# POSSIBLE HEALTH HAZARD(S) ASSOCIATED WITH THE BETA RADIATION LEVELS IN HOUSES IN SOME MINING COMMUNITIES IN PLATEAU STATE

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**Abstract**

In tin's paper, the beta radiation levels in houses from Kuru, Forom and Bukuku communities of Plateau State were monitored using the radiation survey meter (type Puy-7A). The radiation mean equivalent doses for these communities were found to range between 0.0045 +.002 on mSv Avk for Kuru and 0.003 + 0.002 mSv/WK for Bukuru with the overall mean value of 0.004 + 0.002 mSv/WK. From the results obtained, there seemed to be no immediate health hazard posed by the radiation levels since all the measured values are within the standard maximum permissible level of 0.01 mSv/WK. However, the use of mine soil for building houses by these communities should be discouraged due to potential hazards associated with long time dose accumulation.

## Introduction

Mining is an act process or \\ork of extruding minerals of economic importance from (heir natural environments and transporting them to the point of processing and use. Mining, according to Adiuku-Brown (1999), has been taking place in this area for a period of about ninety (90) years. In this process, the minerals mined (which contain some radioactive impurities) are brought to the surface. This exposes the environment to radioactivity. The process of mining in the Jos Plateau has rendered about 325km$^2$ of land derelict (Alexander, 1985). Some of these radioactive materials in the environment find their ways into buildings and homes as building materials.

Some of the ionizing radiations associated with the impurities include Alpha and Beta particles as well as gamma -rays. All ionizing radiations are dangerous to human systems. The level of danger will be a function of such factors as the system exposed, type of radiations, duration of exposure, as well as the magnitude of the dose which one is exposed to (Azu and Ike, 1998).

Exposure of humans to nuclear radiation gives rise to absorption of its energy by bodily organs which in turn may result in the damage of critical and /or radio sensitive organs (Ajayi, 1999). When radiation is absorbed in the body it causes chemical reactions to occur which can alter the normal functions of the body. At high doses (above 1 sievert) this can result in massive cell death. organ damage and possible death to the individual. At low doses (less than 50mSv) the situation is more complex.

If the damage occurs in the testes or ovaries then hereditary effects in descendants may become imminent. The ICRP has therefore set the limits on exposure to ionizing radiation. This stipulates that the genera! public shall not be exposed to more than 5.0mSv per annum (over and above natural background): also occupational exposure shall not exceed 20mSv per annum. However, these limits exclude exposure due to background and medical radiation (radiation and health information, 2004). Houses have been studied that were radioactive and found to have effects on the immune system of the people living in them. (Change *el* a/, 1999).

The environment around these mining areas have been violated (i.e. the natural background), increased beside the fact that because of the nature of the soil, the houses themselves will record high activity: it is therefore very necessary to monitor these environments as regularly as achievable. To achieve this, the current radiation safety (monitoring) practice is to prudently assume protracted environmental exposure.

This study is undertaken to measure the activity levels in buildings around these mining communities and to assess the significance of their dose levels on human health. The communities involved here are Kuru, Forom and Bukuru.

## Material and Method

The instrument used for this research is a PUG-7A radiation survey equipment which is used to detect and measure gross Alpha and Beta radiations. This equipment has the ability by design to discriminate between Alpha and Beta particles and records the count rate per second. By adjusting the

distance between the source and the probe of the counter, the readings for beta radiations (only) were taken.

### Calibration of the Instrument

The instrument was first calibrated by using a strontium- 90 source (which is a beta emitter). The background count rate was taken using the un-calibrated instrument. The instrument was connected to a variable voltage source and the probe of the instrument stationed about 50cm from the radioactive source. The voltage was increased in steps while the count rate, was being recorded. The experiment was repeated by starting with the highest voltage reached and reducing in same steps to the lowest. A mean of the two was taken to represent the count rate against each voltage. The calibration table and curve are represented by table and figure 1 respectively.

After calibration, the radioactive source was removed and the background count rate was retaken so that the average of the two was used as the background count rate.

**Data Collection**

To measure the Beta radiation levels in buildings,-the survey meter was carried to forty buildings in each of the three communities under survey. In each building, four readings were taken and a mean of the readings recorded. A total of one hundred and twenty readings were recorded. The count rate was later converted to dose equivalent in mSv/ week.

**Data Analysis**

In order to compare the radiation level measured here with the maximum permissible level (MPL) of radiation absorbed, the count rates obtained were converted to dose equivalents.

For the counter 20c/s = I mR/week

If we recall that Dose equivalent (rem) = absorbed dose (rad) x quality factor (Q) But in order to convert exposure in roentgens (R) to absorbed dose (D) in rad we have D= FR where F is a factor whose value depends on the type of radiation, the energy of radiation and the nature of the absorbing layer. For mono-energetic beta particles, X - rays and gamma - rays, the mean value of F is 0.86 and 0.93 for air and body tissue respectively (Burcham, 1979).

The quality factor (Q) or relative biological effectiveness (in older literature) reflects an estimate of the relative harmfulness of the various radiations.

$$D = 0.86R$$

$$R - \frac{D}{0.86}$$

But R = 1.2 rad 1 mR=1.2mrad 20 c/s =
1 mR/WK = 1.2 mrad/week

$$1\ c/s = \frac{1.2x10'}{20}$$

$$-6.0xlO''^{5}rad/week$$

The quality factor for each radiation is shown in Table 1

Table 1. Quality factor for each radiation.

| Radiation | Quality Factor (Q) |
|---|---|
| X rays and gamma rays | 1 |
| Beta particles of energy | |
| < 0.03 Mev | 1.7 |
| > 0.03 Mev Alpha | 1 |
| Particles Recoil nuclei | 20 |
| Source: Henry (1963). | 20 |

The beta particles of energy <0.03 Mev with a quality factor of 1.7 have been used in preference to those of energy value > 0.3 Mev with quality factor of I. This was done because the

energies were not measured and a higher value beta particle with a low Q value of I might create a false sense of safety (Azu and Ike, 1998).

All the count rates were converted to dose equivalent in mSv/week by multiplying each count rate with a factor of 8.772x10"[7] The count rates with their corresponding dose equivalents are shown on table 2 and figures 2 and 3

**Results and Discussion Table 2: Count rate and Pose equivalent for the different towns**

| | Kuru | | Forom | | Bukuru | |
|---|---|---|---|---|---|---|
| S/NO | F (count/sec) | Dose Equivalent XI O[7] | F (count/sec) | Dose Equivalent XI(T[T] | F (count/sec) | Dose Equivalent XIO[7] |
| I | 6 | 52.632 | 3 | 26.316 | 4 | 35.088 |
| 2 | 10 | 87.72 | 4 | 35.088 | 5 | 43.86 |
| 3 | 4 | 35.088 | 4 | 35.088 | 5 | 43.86 |
| 4 | 7 | 61.404 | 4 | 35.088 | 4 | 35.088 |
| 5 | 10 | 87.72 | 5 | 43.86 | 4 | 35.088 |
| 6 | 6 | 52.632 | *4* | 45.088 | 2 | 17.544 |
| 7 | 7 | 61.404 | 4 | 35.088 | 3 | 26.316 |
| 8 | 3 | 26-316 | 5 | 43.86 | 2 | 17.544 |
| 9 | 5 | 43.86 | 4 | 35.088 | 14 | 122.808 |
| 10 | 9 | 78.948 | 7 | 61.404 | 4 | 35.088 |
| 11 | 8 | 70.176 | 11 | 96.492 | 17 | 149.124 |
| 12 | 3 | 26.316 | 7 | 61.404 | 4 | 35.088 |
| 13 | 4 | 35.088 | 8 | 71.176 | 14 | 122.808 |
| 14 | 4 | 35.088 | 7 | 61.404 | 3 | 26.316 |
| 15 | 4 | 35.088 | 5 | 43.86 | 4 | 35.088 |
| 16 | 3.2 | 28.0704 | 8 | 70.176 | 5 | 43.86 |
| 17 | 3 | 26.316 | 6 | 52.632 | 3 | 26.316 |
| IS | 3 | 26.316 | 5 | 43.86 | 4 | 35.088 |
| 19 | 4 | 35.088 | 5 | 43.86 | 4 | 35.088 |
| 20 | 3 | 26.316 | 8 | 70.176 | 8 | 70.176 |
| 21 | 3 | 26.316 | 2 | 17.544 | 2 | !7.544 |
| 22 | 4 | 35.088 | 2 | 17.544 | 3 | 26.316 |
| 23 | 6 | 52.632 | 3 | 26.316 | 2 | 17.544 |
| 24 | 6 | 52.632 | 2 | 17.544 | 1 | 8.772 |
| 25 | 4 | 35.088 | 2 | 17.544 | 1 | 8.772 |
| 26 | 5 | 43.86 | 2 | 17.544 | 2 | 17.544 |
| 27 | 8 | 70.176 | 3 | 26.316 | 3 | 26.316 |
| 28 | 4 | 35.088 | 2 | 17.544 | 2 | 17.544 |
| 29 | 4 | 35.088 | 1 | 8.772 | 1 | 8.772 |
| 30 | 3 | 26.316 | 1 | 8.772 | 2 | 17.544 |
| 31 | 7 | 61.404 | ! | 8.772 | 3 | 26.316 |
| 32 | 9 | 78.948 | 1 | 8.772 | 5 | 43.86 |
| 33 | 6 | 52.632 | 3 | 26.316 | 5 | 43.86 |
| 34 | 3 | 26.316 | 2 | 17.544 | 2 | 17.544 |
| 35 | 5 | 43.86 | 2 | 17.544 | 1 | 8.772 |
| 36 | 4 | 35-088 | 3 | 26.316 | 3 | 26.316 |
| 37 | 5 | 43.86 | 2 | 17.544 | 2 | 17.544 |
| 38 | 5 | 43.86 | 2 | 17.544 | 2 | 17.544 |
| 39 | 4 | 35.088 | 2 | 17.544 | 1 | 8.772 |
| 40 | 5 | 43.86 | 3 | 26.316 | 3 | 26.316 |
| Mean | 5.155 | 45.21966 | 3.875 | 33.9915 | 3.975 | 34.8687 |
| Stand. Dev | 2.039853 | 17.89359 | 2.366296 | 20.75715 | 3.519087 | 30.86943 |

Table 2 above represents the results obtained from radiation survey of some one hundred and twenty (120) houses in these three communities.

From table 2, the figures for Kuril are higher than those in the other areas. They range from 3 counts per second to 10 count per second (representing doses of between 0.0026mSv/wee_k and 0.0087mSv/week). The figures from Forom are generally lower, with count rates of between I count per second and II counts per second (representing doses of between O.OOsmSv/wee and 0.01 mSv/week. The figures for Bukuru range from I count per second to 17 counts per second (representing doses of between 0.0008mSv/week and 0.015 mSv/week).

From the figures, Kuril has a mean count rate 5.16+2 (which gives 0.0045 + 0.002 mSv/week). While the mean count rate for Form is 3.9 + 2.4 counts per second (0.003 + 0.002 mSv/week), Bukuru has a mean count rate of 3.98 + 3.5 counts per second (3.004 + 002 mSv).

Although the figures from Kuril show a higher average, no house in the area has radiation dose clearly above the maximum permissible level (MPL). From figure 3, it is clear that only one house in Forom (house number II) has its radiation dose figure close to 0.01 mSv/week. In Bukuru, three houses namely houses numbers 9, II and 13 have radiation doses above the MPL, the rest of the houses are far below the MPL level.

The three houses with elevated radiation doses may be due to the source from which the building blocks were made, the above reason is because the three houses involved are close to each other. The case of Forom may be due to the same factor. In the case of Kuru, although the ionizing radiation figures are fairly high relative to the other areas, people seem to have heeded the warnings not to meddle with mine products.

With only three (3) houses out of the one-hundred and twenty (120) houses surveyed (2.5%) peripherally exceeding 0.01 mSv/week, it is clear that those living in these houses are not under any immediate threat from ionizing radiation. Looking at the results in Table 2 and Figure 3 it is clear that most houses in the communities have their radiation levels quite below the maximum permissible values of 0.01 mSv/week.

## Conclusion

Having used the radiation survey meter to check the radiation levels around the buildings, the result show that more than 90% of the houses have their dose levels below the maximum permissible level for the general public. This is encouraging since it does not spell out any immediate health hazard. However, if the suggestions in the discussion are implemented, the communities will stand to benefit.

## Recommendations

a. It is necessary to educate the members of the mining communities and to discourage them from using mine soil as building materials.
b. Since the tin mining and other prospecting activities are widespread in the Jos Plateau, it will be good to extend the monitoring activity to other mining communities and to make it a continuous process,
c. Mine workers and owners should be advised to close up mine ponds since they constitute potential health hazards (Udezie, 2004; Adikwu-Brown, 1999).
d. The present work (for logistic reasons) was done on the outside walls of these houses, monitoring should also be done inside these houses.

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**Table 3: Count Rate and Voltage**

| Count Rate | Voltage |
|---|---|
| 94 | 320 |
| 96 | 340 |
| 98 | 360 |
| 98 | 380 |
| 98 | 400 |
| 100 | 420 |
| 100 | 440 |
| 101 | 460 |

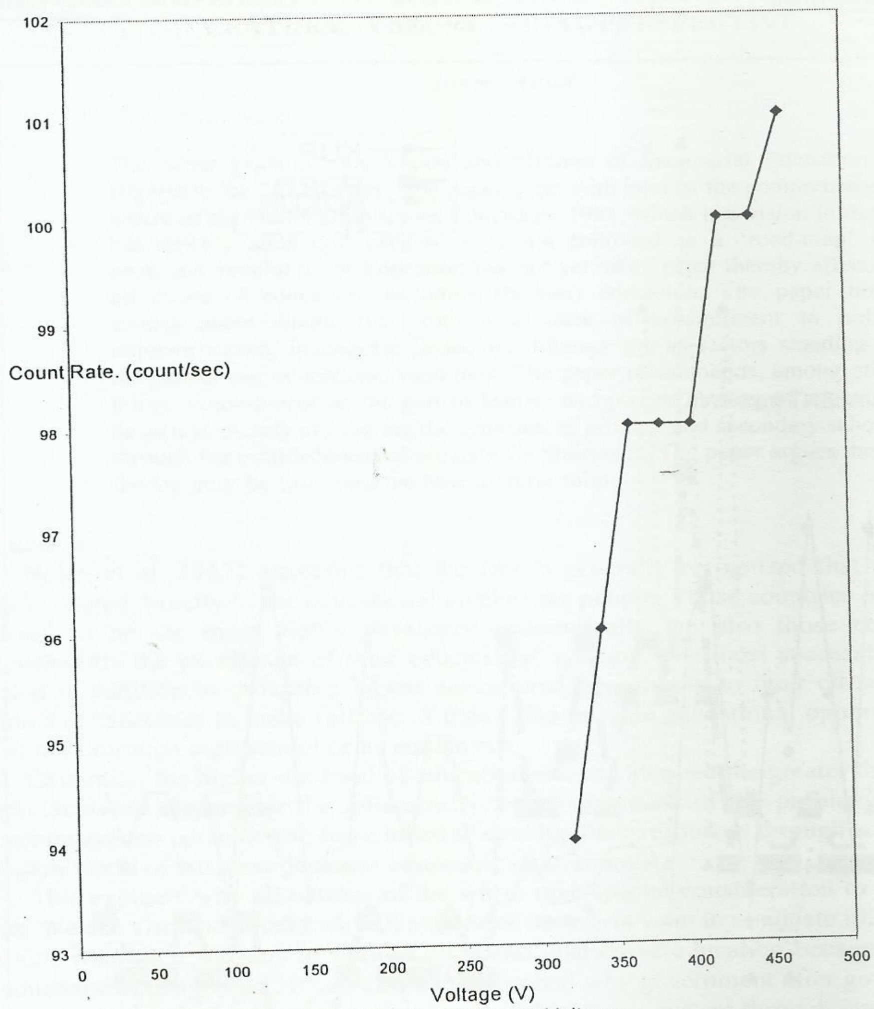


Fig.1 Count Rate against Voltage.

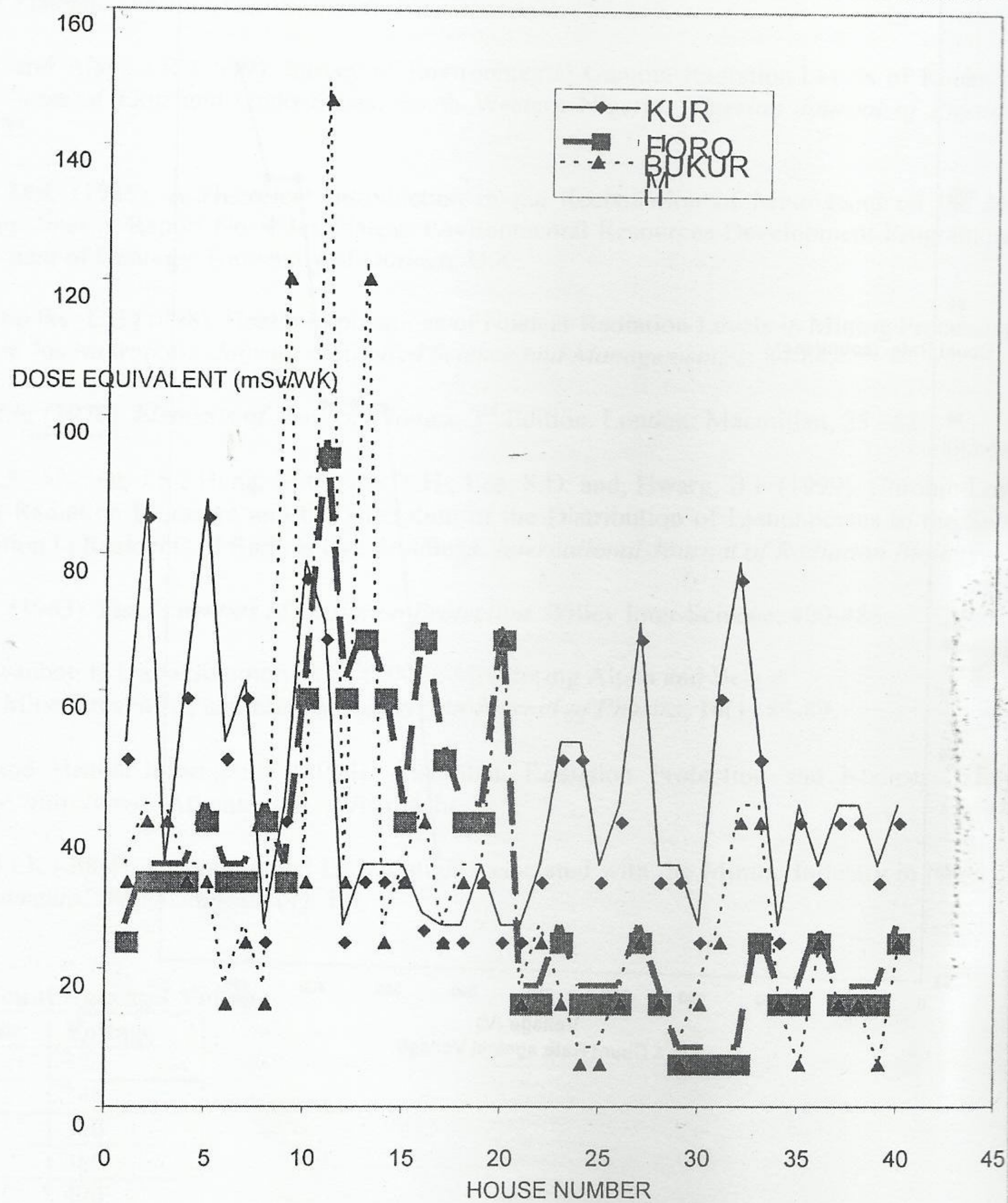


FIG. 3 DOSE EQUIVALENT AGAINST HOUSE NUMBER.