Concentrations of naturally occurring radionuclides in Marine Environment of Mamuju, Indonesia

Heny Suseno,

Wahyu Retno Prihatiningsih

henis@batan.go.id

Ayu-iu@batan.go.id

Introduction

- Mamuju region was situated at West Celebes has remarkable scene, going from marine and waterfront and wetland biological systems to bumpy and uneven environments.
- Mamuju area is likewise rich with little island biological systems.
- Mamuju located in the territory of West Celebes Indonesia that has a background radiation roughly multiple times higher than typical.
- This radiation is the after effect of high common uranium content (Radium-226 and Radon gas, the two of which are exceedingly water solvent) in shake and soil.

Introduction (ctny)

- Limited studies concerning radioactivity at Mamuju have been conducted.
- Study of marine radioecology including its radiological hazard for mapping NORM in coastal of Mamuju have never been conducted.
- The aim of this research work is to monitoring and assessing the NORM in Mamuju Coastal.

Methods

Sampling and sample preparation

Sea sediments samples were collected from the 8 beaches location of Mamuju, West Celebes Indonesia. Collected samples were then taken to the laboratory where they were dried at a temperature 110 ^{o}C until constant weights were achieved. The dried samples were crushed, homogenized and made to pass through a 150 µm mesh sieve. 1 kg of each samples were fed into empty marineli containers that have been previously certified to be non-radioactive. The sample containers were then sealed and left for a period of about 40 days. This was done to enable the short lived members of uranium and thorium series reach secular equilibrium prior to gamma spectroscopy.

Gamma spectrometric analysis

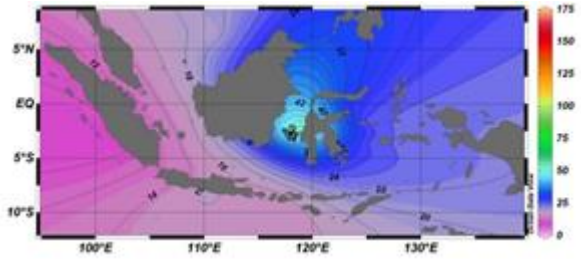
A 25% relative efficiency HPGe detector (model: Canbera, Amplifier model 2020, ADC model 8075, HVPS model 3105) was employed for the gamma-ray spectrometry measurements. The detector has a resolution (FWHM of ^{60}Co) at 1332 keV was 1.89 KeV, which is capable of distinguishing the gamma-ray energies of the radionuclides of interest in this study.

Result

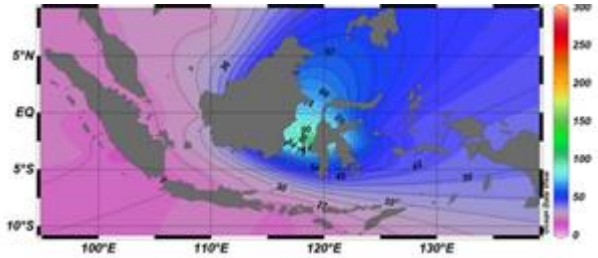
- The present interest concerns from the ^{238}U decay chain are ^{226}Ra, ^{214}Bi, and ^{210}Po and from the ^{232}Th decay chain are ^{228}Th and ^{228}Ac.
- The purpose has been to find out a profile of activity radionuclide concentration in coastal of Mamuju sediments.
- The gamma spectrometric techniques in general are applied to analysis of environmental matrix, such as solids and liquids

Tabel 1. Natural radionuclide in coastal sediment of Mamuju

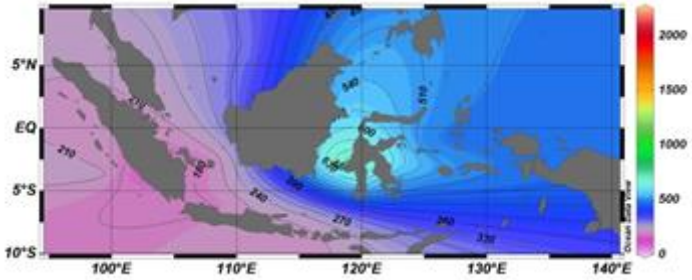
Location	Coordinat	Activity (Bq kg^{-1})		
		^{226}Ra	^{232}Th	^{40}K
ST 1	119 25’ 494” BT 03 27’ 554” LS	91.56 ± 2.52	151.76 ± 5.71	890.32 ± 34.17
ST 2	118 58’ 237” BT 03 32’ 737” LS	75.00 ± 2.06	94.17 ± 3.14	1429.74 ± 54.76
ST 3	118 55’ 757” BT 02 39’ 119” LS	93.63 ± 2.57	157.46 ± 5.89	915.99 ± 35.18
ST 4	118 50’ 917” BT 02 39’ 513” LS	59.87 ± 1.65	140.68 ± 5.38	427.83 ± 15.76
ST 5	118 50’ 244” BT 02 38’ 392” LS	118.71 ± 13.00	245.55 ± 9.51	1152.82 ± 41.90
ST 6	118 49’ 885” BT 02 37’ 991” LS	152.71 ± 4.07	271.31 ± 10.57	1835.59 ± 66.85
ST 7	118 53’ 635” BT 02 40’ 024” LS	118.05 ± 12.34	211.43 ± 35.16	2039.34 ± 135.53
ST 8	118 51’ 946” BT 02 40’ 297” LS	113.05 ± 4.34	285.92 ± 8.025	1196.50 ± 43.70



Ra-226



Th -232



K-40

Figure 1. Concentrations of ^{226}Ra, ^{232}Th and ^{40}K (Bq kg^{-1}) in sea sediments from the Mamuju Coastal

Tabel 2. Activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in sedimen of mamuju Coastal in comparison with sediments of other coastal area from different country.

Name of area/Country	Activity Concentration (Bq kg^{-1})			Reference
	^{226}Ra	^{232}Th	^{40}K	
Tamilnadu. India (coastal sediment)	3.67	37.23	387.17	(Ravisankar et al., 2015)
Oman (marine sediment)	11.83 – 22.68	10.7 – 25.2	222.89 – 535.07	(Zare, Mostajaboddavati, Kamali, Abdi, & Mortazavi, 2012)
Saudi coastline – Gulf of Aqaba (coastal sediment)	11.4	22.5	641.1	(Al-Trabulsy, Khater, & Habbani, 2011)
Karnataka (sediment)	374	158	158	(Radhakrishna, Somashekarappa, Narayana, & Siddappa, 1993)
Hungary (sediment)	28.67	27.96	302.4	UNSCEAR (2000)
Mamuju Indonesia (coastal sediment)	102.82 ± 27.17	194.79 ± 64.53	1236.02 ± 490.65	Present work
Worldwide	35	30	400	UNSCEAR (2000)

Table 3. Radiological data of sediment Mamuju

Lokasi	Koordinat	D_{in} (nGy h^{-1})	$AEDE_{in}$ (mSv y^{-1})	AUI	AGDE	Ra_{eq}	Hex	Hin	ELCR × 10^{-3}
ST 1	119 25' 494" BT 03 27' 554" LS	322.40	1.58	2.75	1196.86	370.91	1.02	1.27	5.53
ST 2	118 58' 237" BT 03 32' 737" LS	286.98	1.41	1.95	1074.35	309.76	0.86	1.07	4.94
ST 3	118 55' 757" BT 02 39' 119" LS	442.57	1.63	2.84	1235.14	382.92	1.05	1.30	5.71
ST 4	118 50' 917" BT 02 39' 513" LS	244.07	1.20	2.29	907.46	291.00	0.79	0.96	4.20
ST 5	118 50' 244" BT 02 38' 392" LS	471.55	2.31	4.16	1755.21	550.55	1.51	1.84	8.10
ST 6	118 49' 885" BT 02 37' 991" LS	585.79	2.87	4.84	2182.35	669.18	1.84	2.25	10.06
ST 7	118 53' 635" BT 02 40' 024" LS	504.33	2.48	3.82	1888.90	563.15	1.56	1.88	8.66
ST 8	118 51' 946" BT 02 40' 297" LS	514.24	2.52	4.60	1920.19	605.68	1.67	1.96	8.83

Tabel 4. Radiological parameters of present work compared with other countries

Location	References	D_{in} (nGy h^{-1})	$AEDE_{in}$ (mSv y^{-1})	AUI	AGDE	Ra_{eq}	H_{ex}	H_{in}	ELCR $\times 10^{-3}$
Tamilnadu. India (coastal sediment)	(Ravisankar et al., 2015)	41.70	0.051	-	0.282	84.57	0.22	0.23	-
Oguta Lake. East Nigeria	(Isinkaye & Emelue, 2015)	186.80	0.92	1.20	653	205.67	0.56	0.67	3.21
Egypt red sea (marine sediment)	(Dar & Saman, 2012)	30.69	0.04	-	-	63.81	0.17	0.21	-
Saudi coastline Gulf of Aqaba (coastal sediment)	(Al-Trabulsy et al., 2011)	92.9	0.056	-	-	92.9	0.13	0.28	-
Bangladesh (coastal sediment)	(Yasmin, Barua, Kamal, & Rashid, 2014)	55.15	0.14	-	-	121.27	0.33		-
Oman (marine sediment)	(Zare et al., 2012)	24.38	-	-	-	90.2	0.25	-	-
Mamuju. Indonesia (sediment coastal)	Present work	421.49	2.00	3.40	1520.05	467.89	1.29	1.57	7.00
World average	UNSCEAR (1998; 2000)	84	0.41	-	300	370	< 1	< 1	1.16

CONCLUTION

- Sediment samples from eight stations in Mamuju coastal, West Sulawesi have been analyzed using HPGe gamma detector.
- The average activity concentration of ^{226}Ra, ^{232}Th and ^{40}K obtained were 102.82 ± 27.17 Bq kg^{-1}; 194.79 ± 64.53 Bq kg^{-1} and 1,236.02 ± 490.65 Bq kg^{-1} which is higher compared to other region in the wolrd.
- Activity concentration of these radionuclides used to determined radiation hazards indices. Where the average value for Indoor gamma dose rate ($D_{in)}$ 421.49 nGy h^{-1}, Annual indoor effective dose equivalent ($AEDE_{in}$) 2.00 mSv y^{-1}. Activity utilization index (AUI) 3.40. Annual gonadal dose equivalent (AGDE) 1,520.06, Radium equivalent (Ra_{eq}) 467.89. External and internal hazards (H_{ex}) 1.28. (H_{in}) 1.56 and Excess lifetime cancer risk (ELCR) 7.00×10^{-3}.
- The result showed that are generally high for most radiation hazard indices calculated. There may be serious radiological effects to the environment and to the population, where the risk due to radiation is important and should be need to further monitored and investigated.

BADAN TENAGA NUKLIR NASIONAL

Jl. Kuningan Barat, Mampang Prapatan Jakarta, 12710

(021) 525 1109 | Fax. (021) 525 1110

humas@batan.go.id

Humas Batan @humasbatan badan_tenaga_nuklir_nasional Humas Batan