Deformation environment of the mylonite zone to the west of Shirakami Mountains, Northeast Japan

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The N-S striking ductile shear zone (Takahashi, 2001; Fujimoto and Yamamoto, 2010; Sakai et al., 2012) along the western coastline of southernmost Aomori Prefecture is developed in the Cretaceous Shirakamidake granitic body (Katada and Osawa, 1964). This mylonite zone is called Shirakamidake mylonite zone (Fujimoto and Yamamoto, 2010). In this presentation, (1) detailed occurrence and microstructures are described, and (2) deformation environment is estimated on the basis of crystallographic preferred orientation (CPO) pattern of recrystallized quartz grains in the mylonitic rocks.

(1) The mylonite zone extends N-S for ~2 km with a width of ~600 m. The center of the mylonite zone with a width of ~200 m consists of ultramylonite and locally cataclasite overprinting ultramylonite. The foliation of the mylonites strikes mainly N-S and dips 40-80° to the east. The lineation plunges at 30-70° to the northeast. Asymmetric deformation microstructures (e.g. asymmetric pressure shadow) indicate sinistral normal shear as Takahashi (2001) already described.

(2) We measured CPO and grain size of recrystallized quartz in two transects across the mylonite zone using SEM-EBSD method. As a result, most fine-grained ultramylonite in the central part of the mylonite zone in both transects show a random CPO pattern and mean grain size of recrystallized quartz is about 8.5 μm. Other samples apart from central part of the mylonite zone show a type I crossed girdles and Y-maximum CPO pattern and mean grain size of recrystallized quartz is 13.1-198 μm. The former suggests that the diffusion creep was the dominant deformation mechanism from mean grain size of recrystallized quartz and CPO pattern (Passchier and Trouw, 2005), whereas the latter suggests that the dislocation creep took place at 350-450 °C which is switching temperature from type I crossed girdles to Y-maximum (Takeshita, 1996). From mean grain size of the most fine-grained sample with clear CPO pattern and estimated deformation temperature (about 400 °C), the differential stress is about 87 MPa using paleo-piezometer (Stipp and Tullis, 2003), and the strain rate is about 10^{-10} s^{-1} using flow law for dislocation creep (Hirth et al, 2001). On the other hand, the diffusion creep took place locally about 70 m thick ultramylonite zone after the formation of entire mylonite zone deformed by dislocation creep, because differential stress (<10 MPa) is estimated during diffusion creep using flow laws for dislocation creep and diffusion creep (Coble, 1963). The mylonite zone was therefore deformed by dislocation creep at about 400 °C, and subsequently diffusion creep took place locally in a center of the shear zone. At shallower depth, brittle deformation took place to form cataclasite locally.

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