Distribution of fault rocks in the deeper part of an intraplate fault and the earthquake

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The Hatagawa Fault Zone (HFZ) is exposed at the eastern margin of the Abukuma Mountains in NE Japan, and extends for approximately 100 km. The HFZ consists of three structural settings: mylonite zones with a sinistral sense of shear, a cataclasite zone, and small shear zones. We discuss the relationship between earthquake and plastic deformation based on the distribution of the cataclasite zone and the mylonite zones with a sinistral sense of shear along the HFZ.

A conspicuous cataclasite zone with a maximum width of 100 m extends continuously in the HFZ for at least 40 km. The mylonite zones with a sinistral sense of shear can be subdivided into two groups, one which deformed under approximately 300 ºC (Lower temperature mylonite) and one which deformed under approximately 400 ºC (Higher temperature mylonite). The lower temperature mylonite is exposed only for 6 km along the HFZ.

Plastic deformation in the lower temperature mylonite is generally heterogeneous. The strongly plastically deformed domains where the plastic deformation was localized are often crushed. The crush zones were sometimes plastically deformed again. The occurrences of brittle and plastic fault rocks are closely associated. Pseudotachylyte has sometimes been found in the lower temperature mylonite. The close association between brittle and plastic fault rocks is unusual in the higher temperature mylonite.

The K-Ar age of hornblende from the Kawabusa granodiorite which suffered the deformation of the higher temperature mylonite is 97.4+/-4.9 Ma (Kubo and Yamamoto, 1990). The K-Ar age of hornblende from an undeformed granodiorite porphyry dike intruding into cataclasite is 98.1+/-2.5 Ma (Tomita et al., 2002). These suggest that the duration of the fault activity was within the error of K-Ar ages.

The base of the seismogenic zone has been considered an area of brittle-plastic transition. The repetition of fracturing and plastic deformation indicates that the lower temperature mylonite in the HFZ was deformed at the base of the seismogenic zone and generates earthquake repetitiously.

The lower temperature mylonite is exposed in limited areas along the cataclasite zone. On the other hand, the cataclasite zone extends continuously in the HFZ for at least 40 km. The HFZ was formed in a geologically short duration. One possibility is that the propagation of the fracturing starts from the lower temperature mylonite resulted in the formation of the cataclasite zone. The HFZ may provide an insight for the generation and propagation of earthquakes, and the lower temperature mylonite would be of major significance in the generation of earthquakes. We need to examine this possibility as well as mechanically evaluation, so that we would understand the earthquake generation in the crust.