Development of Controlled Drilling Technology for Efficient Geological, Hydrological and Mechanical Surveys

Background

It is very important to estimate the geological, hydrological, physical, mechanical and geochemical properties of the host rock in cases of underground development. The field geological and geophysical survey and survey using a few drilled boreholes will be required at the second stage of the site selection procedure for radioactive waste disposal called 'selection of areas for detailed investigation'. Since the controlled drilling system can control direction and inclination of the borehole, collect core samples and enable several measurements and loggings in the borehole under the limited topographic and geological condition, it is possible to reduce the number of the boreholes and conduct the efficient survey by using this system at the second selection stage.

Each part that consists of the controlled drilling system has already developed, but the total system of the controlled drilling technology has not been integrated yet.

Objectives

To conduct efficient hydro-geological survey for selection of sites for radioactive waste disposal, the controlled drilling system will be developed. Furthermore, in order to demonstrate and systematize the technology of the controlled drilling and survey in its borehole, controlled drilling over 600m length and 400m depth and several loggings and measurements in the borehole will be carried out in the soft sedimentary rock at the Horonobe site in Hokkaido.

Principal Results

1. Development of the drilling technology

The sub-systems, which can vend the borehole and can collect the geological core sample and WL-MWD (Wire-line Measurement While Drilling) system, which can detect the drilling location were designed, manufactured and tested, then these sub-systems were integrated to a total drilling system. The applicability of this system was checked by the performance test in the mock borehole.

2. Development of the logging and measuring technology

As the logging and measuring technology, the WL-LWD (Wire Line Logging While Drilling), Permeability/Water Sampling/Imaging tool, pressuremeter and stress measurement tools were developed and basic design of the borehole packer enabling the underground water monitoring in the borehole after drilling was performed.

3. Demonstration and systematization of the drilling and survey technology

As a collaboration research with the Horonobe Underground Research Center of JNC (Japan Nuclear Cycle Development Institute), controlled drilling of 550m length and 400m depth was performed in the soft sedimentary rock of the Neogene Tertiary at the Horonobe site in Hokkaido during FY 2003 and 2004, and its applicability to the site was verified. The performance of WL-LWD and Permeability/Water Sampling tool was checked in the borehole during and after drilling, and the instruction manual for the drilling and survey was described. By using this drilling and survey system, it becomes possible to characterize hydro-geological condition at the Horonobe site, and we have prospects for the practical application of the system.

This research was done under contracts awarded from METI (Ministry of Economy, Trade and Industry).

Future Developments

We will continue to drill the borehole to the length of 700m and check the applicability to deeper parts. From FY 2006, we will move to another point to drill a fault zone that is more difficult to drill, in order to check applicability and make the system practical.

Main Researcher: Kenzo Kiho, Ph. D.,
Senior Research Geologist, Nuclear Fuel Cycle Backend Research Center, Civil Engineering Research Laboratory

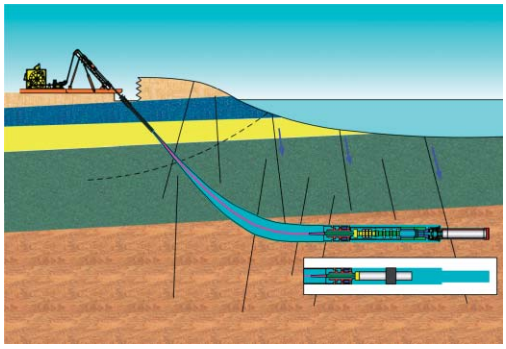

Fig.1 Conceptual design of the controlled drilling

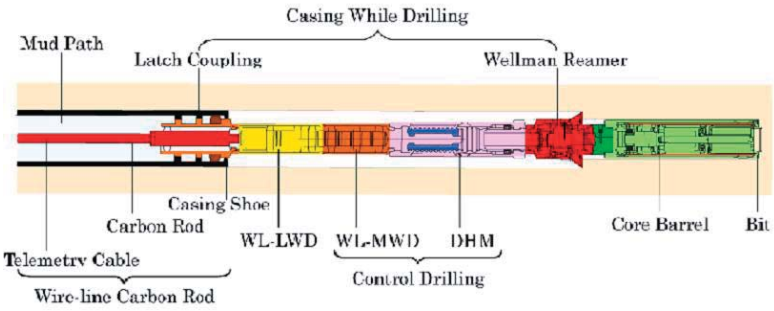

Fig.2 Conceptual design of coring, MWD and LWD composition

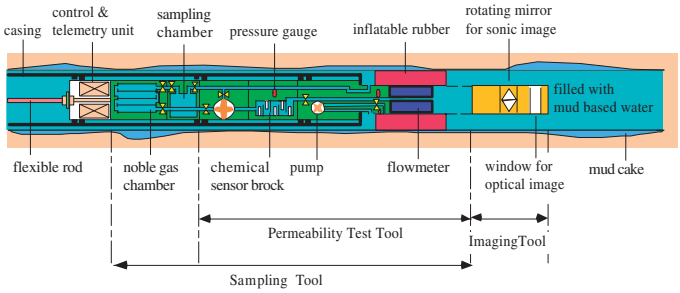

Fig.3 Conceptual design of permeability test, water sampling and imaging composition

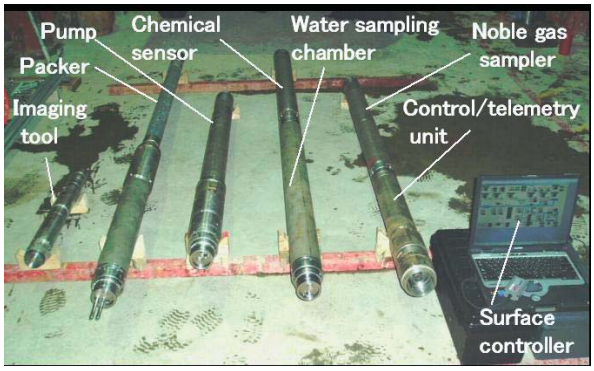

Fig.4 Each tool of the permeability test, water sampling and imaging

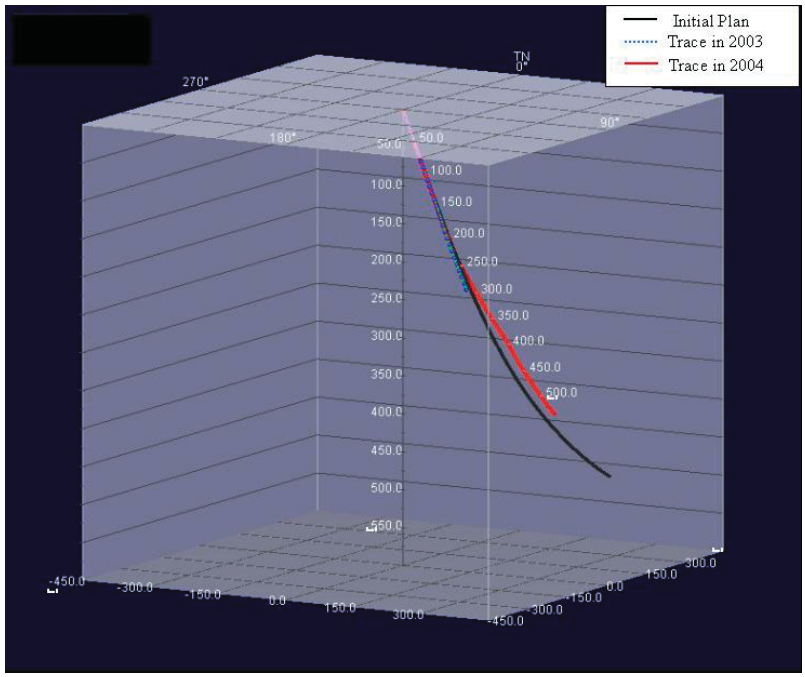

Fig.5 Borehole trace (Horonobe site)