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INVESTIGATION OF THE URANIUM CONTENT IN SOME SOIL SAMPLES FROM BARKIN LADI LGA, PLATEAU STATE – NIGERIA

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Abstract
In this work the Uranium (238U) content in soil samples collected in BarkinLadi LGA from some villages was been determined. The measurement of the soil Uranium activity concentration were made using a multi –channel pulse height analyzer (Canberra series 10 plus) coupled to a 76.2mm x 76.2mm NaI (TI) scintillation detector. The mean uranium content in the analyzed samples was found to be (39.61 ±2.93) Bq/kg which is slightly higher than the world mean value of 35Bq/kg. The results were in good agreement with others for soils from region which is considered as normal or slightly high in radioactivity level.
Keywords: Uranium,Soil samples, Barkinladi,Gamma ray spectrometry and Nigeria

1. Introduction

Natural radioactivity occurs when a nucleus decays spontaneously without external interference. The greatest contribution to the average public radiation exposure comes from radioactive elements in the earth crust and from cosmic radiation originating in deep space. Natural sources contribute on the average more than 98% of the human radiation dose excluding medical exposure (UNSCEAR, 1998). The most common of these primordial radionuclides are 40K, 238U and 232Th and progenies. Uranium (238U) which is the heaviest chemical element of natural occurrence and can be found in food, soils, waters sediments and living organism in trace quantities. Hence different techniques are usually employed to determine small amount of Uranium among which are: mass spectrometry, neutron activation analysis, nuclear fission track registration technique and gamma spectroscopy (Yamazakiol and Geraldo, 2003).

Uranium results from radionuclide sources found in the earth's crust occurring in different types of rocks and soil and the concentration and activity of uranium in any given environment depend on factors such as the geological features of the area, weather conditions, human, economic and industrial activities.

Several of the elements in the decay of Uranium (238U) emit beta and gamma rays, the radiation of which also form a significant portion of the external radiation field on the earth's surface. Hence the presence of 238U in large scale in the study area can induce its accumulation in living beings and consequently will represent a potential radiological risk to the population of this area of concern. In this way the knowledge of the238 U concentrations in soils is important not only to assess the contamination level but also to understand the transference processes which have occurrence at different levels of the feed chain.

The study area is BarkinLadi LGA is located at longitude 008050'22.1" – 008058'22.2" and latitude 09025'08.1" –

09042'48.2" on a granite Plateau of about 1440m above sea level in Plateau State in the North Central part of Nigeria (Figure 1).The Objective of this study is to determine the Uranium content in some soil samples collected from BarkinLadi LGA, Plateau State – Nigeria. The main geological formation of this area lends itself to the mining and milling of tin in the 1930's. The lithological formations in the area are composed of basement complex biotite granite and new basalts. Tin and columbite ore are associated with greisenized and biotite granites.

2. Materials and Method

A total of 20 surface soil samples of natural origin were collected from the 20 different locations at the same depth level of 0 to 6cm around BarkinLadi LGA. The samples were collected from 10 villages with two sample collected from a village at 1kilometer square apart and these points of collection were marked out using (GPS). Samples obtained by clearing the surface vegetation and removing dead organic matter from the surface of the location and then taking a core sample from it from a depth of 6cm sample mass varied from 1.0 to 1.5kg.

At a collection point the soil sample was wrapped in black plastic bag and again double bagged to avoid cross contamination of the samples then taken to the laboratory. All soil samples were individually allowed to dry for 72 hours under laboratory temperature of about 270C and relative humidity of about 70 % (IAEA, 1989). Each dried soil sample was grinded and sieved using a 2mm mesh screen. The large particles were disposed off and the meshed soil sample were stored in plastic containers of specific dimensions for four weeks to allow time for secular equilibrium for 238U and its corresponding progenies. The plastic container of fixed geometry used was ensured air-tight by using an epoxy glue to seal samples.

About 100g each of meshed soil sample was then transferred to a 100cm3 capacity aluminum container and analyzed for gamma activity immediately.

The gamma-ray analysis was done on a very sensitive gamma spectroscopic system which consists of a 76.2cm x 76.2cm NaI (TI) scintillation detector coupled to a Camberra series 10 plus multichannel analyzer (MCA). The detector has a resolution of about 7.4% at the 662kev line for 137Cs which is good enough for distinguishing gamma-ray energies of the radionuclide being measure(Ajayi and Ajayi, 1999). The detector was placed in a 5cm thick lead shield to reduce the effects of natural background radiation (Ajayi, 1994 and Farai, 1989).

The gamma ray spectrometry located at Centre for Energy Research and Training ABU Zaria was employed in the determination of activity concentration of the uranium (238U). The soil samples were mounted on the surface of the scintillation detector and each counted for 21600 seconds in reproducible sample detector geometry. A computer based multichannel analyzer system with an ACCUSPEC programme (model 2007p) was used for the data acquisition analysis of gamma spectra. The gamma transition of energy of 1765kev (due to 214Bi) was used to determine the concentration of 238U in the soil sample.

3. Results and Discussion

The uranium contents obtained in this work for all the soil samples and their mean value from BarkinLadi LGA Plateau State, Nigeria are as presented in Table 1.

The average value found in this work for U content in some soil samples is 39.61Bq/kg higher than the world mean value of 35Bq/kg 238U isotope. Thevalues of 238U activity concentrations in the soil wasfound to vary from 10.54Bq/kg to 101.85Bg/kg.

A comparison of the our results with other results elsewhere are listed in Table 2

As can be seen in Table 2 values in this work compare suitably with the intervals found by other authors for soils which are considered as polluted or having high natural radioactivity and are slightly higher than those found for samples supposed to be not polluted or having normal radioactivity levels. Compared to the worldwide average concentrations in soils, the present results are higher in some places and as well lower than the world mean value. Averagely our result is higher than the world mean value with a factor of four (4) indicating a possible accumulation of U in BarkinLadi LGA which may be due to the mining activities in the past.

4. Conclusion

The average238U content values obtained in this work for soil sample from BarkinLadi LGA were slightly above the worldwide value of 35Bg/kg. However the results obtained very from 10.54224 ± 2.6182 to 101.83 ± 1.8536 indication that while some places do not pose little or any health hazard, some places are found to have significantly high activity concentration of 238U above the world mean value. The present 238U content interval determined in terms of 238U activity concentration for soil samples is according to the results reported in the literature compatible with those found for areas considered as normal or slightly of natural radioactivity. The data obtained in this work can therefore reliably serve as reference values for the current assessment of Uranium activity in BarkinLadi LGA

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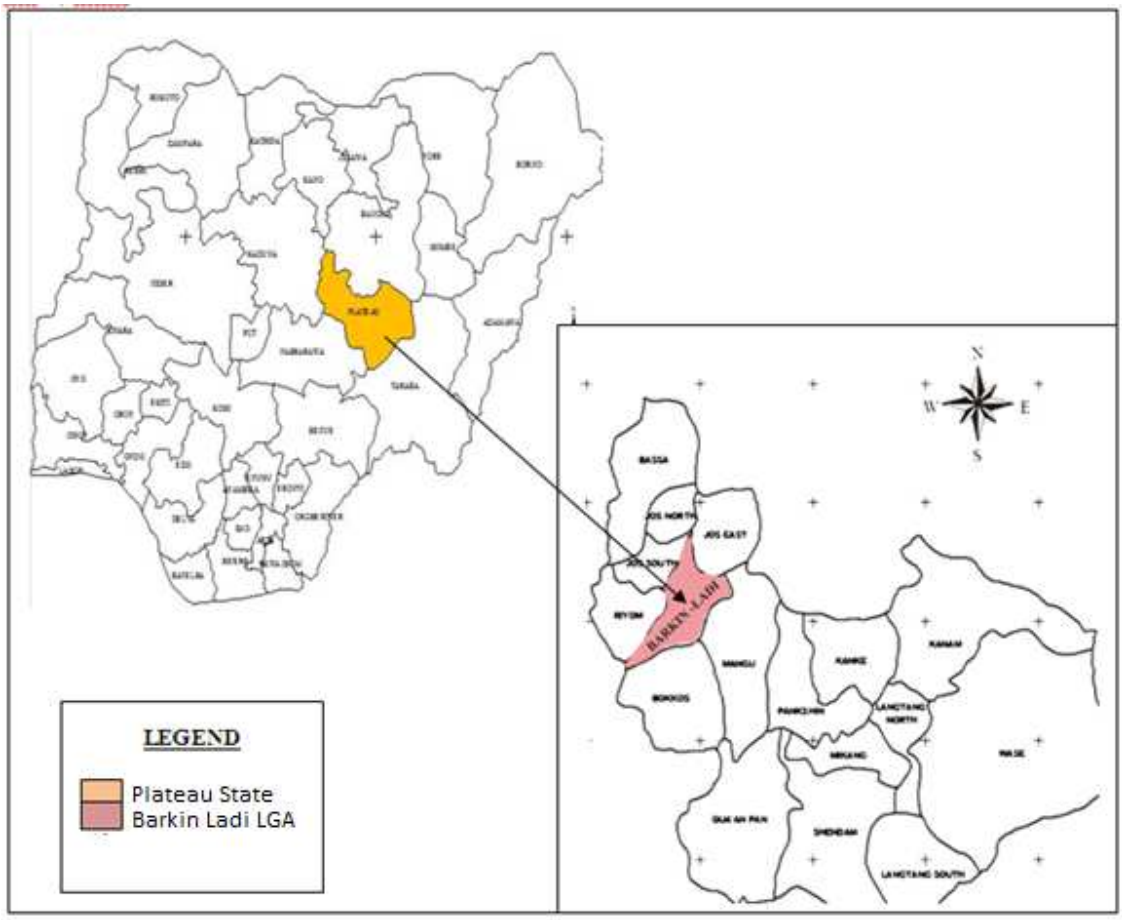

Fig 1: The map of Nigeria showing BarkinLadi LGA (Study Area).

Table 1: Activity concentration of uranium (238U)Bq/kg

Sample Location	Longitude	Latitude	238U(Bq/kg)
BarkinLadi A	0080 54' 11.3"	090, 32' 38.0"	34.071 ± 3.5913
BarkinLadi B	0080 54' 03.2"	090, 32' 7.7"	71.36 ± 3.823
Bisichi A	0080 54' 23.7"	090, 42' 48.2"	10.5424 ± 2.6182
Bisichi B	0080 54' 40.8"	090, 42' 28.4"	32.072 ± 2.5921
Fan A	0080 58' 22.2"	090, 07' 31.2"	46.177 ± 4.6339
Fan B	0080 58' 19.5"	090, 07' 46.9"	23.865 ± 2.6645
Foron A	0080 56' 40.7"	090, 39' 55.7"	28.151 ± 0.3823
Foron B	0080 55' 13.8"	090, 41' 46.8"	30.243 ± 1.6222
Gassa A	0080 54' 11.8"	090, 35' 02.1"	44.254 ± 3.4754
Gassa B	0080 54' 07.0"	090, 34' 56.3"	99.629 ± 1.0429
GindinAkwati A	0080 50' 12.3"	090, 28' 48.5"	101.83 ± 1.8536
GindinAwwati B	0080 50' 15.9"	090, 28' 36.8"	49.699 ± 3.2437
Kassa A	0080 53' 44.9"	090, 35' 45.2"	26.066 ± 3.4754
Kassa B	0080 50' 36.2"	090, 35' 44.6"	40.325 ± 3.1256
Kuru- Jenta A	0080 50' 22.1"	090, 41' 24.7"	46.254 ± 3.4754
Kuru- Jenta B	0080 52' 52.7"	090, 40' 49.8"	18.93 ± 3.1279
Rakwok A	0080 53' 07.4"	090, 28' 28.8"	14.736 ± 4.5876
Rakwok B	0080 53' 09.9"	090, 28' 39.7"	95.69 ± 3.7071
Tenti A	0080 55' 17.0"	090, 27' 57.4"	20.042 ± 0.1158
Tenti B	0080 55' 23.2"	090, 25' 08.1"	48.077 ± 4.6339
Average			39.61 ± 2.9301

Table 2: Comparison of 238U activity concentration levels for soil samples from BarkinLadi LGA with values obtained in some areas.

Country – Region	Sampling Location	Results(Bq/kg)	Ref.
Nigeria – Jos	BarkinLadi LGA	10.54 – 101.83	This work
Nigeria – Jos	Bukuru – Jos	80 – 1240	Ajayi,2008
Nigeria–Port Harcourt	Around cement companies in Port Harcourt	17.34 – 49.90	Avwri,2005
Nigeria – Zaria	Around(Center forEnergy Research and Training)	4.8 – 11.9	Mohammad,2010
Nigeria –Ibadan	Near Road Area Soil	10.2 – 40.7	Jibiri,2005
Saudi Arabia	Riyadh	10.8 – 29.7	Alaamer,2008
Brazil – Santos (SP)	Mangle Area-sediment and Soil	38.5 – 226	Richardo et al,2008
Greece – Milos Island	Volcanic Origin Area Soil	21 – 187	Florou and kriditicset,2005
China –Xiazhuang	Near Uranium Ore Field-Soil	40.2 – 442	Yang et al,2005
Madagascar- Antsirabe	High Radioactivity Area-Soil	22 – 765	Rabesiranana,2008
Turkey – Kestanbol	Granite Area Soil	82.3 – 167.0	Merdanogula andAltinsay,2006
India –Kangra	Country Area Soil	9.26 – 25.4	Sharma et al,2003
Turkey – Istanbul	Near City Area – Soil	2.63 – 58.98	Karahan and Bayulten,2000

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