High-Level Radioactive Waste Management

Background and Objective

Long-term durability of underground facility and suppressive function of ultralong-term radioactive nuclide migration are required by considering geological/rock mechanical/hydraullic properties of deep-seated rock mass in the geological disposal of HLW. In this project research, CRIEPI clarifies the applicability of survey technologies for the PI (preliminary investigation) and the DI (detailed investigation) and long-term behavior of the near-field engineered and natural barriers.

Main results

1. Systematization and verification of survey technology and estimation method for site selection

As a collaboration work with NUMO (Nuclear Waste Management Organization of Japan), several field surveys and drilling in accordance with the survey flow diagram of the PI, which was advanced by CRIEPI, were conducted at CRIEPI's Yokosuka site during 2006 to 2009 and their applicability for siting was verified [N15] [N10008] [N10017]. In addition to this, build process for the monitoring system in the borehole was proposed based on in-situ survey results (Fig. 1). These results are very helpful for NUMO to plan the PI.

2. Development of advanced element technology for site selection

The following element technologies, which are very important for site selection, were developed.

Survey technology at the underground tunnel: Survey technologies for the sedimentary rock were conducted at the Mont Terri site as a co-operation research project "Mont Terri project", and the results were summarized [N14]. These technologies were applied to the Japanese sites. (2) Groundwater dating: Dating method for the underground water of about tens of thousands years old was developed [N10001] and existing dating method using 4He and 36Cl was improved [N10021] [N10040]. Applying these methods to the Horonobe and Mizunami sites, we confirmed these methods were highly reliable. (3) Directional Drilling technology: Following last year, horizontal borehole with length from 900 to 950 m was drilled and hydraulic test in it was carried out (Fig. 2). We received vision of optimal realization of the directional drilling from these results.

These results were reflected in the planning for the PI and NUMO technical report (2010 report). The directional drilling and ground water dating were conducted as a funded research from METI (Ministry of Economy, Trade and Industry), and these applications at the Hornobe and Mizunami sites were conducted as a collaboration work with JAEA (Japan Atomic Energy Agency).

3. Resolution of long term mechanical behavior of near field

Using centrifuge installing the model of the near field of vitrified waste [N10011] [N10018], the acceleration test was conducted for several moths. After the test, the model was visualized by the X ray CT method (Fig. 3) and swelling pressure change in time of the bentonite in the disposal pit could be estimated for 280 years.

Other reports [N10013] [N10014] [N10016] [N10026] [N10049] [N10050]

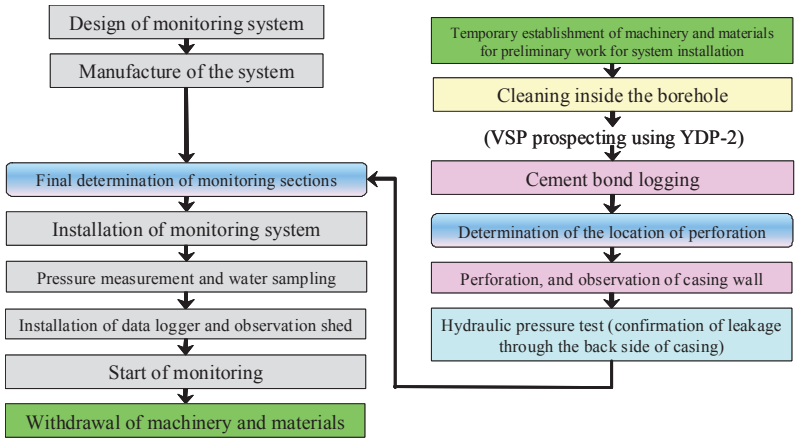

Fig. 1 Build process of monitoring system

Considering hydro-geological condition, borehole condition was improved and hydraulic monitoring system was set in the borehole. The build process of monitoring system was proposed based on this work.

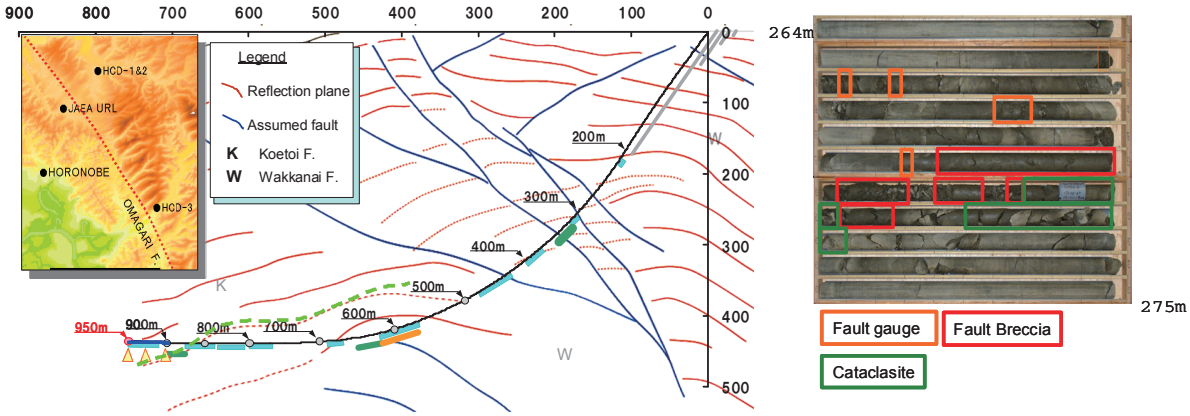

Fig. 2 Outline of the directional drilling (Left: drilling trace, Right: Rock core sample of fault zone)

Directional drilling technology was applied to the Horonobe site, Hokkaido. From this result, the vision of optimal realization of the drilling technology was received and the Oomagari fault was characterized by this drilling.

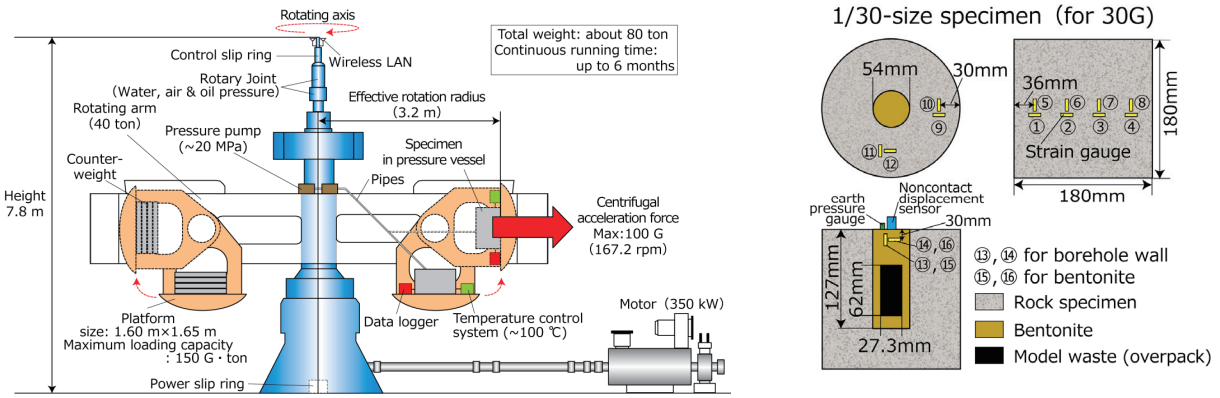

Fig. 3 Acceleration test of the near field behavior by centrifuge (Upper left: Centrifuge, Upper right: Model of near field, Lower right: Picture of the near field model taken by X ray CT)

By using X-ray CT, the simulated waste and bentonite/rock can be distinguished and behavior around the disposal pit for about 280 years can be estimated.