Analytical Study on Groundwater Flow Characteristics of Sedimentary Rocks in Horonobe

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Japan Nuclear Cycle Development Institute has been conducting Horonobe Underground Research Project on the Neogene sedimentary rocks to confirm reliability of technologies for disposal of high level radioactive waste through the systematic research in the Horonobe Underground Research Laboratory (URL) area [JNC, 2004]. Building a hydraulic model plays an important role in a groundwater scenario of the disposal. This paper shows numerical results of groundwater flow analyses in and around the Horonobe URL area.

The Horonobe URL area lies over the Shimizu river basin (area: about 12km2) and the Penke-ebekorobetsu river basin (area: about 29km2) involved in the Teshio river basin (area: 5594km2). The Teshio river flows west in about 5 km south of the URL area, while the Shimizu river and the Penke-ebekorobetsu river flow north-west in the URL area. Groundwater flow is basically controlled by a distribution of groundwater table. In other words, undulation of ground surface forms regional, medium and local groundwater flow systems [Tóth,1963]. In the Horonobe URL area, the Shimizu river and the Penke-ebekorobetsu river make local groundwater flow systems and the Teshio river makes a regional groundwater flow system.

Finite element analyses were performed in order to clarify the groundwater flow system in and around the URL area. The results show that the shallower groundwater flows upward into the Shimizu river or the Penke-ebekorobetsu river obeyed by the local flow systems and that the deeper groundwater flows downward and south to south-west and finally flows into the Teshio river obeyed by the regional flow system. The depth of the boundary between the local and the regional flow systems depends on the place, which means that the groundwater flow system is governed not only by the distribution of ground surface but also by the distributions and hydraulic properties of the layers and the fault. The tracks of the groundwater flow from EL-400m at 7 points (boreholes : HDB-1,3-8) to the ground surface show that the Darcy velocity depends on the starting point and varies from 10-5 m/y (HDB-3,6) to 0.16 m/y (HDB-4). By the way, the analytical results of oxygen and hydrogen isotope of the groundwater show that the shallow groundwater at HDB-3 is mainly composed of the old seawater and that the groundwater at HDB-4 is affected by the precipitation to deeper zone [JNC, 2004]. It implies that the velocity is greatly related to the infiltration amount of the precipitation.

We will continue the modeling with more detailed surveys.

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Tóth, J. : A theoretical analysis of groundwater flow in small drainage basins, J. Geophys. Res., v.68, pp.4795-4812, 1963.