3D fault architecture along the Median Tectonic Line, eastern Kii Peninsula, SW Japan

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The heterogeneous fault deformation around the brittle-plastic transition possibly affects the fault behavior significantly including the generation of earthquakes (e.g., Scholtz, 2001). To understand the effect, a detailed fault zone architecture is essential. In this study we have tried to construct a 3D fault zone architecture model based on the geological study of an exhumed fault zone, the Median Tectonic Line (MTL) in the western Kii peninsula SW Japan.

Accurate positions were determiend by applying SfM (structure from motion) and MVS (multi-view stereo) calculation (e.g., Furukawa and Hernández, 2013) to photos taken by an UAV (Unmanned Aerial Vehicles), and GNSS (Global Navigation Satellite system) surveying (e.g., Bemis et al., 2014) to reveal the 3D structures. The microstructures, chemical composition of minerals and crystallographic orientations of quartz using an electron back-scatter diffraction (EBSD) (Prior, et al., 1998) were analyzed to characterize the defomation of fault rocks. Based on these deformation features, the 3D fault zone architcture were constructed using a 3D-CAD software.

In the 3D fault zone architecture model, the fault plane of the MTL (lithological boundary) is an almost perfect plane dipping to the North. The structures can be divided into two main structures. One includes mylonite and cataclasite showing sinistral sense of shear. The other structures consist of scaly cataclasite showing dextral sense of shear and further younger structures including the lithological bonadry. The later structures cut the former structures indicating the sequence of deformation within the fault zone.

Scaly cataclasite only apper in the vicinity of the MTL, and is characterized by the strong foliation defined by the alignment of chlorite. Modal fraction chlorite is much larger than that in the surrounding Ryoke drived rocks, and pressure-solution seam is well developed. The estimated temperature based on the chlorite geothermometry is about 300 ºC (Bourdelle et al., 2013).
The deformation of the structures showing sinistral sense of shear varies from mylonite deformed at temperature of about 450 ºC (Higher-T mylonite), that deformed at about 300 ºC (Lower-T mylonite) to cataclasite deformed at about 300 ºC, suggesnting these structures record the brittle-plastic transition. One conspicuous feature in these structures is an altanation zone of black cataclasite and ultramylonite. This zone is a narrow and planar zone with width of 10 m. The cataclasite in this zone is black colored and strongly foliated. The ultramylonite in this zone show almost ramdom CPO (crstallographic preffered orientation) of quartz. We consider that this zone was the fault core when the present exhumed level experienced the brittle-plastic transiton.

Keywords: Fault Zone Architecture, Brittle–Plastic transition, the Median Tectonic Line, Mylonite, Cataclasite

