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MEASUREMENT OF ACTIVITY CONCENTRATIONS IN SOIL SAMPLES IN BITSICHI AREA OF PLATEAU STATE

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ABSTRACT
The activity of thirty (30) soil samples collected from the mines and mills were determined using gamma ray spectrometry. For ^{40}K the value lies between (93.3 ± 30.1) Bq/kg – (10231.7 ± 482.0) Bq/kg. The activity concentration for Uranium range from (81.1 ± 22.2) Bq/kg – (12025.0 ± 289.6) Bq/kg while that of Th fall between (171.1 ± 11.4) and (52588.9 ± 250.9Bq/kg). It may be deduced that the major source of the radioactivity is Th with a peak value recorded where monazite was mainly processed. The contributions to radiation dose that can be derived from these concentrations are seen to be high and pose serious detrimental health effect to the population in the area.

Keywords: Activity concentrations, soil samples, gamma ray spectrometry, Plateau State

INTRODUCTION

Among primordial radionuclides ^{238}U, ^{232}Th and ^{40}K contribute most to the total dose from the natural background radiation. Acidic igneous rocks such as those present at the island of "Volcano", generally exhibit high concentrations of these radionuclides as pointed out by Larsen and Goltfried (1960).

Man is exposed to ionizing radiation from various sources in his environment; these sources include the cosmic rays and natural nuclide sources in air, food and drinking water (NCRP, 1976). The external exposure is made up of the gamma radiation from natural radionuclides and cosmic rays while those obtained from food and drinking water constitute internal exposure. Also in our environment artificial sources maybe present due to human activities such as nuclear and atomic bomb testing, nuclear reactor explosions, industrial waste and affluent from factories. IAEA (1986) estimate of dose contribution in the environment shows that over 85% of radiation dose received by man are derived from the natural radionuclides while the remaining 15% is from cosmic rays and nuclear processes.

Tin mining and smelting in this area started many years ago. Frequently tinstone is associated with a number of mineral impurities (Mantell, 1970). Among these minerals are zircon, thorite, monazite and xenotine which appear to contain certain amount of radioactive Uranium and Thorium. Hence as a result of mining activity, their radioactive substances are released thereby contaminating the environment to which they are exposed (Ike et al, 2002, Umar and Rabiu 1999). This serves as a source of radiological hazard to man, plants and animals that reside in this environment. Studies were carried out in order to estimate the concentration of U and Th (Sanni et al, 1985). As a follow-up to these research works, the current work attempts to determine the activity concentrations due to ^{238}U, ^{232}Th and ^{40}K in this area with a view of assessing its possible radiation hazards on the workers and the general public living around the mining and milling areas.

MATERIALS AND METHOD

Thirty (30) soil and tailing samples were collected from the mining and milling areas of Bitsichi. These soils and tailings were air dried for several days and the samples were each separately grounded to pass through 500μm sieved and packed to fill cylindrical plastic containers of dimension 7.2cm in diameter and 6.0cm high to satisfy the selected optimal sample container height. The sample containers were subjected to three stages of sealing processes to prevent random escape of Radon and they were stored for a minimum period of 20 days.

Gamma ray spectrometer was employed in the measurement of the activity concentration using the high γ -lines. The measurement system consists of a 7.62cm X 7.62cm NaI (T1) detector housed in a 6cm thick lead shield line with Cadmium and copper sheets. The soil samples were mounted on the surface of the detector and each counted for 6 hours in reproducible sample-detector geometry. A computer based multichannel analyzer system with an ACCUSPEC programme was used for data acquisition and analysis of gamma spectra. The 1764 keV γ –line of ^{214}Bi was used in the assessment of the activity concentration for ^{226}Ra while 2614 keV γ –line of ^{208}Ti was used for ^{232}Th. The single 1460keV γ –line of ^{40}K was used in its content evaluation.

RESULTS/DISCUSSION

The activity concentrations of all the soil samples collected from the mining sites and mills at the various locations are presented in figures1to 3.From the results a peak value of (10231.7 ± 482.0) Bq/kg was observed for site number 13 and a minimum value of (93.3 ± 30.1) Bq/kg and (93.3 ± 29.8)Bq/kg were recorded for site numbers 1 and 2 for K, activity concentration.

A peak value of (12025.0 ± 289.6)Bq/kg for site number 13, (81.1 ± 22.2)Bq/kg and (81.1 ± .6)Bq/kg for site numbers 1 and 7 were observed for ^{238}U activity concentration as shown in fig 2. For ^{232}Th, a maximum value of (52588.9 ± 250.9)Bq/kg for site number 3 and a minimum value of (171.1 ± 11.4)Bq/kg for site number 1 was recorded as indicated in fig 3.

The least value that was recorded for site number 1 and 2 may be due to the fact that these were abandoned mining sites which shows that no mining activity is going on in these areas any longer and enrichment is reduced to the bearest minimum.

The U activity concentration ranged from (81.1 ± 22.2 – 12025 ± 289.6)Bq/kg. From the results, it may be deduced that the major source of radioactivity is Th with a peak values recorded where monazite is mainly processed. This is in agreement with previous works carried out by Jwanbot and Ike 1999, Ike et al 2002, and Banwo, 1989.

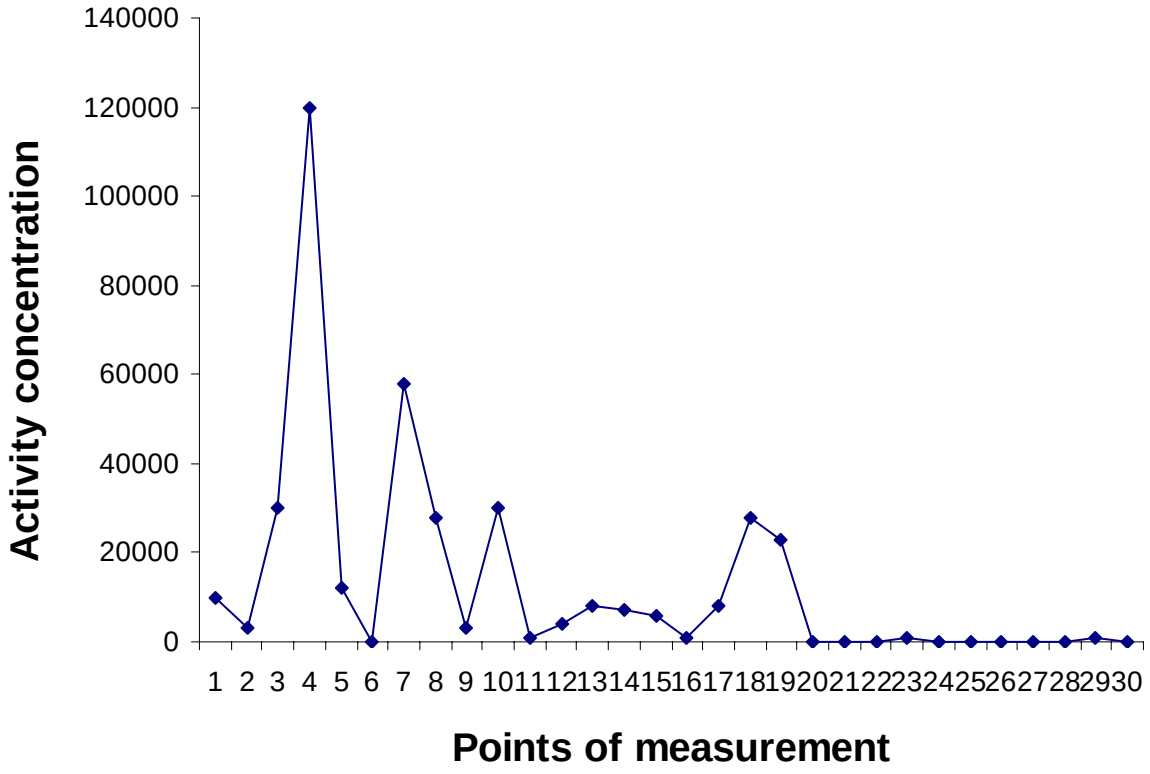

Figure 1: Activity concentrations (Bq/Kg) for ^{40}K for the soil sample

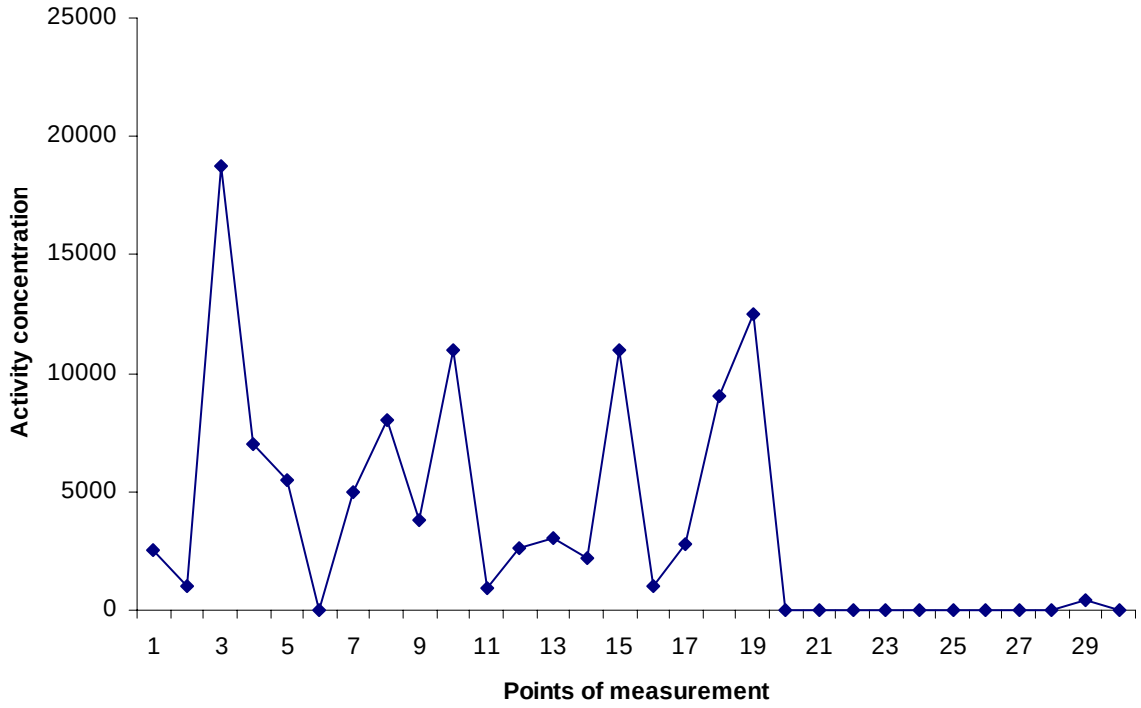

Figure 2: Activity concentrations (Bq/kg) for ^{226}Ra from the soil samples

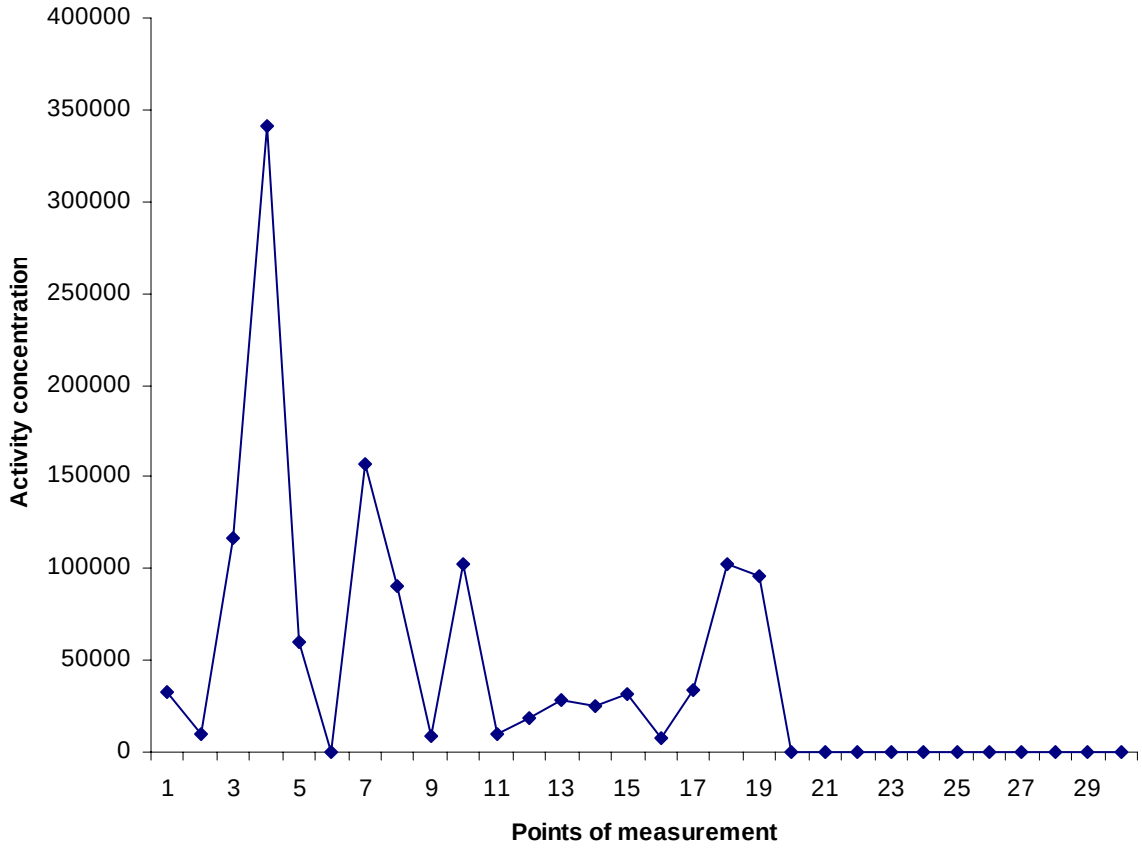

Fig 3: Activity concentrations (Bq/Kg) for ^{232}Th for the soil samples

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