Geo-synthetic study on the geological and hydro-geological model around KURT area

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1. Introduction

KURT (KAERI Underground Research Tunnel) is a small-scale research tunnel which was located at Korea Atomic Energy Research Institute (KAERI). This research tunnel was constructed for the demonstration study including engineering and natural barrier system for a radioactive waste disposal. Before beginning of demonstration study, the site characterization works should be preceded all of the research activities. It is caused that the site specific conditions may affect the environments of demonstration studies such as the heat transfer test, solute migration test and groundwater flow test.

2. Methods and Results

2.1 Geological model

To understand the geological environment around KURT area, the several geological surveys such as lineaments analysis, geophysical survey and borehole investigation were performed. From this study, three-dimensional geological model has been constructed using surface, borehole and tunnel geological data [1].

2.1.1 Weathering zone

Weathering zone was investigated by using surface geophysical survey and borehole logging data. As the surface geophysical survey, the electrical resistivity and reflection survey were carried out to identify geophysical anomalies at surface. Furthermore, the depth distribution of a weathering zone was determined by borehole logging data (Table 1).

Table 1. Depth distribution of the weathering zone and low angle fracture zone around KURT area

(mabh:meter along borehole)

Borehole	Weathering zone (mabh)	Low angle fracture zone (mabh)
KP-1	27	No (horizontal well)
KP-2	10	31
YS-01	16	53
YS-02	15.2	51
YS-03	15	74.1
YS-04	13	28
YS-05	10	22.5
YS-06	15	45.8
YS-07	38	84.2

2.1.2 Fracture zones

Fracture zones were compared with a lineament analysis and a geophysical survey. As a result, total of 9 fracture zone were finally determined. Furthermore, major fractures of each fracture zone were analyzed by borehole core logging, and the information of major fracture core and damaged zone were also obtained in each fracture or fault zone. An additional fracture zone, which was expected to exist in eastern area of KURT, was also added to fracture zone system around KURT based on the lineament analysis, although the more fracture zone data were not identified due to the lack of borehole data. Total 10 fracture zone were suggested in Table 2.

Table 2. Fracture zones around KURT area. Total 10 fracture zone were obtained from geological investigation

No	Fracture zone	Width(m)	Order	Results	remarks
1	YS1_104F	14	2	Class A	FZ2A-1
2	YS1_433F	17.3	2	Class A	FZ2A-2
3	YS2_106F	18.5	2	Class A	FZ2A-3
4	YS6_70F	11-20	2	Class A	FZ2A-4
5	KP1_75F	65.9	2	Class S	FZ2S-1
6	KP1_120F	12.5	2	Class A	FZ2A-5
7	KP1_177F	14.0+	2	Class A	FZ2A-6
8	DB1_213F	17.32	2	Class A	FZ2A-7
9	DB1_241F	5.6	2	Class B	FZ2B-1
10	L1		1 or 2	Class S	FZ2S-2

2.1.3 Low angle fracture zone

Based on the directional analysis of a fracture orientation from the BHTV logging, the low angle fracture zone was classified into one element of geological model around KURT. It also could be recognized by the surface geophysical survey and borehole logging data. Especially, the low angle fracture zone was continuously layered between surface weathering zone and the lower bedrock around KURT area. The depth distribution of the low angle fracture zone was estimated by BHTV logging data, which ranged from 22.5m ~ 84.2mabh (meter along borehole) in each borehole (Table 1).

2.2 Hydro-geological model

The constant head injection test was a classical in-situ hydraulic testing method for obtaining the hydraulic conductivity from the flow rate injected to test section [2]. To identify the hydro-geological properties of the hydro-geological elements around KURT area, several fixed-interval constant head injection tests were carried out in the borehole. From the results of the hydraulic tests, the hydraulic conductivities of each hydro-geological element were estimated by a comparison with the suggested depth of geological element in Table 1 and 2. The estimated hydraulic conductivities were shown in Table 3.

Table 3. Hydro-geological properties of each element around KURT area

Geological elements	Hydrogeological elements		Hydraulic Conductivity (m/sec)
Weathering zone	HSD		1.50E-07
Low angle fracture zone	LAFD		1.05E-07
Fracture zones	HCD	FZ2A-1	4.08E-09
		FZ2A-2	4.53E-09
		FZ2A-3	2.88E-08
		FZ2A-4	3.52E-07
		FZ2S-1	3.22E-07
		FZ2A-5	5.95E-07
		FZ2A-6	7.53E-06
		FZ2A-7	8.78E-06
		FZ2B-1	7.95E-06
		FZ2S-2	4.36E-7 (expected)
Bedrock	HRD		4.3E-10

2.3 Geo-synthesis

Hydro-geological properties of each geological element were estimated in Table 3. From the Table 3, FZ2A-1 and FZ2A-2 fracture zones are relatively less permeable than other fracture zones. Though their hydraulic conductivities are 10 times higher than the average hydraulic conductivity of HRD around study area, the higher permeable zones could be found in HRD (Fig. 1). Therefore, from the hydro-geological point of view, two fracture zones (FZ2A-1 and FZ2A-2) might not be considered as HCD, but a part of HRD.

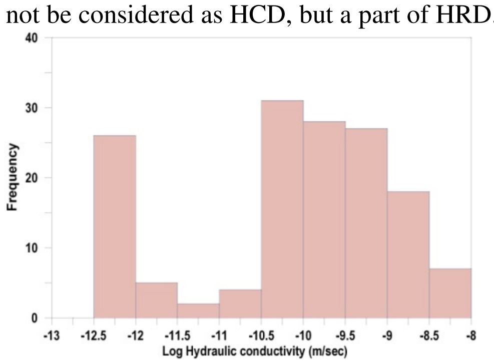

Fig. 1. Hydraulic conductivity of HRD around KURT area

As a result, total 8 fracture zones could be finalized as HCD around KURT area based on the geo-synthetic study which considers the geological and hydro-geological characteristics.

3. Conclusions

Using the in-situ field data, the geological and hydro-geological model were constructed around KURT area. There are four geological elements, weathering zone, low angle fracture zone, fracture zones and bedrock in the study area. Furthermore, their hydro-geological properties were also estimated from the hydro-geological investigation. Through geo-synthetic study, two fracture zones, which were fracture zones in geological model, were not considered as HCD in hydro-geological model.

This result will be used as basic model of site descriptive model around KURT. And, it is also a useful site specific data for the future in-situ demonstration study of a radioactive waste disposal research around KURT.

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