

Laboratory test based estimation of permeability and porosity in Neogene sedimentary basin at Horonobe, northern Hokkaido, Japan

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Deep underground has been brought to attention as a site of geological deposit of high/low-level radioactive waste or CO². It is obviously important to evaluate the distribution of hydraulic properties such as permeability or porosity in deep part of sedimentary basin for these usages. However, it is still big issue to evaluate the hydraulic properties of underground sedimentary rock including faults and fractures, and therefore researches relating to methods for the evaluation are necessary. We operated gas permeability and porosity measurements by laboratory test under high pressure (up to 100 MPa) of Neogene and Quaternary sedimentary rock specimens from Horonobe area, northern Hokkaido island, Japan (Yuchi Formation sandstone, Koetoi Formation diatomaceous mudstone, and Wakkanai Formation shale). We then estimated permeability and porosity profiles in these formations as a function of depth based on the laboratory test results, and compared the profiles with the results of in situ hydraulic tests at boreholes operated by Japan Atomic Energy Agency.

The permeability values estimated from laboratory test results of intact Koetoi Formation specimen at the depth down to 400 m distribute among the range between 1e-10 and 1e-8 m/sec, and the permeability values from the test results of Koetoi Formation fault breccia specimens are one to two order larger than those of the intact specimens. The results of in situ hydraulic tests at Koetoi Formation locate in the permeability range of the values from the intact rock specimens, except that several measured permeability values of tests operated at the depth above 200 m are higher than 1e-8 m/sec. Even these high permeability values from the in situ tests are in the range of the results from laboratory tests including fault breccia specimens.

The permeability values from laboratory tests of Wakkanai Formation are in the range between 1e-11 to 1e-9 m/sec for intact specimens, and in the range between 1e-7 to 1e-5 m/sec for fault breccia specimens at the depth down to 1000 m. The permeability values measured by the in situ tests at Wakkanai Formation distribute in the wider range than the test results of Koetoi Formation, but in general are in the range of the results from the laboratory test results.

The results of this study support the possibility to estimate permeability range of sedimentary rock in depth of several hundreds m to a few km by using laboratory tests.

References

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