

Fission track analysis of NIED-Hirabayashi borehole core samples

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NIED drilled an 1838m borehole penetrating the Nojima Fault activated during the Hyogo-Ken Nanbu earthquake (M7.2, 1995). Three major fracture zones (FZ) were found along the core at about 1140, 1310 and 1800 m. The core sample consists mainly of the Cretaceous Ryoke granitic rocks that crop out widely on the eastern side of the fault. We performed fission-track (FT) age dating on the granitic samples around these fractures, in order to assess the amount of slip and the earthquake-related thermal anomalies. Results showed contrasting patterns of apatite and zircon FT ages, whose closure temperatures (T_c) are approximately 110 and 240 deg. C, respectively. Each of three FZs, recognized as the distribution of cataclastic rocks, has a width of 30 to 100 m along the core length. Samples were collected at different distances to the centre of the fractures. Eight samples were taken from around each FZ at 1140 m and 1300 m, and seven samples were collected from around the 1800 m FZ.

Clear discordance in zircon and apatite FT age was found at 2-sigma error level for two samples located at a couple of meters below the central part of FZs (CFZs) where the largest slip is expected because of the presence of pseudotachylyte and/or fault gouge. Asymmetric distribution was recognized in discordant ages in regard to CFZs. It is interpreted that these very local discordant ages reflect the thermal anomaly caused by secondary heating with a maximum temperature between zircon and apatite closure temperatures (i.e., approximately 110 and 240 deg. C) later than 48 Ma, based on zircon and apatite FT dating. As a source of the secondary heating, heat transfer or dispersion via geothermal fluid may have caused the similarity in asymmetric distribution of discordant FT ages at two different FZs. Other samples than these two showed concordant FT zircon and apatite ages at 1-sigma analytical error level. They indicate rapid cooling within the bounds of two closure temperatures of these minerals, and which may relate to the rapid uplifting at approximately 60 Ma of the Ryoke Granitic Rocks, which comprise the basement at Nojima-Hirabayashi.