§4. Analysis of U and Th Series Radionuclides in Soil from Toki Area II. Effects of Soil Type, Landscape and Concrete Buildings on Environmental Radiation

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INTRODUCTION

Principal sources of external radiation in the environment are cosmic ray and terrestrial radiation. The purpose of our study was to investigate the extent and mechanisms of variation in external gamma-ray radiation level at the Toki area.

Fourteen radiation-dose monitoring stations are currently in operation at the campus of National Institute of Fusion Science (NIFS). The monitoring data suggested that some stations near the boundary of the campus showed consistently lower dose values than the stations near LHD building. The cause of such variation was considered to be varying terrestrial radionuclide contents with locations or the effect of concrete buildings, as the spatial variation in cosmic ray intensity should be negligibly small in the area (220-270 m altitude above sea level).

In the present study, we conducted *in-situ* gamma spectroscopy measurement, and collection of soil samples for analyses of U and Th daughter radionuclides at several locations in the NIFS campus. Through comparison between the *in-situ* measurement and laboratory data at each sampling location, factors relevant to the radiation dose variation were discussed.

MATERIALS AND METHOD

Soil sampling and *in-situ* gamma spectroscopic measurement were conducted at the following locations in NIFS campus.

(1) Sampling locations near the border of NIFS campus (Station WA, WC, WE, WF):

Station WA was on natural soil horizons located near the peak of a hill. Station WC was located 10 m from a pond, and was often waterlogged after rain. Station WE was under a deciduous forest and was located approximately 2.5 m from a paved road. WF is located on a strip between a paved parking lot and a paved road.

(2) Other sampling locations in NIFS campus (Station IB, IF, IX)

Station IB was located in a courtyard surrounded by a LHD building and several other buildings. The soil surface there was partly covered by a white soil sold for gardening purposes. Station IF was located 15 m from a LHD building, on a flat ground covered with lawn. Station IX was located on a flat ground covered with pebbles, far (at least 25 m apart) from any of the building.

In-situ gamma-ray spectra was obtained by tripod-mounted, downward-facing partable HPGe semiconductor detector (Canberra) and NaI(Tl)- DBM detector (Aloka). The measurement was conducted at the 1.0 m height above the ground. Soil collected were analyzed by laboratory Ge semiconductor detector and ICP-MS. Results of soil sample analyses showed that the relative discrepancy between laboratory Ge and the ICP-MS analyses of U-238 (Bi-214) and Th-232 (Ac-28) was less than 15 % .

RESULTS AND DISCUSSION

Results of the measurement are shown as concentrations of Ac-228 (Fig. 1) and Bi-214 (Fig. 2) in soil plotted versus those detected by *in-situ* HPGe spectroscopy. Diagonal dashed lines indicate the results that should be obtained if the radiation dose at each locations are governed solely by terrestrial radionuclides distributed uniformly in flat land. Figs. 1 and 2 showed that soil concentrations of U and Th daughter nuclides were higher than those detected by *in-situ* measurement at locations near NIFS campus border. It probably is attributable to decreased terrestrial radiation due to geomorphological factor in station WA, water-logging in station WC and the effect of paved road beside WE and WF. Station IX showed good agreement between *in-situ* and laboratory measurement. Radiation dose at station IB is probably influenced by the concrete building near the station. It was found that white gardening soil that was used around the LHD building also had high radionuclide contents, and therefore could have contributed to elevated radiation dose there. Station IF showed only slightly elevated level of radiation dose relative to radionuclide contents in soil.

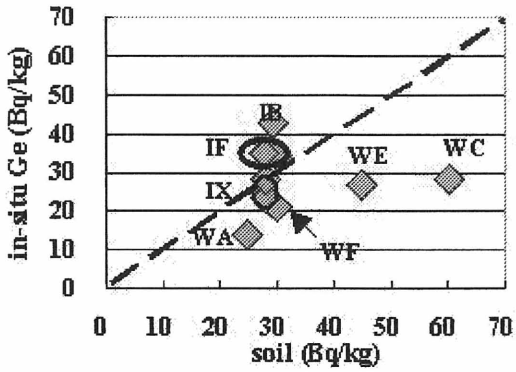

Fig. 1 Measurement of Th daughter (Ac-228) in NIFS campus

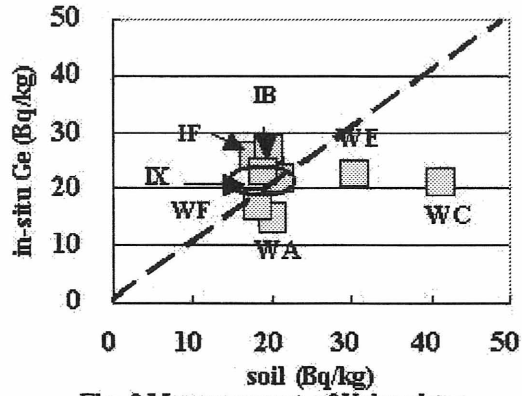

Fig. 2 Measurement of U daughter (Bi-214) in NIFS campus