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Stress history along the Median Tectonic Line revealed by a borehole core

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Property of faults is changed depend on the physical condition. The Median Tectonic Line (MTL) is the Japan's largest onshore exposed fault, has a long history of displacement, and the fault rocks deformed under variable conditions are exposed at the surface. The analysis of the fault rocks of the MTL, therefore, helps to improve our understandings of variable fault behaviour depend on the physical conditions. It is necessary, however, to reveal the tectonic events which the fault rocks experienced, before we understand the physical processes at each condition.
The tectonic events which the core experienced were extracted by applying the multiple stress inverse method (Yamaji, 2000) to a borehole core penetrating the MTL (the Iitaka Ako core). Then the mineral assemblage along the fault planes was detected using the X-ray powder diffraction to reveal the temperature conditions for each tectonic event.
We obtained 62 fault lip data (foliations and lineations) from the Ryoke mylonite, and 217 fault slip data from the brittle fault within the borehole core. The fault slip data obtained from the Ryoke mylonite are very homogeneous and it is likely that the applying the multiple inverse method to the dataset which include both the cluster of very homogeneous fault slip data and the clusters of heterogeneous slip data cause a significant artifact. We therefore the calculations for the mylonite and the brittle faults were carried out separately.
Almost axial compression regime of stress state with ENE-WSW trending S_1axis (Stress A) was obtained from the Ryoke mylonite. This consistent with the previous interpretation where the mylonitization were occurred under the transpressional tectonics (Shimada et al., 1998).
Several clusters were recognized after applying the k-means clustering technique (Otsubo et al., 2 006) to the results of the multiple inverse method from the brittle faults, such as B: axial compression regime of stress state with N-S trending and 45°plunging S_1axis, C: axial compression regime with NE-SW trending S_1axis, and D: axial tension regime with more or less N-S trending S_1 axis. The overlapping of the striations on the fault planes indicates that the stress field was changed from C to D, and then to B.
In the Ryoke mylonite, quartz was plastically deformed, and some of them contain very fine muscovite and chlorite, indicating that those deformed above 300°C. On the other hand, the faults corresponding the stress state of B and D characteristically contain laumontite, suggesting the faulting at the temperature of 150-200°C.
We can summarize the followings. The fault rocks along the MTL deformed under the axial compression regime of stress state with ENE-WSW trending S_1axis at the temperature above 300 °C. After this deformation the fault rocks experienced axial compression regime of stress state with NE-SW trending S_1axis, then faulting occurred under the axial compression regime of stress state with N-S trending and 45°plunging S_1axis or axial tension regime with more or less N-S trending S_1axis at the temperature between 150-200°C.. These presumably constrain not only our understandings of variable fault behaviour depend on the physical conditions, but also the evolution of the Japan island.

Keywords: Median Tectonic Line, Fault, borehole core, stress inversion, altered minerals