Deformation at the seismogenic zones in the upper sequence of Hidaka metamorphic belt, Nozuka & Rakko-gawa area, Hokkaido, Japan

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Many layer-parallel pseudotachylytes and related fault rocks occur within the middle tonalite in the Nozuka & Rakko-gawa River areas. Within these fault rocks, pressure solution and precipitation structures are particularly abundant. The spatial distribution and structural characteristics of these fault rocks preliminarily suggest that Nozuka & Rakko-gawa Rever areas may represent an ancient seismogenic or earthquake rupture areas in Hidaka crust. On the basis of field and microscopic observations and chemical analysis, we present an example of the nature and seguence of seismogenic slip and interseismic deformation. The following conclusions are reached:

(1) Most of the layer-parallel pseudotachylytes are preferentially located along ultramylonite zones and on their strong mylonitic foliation mainly composed of sheet silicates. This suggests that the pseudotachylyte-producing faults were initiated by clustering of the preceding thin plastic high-strain zones with strong preferred orientation of micas, as concluded in the other area by Shimada et al. (2004), Tanaka et al. (2004), and Toyoshima et al. (2004). The pseudotachylites show microtextures formed under melting-supercooling conditions. The bulk chemical composition of the pseudotachylytes is characterized by high FeO, MgO and low SiO_2, CaO, Na_2O contents and is close to that of host mylonitic rocks. These suggest that seismic slip and pseudotachylyte generation utilized the boundary surfaces of the mica-rich ultramylonites and their mica-rich layers were preferentially melted by frictional melting.

(2) Pressure solution-precipitation structures are characteristically abundant in the pseudotachylyte-producing fault zones. Their mode of occurrence indicates that seimic slip with pseudotachylyte generation and slow plastic deformation (pressure solution with precipitation) occurred alternatively and repeatedly in the same fault zones and fault surfaces.

(3) The pressure solution-precipitation caused concentration of immobile major elements (principally Fe, Mg, and Ti) and decrease of Si, Na, and K in the pseudotachylytes, forming pressure solution cleavages. Removed major elements (principally Si and K) have been precipitated as alkali feldspar and/or quartz veins filled micro cracks in the fault zones. These processes lead to increase in number of grain-to-grain contact and in real contact areas of the fault surfaces, resulting in healing of the fault zones. Pressure solution-precipitation is likely one of the principal deformation mechanisms for time-dependent strength recovery of fault zones during interseismic periods.