Mechanical properties on gouge and physicochemical process of shear-induced potential (SIP)

Koichi Nakagawa[1]

[1] Graduate School of Sci., Osaka City Univ.

The electrical conductivity of both the pore water and composite clay-water-electrolyte system could be measured. The variations measured would provide information to interpret the changes in the physicochemical properties of the system. The variations in shear wave velocity and conductivity during consolidation of some clays and gouges were consistent. They suggest that the application of an increment of stress to the sample causes a structural breakdown and also that the continuous stress results in a time-dependant development of structure, with changes in mechanical properties that cannot be accounted for by increased density alone. Chemical changes within the pore water are reflected by changes in the electrical conductivity with time.

On the other hand, a plane strain shear test under undrained condition was carried out. The sample was prepared with 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. This phenomenon is called SIP (Shear-induced Polarization). The SIP can be interpreted in terms of physicochemical interaction between the surface of fine particle and interstitial water through the electric double layer. The SIP, however, could not be detected in the remolded clay for handicraft-use which might be treated with some non-dipole oil. We think that an electric disequilibrium is induced between the surface of clay grain and pore fluid by applied shearing stress. It is hypothesized that breaking the inter-particle bonding by deformation upset an electric equilibrium near the particle contacts and releases cations into free pore water.

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. 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.