THE VERTICAL DISTRIBUTION OF RADON 222 IN THE ATMOSPHERE

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INTRODUCTION

Atmospheric vertical diffusion is important for studying the vertical transport of heat, momentum, moisture and air pollutants. Radon-222(Rn) and its daughters have been frequently used as tracers for studying the atmospheric transport phenomenon because Rn is radioactive noble gas.

The present paper describes the vertical distribution of Rn in the atmosphere over the Japan Islands and its surrounding sea. In order to study the vertical distribution of Rn, atmospheric samples are collected in the bags aboard an aircraft(helicopter V-107) in flights at different altitudes as high as 3000 m above the sea level, and later Rn concentration in the collected samples is measured in the laboratory.

SAMPLING AND LOCALITIES

Sampling Localities

The sampling localities are shown in Fig. 1. The sampling has been performed at seven different altitudes of 200 m, 500 m, 1000 m, 1500 m, 2000 m, 2500 m and 3000 m above the sea level.

The sampling flights are classified into two groups; one is circular flight over the sampling point and the other is straight flight around the sampling point. In Fig. 1, the former is shown by the circle and the latter is shown by the arrow, respectively.

Sampling Method

Atmospheric samples have been collected in 33-μm saran film bags of 75 cm diameter by using the blower of 8 m^3 air per min. The amount of the sample is about 1.5 m^3. Permeability of Rn from the saran film is experimentally tested by the following method. The atmospheric sample of about 4 m^3 at the ground level was collected in the saran film bag and the decay of Rn concentra-

tion in this bag was measured. The results obtained are shown in Fig. 2. In this figure, the measured points are shown by the circle and the solid line indicates values calculated by the Rn half life of 3.82 day. From this figure, it can be seen that the measured points are in good agreement with the calculated values. Because it takes about 4 days to measure the Rn concentration in the atmospheric samples at seven different altitudes above the land and the sea, it can be said that the permeability of Rn from the saran film is neglected.

MEASUREMENTS

Radon-222 gas in the sample air is adsorbed on the 5 gram activated charcoal in U-shape glass tubes which are cooled by acetone and dry ice. The flowing rate of the sample air is 4 liter per min. The adsorbed Rn is transfered to an ionization chamber by heating the charcoal trap up to 400°C and the pressure in the chamber is made to 1 atm by adding nitrogen gas. The volume of the chamber is 1.5 liter and 3 liter and the applied voltage is 500 volt.

RESULTS

The results for measurements of Rn concentration are classified into two groups; one is maritime atmospheric sample and the other is land atmospheric sample. The former is shown in Fig. 3 and the latter is shown in Fig. 4.

In maritime atmospheric samples, except two samples of Jan. 27, 1987 Sagami bay and June 30, 1987 Kashimanada, Rn concentration decreases with increasing altitude and the value of Rn concentration at 3000 m is around 10 pCi/m^3 or below. On the contrary, in land atmospheric samples, Rn concentration seems not to decrease above 1000 m and the value of Rn concentration seems to become around 20 pCi/m^3.

From these measurements, some difference in the vertical profile of Rn is found between maritime and land atmosphere, but the seasonal variation in the vertical profile is not obvious.

The cause of high Rn concentration in maritime samples of Jan. 27, 1987 Sagami bay and June 30, 1987 Kashimanada is now under consideration.

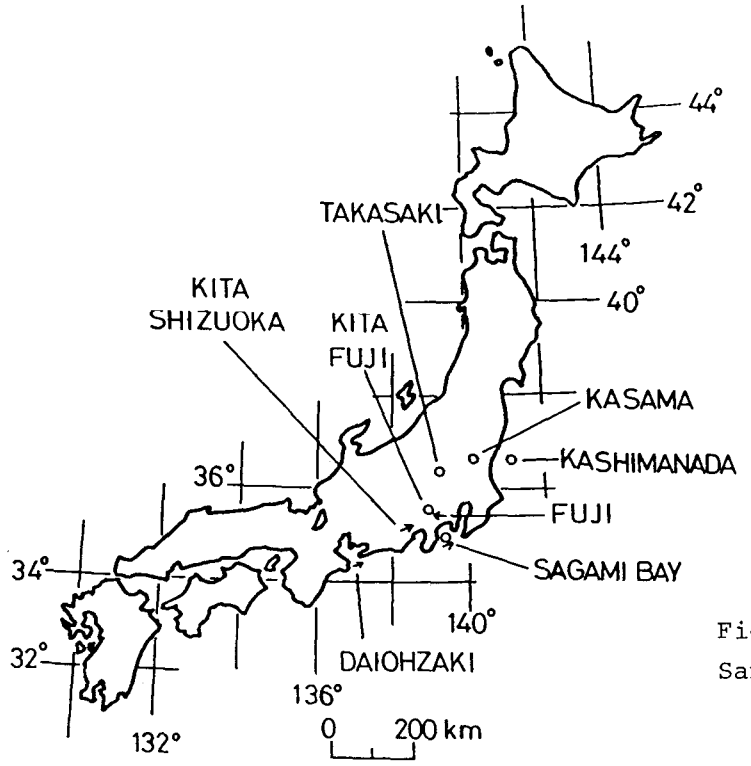

Fig. 1
Sampling localities

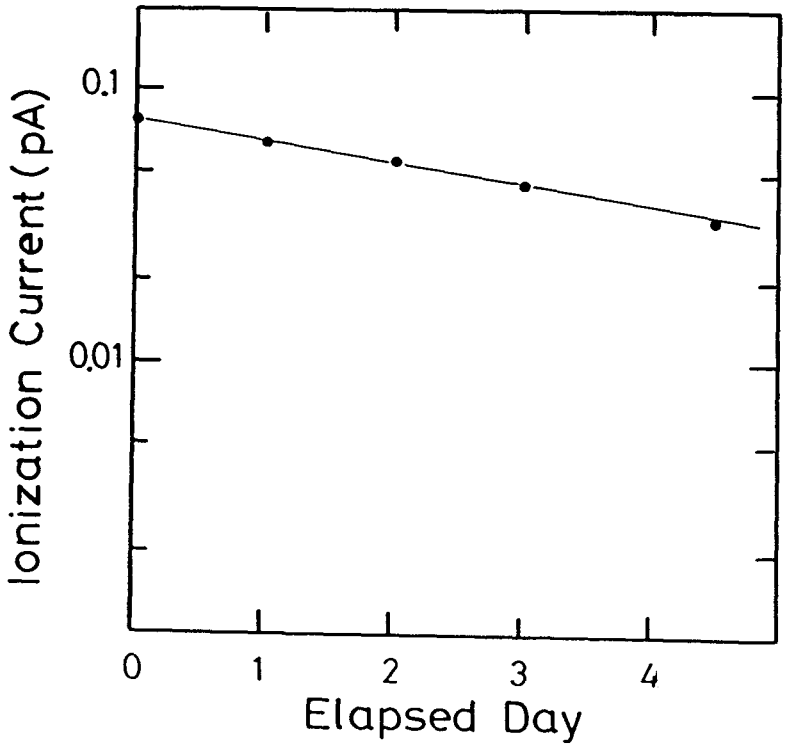

Fig. 2
Decay of Rn concentration in the atmospheric sample collected in the saran film bag

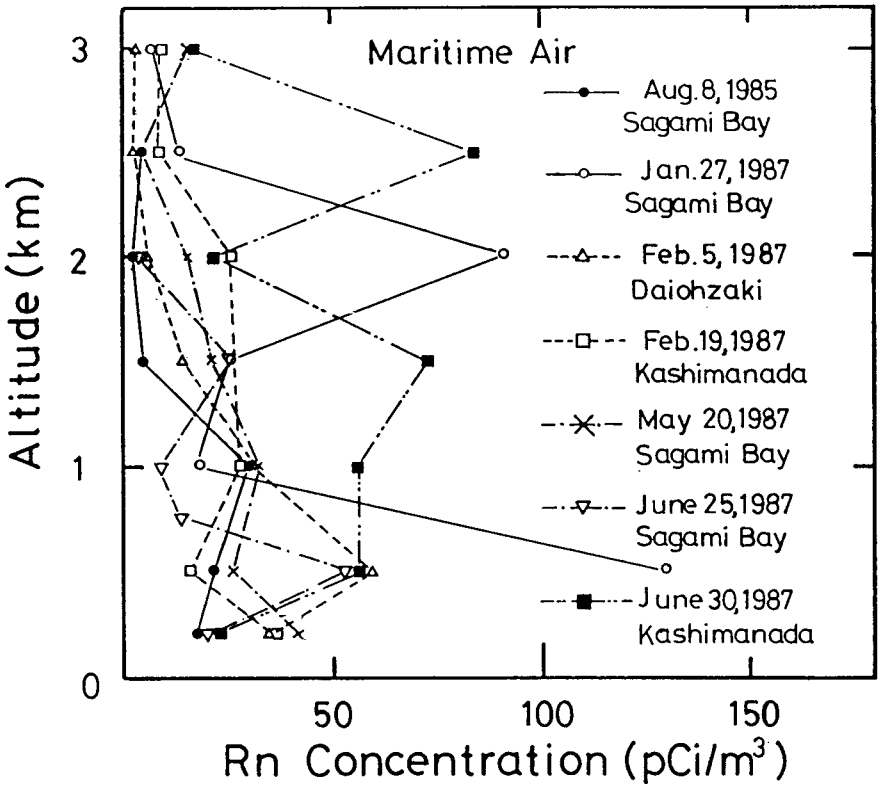

Fig. 3 Vertical profiles of Rn concentration in maritime atmospheric samples

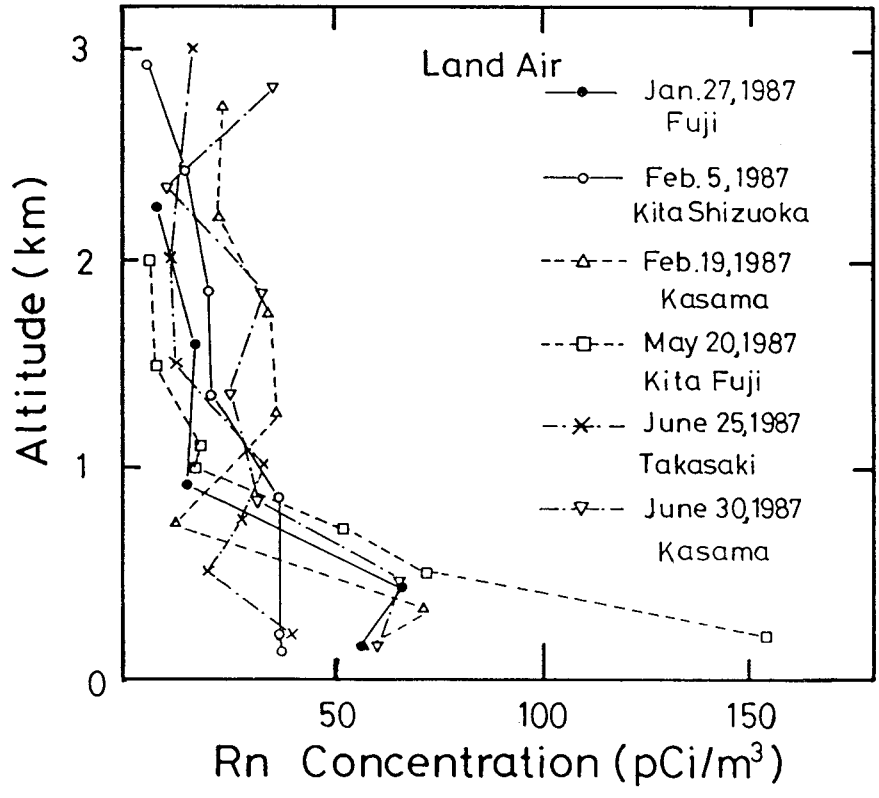

Fig. 4 Vertical profiles of Rn concentration in land atmospheric samples