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ESTIMATION OF NATURAL RADIOACTIVITY INDIFFERENT BEACH SAND SAMPLES AROUND KANYAKUMARI DISTRICT

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Abstract: Natural radiation is a fact of life. All living organisms have been exposed continuously to ionizing radiation, which always existed naturally. People are constantly exposed to small amounts of ionizing radiation from the environment as they carry out their normal daily activities known as natural background radiation. Naturally Occurring Radioactive Materials (NORMs) is a source of natural radiation found on earth of terrestrial origin or from natural processes. The radiological risk due to the presence of natural and man-made radionuclides in beach sands from several public beaches like Kanyakumari, Colachel, Kadiapattanam, Sanguthurai was estimated in this study. Specific radionuclides concentrations in the sand samples were determined by standard gamma-spectrometry. The radioactivity concentration of different beach sands was estimated.

Index Terms: Radiation, Radionuclides, Gamma -Spectrometry, Radioactivity concentration.

I INTRODUCTION

Radiation is energy that comes from a source and travels through space at the speed of light. This energy has an electric field and a magnetic field associatedwith it, and has wave-like properties. We could also call radiation “electromagneticwaves”.

Whether or not radiation can harm us depends on the type of radiation, the dosage we come in contact with, and the length of the exposure. Radiation can be defined as the transmission of energy from a body in the form of waves or particles. At the formation of the earth about four billion years ago, the materials with which it was made contained many radioactive isotopes some with short and others with very long half-life. Natural radioactive materials are found in rocks, soil, air, food and drinking water. The natural environment therefore is a major source of radiation, to which man is exposed. Ionizing radiation from natural sources that we are all exposed to at all times is called natural background radiation [1].

Radioactivity of soil environment is one of the main sources of exposure to humans. Hence it is important to know its distribution, gamma radiation from radionuclides which are characterized by half-lives comparable to the age of the earth, such as ^{40}K and radionuclides from the ^{238}U and ^{232}Th series. Their decay products represent the main external source of radiation to the human body. More specifically, natural radioactivity and the associated external exposure due to gamma radiation depend primarily on the geological and geographical conditions, and appear at different levels in the soil of each region in the world [2–5]. Higher radiation levels are associated with igneous rocks, such as granite and lower levels with sedimentary rocks. However, some shales and phosphate rock have relative high content of those radionuclides [6,7]. In this paper, we measure the specific activity of the naturally occurring radionuclides ^{238}U, ^{232}Th and ^{40}K in soil cores obtained from four locations. The results will be used to establish a baseline map for that area. This map will be used as a reference information to assess any change in the radioactivity background level due to the change

in the topography of the location, other developments and settlement around it, or any artificial influences on the environment.

Eugin Shaji et al. (2015) determined the activity concentration of natural radionuclides such as ^{228}Ra, ^{238}U, ^{232}Th, and ^{40}K were determined in river sediment samples collected from Kanyakumari district and the corresponding mean radionuclide activity concentrations obtained for each of the radionuclides expressed in Bq kg^{-1} are 18.85, 8.71,18.75 and 148.10 for ^{228}Ra, ^{238}U, ^{232}Th, and ^{40}K respectively and the mean absorbed dose rate is 21.77 $nGyh^{-1}$, which is found to be less than the recommended level and would not pose any significant radiological impact on the environment[8]. Chandrasekaran et al. (2015) estimated concentration of natural radionuclides ^{238}U, ^{232}Th and ^{40}K and gamma radiation dose rate in soil of Yelagirihills, Tamil Nadu" using gamma ray spectrometry. The activity concentration of radionuclides is estimated and the determined average absorbed dose rate value was 88.64 $nGyh^{-1}$ which was slightly greater than the world average value of 84 $nGyh^{-1}$[9]. Pearson correlation and cluster analysis were used to determine the interrelation between the natural radionuclides and physico-chemical properties. The multivariate statistical analysis proved that natural radioactivity depends on physicochemical properties.

II.STUDY AREA

These areas lie in the coastal belt of the Kanyakumari District, Tamil Nadu,India. The Geographical explanation of the sampling locations with sample ID is given in Table 2.1.

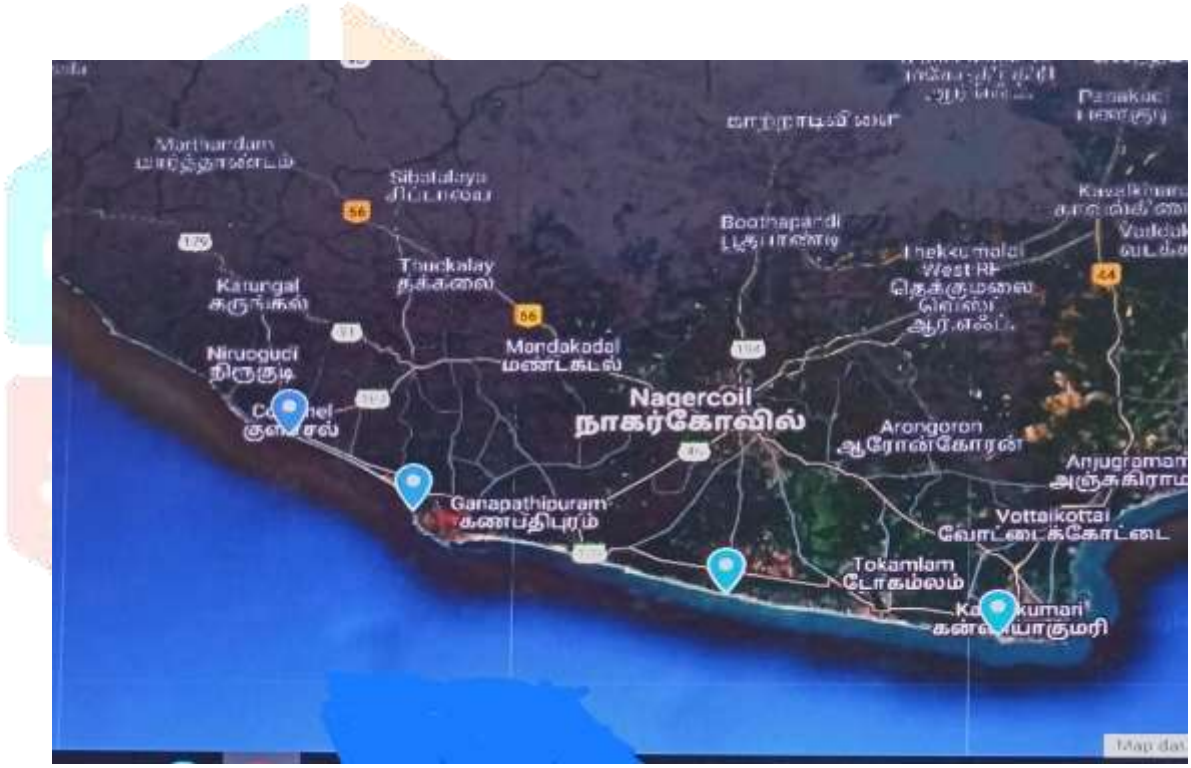


Fig 2.1. Sampling location

Table 2.1: Geographical explanation of the sampling sites.

Location ID	Location Name	Latitude	Longitude
CLL	Colachel	8°9′21.6″	77°28′58.8″
KPN	Kadiapattinam	8°8′9.6″	77°18′18″
KK	Kanyakumari	8°4′44.4″	77°32′60″
SGR	Sanguthurai	8°6′7.2″	77°25′33.6″

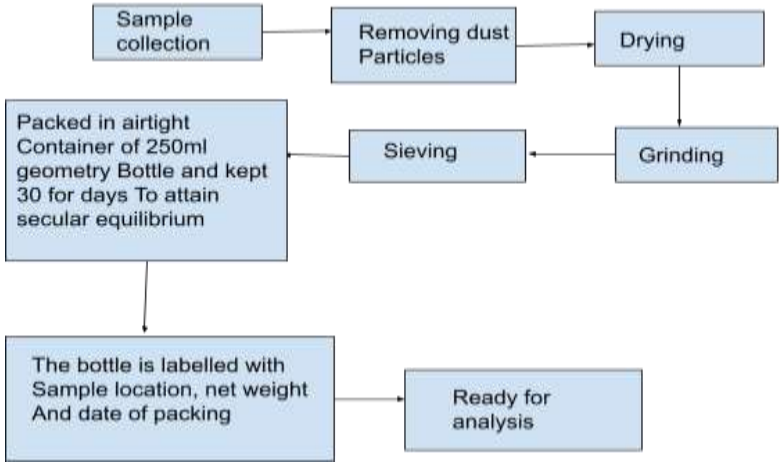
III MATERIALS AND METHODS

3.1 Collection and preparation of samples

Approximately 2 kg of each sand sample was collected from the ground surface down to a depth of 5 cm. After collection, sample preparation was carriedout by following process

- Drying of the samples at room temperature to remove excess moisture.
- Passing through a sieve to ensure homogeneity of the samples.
- Placing in 250 ml plastic beakers which were sealed with PVC tape.
- Dry weighing and storing for approximately 4 weeks to allow radioactive secular equilibrium of 222Rn with its parent (226Ra) in the uranium chain.
- Samples are then labeled based on the location collected along with date of packing and sample weight.

Fig 3.1 Prepared Samples



3.2 Methodology for Measurement of Natural Radioactivity

In addition to the identification of radionuclides in sand samples the most common aim in gamma−ray spectrometry with Scintillation detectors is the determination of the activity concentration of each gamma emitting radionuclide species which is present in the samples to show the distribution of radionuclide insampling locations.

The final activity concentrations of a particular nuclide as given by equation

$$Net\ counts = \frac{Net\ counts - bkg\ counts}{counting\ time}$$

$$Activity(BqKg^{-1}) = \frac{Net\ counts}{Weight \times Efficiency \times Yield\ fraction}$$

3.3 Reference Standard Measurement

Each standard is kept on the top of the detector inside the shielding. A spectrum is acquired for 1000s. Then the corresponding energy ROIs are markedand net counts are recorded.

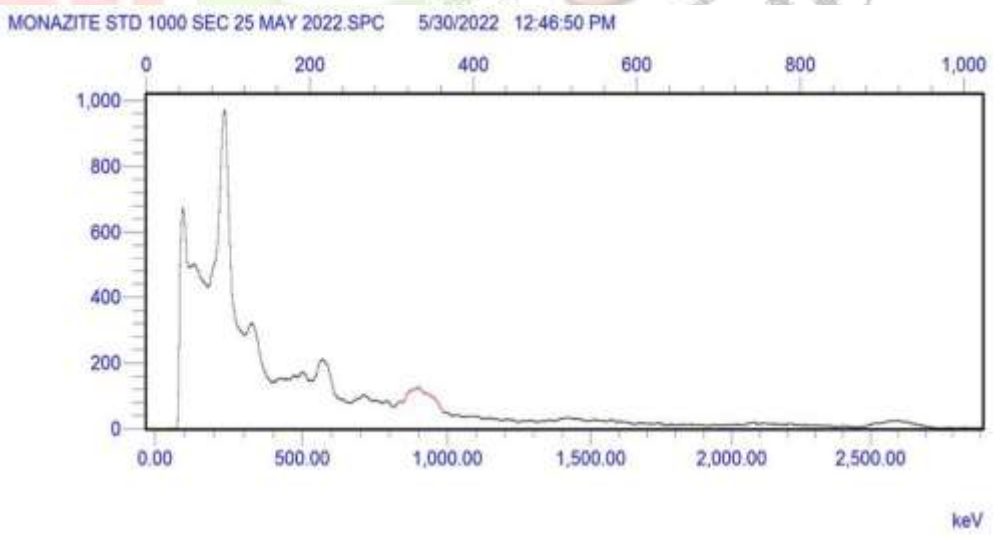


Fig 3.2. Standard Gamma Ray spectrum for monazite sand

IV RESULTS AND DISCUSSION

The gamma ray spectrum of the samples was obtained over periods of 1000 secs. The activity concentration of ^{40}K, ^{238}U, ^{232}Th were determined. The net number of counts under each photo peak of interest was then subtracted from the corrected background spectrum.

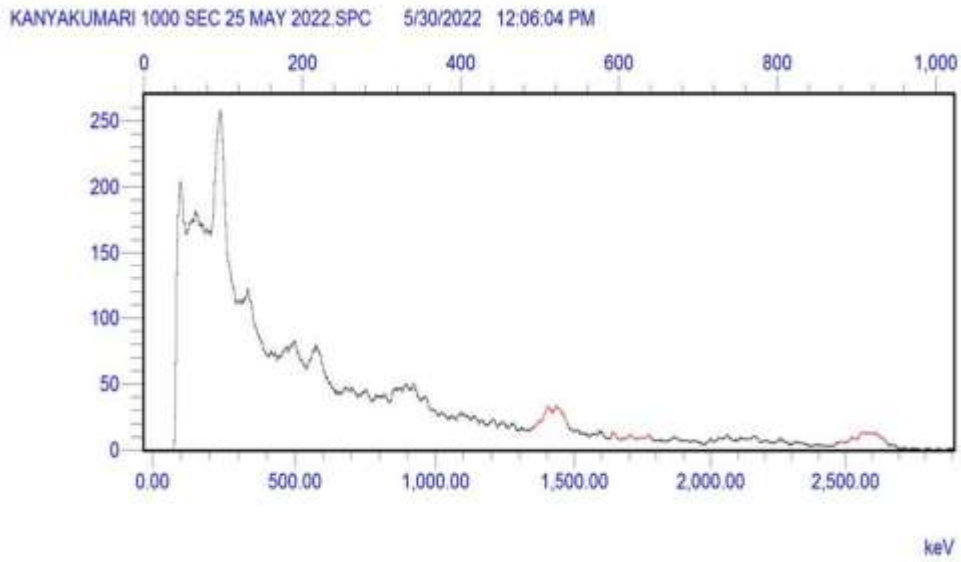


Fig 4.1 Gamma−ray spectrum of Kanyakumari beach sand sample

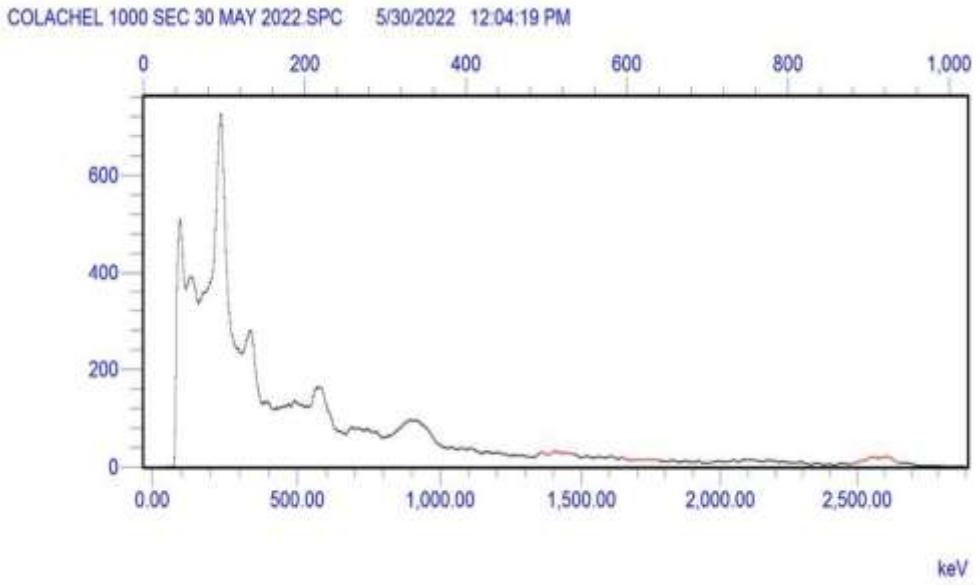


Fig 4.2 Gamma−ray spectrum of Colachel beach sand sample

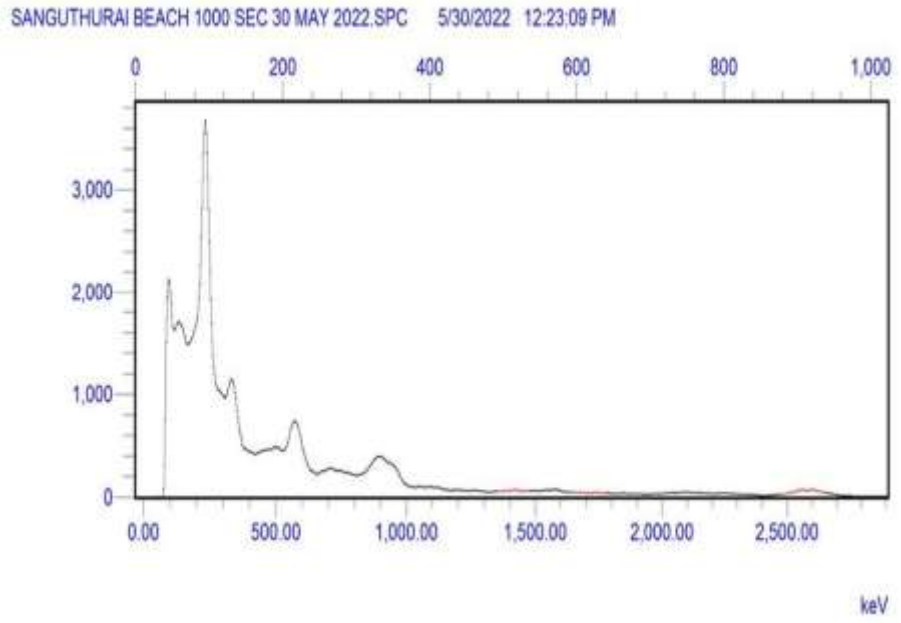


Fig 4.3 Gamma−ray spectrum of Kadiapattanam beach sand sample

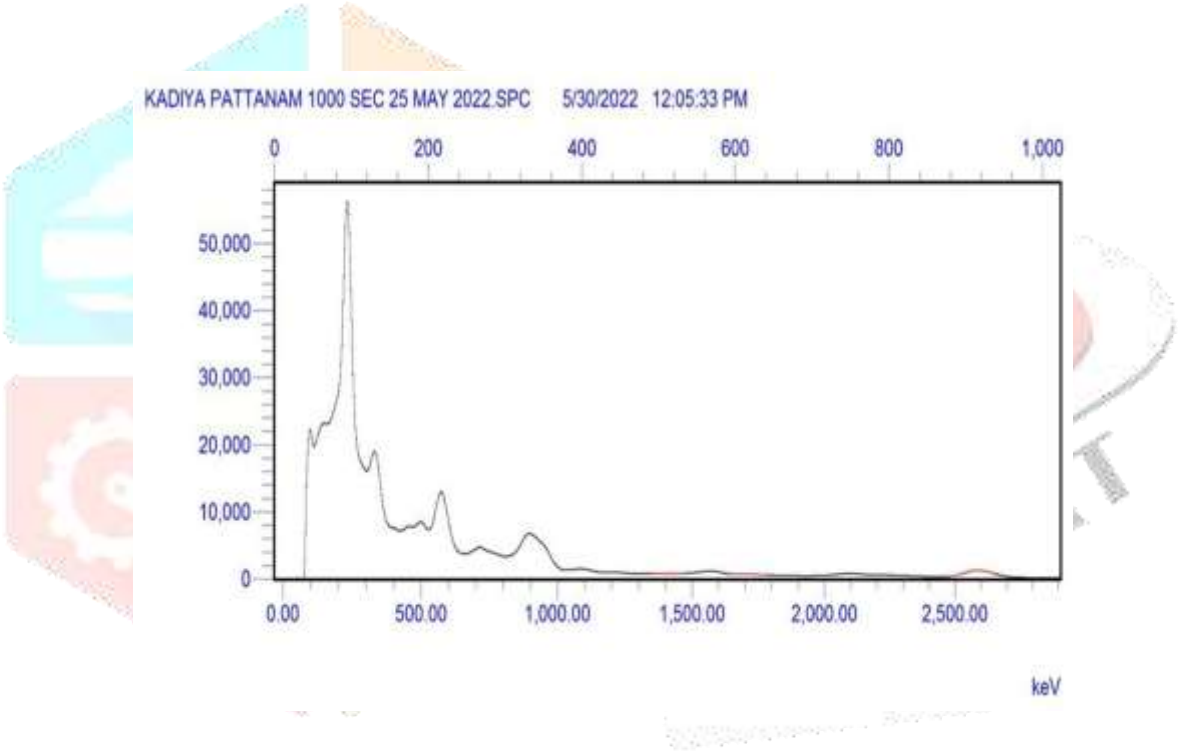


Fig.4.4 Gamma−ray spectrum of Sanguthurai beach sand sample

.1 Activity Concentration of Beach Sand in Areas ofKanyakumari

The activity concentration of each radionuclide such as ^{40}K, ^{238}U and ^{232}Th were determined from the beach sand samples collected. From the data collected adetailed analysis was performed to find out the activity concentration with respect to 4 different locations at different distances in accordance with samples collected from the Kanyakumari coast, based on the analysis performed a detailed inferencehas been given below.

Table 4.1: Activity concentration in the sea inlet of Kanyakumari.

Location	Activity concentration of Radionuclides (BqKg^{-1})		
	K^{40}	U^{238}	Th^{232}
Kanyakumari	491.1085	19.2186	300.7646
Colachel	624.6547	40.4327	94.9594
Kadiapattanam	502.4342	262.1957	33783.648
Sanguthurai	90.6552	—	1936.4046
Mean	427.21315	80.46175	9028.9441

From the result it is estimated that the radioactivity concentration of K^{40} infour places is 427.21315BqKg^{-1} ,for U^{238} is 80.46175BqKg^{-1} and for Th^{232} is 9028.9441Bqkg^{-1} . Hence from the result it is found out that the Thorium content is rich in all places while comparing with potassium and uranium. In Sanguthurai there is no Uranium found. In Colachel it is found that the Potassium content is rich. The Thorium content is rich in Kadiapattanam.

The high value for ^{232} Th activity concentration observed at Kadiapattanam in the study area could be explained due to the presence of black sands, which are enriched in the mineral monazite containing a significant amount of ^{232} Th. The enrichment occurs because the specific gravity of monazite allows its concentrationalong beaches where lighter materials are swept away and anthropogenic inputs can release the additional amounts of natural radionuclides into the environment.

From the results, it is clear that the activity of ^{238} U and ^{40} K are lower while that of^{232} Th is higher when compared with worldwide average value (UNSCEAR, 2000)for this selected high background radiation area (HBRA) regions of this study (MDU, CLL & THR)[10].

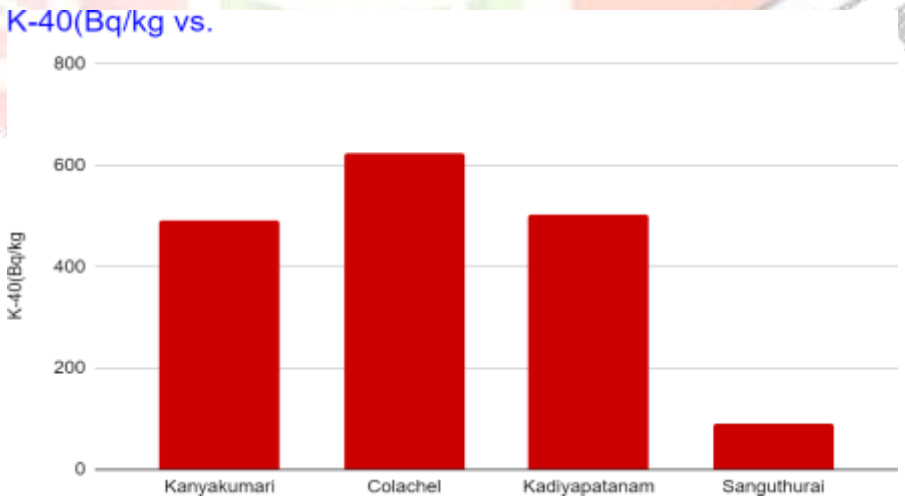


Fig 4.5 Bar graph for activity concentration of K-40

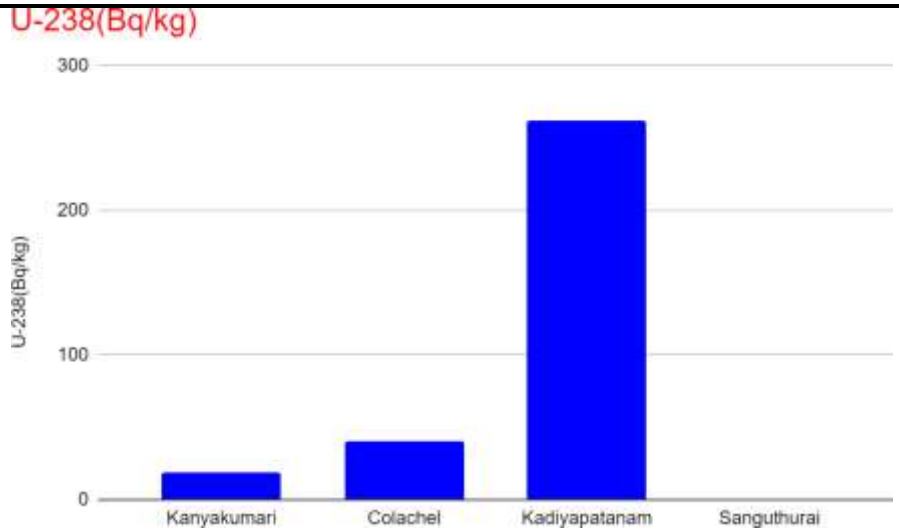


Fig 4.6 Bar graph for activity concentration of U-238

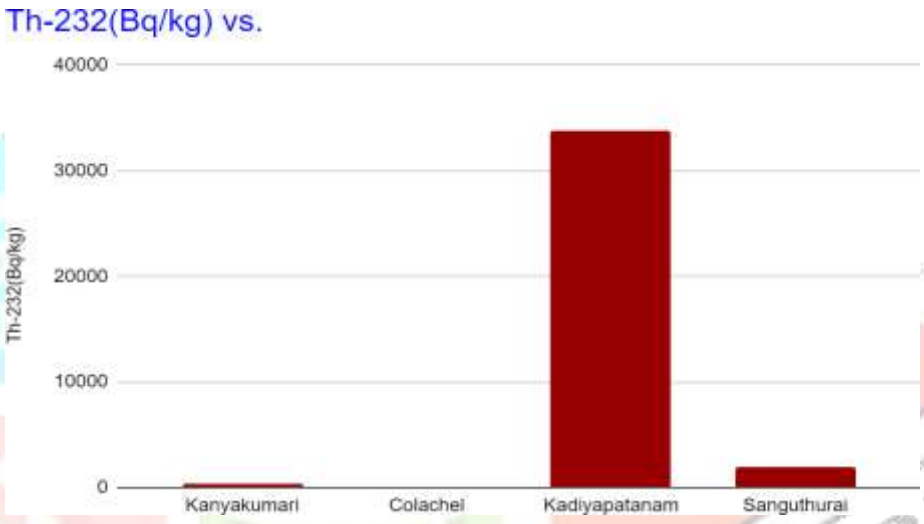


Fig 4.7 Bar graph for activity concentration of Th-232

V CONCLUSION

A study of the natural radioactivity in beach sand samples of four differentregions across Kanyakumari district was carried out by employing gamma−spectroscopy using a Scintillation detector.

In this work the sample spectrum and analysis of spectrum to determine the activity concentrations has been performed. Distribution of radionuclides suchas ^{40}K, ^{238}U and ^{232}Th activity concentrations are estimated. It gives us an idea of elemental range in a region. The locations Kadiyapattanum and Sanguthurai are observed to have enhanced natural background radiation which has been clearly evident from the analysis performed from the data collected; the elevated radioactivity in those locations could be due to the monazite ore present in the beach sands.

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