

Assessment of Radiological in the Beach Sand from Pattani Province

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Abstract. Specific activities of natural (⁴⁰K, ²²⁶Ra and ²³²Th) radionuclides in 250 beach sand samples collected from 5 beaches in 5 districts which are Rachadapisek beach in Nong Chick district, Talokapo beach in Yaring district, Panarae beach in Panarae district, Wasukri beach in Saiburi district and Pamai beach in Mai Kaen district in Pattani province, have been studied and measured. Experimental results were obtained by using a high-purity germanium (HPGe) detector and gamma spectrometry analysis system and also evaluated by using the standard reference materials IAEA-SOIL-6 which were obtained from Office of Atoms for Peace. Experimental set-up and measurement were operated and carried out at laboratory research building, Office of Atoms for Peace, Bangkok. It was found that, the mean values of specific activities of ⁴⁰K in Rachadapisek, Talokapo, Panarae, Wasukri and Pamai beaches were 427.58 ± 14.09 , 1090.62 ± 54.28 , 463.95 ± 14.06 , 449.07 ± 13.80 and 433.49 ± 12.77 Bq/kg, respectively. The mean values of specific activities of ²²⁶Ra were 31.10 ± 7.63 , 160.68 ± 8.07 , 84.41 ± 13.09 , 33.98 ± 7.76 and 44.42 ± 10.17 Bq/kg, respectively. The mean values of specific activities of ²³²Th were 11.40 ± 1.75 , 356.65 ± 6.59 , 74.50 ± 3.07 , 16.04 ± 1.78 and 26.86 ± 2.08 Bq/kg, respectively. Furthermore, the results of the specific activities of natural radionuclides (⁴⁰K, ²²⁶Ra and ²³²Th) in this areas were also used to evaluate the gamma absorbed dose rates (D), the radium equivalent activity (Raeq), the external hazard index (Hex) and the annual external effective dose rate in this area. Furthermore, experimental results were also compared to research data in the southern region of Thailand, the Office of Atoms for Peace (OAP) annual report and the recommended values which were proposed by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1988, 1993, 2000). The first section in your paper

1. Introduction

Natural radioactivity is wide spread in the earth's environment and it exists in various geological formations in soil, sand, rocks, plants, water and air. The natural radioactivity in sand comes from U and Th series and natural K. The radiological implication of these radionuclides is due to the gamma ray exposure of the body and irradiation of lung tissue from inhalation of radon and its daughters. Therefore, the assessment of gamma radiation dose from natural sources is of particular importance as

natural radiation is the largest contributor to the external dose of the world population [1]. The measurement of natural radioactivity due to gamma rays from the dose rate is needed to implement precautionary measures whenever the dose is found to be above the recommended limits. The growing worldwide interest in natural radiation exposure has led to extensive surveys in many countries. Some of the beaches in Pattani Province lack data that has been measured and analyzed for the amount of radioactivity accumulated in the natural system and with international standards. The sample of beaches with the most tourists in the province, including Ratchadapisek beach, Nong Chik district, Taloakapo district, Yaring district, Panaree beach, Panarea district, Sawasdee beach, Saiburi district and Hat Pa Buri district. In the present work, 250 beach sand samples collected from Pattani province in the south of Thailand. All beach samples were used to determine the specific activities of natural radionuclides (^{40}K , ^{226}Ra and ^{232}Th) with the main objective to measure the radiation exposure from the nature to the people who lived this area. Moreover, the experimental results were also compared with Office of Atoms for Peace (OAP) research data, Thailand and global radioactivity measurement and evaluations.

2. Materials and Methods

2.1 Sample Collection and Preparation

250 beach sand samples were collected along the Pattani province in the south of Thailand. All beach sand samples were prepared with standard procedure in Nuclear and Material Physics Research laboratory, Department of Physics, Faculty of Science, Thaksin University (TSU). Each sample was homogenized and sieved through 2-mm mesh sized to remove stone pebbles and other macro-impurities. Then, the sample was taken to oven dried at a temperature of 100 °C for 3 hours to remove the moisture. The PVC containers were used to keep the sand sample, sealed and stored about 30 days in order to reach equilibrium of the radionuclides before the laboratory measurement.

2.2 Calibration and Measurement by Gamma Spectrometry

The specific activities of ^{40}K , ^{226}Ra and ^{232}Th in 250 beach sand samples were measured and carried out by using a high-purity germanium (HPGe) detector and gamma spectrometry analysis system at laboratory research building, Office of Atoms for Peace, Bangkok. Gamma ray radioactive standard sources ^{137}Cs and ^{60}Co were used to calibrate the measurement system. The well-known reference materials (IAEA-SOIL-6) obtained from the International Atomic Energy Agency was used to analyze and compute the ^{40}K , ^{226}Ra and ^{232}Th specific activity in all of the beach sand samples. The spectra were analyzed using program Gamma Vision V32. The specific activity of ^{226}Ra and ^{232}Th were determined by their decay products ^{214}Pb (351.9 keV) and ^{212}Pb (238.6 keV), respectively. The specific activities of ^{40}K was determined from its 1460.8 keV gamma spectrometry line. Counting time for each sample was 10,000 seconds. The background spectrum was recorded immediately after or before the sample counting.

3. Results

Table 1. Comparison of the average value of specific activities of ^{40}K , ^{226}Ra and ^{232}Th , gamma absorbed dose rate, radium equivalent activity, external hazard index, and annual external effective dose rate of 250 beach sand samples collected from Pattani province.

Locations	Specific Activities (Bq/kg)			D (nGy/h)	Ra _{eq} (Bq/kg)	H _{ex}	AED _{out} (mSv/y)
	^{40}K	^{226}Ra	^{232}Th				
Rachadapisek beach in Nong Chick district	427.58	31.10	11.40	41.47	93.11	0.25	0.05
Talokapo beach in Yaring district	1090.62	160.68	356.65	351.66	687.17	1.86	0.43

Locations	Specific Activities (Bq/kg)			D (nGy/h)	Ra _{eq} (Bq/kg)	H _{ex}	AED _{out} (mSv/y)
	⁴⁰ K	²²⁶ Ra	²³² Th				
Panarae beach in Panarae district	463.95	84.41	74.50	108.10	236.62	0.64	0.13
Wasukri beach in Saiburi district	449.07	33.98	16.04	45.81	101.77	0.27	0.06
Pamai beach in Mai Kaen district	433.49	44.42	26.86	58.23	128.38	0.35	0.07
OAP data[5]	511.04	171.55	211.19	231.81	512.90	1.39	0.28
UNSCEAR(1988,1993,2000) [6-8]	400.00	35.00	30.00	55.00	370.00	1.00	0.48

Moreover, the specific activity of ⁴⁰K, ²²⁶Ra and ²³²Th radionuclides has been simulated into a radioactive diagram using ArcGIS Version 10.2. The diagram was supported by the department of geology and humanities, Thaksin University. The diagram was displayed in figure 1, 2 and 3 respectively.

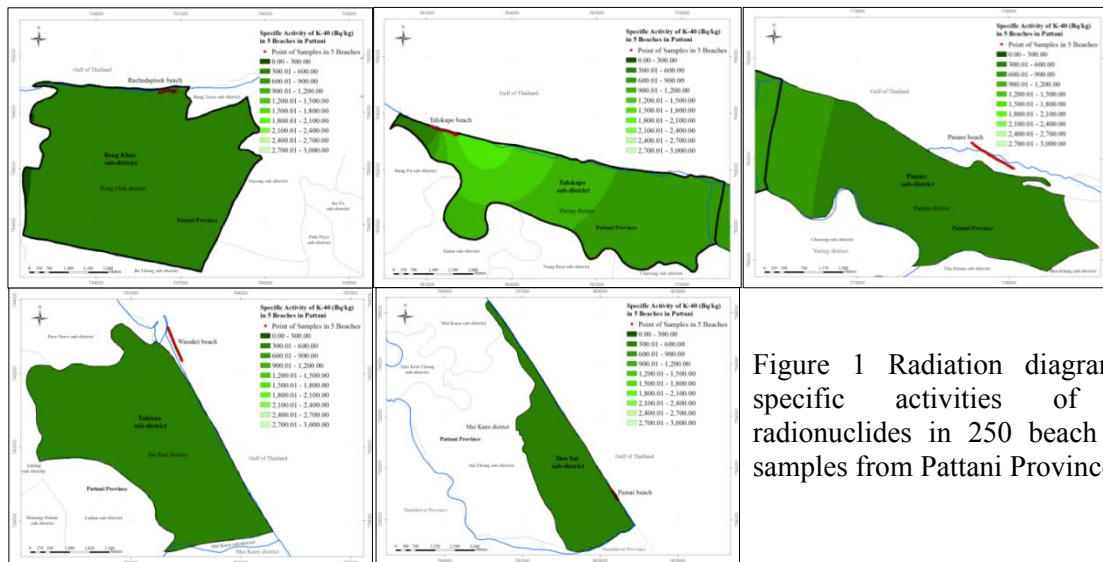


Figure 1 Radiation diagram of specific activities of ⁴⁰K radionuclides in 250 beach sand samples from Pattani Province

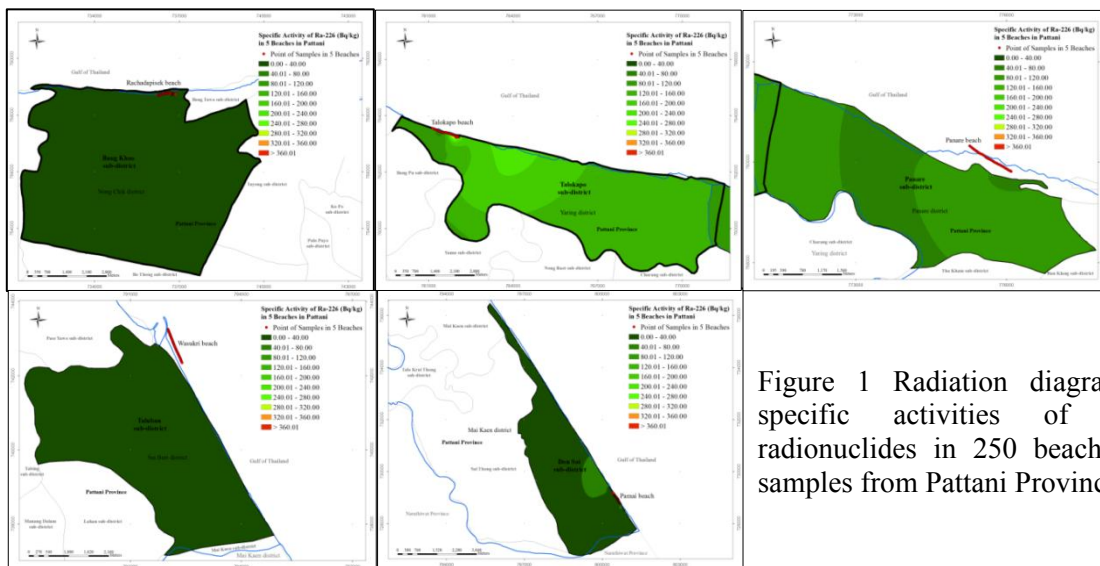


Figure 1 Radiation diagram of specific activities of ²²⁶Ra radionuclides in 250 beach sand samples from Pattani Province

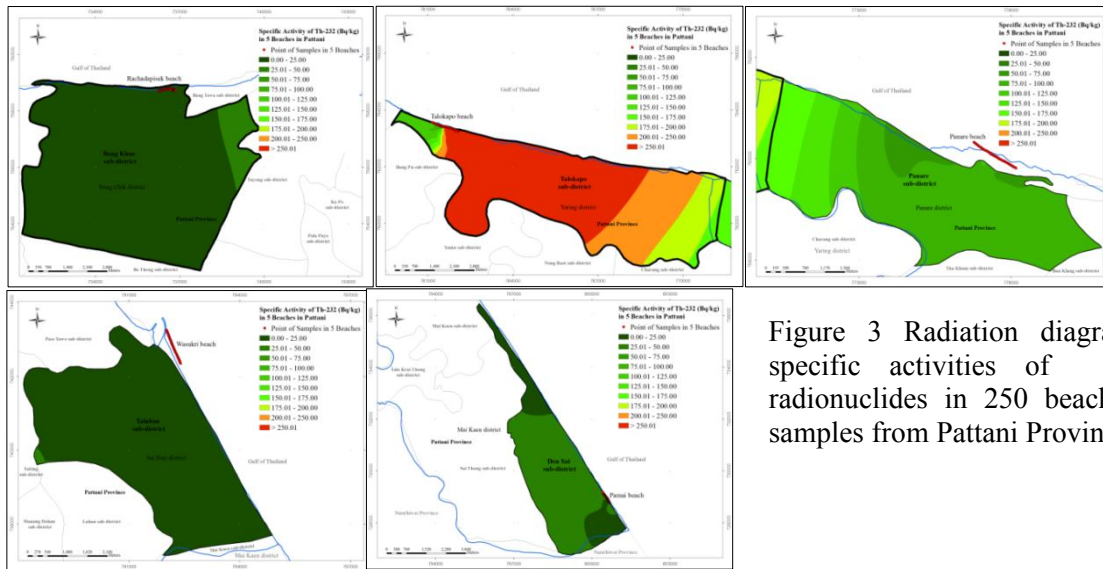


Figure 3 Radiation diagram of specific activities of ^{232}Th radionuclides in 250 beach sand samples from Pattani Province

4. Conclusion

Specific activities of natural ^{40}K radionuclides in 250 beach sand samples collected from 5 beaches in 5 districts including Rachadapisek beach in Nong Chick district, Talokapo beach in Yaring district, Panarae beach in Panarae district, Wasukri beach in Saiburi district, and Pamai beach in Mai Kaen district in Pattani province. Our data exhibits higher values than those reported by the Office of Atoms for Peace, and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1988, 1993, 2000). In summary, the calculation of the Risk Index of Radiation Exposure, specifically, the measured amount of radiation from outside of body (AEDout) are not different from the values measured by the Office of Atoms for Peace, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1988, 1993, 2000). This is because we have not explored the physical quantities of radiation before. It is not known yet whether the value is different, however Thailand is still safe.

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