Simulation of permeability and porosity with impacts of anisotropy, consolidation and fault zone in Niigata Basin

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What is important in geological disposal is to estimate the safety assessment for maintenance of waste materials in underground. We have been studying the evaluation based on field observation in Niigata Basin and experimental approach (Aizawa et al., 2004; Aizawa and Shimamoto, 2005).

In this presentation, I would like to report new permeability and porosity data about the Teradomari Formation which is the Middle to Later Miocene sediment and simulation of fluid transmigration in Niigata Basin by software (SIGMA-2D; Simulator for Integration of Generation, Migration, and Accumulation of Oil and Gas created by Mizuho Information and Research Institute, Inc.) for basin analysis.

Measurements of permeability and porosity as to siltstone in the Teradomari Formation have never been done so far. In the beginning, I collected samples of siltstone from an outcrop where was located in the southern bank of the Ohkouzu Canal, Nozumi, Teradomari town (Nagaoka city at present). The outcrop was identified as one of the type localities of Niigata standard stratigraphical division. It was mainly composed of dark gray mudstone with parallel lamina, alternation of sandstone and siltstone. The hydraulic anisotropy of rock caused by sedimentation needs to be examined in detail. In order to investigate the effect of anisotropy on rock permeability, specimens cored parallel to and perpendicular to bedding for siltstone. All tests were performed by Intra Vessel Deformation and Fluid-flow Apparatus (IVA) designed by Toshihiko Shimamoto (Shimamoto, 2003).Pressure-permeability relationships were measured across a range of confining pressures (3-65-5-120-3 MPa). I assume that 65 MPa is identical with pressure at about 4 km in depth where the Teradomari Formation was most deeply buried. Besides pore pressure was changed four times from 0.5 to 1.8 MPa at each confining pressure. The permeability data more than 100 were obtained from one sample. Porosity data were measured in the same way as Aizawa et al. (2004), which it was that confining pressure was gradually shifted from 5-120-5 MPa.

The results in permeability of sample cored perpendicular and parallel to bedding indicated over a range of 2.00∗10ˆ-16-5.39∗10ˆ-18 [mˆ2] and 4.23∗10ˆ-15-2.30∗10ˆ-16 [mˆ2], respectively. And the permeability was a function of confining pressure, both of them decreased monotonously with increment in confining pressure. Compared with the same confining pressure, permeability in the direction of parallel to bedding was more than 10-fold that of perpendicular. Therefore it is inferred from the result that flow transmigration in underground depends heavily on parallel flow to bedding. The porosity data showed 29.2 to 22.2%, which was quite similar to them (23.3-%) of a quoted matter (Hoshino et al,. 2001). The value linearly changed with increase and decrease in confining pressure.

We would obtain more permeability and porosity data and report the analysis result of fluid transmigration in Niigata Basin by SIGMA-2D.

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