

Fracture Toughness and Brittleness of the Mancos Shale, Utah.

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Fracture toughness is a measure of a material's resistance to dynamic crack propagation. For linear elastic materials it is defined by the critical stress intensity factor, K_{Ic} , beyond which catastrophic crack growth occurs. For materials which deviate from linear elasticity, cyclic loading of the specimen can be used to calculate the brittleness corrected Fracture toughness, K_{Ic}^c .

Fracture Toughness is an important control in the hydraulic fracturing of Gas-Shales, which have become a topic of interest since the US Shale Gas "Revolution". The mechanical properties of Shales remain poorly constrained, with a wide range of reported property values. There is an extreme paucity of published data on the fracture toughness of soft sediments such as shales.

K_{Ic}^c values and a variety of supporting measurements have been made for the Mancos Shale in the three principle Mode-I crack orientations using a modified Short-Rod sample geometry. A very substantial anisotropy is observed in the loading curves and K_{Ic}^c values for the three crack orientations (*Arrester, Divider and Short-Transverse*). The measured brittleness correction factor for Mancos Shales are higher than for any other rocks we have found in the literature, implying that the material is extremely non-linear.