In situ stress measurements in the vicinity of the Nojima fault by core-based methods

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In a cycle of repeating earthquake, the stress on the source fault and in its surroundings gradually accumulates during interseismic period and rapidly drops coseismically. However, the quantitative relationship between stress accumulation and earthquake occurrence has not been clarified yet. In order to elucidate the mechanism of earthquake occurrence, it is essential to grasp the stress state in the vicinity of the source fault and evaluate the change over time. There are roughly two types of rock stress measurements such as “in-situ measurements” and “core-based methods”. The former can measure rock stress with higher reliability because they are done under the in-situ stress condition, but there are also disadvantages that the difficulty of measurements and the cost rise as the depth increases. Therefore, by improving the reliability and accuracy of the relatively inexpensive and simple core methods, it is expected that they complement the results of in-situ stress measurements or replace the in-situ stress measurements. In our study, in order to contribute to the elucidation of the mechanism of the earthquake occurrence, we conducted stress measurements targeting the Nojima fault which caused the Hyogoken-Nanbu earthquake in 1995 and we obtained the current stress state near the Nojima fault. We measured stress state with two core-based methods, “Anelastic Strain Recovery method (ASR method)” and “Diametrical Core Deformation Analysis (DCDA)”. ASR method is a method to calculate stress based on the relation between stress and anelastic strain recovery of cores measured immediately after stress release. The method has the advantage that the stress can be evaluated in three dimensions. DCDA is a method of evaluating the direction of the two-dimensional principal stress and the differential stress by measuring the longer and shorter axis of the core’s cross section based on the assumption that the cross section deforms into an elliptical shape after stress releases. We can repeat measurements due to its non-destructive nature. In our study, we used granitic rock cores collected in Ogura, Awaji-city, Hyogo-prefecture, from the 2016 borehole excavation. We also discussed the temporal change of stress accumulation by comparing our results and the existing results of the hydraulic fracturing method conducted in the same region as this research within a few years after the earthquake occurred. The result shows that stress near by the Nojima fault has not accumulated yet from 22 years ago to now.

Keywords: steress measurement, core-based method, Anelastic Strain Recovery method, Diametrical Core Deformation Analysis

