§20. Investigation on Environmental Behavior of Organically Bound Tritium

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Tritium in plant is found as OBT (Organically Bound Tritium) and FWT (Free Water Tritium). The OBT which are produced by photosynthesis plays a key role in radiation exposure through food while the FWT in tissue water in plant is easily changeable during cooking. To evaluate exposure to tritium by ingestion we need to know OBT and FWT concentrations in vegetation. In this research we examined OBT and FWT concentrations in pine needles collected in 2012 over Japan to know present environmental tritium levels in vegetation. The OBT and FWT levels in plants would be determined by environmental tritium where the plants have grown, therefore, pine needles would be useable as a representative of vegetation in Japan.

The sampling locations and sampling dates are listed in Table 1. The water in pine needles were recovered under vacuum and purified by distillation with oxidation regent to decompose impurity organics avoiding contamination with ambient water vapor. The FWT concentration was determined by LSC (liquid scintillation counting) using a back-ground type counter (Aloka LB-5). Two methods were used to determine OBT concentration: combustion method and mass spectrometry. The water obtained by combustion of dried pine needles were subjected to LSC after purified as the same manner as the FWT. The dried pine needles were sealed in glass tube for a certain period to accumulate He-3 which is a decay product of tritium. The amounts of He-3 accumulated were determined by mass spectrometer (VG-5400 Micromass).

The OBT and FWT concentrations are shown in Table 1. The OBT obtained by mass spectrometry was converted to Bq/L units using hydrogen content in the dried pine needles. The concentrations were mostly below 1 Bq/L which is comparable to tritium concentration in recent rain.[1)] No clear difference was confirmed between OBT and FWT. The latitude dependency was not clear for pine needles, though tritium concentration in river and lake waters showed higher in northern and lower in southern Japan reflecting the larger natural tritium production rate at higher latitude.[2)] The longer growing period of pine needles would obscure the latitude dependency. The OBT by combustion and mass spectrometry showed a good correlation, suggesting a high reliable analytical accuracy for the both method (Fig. 1.).

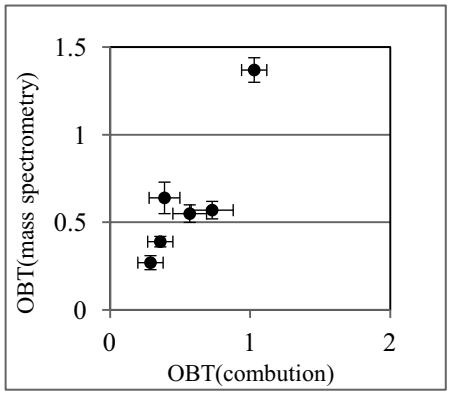

Fig. 1. Relation of OBT concentration between mass spectrometry and combustion method.

1) Momoshima, N., Sugihara, S., Toyoshima, T., Nagao, Y., Takahashi, M., Nakamura, Y., *Fusion Sci. Tech.*, **54**, 293-296, 2008.

2) Sugihara, S., Hirose, A., Momoshima, N., Maeda, Y., *Fusion Sci. Tech.*, **54**, 289-292, 2008.

Table 1. FWT and OBT concentrations in pine needles collected in Japan (2012)

location	Sampling date	FWT* (Bq/L)	FWT# (Bq/L)	OBT* (Bq/L)	OBT# (Bq/L)
Rokkasho, Aomori	2012/10/1	0.74 ±0.09	0.40 ±0.08	0.73 ±0.15	0.57 ±0.05
Tokaimura, Ibaraki	2012/9/27	0.54 ±0.09	0.59 ±0.10	1.03 ±0.09	1.37 ±0.07
Nagoya, Aichi	2012/9/19	< 0.26	< 0.30	0.39 ±0.11	0.64 ±0.09
Kumatori, Osaka	2012/9/20	< 0.26	0.43 ±0.09	0.57 ±0.12	0.55 ±0.05
Fukuoka, Fukuoka	2012/10/22	< 0.24	0.43 ±0.10	0.49 ±0.09	NA
Reihoku, Kumamoto	2012/4/5	0.39 ±0.08	< 0.27	< 0.30	0.28 ±0.02
Yamato, Kumamoto	2012/5/16	0.54 ±0.09	< 0.27	0.36 ±0.09	0.39 ±0.03
Kadokawa, Miyazaki	2012/5/16	0.50 ±0.08	0.44 ±0.09	< 0.35	0.20 ±0.02
Kushikino, Kagoshima	2012/10/24	< 0.26	0.32 ±0.09	0.29 ±0.09	0.27 ±0.04

*OBT was obtained by combustion and LSC. FWT was obtained by LSC.
#OBT was obtained by mass spectrometry. FWT was obtained by LSC.