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Construction of calibration facilities of slim hole logging system for aquifer characterization

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Calibration facilities for slimhole logging system were constructed at the Pohang branch of Korea Institute of Geoscience and Mineral Resources (KIGAM). In order to accurately measure *in situ* physical properties such as density, porosity, and velocity there is a need for a calibration pit for geophysical well logging system and corrections for various borehole environments. Borehole calibration facilities consist of large water tanks, large blocks of limestone and granite, and aluminum block, porous block which is constituted by a glass bead. In the case of a large water tank, the density is 1 g/cm^3 and porosity is 100 %; limestone, granite and aluminum block were used as the calibration of the density in the range of 2.65 - 2.7 g/cm^3 and very low porosity matrix. The water tank has a diameter of 2 m and 3 m height. The length and width of limestone and granite block are 1.5 m and height is 3 m. Drill coring with 4.34 cm diameter conducted to perform the various laboratory tests such as density, porosity, velocity, XRD, XRF etc. Acoustic and optical televiewer logs were acquired to inspect the internal cracks. The estimated porosity of blocks by glass bead is ~13%. Borehole calibration facilities were used to calibrate and test the performance of the commercial slimhole logging system equipment including density log, neutron log, and sonic log of Mount Sopris and Robertson Geologging companies. In addition, it was also carried out the performance tests of KIGAM prototype logging system such as the spectral gamma-gamma density logging and neutron induced gamma logging system. Using the calibrated density and neutron logging sonde, we acquired the density and neutron logs in the 3 inch borehole. We also identified the clay interval using the separation between density and neutron log, and estimated the porosity and density of the unconsolidated formations such as sand and mud, weathered zone, and crystalline bed rock. For identifying the applicability, orientation and limitation of acoustic televiewer for the characterization of the fractures, 3, 6, and 8 inches physical aluminum borehole model have been specially manufactured. The total length of fractured borehole model is 24 cm: the intervals of fractures at the dip angle of 0° and 90° extend to 10 cm respectively, and the remainder consists of fractures with the different orientation at the dip angle of 30° and 60°. The aperture size is 1, 2, 3 and 5 mm, and the depth is the same as aperture size. Those physical borehole models are useful to interpret the fracture apertures using acoustic televiewer. Construction of calibration facilities of geophysical well logging system is expected to fully understand the characteristics of aquifer.

Figure 1: Calibration facilities of KIGAM, Pohang, Korea