The Tono Natural Analogue Project: An overview

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The Tono Natural Analogue Project of the Japan Nuclear Cycle Development Institute (JNC) is characterizing the Tono uranium deposit, central Japan from the standpoint of geology, hydrogeology, geochemistry and microbiology, in order to:

1. develop generic conceptualization and mathematical modeling methodologies for behavior of radionuclides migration that could possibly be applied elsewhere in future site assessments and safety assessments connected with the deep geological disposal of radioactive wastes, and
2. build confidence in this concept by studying analogues for a perturbation scenario, which consists of various geological features, events and processes (FEPs), identified in JNC's safety assessments.

The Tono uranium deposit has been affected by a number of such FEPs such as periodic activation of the fault, which offsets the mineralized sections, and periods of burial and exhumation. Therefore, quantifying geochemical environments of the deposit at specific times can contribute to understanding behavior of radionuclides in the Tono deposit. However, confidence has not been built in an analytical model for radionuclide transport, because previous information on the present geochemical conditions and geological environment of the deposit has indicated the preservation of the uranium only *qualitatively*. Accordingly, the following strategy has been adopted to develop confidence in an analytical model:

1. acquisition of *quantitative* geochemical data such as the solubility of uranium, and *quantitative* information on geosphere evolution;
2. creation of realistic and comprehensive data sets for specific geological environments;
3. testing of an analytical model for radionuclide transport and of model assumptions.

The latter involves comparing analytical results for the deposit's history, from its formation to the present, with the present uranium distribution and evidence for past uranium migration.

A number of tasks have been established to help implement this strategy, which include site investigations, systems analyses and modeling of the geological history. Specific studies to date have focused on geochemical constraints on uranium mobility, the extent of uranium migration and the identification of FEPs and interrelations among FEPs underpinning the systems analyses. Results are presented separately in this symposium.

A change in the chemical composition of ground water around the Mozumi-Sukenobu fault, Japan and its relation to fault activity

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Introduction

Geochemical investigations on fault activity have been mainly conducted with gas geochemisty. However, the major chemical compositions of ground water may have the potential to be a good indicator of fault movement and activity, because in a fault zone, rocks are crushed to fine grain size and contact with water. In this situation, water-rock interaction may occur to change the chemical composition of ground water in the fault zone. A fault survey tunnel was excavated through the Mozumi-Sukenobu active fault from the Nagato tunnel in the northern central part of Japan (Ando, 1998). Ground water samples were collected along the Nagato and fault survey tunnels in and around the Mozumi-Sukenobu fault and were measured their chemical compositions, $\delta^{18}O$ and tritium.

Results and Discussion

A Ca-HCO_3 type composition is observed in ground water samples along the Nagato tunnel and more than 500m distant from the Mozumi-Sukenobu active fault. On the contrary, ground water samples in and adjacent to the Mozumi-Sukenobu fault have Na-HCO_3 type composition (Satake et al., 2003). In the Mozumi-Sukenobu fault zone, rocks are finely fractured and fault gouge is formed. Ca-montmorillonite, which is not the constituent of the mother rock, is observed in the fault gouge (Tanaka, personal communication). This suggests that in the fault zone intense rock weathering occurs. It is well known that plagioclase which contains Na ion as major chemical constituent is easily weathered to clay minerals. Thus Na ion, the major cation of ground water in the fault zone, probably introduced to ground water by the dissolution of Na ion from plagioclase during weathering and the exchange of Ca ion in ground water with exchangeable Na ion in montmorillonite.

Na/Ca ratio in ground water is highest (10-25) in the intensely fractured zone between two fault zones A and B. The ratio decreases with increasing distance from the fault zone. The increase of Na/Ca ratio with approaching to the fault zone is regarded to be the result of Na release from plagioclase to ground water due to the intense chemical weathering in fault zone and the exchange of Ca in ground water with Na in clay minerals. This fact suggests that Ca/Na ratio is a good indicator of fault activity. Based on environmental isotopic evidence of ground water, the fault A is inferred to be fairly permeable but the fault B, impermeable. This implies that the fault A is active and fault B inactive.

References

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