organization for Economic Cooperation and Development.

KEY WORDS: Gamma, Pulverizing, Radionuclides, Radium, Rocks.

INTRODUCTION

It is found that a few naturally occurring substances consist of atoms which are unstable that is they undergo spontaneous transformation into more stable product atoms. Throughout his history, man has been exposed to radiation from the environment in which he lives. This natural background radiation comes from three main sources cosmic radiation, radiation from terrestrial sources and radioactivity in the body (Alan and Samuel, 1982)

It is well known that every rock of the Earth strata contains natural radionuclides such as Uranium, thorium and potassium with their daughter products. The concentration of these elements varies considerably depending on the type of rock formation (Alan and Samuel, 1982, Susumu, 1995, Susumu, 1996)

Exposure to ionizing radiation is generally regarded undesirable at all levels although no harmful effects are confirmed to result from very low-level exposures (National Academy of Sciences BEIR III report, 1980). Recently, considerable attention has been given to low level exposures arising from natural radioactive isotopes present in all building materials (OECD, 1979, Stroden, 1979, Mustomen 1984, ICRP, 1984, Mollah et, al, 1986).

Ekiti State is located on longitude 7^0 37^1 east of Greenwich meridian and latitudes 5^0 13^1 North of the equator. The area has a general elevation of 300-700 metres above sea level. The geology of the area is dominated by crystalline rocks, which form part of the basement complex of southwestern Nigeria. The rock in this area are; pegmatites and aplites, granitic rocks, charnokitic rocks, the quartzite series, gneisses and magnatites (Olanrewaju, 1981). The state in the last 3 years witnessed tremendous construction of roads, bridges and buildings. All these construction depend on rocks from the quarry in the area as raw materials. The aim of this study is to assess radium equivalent in the rocks materials. The aim will be compared with Nuclear Energy Agency, organization for Economic cooperation and development, to known their suitability for construction.

MATERIALS AND METHOD.

The coarse grained rock sample were disaggregate in Meyer and Burger Jaw crusher and powered in a Meyer and Burger pulverizing machine at the department of Geology, University of Ibadan. Two hundred gram (200gm) of each of rock samples were then placed in plastic containers of specific size, sealed and left for at least 3 week to attain secular radioactive equilibrium before counting. The detection assembly set up for this study consists of the thallium activated sodium-iodide detector NaI(Tl), the photomultiplier tube and the multi-channel analyzer (Canberra series 10 plus MCA). The detector has a resolution of about 8% of 0.662MeV of Cs-137 which is capable of distinguishing the gamma ray energy considered during the measurement. The counting time of each sample was set for 10 hours (36000s) in order to produce a sufficient number of count.

RESULT AND DISCUSSION

The observed radioactivities in the rocks are shown in table 1. The radium equivalent concentration C_{Ra}^{Eq} which is expressed mathematically as:

$C_{Ra}^{Eq} = C^{214}Bi, + 1.26C^{232}Th + 0.086C^{40}K$ (Oresegun, 1986)

where $C^{214}Bi$, $C^{232}Th$ and $C^{40}K$ are the concentrations of ^{214}Bi (^{238}U), ^{208}Ti (^{232}Th) and ^{40}K respectively in Bqkg^{-1} was calculated and presented in table 1. These were plotted in figure 1. The means concentration of ^{40}K, ^{238}U and ^{232}Th in the rock samples were 719.10Bqkg^{-1}, 22.40Bqkg^{-1} and 23.10.10Bqkg^{-1} respectively. This implies that rock samples in Ekiti state have high potassium content. The sample have the lowest radium equivalent 53.56Bqkg^{-1} at Ose-Emure and highest radium equivalent 228.41Bqkg^{-1} at Ugele Ikere. This is shown in fig 2. The mean radium equivalent is 112.48Bqkg^{-1}. This is 30% of the least value (<370Bqkg^{-1}) set for good home by Nuclear Energy Agency, Organization for Economic Cooperation and development (OECD, 1979)

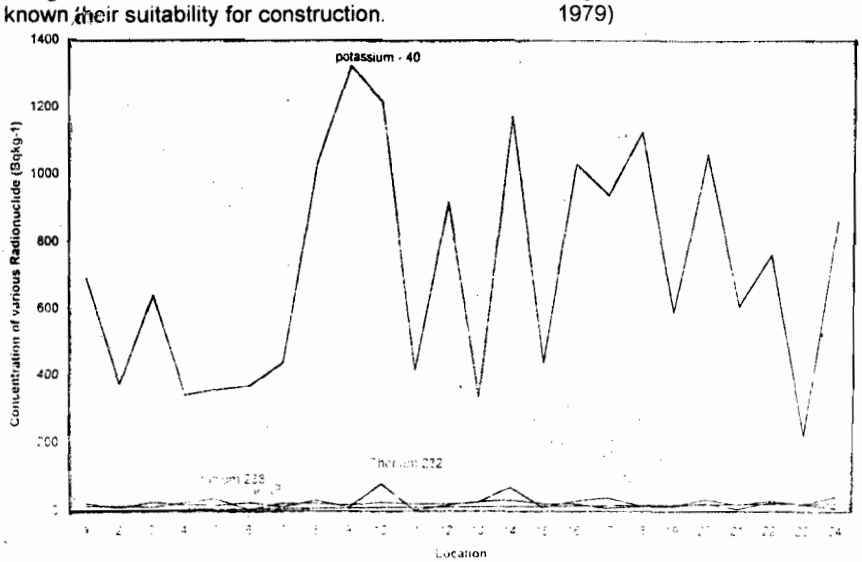

Figure 1: Graph of concentration

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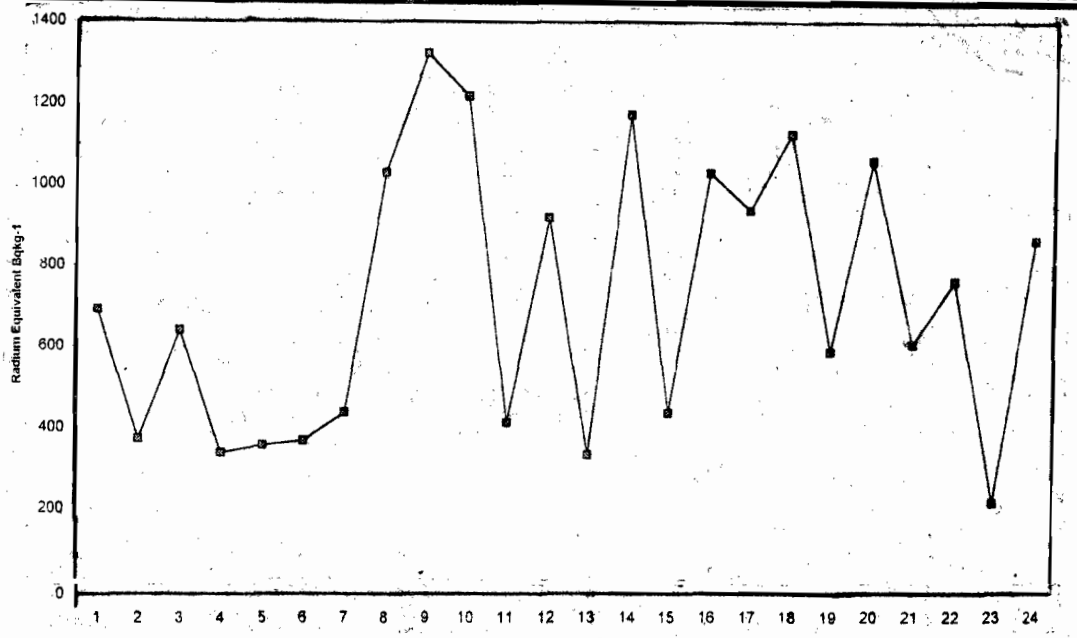

Figure 2: Calculated Radium Equivalent

Table1: Activity of the various samples in$Bqkg^{-1}$ and Radium equivalent

	Names and No of samples	^{40}K	^{214}Bi (^{238}U)	^{208}Ti (^{232}Th)	C_{Ra}^{Eq}
1	Itako Emure	692.05	13.08	21.12	99.21
2	Okuta Elemure	371.81	14.43	8.65	58.30
3	Oke Aremo	639.68	10.01	25.15	96.71
4	Ose Emure	338.28	22.62	17.34	53.56
5	Oke Ilisa Omuo	356.85	34.04	15.72	84.54
6	Ori Utagba Ikole	367.93	2.56	23.88	85.29
7	Ori-Utala Ikole	438.88	22.50	11.02	74.13
8	Oke-efo Ire	1030.19	22.26	29.98	148.63
9	Agbayan Ikere	1322.51	16.86	10.40	143.69
10	Ugele Ikere	1217.50	24.74	78.54	228.41
11	Oke Igbara Ilawe	413.50	21.09	2.81	60.19
12	Eyinrin Ilawe	918.37	21.09	17.21	121.75
13	Aponkojuya Ilawe	334.13	26.39	25.77	87.60
14	Uta-Olo Ilawe	1173.01	33.34	70.24	222.72
15	Eyinrin Igede	438.88	22.50	11.02	74.13
16	Olota Ado	1030.19	22.26	29.93	148.63
17	Esiku Ilupeju	937.60	9.31	39.91	140.23
18	Umojo Ilupeju	1126.52	14.61	17.03	132.95
19	Aorogun Osi	590.11	14.14	13.87	82.37
20	Ewekerewe Osi	1059.85	34.28	21.69	152.76
21	Alele Aramoko	608.55	19.19	6.23	80.10
22	Ijuku Aramoko	765.13	30.27	25.51	128.21
23	Eyo Ijero	221.51	20.38	21.03	65.93
24	Igemo Ijero	865.46	43.47	9.22	129.52
	Mean	719.10	22.40	23.10	112.48

Table 2: Recommendation radium equivalent for building materials for OECD countries (OECD, 1979, Meludu and Oresegun 2000)

C^{Eq}_{Ra} ($Bqkg^{-1}$)	Class	Recommendation
< 370		Good for dwelling homes
370-740	2	For industries
740-2220	3	Roads bridges
2220-3700	4	Only for use in foundations of non-residential buildings
>3700	5	Not to be used for construction of any type

CONCLUSION

The study revealed that radium equivalent in the rock samples will not constitute any deleterious effects to inhabitants (Ekiti's), since the highest value (228.41$Bqkg^{-1}$) is less than the minimum value (370$Bqkg^{-1}$) set for good homes; (370-740$Bqkg^{-1}$) for industries; (740-2220$Bqkg^{-1}$) for roads, bridges and (2220-3700$Bqkg^{-1}$) for foundations of non-residential buildings (Meludu and Oresegun 2000).

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