

Cancer risk assessment for granite quarry workers from external gamma dose rates

Shiva Prasad N G^a, Harish V^b, Ashok G V^{c*}, Nagaiah N^d

^aDepartment of Physics, Govt. First Grade College, Srirangapatna – 571438.

^bDepartment of Physics, Govt. First Grade College, Shivamogga – 577201.

^cDepartment of Physics, Government College (Autonomous), Mandya - 571401

^dDepartment of Physics, Bangalore University, Jnanabharathi Campus, Bangalore – 560056.

*Corresponding Author: Ashok GV

Abstract

The external gamma dose rates in air were measured at 10 granite quarries and hence the risk of cancer due to outdoor gamma radiation exposure were estimated. The mean life time cancer risk for each person working in the granite quarries of the study area are found to be high compared to the world average values. The results show that the workers of the granite quarry are at higher radiation risk compared to others.

Keywords: absorbed dose, the annual effective dose, cancer risk.

Introduction

Background radiation is natural and ubiquitously present in the environment and varies significantly from place to place on the globe. People living in granite areas or in mineralised sands receive more terrestrial radiation than in other areas, whereas people living or working at high altitude receive more radiation from cosmic rays¹.

The study area covers the granite quarries present in Ramanagara and Kanakapura taluks of Ramanagara district. The geology of this part forms predominantly a granite terrain with numerous varieties of granites, granitic gneiss, pegmatite, charnockites and so on. The

mining activity in this area covering a string of more than 80 hillocks spread between Kanakapura and Ramanagara over 1000 sq km.

Materials and Methods

The external gamma dose rates in air were measured at active granite quarries of the study area using a portable G M tube based Environmental Radiation Dosimeter. The instrument is capable of measuring gamma dose rates in the range 0-10 mR h⁻¹. The measured exposure rate (in μR h⁻¹) was converted into absorbed dose rate (in nGy h⁻¹) using the conversion factor of 1 μR h⁻¹ = 8.77 nGy h⁻¹ which stems from the definition of the Roentgen². The dose rate recorded by this instrument includes both terrestrial and cosmic ray components.

There is a linear relation between the lifetime relative risk of all cancers and background gamma radiations. Studies have been conducted to examine the risks of cancer in areas of high natural background radiation⁽³⁻⁴⁾. The life time cancer risk to the population of the study area due to outdoor gamma radiation exposure from natural radionuclides was calculated using the relative risk equation and the fatal cancer risk factor⁵.

$$R = E \times AL \times RF$$

Where, E is the annual effective dose equivalent, AL is average lifetime (70 y), RF is the risk factor (0.0582 Sv⁻¹), fatal cancer risk per Sievert (BEIR VII)⁶.

Results and Discussion

The absorbed dose rate observed in granite quarries of Ramanagara district varies from 201.71 -306.95 nGy h⁻¹ with a mean value of 256.96 nGy h⁻¹. This mean value is nearly 3 times high when compared to the Indian national average values of 80.7 nGy h⁻¹ and 88.5 nGy h⁻¹ reported by Mishra and Sadasivan⁷ and Nambi et al²., respectively. It is four times higher than that of the world average values³ of 60 nGy h⁻¹. The higher values of absorbed dose rates observed in the study region are mainly attributed to the local geology of the

region which largely comprises of numerous varieties of granites. It is well known that granites are enriched with radioactive elements.

From the measured external gamma dose rates, the life time cancer risk were estimated for the workers of granite quarries. The statistics of the results are presented in Table 1.

Table 1. The details of the results in study area

Sl No	Quarry	Life time cancer risk (10^{-4})
1	Q ₁	12.27
2	Q ₂	14.02
3	Q ₃	15.34
4	Q ₄	11.39
5	Q ₅	10.08
6	Q ₆	11.83
7	Q ₇	13.58
8	Q ₈	10.52
9	Q ₉	14.90
10	Q ₁₀	14.46
Range		10.08 – 15.34 (12.84)

The values given in the parenthesis are the mean values.

The risk of cancer due to outdoor gamma radiation exposure was calculated using the relative risk relation provided by UNSCEAR³. The cancer risk for quarry workers varies in the range of $10.08 \times 10^{-4} - 15.34 \times 10^{-4}$ with a mean value of 12.84×10^{-4} . This is nearly four times higher than the global average of 2.99×10^{-4} .

Conclusions

The mean life time cancer risk found in the present study are found to be high compared to the world average values. The results show that the granite quarry workers are at higher radiation risk.

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