Fault zone architecture and mass change associated with deformation and fluid flow

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Material budgets and its relation to fault zone architecture at brittle/ductile transition zone are investigated by using small plastic shear zones developed in Ryoke granitic rocks at Teshima, Kagawa pref. SW Japan. A ductile shear zone including large volume of Quartz has been studied in detail. This report presents fault zone architecture observed at an outcrop, mode of deformation and mass change based on the meso/micro structural observation and whole rock chemical analysis.

Fault zone architecture.

The minor ductile shear zone shows right lateral displacement. Both structures of perpendicular (YZ) and horizontal (XZ) direction can be observed (Fig.1). Fault rocks are classified into 4 types ; ultramylonite, mylonite, altered rock and cataclasite. It is clearly observed that two faults are partly overlapped, showing stepping structure (Fig.1). the rocks are apparently altered between the two faults.

Micro-structural observation.

In polished specimens and thin sections, quartz veins in the shear zone show ductile deformation and feldspars in granite surrounded by the veins show cataclastic flow caused by brittle deformation (Fig.2). While granites surrounded by the vein are elongated by mylonitization (Fig.2). These occurrence of fault rocks indicate that the shear zone is deformed at brittle-ductile transition zone and that a series of the deformation occurred at temperatures of between 300 degrees C and 500 degrees C (for example Voll, 1976;) in the presence of a fluid phase.

Whole rock chemistry.

In order to understand chemical changes during fluid-rock interaction associated with deformation, deformed and/or altered rock on the shear zone and protolith granite were sampled and analyzed by whole rock XRF method. Mass change was calculated by using isocon method (Fig.1) (Grant, 1986). Mylonites do not show mass change, cataclasites show moderate mass change, ultramylonite show large mass loss and altered rocks show various mass change (increase of 53 % to decrease of 68 %). These data indicate that stepped region is a most important place for mass transfer.

Mass transfer associated with fluid at the region of stepping along shear zone even at the brittle-ductile transition zone. It is clear that the protolith had become in homogeneous. If the fault zone was exhumed to the full brittle region, these heterogeneity is potentially a region of barrier for dynamic rupturing. Thus quantitative estimation of material budget within stepped region has fundamental importance for earthquake generation mechanism.

References

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