In-situ crustal stress measurement in inland Japan - Applications of DCDA method to rock core samples from NIED seismic observation wells -

*Kentaro Omura[1], Akio Funato[2], Takatoshi Ito[3]

1. National Research Institute for Earth Science and Disaster Resilience, 2. Fukada Geological Institute, 3. Institute of Fluid Science, Tohoku University

In-situ crustal stress is an important factor to understand earthquake mechanism and tectonic activities. However, the reliable in-situ crustal stress data seems to still be poor, because complicated procedures are necessary for measure the in-situ crustal stress in a borehole. We tried to apply DCDA (Diametrical Core Deformation Analysis) method for in-situ crustal stress measurement using boring core rock samples. DCDA method measures the circumferential diameter variation and elastic constants of core sample if we have recovered the core sample from the borehole. We expect the method can be applied to old-time boring core samples from NIED (National Research Institute for Earth Science and Disaster Resilience) seismic observation wells, and we may collect global in-situ crustal stress data in Japan island.
We used recovered hard rock core samples from 7 Hi-net observation wells of NIED (more than 10 years ago) from the depth about 100m - 200m (one is from the depth of 2000m). The circumferential core diameter variation was measured by an especially designed apparatus that consists of an optical micrometer, a pair of motor-driven rollers and a data processing system (Funato and Ito, 2017, IJRMMS). We got the sine curves of circumferential diameter variation of some of the core samples associated with stress relief. The data suggest that the DCDA method is applicable to boring core samples from shallow seismic observation wells.
To decide the value of stress, we need elastic constants of the core samples; Young's modulus and Poisson's ratio. We tried to use the data of rock mass P and S wave velocities by means of P-S logging at the time of boring. Assuming the value of densities, we calculated the elastic constants of the core samples. Assuming 2.5 g/cm3 as a representative value of various kind of rocks composing the crust, the differential stresses are around 10 MPa. Those results suggest the in-situ crustal stresses are measured by DCDA method in global area of inland Japan with existing core rock samples. In the next step, we will apply laboratory rock tests to measure the elastic constants of core samples directly.

Keywords: DCDA method, in-situ crustal stress, rock core, inland Japan

