# Low-level measurement of organically bound tritium in environmental samples with noble gas mass spectrometer

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Accompanied with release of $^{3}H$ from nuclear power plants and spent nuclear fuel reprocessing plants to the environment, increased $^{3}H$ concentration is observed in various environmental materials around them. Tritium in environmental samples consists of free water $^{3}H$ (FWT) and organically bound $^{3}H$ (OBT). OBT has a longer biological half time and higher assimilation to organic materials than FWT. Therefore, the concentration of OBT should be separately measured from that of FWT for radiation dose estimation from $^{3}H$ in environmental samples. OBT has been generally measured by a liquid scintillation counting of combustion water from freeze-dried sample. The alternative method is to measure the decay product of $^{3}H$, $^{3}He$, with a noble gas mass spectrometry (NG-MS). Although the method is readily adaptable to a wide variety of sample matrices, there is no report to measure the low-level OBT concentration less than 1 Bq $L^{-1}$ combustion water. We developed the measurement method adoptable to the sample with the low-level OBT concentration less than 0.1 Bq $L^{-1}$ combustion water.

Fresh pine needles and humus samples which have OBT concentration of around 0.5-0.9 Bq $L^{-1}$ combustion water were collected from a forest floor in Rokkasho, Japan (40°58'N, 141°22'E) in July 2002. The samples were cryogenically processed to separate free water and dried residue. A portion of the residue sample was sealed in an evacuated Al-Si glass ampoule (8252, SCHOTT). To remove atmospheric He as completely as possible to lower background of $^{3}He$ from $^{3}H$, a small amount of acetone was added to the sample, and the ampoule was evacuated to expel adsorbed gases in the sample before sealed. The $^{3}He$ was measured with a NG-MS (VG-5400, Micromass) after the sealed ampoule was stored at -30°C over 90 d. The other portion of the residue sample was combusted, and the $^{3}H$ concentration in combustion water was measured by a liquid scintillation counter after electrolytic enrichment. Both OBT concentrations agreed well with each other, which showed that this method was practical and effective.

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