§4. Estimation of Regional and Seasonal Variations for Environmental Tritium and Radon Concentrations in Japan

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Introduction

Environmental radiation monitoring and radiation safety study are essentials to pursue the development of the nuclear fusion. Particularly, for the environmental tritium data around NIFS, it is required to draw a comparison with data obtained in the past and in the wide area.

From the above viewpoints, the measurement of tritium concentration has been carried out on precipitation and inland water samples collected in Okinawa and Hokkaido prefectures located in the southwestern- and the northern-most parts of Japan, respectively. Many researches on the tritium were performed in Japan, but there is very little data in these prefectures in recent years.

It is well known that the environmental tritium concentration varies with latitude and some geographical conditions, therefore the comparison between tritium data obtained at NIFS in Gifu prefecture, the central part of Japan, and other region is very important to safety operation of the nuclear fusion plant. In addition to the above experiments, to estimate the detailed behavior of the tritium in environment, measurement of atmospheric radon concentration, a good tracer of the atmospheric flow, has been started around NIFS in this study.

Materials and Methods

In order to estimate the recent environmental tritium concentration, water samples were taken at five sites in the middle and southern part of Okinawa Island, the main island of Okinawa prefecture, every month from June 2014. Rain samples were collected at the rooftop of a building of University of the Ryukyus, and the monthly amount of precipitation was approximated. In the island, inland water samples were also taken from two springs, a well and a limestone cave. The samples from cave are dripping water seeped through a stalactite straw. Added to these monthly samples, spring waters were collected at 8 sites in the island on just June 2015.

Also in Sapporo City, the seat of Hokkaido prefectural government, rain and snow samples were collected every month from June 2015 at a balcony of Hokkaido University of Science.

These water samples were distilled to remove impurities. Then the distilled water samples were electrolysis enriched, because the concentration of tritium in the environmental water is extremely low in the recent. Analysis for the tritium concentration was performed by a liquid scintillation counter in NIFS.

The measurement of the monthly outdoor radon concentration at five sites around NIFS has been performed

by a passive method with the solid-state track detector system from July 2014.

Results and Discussions

For Okinawa Island, arithmetic means of tritium concentrations of the precipitation and inland water samples obtained from May 2014 to July 2015 were calculated to be 0.13 Bq/L (range: 0.06-0.19 Bq/L) and 0.15 Bq/L (0.09-0.22 Bq/L), respectively. The mean for the spring water samples on June 2015 was calculated to be 0.10 Bq/L (0.09-0.11 Bq/L). Based on these results, there is not much difference for the concentration between precipitation and inland water samples at the present time in Okinawa Island. For information, the correlation between tritium concentration and amount of precipitation was not recognized in Okinawa Island.

The tritium concentration of precipitation in Okinawa Island is clearly lower than those obtained at NIFS in Gifu prefecture (range: 0.15-0.45 Bq/L from June 2014 to July 2015) and at Sapporo city in Hokkaido prefecture (0.40 Bq/L on June 2015) (Fig. 1). Also the results indicate that the tritium concentration of environmental water in Okinawa Island is considerably lower than the past data of inland waters obtained in the mainland of Japan (0.36-2.66 Bq/L, Sugihara *et al.*, 2008). These suggest that the latitude effect brings the low tritium concentration in Okinawa Island. In addition, it is considered that the decrease with physical half-life of tritium originated from the past atmospheric nuclear tests contributes the low tritium concentration in Okinawa Island.

The outdoor radon concentration around NIFS was estimated to be about 44 Bq/L.

To view the recent seasonal and geographical variations of the environmental tritium concentrations, continuous study in the East Asia is minimum requirements.





Fig.1 Seasonal variation for tritium concentration (Bq/L) of precipitation samples obtained from Okinawa, Hokkaido and Gifu (NIFS).