Validation of groundwater flow model using geochemical information

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Numerical simulations are conducted to check the validity of groundwater flow model using geochemical information.

The modeling site consists of granite, and is in a costal area. The main features of groundwater flow are as follows, 1) main driving force of groundwater is rain infiltration at mountain area, 2) groundwater flow system depends on fractured system, 3) sea-fresh water interface is formed around 200m in depth from the sea level, 4) groundwater age are younger than 1000 years in fresh-water zone and more than 10,000 year in sea-water zone. In spite of fractured media, spatial distribution of salinity and groundwater age are shown as homogeneous media.

The groundwater flow model was constructed by the in-situ investigations. The main features of numerical model are follows, 1) topology of land and seabed are taken into account, 2) homogenous media is assumed, 3) hydraulic conductivity are estimated on the basis of in-situ test, 4) porosity are determined by laboratory tests, 5)dispersivity are estimated from flow scale. The numerical simulations are performed for groundwater flow considering density effect of salinity and hydrogeologic residence time proposed by Goode(1994).

The sensitivity analyses are performed for rain infiltration rate. As a result, the salinity distribution is reproduced by the following condition. 1) Rain infiltration rate is 2mm/y. 2) Hydraulic conductivity is 5.0e-9, which is approximately equal to average hydraulic conductivity in log scale. 3) Porosity is 0.5%. 4) Longitudinal and lateral dispersion length are 100m and 10m, respectively. However, hydrogeologic residence time is ten times as old as measured groundwater ages. These groundwater ages are represented by 10 times higher hydraulic conductivity and infiltration rate. These results show that there are some difficulties to decide hydraulic conductivity by salinity distribution, and the groundwater age will be powerful index to decide hydraulic conductivity. This kind of two step approach for calibrating model by salinity and groundwater age is effective.

From these results, it is useful to use groundwater age for model calibration. This kind of approach is necessary to evaluate groundwater flow in deep geological formation.