

§11. Study on Model to Predict Tritium Behavior in Environment at NIFS Site

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To assess the impact on public health caused by nuclear fusion facilities by a routine operation or accidental release, it is important to understand the behavior of tritium released from the facilities into terrestrial environment. Therefore, we are trying to develop a dynamic compartment model to predict the tritium behaviors in 'atmosphere – soil – river and groundwater flow' system with the environmental parameters estimated by monitoring data at NIFS site as case studies.

In a dynamic compartment model, the environment for the assessment is described as an assembly of compartments. Every compartment in the model is corresponding to environmental part. Simultaneous ordinary differential equations are used to describe the change of inventories of tritium in each compartment. In this study, the migration prediction code, MOGRA¹⁾ was used for development of the dynamic compartment model and case studies. The conceptual illustration of major transfer pathways of environmental tritium considered in this study is shown in Fig. 1.

In this model, the deposited HT from air into soil is oxidized to HTO by a microorganism in soil rapidly. A part of HTO in soil is reemitted into air and the remainder is eliminated from soil by surface flow or infiltration. The

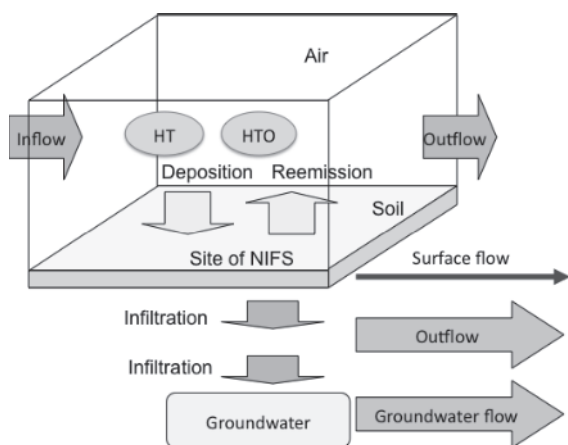


Fig. 1 Conceptual illustration of major transfer pathways of environmental tritium.

both of river flow and groundwater flow are considered for the outflow pathway of tritium from the 'soil compartment' at NIFS site. The elimination coefficients used in these pathways are important for dose assessment of public lived in the downstream of the site because tritium deposited on the ground around nuclear facilities is easily transported to downstream area by river water flow and causes an internal exposure at the area.

Tritium concentrations and stable isotopes of oxygen and hydrogen in rain water, stream water and groundwater at the NIFS site were analyzed to understand behavior of the natural tritium in coupling with rain event, continuously²⁾. The analyses at the precipitation event were carried out at 2009/05/22, 2009/06/21, 2009/11/10, 2010/09/22, 2010/10/24, 2010/12/13, 2011/02/27 and 2011/06/10. The tritium concentration in rainwater is low in summer and autumn and is high in winter and spring. However, a significant difference is not observed at the concentrations of the stream and the river waters. For example, the result of the concentration of tritium and conductivity in river water with the rainfall at the time of the precipitation event on 2011/02/27 at upstream sampling point (R-10 point) is shown in Fig. 2. The change of conductivity and tritium concentration in river water started 3-5 hour behind the initiation of rain event. This result indicates that the outflow water is the mixture of the rain (new water) and the groundwater (old water). We are analyzing these change patterns at each precipitation event to derive parameter values concerned in the wet deposition of tritium from 'air compartment' to 'soil compartment' and outflow from 'soil compartment' to downstream.

- 1) Amano, H. et al.: J. Nucl. Sci. Technol., 40, (2003) 975-979.
- 2) Sugihara, S. et.al: Behavior of environmental tritium at NIFS toki site of Japan, Fusion Sci. Technol., 60, (2011) 1300-1303

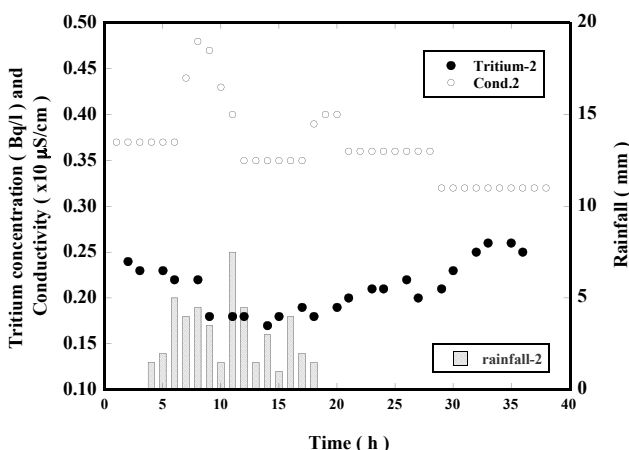


Fig. 2 The change of the concentration, conductivity and rainfall at the rain event (2011/02/27).