Development of 3D self-potential tomography and electro-kinetic effects

*ayaka ishikawa[1], Katsumi Hattori[1]

1. chiba university

Visualization of the dynamics of underground fluid is important to investigate geothermal resources and study earthquake generation physics. Conventionally, potential as a resource and physical characteristics of the epicenter have been estimated and interpreted using snapshots from MT and electrical exploration. If a dynamic image of underground flow could be visualized, its understanding would be further advanced. Therefore, in this paper, we tried to visualize underground flow by constructing three-dimensional self-potential tomography using sandbox experiments. Specifically, we have constructed a three-dimensional self-potential tomography algorithm for numerical simulation of self-potential generation due to groundwater flow (electro-kinetic effect) and for estimation of groundwater dynamics (pressure head and direction of water flow) using self-potentials. It was also verified by actual experiments of water injection. In the water injection experiment, the box was filled with homogeneous sand and water was injected from the lower part of the tank on the one side, which is simulating the groundwater flow. The parameters of the sand in the box, such as the permeability coefficient and the interface conductivity coefficient, were measured in another experiment, and are constant in the box. So, realistic values are used.
First, the reconstruction results of pore water pressure (pressure head) and water flow from the self-potential changes by the numerical simulation of the injection experiment and those by the reconstruction using the developed tomography are consistent. It suggests that the developed tomographic algorithm are confirmed effective. Furthermore, the dynamics of underground flow were investigated by applying the developed algorithm to the actual experimental data. Details will be shown in the presentation.

