Abstract

The objective of this study is to experimentally determine the effect of elevated temperatures on the compressive strengths and elasticity of Tak granite, and on the shear strength of granite fractures. The compressive strengths of the rock are determined under the constant confining stresses of 0, 3, 7, to 12 MPa by using a polyaxial load frame. The specimens are prepared to obtain rectangular block specimens with nominal dimensions of 5×5×10 cm^3. The testing temperatures are varied from 273 to 773 K (0-500°C). The results indicate that the uniaxial compressive strength and Brazilian tensile strength decrease with increasing temperatures which can be best described by power equations. The triaxial test results suggest that the cohesion decreases as the temperature increases while the internal friction angle tends to be independent of the temperature. The elastic modulus also decreases with increasing temperature. The rock strength can be well described in terms of the distortional strain energy density as a function of the mean strain energy density at failure for various temperatures and confining pressures.

To determine the effects of the elevated temperatures on the shearing resistance of the granite fractures, the triaxial shear tests are performed. The effects of temperature are determined for the peak shear strengths of tension-induced fractures and smooth surfaces are determined. The polyaxial load frame applies confining (lateral) stresses while the axial stress is increased. The axial load is applied at the rate of 1 MPa/s until a total displacement of 2 mm is reached. The specimens have nominal dimensions of 5.0×5.0×8.7 cm^3 and the fracture area of 5×10 cm^2. The normal of fracture plane makes an angle of 60° with the axial (major principal) stress. The testing temperatures range from 30°C (ambient temperature), 100°C, 300°C to 500°C with confining stresses from 1, 3, 7, 12 to 18 MPa. The results clearly show the thermal effect on the friction resistance of granite fractures. For rough fracture surfaces the higher the temperatures can lower the shear strength. This can be seen also from the reductions of the friction angle and cohesion with increasing temperature. The proposed exponential equation can be used to predict the friction resistances of the fractures under temperatures within the range tested here. The shear strength of smooth surface tends to increase with temperature particularly above 100°C. This may be due to stick-slip phenomenon. More testing is needed to assess the effects of facture roughness and mineral compositions on the fracture shear strength.