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Geophysical well logs to evaluate the subsurface structure and groundwater flow from deep boreholes, Seokmodo, Korea

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Recently governmental concern and investment are increasing on the development of geothermal, wind or tidal power plant etc. because of rising oil prices. Geothermal energy is clean and sustainable, so the development of geothermal energy is promising. We have conducted the various geophysical well loggings from several deep boreholes to develop the hot spring in the Seokmodo, Korea. The purpose of geophysical well logging is to evaluate the structure of subsurface geology and the spatial distribution of high temperature groundwater flow, finally understand the relationship between the subsurface geology and high temperature groundwater. We have performed the geophysical well loggings in the 22 deep boreholes (YG-1, YG-2, YG-6, YG-7, YG-8, YG-3, YG-4, YG-5, HM-1, HM-2, HM-3, PSG-1, PSG-2, YA-4, KG-1, K-2, K-3, M-1, M-2, YA-1, YA-2, and YA-3) since 2005. Various geophysical well logs, including natural gamma , temperature, electrical conductivity, caliper, and acoustic televiewer logging, were obtained. We have interpreted the geophysical well logs using the spatial distribution of natural gamma, temperature, and electrical conductivity at the depth of 300 m, 400 m, 500 m, 600 m, 700 m, and 850 m, respectively. Granite showing the natural gamma intensity of about 200 API locate at the shallow depth of the north-east area, and west-south area at the depth of 600m in survey area. Area showing high natural gamma intensity is Jangbong gneiss of Precambrian or acidic dyke after cretaceous period. From the distribution of electrical conductivity, high salinity groundwater at the depth of the interval from 300 m to 500 m widely distributed in the direction of north-west and south-east, and only distributed in the direction of south-west area at the depth of 850m. Areas showing high temperature relatively coincide with the areas or boundaries changing the natural gamma intensity at the depth of 700m and 800m, and also show the similar trend in the area showing high salinity groundwater. To evaluate the phenomenon of fracture and brittle failure in the survey area, we have obtained the acoustic televiewer log data in 12 boreholes (HM-1, HM-2, HM-3, PSG-1, YA-2, YA-3, YA-4, YG-3, YG-4, YG-5, YG-6, and YG-8). From the image and traveltime data, we have analyzed the fracture distribution and breakout phenomenon. The direction of overall fractures is NNW-NNE at the depth of above 700 m, and NNW, ENE at the depth of below 700 m. Also we did not find the breakout phenomenon at the survey area.