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High resolution analyses of temporal variations of airborne radionuclides

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Abstract. Temporal variations of ^{210}Pb, ^{212}Pb and ^{7}Be were measured at 1–2 h of intervals simultaneously at Tatsunokuchi, Shishiku Highland (640 m above sea level) and Hegura Island located 50 km from Noto Peninsula. It was recognized that variations of these nuclides occured in a short time depending on meteorological circumstances such as the passage of typhoon, snow fall and even in calm conditions.

Keywords: Airborne nuclides; ^{210}Pb; ^{212}Pb; ^{7}Be; Diurnal variation; Low-level gamma spectrometry; Underground laboratory

1. Introduction

Concentrations of airborne ^{210}Pb (half-life: 22.3 years) and ^{7}Be (53.3 days) are expected to vary hourly or within a shorter time period as observed for ^{222}Rn [1]; however, no measurements have been performed mainly due to difficulty in measurement because concentrations of ^{210}Pb and are only in the range of 0.1–10 mBq m^{-3}. This problem could be overcome by using ultra low-background Ge detectors in Ogoya Underground

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Laboratory (OUL) [2,3]. In this paper, we report examples of high resolution measurements of airborne ^{210}Pb, ^{212}Pb and ^{7}Be.

2. Experimental

2.1. Sampling points

Airborne radionuclides were collected on a filter paper at Tatsunokuchi, Shishiku Highland (640 m above sea level) and Hegura Island located 50 km from Noto Peninsula (Fig. 1).

2.2. Sampling of airborne radionuclides

Airborne nuclides were collected on a silica-fiber filter (Advantec QR-100) by high volume air sampler (Shibata HV-1000 F) [4]. Sampling aimed for the analysis of seasonal variations of ^{210}Pb and ^{7}Be was performed at 1–2 days of intervals at LLRL and Shishiku and at 1-week intervals at Hegura. On the other hand, the sampling aimed to investigate diurnal variations of ^{210}Pb, ^{212}Pb and ^{7}Be was made at 1–2 h of intervals at either only at Tatsunokuchi or simultaneously at 2 or 3 points, i.e., Tatsunokuchi–Hegura, Tatsunokuchi–Shishiku and Tatsunokuchi–Shishiku–Hegura.

2.3. Measurements

After the sampling, one-half or one-third portion of each filter was taken for gamma spectrometer of ^{210}Pb, ^{212}Pb ($T_{1/2}$=10.64 h) and ^{7}Be. Counting sources of 35 or 21 mmϕ were prepared using 10 tons of hydraulic press and subjected to gamma spectrometry by 11 Ge detectors at OUL. Each sample was measured two times, i.e., short time measurement aimed for ^{212}Pb and long one for ^{210}Pb and ^{7}Be.

3. Results and discussion

3.1. High resolution analysis of variations of airborne ^{210}Pb and ^{7}Be

Main purpose of present study is to investigate temporal variations of ^{210}Pb and ^{7}Be at 1–2 h of intervals. More than 10 experiments have been performed under various meteorological conditions. Fig. 2 shows an example performed on November 7–12, 2002. As shown in Fig. 2, both ^{210}Pb and ^{7}Be vary in a very short time as expected prior to experiment. However, their variation patterns are different from that of ^{222}Rn, which

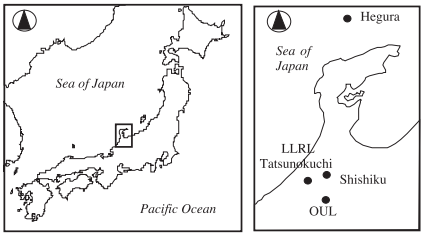

Fig. 1. Locations of monitoring points and OUL.