The evolution of cataclastic rocks and their implication on the development of the Median Tectonic Line fault architecture, Japan

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The Median Tectonic Line (MTL) is a long-lived crustal scale fault that experienced a long history of movement. Beginning from the Late-Cretaceous period, the MTL has been an active strike slip fault, directly related to the formation of the mylonites in the southern marginal shear zone of the Ryoke granitoid belt (e.g. Hara et al., 1980) and was later superposed by cataclasite at the core region during exhumation. During the early Paleocene (c.60Ma), large scale north dipping normal faulting occurred which led to the juxtaposition of the Ryoke granitoids against the Sanbagawa metamorphic rocks. (Kubota & Takeshita, 2008)

Field observations in the Ryoke granitoids of the MTL fault zone in Mie Prefecture, SW Japan, show that the mylonitic rocks originated from two main protoliths namely tonalite and granite located at the southern and northern part respectively, both of which are extended in the E-W direction (Bui, 2019). We for the first time found that the two bodies were separated by a north dipping normal fault which we named Akaiwadani fault. The granitic body are mainly mylonites with bands of ultramylonites at the proximal region of the Akaiwadani fault. The tonalitic body mainly consists of protomylonite with bands of mesomylonites and also utramylonites at the core region of the MTL.

The purpose of our study is to characterise the types of cataclasites found in the MTL region and relate them to their deformation mechanism and conditions. Methods applied include SEM-EBSD analysis for quartz CPOs, XRD analysis for bulk mineralogy, and image analysis of microstructures were preformed. Analysis done includes shaped preferred orientations (SPOs), clast sizes, orientations, etc.

The cataclasites overprint the core region of both fault zones, evidenced by the occurrence of ultramylonite clasts. The cataclasites can be roughly divided into foliated and non-foliated ones. Non-foliated cataclasites only exist near the fault core of the MTL, whereas foliated cataclasites are found in abundance. All foliated cataclasites have a various degree of alteration to phyllosilicates, potentially indicating the degree of maturity, coinciding with the phyllonites described by Jefferies et. al (2006). XRD results indicate a significant drop in the percentage of K-feldspars in the Akaiwadani fault cataclasites and also a reduction of plagioclase in cataclasites of the MTL core zone. This may be contributed by the enhancement of fluid flow during cataclasis causing albitisation and pressure solution. We also first observed that some of the phyllonites have undergone poly-cataclasis. The SPO of clasts within a poly-cataclasites suggests that the smaller older clast (G_1) is randomly orientated whereas the larger younger clast (G_2) shows a stronger preferred orientation. This implies that the rock experienced multiple cycles of brittle deformation and consolidation during the prolonged fault movement.

Such study holds significance in characterising the spatiotemporal strain distributions in the MTL fault zone in relation to the changes in slip rate of the MTL. Phyllonites are found to formed with the presence of phyllosilicates as a result of pressure solution or alteration associated with the aseismic slip of the MTL. Such mechanism was first described by Spry (1969) as phyllosilicate creep and Niemeijer & Spiers (2005)

stated that phyllosilicate creep occurs with slow slip velocity <0.5 μms^{-1}. Moreover, the poly-cataclasites may potentially indicate the evidences of both generation of earthquake and phyllosilicate creep, which are associated with their respective palaeo-seismic and aseismic slip periods.

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Keywords: Median Tectonic Line, Phyllonites, Poly-cataclasites, Fault Architecture, Ryoke Granitoids, Multiphase deformation

