

Influence of temperature on the fracture toughness of several rocks

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Abstract

This paper aims to analyse the variability of the fracture toughness of rocks with temperature, which implies a critical parameter for rock fracture prediction and assessment methodologies. Four types of rocks with different characteristics and lithologies have been chosen with this purpose: the Floresta Sandstone, the Moleano Limestone, the Macael Marble and the Carrara Marble.

The research is based on the results obtained in an exhaustive, systematic and rigorous experimental programme comprising 48 notched specimens tested in four-point bending conditions both at room temperature and at 250°C, being this latter temperature quite common in high enthalpy geothermal applications. All the test specimens consist of parallelepiped pieces with a U-shaped notch located in the middle. These notches have a radius of 0.15 mm, which make it possible to assume that they behave as cracks rather than as notches. Based on this assertion, the performed tests allow calculating the fracture toughness with reasonable accuracy.

Rock attributes like low- and high-porosity, grain size and microstructure, together with the temperature, show a direct influence on the mechanical behaviour of geological materials. For this reason, changes in their behaviour are studied in this work through the deviations in the already mentioned key parameter: the fracture toughness.