

# Structure of fault zone in the brittle-plastic transition zone of the continental crust: A case study of the Hatagawa Fault Zone

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Most of the inland large earthquakes occur at the base of the seismogenic zone (Sibson, 1982; 1984; Das and Scholz, 1983; USGS Staff, 1990; Nakamura and Ando, 1996). The base of the zone has been considered an area of brittle-plastic transition (Sibson, 1982; 1984). The deformation process in the brittle-plastic transition zone is, therefore, of major significance in understanding the generation of large earthquakes (e.g., Shimamoto, 1989; Scholz, 1990). To understand the relationship between the rock deformation and the occurrence of large inland earthquakes, exploring exhumed brittle-plastic fault zones is important. In this study, Occurrences of fault rocks were analyzed along an exhumed brittle-plastic fault zone in the Earth's crust, the Hatagawa Fault Zone (HFZ) of NE Japan.

A conspicuous cataclasite zone with a maximum width of 100 m extends continuously for at least 40 km along the HFZ, corresponding to a rupture size of an inland earthquake as large as M7. The cataclasite zone was formed at temperatures above 220 degree in Celsius, and its activity had terminated by 98.1 $\pm$ 2.5 Ma. Mylonite zones with a sinistral sense of shear are heterogeneously distributed over the entire 45 km length along the HFZ. The temperatures calculated by two-feldspar thermometry from most of the mylonite zones are above 360 degree in Celsius. On the other hand, there is a mylonite zone with a length along the HFZ of approximately 6 km where the temperatures calculated are below 360 degree in Celsius. Microstructures of the fault rocks in this zone indicate that the deformation condition was at the brittle-plastic transition.

The distribution of fault rocks along the HFZ suggests that only limited areas of the brittle-plastic transition were plastically deformed when the present exhumed level was in the brittle-plastic transition zone. Such heterogeneity of plastic deformation in the brittle-plastic transition zone can result in a significant stress concentration and the nucleation of large earthquakes. The cataclasite zone along the HFZ was possibly formed by the propagation of an earthquake nucleated in the brittle-plastic mylonite zone.