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Deformation processes along faults at cataclastic-plastic transition regions estimated from a natural shear zone

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A shear zone on the western side of the Hatagawa Fault Zone was described. Close association of cataclasite and ultramylonite is often observed. The mylonitic microstructures are often crushed along C' planes. The measurement of the recrystallized fraction of quartz and width of the crushed zone indicates that more strong fracture occurred where more strong plastic deformation occurred. Therefore, the deformation at cataclastic-plastic transition regions was expected in this shear zone. The plastic deformation was expected to occur during accumulation of the elastic strain that caused the fracture along the crushed zone. The further analysis will be examined, and the results will be compared with a physical model, to establish the generality of the conclusions.

Most of earthquakes in the continental crust are of shallow origin, which form a seismogenic zone. The mainshocks of the faults usually occur along the basement of this zone. The basement of the zone has been considered to correspond to cataclastic-plastic transition. The deformation processes under cataclastic-plastic transition, therefore, are of major significance in the understanding of earthquake. In the Abukuma granitoids on the western side of the Hatagawa fault zone in Northeast Japan , small-scale shear zones are locally and sporadically developed. Occurrences of brittlely and plastically deformed fault rocks are closely associated in these small shear zones. In this study, we will present detail descriptions of one of the outcrop, to constraint the deformation processes along faults at cataclastic-plastic transition regions.

The outcrop in this study is located along the Takase river. At the outcrop, two conspicuous NE-SW trending dextral shear zones occur in the granodiorite. Along one of the shear zone, sigmoidally shaped foliations and S-C' structures are developed, and the deformation gradually becomes stronger to the center of the zone (Shear zone A). The other shear zone contains a dark colored zone with sharp boundaries with surrounding rocks. The granodiorite at the NW side of the zone do not show any features of ductile deformation, whereas the deformation gradually becomes stronger to the dark colored zone at the SE side of the zone (Shear zone B).

In the shear zone A, the mylonitic microstructures are often crushed along C' planes. The rotation of the blocky fragment along the crushed zone is consistent with the sense of shear for the surrounding mylonite. The width of the crushed zone is sometimes tapered off. In the shear zone B, the dark colored zone consists of the cataclasite and ultramylonite, and the close association of these fault rocks is often observed. At the center of the dark colored zone, a crushed zone is developed, like as the shear zone A.

In the shear zone A, the recrystallized fraction of quartz (Xqz) and width of the crushed zone were measured along a crushed zone, to discuss the relationship between the plastic deformation and the brittle fracturing. This results in that the width of the crushed zone is wider where Xqz is larger: i.e. more strong fracture occurred where more strong plastic deformation occurred.

The close association of ultramylonite and cataclasite suggests the overprinting of the plastic deformation and the cataclastic deformation, indicating the deformation at cataclastic-plastic transition regions. Furthermore, the result of Xqz and width of the crushed zone suggests that the plastic deformation occurred during accumulation of the elastic strain that caused the fracture along the crushed zone. The further analysis of Xqz and width of the crushed zone will be examined, and the results will be compared with a physical model, to establish the generality of the conclusions.