Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS029-10 会場:104 時間:5 月 23 日 11:00-11:15

流動化したウルトラカタクラスティック脈に記録された地震すべり:下円井断層を例に
Seismic slip recorded in fluidized ultracataclastic veins: an example from the Shimotsuburai Fault, central Japan

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It is well known that large earthquakes occur repeatedly along pre-existing mature active faults and that the history of seismic slip may be recorded by the meso- and microstructures in fault rocks that form at all depths from the near-surface to deep levels within fault zones in the crust. It is possible, therefore, to gain an insight into the deformation process of seismic slip recorded in seismogenic fault zones by studying the macro- and microstructures, fabrics, physical properties, and chemical compositions of fault rocks exposed at the surface. In this study, we report typical fluidized ultracataclastic veins formed repeatedly along the active Shimotsuburai Fault of the Itoigawa?Shizuoka Tectonic Line (ISTL) active fault system.

Field investigations and meso-microstructural analyses reveal that multi-stage veinlet ultralcataclastic rocks, composed of aphanitic pseudotachylyte (Pt) and unconsolidated fault gouge and alluvial deposits, are widely developed within a fault shear zone (<5 m wide) as simple veins, breccias, and complex networks, along the Shimotsuburai Fault. Early veins are generally fractured and overprinted by younger veins, indicating that vein-forming events occurred repeatedly within the same fault zone. Microstructurally, both the Pt and fault gouge veins are characterized by a superfine- to fine-grained matrix and angular?subangular fragments ranging in size from sub-micron scale to several centimeters. Powder X-ray diffraction patterns show that the fault veins and injection veins of fault gouge and Pt are characterized by crystalline materials composed mainly of quartz and feldspar, similar to the host granitic cataclasites.

Based on the meso- and microstructural features of ultracataclastic veins and the results of powder X-ray diffraction analyses, we conclude that i) the Pt veins were generated mainly by crushing rather than melting, ii) multi-stage veinlet fault gouge and Pt formed repeatedly within the fault-fracture zone via the rapid fluidization and injection of superfine- to fine-grained materials derived from the host granitic rocks during seismic faulting events, and iii) veins of alluvial deposit formed by liquefaction associated with strong ground motion during large-magnitude earthquakes that occurred along the ISTL. The present results show that the fluidized ultracataclastic veins and alluvial deposit veins record paleoseismic faulting events that occurred within a seismogenic fault zone; consequently, these features are a type of earthquake fossil, as is melt-origin pseudotachylyte.

Reference:
Lin, A. (2011). Seismic slip recorded in the fluidized ultractaclastic veins formed along the coseismic shear zone during the 2008 Mw7.9 Wenchuan earthquake, Geology, in press.

Keywords: ultracataclastic veins, pseudotachylyte, earthquake fossil, fluidization, fault gouge, fault rocks