

Feasibility of experimental determination of three-dimensional crustal stresses in seismogenic zone drilling

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A feasibility study about whether the in-situ rock stress can be measured or not and how to measure or to estimate the stress at great depth up to seismogenic zone in ocean deep drilling had been carried out in order to examine and to propose a survey plan to estimate the in-situ stress state in a integrated ocean drilling program (IODP) plan at Nankai Trough, Japan. One of the scientific objectives of stress estimation is to improve the understanding on the mechanisms of earthquakes which occur at the vicinity of the boundary of oceanic plate subducting below continental plate.

Based on the investigation of various existent stress measurement methods, it was preliminarily concluded that there is not a perfect method by which the magnitudes and orientations of the three-dimensional in-situ stress can be reliably measured at great depth. We suggest that combinational applications of borehole methods and core-based methods, considered being possible and practical approach for ocean deep drilling projects, should be employed. With respect on the borehole method, hydraulic fracturing test or extended leak-off test (also be called micro-hydraulic fracturing test) will be suitable to obtain magnitudes of the minimum horizontal principal stress or/and the maximum horizontal principal stress, if the conceivable failure of borehole wall dose not result in that the operation of the tests become impracticable. In addition, the observation of borehole breakout, drilling induced tensile wall fracture can also provide important information. On the other hand, core-based methods such as anelastic strain recovery (ASR), differential strain curve analysis (DSCA), core discing etc. are possible methods to estimate the three-dimensional orientations and the ratios of three principal stress deviations or the ratios of three principal stresses.