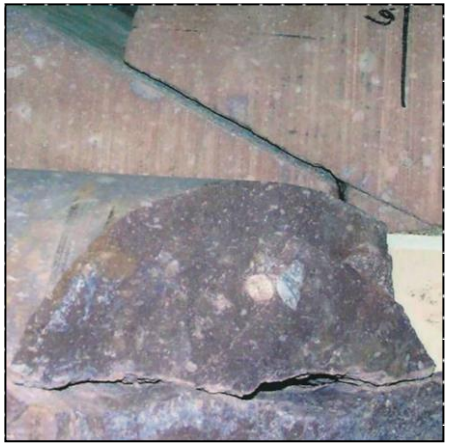
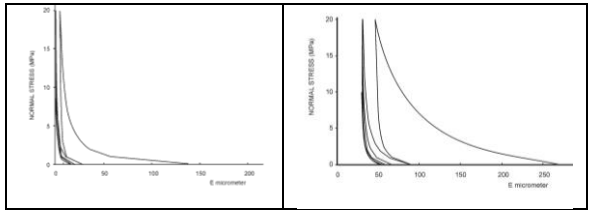
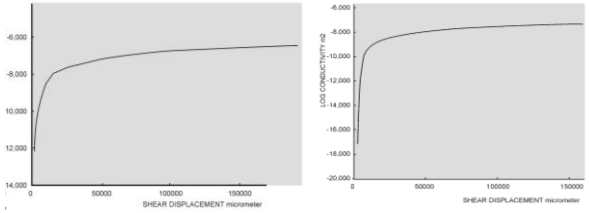
SOME IMPORTANT ASPECTS OF FRACTURE CHARACTERIZATION FOR 4D INTERPRETATION



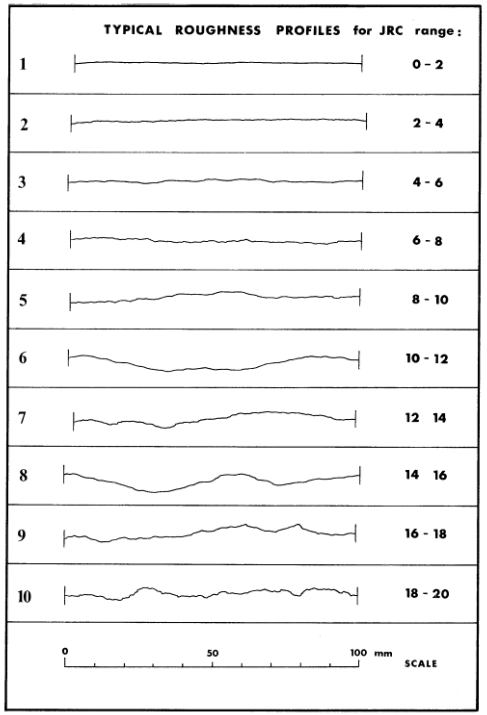
(Nearly) planar fractures will be closed by normal stress unless they are sheared. Rough fractures are more likely conductors – but they shear less easily.



Left: A nearly planar fracture (JRC = 5) in a weak rock. Right: A rougher fracture (JRC = 10) in a stronger rock. There is a huge difference in conducting apertures (e).

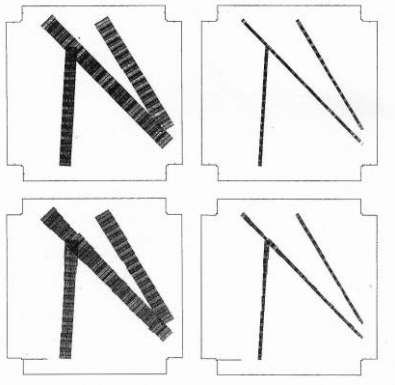


With shearing, the permeability in both cases can increase dramatically. Even at 3 km depth this helps.



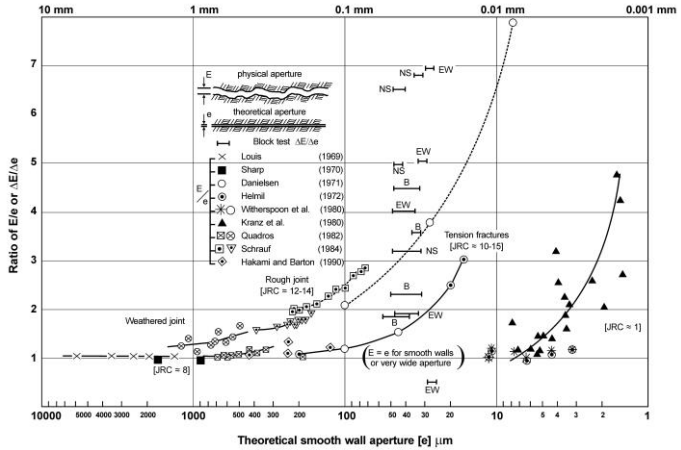
JRC - joint roughness coefficient, helps model closure, shear, dilation, shear-and-normal stiffness, apertures (E and e) and permeability changes that will be contributing in 4D seismic responses. Barton and Choubey, 1977.

Example of a high JRC (12-14?) fracture in crystalline rock. Shear and dilation are obviously exaggerated.



Fractures have (at least) two apertures, the larger physical aperture (E) and the smaller hydraulic (parallel-plate) aperture (e), where $K = e^2/12$. Modelling of HMT block test.

E and e are related by JRC, so understanding of JRC may be important for 4D interpretation.



Evidence for E ≥ e, and JRC-dependence. Barton and Quadros, 1997.

During production with 4D monitoring, closure of fractures (or shear in domal / anticlinal reservoirs) will each be influencing attenuation, anisotropy, and permeability changes. Each may be related to JRC.