§1. Distribution of Environmental Radioactivity in Environmental Media at Toki

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The National Institute of Fusion Science (NIFS) is located in the Toki granite zone. Some uranium rich areas exist locally and high natural background radiation dose rates are observed around these areas. Although fallout cesium, such as Cs-137, from previous atmospheric nuclear tests has been detected on surface soil in Japan, the concentration is decreasing. Thus, it is important to measure the concentration of radioactive cesium as well as uranium and its progenies in environmental media, such as the atmosphere, soil, surface water, and vegetation to investigate the factor of variations in the environmental background radiation dose and the influence of radionuclides released from the facilities on the environment. To ensure radiation safety for advances in the plasma confinement of the Large Helical Device (LHD), the concentration of uranium, thorium, potassium, and cesium was measured in soil collected from wooded areas, a developed lawny ground, and the bank of a brook in the woods of the NIFS site in previous studies [1-2]. In this study, the radioactivity of lead (Pb-214 and Pb-212 are the progenies of U-238 and Th-232, respectively), potassium (K-40), and cesium (Cs-137) in soil samples collected at two different areas was measured using a Ge (Li) semiconductor detector, and concentrations of these radionuclides, dependent on the type of soil, were investigated.

Soil samples were collected using a core sampler (5 cm ϕ × 5 cm high) at areas (Tsubashi area: granite type and Hida area: sedimentary type) around the NIFS and near sampling points of a previous study [3], as shown in Fig. 1. The soil samples were prepared using the same method as in previous studies [1-2]. The classification of soil particles indicated that the soil contained more than 53–85 % sand and some silt and clay. The water content of the soil samples (2.5–20 cm) collected at Tsubashi and Hida areas was 11–15 % and 21–36 %, respectively.

Figures 2 and 3 show the depth profiles of the concentrations of K-40, Th-232, and U-238 in soil samples collected at Tsubashi and Hida areas, Toki, respectively. The activity of K-40, Th-232, and U-238 in soil samples collected at Tsubashi area was 2–3 times as high as that collected at Hida area. In Fig. 2, the concentration of K-40 in soil is uniform and independent of soil depth. In contrast, the concentrations of Th-232 and U-238 in soil samples collected at depths of 12.5–20 cm are higher than those collected at shallower parts. Furthermore, the concentration of Th-232 is almost 3 times as high as that of U-238 in Tsubashi area, independent of depth. The high concentration of Th-232 and U-238 at deeper layers is probably because Th and U specifically accumulated in certain layers such as mudstone layers. At Hida, the concentration of Th-232 is about 1.6 times as high as that of U-238. The concentration of K-40, Th-232, and U-238 in samples collected at deeper layers increased with soil depth. Transfer of surface soil is suggested to be the cause of these different concentrations.

1) Yokoyama S. et al., Annual report of NIFS April 2014-March 2015 (2015).
2) Yokoyama S. et al., Annual report of NIFS April 2013-March 2014, 169 (2014).
3) Nagoya Univ., IPPJ-DT-116 (1985).

Fig. 1 Soil sampling points (Tsubashi and Hida)

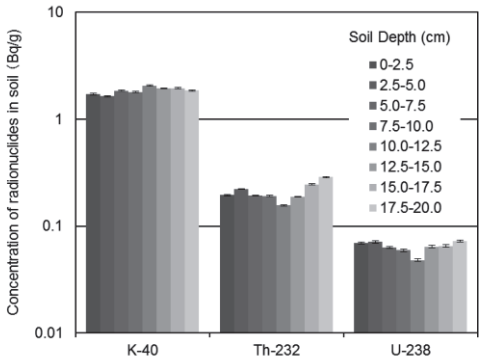

Fig. 2 Soil depth profiles of K-40, Th-232, and U-238 at Tsubashi area, Toki.

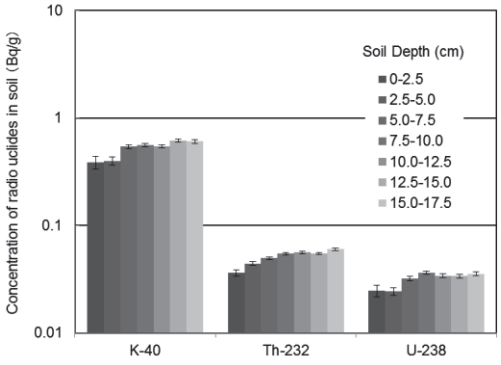

Fig. 3 Soil depth profiles of K-40, Th-232, and U-238 at Hida area, Toki.