



## MEASUREMENT OF $^{210}\text{Po}$ AND $^{210}\text{Pb}$ ACTIVITY CONCENTRATION IN ROCK SAMPLES OF WESTERN GHATS, TAMIL NADU, INDIA

J. Eugin shaji<sup>1</sup>, C. Kannan<sup>2\*</sup> and M. Feroz Khan<sup>3</sup>

<sup>1,2</sup>Department of Chemistry, Manonmaniam Sundaranar University, Tirunelveli, TN, India

<sup>3</sup>Department of Advanced Zoology and Biotechnology, Sadakathullah Appa College, Tirunelveli, TN, India

Received: 18.04.2014 Accepted: 10.08.2014

### Abstract

A study on radiation level and radionuclide distribution such as ( $^{210}\text{Po}$  and  $^{210}\text{Pb}$ ) were determined in rock samples collected from the lower hills of western ghats, kanyakumari district. The activities are counted using Zns(Ag) alpha counter. The activity of  $^{210}\text{Pb}$  was estimated through  $^{210}\text{Po}$  by allowing the  $^{210}\text{Po}$  plated solution for a period of 12 months to build up  $^{210}\text{Po}$  from  $^{210}\text{Pb}$ . The concentration of  $^{210}\text{Po}$  in rock samples ranged from  $8.2 \pm 0.3$  to  $36.2 \pm 1.4$  Bq/Kg. Mean while,  $^{210}\text{Pb}$  ranged between  $10.3 \pm 0.4$  to  $41.6 \pm 1.8$  Bq/Kg. The levels of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in the study region was found less and would not pose any significant radiological impact on the environment.

**Keywords:** Rock; Distribution; activity; environment; Western Ghats.

### 1. INTRODUCTION

The radionuclides of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  are among the most important natural radionuclides in the uranium series from a radiological point of view. Both  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  are of great concern for reasons mainly because of their large contribution to the natural radiation dose received by many species. The  $^{210}\text{Po}$ , an alpha emitter with a half life of 138.4 days and  $^{210}\text{Pb}$ , a beta emitter with a relatively long half – life of 22 years, are found in varying concentrations in rock. The main route of the radionuclides intake by human body inhalation, injection. The injection, ie., the intake of radionuclides by means of consumption of food, is usually the most important route by which these radionuclides enter the human organs. The alpha emitter  $^{210}\text{Po}$  casues considerably greater biological damage compared to the beta emitter  $^{210}\text{Pb}$ . It is estimated that the equivalent dose resulting from a single disintegration of  $^{210}\text{Po}$  is thousand times greater than  $^{210}\text{Pb}$  decay (Parfenov et al., 1974). The major contribution to radiation exposure to mankind comes from natural sources. The include external sources such as cosmic rays and terrestrial radiation originating largely from  $^{238}\text{U}$  and  $^{232}\text{Th}$  and their progeny. The radionuclides  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  are the final radioactive

members of  $^{238}\text{U}$  series and are widely present in the environment, contributing about 8% of the natural radiation exposure to humans. Numerous studies have utilized  $^{210}\text{Pb}$  data at choronometers for sediment accumulation for mixing in lakes, estuarine, marsh, and coastal areas, since they provide a reliable method of dating over the last 100-150 years. As applied to limnology, the data provide a measurement for evaluation of accelerated eutrophication (Krishnaswami et al., 1971). The sediments contain a repository of valuable historical information on temporal changes of population growth and industrial development, but significantly fewer studies provide reliable radiochemical datas due to difficulties on obtaining  $^{210}\text{Pb}$  concentration data that are above the detection limit of the technique utilized and that are not affected by sediment mixing (Ravichandran et al. 1995). We are now reporting the results from the lower hills of western ghats. radioactivity studies remain fragmentary at this site and hence the present investigation was launched to determine the activity of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$ .

### 2. MATERIALS AND METHODS

#### 2.1 Study area

In the present study rock samples were collected from lower hills of western ghats, Kanyakumari district.

\* C. Kannan Tel.: +919443507036

E-mail: [chellapandiankannan@gmail.com](mailto:chellapandiankannan@gmail.com)

The lithology of the study site consists largely of grey wackes in the upstream catchment area, Whereas tonality gneisses occur in the down stream segment. Patches of limestone and ultramafics are the minor rock types. The principal rock types found in the drainage basin are pre- Cambrian gneisses, granites, granite gneisses, phyllites, quartzite and chlorite schists and charnockites.

## 2.2 Sample collection

The sampling stations were identified along western ghats. The rock samples were collected from lower hills following standard procedure. The sampling stations are shown in fig,1

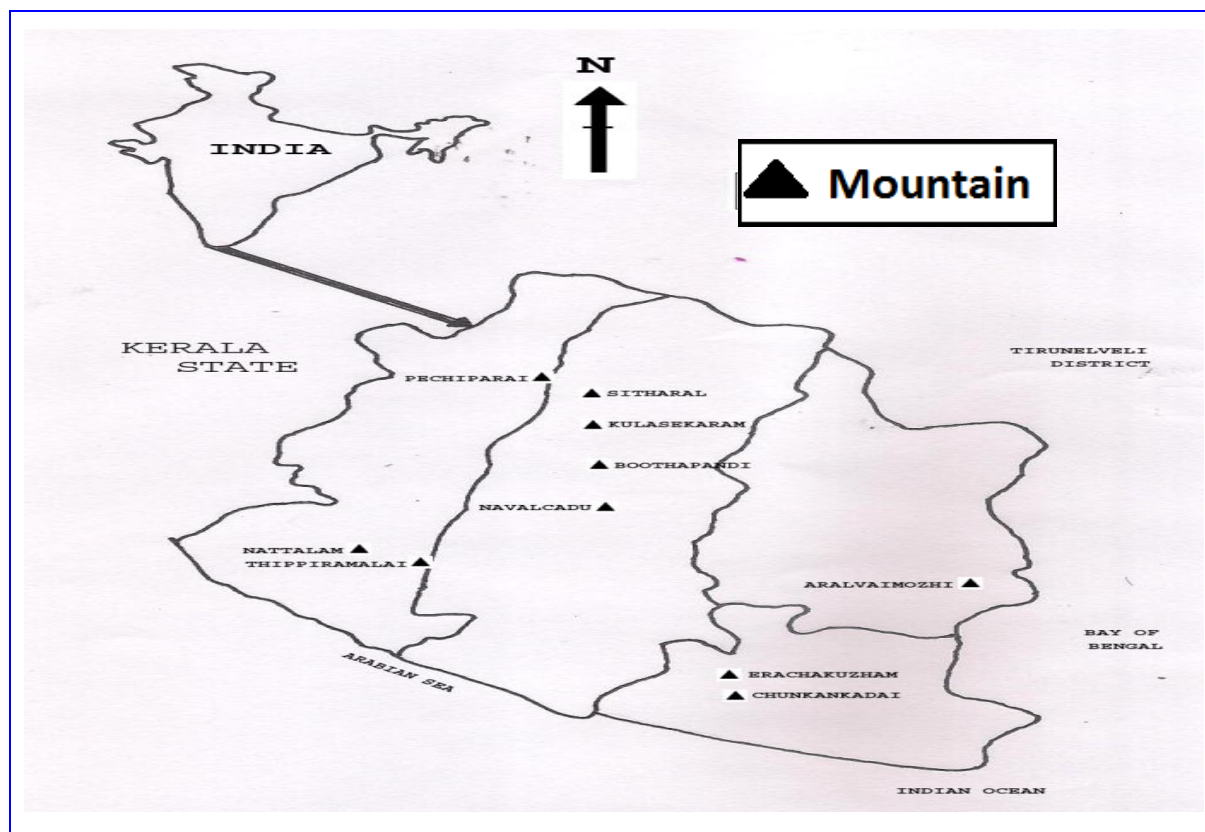


Fig. 1: Map showing the study area

## 2.3 Sample processing and activity measurement

The rock sample was removing the extraneous material like plant material and transferred to porcelain tray and dried in an oven at  $110^{\circ}\text{C}$  till constant dry weight is obtained. The moisture content was noted. The dried sample was then powdered and stored in polythene bags. The electro chemical deposition method was employed for determination of  $^{210}\text{Po}$  activity. The dried samples was leached with  $4\text{M HNO}_3$  and then organic matter present in the sample were destroyed by digestion by adding 3:1 mixture of  $\text{HNO}_3$  and  $\text{HClO}_4$  in small increment white residue appears. Each sample was converted to  $1\text{M HCl}$  medium and  $^{210}\text{Po}$  in the solution was deposited on a silver disc using magnetic stirrer at  $97^{\circ}\text{C}$  for 6 h. The silver disc was then washed with distilled water, rinsed with alcohol, dried

under infra red lamp and then alpha activity was counted using  $\text{ZnS (Ag)}$  alpha counter of 30% efficiency. The percentage of recovery of polonium was found to be 90%. The percentage of recovery was calculated using  $^{209}\text{Po}$  as tracer. The percentage of recovery has been taken into account while calculating the activity of  $^{210}\text{Po}$ .

The activity of  $^{210}\text{Pb}$  was estimated through  $^{210}\text{Po}$  by allowing the  $^{210}\text{Po}$  plated solution for a period of 12 months to build-up  $^{210}\text{Po}$  from  $^{210}\text{Pb}$ .

## 3. RESULTS & DISCUSSIONS

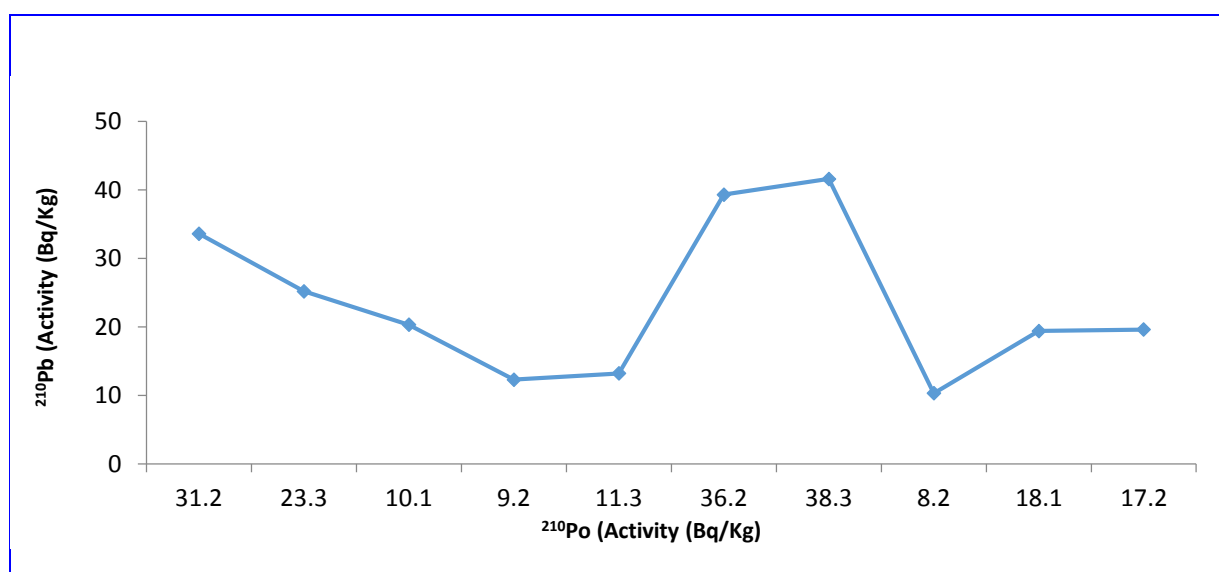
The results of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  activity in rock samples are mentioned in table 1. The  $^{210}\text{Po}$  activity of rock samples ranges between  $8.2 \pm 0.3$  to  $36.2 \pm 1.4$

Bq/Kg with mean value  $20.3 \pm 4.1$  Bq/Kg. The highest activity was found in the rock samples of thippiramalai near Karungal.. The minimum activity was found in the rock samples of sitharal near pechipparai. The present values are comparable with values reported for HBR, Kerala and Ullal region, Karnataka. and  $^{210}\text{Pb}$  activity

of rock samples ranges between  $41.6 \pm 1.8$  to  $10.3 \pm 0.4$  Bq/Kg With mean value  $23.4 \pm 4.6$  Bq/Kg. The mean activity ratio of the  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in rock sample is 0.8. Variation between  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  activity concentration in rock samples are shown in fig.1.

**Table 1.**  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  activity in rock samples

S.no	Rock/sampling stations	Activity concentration in rock in Bq/Kg		Activity ratio
		$^{210}\text{Po}$	$^{210}\text{Pb}$	$^{210}\text{Po}/^{210}\text{Pb}$
1.	Chunkankadai	$31.2 \pm 1.3$	$33.6 \pm 1.5$	0.9
2.	Aralvaimozhi	$23.3 \pm 0.8$	$25.2 \pm 0.9$	0.9
3.	Bhudhappandi	$10.1 \pm 0.7$	$20.3 \pm 0.8$	0.5
4.	Kulasekaram	$9.2 \pm 0.6$	$12.3 \pm 0.7$	0.7
5.	Nvalkadu	$11.3 \pm 0.9$	$13.2 \pm 0.8$	0.8
6.	Nattalam	$36.2 \pm 1.4$	$39.3 \pm 1.3$	0.9
7.	Thippiramalai	$38.3 \pm 1.6$	$41.6 \pm 1.8$	0.9
8.	Sitharal	$8.2 \pm 0.3$	$10.3 \pm 0.4$	0.8
9.	Erachakuzham	$18.1 \pm 0.2$	$19.4 \pm 0.7$	0.9
10.	pechiparai	$17.2 \pm 0.6$	$19.6 \pm 0.6$	0.8



**Fig. 2:** Correlation between  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  activity in rock samples

#### 4. CONCLUSION

The activity concentration of  $^{210}\text{Po}$  is high compared to the activity concentration of  $^{210}\text{Pb}$  in the western ghats. These activity levels are low when compare the international guidelines. A good correlation exists between the activity concentration of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in rock samples in the western ghats.

#### REFERENCES

- Parfenov, Y. D., Po-210 in the environment and in the human organism Atomic Energy Review, 12, 75-143 (1974).
- K. B, R. Shankar. M. M. Sarin, B. R. Manjunatha, J. Environ. Radioact., 57, 21-33 (2001).  
[doi:10.1016/S0265-931X\(00\)00215-0](https://doi.org/10.1016/S0265-931X(00)00215-0)
- Kidwai, R. M., Nair, R. R. and Hashinmi, N. H., J. GSI. 22, 32-36 (1981).
- Eakins, J. D., Morrison RT A new procedure for the determination of lead -210 in lake and marine sediments. Int J Appl Radiat Isot 29, 531-536(1978).  
[doi:10.1016/0020-708X\(78\)90161-8](https://doi.org/10.1016/0020-708X(78)90161-8)
- Krishnaswami. S., Lal. D., Martin. J. M. and Meybeck M Geochronology of lake sediments, Earth planet Sci Lett, 11, 407-414(1971).  
[doi:10.1016/0012-821X\(71\)90202-0](https://doi.org/10.1016/0012-821X(71)90202-0)
- Ravichandran, M., Baskaran, M. and Santschi, P. H., Bianchi TS Geochronology of sediments in the sabine-Neches estuary, Texas, USA. Chem Geol 125, 291-306(1995).  
[doi:10.1016/0009-2541\(95\)00082-W](https://doi.org/10.1016/0009-2541(95)00082-W)