Characterizations of fault slip zones in Nojima fault gouge by scanning magnetic microscopes

Tomohiko Fukuzawa[2], *Norihiro Nakamura[1], Hirokuni Oda[4], Minoru Uehara[3], Hiroyuki Nagahama[2]

1. Institute for Excellence in Higher Education, Tohoku University, 2. Earth Science, Tohoku University, 3. CEREGE, France, 4. National Institute of Advanced Industrial Science and Technology

Microscopic billow-like wavy folds and frictional slip zones have been observed along slip planes of the Nojima active fault, southwest Japan. The folds are similar in form to Kelvin Helmholtz (KH)-instabilities occurring in fluids, which suggests that the slip zone underwent "lubrication" such as frictional melting or fluidization of fault gouge materials. Since the folds and frictional slip zones are consisted of fine-grained granular materials, the driving mechanism of faulting might be fluidization induced by fault rupture and frictional heating. If the temperature range for generation of the billow-like wavy folds and slip zones can be determined, we can constrain the physical properties of fault gouge materials during seismic slip. In this presentation, we report on rock magnetic studies that identify seismic slip zones associated with the folds and slip zones, and their temperature rises during ancient seismic slips of the Nojima active fault. Using a scanning magneto-impedance (MI) magnetic microscope and a scanning superconducting quantum interference device (SQUID) microscope (SSM), we observed that such folds and slip zones are magnetized. Our heating experiments suggested that this magnetization is due to the production of magnetite through thermal decomposition of antiferromagnetic or paramagnetic minerals in the gouge at temperatures over 350°C. Considering rock magnetic results and microtextural records with fluid mechanical method, the existence of KH-type billow-like wavy folds prefers the fluidization model to frictional melting, suggesting that the existence of such low viscosity fluid induced by fluidization and frictional heating decreased the frictional strength of the fault slip zone.