Effects of Groundwater Flow and Saltwater Intrusion under Coastal Seabed Sediment on Radionuclide Releases Rate from a HLW Disposal

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Coastal seabed disposal is one of the disposal options isolating high-level radioactive wastes (HLW) from human. HLW under seabed sediments would be covered by various layers of sediments. Radionuclide transport simulation with flat strata consisting of various sediments was performed to interpret the effects of groundwater flows caused by mixing of fresh and saline groundwater on radionuclide release rates from a hypothetical HLW repository. The results showed that the release of non-sorbing radionuclide to the top of the inland zone was lower while the intrinsic permeability was higher as it was confined in the original stratum and move further into the inland zone

1. Introduction

Coastal seabed disposal is one of the disposal methods which could protect human from radionuclides arising from disposed HLWs. Since a repository may be located close to freshwater-saltwater interface, the influence of density differences arising from varying salinity on groundwater that is critical to radionuclide transport must be considered. A coastal seabed model with a hypothetical nuclear repository was performed to evaluate the radionuclide releases under different groundwater velocity. The variable density flow simulation by the PFLOTRAN code has been validated with reproducing the MACRO experiment carried out by JAEA [1]. The objective of this presentation is to demonstrate radionuclide transports from hypothetical repositories with different locations influenced by different sediment permeabilities and to discuss the behavior of radionuclide releases at inland boundary of the coastal seabed model.

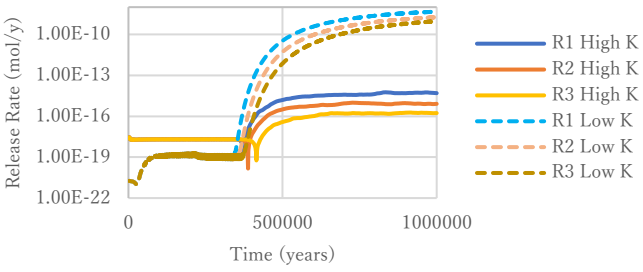
2. Methodology

The coastal seabed model validated by the JAEA's MACRO experiment was constructed by PFLOTRAN. The setting was extended to simulate groundwater flow by varying salinity and I-129 radionuclide transports from hypothetical nuclear waste repositories. Three different layers consisting of sand, clay and crystalline rock which have different intrinsic permeability and porosity were assumed, where a hypothetical nuclear waste repositories (R1, R2, and R3) containing non-sorbing I-129 as a model radionuclide were located in each layer in different scenarios. Moreover, two additional scenarios consisting of high (High K) and low permeability cases (Low K) were made. Radionuclide release rates were calculated at a top inland boundary by integrating its fluxes.

3. Result and Discussion

The result of coastal seabed model by PFLOTRAN showed that the radionuclide release rates through the inland zone in the inland zone in the case of high permeability has been lower than the ones in case of low permeability (Fig.1). In the presentation we will discuss the cause of radionuclide release rates influenced by intrinsic permeability at inland boundary and how the radionuclide transport is affected by local groundwater flow driven by mixing of fresh and saline groundwater.

Fig 1. I-129 Release Rate at Inland Boundary



References

[1] Y. Oda, H. Sato, A. Sawada, and T. Watahiki, "Advection dispersion and density flow simulation for salinity distribution on the transition zone of saltwater intrusion experiment," 2010.