Groundwater flow simulation related to flow barrier fault for geological disposal

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Introduction

Not a few fault or shear zone have fault core of its center with damaged zone on its both side (Evans et al.1997). There are lots of faults in Japan since it is located at convergent plate boundary. If there is a fault block surrounded by low permeable fault, groundwater cannot easily flow into the fault block from its surroundings, causing a huge drawdown in the block, whilst very small drawdown at the outside of the block. On the other hand, the ground water recovery could be very slow of its recovery phase, causing long duration of unsaturated field.
Previous our study are as follows; a) simple simulation of groundwater drawdown behavior due to a withdrawn of ground water from the shaft, b) distribution characteristics of the fault block in Japan, and c) relationship between the trace length of fault and thickness of the fault core.
As a result, for the a) above, a large difference occurs in drawdown inside and outside of the fault block by simple simulation in the case of 4 orders of magnitude difference in hydraulic conductivity of the host rock and the fault. In particular, seldom drawdown has calculated at the outside of the fault block. For the b) above, the area of the fault block based on the seamless geological map in Japan (AIST) is about 2 % of the entire Japanese area. Moreover, the area of a fractured rock such as pre-Neogene deposit and plutonic rocks is more than 90% for the area of the fault block in Japan (Takeuchi other 2015). In addition, the histogram of the area of the fault block in each district in Japan is almost the same as the area of geological disposal facilities (Takeuchi et al., 2015). For the c), we found out general relationship between the thickness of the fault core and the trace length of the fault based on the existing data. Namely the thickness of the fault core has plateau as about 20cm against the trace length of few hundred meters or more (Takeuchi et al., 1995). In this study, we analyzed drawdown behavior inside and outside the fault block by changing the hydraulic conductivity and thickness of the fault, respectively.

Result

In the case of the hydraulic conductivity is 1E-10 (m/s), the drawdown is uniformly about 155m from the ground level for the 50m in fault thickness, and about 250m for the 80 and 100m, respectively.
In the case of the hydraulic conductivity is 1E-11 (m/s), the drawdown is uniformly about 355m for each thickness of the fault. Moreover, in the case of the hydraulic conductivity is 1E-12 (m/s), the drawdown is uniformly about 355m for the 50 and 80m, and about 455m for the 100m. In any case, the obvious drawdown was not observed at outside of the fault block.

Conclusion

The simulation has revealed that the drawdown behavior inside the fault block could vary with the hydraulic conductivity of the fault and its thickness. Moreover, it has been suggested that the ground water level could be deeper than the shaft depth in some cases. In the future, it should be simulated the ground water behavior in the recovery phase and fault property such as hydraulic conductivity of the fault core for the major fault in the field.

Keywords: Fault Core, Flow Barrier Effect, Fault Block, Groundwater flow, Geological Disposal

