Radiometric And Petrographic Studies Of A Typical Basement Complex Terrain, Southwestern Nigeria

Olayanju, G. M, Adigun, O. E

Abstract: Radiometric and petrographic study was carried out over a typical basement terrain of southwestern Nigeria in order to evaluate possible impact of high radiation in the environment, which can pose any health hazard. In this study, the radiometric mapping was done using a portable hand-held Geiger-Muller counter with the aim of establishing the background radiation level within the campus and possible association with lithology pattern in the area. The petrographic analysis of the rock samples obtained from outcrops of rock masses in the study area revealed that the major minerals are Quartz, Biotite, Plagioclase, Orthoclase, Myrmeckite, Microcline and Opaque minerals. The radiation emitting mineral in these rock samples are Biotite, Orthoclase and Microcline. A strong linear relation was established between the percentage mineral composition in the rocks and the background radiation measured over the study area at 95% confidence level. The local high values in background radiation can be attributed to high percentage of potassium and aluminium minerals in the rock composition as observed over charnockites and migmatite-gneiss. The background radiation level in most of the study area falls within the range of 0.16μSv/hr (1.4mSv/yr) and 0.27μSv/hr (2.36mSv/yr), considered to be within the normal world average background radiation level. In addition to oxyphile and biophile tendency of radioactive elements in the mineral assemblages of the rocks, resulting in their concentration in the organic compounds, humus and other agricultural soils, notable high radiation levels can be attributed to human activities, especially where radiation level is above the 0.27μSv/hr (2.36mSv/yr). High background radiation levels within the range of 0.28μSv/hr (2.45mSv/yr) and 0.38μSv/hr (3.33mSv/yr) recorded in some parts of the study area are at car parks, around laboratories and isolated areas close to the farm in the area.

Index Terms: basement complex, biophile, health hazard, ionizing, oxyphile, petrography, radiation, radioactive minerals, radiometry.

1 Introduction

Ionizing radiation is produced when heavy elements such as uranium-238 (238U) and thorium-232 (232Th) decay. According to United Nations Scientific Committee on the Effect of Atomic Radiation [1], [2] report, exposures to ionizing radiation results in health problems after few years with the largest contributor to radiation exposure being Radon-222 (222Rn), a common radioelement in rocks and soils. Both uranium and thorium have remarkable affinity for oxygen, being oxyphile, however, they also have largely biophiles tendency, resulting in their trace concentration in organic compounds, humus, bitumen and petroleum. Radioactive methods can be employed as a good tool to geologic mapping [3], [4] or to evaluate land degradation and threat to human health arising from radiation in environments [5], [6],[7],[8],[9], [10]. Apart from geological and geographical factors, human activities can enhance the natural radiation background levels [11], [12], [13]. These human operations bring large amounts of buried materials containing naturally occurring radionuclides to the surface of the environment [14]. While the terrestrial sources of radiation are responsible for most of human exposure to radiation, primarily through external exposure [14], the radiation from the rocks and soil in addition to the associated environmental exposures of the populace depends on the geographical and geological conditions of the region [2],[15], [16], [17].

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The work of [18] on in-situ measurement of the background radiation level at the campuses of two major tertiary institutions in Minna, Nigeria demonstrated the significance of assessing impacts of radiation in an environment. Their work was carried out using a portable Geiger-Mueller tube-based environmental radiation dosimeter in order to have information about the level of background radiation and to know the possibility of background radiation levels posing any health related problem to lives in these Campuses. The portable type Geiger-Mueller counter are readily available in Nigeria Institutions, which are very convenient and easy for baseline researches in monitoring the background radiation level of different environments and implication on clinical safety of the background radiation levels [15], [18], [19], [20], [21]. Radioactive method can be employed as a good tool. Radiation is often categorized as either ionizing or non-ionizing depending on the energy of the radiated particles. Ionizing radiation carries more than 10 eV, which is enough to ionize atoms and molecules, and break chemical bonds [21], [22]. This is an important distinction due to the large difference in harmfulness to living organisms. A common source of ionizing radiation is radioactive materials that emit α- or β particles or γ radiation; consisting of helium nuclei, electrons or positrons, and photons, respectively [23]. While many naturally occurring elements have radioactive isotopes, only potassium, uranium and thorium decay series have radioisotopes that produce gamma rays of sufficient energy and intensity to be measured by gamma ray spectrometers. This is because they are relatively abundant in the natural environment. Average crustal abundances of these elements are in the range 2-2.5% K, 2-3 ppm U and 8-12 ppm Th [21], [24]. As a fast growing community, the Federal University of Technology, Akure (FUTA) Nigeria is dramatically being opened to erection of infrastructures including Laboratories, Lecture Theatres, roads and Recreation centres. With increase in human activities and rise in the industrial and non-industrial facilities, there is a great need to monitor radiation levels in the University community so as to prevent undue exposure to radiation in the area. In this paper, the need to assess the impacts of radiations from human activities and that of natural source of geologic environment is therefore expedient. Thus, this paper presents a baseline radiometric survey conducted to investigate the level and pattern of background radiation within FUTA Campus and possible influence of lithological influence from basement rocks on the radiation within the area.

2 Location and Geological Setting of the Study Area

The study area is a typical basement complex area of Nigeria hosting the Federal University of Technology, Akure Campus located about 250 m north of Highway 346 (Ilesa-Owo Expressway), in the outskirt of the ancient town of Akure, southwestern Nigeria. The Campus falls within latitudes 7°17'03''N - 7°19'06''N and longitudes 5°07'02''E -5°09'05''E (Figure 1). The topography is gently undulating and is located within the sub-equatorial climatic belt with tropical rain forest vegetation characterised by densely distributed wide foliage tress in the areas yet to be developed and in the built up areas by mainly low lying grasses. The study area experiences a tropical climatic condition, rainfall for about eight months and dry season for about four months in the year. The mean temperature is between 28°C and 30°C, while the humidity is constantly high, enhancing proper precipitation [25]. The major rock types in southwestern area of Nigeria as classified by [26] are (a) The gneiss-migmatite-quartzite complex; (b) The schist belts which are low to medium grade supracrustal and meta-igneous rocks; (c) The Pan African granitoids (Older Granites) and other related rocks such as charnockitic rocks and syenites; and (d) Minor felsic and mafic intrusives. According to [27], the local geology indicate occurrence of undifferentiated granite, Charnockite and migmatite gneisses, with major outcrops occurring as granites and the migmatite gneisses, while the Charnockites occur as discrete bodies in some parts of the study area. The charnockitic rocks of Akure intruded into the migmatite gneiss quartzite complex and the older granite suite [28].

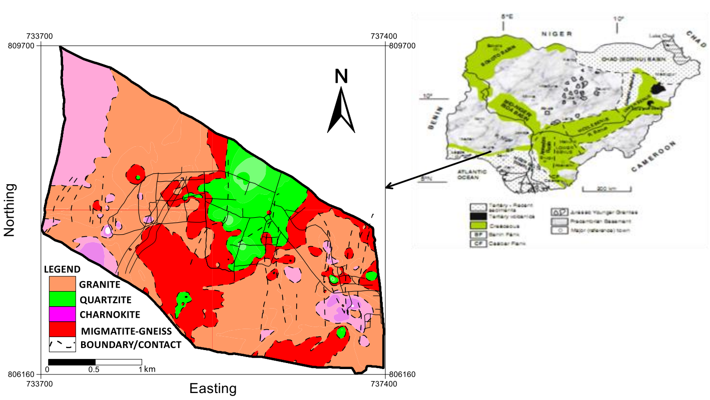

Figure 1: *Geologl map of FUTA Campus showing the Study Area (after [27]; inset Geological map of Nigeria , after [29])*

[30] distinguished three types of charnockitic intrusives in the southwestern parts of Nigeria on the basis of their structure as follows: (i) gneissic charnockitic rocks that possess a planar penetrative fabric; (ii) foliated charnockites which show a magmatic foliation due to the platy parallelism of feldspar megacrysts and the concentration of mafic minerals into discrete planes; and (iii) coarse-grained, massive, non-foliated, often porphyritic charnockitic rocks. According to [31] the igneous charnockitic intrusives of Akure, Ikerre and Ado Ekiti in the southwestern area of Nigeria are identified and distinguished from the metamorphic ones by their igneous texture and field relationships, even though the former resemble the latter in their mineral assemblages and that igneous charnockites are closely associated with non-charnockitic granites in some places, suggesting contemporaneous emplacement and an association of both rock types. [32] concluded that the granitic and charnockitic rocks were emplaced by fractional crystallisation of magma which was derived from the subduction of an ocean slab into the mantle in a back arc tectonic setting. In line with these previous studies, Shitta [33] described the three types of charnockitic rocks in Akure area on the basis of their textural characteristics as (i) coarse-grained as exemplified by the Akure body, (ii) massive fine-grained which form along the margins of the granitic bodies (as observed around FUTA Campus and neighbouring towns of Akure), Uro and Edemo-Idemo and (iii) the gneissic fine-grained types which were recognized within the bodies of the gneisses in Ilara and Iju. Ademeso [34] concluded that the charnockitic rocks of Akure area have experienced extensive deformation with age.

3 Materials and Methods of Study

The study presented in this paper involved two levels of data acquisition including radiation measurements at closely discrete locations and petrographic study of rock samples randomly obtained within the Campus. The Geiger counter employed in the radiometric survey is the Blue Geiger PG-15^{Tm} manufactured by Kindenoo, France. The instrument's measurement of effective radiation rate is in the range is 0.05 to 300 μSv/h and has accuracy of ±10%, with the calibration approved by the Institut de Radioprotection et de Suret Nucleaire, (IRSN, France). The Geiger counter is light in weight (124 g without batteries) and works with two AA batteries (alkaline or rechargeable) up to 60 hours. The radiation measurements were made at closely spacing of 20 meters intervals along existing paths, roads and virgin lands across the campus. In order to avoid high level of background noise, vehicular movements was avoided by ensuring that data collection was strictly conducted during quite period with time of measurement and atmospheric temperature also monitored during the radiometric survey. Period of data collection was limited to a maximum period of three days in order not to improve on the data quality by ensuring shortest period of data gathering and ensure reliability of densely acquired data. The Global Positioning System, a Garmin etrex-12^{TM} was used in recording the coordinates of data and rock sampling points. Polarising microscope was used in the laboratory analysis of the thin section of the different rock samples collected on the field in order to view the different minerals in the sample. The photomicrographs of the samples` mineral composition were also produced for qualitative analysis.Processing of the radiation data gathered during the survey involved inputting and editing of raw data and transformation into grids and profile forms using Microsoft Excel ^{TM}, Grapher-9 ^{TM} and Surfer-12^{TM} computer packages. Following production of the high resolution radiometric map of the study area, both visual inspection of radiation map and statistical analyses of the radiation data were also carried out. From the radiation pattern observed from the processed data, rock samples were collected in areas that have relatively high radiation count in order to establish any correlation between mineralogy and radiation level by identifying abundance of radiation emitting minerals in the rocks. The preparation of thin sections was made in the Geotechnical laboratory of the Geology Department of the Federal University of Technology, Akure. Nigeria. The rock cuts were initially marked in order to decide where to cut the rock. This is very important in rocks that have a fabric because it is desired to cut a thin section on a plane perpendicular to the planner fabric, and later in other orientations. After the different processes of the rock cutting, the surfaces of the different rocks were lapped with the use of carborundum to smoothen the surface of the rock to be attached to the slide and the lapped rock attached to the slide. Constant thickness of epoxy across the section was ensured during this stage, while the majority of the glued rock is grinded off. When doing this, extra caution was taken in order not to destroy the slide. After the grinding off of the rock from the slide, 0.03 mm thick slice of rock is left on the slide. The final process of thin section preparation is to cover the section with a cover slip to protect the section from damage. Photomicrographs of the thin sections were taken with digital camera and the modal content of the rocks analysed by studying the photomicrographs with ImageJ™ [35]. As demonstrated by [28], the selected photomicrograph of the rock sample is displayed in the Image Analyzer's counter window, from which the plug-in for grid analyses of the photograps is made via the Cell Counter from which the results is displayed in a table (Figure 2). The procedure was then repeated for at least three photomicrographs taken from three different views of each thin section.

4 Results and Discussion

The background radiation data obtained are processed and presented in form of radiometric maps, while the results obtained from the petrographic analysis of the rock samples taken from the field are presented as photomicrographs and tables. Spatial display of the background radiation pattern over FUTA Campus is presented in Figure 3. Comparison of the radiation pattern over the geology of the study area revealed radiation levels across different rock types within the Campus (Figure 4). The locations of the outcrops from which the different rock samples were obtained were plotted to show their field relationships as shown in Figure 4. Modal composition of the rocks samples from the petrographic analysis carried out over the eight randomly obtained rock samples within the Campus are presented in Table 1. The results revealed percentage mineral composition of the various samples with regards to their accessories minerals, which were later analysed for radiation emitting characteristic.

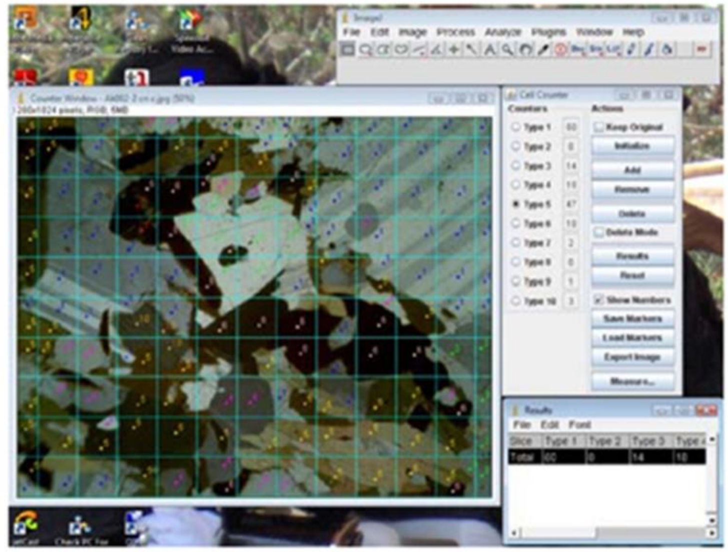

Figure 2: *Determining Modal Composition of Rocks with ImageJ [28], [35]; Cell Counter Legend: Type 1 is plagioclase, Type 2 is Orthoclase, Type 3 is quartz, Type 4 is Biotite, Type 5 is Hornblende, Type 6 is Myrmeckite, Type 7 is Hypersthene, Type 8 is Muscovite and Type 9 is Pyroxene.*

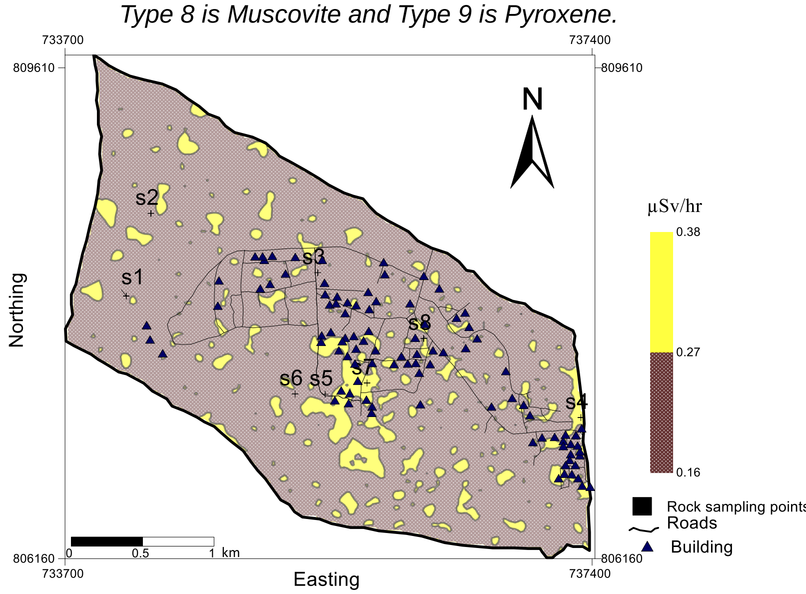

Figure 3: *Processed Radiation Background Pattern over Federal University of Technology, Akure Nigeria Showing Areas with Radiation above the World Average Background Radiation Value of 0.27 µSv/hr.*

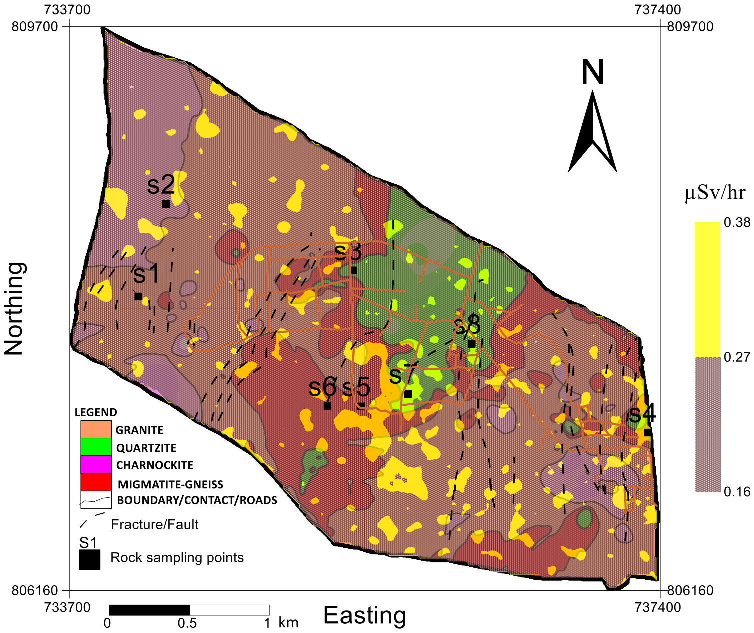

Figure 4: *Radiation Distribution Pattern over the Geologic Map of the Study Area.*

4.1 Radiation Pattern over the Geology of the Study Area

The generated radiometric map was overlaid on the existing geologic map of the study area in order to characterise the background radiation pattern in correlation with various rock types in the study area as shown in Figure 4. This is done with the objective of identifying any direct association between rock type and radiation level in the Campus, which inform the need to carry out rock petrographic analysis of rock samples obtained from the outcrops of the various rocks in the area. Eight (8) rock samples were collected at location marked out in Figure 3 over the positive radiation haloes showing high background radiation above the bench mark of 0.27 μSv/hr. Measured radiation over a total 2,753 points evenly distributed across the study area ranges in values from 0.16 to 0.38 μSv/hr (Figure 3). The chocolate coloration on the map shows areas with background radiation values that range from 0.16 to 0.27 μSv/hr, while the red coloration portions on the map are areas that have background radiation values ranging slightly above 0.27 to 0.38 μSv/hr. The yellow portions on the map are considered to have high background radiation values higher than the world average background radiation value of 0.27 μSv/hr. It can be observed in Figure 4 that some high radiation levels coincide with rock boundaries and fracture or fault zones in the area.

Table 1: *Composition of Accessories minerals from Petrographic analysis of rocks from the study area.*

Mineral	First count	second count	third count	grand total	% mineral composition	Minerals	First count	Secon d count	Third count	Grand total	% mineral composition
	SAMPLE 1(Granite)						SAMPLE 2 (Charnockite)				
Biotite	5	4	4	13	17.80	Biotite	5	6	4	15	20.83
Quartz	10	14	16	40	54.80	Quartz	10	14	15	39	54.17
Orthoclase	2	1	2	5	6.85	Orthoclase	2	1	1	4	5.55
Plagioclase	4	3	4	11	15.07	Plagioclase	3	3	2	8	11.11
Opaque minerals	3	1	-	4	5.50	Myrmeckite	2	-	1	3	4.17
						Microcline	2	1	-	3	4.17
	SAMPLE 3 (Quartzitic_ gneiss)						SAMPLE 4 (Granite)				
Biotite	5	4	2	11	25.58	Biotite	5	4	2	11	17.46
Quartz	8	6	9	23	53.48	Quartz	14	12	13	39	61.91
Plagioclase	2	4	1	7	16.28	Orthoclase	-	1	1	2	3.17
Myrmeckite	1	1	-	2	4.65	Plagioclase	2	3	2	7	11.11
						Opaque	1	2	1	4	6.35
	SAMPLE 5 (Migmatite-gneiss)						SAMPLE 6 (Migmatite-gneiss)				
Biotite	2	2	1	5	20.83	Biotite	4	6	5	15	21.13
Quartz	5	4	4	13	54.16	Quartz	12	17	11	40	56.33
Plagioclase	2	1	1	4	16.66	Orthoclase	2	1	2	5	7.04
Myrmeckite	1	-	1	2	8.33	Plagioclase	3	2	3	8	11.27
						Opaque	1	2	-	3	4.23
	SAMPLE 7 (Quartzitic_ gneiss)						SAMPLE 8 (Migmatite_ gneiss)				
Biotite	4	3	5	12	16	Biotite	5	7	4	16	24.24
Quartz	11	14	17	42	56	Quartz	12	14	11	37	56.06
Plagioclase	5	5	4	14	18.66	Orthoclase	1	-	2	3	4.54
Myrmeckite	1	-	1	2	2.66	Plagioclase	2	3	2	7	10.60
Opaque	3	-	2	5	6.66	Opaque	-	1	2	3	4.54

4.2 Petrographic Analysis

The petrographic analysis of the rock samples were carried out on samples obtained where outcrops of local rock masses were encountered and the major minerals detected are Quartz, Biotite, Plagioclase, Orthoclase, Myrmeckite, Microcline and Opaque minerals. Figures 5 – 12 show the photographic images for the rock samples analysed. The radiation emitting mineral assemblages in this rock samples are Biotite, Orthoclase and Microcline as shown in Table 2.

Table 2: *Radiation emitting minerals detected through the petrographic analysis.*

Sample	Detected radiation emitting minerals			Total % composition of the radioactive minerals
1(Granite)	Biotite $(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	Orthoclase $\{K(AlSi_3O_8)\}$	-	24.65
2 (Charnockite)	Biotite $\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	Orthoclase $\{KAlSi_3O_8\}$	Microcline $\{KAlSi_3O_8\}$	30.55
3(Quartzitic-gneiss)	Biotite $\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	-	-	25.58
4(Granite)	Biotite $\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	Orthoclase $\{KAlSi_3O_8\}$	-	20.63
5(Migmatite-gneiss)	$\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	-	-	20.83
6(Migmatite-gneiss)	Biotite	Orthoclase $\{KAlSi_3O_8\}$	-	28.17
7(Quartzitic- gneiss)	$\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$		-	16
8(Migmatite_ gneiss)	Biotite $\{(MgFe)_3(AlSi_3O_{10})(OH)_2\}$	Orthoclase $\{KAlSi_3O_8\}$	-	28.78

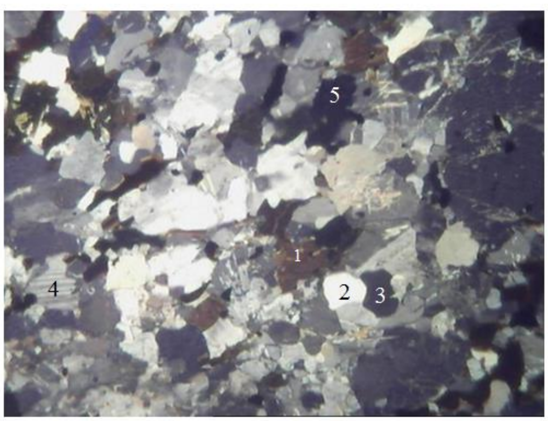

Figure 5a: Photomicrograph of Sample 1 (granite) in Crossed Nicols view (L10 CNa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and opaque minerals (5). Bar Scale is 1μm.

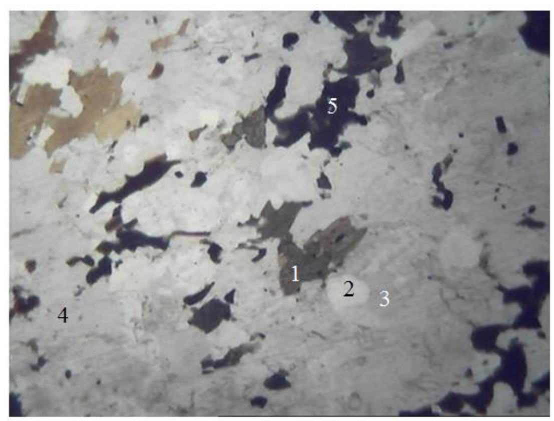

Figure 5b: Photomicrograph of Sample 1 (granite) in Plane Polarized view (L10 PPLa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and opaque minerals (5). Bar Scale is 1μm.

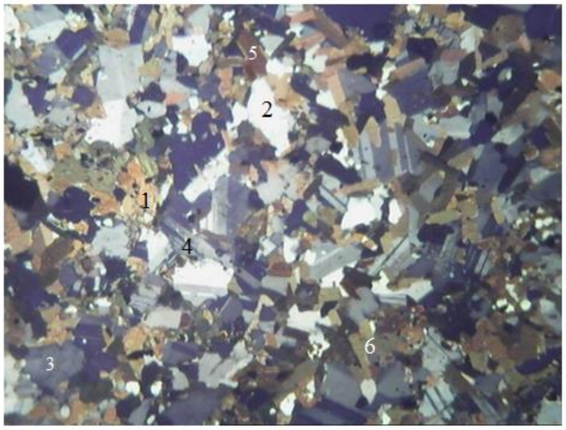

Figure 6a: Photomicrograph of Sample 2 (Charnockite) in Cross Nicols view (L2 CNa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), myrmeckite (5) and microcline minerals (6) minerals. Bar Scale is 1µm.

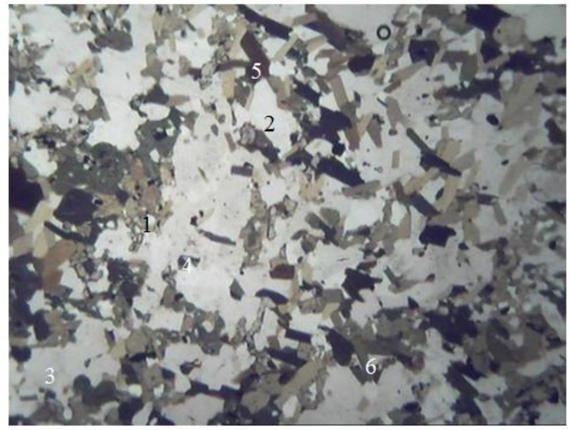

Figure 6b: Photomicrograph of Sample 2 (Charnockite) in Plane Polarized view (L2 PPLa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), myrmeckite (5) and microcline minerals (6) minerals. Bar Scale is 1µm.

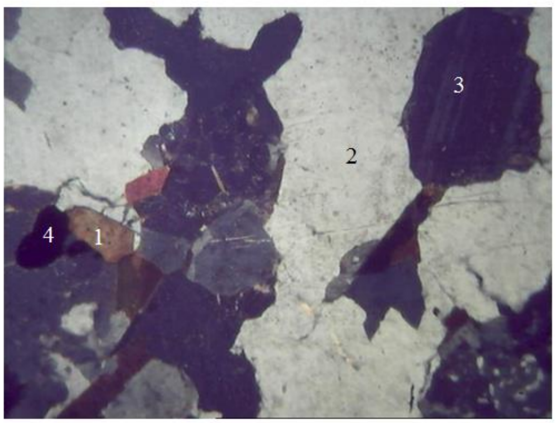

Figure 7a: Photomicrograph of Sample 3 (Quartzitic_gneiss) in Cross Nicols view (L3 CNa) showing biotite (1), quartz (2), plagioclase (3) and opaque (4) minerals. Bar Scale is 1µm.

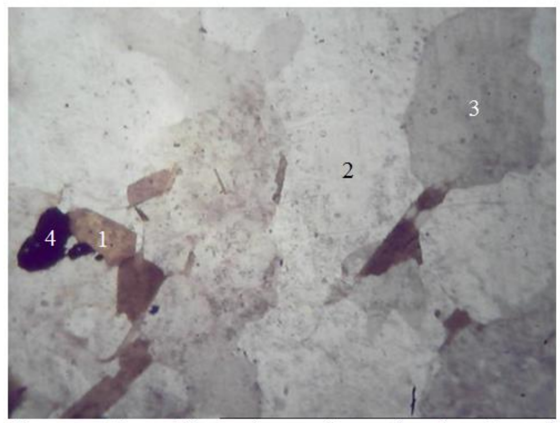

Figure 7b: Photomicrograph of Sample 3 (Quartzitic_gneiss) in Plane Polarized view (L3 PPLa) showing biotite (1), quartz (2), plagioclase (3), and opaque (4) minerals. Bar Scale is 1µm.

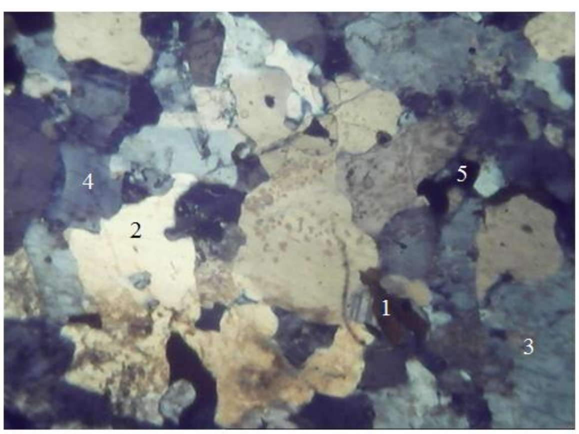

Figure 8a: Photomicrograph of Sample 4 (Granite) in Cross Nicols view (L4 CNa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and opaque (5) minerals. Bar Scale is 1µm.

Figure 8b: Photomicrograph of Sample 4 (Granite) in Plane Polarized view (L4 PPL a) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and opaque (5) minerals. Bar Scale is 1µm.

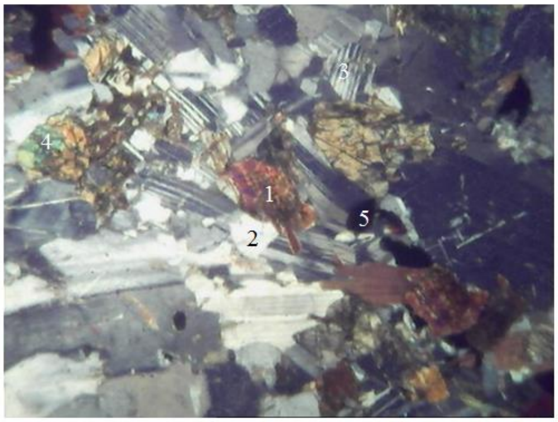

Figure 9a: Photomicrograph of Sample 5 (Migmatite-gneiss) in Cross Nicols view (L5 CNa) showing biotite (1), quartz (2), plagioclase (3), myrmeckite (4) and opaque (5) minerals.
Bar Scale is 1µm.

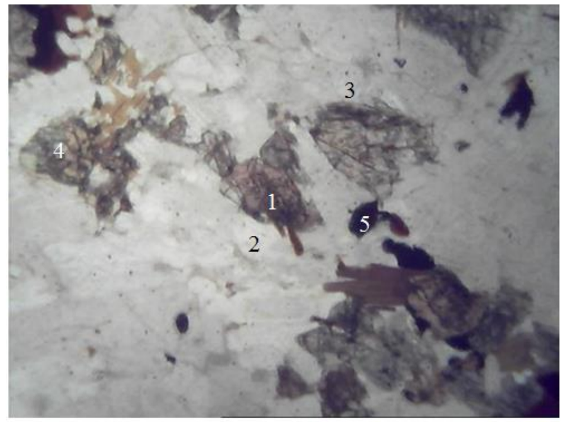

Figure 9b: Photomicrograph of Sample 5 (Migmatite-gneiss) in Plane Polarized view (L5 PPLa) showing biotite (1), quartz (2), plagioclase (3), myrmeckite (4) and opaque (5) minerals.
Bar Scale is 1µm.

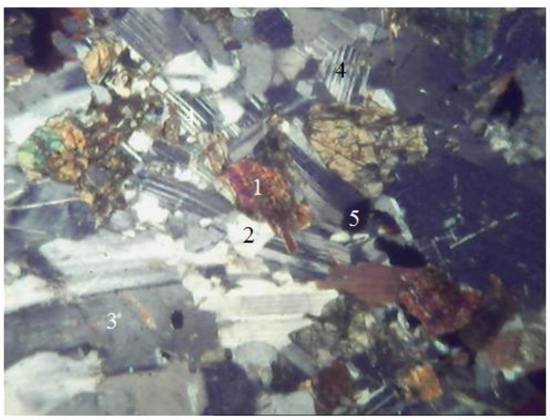

Figure 10a: Photomicrograph of Sample 6 (Migmatite-gneiss) in Cross Nicols view (L6 CNa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and Opaque (5) minerals.
Bar Scale is 1µm.

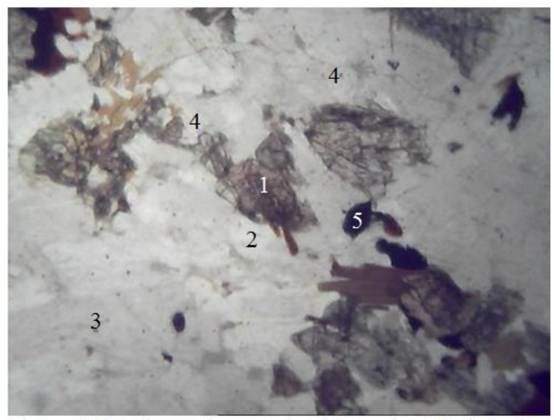

Figure 10b: Photomicrograph of Sample 6 (Migmatite-gneiss) in Plane Polarized view (L6 PPLa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and Opaque (5) minerals.
Bar Scale is 1µm.

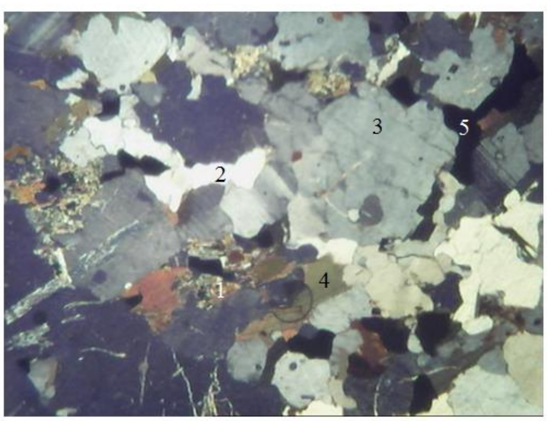

Figure 11a: Photomicrograph of Sample 7 (Quartzitic_gneiss) in Cross Nicols view (L7 CNa) showing biotite (1), quartz (2), plagioclase (3), myrmeckite (4) and Opaque (5) minerals.
Bar Scale is 1µm.

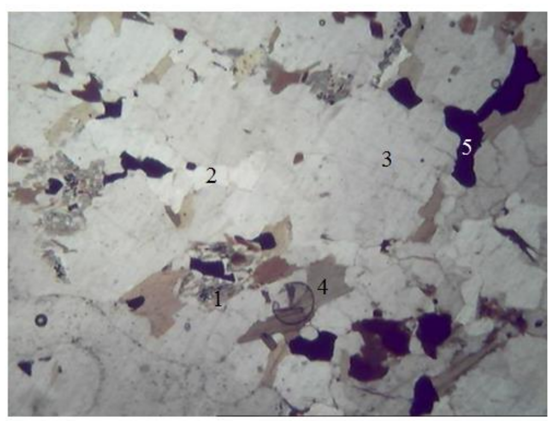

Figure 11b: Photomicrograph of Sample 7 (Quartzitic_gneiss) in Plane Polarized view (L7 PPLa) showing biotite (1), quartz (2), plagioclase (3), myrmeckite (4) and Opaque (5) minerals.
Bar Scale is 1µm.

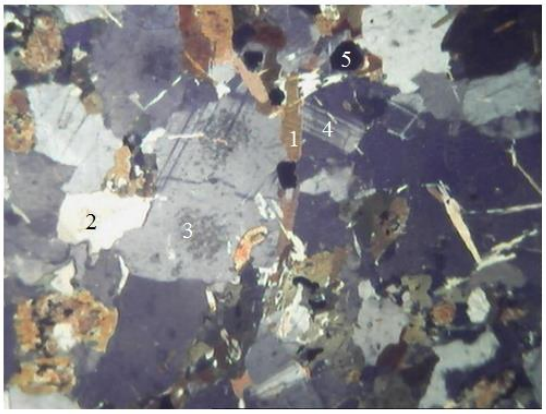

Figure 12a: Photomicrograph of Sample 8 (Migmatite_gneiss) in Cross Nicols view (L8 CNa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and Opaque (5) minerals.
Bar Scale is 1μm.

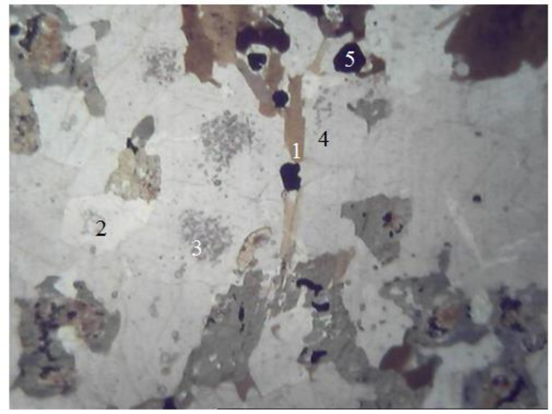

Figure 12b: Photomicrograph of Sample 8 (Migmatite_gneiss) in Plane Polarized view (L8 PPLa) showing biotite (1), quartz (2), Orthoclase (3), plagioclase (4), and Opaque (5) minerals.
Bar Scale is 1μm.

From the results of rock petrographic analysis in sample 1, radiation emitting minerals are Biotite and orthoclase. These minerals make up 24.65% of the mineral composition of the sample. From sample 2, the radiation emitting minerals are Biotite, Orthoclase and Microcline constituting about 30.55% of the sample`s mineral composition. Sample 3 has only Biotite as its radiation emitting mineral and this constitute 25.58% of the sample`s mineral composition. Sample 4 contains Biotite and Orthoclase as its radiation emitting minerals and make up 20.63% of the sample`s mineral composition. Sample 5 has only Biotite as its radiation emitting mineral, this makes up 20.83% of the sample`s mineral composition. Sample 6 has Biotite and Orthoclase as its radiation emitting minerals and they constitute about 28.17% of the sample`s mineral composition while sample 7 has Biotite as its radiation emitting mineral and it makes up about 16% of the sample`s mineral content. Sample 8 has Biotite and Orthoclase as its radiation emitting minerals and they make up 28.78% of the sample`s mineral composition. These radiation emitting minerals detected in all the 8 samples are considered radioactive due to the presence of Potassium K) and Aluminium (Al) in their chemical make-up. Regression analysis of the radiation intensity with reference to the total percentage of radioactive minerals from the rock petrographic analysis is presented in Figure 13. As expected, there is a strong correlation between the percentage mineral composition in the rocks of the area and the background radiation measured over the study area. At 95% Confidence level, the relationship between the composition of radioactive minerals and radiation intensity over the FUTA campus is as summarised in the following expression:

$$Y = 0.010159 * X \quad (1)$$

where Y = Radiation (μSv/hr), and X = Total % composition of the radioactive minerals. Average X = 24.3887; Average Y = 0.259398; Spearman Coefficient of determination, R^2 = 0.9328 Regression Statistics at 95% Confidence level.

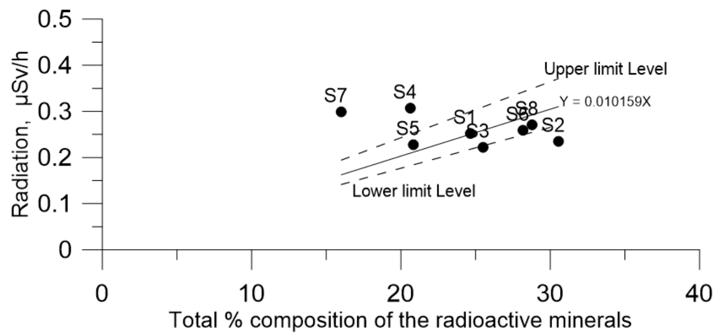

Figure 13: *Regression Plot showing relationship between the radiation intensity and percentage composition of minerals in the rocks of the study area.*

4.3 Correlation of Background Radiation and Land Use of the Study Area

In order to isolate possible implication of high radiation from land usage, the radiometric map over the study area was compared with the land use of the study area (Figure 4). Some radiation highs were observed to occur around intense humanly activities close to administrative and laboratories. At the Admin areas in the northern part of the Campus (Oba Nla), high radiation coincides with the Car Parks at the Senate Buildings, School Buildings, while to the southern part of the Campus (Oba Kekere) the observed radiation highs occur mostly around Department of Physics Car Park and South Gate where most vehicular movement and human activities are at the pick. However, other high radiation haloes were found to occur as pocket of background radiation across vegetated areas where human activities are at lowest ebb. High radiation across these facilities can be attributed to possible suspension in the atmosphere of emission from cars, construction activities and agricultural practices (where aluminium and potassium constitute possible constituents of fertilisers, etc.) in addition to the low radiation from biotite, orthoclase and microcline minerals in the rocks in some areas in the Campus.

5 Conclusion

In this paper, the background radiation measurements over the Federal University of Technology, Akure, Southwest Nigeria revealed low level of radiation in general. The background radiation level in most of the study area falls within the range of 0.16μSv/hr (1.4mSv/yr) and 0.27μSv/hr (2.36mSv/yr). These values are considered to correspond or fall below the normal world permissible average background radiation level. However, notable increase radiation levels can be attributed to human activities around car parks and laboratories. Especially, around Schools of Sciences and Engineering Technology, radiation level is above the 0.27μSv/hr (2.36mSv/yr). The radiation level at School of Science is 0.30 μSv/hr, 0.292μSv/hr at School of Engineering car park, and 0.82μSv/hr at the School of Earth and Mineral Sciences. High background radiation levels recorded in some parts of the study area, including the southern part of the Campus, where human activities are at highest and isolated areas close to the University Farm area fall within the range of 0.28μSv/hr (2.45mSv/yr) and 0.38μSv/hr (3.33mSv/yr). In many places, it was observed that there is close association of radiation highs along linear structures identified as fault and rock boundaries. This might be attributed to high percentage of potassium and aluminium minerals in the rock composition as observed over charnockites and migmatite-gneiss. In addition, the background radiation values recorded in some parts of the study area are considered not to be as a result of the geology of these parts of the study area but rather as a result of human activities, such as emission from building construction works, vehicular movements and agricultural practices. Generally, the background radiation recorded in the study area are considered to be normal and pose no health risk to the human population in the study area.

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