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# Fault Lubrication and Billow-like Wavy Folds in a Seismic Slip Plane of Nojima Fault Gouge: Rock Magnetic Perspective

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An earthquake can occur only if friction decreases rapidly as slip proceeds and the shear stress on its fault planes surpasses the frictional strength of faults, indicating frictional coefficients significantly decrease (0.7→0.1) in proportion to a displacement. High-velocity friction experiments have proposed thermal pressurization and fluidization as weakening mechanism of a frictional strength of faults, but few geological traces for this mechanism are left behind in a natural fault zone. Asymmetric folding and fluttering structures have been found in a natural fault zone, such as in Nojima active fault and in in Kodiak accretionary prism. In Nojima fault gouge, it is well known that there are billow-like wavy folds along slip planes, being similar to the pattern of Kelvin Helmholtz (KH)-instability which normally occurs in fluid. This instability generates at the interface between two fluids of different densities shearing at different velocities (Thorpe, 2005). Therefore, the presence of billow-like wavy folds in Nojima fault gouge suggests the fluidization of gauge materials. If a temperature range for the generation of such billow-like folds could be determined, one can give a constraint to the weakening mechanism of frictional strength of faults. Here I show rock magnetic studies to prove the temperature rise in the generation of billow-like folds in cohesive blackish gouges, using a custom-made scanning magneto-impedance magnetic microscope. The results showed the billow-like folds and the sharp slip zones experienced at least a 375 ℃ heating during its formation from the incohesive grayish gouges, because of the magnetite formation through thermal decomposition of siderite in the grayish gouge. The upper limit of temperature rises can be constrained as at maximum 800 ℃ by the preservation of microfold textures because high viscosity fluid, such as melt, can't generate a shear flow forming KH-instability. Based on these results, these two zones had been experienced a frictional heating (375 ℃ ~800 ℃). From the temperature condition and the one-dimensional diffusion model, I estimated the frictional coefficient of a fault zone in Nojima fault gouge is approached to be 0.02~0.04 during coseismic slip. These results indicate that thermal pressurization-induced fluidization occurred in the fault slip.