2-9 Estimation of the 3D Distribution of Groundwater Chemistries

— Hydrochemical Investigation in the Horonobe Underground Research Laboratory (URL) Project —

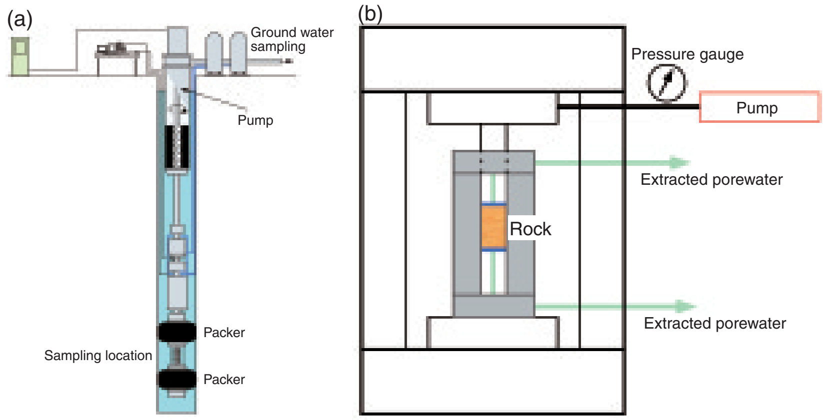

Fig.2-21 (a) Groundwater pumping system
After the packers were inflated, the drilling fluid was removed from the packed-off interval with a pump. During the pumping, the tracer concentration was measured at the site to estimate the contamination of the groundwater by the drilling bentonite fluid.
(b) Equipment of extracting porewater
The core is subjected to high pressure (ca. 70~100 MPa). 10~30 cc of porewater was extracted from the 200 cc core in two weeks.

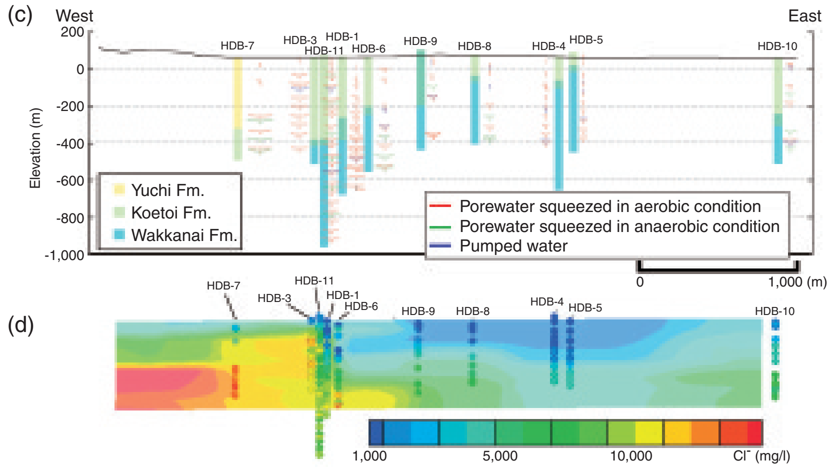

Fig.2-22 (c) Geological columns and Hexadiagram
This figure shows hexadiagrams of groundwater chemistries. The distribution of groundwater chemistries changes from the fresh water system (Na-HCO_3 type) to saline water system (Na-Cl type) with the depth.
(d) Estimated pattern by inverse - distance interpolation of water samples
3-D distributions of groundwater chemistries were estimated by using a geostatistical method (inverse-distance interpolation method) based on the borehole location and sampling depth. As a result, the zone at the east side of Omagari fault has a low concentration of chloride ion (Cl^-), down to deep levels.

In Japan, the high-level radioactive wastes (HLW) generated with the reprocessing of used fuels are planned to be disposed in the ground deeper than 300 meters. The groundwater will be pumped up during the construction and operation phase of the disposal facility. It is suggested that the geological environments around the facility will be changed. In this research, the techniques to estimate the distributions of groundwater chemistries from the ground level (GL) to about GL -500m before constructing the facility were developed.

The chemical data of meteoric water, river water, groundwater and porewater were used for the estimation. The chemical data of 18 groundwater and 170 porewater samples were analyzed (Fig.2-22(c)) during 11 borehole investigations (HDB-1 to HDB-11). The boreholes were Our research results show clearly that the bentonite fluid influences the groundwater chemistry. The groundwater was sampled in the hydraulic packer test (Fig.2-21(a)).

The porewater was extracted by squeezing in a suitably-designed high pressure cell. This technique has been successfully utilized by the British Geological Survey (BGS) in the Nirex site investigations (Fig.2-21(b)).

The inverse - distance interpolation method was applied to these data, and three dimensional distributions of groundwater chemistries have been estimated (Fig.2-22(d)). As the result, the distribution revealed a change in groundwater chemistry from the fresh water system (Na-HCO_3 type) to saline water system (Na-Cl type) with increasing depth. It is understood that the boundary depth of the fresh water and saline water is different in the east and west portions of the area.

We will simulate and discuss the evolution process of these groundwater chemistries in the future. Also, the validity of this geochemical model will be confirmed by comparison with the groundwater chemistry changes during the construction and operation of the underground facility.

Reference

Hama, K., Kunimaru, T. et al., The Hydrogeochemistry of Argillaceous Rock Formations at Horonobe URL Site, Japan, Physics and Chemistry of the Earth, Parts A/B/C, vol.32, issues 1-7, 2007, p.170-180.