



Geophysical well loggings to identify basalt sequences and aquifers in Jeju Island, Korea

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Jeju that is located in the southern extremity of Korea is volcano island, and consisted of basalt mainly, there is one of best-known recreation center in Korea. Jeju, the largest island in Korea, is 73 km wide and 41 km long with a total area of 1,845 $\frac{1}{2}$ km². Jeju island came into existence 700 to 1,200 thousand years ago when lava spewed from a sub-sea volcano and surfaced above the waters. And the final volcanic eruption took place approximately 25 thousand years ago. Jeju Province and KIGAM (Korea Institute of Geoscience and Mineral Resources) began joint research for the purpose of systematic management of groundwater resources since 2004. Jeju Province operates the monitoring wells for seawater intrusion problems around Jeju island for evaluation of groundwater resources in coastal area. Therefore, various surveys and monitoring performed in boreholes, and also conventional geophysical well loggings conducted to identify basalt sequences and estimate the total porosity of aquifer related the evaluation of groundwater resources. Various conventional geophysical well logs, including radioactive logs (natural gamma log, dual neutron log, and gamma-gamma log), electrical log (or electromagnetic induction log), caliper log, and fluid temperature and conductivity log and heat-pulse flowmeter log were obtained in 29 boreholes. Monitoring wells are drilled from seashore into inland with several kilometers distance, and the borehole bottom is the below of sea level with about 150 m depth. Major rock types identified from drill cores are trachybasalt, acicular basalt, scoria, hyalocastite, tuff, unconsolidated U formation, and seoguipo formation and so on. Natural gamma logs are useful in basalt sequences if sedimentary inertbeds, unconsolidated U formation, and seoguipo formation with higher natural gamma log exist for saturated or unsaturated basalts. Neutron logs are very effective to discriminate between individual

lava flows, flow breaks, and sedimentary interbeds in saturated formation. The range of basalt total porosity estimated by using dual neutron logs is from 30 to 35 LPU (Limestone porosity unit), basalt porosity can be overestimated due to the presence of hydrous alteration minerals (Helm-Clark et al., 2004). To evaluate reliable basalt porosity, re-calibration by using basaltic-specific calibration block and laboratory test with core will be implemented in 2005. The results of geophysical well loggings to saturated rocks are interesting and consistency. In hyalocastite, porosity is high and resistivity is low, and we think that hyalocastite is a major pathway of fluid flow. In trachybasalt, porosity has a wide range and resistivity is high. In sedimentary interbeds, unconsolidated U formation and seoguipo formation, porosity is high and resistivity is low. Radioactive logs, fluid temperature and conductivity log, and heat-pulse flowmeter log have been used successfully to interpret seawater intrusion of eastern coastal part of Jeju island. We interpret that problems of seawater intrusion are related to flow patterns of lava. Finally, horizontal correlation in only natural gamma logs between boreholes is not clear.

Reference: Helm-Clark, C. M., Rodgers D.W., and Smith, R. P., 2004, Borehole geophysical techniques to define stratigraphy, alteration and aquifers in basalt, J. Applied Geophysics, 55, 3-38.