

Depth dependency on fracture permeability in Neogene sedimentary basin at Horonobe, Hokkaido, Japan

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How effectively do faults and fractures in mudstone act as flow paths in underground condition? This is one of key questions when we evaluate an ability of mudstone as a barrier against fluid flow in depth. In the case of Neogene mudstone, the permeability of a fracture is close to that of a intact part under some depth because of closure of the aperture under normal stress. The depth dependency on a permeability of a fracture in mudstone is important issue, but there are few studies about a quantitative estimation of this property of mudstone.

We operated laboratory permeability measurements with Neogene mudstone specimens in order to approach this issue. We collected rock samples of Koetoi Formation diatomaceous mudstone and Wakkanai Formation shale at Horonobe area, northern Hokkaido island, Japan. Japan Atomic Energy Agency (JAEA) has operated twelve drillings of the length of several hundreds m to 1 km, and we collected samples from the drilling cores. We prepared specimens with a saw-cut discontinuity, simulating a fracture in rock, and measured permeability in the direction parallel to the discontinuity under hydrostatic stress condition up to 80 MPa.

The measured permeability of a specimen with a saw-cut discontinuity fracture was larger than that of an intact specimen when confining pressure is less than 1 MPa (comparable to the depth of approximately 150 m) in the case of Koetoi Formation, but, when confining pressure is 1 MPa or more, the permeability values of a saw-cut specimen and an intact specimen became a similar to each other. On the other hand, in the case of Wakkanai Formation, the confining pressure under which the permeability of a saw-cut specimen became similar to the permeability of an intact specimen was close to 80 MPa (comparable to the depth of several km). The stress under which a fracture does not work effectively as a flow path is probably related to mechanical properties of the rock. We will attempt to investigate the mechanism of the depth dependency of a fracture permeability of mudstone.