Summary of Doctoral Dissertation

Degree requested Doctor of Science Applicant's name Bui Van Dong

Title of Doctoral Dissertation

Development of the Median Tectonic Line fault zone, Mie Prefecture, southwest Japan:
Strain localization and softening

(西南日本、三重県の中央構造線断層帯の発展：歪の局所化と軟化)

The Median Tectonic Line (MTL) fault zone in Japan includes fault rocks that formed at different conditions of deformation. We examined the development of the MTL fault zone in Mie prefecture, central Japan, which originated from the Cretaceous Ryoke granitic rocks, in order to understand the development of fault rocks and architecture during exhumation. In the study area, the mylonitic rocks consist of two types of mylonitic rocks distributed in different areas at the north of the MTL. Area A mostly consists of protomylonite, which is up to c. 300 m wide from the MTL originated from tonalite and Area B which is up to c. 500 m wide and distributed further north, consists of mylonite which originated from granite. We use microstructures and crystallographic preferred orientations (CPOs) of quartz and microstructures of K-feldspar to constrain the deformation conditions and mechanisms and analyze a spatio-temporal distribution of these in the MTL fault zone, along with the Akaiwadani-River, western Mie prefecture.

Based on observed microstructures of quartz, it has been found that in Area B the mylonites consisting of recrystallized quartz grains with S-type microstructure created by subgrain rotation (SGR) recrystallization are distributed from the distance of 300 m to 490 m from the MTL, while those with P-type microstructure created by grain boundary migration (GMB) recrystallization are distributed from the distance of 490 m to 800 m from the MTL. In direct proximity to the MTL, Area A, protomylonite occurs, where recrystallized quartz grains are formed by SGR. The quartz c-axis CPOs dominantly show Y-maxima patterns in both areas A and B, however, some samples from the proto-mylonite in Area A show a type-I crossed girdle quartz c-axis fabric with R-maxima, and some of the S-type mylonites in Area B show a transitional quartz c-axis fabric between a Y-maximum and type-I crossed girdles. K-feldspar is abundant and strongly deformed in mylonite of Area B with dominant intergrowth of myrmekite. K-feldspar microstructure shows brittle deformation in S-type mylonite, whereas, in P-type mylonite, K-feldspar porphyroclasts show ductile deformation with an elongated ribbon or fish shape.

The deformation of quartz occurred at high temperatures around 500 ^{o}C in the wide zone forming P-type quartz microstructures and large recrystallized grain size (c. 100 μm) in Area B, which is inferred from two-feldspar geothermometry. However, the strain became localized during cooling of the granitic mylonites in the southern part of Area B, where S-type microstructures and smaller recrystallized grains of quartz (c. 20 μm) formed. Ductile deformation of quartz to form S-type microstructures is inferred to have occurred at 350 to 400 ^{o}C, based on two feldspar geothermometry. The strain localization occurred at different stress of ~100 MPa and strain rate of 10^{-16} s^{-1} at temperature conditions of c. 400 ^{o}C, which is inferred from the experimentally determined constitutive equation of quartz flow law. Below 350 ^{o}C, ductile deformation stopped in mylonites in Area B and only occurred in a very narrow zone up to 50 m wide forming ultramylonite in direct proximity to the MTL (the southernmost part of area A). This strain localization might have been caused by water weakening in quartz following incorporation of fluids into the present MTL locality.