A study on a methodology of natural flux assessment

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1. Introduction

Complementary indicators of dose and risk which have been used as a safety indicator of geological disposal of radioactive waste have been presented as those which should be used in a far future in which uncertainty of potential exposure to human or an environment will surely increase (IAEA, 1994). And, in recent studies such methodologies in order to compare a flux of natural radionuclides with that of nuclides potentially caused by radioactive waste disposal have been studied (Miller et al., 1996; JNC, 1999). This study deals with preliminary consideration and application of a methodology on an assessment of natural flux in natural environment based on an international trend of those studies.

2. Study of a methodology

We divided natural environment to air, surface and subsurface environments. And, we determined some size of a catchment as the assessment area because material cycle is based on water cycle, and a phenomenon of an occurrence of the water cycle happens principally in the catchment. Furthermore, the upper part and the lower part of surface environment were corresponded to recharge and discharge phenomena, respectively. And, both of the parts of surface environment along a river and subsurface environment were determined as parts for existence of cycling materials. Further, a part of an air which similarly contacted both parts of the surface was added. In these five parts, vapor, liquid and solid phases exist and these materials move constantly among these parts. We examined these materials and processes as mechanisms of matter migration. Fig. 1 shows main substances in each part and main processes which connect neighboring parts. If an assessment point(s) will be determined at some small area within the catchment, natural fluxes at the assessment point(s) will be presented as masses of migrating natural radionuclides within liquid and solid phases which go through the assessment point(s).

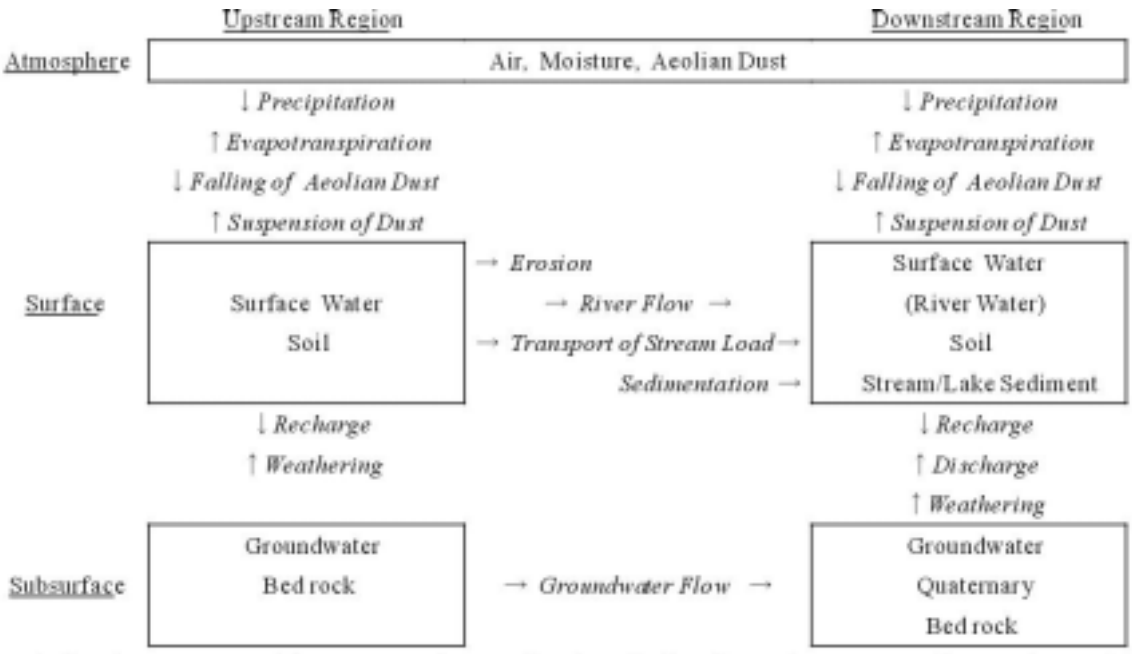
3. Study of applicability of the methodology

Based on the above mentioned methodology, we first determined a hypothetical catchment and an assessment point along a lower part of a main river within the catchment. Next, we gathered process data such as river flow rate and distribution data of mass concentrations of U, Th, K, Ra and Rn, and activity concentrations of Th-232, K-40, Ra-226 and Rn-222 within the media of sedimentary rock, crystalline rock, groundwater, surface water, soil and stream sediment based on existing outcomes. After we checked the credibility of gathered data, we examined a data set for our study. Based on these data, we preliminarily calculated fluxes of natural radionuclides which go through the assessment point, checked the meaning of the results, and picked up items to be resolved for the above mentioned methodology. In order to make the concept of natural flux assessment more concrete and improve the credibility of the assessment result, we have pointed out the necessities of examination and deep consideration of how to determine the assessment point and matter migration processes, how to gather concentration data and flux data based on site specific characteristics, how to model a specific area for the assessment, how to deal with uncertainty, how to compare the results of the assessment with fluxes potentially caused by radioactive waste disposal, etc. and improvement of an overall methodology.

[Ref.] IAEA, 1994, Safety Indicators in Different Time Frames for the Safety Assessment of Underground Radioactive waste Repositories. First Report of the INWAC Subgroup on Principles and Criteria for Radioactive Waste Disposal, IAEA-TECDOC-767

Miller, W. M. et al., 1996, Natural Radionuclide Fluxes and their Contribution to Defining Licensing Criteria for Deep Geological Repositories for Radioactive Waste, Radiochimica Acta, 74, pp.289-295

JNC, 1999, H12 Project to Establish Technical Basis for HLW Disposal in Japan, Project Overview Report, JNC TN1400 99-010



Note: Italics show processes. The arrow → shows a direction of a flux. Boxes show spaces with natural materials.

Fig. 1 Framework of natural flux assessment

図１　ナチュラルフラックス評価におけるプロセス、物質及び場の体系