

Re-examination of the Present Stress State of the Atera Fault System, Central Japan, Based on the Calibrated Crustal Stress Data of Hydraulic Fracturing Tests Obtained by Measuring the Tensile Strength of Rocks

Yamashita, F⁽¹⁾, Mizoguchi, K⁽²⁾, Fukuyama, E⁽¹⁾ and Omura, K⁽¹⁾

(1) National Research Institute for Earth Science and Disaster Prevention,
Tsukuba, Japan

email yamafuto@bosai.go.jp

(2) Central Research Institute of Electric Power Industry, Abiko, Japan

To investigate past faulting activity and the present physical state of intraplate faults in Japan, we re-examined the crustal stress measured by hydraulic fracturing tests (HFTs) incorporating the tensile strength of rocks. The tensile strength was measured by fracturing hollow cylindrical rock samples which were obtained close to the Atotsugawa, the Atera, and the Rokko-Awaji fault systems in central Japan, where in situ stress measurements had been conducted with HFTs. Prior to the main measurements, we checked the reliability and accuracy of this test by conducting similar experiments with the standard rock sample (Inada granite) whose physical property is well known. The measured tensile strength data reveal that the reopening pressure was obviously biased in the conventional HFT with a large compliance system. This means that the conventional HFT has under-estimated the maximum in situ horizontal stress. We re-estimated the reopening pressure using the measured tensile strength and re-calculated the in situ stress around the Atera fault system. We found that the normalized shear stress decreases towards the fault. Although the past long-term slip direction of the Atera fault system has been considered to be left-lateral from the geomorphological features, the re-estimated stress suggests that the present slip direction is right-lateral, a finding that is also supported by the present-day horizontal crustal deformation observed by triangulation and GPS surveys by Geographical Survey Institute in Japan. The amount of accumulated right-lateral dislocation estimated from the stress data using the dislocation model of Okada [1992] was 2.1 m. Because the current slip rate from the GPS survey is 1.9 ± 1.4 mm/yr, the accumulation period of the right-lateral dislocation becomes approximately 1100800 years if the slip rate is stable. This estimation suggests that during the latest earthquake the Atera fault system underwent right-lateral dislocation.