Evolution of the Median Tectonic Line, Mie Prefecture, south-west Japan and implication for weakening in a large-scale fault zone: a tentative model

*Toru Takeshita[1], Shun Arai[1]

1.Department of Natural History Sciences, Graduate School of Science, Hokkaido University

The Median Tectonic Line (hereafter referred to as the MTL) extends from eastern Kyushu to the Kanto mountains, north-west of Tokyo, over 800 km throughout south-western Japan, and the largest scale tectonic line in Japan. Although the structural development of the MTL is complex, the proto-MTL, which was originally formed as a granitic mylonite belt in the Ryoke belt of the inner belt of southwest Japan, was formed when the Sambagawa metamorphic rocks in the outer belt of southwest Japan were exhumed and juxtaposed against the granitic mylonite belt in the Ryoke belt at 63-58 Ma (Ichinokawa phase). Therefore, the MTL was originated as a large-scale normal fault (e.g. Kubota and Takeshita, 2008).
In the eastern part of Mie prefecture, the MTL was not reactivated in the Quaternary period, and hence the proto-MTL is relatively well preserved. We have worked on the MTL in this area to elucidate structural development and weakening processes in a large-scale fault zone since 2014. As a result, we have found some preliminary new facts, which will be presented here. (1) In the study area (Tsukide district, Matsuzaka-city, Mie prefecture), the MTL consists of a few segments each of which trends east-west and dips north at moderate angles, and extends for 0.5 to 1 km. The eastern end of each normal fault segment is stepped to north by c. 70 m (fault jog), and the two fault segments separated by a jog could have been connected by a transfer fault. The upper plate of the MTL consists of cataclasite (i.e. fault core) of c. 70 m thick originated from granitic mylonite, and further overlain by fractured protomylonite (fault damage zone). It should be noted however thin anastomosing cataclasite zones are developed in the protomylonite. (3) Cataclasite was developed into foliated cataclasite with increasing displacement, and the cataclasite developed along the MTL contains clasts of ultramylonite (Jefferies et al., 2006). (4) In the fractured protomylonite, pulverized rocks, which could have been formed by rupture events at the time of earthquakes, have been found. Based on the observation mentioned above, we will discuss the structural development and associated weakening in the MTL fault zone below. The MTL was originally formed as east-west trending many short segments during large-scale normal faulting, which were linked with each other, and further developed into a wide cataclasite zone with increasing displacement. When the MTL was originally formed, the differential stresses were built up to the level expected from rock deformation experiments of intact rocks, generating ultramylonite. However, once cataclasite was formed by seismic faulting, fluids migrated into the MTL fault zone resulting in the formation of mica and clay minerals, which not only facilitated sliding along the MTL by lowering the coefficient of internal friction in rocks, but also operation of pressure solution creep. This series of processes significantly weakened rocks in the MTL fault zone. Textures in foliated cataclasite are very similar to those of weakly metamorphosed rocks (semi-schists), indicating dissolution and precipitation were dominant in these rocks. When the cataclasite zone was weakened, the stress buildup leading to the generation of earthquakes no longer occurred there, which results in the stress concentration in the surrounding rocks, where earthquakes occurred. The hypothesis that this series of processes is repeated in the MTL fault zone, resulting in the increase of thickness of the cataclasite zone can well explain the facts that ultramylonite clasts are contained in the cataclasite zone, and evidences for seismic faulting (i.e. pulverized rocks), which initiated the formation of cataclasite, are observed in the protomylonite in direct proximity to the cataclasite zone.

Keywords: Median Tectonic Line, weakening in a large-scale fault zone, cataclasite, pressure solution, pulverized rocks

