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Hydrogeological Evaluation of Fractured Rock Mass in Yeosu Peninsula, Korea

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ABSTRACT

This study aims to evaluate the hydrogeological system of large scale storage caverns in a volcanic rock mass in the Yeosu peninsula, Korea. The storage caverns were constructed at EL. -30 m(GL. -140 ~ -370 m; width : 30 m, height : 60 m). The fracture system was analyzed on the basis of the fracture mapping data of surface and tunnel, and the BHTV data of drilling holes. The hydraulic tests data, the hydrochemical data, and the evolution of groundwater levels from the surface monitoring boreholes and water curtain holes in the caverns were utilized for the hydrogeological analysis. At the cavern level, the hydraulic conductor domain (HCD, fracture zones) is characterized by one local major fracture zone(NE-1) and two local fracture zones(NW-1, NW-2) between the F1-1 and F1-3 local major fracture zones. The hydraulic rock domain(HRD rock mass) can be divided into four compartments by the HCD. In the Domain-A and B around the F1-3 fracture zone, the initial pressures measured from horizontal water curtain holes are very high(Domain-A : 0 ~ 16.5 kg/cm^2, Domain-B : 0 ~ 6.5 kg/cm^2). On the other hand, the Domain-C and D around the F1-1 zone are low(Domain-C : 0 ~ 3.2 kg/cm^2, Domain-D : 0 ~ 1.4 kg/cm^2). Also, the initial pressures of vertical water curtain holes indicate that there are some differences (about 0.5 ~ 1.2 kg/cm^2) between NW-1 and NW-2 fracture zones. Therefore, the hydraulic boundary in the study area is NE-1, NW-1, NW-2 fracture zones(HCD). Each domain(HRD) shows the unique values of their potential heads(Fig. 1). According to the numerical modeling, the horizontal flow is predominant in upper groundwater of the two HRD around the F1-1 zone. This might be resulted from the poor hydraulic connectivity, very low hydraulic conductivity($7 \times 10^{-10} \sim 5 \times 10^{-9}$ m/sec) in the lower zone, and low groundwater recharge rates. On the other hand, for the two HRD around the F1-3 zone, the draw down after the excavation is large and the vertical flow is predominant in the upper groundwater because of good hydraulic connectivity and relatively high hydraulic conductivity ($4 \sim 5 \times 10^{-9}$ m/sec).

In addition, according to the hydrochemical analysis, in two HRD around the F1-3 zone, the residence time is longer(TU : 1 ~ 4.5) than those around F1-1 zone. Groundwater samples of the HRD around F1-3 zone belong to the Na-HCO_3 type. The recharge rates obtained from the numerical modeling are 50 mm/year in Domain-A, 35 mm/year in Domain-B, 10 mm/year in Domain-C, 15 mm/year in Domain-D.

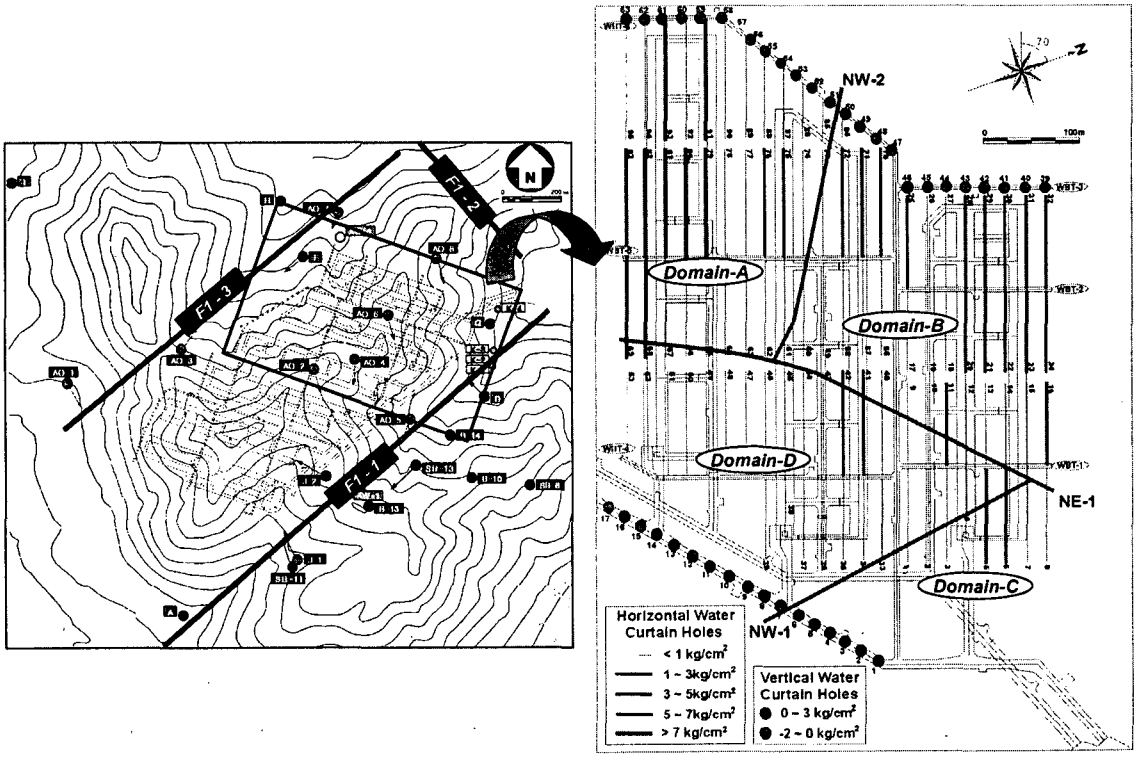

Fig. 1. Distribution of the initial pressures in the water curtain holes and the hydraulic compartment.

Key words : Groundwater, fractured rock mass; storage cavern, hydraulic compartment