

New aspect on mechanism of electromagnetic anomaly associated with shear fracturing

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It is well known that the electromagnetic anomaly is often associated with large earthquake occurrence. However, the detailed mechanism on the occurrence anomaly has not yet been cleared.

Some electrical polarizations were observed in common saturated fine aggregates, such as fault gouge during the shear deformation test in laboratory (Nakagawa et al., 2004). This phenomenon is called SIP (Shear-induced Polarization). The SIP can be interpreted in terms of physicochemical interaction between fine particle and interstitial water through the electric double layer. The SIP, however, was not detected in the remolded clay for handicraft-use which may be treated with some non-dipole oil. We knew that an electric disequilibrium was induced between at surface of clay mineral and pore fluid by applied shearing stress. It is a very interesting topic whether a change of electrical potential accompanying with the shear deformation can be detectable or not in practice. Some experimental studies were made in order to verify this topic.

A plane strain test under undrained condition was carried out. The sample was prepared by salt water and consolidated one dimensionally. The reference potential is of an electrode embedded at center of the sample. Level of the potential induced is enough to detect and indicates positive for sense from compression to tension fields relatively. It is hypothesized that breaking the inter-particle bonding by deformation upset an electric equilibrium near the particle contacts and releases cations into pore water.

We applied the phenomenon obtained from the laboratory to the field for investigation on the electrostatics during the fault sliding. Three dynamically active sites were selected for the measurements of self potential. Those sites are in the Atotsugawa active fault at Kamioka mine, Central Japan, the Busuno landslide block in Niigata Prefecture, Northeast Japan and the Nuta-Yohne landslide block in Kohchi Prefecture, Southwest Japan. Several tens carbon electrodes of 40cm in length and 13mm in diameter were buried at depth of 2 or 3m at each site. In many cases, the precipitations gave rapid changes of self potential. General features of the self potential variation with time recorded were similar to the variation of land slide displacement. The senses of self potential generated in field can be explained by the physicochemical hypothesis established at the laboratory as mentioned above.