



Evaluation of the brittleness of the rocks using various brittleness indices

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In general, the rock has the feature of drastically reduced bearing capacity during the small strain by the brittle characteristic. Because brittleness is considered as both of inherent property and behavior of materials, various brittleness indices have been proposed and based on these the brittleness degrees of the rock are determined. The brittleness indices are used for evaluating the stability of brittle failure in deep mines or underground excavations, drillability evaluation in the well drilling field, sawability evaluation in the building stone field and others. In recent years there has been utilized as a descriptor of the hydraulic fracturing in shale gas and enhanced geothermal system.

In this paper, we estimated the brittleness index of different types of rocks using various brittleness indices proposed by previous researchers and investigated their relationship and applicability. The commonly used brittleness index in Rock Mechanics is the ratio between uniaxial compressive strength and tensile strength. In Reservoir Geomechanics, the indices using dynamic elastic modulus and Poisson's ratio calculated from well logging data are generally used. In higher brittleness or brittleness index, the rock shows the following characteristics; low values of elongation of grains, fracture failure, formation of fines and debris, a higher ratio of compressive to tensile strength, higher resilience, higher internal friction angle, formation of cracks in indentation, easy to fracture etc.. The brittleness index showed relatively good relations with rock intrinsic properties such as uniaxial compressive strength, elastic modulus and fracture toughness in particular rock types. The correlation among brittleness index using geophysical logging data was shown. However, it was difficult to find a relationship of the brittleness indices between uses in traditional Rock Mechanics and Reservoir Geomechanics. Since some brittleness indices have no special meaning, a careful attention should be taken when we use them and it was found that the use of different brittleness indices is preferred for the purposes.