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# Study of the natural background gamma radiation and the gamma exposure level around Mysore

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**Abstract** : The ambient gamma radiation exposure level has been measured using scintillometer at selected locations around Mysore. In addition to this, the natural background gamma spectrum at the Department of Physics has also been recorded using HpGe detector. The result reveals that the ambient gamma radiation exposure level ranges from 50 ngray/hr to 200 ngray/hr.

**Keywords** : Background spectrum, exposure rate, scintillometer, HpGe detector.

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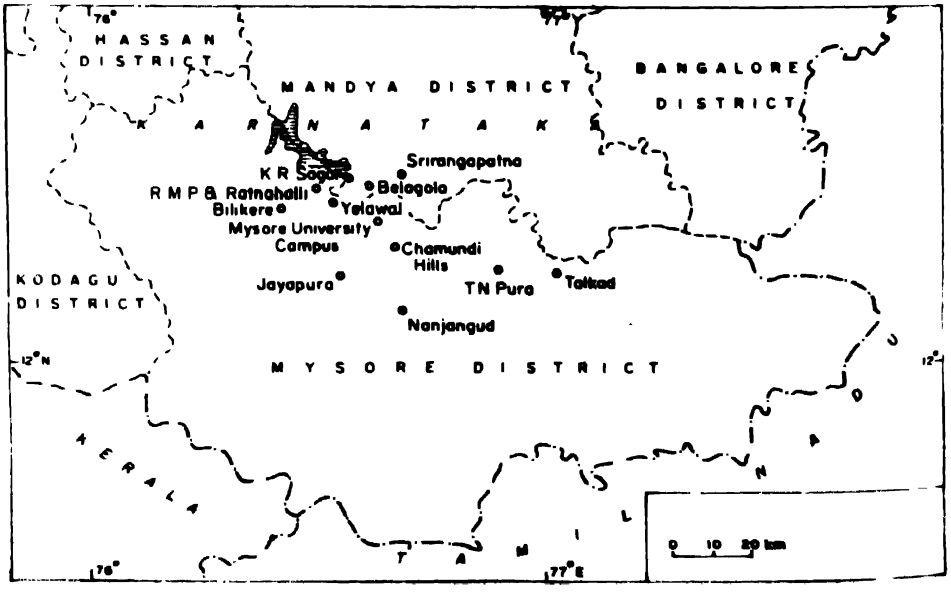
## 1. Introduction

The radiations which emanate from the environmental matrices (soil, water, building materials etc.,) in the energy range of the order of a few keV to MeV are referred to as the environmental radiations or background radiations. This is due to several factors, such as, cosmic radiation, the presence of radionuclides in the earth's crust, radon/thoron gases present in the atmosphere and also due to atmospheric fallout. The most common radionuclides present in the earth's crust are $K^{40}$, $Th^{232}$ and $U^{238}$. The radioactive decay of thorium and uranium result in the production of a large number of radionuclides having small as well as large life times. These radionuclides emit $\alpha$, $\beta$ and $\gamma$ radiations. The first two radiations emitted inside the earth's crust are completely absorbed, where as the gamma radiations will be transmitted to the atmosphere. The radiations due to cosmic rays, radon/thoron gases present in the atmosphere, radioactive elements present in the environment due to radioactive fallout and the radiations emanated from the earth's crust are responsible for the environmental radiation. Because of low concentration of uranium, thorium and K-40 and also scarce fallout, the radiations in the environment is of very low level.

The human population is continuously exposed to the above ionising radiations both internally as well as externally. This is due to intake of air contaminated with radon and thoron gases, also due to drinking water containing radium and also because of consuming food materials with number of radionuclides such as $U^{238}$ and its daughters, isotopes from fallout *viz.*, $Sr^{90}$, $Cs^{137}$, $I^{131}$, $H^3$ etc [1]. The dose rate that a person receives in a specified period due to these radiations should be within the maximum permissible (0.3 R/week or 17,857 ngray/hr) limit as recommended by the International Commission on Radiological protection [2].

Mysore is located in the southern part of Karnataka (India) and it is known for its beautiful environment (Geographical latitude 12° 18′ and 777 m above the sea level). A large number of different types of industries are coming up around Mysore. This is expected to enhance the air pollution. Therefore, the study of natural background radiation level as well as the presence of radionuclides in the environmental matrices is very important from the point of view of assessment of the impact due to these various industries on the Mysore environment.

An attempt is made to measure the ambient gamma radiation exposure level in and around Mysore by selecting the places like Bilikere, RMP surroundings, Yelawala, Srirangapatna, Chamundi hill, Jayapura, Nanjangud, Talkad and T. Narasipura (map) Except T. Narasipura and Talkad all the places fall within the radius of about 20 km from the city of Mysore. The study of this nature has not been made so far in this part of the country.



## 2. Experimental method

### *2.1. Ambient gamma radiation exposure level :*

The ambient gamma radiation exposure level has been measured using 1 3/4" × 2" NaI(Tl) Scintillometer (ECIL) that has been calibrated using standard sources at IGCAR, Kalpakkam. The sensitivity of the scintillometer is 0.005 mR/hr (or 50 ngray/hr). Since the maximum permissible exposure rate is of the order of 18,000 ngray/hr, the sensitivity of a 50 ngray/hr of the scintillometer used for recording the data is taken to be quite adequate. The scintillometer data has been recorded at all the selected places and also at four places within the city of Mysore *viz.*, St. Philomena's college, Teresian college, JSS college and hospital and Mysore university campus during the month of Sept 1991, Feb 1992 and Dec 1992. The data were collected at all these places at different periods of the months of the measurement. The average exposure rate per hour and total exposure rate per year are shown in Table 1.

**Table 1.** Ambient gamma radiation exposure level (ngray/hr) around Mysore measured by scintillometer

| Sl. No. | Location | Exposure rate per hour (median value) in nano gray | Exposure rate/year ($\times 10^3$ ngray) |
|---|---|---|---|
| 1 | Bilikere | 50(50)* | 438 |
| 2 | RMP surroundings | 100(92) | 876 |
| 3 | Yelawala | 100(54) | 876 |
| 4 | Srirangnatha temple (Srirangapatna) | 150(74) | 1314 |
| 5 | Manasagangotri (univ. campus) | 50(1685) | 438 |
| 6 | Kukkarahally tank bund | 50(50) | 438 |
| 7 | St. Philomena's college | 50(115) | 438 |
| 8 | Teresian college | 50(82) | 438 |
| 9 | Chamundi hills | 200(111) | 1752 |
| 10 | JSS college and hospital | 100(57) | 876 |
| 11 | Nanjangud temple | 100(68) | 876 |
| 12 | Jayapura | 100(56) | 876 |
| 13 | T. Narasipura temple | 100(34) | 876 |
| 14 | Talkad | 50(40) | 438 |

* The vaues given in the parenthesis are number of observations

The numbers given within the parenthesis in Table 1 correspond to the number of spots at which the data is collected. Each spot being separated from each other by atleast 5 to 10 meters. This procedure provides an average exposure rate over a wide area at each place

selected. Since there is no significant variation (seasonal and diurnal ) in exposure rate due to the sources responsible for this. The data on the average exoposure level recorded at these places can be used for the calculation of the annual exposure rate. This can be understaood as discussed below.

The exposure rate at a particular area depends mainly on the concentrations of the radionuclides (U-238, Th-232 and K-40) present in the earth's crust and of cosmic rays. The geological features of the earth's crust in the area of investigation is known to be stable Hence the concentrations of the radionuclides in the earth's crust are fairly constant. The background spectrum recorded at this laboratory since 1983 show no significant variation.

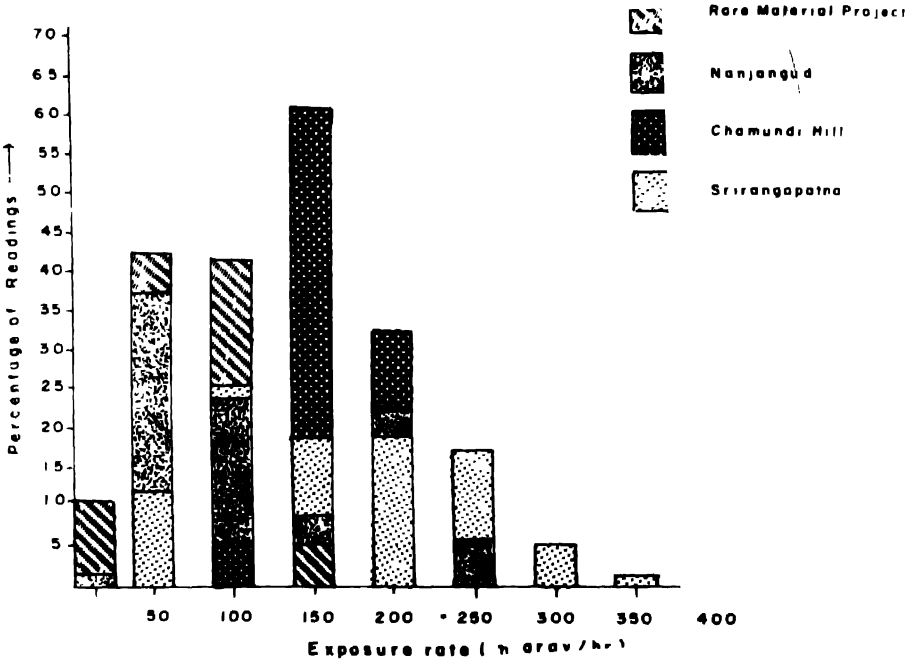



**Figure 1.** Histogram of ambient gamma radiation exposure level.

Therefore one can conclude that the environmental radiation exposure level remains more or less constant. Figure 1 represents the histogram of gamma radiation exposure level measured at Chamundi hill, Srirangapatna, Nanjangud and RMP surroundings.

2.2. *Gamma radiation spectrum :*

The natural background gamma spectrum at the department of Physics has been measured using high resolution HpGe detector (EG & G ORTEC) having a relative efficiency of 10% without any shielding and coupled to a 4 K multichannel analyser (Nucleonix).

## 3. Results and discussion

It is found that the exposure rate is quite small at all the places except at Chamundi hill region and Sriranganatha temple at Srirangapatna. The exposure rate is high in the Chamundi hill region due to the presence of granite which might contain a small amount of uranium and its daughter products. The high rate at Srirangahatha temple can also be attributed to the presence of small amount of uranium and thorium and their daughter products in different types of granites used in the construction of the temple. The exposure rate at all the places except at Chamundi hill region and Sriranganatha temple is 100 ngray/hr and less, whereas at Chamundi hill region it varies from 100 ngray/hr to 250 ngray/hr and at Sriranganatha temple it varies from 50 ngray/hr to 350 ngray/hr. The natural background gamma radiation exposure level around Mysore including RMP surroundings is found to be quite small. This ambient gamma radiation exposure level compares with the levels observed [3] at west coast of Karnataka exception being that at Ullal beach. The present values are also low when compared to the levels observed [4] at western Rajasthan.

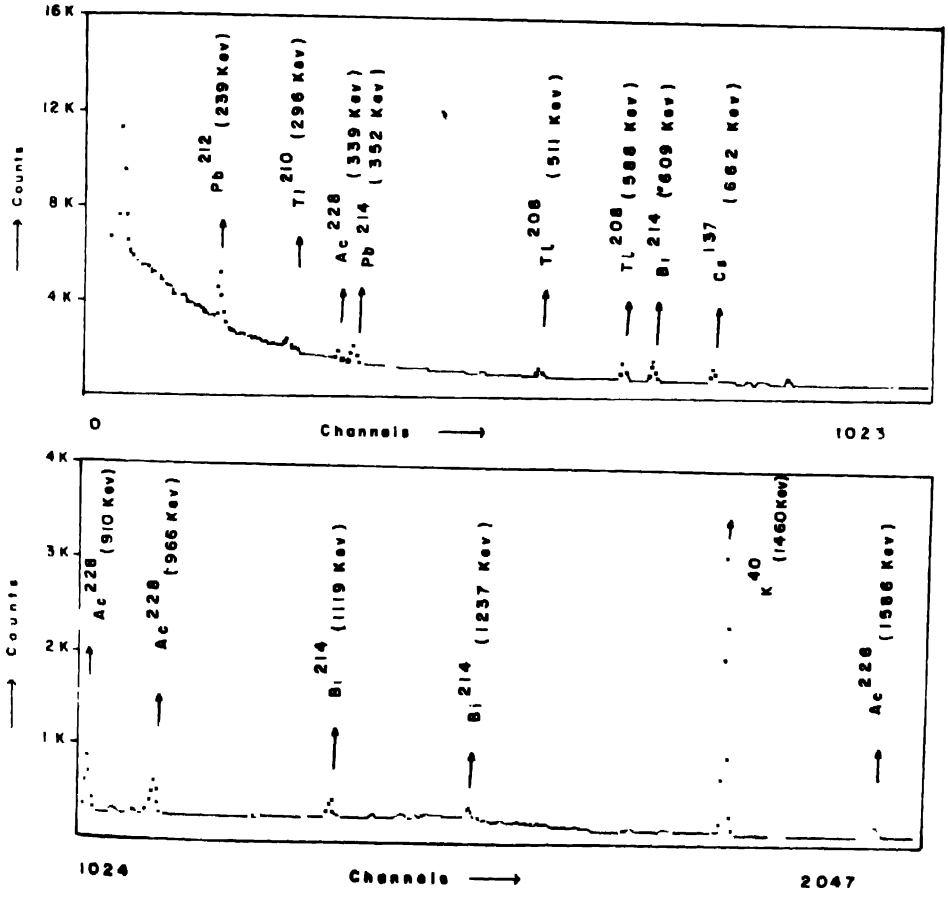



**Figure 2 (a–b).** Natural background gamma spectrum.

The spectrum of the natural background gamma radiation recorded at the department of Physics, in Figure 2, shows prominent peaks at energies 239, 1460 and 2614 keV, in addition to small peaks at energies 296, 339, 352, 511, 583, 609, 662, 910, 966, 1119, 1237, 1586, 1728,1763, 1846, 2091 and 2202 keV.

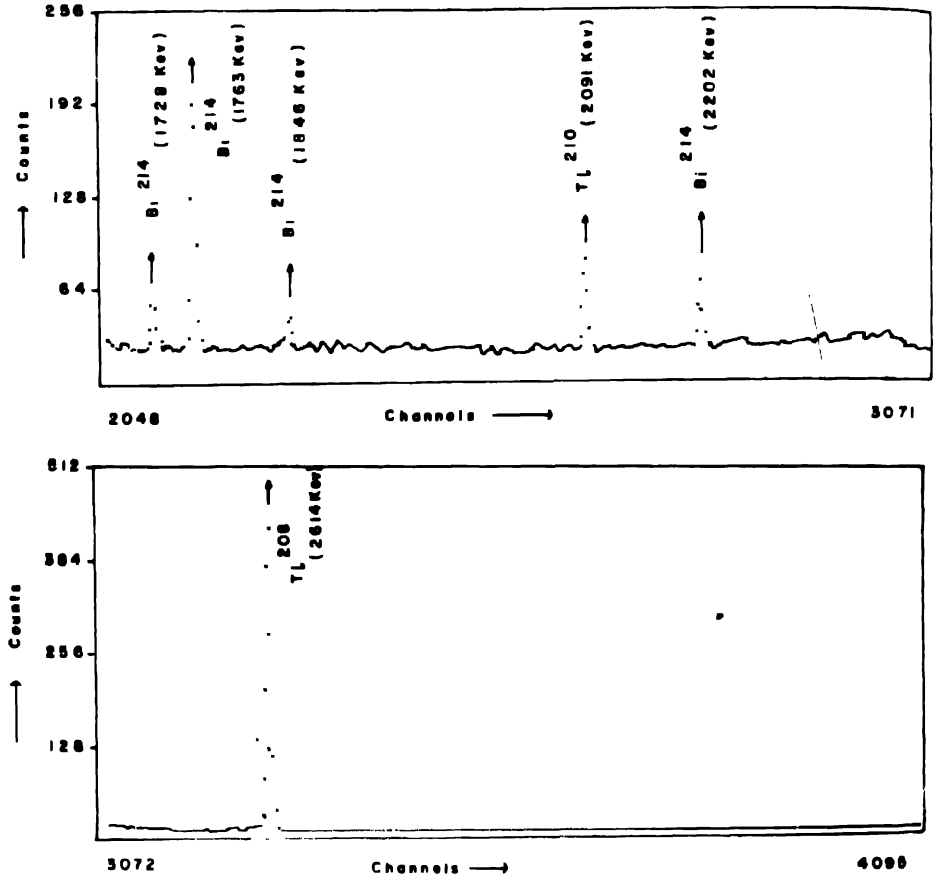



**Figure 2 (c–d).** Natural background gamma spectrum.

The prominent peaks at 1460, 2614 keV and the peak at 662 keV are due to the presence of $K^{40}$, $Tl^{208}$ and $Cs^{137}$ respectively in the structural materials [5-8]. Elements responsible for the various gamma peaks observed are indicated at the corresponding lines in the spectrum.

The above observation suggests that the elements responsible for the observed gamma lines are the members of both $U^{238}$ ($Tl^{210}$, $Bi^{214}$ and $Pb^{214}$) and $Th^{232}$ series ($Tl^{208}$ and $Ac^{228}$). The pattern of the background spectrum observed is similar to the data obtained [9] in this laboratory during 1983 using NaI(Tl) detector and also similar to the one reported by Finck *et al* [10] using Ge(Li) detector.

## 4. Conclusion

One can conclude that the ambient gamma radiation exposure level around Mysore including RMP surroundings is quite low except at Chamundi hill region and Sriranganatha temple at Srirangapatna. The natural background gamma spectrum shows the presence of both uranium and thorium series in the Mysore environment.

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