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Title/Affiliation
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Specialized Field
Environmental Geomechanics

Research Subject
Development of technologies utilizing the earth crust for the conservation of the global environment

Objectives:
Sakaguchi aims to develop technologies utilizing the earth crust for the conservation of the global environment in fields of geological disposal of high-level radioactive waste and development of clean energy such as geothermal energy and natural gas. For that purpose, Sakaguchi investigates mechanical and hydraulic properties of a fracture and develops methods both for measuring in situ stress at great depth with high precision.

Results:
(1) Study of mechanical properties of a fracture
A tensile fracture of about 1 m in length was created by indenting wedges in a block of granite, and the heights of the two fracture surfaces were measured using a large, non-contact surface profile measurement system with a laser profilometer to determine the aperture distribution of the fracture. Based on the measured data, the frequency characteristics of the asperity heights, the initial aperture, and the size effect on the statistical properties were analyzed. The results can be summarized as follows:

1. The relation between the power spectral density of the fracture surface and the spatial frequency shows linearity on a log-log plot and thus the fracture surfaces can be assumed to be fractal object. On the other hand, the power spectral of the initial aperture becomes almost constant for wavelengths greater than about 100 mm. Thus, the matedness between the two surfaces of a fracture of 1 m monotonously increases with wavelength.

2. The standard deviation of the initial aperture increases with fracture size until the fracture size is about 200 mm, beyond which the standard deviation is almost independent of the fracture size. On the other hand, the mean initial aperture still increases when the fracture size exceeds 200 mm, since the initial aperture depends on the minimum value of the aperture, which decreases with the number of data points.

(2) Study of the hydraulic properties of a fracture
A shear-flow test under constant normal stress to clarify anisotropic and heterogeneous water flow of a rock fracture was carried out using a true triaxial compression test apparatus. The main results in this study can be summarized as follows:

1. The hydraulic conductivity in rock fracture shows remarkable anisotropy and heterogeneity with increase of shear displacement due to the formation of both channels and ridges. This anisotropy becomes more remarkable with shear displacement. However, hydraulic conductivity of whole flow area is not
influenced by this anisotropy.

2. Spatial distribution of the aperture during shearing plays an important role in anisotropy of hydraulic conductivity of the fracture.

3. In this study, the hydraulic aperture $e_h$ is almost constant until the shear displacement is 13.4 mm, and decreases dramatically when the shear displacement exceeds 13.4 mm. It was considered that water flow was inhibited since contact stations of the aperture are enlarged and localized as shear displacement increases. Moreover, it was clarified that an accumulation of gouge which was produced by shearing becomes an important factor of dramatic decrease of hydraulic conductivity.

**Publications:**

**Journals:**


**Symposium Participations:**

