Development of the Median Tectonic Line fault zone, Mie Prefecture, southwest Japan: Processes of strain localization

*Toru Takeshita[1], Dong Van Bui[1], Jun-ichi Ando[2]

1. Department of Natural History Sciences, Graduate School of Science, Hokkaido University, 2. Department of Earth and Planetary Systems Science, Graduate School of Science, Hiroshima University

The Median Tectonic Line (MTL) sensu stricto is defined by the boundary fault between the Cretaceous high-P/T type Sambagawa metamorphic rocks and Cretaceous low-P/T type metamorphic rocks and granitoids, which was formed by large-scale normal faulting at c. 59 Ma (Kubota and Takeshita, 2008; Kubota et al., accepted for Tectonics). It is interesting to note however that the present MTL is originally formed in the Ryoke southern marginal shear (i.e. mylonite) zone up to a few km wide in Late Cretaceous (Hara et al., 1980), and therefore the strain becomes so much localized to form the very narrow MTL fault cataclasite and gouge zone at c. 59 Ma (Paleocene). We examined the development of the MTL mylonite zone, Mie Prefecture, southwest Japan, which originated from the Cretaceous Ryoke granitic rocks, in order to understand the development and strain localization during exhumation and cooling. The mylonitic rocks originated from two types of granitoids distributed in different areas at the north of the MTL: Areas A and B mostly consisting of protomylonite and mylonite originated from tonalite and granite, which are distributed from the distance of c. 0-300 m and 300-800 m from the MTL, respectively.

Microstructures and crystallographic preferred orientations (CPOs) of quartz and two feldspar geothermometry have been analyzed to infer the deformation conditions and a spatiotemporal distribution of these in the MTL mylonite zone. It has been found that in Area B mylonite can be divided into two mylonite zones showing the S-type and P-type quartz microstructures (Masuda and Fujimura, 1981; Masuda, 1982), which are created by subgrain rotation (SGR) and grain boundary migration (GMB) recrystallization, respectively. These mylonite zones are distributed from the distance of 300-490 m and 490-800 m from the MTL, respectively. The quartz c-axis CPOs dominantly show a medium-temperature Y-maxima pattern in both areas A and B, with some occurrences of a low-temperature type-I crossed girdle quartz c-axis CPO. K-feldspar in mylonites of Area B, which is accompanied by the formation of myrmekite, shows brittle and ductile deformation in mylonite with the S-type and P-type quartz microstructures, respectively.

The strain localization in the MTL mylonite zone during exhumation and cooling will be summarized below. Originally, the deformation of quartz occurred at high temperatures at 400-500 °C in a wide zone forming mylonite with the P-type quartz microstructure in Area B. However, the strain became localized into the southern part of Area B, where S-type quartz microstructure formed at 350-400 °C. Also, protomylonite formed at the similar temperature conditions in Area A. Below 350 °C, ductile deformation stopped in mylonite in Area B, which could be succeeded by ductile deformation in a very narrow zone up to 50 m wide forming ultramylonite in direct proximity to the MTL in area A, where a low-temperature type-I crossed girdle quartz c-axis CPO develops (Czertowicz et al., 2019). We interpret that the formation of ultramylonite in Area A (i.e. tonalite region) might be induced by the fluid percolation during brittle fracturing (Zibra et al., 2018), which tends to occur more easily in area A than area B, because the ductile strength is lower in the granite and tonalite at the same temperature. A large amount of white mica in the ultramylonite could suggest that such fluid percolation in fact pervasively occurred to form the ultramylonite in area A.

Keywords: Median Tectonic Line, mylonite, quartz c-axis CPO, dynamic recrystallization mechanism in quartz, strain localization, fluid percolation and formation of ultramylonite