

Coseismic stress of ancient seismic fault of Median Tectonic Line at Mie Matsusaka, Japan

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Introduction

The frontal stress of propagating fault increases from initial state (τ_1) to peak state (τ_p), and stress will drop to residual level (τ_2) (Kanamori and Rivera., 2004). The value of these stress are still uncertain in natural fault. The calcite-twin piezometer (Sakaguchi et al., 2011), enables paleo-stress estimation in this process. We applied this method to Median Tectonic Line (MTL) at Mie Matsusaka, Japan. Extra high stress that concern with τ_p is expected at central part of fault zone. Low stress level will be appeared at area distance from fault center, and this may show τ_1 of the crust. Seismologic analysis revealed that the value of stress drop ($\tau_1 - \tau_2$) is several MPa in many fault, and the residual stress of τ_2 can be constrained from value of τ_1 of the crust. We propose an one case study of quantitative stress evaluation in natural fault.

Matsusaka-Iitaka core sample

The MTL, length of >1000km is a boundary between the Ryoke and Sanbagawa Belts. The drilling core sample of 600m in length was obtained for groundwater observation at Iitaka area, Mie Matsusaka. This hole penetrates the MTL at 473.9m in depth. This site is composed of the granite and crystalline schist, and some of Protomylonite and Ultramylonite are developed (Shigematsu et al., 2014). Many calcite veins are occurred in these fault zones, and twenty one of calcite bearing samples are measured to estimate ancient stress.

Results

As a result, the highest twin density of 340.28/mm was found at central part of the MTL at depth of 473.3m, and the lowest twin density of 142.4/mm was found at 242.65m in depth. In other parts, high calcite twin-density are found at the branch faults from MTL. The values of the calcite twin-density are 277.3/mm at 340.28 to 358.08m in depth and the 208.1/mm at 213.1 to 248.32m in depth. In particular, Twin density tends to remarkably raised, towards at central part of MTL around depth of 450~470m. The estimated paleo stress of the central part of MTL is approximately 490 (+/- 15) MPa, obtained from the calcite-twin density of 331.7/mm. This high stress may shows the τ_p of the MTL in this site. The lowest stress of 320 (+/- 15) MPa of this study was found at 242.65m in depth. Since this low stress was obtained around the branch fault, the value of τ_1 of the crust probably lower than 320 MPa.

Keywords: coseismic, Initial state, peak state, residual level, calcite twin piezometer, twin density