Estimation of the porosity and permeability structure of Niigata Basin: evaluation of fault and tension fracture plane effects

Yasutaka Aizawa[1]; Toshihiko Shimamoto[2]; Kenta Kobayashi[3]

[1] Dept. of Geol. &Mineral., Graduate School of Science, Kyoto Univ.; [2] Dept. of Geol. & Mineral., Graduate School of Science, Kyoto Univ.; [3] Grad. Sch. Sci. & Tech., Niigata Univ.

Porosity, permeability and storativity are important indices of behavior of fluid flow in underground. These data help to estimate geological isolation of radioactive wastes and underground disposal of CO2. Because crustal movement and earthquakes often occur in mobile belt zone, such as Japan, there are complex geological structures there. For example, faults and fractures, and so on. It is possible that they are also essential factors which have to consider. Consequently clarifying geologically and hydraulically underground structure contribute to environment issues.

The subject of my study is the sediments of the Cenozoic in Niigata Prefecture. As there are oil and natural gas fields in that place, many people conducted into the geological features and physical loggings, and the like. The best of strong point is that we can compare the data of the indoor experiment with those of the field survey. Therefore we can evaluate whether they enable to reappear the natural phenomena in a laboratory.

We used samples which formed the various rocks into column. Their diameter is about 20 mm and length is 10 to 20 mm. In case of the soft sediment and fault gouge, we shaped column by copper tubes. We measured porosity and permeability as a function of confining pressure from 5.0 to 120.0 MPa using the intra vessel apparatus at Graduate School of Science, Kyoto University. For porosity, we found value by the Boyle's low. At first, pores of sample are filled with pore fluid and confining pressure is changed from 3.0 to 120.0 MPa. At that time, pressure and pore volume of sample are changed, and we measure porosity from the connection with them. For permeability, we used the constant flow rate method which we did volume of nitrogen gas flow per minute from the one side through the other. And we study a presumption of the storativity, an effect of anisotropy, observation of sample, a thin section, a grain size distribution before and after experiment, and others.

The porosity was indicated that the older formation was lower than the newer under each confining pressure. Porosity was influenced by time than facies. But igneous rocks were not depended on time. There is hysterics between porosity and confining pressure.

Permeability was shown that generally the older samples were indicated lower. Compared with the same age, the kinds of the low value were mud stones, igneous rocks and chemical rocks. On the contrary, the rocks of high were sandstones, rock with fractures and broken sandstones in crush zone. Considering only the effects of time-dependent compaction, permeability of Shiiya and Nishiyama formations of the Pliocene were a little high. Permeability decreased with increasing confining pressure and during decompression it did not fully recover to the value at the start of experiment. There was permanent strain of the sample left and hysterics like porosity.

In this meeting, we will expand new data about porosity, fluid flow along fault zone and tension fracture plane and report synthetic porosity and permeability structure more.