Aseptic and deoxidized drilling program in sedimentary rocks and estimation of hydraulic/microbiological conditions

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In the preliminary site characterization of nuclear waste disposal, hydraulic, chemical, and microbiological conditions and mechanical, and hydraulic properties must be estimated from the limited number of boreholes. To obtain data about chemical and microbiological conditions, and hydraulic properties, it is indispensable to excavate a borehole with minimum disturbance to hydraulic, chemical and microbiological conditions, and retrieve undisturbed rock and groundwater samples.

We made 350 m depth borehole in tertiary sedimentary rocks to examine the drilling and monitoring methods to minimize the various disturbances of drilling. As the drilling water, we used the aseptic filtration and deoxidization with nitrogen gas purging. The aseptic filter could decrease the concentration of microbes as low as five orders of magnitudes comparing to the initial water from the result of a test with a micrometer size particle, and deoxidization with nitrogen gas can reduce the concentration of dissolved oxygen less than 0.1 ppm with flow rate of 10l/min.

Rock samples were handled and cut to the proper size in the aseptic and deoxidized water without exposure to the air, and the pore water will be extracted in the chamber filled with nitrogen gas. In-situ groundwater sample will be retrieved from the bottom of the borehole to measure the noble gas isotope analyses.

To estimate the disturbance caused by drilling, potassium iodide was used as a tracer, and the concentrations of iodine content in pore water samples were measured.

Geophysical and hydraulic well logging, including heat pulse type flowmeter logging and FEC (Fluid Electric Conductivity) logging were carried out for the assessment of highly permeable zones along the borehole.

Chemical and microbial analyses of pore water samples show that several thin tuff layers in thick mudstone were disturbed by drilling water, and show high bacteria density. The flowmeter and FEC logging shows that these tuff zones also act as the inflow/outflow zones. The multi-packer type pressure measurement/groundwater sampling system was set aiming at the monitoring of these inflow/outflow or bacteria bearing zones.