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Relation of the Tsukiyoshi Fault and orientation distribution of microcracks in the borehole MIU-3 core in Mizunami City

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The orientation measurement of microcracks was performed using the borehole core penetrating a fault to clarify the relation of the microcrack distribution pattern near a fault. The studied borehole is MIU-3 drilled by Japan Atomic Energy Agency (JAEA). The MIU-3 borehole is 1014 m length and penetrates the Tsukiyoshi fault at the depth of 707 m. The host rock of the Tsukiyoshi Fault is the Late-Cretaceous Toki Granite. The Tsukiyoshi Fault trends E-W and dips about 70 degree to the south. The sense of shear is mainly reverse after the deposition of the Miocene Mizunami Group, although the evidence of normal and strike-slip was also reported based on the texture analysis of the fault rocks (Niizato, 2003).

Seven granite samples from the MIU-3 borehole were used for this study. Sampling depths are 496 m, 623 m, 662 m, 698 m, 755 m, 851 m and 996 m. Four samples from the hanging wall are course-grained granite, and three samples from the footwall are medium-grained granite. Attitude of microcracks developed in quartz grains in the granite are measured by the method of Vollbrecht et al. (1991), which is performed under the optical microscope with the universal stage using three perpendicular thin sections. The target of measurement is healed and sealed microcracks. Open microcracks are excluded from measurement because of the possibility of artificial formation during drilling.

From the occurrence of the microcracks, the formation of healed microcracks is probably prior to that of sealed microcracks. From the orientation measurement, the preferred orientations of the healed microcracks are subhorizontal to gentle dip and N-S strike with steep dip in all depths, and moderate dip except 496 m depth. As healed microcracks with moderate dip strikes E-W in 623 m depth and N-S in 662 m depth, their preferred strikes are different among the samples. The preferred orientations of the sealed microcracks are subhorizontal to gentle dip, N-S strike with steep dip and E-W to WNW-ESE strike with steep dip in most depths. The concentration of N-S and E-W strikes with moderate dip is also recognized in the samples of 698 m and 755m, which are located near the fault.

As described above, both healed and sealed microcracks with moderate dip appears near the fault. Moore and Lockner (1995) revealed the microcrack pattern from an experimental study to generate shear fracture in laboratory. The microcracks that were formed during the experiment are principally tensile cracks of which orientations reflect the local stress field: those formed prior to the nucleation of the fault are roughly parallel to the cylinder axis, whereas those generated in the process zone make angles averaging 30 degree to the overall fault strike (and 20 degree to the cylinder axis). The appearance of microcracks with moderate dip near the Tsukiyoshi Fault shows that the preferred orientation of microcracks near the natural fault is also different from that far from the fault. The zone of the sealed microcracks with moderate dip is thinner than that of the healed microcracks. The microscopic features show that the formation of the healed microcracks is prior to that of the sealed microcracks, so that the thicker zone of the healed microcracks with moderate dip was developed in the intact granite at the earlier stage of the faulting history, and thinner of the sealed microcracks was in the weak fault zone which has repeated rupturing and healing at the later.

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