Veinlet fault gouge and pseudotachylyte developed along the active Shimotsuburai fault and its implication for seismotectonics

Jeong Hwan Shin[1]; Aiming Lin[2]; Ken-ichi Kano[3]

[1] Shizuoka Univ.; [2] Graduate School,Shizuoka Univversity; [3] Faculty of Sci., Shizuoka Univ.

http://www.ipc.shizuoka.ac.jp/%7eslin/index.html

Veinlet cataclastic rocks such as fault gouge and crushing-origin pseudotachylyte occurred as both simple veins and complicated networks within fault zones are generated by rapid comminution and injection during seismic faulting and are therefore considered to record fossil earthquakes. Accordingly the study of such veinlet rocks can provide evidence of seismic faulting within seismogenic fault zones. In this study, we report a typical veinlet cataclstic rock involving crushing-origin pseudotachylyte and fault gouge veins developed in granitic rocks along the Shimotsuburai Fault of the Itoigawa-Shizuoka Tectonic Line and discuss the formation mechanisms.

The Shimotsuburai Fault is a main active thrust fault of the Itoigawa-Shizuoka Tectonic Line (ISTL), central Japan, extending for about 12 km with a strand of NNW-SSE, which is bounded by the Upper Pleistocene sediments in the east and the grantic cataclasite in the west. The trenching surveys reveal that the most recent seismic faulting event occurred in the period between 1550 and 2350 yr.B.P. with a displacement of 1-1.2 m along the main fault plane (Toda et al.,2000).

Veinlet fault gouge and pseudotachylyte are widely developed along the fault plane and within the fault-fracture zone of less than 10 m in width. Both the fault gouge and pseudotachylyte veins observed along the fault plane show a simple and linear geometric feature, generally ranging from a few millimeters to 5 centimeters in thickness. In contrast, the fault gouge and pseudotachylyte veins developed within fault-fracture zone are generally distributed in the fractures as complex networks, generally ranging from sub-millimeter to 1 cm with a maximum width of 3 cm. Locally, some network veins are cut and offset by newly-formed injection veins. This finding shows that the injection vein-forming events occurred repeatedly in the same fault zone. The fault gouge veins are bluish gray to dark bluish gray in color and the pseuotachylyte veins generally show a dark and aphanitic appearance with a sharp contact with the country rocks. Microstructurally, both the fault gouge and pseudotachylyte veins are composed of fine-grained clasts derived from the country grantic rocks. All the clasts show an angular outline. Powder X-ray diffraction analyses show that both the fault gouge and injection pseudotachylyte vein are characterized by crystalline materials similar to those of the country rocks involving cataclasite. The crystalline peaks indicate that these veins are mainly composed of quartz and feldspar as those of the country granitic rocks. The analytical results show that the main rock-forming minerals of vainlets fault gouge and pseudotachylyte are the same as that of the country cataclasites derived from the grantic rocks.

Based on the meso-micro structural features and powder X-ray diffraction analytical results, we conclude that i) the pseudotachylyte veins observed in this study are generated by crushing rather than melting, ii) the complex networks of fault gouge and pseudotachylyte veins developed within the fault-fracture zone repeatedly formed by rapid injection and fluidization of fine-grained clasts derived from the host grantic rocks during seismic faulting events along the active Shimotsuburai Fault of the Itoigawa-Shizuoka Tectonic Line. Our results show that the veinlet cataclasitic rocks are a kind of earthquake fossil formed within seismogenic fault zone.