Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

U004-P09 Room: Convention Hall Time: May 24 17:15-18:45

Numerical Model Analysis of Fracture Flow Using X-ray CT Data

Noriaki Watanabe[1*], Yutaka Ohsaki[2], Yoshihiro Tsuchiya[3], Tetsuya Tamagawa[2], Nobuo Hirano[1], Hiroshi Okabe[3], Noriyoshi Tsuchiya[1]

[1]Environmental Studies, Tohoku Univ., [2]JAPEX, [3]JOGMEC

A three dimensional numerical modeling coupled with X-ray Computed Tomography (CT) for fracture flow was applied to fractured granite core samples. One of the samples had an artificial single fracture, and the others had natural multiple fractures. A relationship between CT value and fracture aperture (fracture aperture calibration curve) was obtained by X-ray CT scanning for a fracture aperture calibration standard with varying the aperture from 0.1 to 0.5 mm. As a result, a linear relationship was obtained between CT value and fracture aperture. With the fracture aperture calibration curve, three dimensional distributions of CT values of the samples were converted into fracture aperture distributions to obtain fracture models of the samples. Porosities of the fracture models could provide good agreement with experimentally determined porosities for all the samples. By using the fracture models, a fluid flow simulation was also performed with a local cubic law-based fracture flow model. Numerical permeabilities by the flow simulation were much higher than experimentally determined permeabilities of the samples. It was however possible to match the numerical permeabilities with the experimental permeabilities for all the samples, by using a unique modification coefficient of 0.5 for the fracture aperture in the fracture flow model. With the modified flow model, it was possible to obtain detailed information of heterogeneities in fracture flow as well as permeabilities of the samples. Although the present X-ray CT scanning was performed at room temperature and pressure, it was expected that the numerical modeling had possibility to provide insights into heterogeneous nature of fracture flow in subsurface fracture systems, such as channeling, as well as porosity and permeability, when the CT scanning was performed at in-situ conditions.

Keywords: Numerical model analysis, Fracture flow, X-ray CT, Rock core, Permeability, Porosity