SAFETY ENGINEERING OF NUCLEAR SYSTEMS

NUCLEAR ENERGY-FLOW ENVIRONMENTAL ENGINEERING

Department of Quantum Science and Energy Engineering

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Building a secure, safe and stable disposal system for radioactive wastes
- The research that the future depends on -

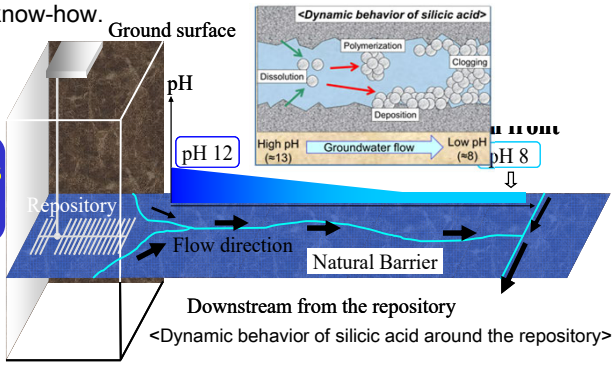
Radioactive wastes are sealed in concrete and buried in underground. In the Niibori Laboratory, we focus on the research of the construction of safe and economic disposal system of radioactive wastes and the performance assessment of ultra-long term disposal system, based on an understanding of the migration behavior (of mass and heat transfer and chemical reaction) taking into consideration their effects on the disposal structures in underground. Especially, we make the research and development of stable barrier materials which utilize the interactions of cement-based materials and nuclides with an updated perspective by actively adapting applicable technology and know-how.

Environment and Energy

Development of barrier materials confining radionuclides
Performance assessment of the disposal system

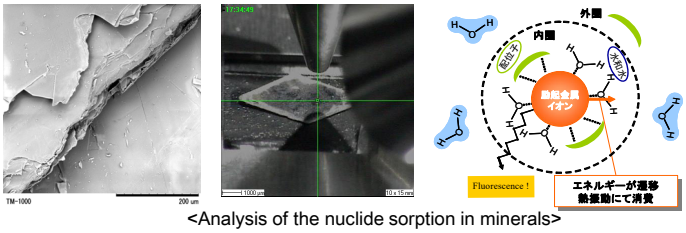
- Radionuclide behavior in heterogeneous condition
- Sorption mechanism
- Alteration process
- Reduction condition
- Flooding process, Unsaturated condition

Migration theory (mass and heat transfer), Chemical reaction (kinetic and equilibrium), Mathematical analysis, Radiochemistry, System engineering, Heat transfer engineering, Simulation technique

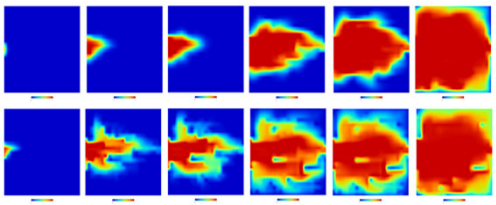


Downstream from the repository

<Dynamic behavior of silicic acid around the repository>

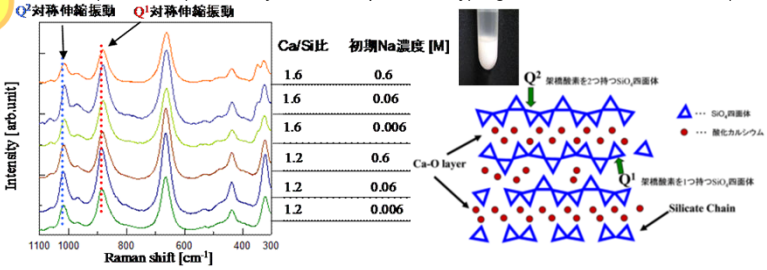


<Analysis of the nuclide sorption in minerals>
(left: SIMS(secondary ion mass spectrometry), right: life time of fluorescence)

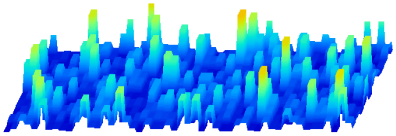


The retardation effect of the nuclide migration in heterogeneous conditions

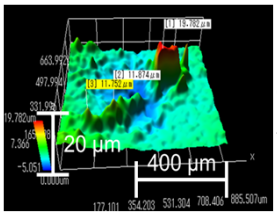
<Evaluation of radionuclide migration in barrier materials>



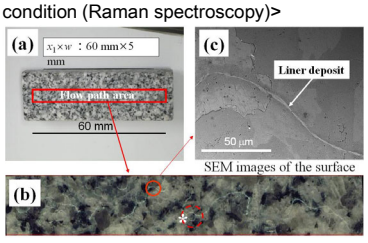
<Analysis of the interaction of nuclides and cementitious materials in the flooding condition (Raman spectroscopy)>



<Spatial distribution model of the interaction of nuclides and solid surface>



<Formation process of the barrier effect by the deposition on the granite surface>



<Clogging and deposition of CSH on the granite surface>

Research Activities

- Development of barrier materials which utilize the interaction of CSH (Calcium Silicate Hydrate) and nuclides
- Retardation effect of nuclide migration with the deposition of silicic acid in alkali and thermal front condition
- Assessment of nuclide migration considering the heterogeneous sorption of actinide elements on minerals
- Clogging barrier effect with the deposition of CSH caused high alkaline groundwater in rock crack
- Utilization of the repository and heat removal effect considering the formation process of unsaturated zone

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