Geosphere Stability Project

*Ken-ichi Yasue[1], Eiji Sasao[1], HIRONORI ONOE[1], Teruki Iwatsuki[1], Tomoko Kato[1], Ryuji Takeuchi[1], Yoko Saito Kokubu[1], Koichi Asamori[1], Koji Umeda[1]

1.Japan Atomic Energy Agency

Introduction

Geosphere stability project is being carried out by Japan Atomic Energy Agency in order to establish techniques for investigation, analysis and assessment of the long-term evolution of geological environments, taking into account long-term geological phenomena such as volcanism, faulting, uplift, denudation, climate change, and sea-level change. This project is being conducted under a contract with Agency of Natural Resources and Energy, part of Ministry of Economy, Trade and Industry of Japan as part of its R&D supporting program for developing technology of geological disposal of high-level radioactive waste.

The geological disposal secures the safety in the time scale over tens of thousands of years by the multiple barrier system which consists of an engineered barrier and a natural barrier together. Crustal movement in and around Japanese Islands is active, because Japanese Islands is located in the mobile belt. Therefore it is important that identification of the natural phenomenon that may have a remarkable influence on geological disposal system and understanding of the behavior pattern and scale of the geological environments with the natural phenomenon. The project has the development of a numerical model "Geological-Evolutionary Model" expressing a change of the geological environments and the development of "Innovative Elemental Technique" that is elemental technology required for model construction.

Overview of Project

Geological-Evolutionary Model

The purpose of the Geological-Evolution Model is to establish modeling techniques, which can express a long-term change of the geological environments. In addition, the project contains the R&D such as the methodology for verification and an uncertainty estimate of the models, and the visualization technology of the model.

In the R&D, FEP (Features, Events and Processes) analysis and scenario development for geological-evolutionary modeling of mountain area and plain area have been carried out. Paleo-hydrogeological model was constructed in consideration for long-term geological environments such as topography, geology and surficial environment, and spatial distribution of long-term stability of groundwater flow conditions were numerically assessed with the standard deviation and the variation coefficient.

Innovative Elemental Technique

The Innovative Elemental Technique consists of Provenance analysis techniques, Groundwater recharge estimation techniques, Carbonate mineral measurement techniques and Crustal movement estimation techniques as the technique required for the modeling on a long-term scale and the analysis evaluation.

The technique to identify a supply source of the sediment using the ESR signal of the quartz, technique to estimate a river spillage in consideration of the topography, technique to analyze the microscopic area of the carbonate mineral, distorted speed distribution based on the displacement speed of the active fault were developed in the R&D.

Future studies
In future work, geomorphological, geological, hydrological, and geochemical models will be integrated, and uncertainties of geological-evolutionary modeling will be analyzed based on difference in geological environments of the mountains and plains. In addition, it is necessary for continuation of the development of the elemental techniques and to develop the modeling method using the techniques.

Keywords: Long-term stability of the geological environments, Geological-Evolutionary Model, Innovative elemental techniques, High-level radioactive waste, Geological disposal

