Borehole Survey and In-situ Stress Measurement in Deep Part of Granite

Kinichiro Kusunose[1]; Akio Cho[1]; Ikuo Hagiwara[2]; Shigeo Horikawa[3]; Masamitsu Yoshioka[3]; Tatsuji Matsuzaki[3]

[1] AIST; [2] SUNCOH CONSULTANTS CO.,LTD.; [3] SUNCOH CONSULTANTS CO.,LTD.

www.aist.go.jp/index_j.html

In the design and the construction of an underground space, the information about the stress state of rock mass is one of the most important geological features. In Japan, the measurements of initial stress have been performed by using the releasing stress method and the hydro-fracturing method. In the results of these measurements, the vertical distribution of stress is varied regionally and the local extremums of stress are recognized. The purpose of this study is to investigate the geological conditions concerning to those variations of the stress distribution through a field survey. As a field survey, a core-drilling was done to the depth of 750m with geophysical logging and hydro-fracturing in the granite area of West Japan, where had been regarded as inactive area geologically from diastrophism and earthquake data.

A borehole was drilled by using a wire-line technique and core samples of rock were obtained overall drilling, while the drilling water supply was monitored continuously. From the evaluation of core samples, rock mass of surveyed point consisted of granite and applite, and a breccia zone accompanied with clay was observed. The rock mass of grade CH or CM in the rock classification system were dominant in the shallow level, and the rock of grade A or B were dominant in the deep level with corresponding to the rock mass characteristics such as the distribution density of discontinuity. Weathering of rock was recognized near the ground surface and the alternation was recognized intermittently. Remarkable leakages of drilling water were recognized at two positions, and the leakage rate showed 50-100%.

After the drilling, the geophysical loggings of five kinds (temperature/caliper/density/electricity/elastic wave) and the borehole TV observation were carried out. From these surveys, the variations of rock mass characteristics were found, such as the decrease of the density in the alternated rock mass, the decrease of electrical resistivity and the increase of elastic wave speed (P-wave) in the deep level.

In-situ stress measurements were carried out in the interval of about 50m depth where discontinuity such as a joint was not recognized. In each measurement, horizontal maximum principal stress was calculated by the equation considering breakdown pressure measured and tensile strength of rock mass assumed, and horizontal minimum stress was calculated according to shut-in pressure measured. From the stress measurements, the tendency of gradual increase of stress in the shallow level and flattening of stress in the deep level were found.

Through the field survey, we evaluated that the geological structure of the investigated area was characterized by applite dykes gently inclining, and the condition of rock mass was controlled by the structure and geological events such as alternation. And we report the possible correlation between these geological characteristics and the vertical distribution of stress measured.