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Article *in* International Journal of Global Environmental Issues · October 2022

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Natural radioactivity level and evaluation of radiological hazard in the soil around a gold mining area in the North Region of Burkina Faso

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Abstract: The activity concentrations of natural radionuclides ^{226}Ra, ^{232}Th and ^{40}K in soil samples from the North Region of Burkina Faso around the mining site of Kalsaka were measured by gamma spectrometry using high purity germanium detector. Radiological hazard assessment due to such natural radioactivity was also investigated. The average activity concentration of ^{226}Ra, ^{232}Th and ^{40}K were found to be 26.06 ± 1.50 Bq.kg^{-1}, 33.27 ± 1.97 Bq.kg^{-1} and 133.11 ± 13.69 Bq.kg^{-1} respectively. The average absorbed dose was 0.038 μGy/h whereas the annual committed effective dose was 0.050 ± 0.003 mSv.y^{-1}. The average radium equivalent activity concentration was 83.89 Bq.kg^{-1}. The external and internal hazard indices were 0.23 and 0.30

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respectively which are three times less than one. The activity utilisation index was 0.6 Bq.kg^{-1} with maximum of 0.79 Bq.kg^{-1}. The mean effective dose rate of 0.05 ± 0.003 mSv.y^{-1} and the mean values of Ra_{eq} and H_{ex} and H_{in} for the studied area are below their respective permissible limits, thus indicating that radiation hazard is not significant in this area.

Keywords: activity concentration; uranium; thorium; potassium; natural radioactivity; soil; Burkina Faso.

Reference to this paper should be made as follows: Kabore, K., Bambara, L.T., Zongo, I., Cisse, O., Zougmore, F. and Darko, E.O. (2022) 'Natural radioactivity level and evaluation of radiological hazard in the soil around a gold mining area in the North Region of Burkina Faso', *Int. J. Global Environmental Issues*, Vol. 21, Nos. 2/3/4, pp.343–356.

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1 Introduction

Radionuclides are present everywhere in the natural environment (UNSCEAR, 2000). The main natural contributors to external exposure from gamma-radiation are the uranium and thorium series, also with potassium 40 (^{40}K) and may be present in small quantities on the surface of the earth (Aguko, 2013; Faanu et al., 2012). Long-lived

radioactive elements such as uranium, thorium and potassium and their decay products, such as radium and radon are examples of naturally occurring radioactive materials (NORMs). These elements have always been present in the earth's crust and atmosphere since earth creation.

The ^{238}U and its daughters rather than ^{226}Ra and its daughter products are responsible for the major fraction of the internal dose received by humans from naturally occurring radionuclides. Even though the concentrations of these radionuclides are widely distributed in nature, they have been found to depend on the local geological conditions and as a result vary from place to place (UNSCEAR, 2000; Faanu, 2011). This is because the specific levels are related to the type of rock from which the soil originates. Throughout the history of life on earth, organisms have been continuously exposed to radiation mainly from cosmic rays in the atmosphere, and from naturally occurring radionuclides which are ubiquitously distributed in all living and non-living components of the biosphere. A wide range of activity concentrations in a wide variety of materials is reported (IAEA, 2011).

Mining has been identified as one of the potential sources of exposures to NORM (UNSCEAR, 2000).

Within the last ten years, many mining companies have been operating in Burkina Faso and some are even establishing. Burkina Faso is a country in West Africa with the capital city Ouagadougou. However, like in the other developing countries, in Burkina Faso mining activities have not been duly controlled and no radiological regulatory controls are applied. Therefore, there is general lack of awareness and knowledge of the radiological hazards and exposure levels by legislators, regulators and operators.

The objective of the study was to assess the level of NORM in the North Region of Burkina Faso surrounding the mining site of Kalsaka. This consists of measuring the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K in soil samples from Kalsaka area around the mining site by assessing the radiological hazard and risk associated to the members of the community living in this area.

2 Materials and methods

2.1 Studied area characteristics

The studied area is the North Region of Burkina Faso surrounding the mining site of Kalsaka. Kalsaka is located in the North Region of Burkina Faso approximately 150 km from Ouagadougou, the capital city of Burkina Faso at a latitude of 13°10′51″N and a longitude of 1°58′46″W.

2.1.1 The relief

Burkina Faso is a land rock country located in the West Africa Region. The relief of the Northern Region of Burkina Faso is uneven. The main forms of reliefs are dominated by granite and sedimentary monotone peneplains. The hills are composed by schists and green rocks which localised in the eastern part of the region. There are also undulating

Birimian landscapes in the central part. Some tabular cuirasses and a dune system are to be noted in a little varied landscape. In the south of the region the territory is largely covered with thick, well-consolidated ancient ferruginous lateral cuirasses: crystalline rocks and metamorphic rocks (Koama, 2009).

2.1.2 The soil

Soils in this region can be classified into four groups (Koama, 2009):

- Rough mineral soils, more or less hard and unsuitable for crops. These soils are not very useful for agriculture and they have a humiferous horizon of 20 to 80 cm. It's a more common soil in the region (57.6% of the area).
- Soils of the type 'ferruginous leached deep' (10% of the surface), they are located on medium glazes and it's not submitted to erosion.
- Brown and ferruginous soils. These soils are a satisfactory depth from 80 to 120 cm and represent only 2.1% of the area.
- Plains, lowland and depression soils. Their silty-clay texture and their depth (over 120 cm) give them a good water retention capacity (20% of the area).

2.1.3 Climate and vegetation

The climate of the northeast region is essentially dry continental Sudano-Sahelian in the South and Sahelian in the North. It is characterised by two seasons: a dry season from October to May with a cold period from November to February characterised by north-east harmattan and south-west winds. A rainy season goes from June to September with an average rainfall that varies between 500 and 800 mm. Every season duration is very variable.

Thermal amplitudes are also very variable. Maximum temperatures reach 45°C (in April) and a minimum temperature is 15°C (in February). Evapotranspiration rises to 2,600 mm in the north and 1,900 mm in the south.

The months of July, August and September represent a period of excess of precipitation and evapotranspiration. The precipitation of this period contributes highly to the supply of underground aquifers.

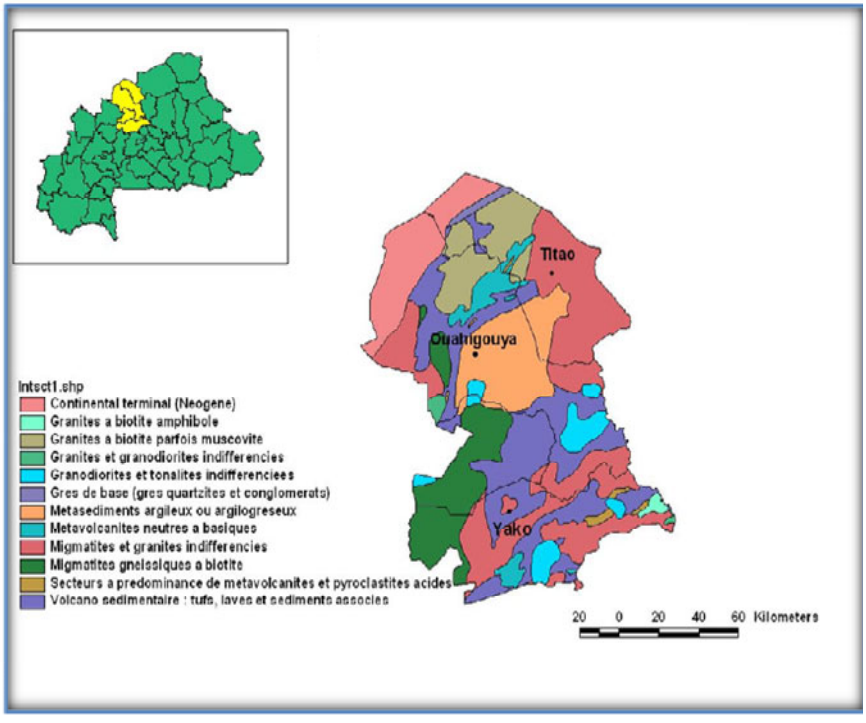
The Northern Region of Burkina Faso is located in the Savanna of Burkina Faso. The main plant formations are tiger bush in the north, typically Sahelian vegetation at the centre; thorny trees and shrubs concentrates dominate in the plains which is the shrub steppe. A Savanna more southerly and along the backwaters, their extent and density reduced by anthropogenic degradation (Koama, 2009).

2.1.4 Geology

The crystalline rocks constitute almost the entire subsoil of the northern region except in the northwest where the base disappears under the sedimentary formations of the infracambrian (Koama, 2009).

Figure 1 shows the geology of the study area.

Figure 1 Geological map of the studied area (see online version for colours)

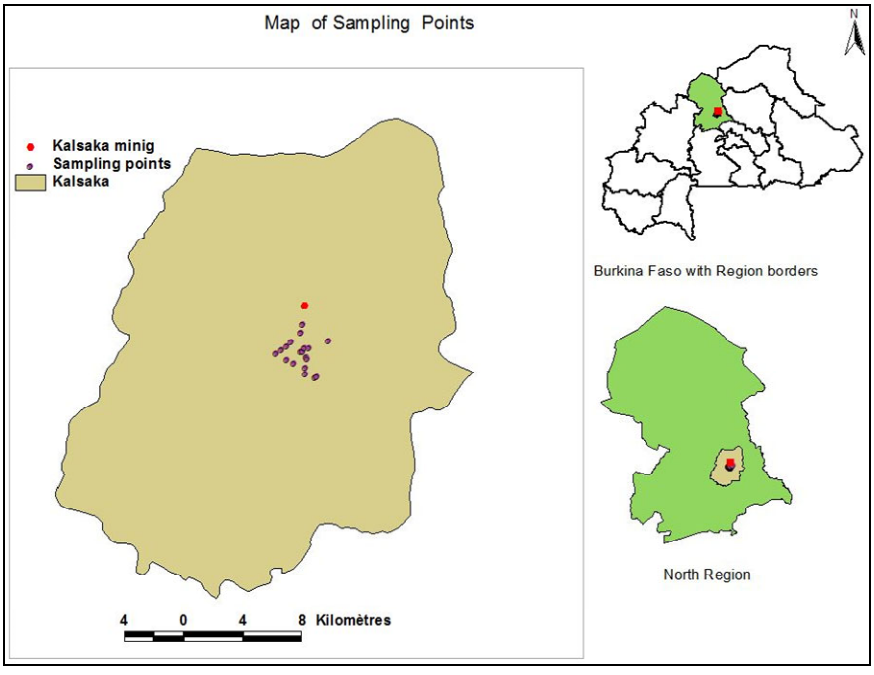


2.2 Sampling and samples preparation

Nineteen soil samples were collected randomly within selected areas in the North Region of Burkina Faso surrounding the mining site of Kalsaka in Burkina Faso as shown in Figure 2. A plastic dust pan and brush were used to collect the soil and transferred into some clean polythene bags. The samples were properly labelled catalogued and brought to the radiation laboratory at the Radiation Protection Institute (RPI) at Ghana Atomic Energy Commission (GAEC) in Ghana. The samples were analysed using gamma spectrometry to determine the activity concentration of radionuclides. In the laboratory, the soil samples collected were air-dried in trays for seven days and then oven dried at a temperature of 105°C to remove all the moisture contents. The samples were then grinded into fine powder using a ball mill to increase the total emission area (Faweya et al., 2014) and packed into 1 litre Marinelli beakers. The Marinelli beakers filled with the samples were then sealed and stored for four weeks in order to allow secular equilibrium between ^{226}Ra and ^{232}Th and their decay products before counting by gamma-ray spectrometry. Each sample was counted using a high purity germanium (HPGe) detector.

Figure 2 shows the sampling locations obtained by using the GPS coordinates of sampling points.

Figure 2 Sampling location points (see online version for colours)



2.2.1 Spectrometry system calibration

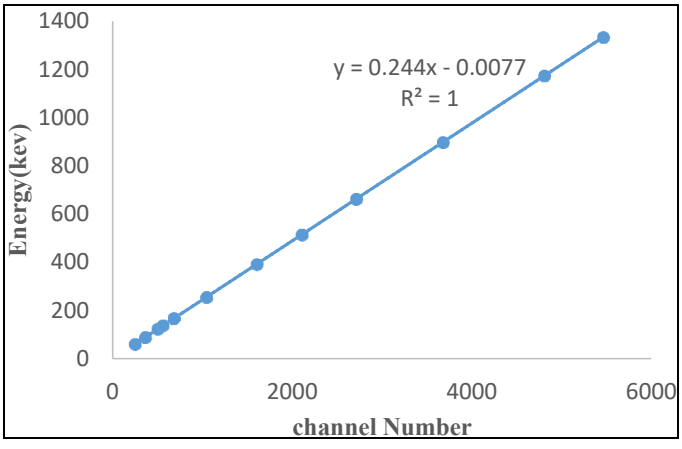
The gamma spectrometry system used for this study consists of a HPGe detector with the following characteristics (Canberra detector model GX4020, cryostat model 7500SL and preamplifier model 2002CSL). It has a diameter of 60.5 mm, length of 61.5 mm. The resolution of the detector is 2.0 keV and relative efficiency of 40% for 1.33 MeV gamma energy of ^{60}Co. The output from the detector is connected to a desk top computer provided with 'Genie 2000' configuration software for spectrum acquisition and evaluation. In order to do the measurement, energy and efficiency calibration were adjusted previously.

A relationship between the channel numbers corresponding to specific gamma-ray energies was determined before sample counting. The establishment of this relationship is known as energy calibration (shown in Figure 3) and the idea is to identify the radionuclides in a sample. The linearity of energy response is an essential feature for any γ-ray detector and the direct proportionality between the quality of energy deposited in the detector by the incident radiation event and the height of the output pulse ensures that the system is working properly (Osvath, 2008). Accurate calibration involves a standard sources with gamma ray energies that are not widely different from those to be measured in the unknown spectrum.

The energy calibration was made by means of multi peaked and multi nuclides radioactive standard sources emitting gamma rays of precisely known energy and the peak position in channels with this energy is identified. In this study this was carried out by counting standard radionuclides (a mixture of ^{241}Am, ^{109}Cd, ^{139}Ce, ^{57}Co, ^{60}Co, ^{137}Cs,

^{113}Sn, ^{85}Sr and ^{88}Y) of known activities with well-defined energies in the energy range of 60 to ~2,000 keV. The standard was counted on a detector for ten hours or 36,000 s.

Figure 3 Energy calibration curve (see online version for colours)



2.2.2 Determination of activity concentration

From the spectrum analysis, count rates for each detected photo peak and activity per unit mass, the specific activity for each of the detected nuclides are calculated. The specific activity (in Bq.kg^{-1}) A_{Sk}, of a nuclide k, for a peak at energy net and molecular mass m is given by:

$$A_{Sk} = \frac{(Net)_{Ek}}{\varepsilon_{Ek} \times p_{\gamma} \times T \times m} \tag{1}$$

where A_{Sk} is the activity concentration (Bq/kg) of the radionuclide of interest, ε_{Ek} is the detection efficiency at energy E_k, T is the counting live time, P_{γ} is the number of gamma-rays per disintegration of this radionuclide for a transition at energy E of the measured sample. If there is more than one peak in the energy analysis range for a nuclide an attempt is made to average the activities for the peak. The result is then the weighted radionuclide's average activity concentration. The activity concentrations of ^{238}U and ^{232}Th in samples collected were determined using the measured γ-ray photo peaks, emitted by specific radionuclides in their decay series whereas the activity concentrations of ^{40}K is calculated from the measured γ-ray photo peaks directly. In other words, the activity concentration of ^{238}U was calculated from the average of 609.31 keV of ^{214}Bi and 1,764.5 keV of ^{214}Bi, in the decay series of ^{232}Th gamma photons are emitted at energies of 239 keV (^{212}Pb), 583 keV (^{208}Tl) and 911 keV (^{228}Ac) which are used to determine the activity concentrations of ^{232}Th by gamma spectrometry, and 4^{0}K was determined from 1,460.0 keV.

2.2.3 Calculation of absorbed dose rate in air (D) and annual effective dose equivalent from activity concentration

A direct relationship between radioactivity concentrations of natural radionuclides and their exposure is referring to absorbed dose rate in air at 1 m above the ground. This factor is important quantity to assess when considering radiation risk to a bio system. This is calculated from the activity concentrations using the equation (2) (Faanu et al., 2012; Oyedele, 2006).

$$D_\gamma \left(nGyh^{-1}\right) = DCF_K \times A_K + DCF_U \times A_U + DCF_{Th} \times A_{Th} \quad (2)$$

where DCF_K = 0.0417, DCF_U = 0.462 and DCF_{Th} = 0.604 are the absorbed dose rate conversion factors for *K*-40, *U*-238 and *Th*-232 in nGy/h/Bq/kg and A_K, A_U and A_{Th} are the activity concentrations for *K*-40, *U*-238 and *Th*-232, respectively.

For the safe use of a stone, *D* must be lower than the recommended value 55 nGy/h (UNSCEAR, 2013; Shohda et al., 2018).

The radium equivalent and hazard indices will be calculated for the studied soil. In order to provide the radiological risk to which an individual is exposed, the absorbed dose is considered in terms of annual effective dose equivalent (AEDE) from terrestrial gamma radiation taking into account the conversion coefficients from absorbed dose in air to effective dose which is estimated to be 0.7 Sv/Gy and the outdoor occupation factor of 0.2 (UNSCEAR, 2000). The outdoor AEDE was estimated by using the following equation (3) (Faanu et al., 2012; Baba et al., 2004; Darko and Faanu, 2008).

$$E_\gamma = D_\gamma \times 0.2 \times 8760 \times 0.7 \quad (3)$$

where E_γ is the average annual effective dose and D_r is the absorbed dose rate in air

2.2.4 Determination of radium equivalent activity and radiation hazard indices

The radiological hazard of the natural radioactivity was evaluated also by calculating the radium equivalent concentration (Ra_{eq}), the external and internal hazard indices. The radium equivalent concentration (Ra_{eq}) is used to compare the uniformity in radiation of material containing different amounts of ^{226}Ra, ^{232}Th and ^{40}K. It is based on the estimation that 350 Bq/kg of ^{226}Ra, 259 Bq/kg of ^{232}Th and 4,810 Bq/kg of ^{40}K produce the same γ-ray dose rate (Xinwei et al., 2006). (Ra_{eq}) was calculated using equation (4) (Beretka and Mathew, 1985).

$$Ra_{eq} = C_{Ra} + 1.43C_{Th} + 0.077C_K \quad (4)$$

where C_{Ra}, C_{Th} and C_K are the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K respectively.

The external and internal hazard indices values must be less than one for the radiation hazard to be considered negligible, i.e., the radiation exposure due to the radioactivity from the construction material is limited to 1.5 mSv/y (Beretka and Mathew, 1985). In addition, Radon and its short-lived products are hazardous to the respiratory organs and as a result, the internal exposure to radon and its short-lived daughter products is quantified using the internal hazard index.

Radiation exposure due to ^{226}Ra, ^{232}Th and ^{40}K may be external and defined in terms of external hazard index. To evaluate the external gamma (γ) radiation dose from soil, the

following model was used as criterion. This model uses the external hazard index Hex used by Hayumbu et al. (1995) defined as equation (5):

$$H_{ex} = \frac{C_{Ra}}{370} + \frac{C_{Th}}{259} + \frac{C_K}{4{,}810} \leq 1 \tag{5}$$

where C_{Ra}, C_{Th} and C_K are the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K, respectively. This index must be less than unity so that the annual effective dose due to radioactivity in the soil will be less than or equal to 1.5 mSv.yr^{-1}.

Radon and its short-lived products are also hazardous to the respiratory organs. The internal exposure to radon and its daughter products is quantified by the internal hazard index (H_{in}) which is given by the following equation (6) used by Nada (2004).

$$H_{in} = \frac{C_{Ra}}{185} + \frac{C_{Th}}{259} + \frac{C_K}{4{,}810} \leq 1 \tag{6}$$

where C_{Ra}, C_{Th} and C_K are the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K, respectively, in Bq.kg^{-1} for the soil. For the safe use of a soil H_{in} should be less than unity.

2.2.5 Determination of activity utilisation index

To estimate the level of γ-radiation hazard associated with the natural radionuclides another radiation level index suggested by OECD (1979) are evaluated using the following equation:

$$I_\gamma = C_{Ra}/150 + C_{Th}/100 + C_K/1{,}500 \tag{7}$$

where C_{Ra}, A_{Th} and C_K are the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K, respectively, in Bq.kg^{-1} for the soil. For the safe use of a soil I_γ should be less than unity.

3 Results and discussion

3.1 The radioactivity concentration

The activity concentrations of ^{238}U, ^{232}Th and ^{40}K in soil samples from the North Region of Burkina Faso around the mining site of Kalsaka are shown in Table 1. As can be remarked in Table 1, the highest value of radioactivity of ^{238}U, ^{232}Th and ^{40}K are 41.43, 46.91 and 323.04 Bq.kg^{-1} respectively while the lowest value is 10.5, 15.01 and 63.87 Bq.kg^{-1}. The mean values for ^{238}U, ^{232}Th and ^{40}K are 26.06 ± 1.50 Bq.kg^{-1}, 33.27 ± 1.97 and 133.11 ± 13.69 Bq.kg^{-1} respectively.

The average activity concentrations of ^{238}U, ^{232}Th and ^{40}K in this study are lower than the values of 32, 45 and 420 Bg/kg respectively (UNSCEAR, 2000) but the most of values are higher than the activity reported by Shohda et al. (2018) and Baba et al. (2004). The activity concentration varies from one location to another. We can also notice that the ^{238}U activity concentrations in all the samples are lower than the world

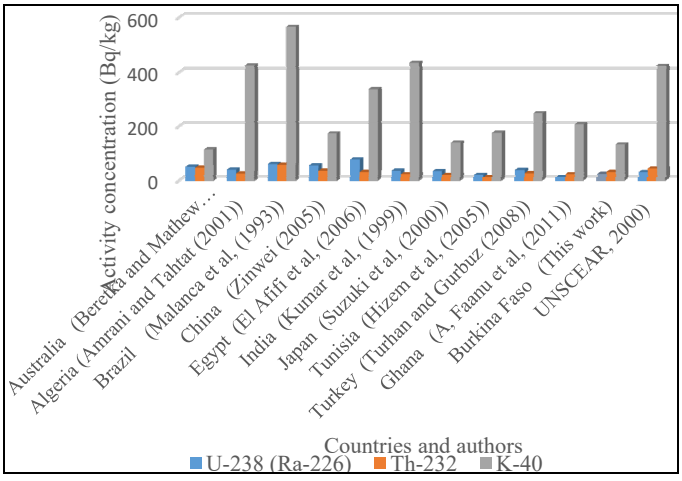
average except values in soil samples SSKA-007, SSKA-008 and SSKA-012. These differences could be explained by the mineral content difference of soil or the non-uniformity of sampling depth. For ^{232}Th and ^{40}K, all the samples had activity concentrations values less than the worldwide average except value in soil sample SSKA-007 for ^{232}Th which is above the limit value. Table 1 shows the activity concentration of ^{238}U, ^{232}Th and ^{40}K in soil samples from the North Region of Burkina Faso around the mining site of Kalsaka.

Table 1 Activity concentration of ^{238}U, ^{232}Th and ^{40}K in soil samples (see online version for colours)

Sample ID	*Activity concentration (Bq/kg)*		
	U	*Th*	*K*
SSKA-001	30.36 ± 2.31	38.50 ± 1.28	146.48 ± 15.49
SSKA-002	11.87 ± 0.97	15.06 ± 0.40	103.21 ± 10.91
SSKA-003	25.02 ± 1.58	24.06 ± 1.33	191.37 ± 19.95
SSKA-004	26.79 ± 1.44	36.14 ± 2.25	134.56 ± 14.22
SSKA-005	10.50 ± 0.82	15.01 ± 0.62	323.04 ± 33.67
SSKA-006	27.45 ± 1.19	27.68 ± 1.19	92.50 ± 09.77
SSKA-007	41.43 ± 2.05	46.91 ± 2.19	63.87 ± 06.75
SSKA-008	37.34 ± 3.46	32.71 ± 2.71	109.66 ± 11.43
SSKA-009	19.27 ± 1.32	38.54 ± 2.92	87.05 ± 08.47
SSKA-010	23.14 ± 1.37	40.73 ± 2.36	119.46 ± 12.45
SSKA-011	27.36 ± 1.49	35.61 ± 2.44	104.68 ± 11.62
SSKA-012	32.18 ± 2.11	39.73 ± 2.27	213.26 ± 20.47
SSKA-013	29.42 ± 1.51	34.82 ± 2.28	167.85 ± 16.80
SSKA-014	28.34 ± 1.42	29.91 ± 1.77	114.74 ± 11.49
SSKA-015	21.87 ± 1.11	32.56 ± 2.40	89.33 ± 08.53
SSKA-016	28.75 ± 1.52	41.23 ± 2.21	117.27 ± 12.64
SSKA-017	20.87 ± 1.13	38.81 ± 2.72	108.73 ± 11.79
SSKA-018	25.69 ± 1.04	30.56 ± 2.43	127.53 ± 12.56
SSKA-019	27.53 ± 1.15	33.64 ± 1.75	113.74 ± 11.20
Min	10.50 ± 0.82	15.01 ± 0.62	63.87 ± 06.75
Max	41.43 ± 2.05	46.91 ± 2.19	323.04 ± 33.67
Mean	26.06 ± 1.50	33.27 ± 1.97	133.11 ± 13.69

Figure 4 shows a comparison of the activity concentrations of ^{238}U, ^{232}Th and ^{40}K of the present work with other works (Amrani and Tahtat, 2001; Malanca et al., 1993; Afifi et al., 2006; Kumar et al., 1999; Suzuki et al., 2000; Hizem et al., 2005; Turhan and Gürbüz, 2008) and UNSCEAR reference limits in soil sample. Regarding to Figure 4, the results of the activity concentrations in this study are lower than the worldwide average values compared to similar works done in other countries.

Figure 4 Comparison of the activity concentrations of ^{238}U, ^{232}Th and ^{40}K with other works and UNSCEAR reference limits (see online version for colours)



3.2 The adsorption dose rate

The absorbed dose in air express the received dose in the open air from the radiation emitted from radionuclides activity concentrations in the environmental materials. This factor is important quantity to assess when considering radiation risk to a bio system. The absorbed dose rate obtained in this work varied in a range of 16.58–60.95 nGy/h with an average value of 37.69 nGy/h. The average value in this study is lower than the value of 60 nGy/h limit estimated from soil concentrations.

3.3 The annual effective dose

The corresponding average annual effective dose was 0.050 mSv/year. The natural radioactivity in building materials is usually determined from the activity concentrations of ^{226}Ra, ^{232}Th and ^{40}K.

3.4 Radium equivalent activity

The radium equivalent activity (Ra_{eq}) is related to the external gamma dose from the terrestrial radionuclides and the internal dose due to radon and its decay products of ^{210}Pb and ^{201}Po.

In this study, the average radium equivalent activity (Ra_{eq}) obtained in the samples was 83.89 Bq/kg in a range of 36.88–133.39 Bq/kg. The acceptable limit value of Ra_{eq} for building purposes is 370 Bq/kg for the material to be considered safe for use.

3.5 External hazard index

Radiation exposure due to ^{226}Ra, ^{232}Th and ^{40}K may be external and defined in terms of external hazard index. The average external is 0.23 which are less than the unity considered as a limit by UNSCEAR.

3.6 Internal hazard index

Radon and its short-lived products are also hazardous to the respiratory organs. The internal exposure to radon and its daughter products is quantified by the internal hazard index (H_{in}). The average internal is 0.30 are less than the unity.

3.7 Activity utilisation index

The activity utilisation index is used to estimate the level of γ-radiation hazard associated with the natural radionuclides another radiation level index suggested by OECD (1979). The average activity utilisation index is 0.60 with a maximum of 0.79 and the minimum of 0.30 that are less than the unity, so no hazard can be due to the activity utilisation index.

Table 2 absorbed dose rate, annual effective dose, radium equivalent activity (Ra_{eq}), external (H_{ex}) and internal (H_{in}) hazard indices and activity utilisation index

Sample ID	*Absorbed dose rate, nGy/h*	*Annual effective dose, mSv*	*Radium equivalent (Bq/kg)*	*External hazard index (H_{ex})*	*Internal hazard index (H_{in})*	*Activity utilisation index (Bq/kg)*
SSKA-001	43.39	0.05	96.69	0.26	0.34	0.69
SSKA-002	18.89	0.02	41.37	0.11	0.14	0.30
SSKA-003	34.07	0.04	74.16	0.20	0.27	0.53
SSKA-004	39.82	0.05	88.83	0.24	0.31	0.63
SSKA-005	27.39	0.03	56.84	0.15	0.18	0.44
SSKA-006	33.26	0.04	74.15	0.20	0.27	0.52
SSKA-007	50.14	0.06	113.43	0.31	0.42	0.79
SSKA-008	41.59	0.05	92.58	0.25	0.35	0.65
SSKA-009	35.84	0.04	81.13	0.22	0.27	0.57
SSKA-010	40.27	0.05	90.58	0.24	0.31	0.64
SSKA-011	38.51	0.05	86.34	0.23	0.31	0.61
SSKA-012	47.76	0.06	105.41	0.28	0.37	0.75
SSKA-013	41.62	0.05	92.14	0.25	0.33	0.66
SSKA-014	35.94	0.04	79.95	0.22	0.29	0.56
SSKA-015	33.50	0.04	75.31	0.20	0.26	0.53
SSKA-016	43.08	0.05	96.74	0.26	0.34	0.68
SSKA-017	37.62	0.05	84.74	0.23	0.29	0.60
SSKA-018	35.65	0.04	79.21	0.21	0.28	0.56
SSKA-019	37.78	0.05	84.39	0.23	0.30	0.60
Average	37.69	0.05	83.89	0.23	0.30	0.60
Min	18.89	0.02	41.37	0.11	0.14	0.30
Max	50.14	0.06	113.43	0.31	0.42	0.79

Table 2 shows the absorbed dose rate, the annual effective dose, the radium equivalent activity (Ra_{eq}), and the external (H_{ex}) and internal (H_{in}) hazard indices and the activity utilisation index (Bq/kg) in the soil samples activity from the North Region of Burkina Faso surrounding the mining site of Kalsaka.

The radium equivalent activity (Ra_{eq}), the external (H_{ex}) and internal (H_{in}) hazard are used in order to assess if the soil could be a source of public radiation exposure if the it is used for building purposes the following hazard assessment.

The values of Ra_{eq}, H_{ex} and H_{in} are below the acceptable values. This indicates that soil in the studied area that might be used for building purposes may not pose any significant radiological radiation hazard and, thus, regarded safe.

All the average values are below the references limits.

4 Conclusions

The activity concentrations of natural radionuclides ^{238}U, ^{232}Th and ^{40}K in soil samples were measured using gamma spectrometry with high purity germanium detector. The mean activity concentration of ^{226}Ra, ^{232}Th and ^{40}K were 26.06 ± 1.50 Bq.kg^{-1}, 33.27 ± 1.97 Bq.kg^{-1} and 133.11 ± 13.69 Bq.kg^{-1} respectively. The average absorbed dose was 0.038 μGy/h whereas the annual committed effective dose was 0.050 ± 0.003 mSv.y^{-1}. The average radium equivalent activity concentration was 83.89 Bq.kg^{-1}. The external and internal hazard indices where 0.23 and 0.30 respectively which are three times less than one. The mean effective dose rate of 0.05 ± 0.003 mSv.y^{-1} and the mean values of Ra_{eq} and H_{ex} and H_{in} for the studied area are below their respective permissible limits. The activity utilisation index was 0.6 Bq.kg^{-1} with maximum of 0.79 Bq.kg^{-1} inferior to the unity. This indicates that soil in the studied area that might be used for building purposes may not pose any significant radiological radiation hazard and, thus, regarded safe. The results of this study show that radiation hazard is not significant in this area.

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