§29. Study on Environmental Behavior of Tritium

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i) Comparison of atmospheric tritium concentrations at Kumamoto and NIFS

Atmospheric tritium concentrations of three different chemical forms have been measured at Kumamoto (Kumamoto Univ.) and Toki (NIFS) to elucidate background levels and their variations in the general environment. Three chemical forms, water vapor (HTO), hydrogen gas (HT) and hydrocarbon mostly methane (CH_3T) are the major chemical species of tritium in the atmosphere and would be key species for environmental tritium monitoring around a nuclear fusion facility. The sampling systems collect three tritium species successively and concentrations were determined by liquid scintillation counting (LSC). As far as very low tritium concentrations of these species in the general environment, sampling and measurement techniques should be applicable to be low level. The sampling systems used at Kumamoto Univ. and NIFS are quite similar collecting tritium in molecular sieves (MS) after converting their chemical forms to water. The recovery of water from MS is carried out by flowing N_2 under heating MS. No alteration in tritium concentration during sampling and recovery from MS was confirmed by simultaneous sampling at NIFS using the each sampling system following recovery from MS and LSC at Kumamoto Univ. Simultaneous sampling was carried out three times in 2005 and the tritium concentrations were consistent as shown in Fig. 1 within counting error for three chemical species suggesting no bias or contamination of tritium during the sampling and recovery process adopted at Kumamoto Univ. and NIFS.

ii) Model calculation

Basic concept of tritium transfer model should be expanded to a site specific model. Tritium transfer model applicable to HTO release from NIFS site was considered. The model consists in underground reservoirs and rivers which defined as water catchments for rain. The river network at Toki area which includes NIFS was constructed: representative rivers in Toki area; Tsumaki River, Ikuta River and Toki River and their branches are considered, and sizes of underground reservoirs were determined in proportion to the size of each catchment. The residence times of the underground reservoir and river water, and precipitation are variable parameters in the model, which influence transfer of HTO released from NIFS to the branch of IKUTA River. The response of the model was examined to idealized releases of HTO from NIFS at different parameter conditions to validate the constructed model. The tritium concentrations in river and underground reservoir with time after HTO release showed quick response in river water and slow change in tritium concentrations in underground reservoir coupling with the short and longer residence times for river and underground water. The model would realize by fitting actual tritium level in river waters using rain data, which gives us a way to evaluate realistic parameter value for residence times of the underground reservoirs.

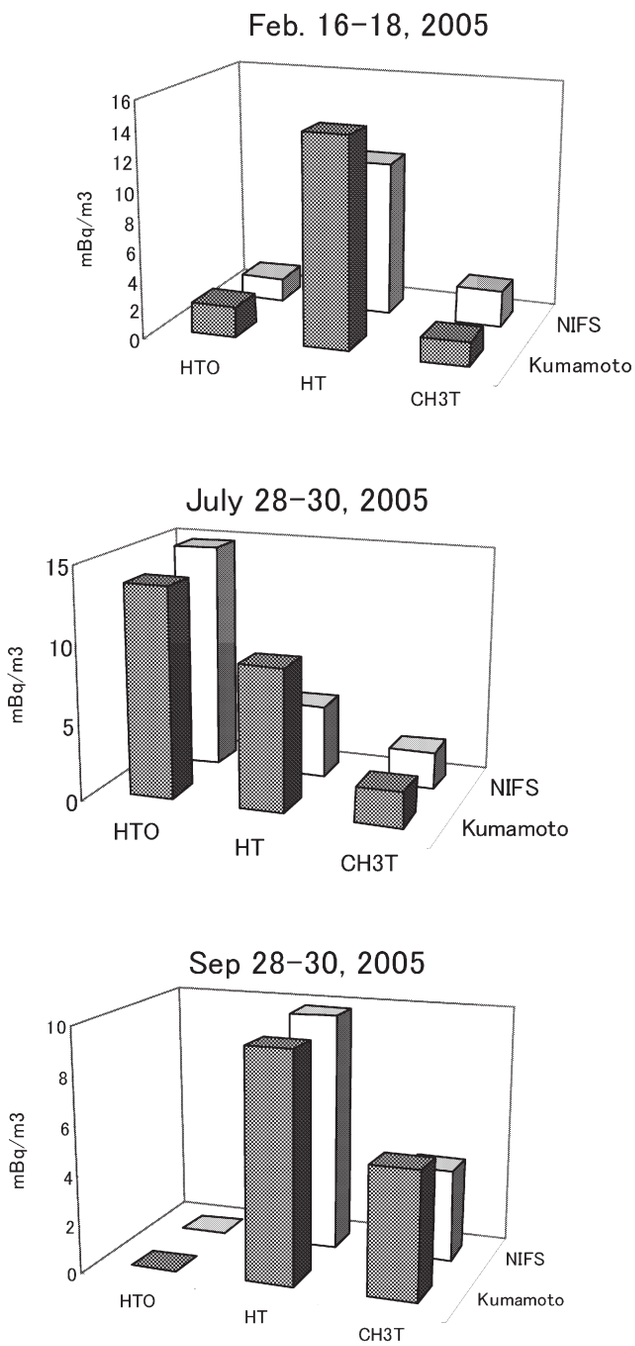

Fig. 1. Tritium concentrations at NIFS in 2005. Sampling was carried out by Kumamoto Univ. and NIFS using each sampling and recovery system. Tritium concentrations were measured at Kumamoto Univ. by LSC.