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Kinematics of the mylonite controlled by the stress regime

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The kinematics of mylonite is usually discussed based on the orientation of foliations, lineations, and microstructural asymmetric structures in structural geology. The relationship between the kinematics of the mylonite and the stress field has not been quantitatively evaluated previously. In this study, we examine the relationship within the mylonite developed along the Median Tectonic Line, in the eastern Kii peninsula in Japan.

The Geological Survey of Japan, AIST (GSJ, AIST) recently constructed an integrated groundwater observatory close to the MTL in the eastern Kii peninsula in Japan, and borehole core sample which penetrates the MTL was obtained during the construction. We used the fault slip data acquired in this core sample for the analysis.

The orientation of the foliations and lineations in the mylonite is gradually changed towards the MTL. Foliations dip to NNE or NE and the lineations plunge shallowly to east in the region apart from the MTL. Foliations dip to NNW and lineations plunge ENE and some of the lineations plunge steeply to the direction from NE to east in the vicinity of the MTL. These suggest that sigmoidal shaped foliations are developed within the mylonite along the MTL, and shear strain gradually increase toward the center of the shear zone.

The stress inversion based on the orientations of the foliations and lineations in the mylonite yield the stress field where the maximum stress axis is oriented WSW and stress ratio (=(S2-S3)/(S1-S3)) is approximately 0.2. The calculated orientations of the resolved shear stress for the sigmoidal shaped foliations are almost parallel to the observed orientation of lineation, i.e. the kinematics of the mylonite is controlled by the stress regime.

It has long been believed that the mylonite along the MTL shows the sinistral sense of shear. This is the case in weakly deformed mylonite. However the stress regime during the mylonitization resulted in the steeply plunging lineations in the vicinity of the MTL, suggesting the considerable component of reverse fault along the MTL during the mylonitizaion. The kinematics of the mylonite controlled by the stress regime may also influence the stress accumulation for the earthquake generation.

Keywords: Kinematics, Stress regime, mylonite, resolved shear stress, the Median Tectonic Line