§3. Investigation of Natural Radiation and Radioactivity at Tono Area in Gifu Prefecture, Japan

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Introduction

According to the report by National Institute of Radiological Sciences, highest natural radiation dose was observed in Gifu Prefecture. Especially, the annual dose for Tono area has been observed to have high values due to uranium-containing soil. National Institute of Fusion Sciences is located at Tono area. Thus, detailed measurement of radiation doses in Tono area is important from the viewpoint of the radiological consequence evaluation to the public. In this study, measurement of absorbed dose rate in air at Tono area in Gifu Prefecture, Japan, was carried out by car-borne survey and the contour map of absorbed dose rate in air around Tono area was drawn.

Materials and Methods

A car-born survey technique is a convenient method for the evaluation of radiation dose in a wide area in a short period. Thus, a car-borne survey which used a 3" ϕ × 3" NaI(Tl) scintillation spectrometer (EMF-211, EMF Japan Co., Japan) was carried out in Tono area from September 3 to 4 in 2014. Measurements of the counts inside the car were carried out every 30 s along the route. Simultaneously with the gamma-ray count measurements, the latitude and longitude at each measurement point were measured with a global positioning system. Car speed was kept around 60 km/h. Since count rate was measured inside the car, it was corrected by multiplying with a shielding factor in order to represent the unshielded external dose rate. Since it is difficult to obtain the photon peak for each gamma-ray in a 30 s measurement in the natural environment, the accuracy of the energy calibration will be low. Thus, accuracy of the air kerma rate which is estimated using a gamma-ray pulse height distribution obtained by 30 s measurements will be low. Accordingly, the relationship between the total counts of a gamma-ray pulse height distribution and absorbed dose rate in air was examined for the estimation of dose rate conversion factor. The shielding factor and the dose rate conversion factor were estimated as 1.50 and 0.0019 (nGy/h/cpm), respectively. Thus, the absorbed dose rate in air 1 m above the ground surface at each measurement point can be estimated using the following equation.

$$D = 2N \times 1.50 \times 0.0019$$

In this study, the counts (N) inside the car were obtained by the measurements for 30 s. Since the dose rate conversion factor was given as dose rate (nGy/h) for counts per minute (cpm) it is necessary to double N in order to convert into the counts per minute.

Results and discussion

Contour map of absorbed dose rate in air around Tono area was drawn by inverse distance weighted method (Fig. 1). Absorbed dose rates in air in the Toki and the Naegi granites area were relatively higher than that in the Ryoke granites area. Gamma-ray pulse height distributions 1 m above the ground surface were obtained at six points using a 3" ϕ × 3" NaI(Tl) scintillation spectrometer. The photon peaks generated by radiocesium, which are ^{134}Cs and ^{137}Cs, were not observed in the in-situ gamma spectra. However, the absorbed dose rate in air of 552 nGy/h and ^{238}U series activity concentration of 914 Bq/kg was observed at a shrine-yard in Toki City, Gifu Prefecture.

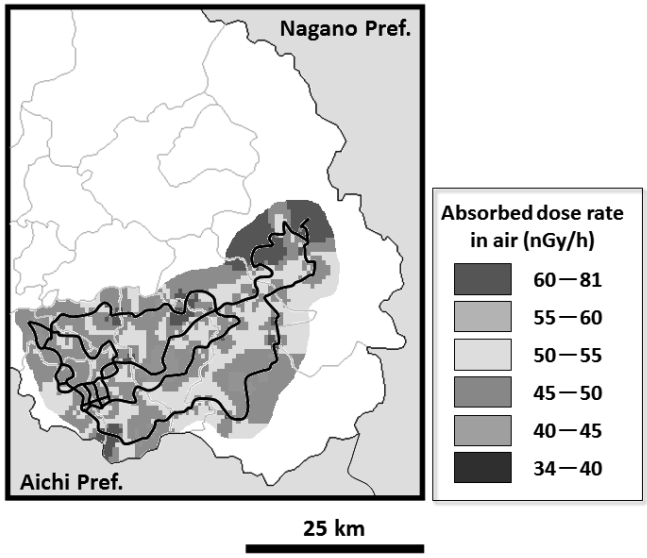

Fig. 1 Distribution map of the dose rates in air within Tono area in Gifu Prefecture.