§11. Study on Environmental Tritium: Development of Monitoring Method and Analysis of Factors Controlling the Variation

Okai, T. (Faculty of Eng., Kyushu Univ.)
Momoshima, N., Kakiuchi, H. (Fac. of Sci., Kyushu Univ.)
Sakuma, Y

National Institute of Fusion Science (NIFS) is now constructing a new fusion device and related facilities at Toki city in Gifu prefecture, Japan. Although no tritium burning experiments will be carried out in the Toki site, it should be appropriate and useful to establish the general database on behavior of atmospheric tritium in and around an actual place of the experiments. Tritium is present in the atmosphere in the three different chemical forms, tritiated water vapor (HTO), tritiated hydrogen (HT) and tritiated hydrocarbons (primarily tritiated methane, CH_3T). Thus, tritium concentrations of atmospheric HTO, HT and CH_3T have been measured in the Toki site a few times a year from 1990 to the present.

The results obtained are shown in Table 1. Atmospheric HTO concentrations expressed in Bq/L-H_2O vary within ranges of 1.18 to 2.73 between 1990 and 1997. A slight lowering of the HTO concentration on August 3, 1990 occurred at a time coresponding to the arrival of a typhoon from the South Pacific Ocean and that on July 12, 1996 is because the Toki site is covered by an oceanic air mass. A tropical oceanic air mass has a low tritium level of water vapor, of 0.26 -0.50 Bq/L, evaporated from sea water. In contract, the rise in HTO concentration on January 23, 1991 corresponds to the movement of continental air mass from the Asian Continent to the direction of the Toki site. Matsuoka et al. reported that the tritium concentrations of water vapor above the Asian Continent are distinctly higher than those in Japan. The continental air masses move from the Asian Continent in the direction of the Toki site. Under such meteorological conditions the air in the Toki area contains a fairly large amount of water vapor from the Asian Continent. Thus we could say that the local meteorological conditions give large effects on the tritium levels of water vapor in the Toki site.

Atmospheric HTO concentrations expressed in mBq/m^3-air vary within ranges of 5.7 to 50.9. They show the same tendency, higher in summer and lower in winter in each year, and are about 4 times higher in the humid season of summer than in the dry season of winter. This tendency is similar to the variation of atmospheric absolute humidity, which varies from about 3 g/m^3 in winter to about 20 g/m^3 in summer.

On the contrary, in the case of HT and CH_3T, no seasonal variations were observed with average monthly values of 23.8 to 43.9 mBq/m^3-air and 9.2 to 23.6 mBq/m^3-air, respectively. Mason and Ostlund reported the average background CH_3T value of 11.9±2.2 mBq/m^3 for 1976 in Florida and high values of 22-67 mBq/m^3 due to puffs of CH_3T which occasionally passed through Miami. High values of HT and CH_3T can seen in our data of 1990 -1994. Like those of HTO, they can be explained by meteorological conditions and may be linked to tritium releases from certain sources, such as the Savannah River Plant in South Carolina, U.S.A. Unfortunately, tritium release data from the Savannah River Plant are not published for reasons of military security and are therefore not available. Nuclear facilities for military purposes may be the principal sources of atmospheric HT and CH_3T. However, further investigation is needed to clarify the cause of these small fluctuations.

Table 1 Tritium concentrations and absolute humidity in air at Toki site

Date		Humidity (g/m^3)	HTO (Bq/L)	HTO	HT (mBq/m^3)	CH_3T
1990	8/2	27.6	1.85	50.9	34.9	13.0
	8/2-3	19.1	1.81	34.5	40.0	17.3
	8/3	19.6	1.35	26.5	43.9	14.4
1991	1/23	3.0	2.73	18.1	35.6	12.4
	2/20				26.4	11.8
	2/20-21	2.8	2.03	5.7	26.5	10.6
	2/21				27.4	12.9
	5/9-10	11.5	1.97	22.7	29.6	10.9
	8/5-6	19.0	2.10	31.0	36.7	17.5
	8/6	17.0	2.15	27.1	29.9	12.8
	10/30-31	9.8	2.52	24.5	25.3	14.8
	10/30	8.1	2.02	16.5	29.6	16.1
1992	3/17-18	7.3	1.62	11.7	33.4	11.8
	3/18	7.5	1.41	10.5	31.0	10.8
	6/11-12	14.2	2.34	33.1	39.7	20.9
	6/12	10.0	2.40	24.0	34.5	23.6
	10/22	8.9	2.57	22.8	35.5	14.3
	10/22-23	7.8	2.21	17.2	30.0	10.8
1993	1/27	4.5	1.92	8.7	27.9	10.3
	3/1	4.1	2.17	8.7	29.0	11.1
	3/1-2	3.9	1.99	7.8	28.5	11.4
	6/10	10.7	1.94	20.9	28.7	12.0
1994	2/2	3.1	2.02	6.3	31.5	13.4
	2/2-3	3.7	1.81	6.6	28.5	11.1
1995	1/24	4.3	1.63	6.9	26.8	9.2
	11/29	7.5	1.80	13.5	27.7	11.0
1996	1/18	3.2	1.77	5.7	26.8	10.5
	7/12	20.3	1.18	24.0	25.2	9.7
1997	3/18	7.3	1.56	11.4	26.0	12.4
	6/19	13.8	1.68	23.2	23.8	11.9