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, $K_{Ic}^\nu$.

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.

$K_{Ic}^\nu$ 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 $K_{Ic}^\nu$ 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.