

## High background radiation sweeping along the southwest coast of Tamil Nadu, India

Ionizing radiations are a grave threat around the high background regions of the globe<sup>1</sup>. Selected pockets of Brazil, China and India are reportedly under the grip of high background radiation<sup>2</sup>. Presence of monazite sand along the beaches of these regions, among other factors, has contributed to these dreaded radiations. Recent studies have indicated the availability of monazite deposits throughout the erstwhile South Travancore region comprising parts of Kerala, and Kanyakumari District, Tamil Nadu<sup>3</sup>. The present study on radioactivity of beach sands of Manavalakurichi region along the southwest coast of India in Tamil Nadu, has revealed the high potency of the monazite sands spanning across the Kadiapattinam estuary on the eastern side of Manavalakurichi. Mention must be made of the Valliyar river with its origin at the Western Ghats and destination at Kadiapattinam, which serves to transport mineral from the weathering rocks of the Western Ghats, thereby constituting the major source of the highly radioactive mineral.

For the present study, ten sampling stations were identified along the southwest coast from Muttom to Colachel via Manavalakurichi (Figure 1). The beach sediment samples collected from each sampling site were first air-dried and later dried in an oven at a temperature of 105–110°C to get a constant dry weight. The samples were cooled and then sieved through a 150 µm mesh. These fine samples were stored in air-tight cylindrical plastic containers of 300 ml volume for 30 days, to allow radioactive equilibrium of <sup>238</sup>U and <sup>232</sup>Th nuclei with their corresponding progenies. About 50 mg of the sample was crushed to fine powder using agate motor and spread as a fine layer in an aluminum planchet and its gross α-activity measured using alpha scintillation counter with ZnS (Ag) detector. Gross β-activity was measured using low beta counting system (ECIL model/K2700B). The concentration of primordial radionuclides in the samples was determined employing high efficiency 5"×5" NaI (Ti) gamma-ray spectrometer. Assuming that the two primordial radionuclides <sup>238</sup>U and <sup>232</sup>Th were in secular equilibrium with their corresponding de-

cay products, the samples were counted in identical containers to measure the γ-activities for a period of 2000 s. Measurement of alpha, beta and gamma activities of beach samples from ten stations around Manavalakurichi, is highly revealing. The gross alpha and gross beta activities range from  $6.31 \pm 0.41$ – $162.25 \times 10^3 \pm 0.42$  and  $2.97 \pm 0.54$ – $325.98 \times 10^3 \pm 0.41$  Bq/kg respectively, in the finest sand fraction.

The highest activities were recorded along the Chinnavilai and Kadiapattinam regions, which constitute the banks of the Kadiapattinam Estuary. The gamma-ray activity was directly related to abundance of the primordial radionuclides

in the area. The values were the highest at Chinnavilai, with  $1412 \pm 3.67$  and  $1300.5 \pm 3.45$  Bq/kg for <sup>238</sup>U and <sup>232</sup>Th nuclei respectively, followed by  $1257.7 \pm 2.43$  and  $1020.2 \pm 2.34$  Bq/kg at Kadiapattinam. It may be recalled that the two areas form strategic regions either side of the Valliyar river, which transports the radionuclides through the Kadiapattinam Estuary into the Bay of Bengal. The values are found to be very high (Table 1) in these regions, to the extent of nearly 50 times the world average (35 and 30 Bq/kg respectively)<sup>4</sup>. Moreover, the gamma activity concentration of <sup>238</sup>U  $1412 \pm 3.67$  Bq/kg at Chinnavilai, is the highest ever recorded value



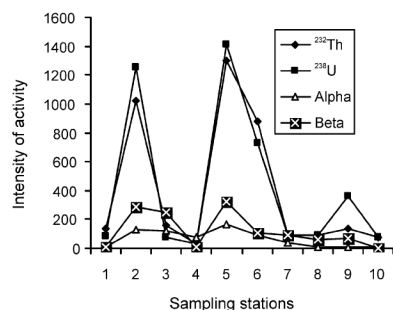
Figure 1. Sampling stations.

**Table 1.** Comparison of gamma activities with global level

Environment	Activity concentration (Bq/kg)		Reference
	$^{232}\text{Th}$	$^{238}\text{U}$	
Tamil Nadu–Southwest coast of India	29.19–1300.50	27.40–1412.00	Present study
Coastal Karnataka	31.10	36.00	Narayana <sup>5</sup>
Coastal Kerala	122.00–5834.00	37.00–618.00	Radhakrishna <i>et al.</i> <sup>6</sup>
North coast of India	121.40	13.20	BARC Report <sup>7</sup>
Japan	54.00	32.40	Ching Jiang Chen <i>et al.</i> <sup>8</sup>
China	32.00–228.00	26.00–119.00	Pan Zigiang <i>et al.</i> <sup>9</sup>
USA	4.00–130.00	44.00–140.00	Myrick <i>et al.</i> <sup>10</sup>
Taiwan	44.00	30.00	Yu Ming Lin <i>et al.</i> <sup>11</sup>
Nigeria	81.60	57.90	Ajayi <sup>12</sup>
World average	30.00	35.00	UNSCEAR <sup>13</sup>

**Table 2.** Intensity of activity in the study area

Sampling station	Gross $\alpha$ -activity $\times 10^3$ Bq/kg $\pm$ SD	Gross $\beta$ -activity $\times 10^3$ Bq/kg $\pm$ SD	Activity concentration Bq/kg $\pm$ SD	
			$^{232}\text{Th}$	$^{238}\text{U}$
1	10.45 $\pm$ 0.43	10.25 $\pm$ 0.24	135.2 $\pm$ 1.20	80 $\pm$ 1.46
2	129.46 $\pm$ 0.35	288.32 $\pm$ 0.23	1020.2 $\pm$ 2.34	1257.7 $\pm$ 2.43
3	119.34 $\pm$ 0.52	251.2 $\pm$ 0.51	156.6 $\pm$ 1.15	76.4 $\pm$ 1.46
4	78.76 $\pm$ 0.36	9.29 $\pm$ 0.34	29.19 $\pm$ 1.16	27.4 $\pm$ 2.43
5	162.25 $\pm$ 0.42	325.98 $\pm$ 0.41	1300.5 $\pm$ 3.45	1412.0 $\pm$ 3.67
6	86.49 $\pm$ 0.41	106.16 $\pm$ 0.45	880.5 $\pm$ 2.76	730.0 $\pm$ 2.62
7	34.76 $\pm$ 0.35	92.11 $\pm$ 0.36	88.9 $\pm$ 2.43	89.2 $\pm$ 2.15
8	06.73 $\pm$ 0.24	58.07 $\pm$ 0.42	92.5 $\pm$ 2.15	92.8 $\pm$ 1.24
9	06.31 $\pm$ 0.41	70.69 $\pm$ 0.24	135.5 $\pm$ 2.67	364.0 $\pm$ 1.23
10	06.32 $\pm$ 0.35	02.97 $\pm$ 0.54	78.1 $\pm$ 1.43	75.2 $\pm$ 2.12
Mean	64.1 $\pm$ 0.38	121.5 $\pm$ 0.37	391.71 $\pm$ 2.02	420.47 $\pm$ 2.08

**Figure 2.**  $\alpha$ ,  $\beta$ ,  $\gamma$ -activities at the sampling stations.

(Table 2) in the literature and the  $^{232}\text{Th}$  activity ( $1300.5 \pm 3.45$  Bq/kg) is also extremely high (Figure 2), but only next to that at Chavara along the Kerala coast.

The calculated dose rates affecting the region indicate values as high as 1451.75 and 1336.33 nGy/h respectively. The incomparably high values are certainly a major threat, affecting the region populated by the fishermen community. The Indian Rare Earths at Manavalakurichi is exploiting the large reserves of monazite in this region to the benefit of the locals. However, it is discomfoting to know

still that there are areas with thick mineral deposits, especially around the large fishermen population who defy any effort to remove the huge deposits, fearing erosion of their natural boundaries by the sea waves.

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Received 6 August 2007; revised accepted 2 April 2008

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