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Trend Analysis of Gamma Exposure Rates and Soil Radionuclides Concentrations in Korea

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1. Introduction

Monitoring and analyzing Gamma exposure rate in environment is important to monitor environmental radiation /radioactivity level in Korea and to provide the base-line data on environmental radiation/radioactivity for radiological emergency situation. Korea institute of nuclear safety has operated monitoring system(Ion chamber, Scintillation detector, Thermoluminescence Dosimeter). Gamma exposure rate dependent on regional environment, season and diurnal(daily) variation, meteorological factor etc. There are many variable so that analysis of gamma exposure rate is too complicated. This paper confirmed diurnal variation and analyzed relation radionuclides in the soil and gamma exposure rate.

2. Methods and Results

For 10 monitoring locations, we compared diurnal variation of gamma exposure rate measured by monitoring ion chambers with the concentrations of radionuclides of the soils nearby the ion chambers.

2.1 Diurnal variation of gamma exposure rate

We collected gamma exposure rate data of January, July, August in 2014 about 10 branches nationwide(Gwanak-gu, Donghae, Anyang, Yeosu, Youngjongdo, Yuseong-gu, Jungnang-gu, Jindo, Cheongsong, Seoul(Hanyang university)) on the IERNet. Diurnal variations of gamma exposure rate data are obtained by averaging 30 or 31 data in a month, these data are examined and categorized in four types.

1. Diurnal variation, seasonal features of gamma exposure rate are clear(January>July, August)
2. Diurnal variation, seasonal features of gamma exposure rate are clear(July, August >January)
3. Diurnal variation is clear, seasonal features of gamma exposure rate unclear
4. Diurnal variation, seasonal features of gamma exposure rate are unclear

Type1 are Donghae and Cheongsong, type2 are Gwanak-gu, Youngjongdo and Anyang, type3 are Yuseong-gu and Jungnang-gu, type4 are Yeosu, Jindo and Seoul(Hanyang).

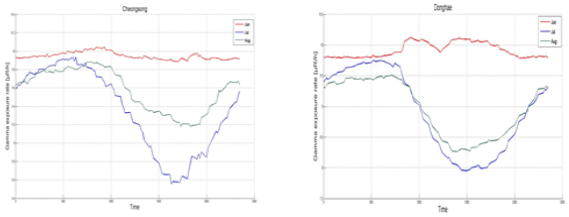

Fig. 1 Type1 diurnal variation (Donghae, Chengsong)

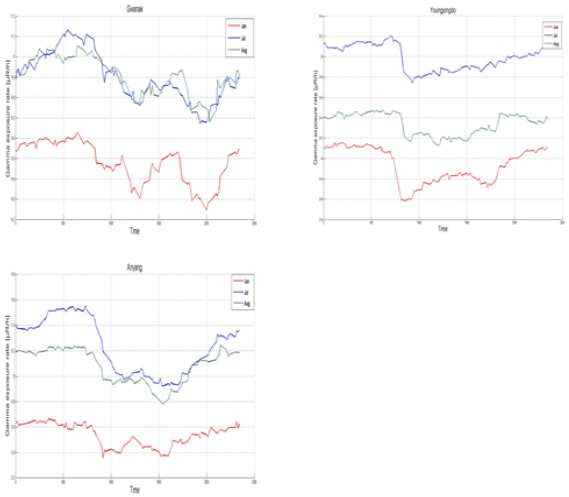

Fig. 2 Type2 diurnal variation (Gwanak-gu, Youngjongdo, Anyang)

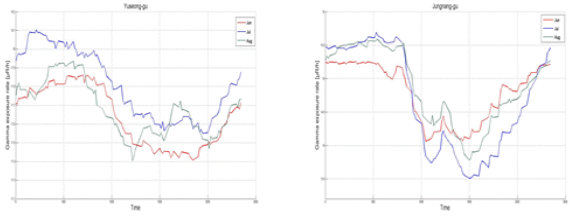

Fig. 3 Type3 diurnal variation (Yuseong-gu, Jungnang-gu)

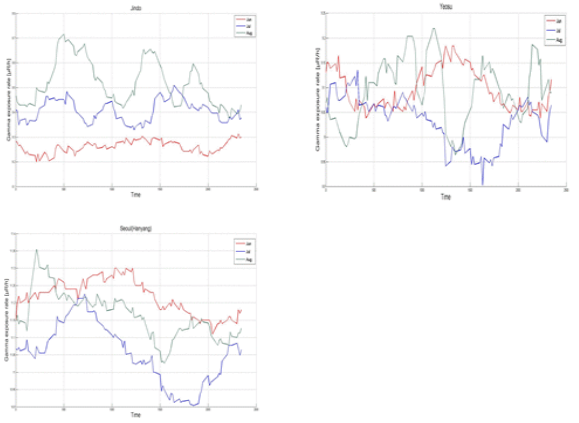

Fig. 4 Type4 diurnal variation (Yeosu, Jindo, Seoul (Hanyang)

The level of gamma exposure rate in the air is generally highly dependent on the radioisotope(K-40, U-238, Th-232, Ra-226) concentration in the soil. Diurnal variations may come from the changes of radon and radon progeny concentrations in the air by atmospheric circulation changes. Seasonal variations may come from radon emission(from the soil in to the air) rate changes due to seasonal temperature and surface condition changes. In addition, seasonal wind direction may have a big impact on the exposure rate data. type1 and type2 features are different aspect. factors of regional difference are

1. If temperature in winter was too low, radon gas is enriched in soil. because soil surface is frozen.

2. Exposure of the soil surface is different by character of paved road each region.

3. Difference in the circulation of the atmosphere by position where installed detector, man-made structures.

In the case of type 4, Jindo and Yeosu are located on the coast so circulation is effected by sea breeze and onshore wind. Detector in Seoul(Hanyang) was installed on the rooftop so type 4 regions are special feature.

2.2 Soil radionuclides concentrations in soil

We collected soil samples in 10 branches nationwide. after preprocessing, airtight contained samples stored for 28 days and then measured by HPGe during one day. Regional radionuclides concentration is shown in table 1. Pb-212 is Th-232 progeny, Pb-214 is U-238 progeny and K-40 is single nuclide. We could know concentration of radon by measuring Pb-212, Pb-214 and K-40 is representative radionuclide in soil
Trend of radionuclides concentration and gamma exposure rate is presented in Fig 5 . Total activity and gamma exposure rate has a close relation.
Radon concentration in soil and diurnal variation were not clearly. because there are many factor that affect diurnal variation

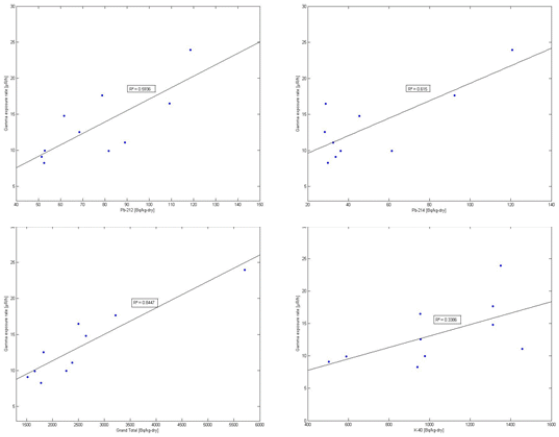

Fig. 5 Linear relation of gamma exposure rate and radionuclides in soil

region \ Radionuclid		Pb-212 [Bq/kg-dry]	Pb-214 [Bq/kg-dry]	K-40 [Bq/kg-dry]	Total activity [Bq/kg-dry]	Gamma exposure rate January/July average [μR/h]
Type1	Donghae	81.74	61.45	589.9	1661	9.915/8.927
	Cheongsong	52.94	36.27	976.8	2263	9.948/9.361
Type2	Gwanak	109.2	28.81	953.8	2502	16.48/16.90
	Anyang	68.58	28.42	954.8	1828	12.54/13.23
	Youngjongdo	118.7	120.7	1351	5707	23.93/24.98
Type3	Yuseong-gu	78.80	92.31	1312	3219	17.64/17.81
	Jungnang-gu	61.67	45.49	1312	2648	14.79/14.69
Type4	Seoul (Hanyang)	89.11	32.57	1456	2381	11.10/11.06
	Jindo	52.67	29.94	940.6	1781	8.261/8.405
	Yeosu	51.51	33.7	503.5	1522	9.096/9.033

Table 1 Concentration of radionuclides in soil and Gamma exposure rate

3. Conclusions

For 10 monitoring locations, we compared diurnal(daily) variation of gamma exposure rate measured by monitoring ion chambers with the concentrations of radionuclides of the soils nearby the ion chambers. Using the data provided by IERNet, the gamma exposure rates are analyzed into four types. The concentrations of radioisotopes of the soil nearby 10 monitoring locations are obtained using a HPGe detector system. Finally, the gamma exposure rates are found to have close(linear)relation with the total activity of the soil near the monitoring posts.

ACKNOWLEDGMENTS

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