



Research Article

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A Study on the Distribution Pattern of Radioactivity in the Heavy Minerals of Coastal Sands of Kanyakumari

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ABSTRACT

The study of gross α and β activities of samples collected from different locations between Thenkapattanam and Periyavilai, spanning across a distance of 6 km indicate wide variation in their activity. Thenkapattanam beach sands recorded maximum activity, the values are lowest in the samples collected along the Periyavilai beach. An examination of the activities of different size fractions of the beach sands has established the presence of the maximum quantities of fine samples of heavy minerals in the finest fraction. The highest α -activity of sand samples is recorded in Thenkapattanam beach and the lowest α -activity is recorded in Periyavilai. The highest β -activity of soil samples are observed in Thenkapattanam station and the lowest β -activity of soil are samples observed in Periyavilai station

Keywords: Radio Activity, Heavy Minerals, Coastal Sands, α -activity, β - activity

INTRODUCTION

Radioactive materials and radiations are part of nature. Radiation has always been present in the environment several naturally occurring radioactive elements are Uranium, Thorium, Radium and Potassium. Man has always been exposed to radiation of natural origin from outer in some places that in other. In recent times the use of artificial sources of radiation has grown extensively. Such usage has contributed to human Welfare in agriculture, medicine, industry and research. Radiation exposure in principle has a potential for causing harm to life. Therefore excessive and unnecessary exposures to radiation must be avoided. The present study deals with the study of gross α and β activities of samples collected from five different locations between Thenkapattanam and Periyavilai, spanning across a distance of 6 km indicate wide variation in their activity. Thenkapattanam beach sands recorded maximum activity, the values are lowest in the samples collected along the Periyavilai beach. An examination of the activities of different size fractions of the beach sands has established the presence of the maximum quantities of fine samples of heavy minerals in the finest fraction. The highest α -activity of sand samples is recorded in Thenkapattanam beach and the lowest α -activity is recorded in Periyavilai. The highest β -activity of soil samples are observed in Thenkapattanam station and the lowest β -activity of soil are samples observed in Periyavilai station.

EXPERIMENTAL SECTION

Sample Collection and Processing of the Sample

Five sampling stations were selected along the south west coast from Thenkapattanam to Periyavilai They are Thenkapattanam, Melmidalam, kadiyapattanam, Simon colony, Periyavilai. The beach surface sands were collected from each sampling site in polythene bags and dried in a hot air oven at 110°C. The samples were passed through different sieves of size 425 μ m, 300 μ m, 212 μ m, 125 μ m to obtain four different fractions. Approximately 0.06 g of the sample from each fraction was powdered using agate motor and spread as fine layer in an aluminum planchet and its Gross alpha activity was measured using alpha scintillation counter with ZnS (Ag) detector Gross beta activity was measured using low beta counting system. (ECIL Model BCS36A)

RESULTS AND DISCUSSION

Gross α - activity of beach sand samples

In Thenkapattanam area, the gross alpha activity varies from 292.39 to 19710.14 Bq/kg with a mean value of 10272.885 Bq/kg recorded the gross alpha and gross beta in the sediment samples of Mandapam coast(palk strait) using alpha and beta counter[1]. In Melmidalam area, the gross alpha activity varies from 592.53 to 18713.45 Bq/kg with a mean value of 5840.61 Bq/kg. In Kadiyapattanam area, the gross alpha activity varies from 292.39 to 12068.96 Bq/kg with a mean value of 3520.165 Bq/kg. In Simon colony area, the gross alpha activity varies from 595.23 to 6489.67 Bq/kg with a mean value of 2289.768 Bq/kg. In Periyavilai area, the gross alpha activity varies from 576.8 to 3681.23 Bq/kg with a mean value of 1276.98 Bq/kg. It could be noted that the gross α activity is highest at Thenkapattanam and lowest at Periyavilai among the chosen locations. In Manavalakurichi also shows that the highest gross α - activity recorded in the finest sand fraction. The reason may be due to the higher percentage of ilmenite and monazite in the finer fraction, the monazite minerals being highly brittle in behavior given in [Table 1] [2,3].

Table 1 : Gross alpha activity of beach sand samples (Bq/kg)

Sl.No.	Stations	Gross α activity in (Bq/ Kg) in size fractions				
		425 μ m	300 μ m	212 μ m	125 μ m	Mean
1.	Thenkapattanam	292.39	1256.40	19540.22	19710.14	10272.89
2.	Melmidalam	595.23	892.85	3160.91	18713.45	5840.61
3.	Kadiyapattanam	292.39	579.71	1139.60	12068.96	3520.16
4.	Simon Colony	595.23	429.80	1139.60	6489.67	2289.76
5.	Periyavilai	576.80	576.80	564.97	3681.23	1276.98

Gross β - activity of beach sand samples

In Thenkapattanam area, the β - activity varies from 1888.6 Bq/kg to 36606.71 Bq/kg with a mean value 13763.95 Bq/kg[4]. In Melmidalam area, the activity varies from 3760.6 Bq/kg to 59452.72 Bq/kg with a mean value 18325.9 Bq/kg. In Kadiyapattanam area, the activity varies from 641.97 Bq/kg to 1296.78 Bq/kg with a mean value 1098.491 Bq/kg. In Simoncolony area, the activity varies from 585.48 Bq/kg to 16091.72 Bq/kg with a mean value 4971.803 Bq/kg[5]. In Periyavilai area, the activity varies from 383.92 Bq/kg to 6888 Bq/kg with a mean value 2647.048 Bq/kg. It could be noted that the gross β - activity is maximum at Thenkapattanam and minimum at Periyavilai among the chosen locations given in Table 2 [6].

Table-2 Gross beta activity of beach sand samples (Bq/Kg)

Sl.No.	Stations	Gross β activity in (Bq/ Kg) in size fractions				
		425 μ m	300 μ m	212 μ m	125 μ m	Mean
1.	Thenkapattanam	1888.60	3466.70	13094.00	36606.71	13763.95
2.	Melmidalam	3760.60	4911.30	5179.00	59452.72	18325.90
3.	Kadiyapattanam	641.97	1167.10	1288.00	1296.78	1098.49
4.	Simon Colony	585.48	1163.70	2046.30	16091.72	4971.80
5.	Periyavilai	383.92	1377.60	1938.70	6888.00	2647.04

Gamma activity of beach sand samples

The Gamma activity of beach sand samples are given in Table-3[7]. The radioactivity of sand samples by standard gamma spectrometry using HPGe detector and found to be the minimum activity concentration 2.24 Bq/kg of ²²⁶Ra in the sand sample from the Copacabana beach, Brazil. In Thenkapattanam area, the Actinium activity ranges from 0.679 to 516.616 Bq/Kg[8]. Bismuth activity varies from 0.2055 Bq/Kg to 1.066 Bq/Kg. Bismuth activity is maximum at Melmidalam 1.066 Bq/Kg and minimum at 0.2055 Bq/Kg[9]. Thallium activity is higher at 395.555 Bq/Kg[10]. It could be noted that the gamma activity is maximum at Melmidalam and minimum at Thenkapattanam[11]. The higher gamma activity is due to Actinium activity.

Table 3: Gamma activity of beach sand samples (Bq/Kg)

Sl.No	Samples	Radioactivity (Bq/Kg)			
		Actinium	Potassium	Bismuth	Thalium

1.	Thenkapattanam	314.500	BDL	0.244	BDL
2.	Kadiyapattanam	BDL	13.614	BDL	BDL
3.	Melmidalam	516.516	BDL	1.066	395.555

Relative amount of light and heavy minerals in the beach sand

The percentage of both the light and heavy minerals in the beach sand samples and their ratio are given and the comparisons between those minerals are given in Table-4. The concentration of the heavy mineral varies from 8.96% to 25.20% with the mean 25.02%, and also the light mineral varies from 40.75% to 56.33%. In Thenkapattanam, the total heavy minerals (THM) present in the samples have 25.20% by weight, out of which the total magnetic minerals (TMM) like ilmenite and garnet are 25.15% by weight, and also the total non-magnetic minerals are 2.89% by weight. The light minerals ($\rho < 2.89$) have 40.75% by weight. In Melmidalam, 22.73% by weight of THM is reported. TMM and TNMM are 17.30% and 7.24% by weight. Here, the magnetic minerals are less than that of Thenkapattanam. The light minerals are 52.73% by weight. In Kadiyapattanam, THM present in the samples are 26.05% by weight. TMM and TNMM are 16.34% and 7.97% by weight. The light minerals are the quartz and have 49.64% by weight. Simoncolony samples have 24.32% THM by weight. TMM are 14.87% by weight, and the-TNMM are 7.98% by weight. The adjoining Periyavilai samples have 23.62% THM by weight, which is distributed as 13.98% of TMM and 6.07% of TNMM, Here the TMM and TNMM are almost equally distributed among the isolated heavy and light mineral in the fine sand fractions by using bromoform and the monazite amount varied from 14.29 to 15.40% of the heavy minerals in the fine sand of Barpalia and Gyaspur of Siwan district in north Bihar has reported the average heavy mineral contents of about 67 wt% for Kanyakumari-Kuttankuli[6,12]. The heavy minerals are dominant in Thenkapattanam (25.20%) in the surface sand samples, when compared to other places. Denser minerals are abundantly found in Thenkapattanam due to continuous winnowing action of the shoaling waves. Heavy minerals may become concentrated naturally by hydrodynamic sorting, usually in shallow marine or fluvial depositional settings [13]. But, the light minerals are dominant in Periyavilai (56.33%), with respect to other places. The result is in agreement with the values reported by in Teri sands (Red sands) of Tamil Nadu [14].

Table 4: Relative amount of light and heavy minerals in the beach sand

Places	THM (%)	TMM (%)	TNMM (%)	Light Mineral (%)	Ratio (L/H)
Thenkapattanam	25.20	25.15	8.90	40.75	1.61
Melmidalam	22.73	17.30	7.24	52.73	2.31
Kadiyapattanam	26.05	16.34	7.97	49.64	1.90
Simon Colony	24.32	14.87	7.98	52.83	2.17
Periyavilai	23.62	13.98	6.07	56.33	2.34

SUMMARY AND CONCLUSION

The study of gross α and β activities of samples collected from 5 different locations between Thenkapattanam and Periyavilai, spanning across a distance of 6 km indicate wide variation in their activity. Thenkapattanam

beach sands recorded maximum activity, the values are lowest in the samples collected along the Periyavilai beach.

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