

Measurement of ASR compliance ratio of the core samples for determining stress state in drilling site C0019

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Tohoku earthquake occurred due to rupturing of the boundary fault between the North American plate and the Pacific plate in north-east Japan. In order to understand the state of stress in the source area of the earthquake near to the Japan trench after the earthquake, the Anelastic Strain Recovery method (ASR method) was applied to the core samples taken from the borehole at Site C0019 drilled during IODP (Integrated Ocean Discovery Program) Expedition 343. To estimate the principal stress magnitude, an ASR compliance ratio, which is a physical property constant of the rock, is required. In this study, we conducted calibration tests to examine the features of ASR compliances of the core samples taken from site C0019. Then, magnitudes of in-situ three dimensional principal stresses were determined by the onboard ASR data and the ASR compliance ratio obtained in this study.

The ASR compliance ratio was measured as follows. The core sample used in the onboard ASR measurements during IODP Exp.343 was formed into a cylindrical specimen with a diameter of 4 cm and its top and bottom end faces were shaped smoothly and parallelly. Strain was generated in the specimen by loading uniaxial preceding stress for 24 hours, and time-dependent change in Anelastic Strain Recovery after unloading was measured in the axial direction and circumferential direction. After a certain time, the strain recovers sufficiently and the value of the ASR compliance ratio converges at a constant approximately. Since the duration of the convergence is shorter than the duration of the anelastic strain recovery measurements conducted onboard, it can be applied to the ASR stress measurements with the ASR compliance ratio as a constant value.

ASR compliance ratio was determined for two core samples from the depths below seafloor of 177 and 697 m in C0019. The dependence of the ASR compliance ratio on the pre-loading stress levels was examined by calibration tests for different pre-loading uniaxial stress levels. And then, in-situ principal stress magnitudes were estimated by the ASR compliance ratio obtained at the pre-loading stress level which is nearly equal to the lithostatic stress magnitude of the core sample at its original depth. As a result, the stress states at the two depths are of the normal faulting regime.

Keywords: Japan Trench Fast Drilling Project (JFAST), Anelastic Strain Recovery Method, In-situ Stress Measurement