

§5. History of Environmental Radioactivity in Soil at NIFS Toki Site: Comparison the Data between 1984 and 2012

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Various radioactive nuclides are found on the earth, such as ^3H , ^7Be , ^{10}Be , ^{14}C and ^{22}Na which have their origin from cosmic rays, ^{222}Rn , ^{210}Pb , ^{210}Po , ^{40}K , U and Th isotopes which have their origin in the land and ^{90}Sr , $^{134,137}\text{Cs}$ and $^{239,240}\text{Pu}$ as well as ^3H and ^{14}C which have their origin in atmospheric nuclear tests by fission and fusion bombs. Among these radioactive nuclides, ^{137}Cs which has a half-life of 30.1 years is well found on the surface soil because it continually falls for a long term after 1950's. In 1980's, Institute of Plasma Physics Japan (IPPJ) in Nagoya University made the project of Large Helical Device with super conducting magnet. Then IPPJ selected the toki site for establishment of a new research institute, NIFS, and created by clearing the forest. To evaluate the impact of the facility and determine the background levels of radioactivity in Toki site, the environmental monitoring of radiation and radioactivity has been done in 1984 before creating the Toki site¹. In this work, our attention is focused on the background levels of ^{137}Cs on the surface soil in NIFS Toki site and the data of radioactivity between 1984 and 2012 are compared.

The soil sample was collected by a core sampler in NIFS toki site. The depth of soil sample was about 5 cm from the surface because almost of ^{137}Cs as radioactive fallout is deposited on the surface layer. The soil samples were dried in an electric drier oven at 105°C with the dry air purging condition for three hours. Then the dried soil sample was used as fine powder by grinding in a mortar and sifted through a screen. The sifted sample was put in U-8 vessel. The concentration of radioactive nuclides was determined by means of γ -ray spectrometry using a high-purity germanium semiconductor detector (GX3018-CP-5F-7915, Canberra). The measurement time of sample was about 12 or 24 hours.

Figure 1 shows an example of the γ -ray spectrum of a soil sample. Various peaks were observed in the spectrum. In these peaks, the spectrum lines of ^{137}Cs and ^{40}K were higher counting rate. ^{40}K which is one of natural radionuclides exists in soil from the birth of the earth 4.5 billion years ago. The amount of ^{40}K is much influenced by the landscape architecture using the artificial manure. On the other hands, ^{137}Cs is the artificial radioactivity produced by the atmospheric nuclear atomic bombs. The concentration of ^{137}Cs was 36.9 Bq/kg at WH point. It was continually falled and deposited on the surface soil from 1950's. After 1970's, the atmospheric nuclear test was banned and the radioactive fallout is decreasing. Because the atmospheric nuclear tests have not been carried out since 1980, thus the amount of ^{137}Cs in environment would decrease by half-life of 30.1 years.

The background levels of ^{137}Cs in soil around Toki site in 1984 ranged in the concentration from about 2 Bq/kg to

about 600 Bq/kg.¹ The concentration lowered at the side of road because the soil was changed by the road construction. The typical ^{137}Cs concentrations in 1984 are shown in Fig. 2 with the map of sampling point. The sampling point at Toki site in 1984 was a spread of timber. Therefore the radioactive fallout was deposited on the surface soil and the timber. In 2012, the sampling point was carefully selected as the similar sampling point in 1984, i.e. in the forest. The measurement results and sampling points in 2012 are also shown in Fig. 2. The concentration of ^{137}Cs was less than 50 Bq/kg. The background levels of ^{137}Cs may be reduced to less than half of 1984 by the radioactive decay. To evaluate the impact of the fusion test facility, we will continue the monitoring of environmental radioactivity in Toki site.

1) Komura, K., et al., IPPJ-DT-130, 5, (1986).

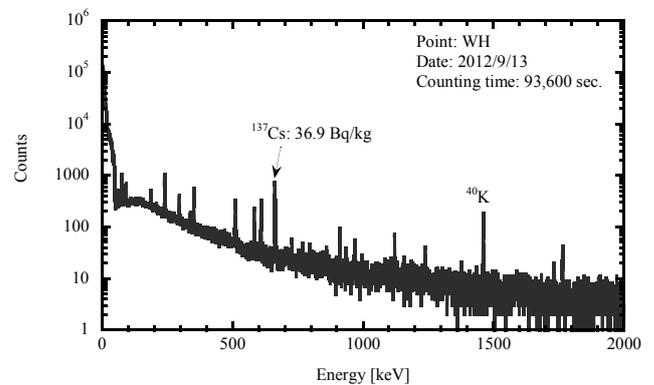
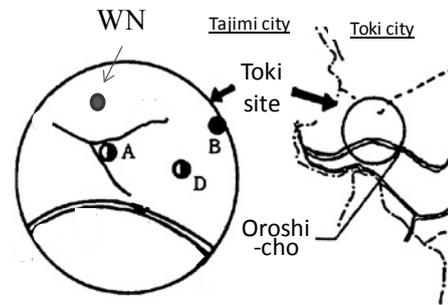


Fig. 1. An example of the measured spectrum of the soil sample by a high purity Ge semiconductor detector



Data in 1984 ¹		Data in 2012	
Sampling point	Radioactivity ^{137}Cs [Bq/kg]	Sampling point	Radioactivity ^{137}Cs [Bq/kg]
A	67.71	WN	44.45
B	84.73	B'	12.53
D	143.56	B''	31.88

Fig. 2. The map of sampling points and the concentration of ^{137}Cs on the surface soil at NIFS Toki site comparing the data between 1984 and 2012.