

野島断層ガウジの地震性すべり面にみられる磁化した波状褶曲: 摩擦熱による間隙水圧上昇の証拠

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Magnetic billow-like wavy folds in a seismic slip plane of Nojima fault gouge: evidence for thermal pressurization

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There is an enigma whether steadily creeping fault could trigger a big earthquake. Recent study suggests that a key mechanism would be an infiltration by hot geological fluids into fault zones, acting as a lubricant to occur a big slip. Therefore, it is very useful for a fault gouge as a fossilized slip zone to seek evidence of frictional heating associated with geological fluids in the fault zone. Nojima fault gouge is one of best materials with a laminated breccia of incohesive grayish gouges and cohesive blackish gouges, including a sharp slip zone, turbulent disordered textures and billow-like wavy folds. Our previous rock magnetic studies provide cohesive blackish gouges experienced at least a 400 degrees heating during its formation from the incohesive grayish gouges, because of the magnetite formation through thermal decomposition of siderite in the grayish gouge. Our scanning Magneto-Impedance magnetic microscope observation shows the billow-like wavy folds and sharp slip zone are strongly magnetized, indicating these two zones had been experienced a frictional heating (over 400 degrees). The billow-like wavy folds are very similar to Kelvin-Helmholtz (KH) instability pattern in nature. Conspicuous examples of KH-instability are the cloud-atmosphere interface, Jupiter and Saturn's atmosphere and cold-warm interface at the ocean current. This instability generated at the interface between two fluids of different densities shearing at different velocities (Thorpe 2005). Spectral analysis of square amplitude against wave numbers of wavy folds indicates a good correlation ($R^2=0.9$) with power law form. The index of the power law was -1.9, agreeing well with the previous results. This leads us to consider that our billow-like wavy folds were surely produced by KH-instability, suggesting that the cohesive blackish gouges deformed as fluids. The preservation of this KH texture suggests that a part of the blackish gouge mixed with hot fluids and a granular dense layer flew with a less dense layer at different velocity. This result suggests that shear-induced thermal turbulence in the fault gouge decrease a frictional strength along the billow-like wavy folds during earthquake slip dynamics. This provides the geological evidence for thermal pressurization. In this presentation, the X-ray computed tomography (CT)-based three dimensional analysis of our billow-like wavy folds in a slip zone will also be shown to determine slip orientation of the fault.