SAMPLE SIZE IN TRIAXIAL LOADS

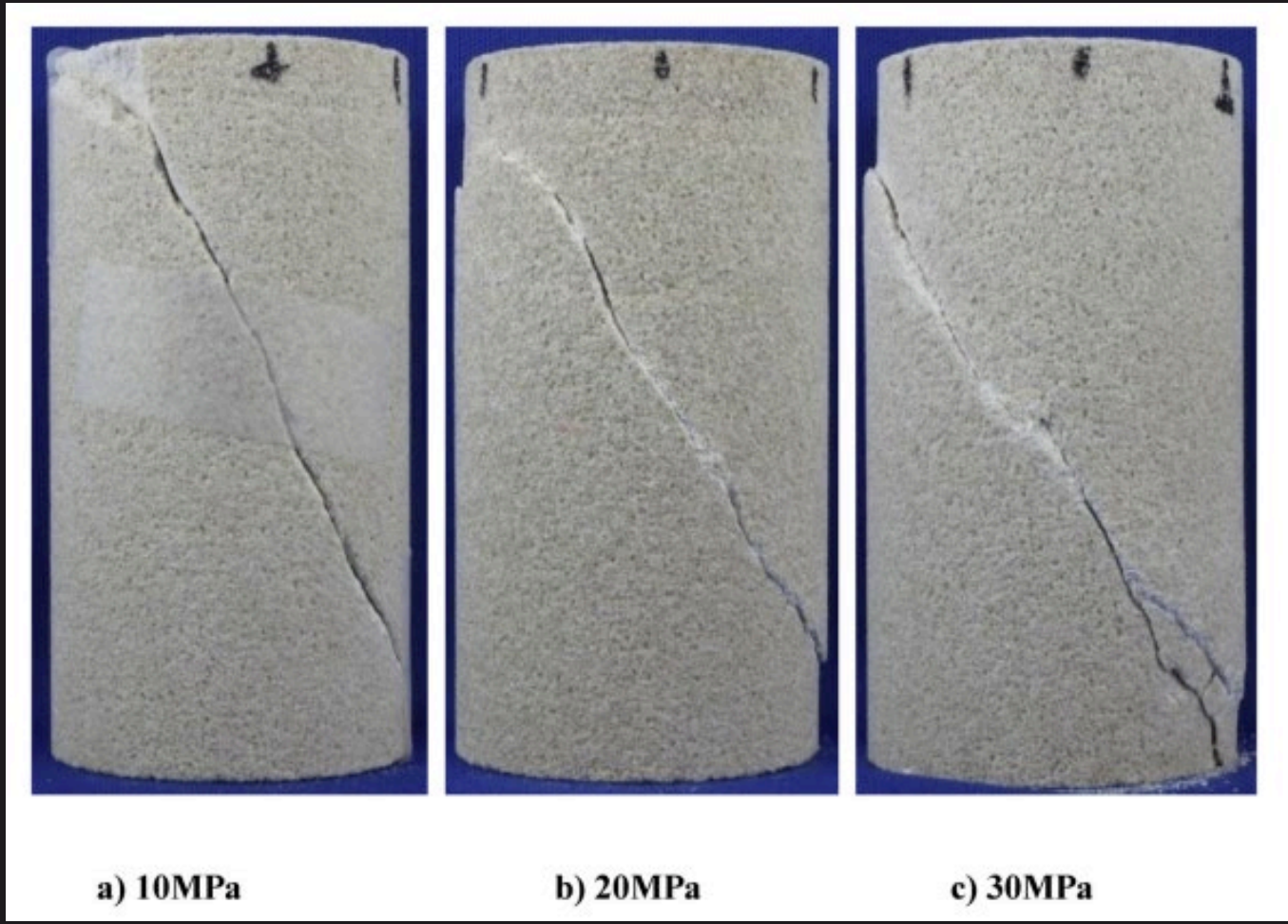
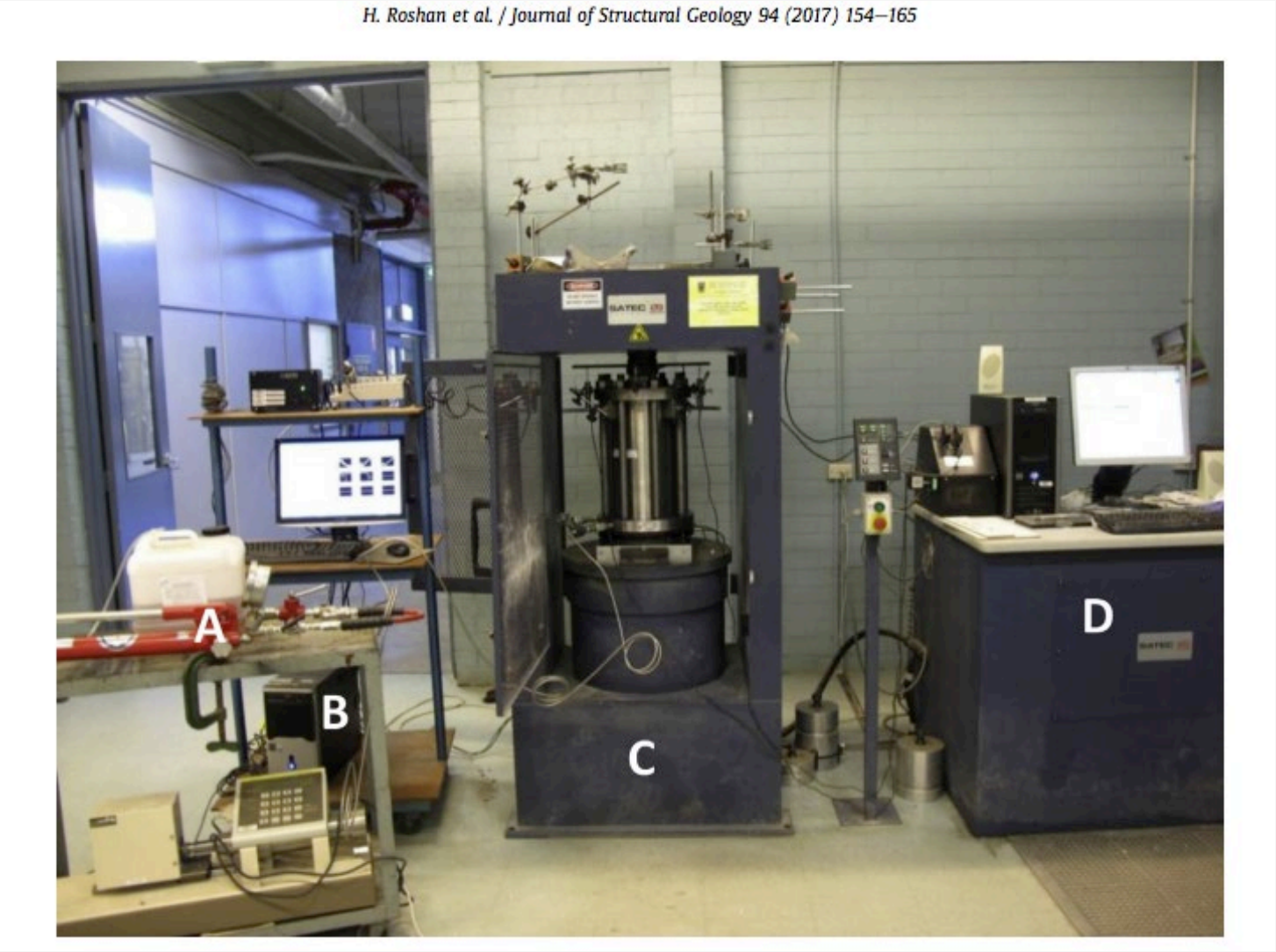


Photo by H. Roshan et al.

How sample size affects the frictional behavior

STUDY OVERVIEW

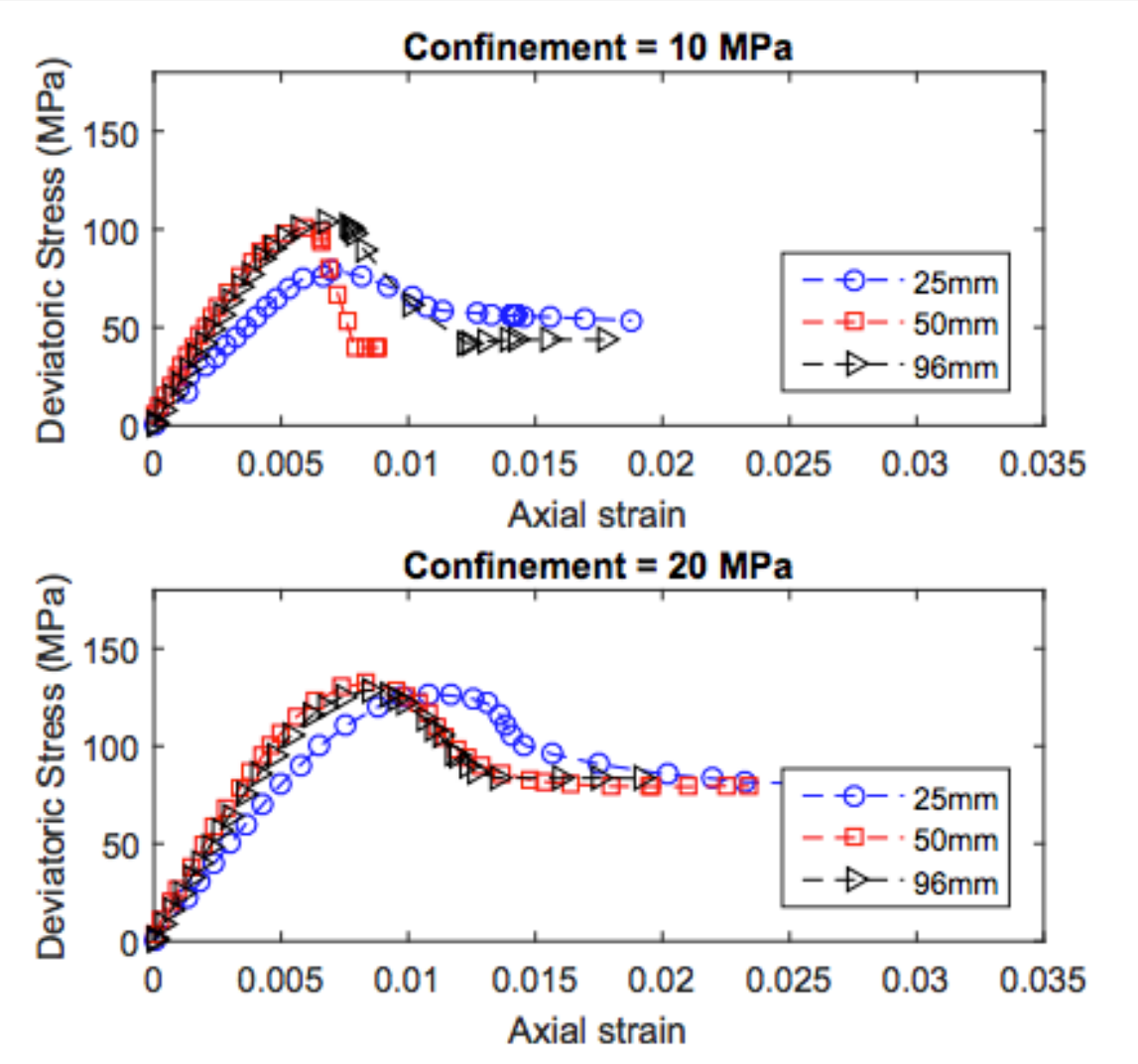
- *The rate of brittle-ductile transition varies based on sample size*
- *The sample size influences the angle of the shear plane*
- *Friction coefficient of shear plane is size-dependent*



A: Hydraulic Pump B: Computer to collect data C: Loading frame D: Loading frame control

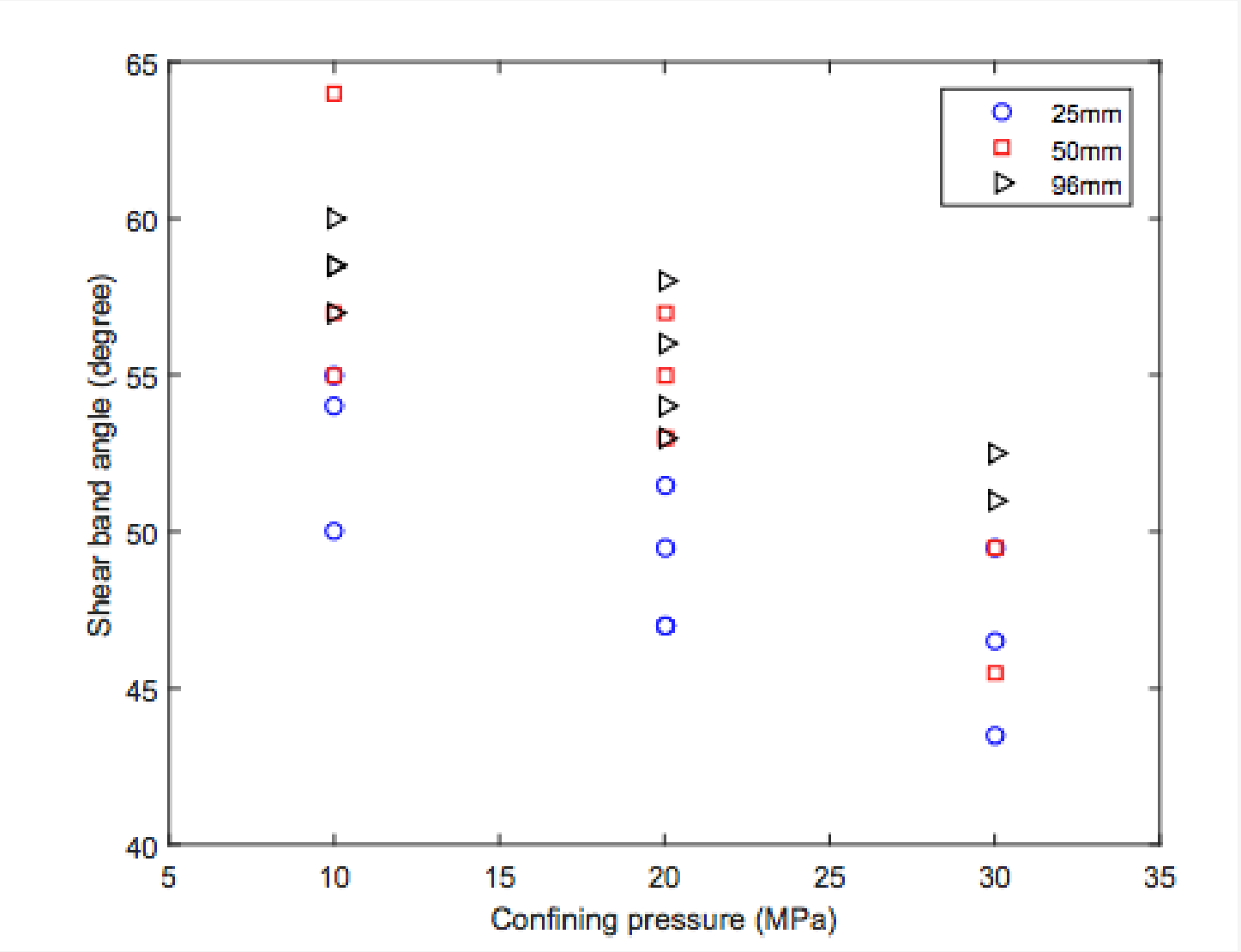
Experiment Setup

- Experiments conducted on Gosford Limestone (NSW, Australia)
- Samples were selected to be as homogenous as possible
- Oven dried for 24 hours at 105C
- Cores were ground flat to .003mm



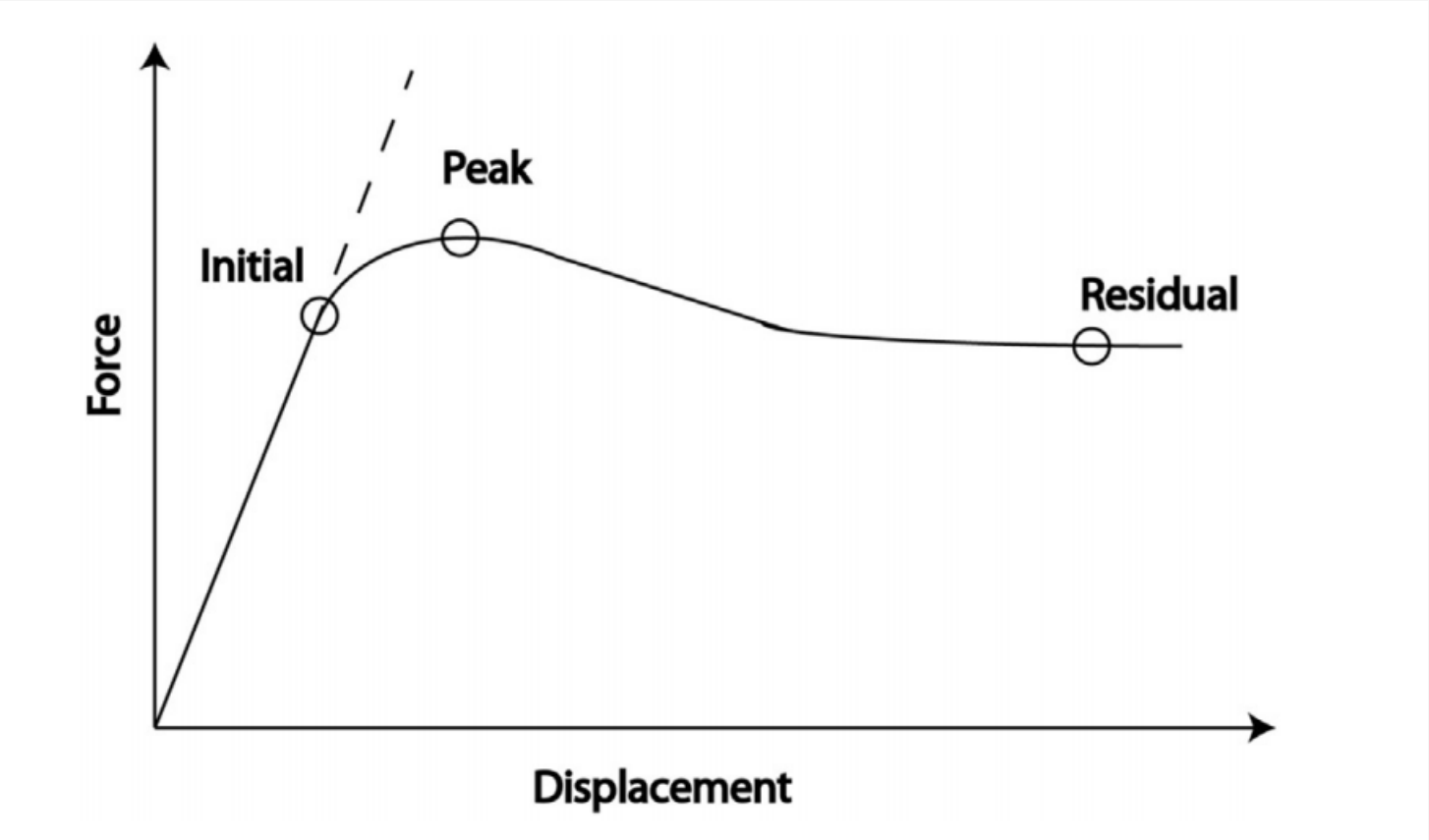
Brittle-Ductile Transition

- 3 sample sizes
- 25mm diameter samples transition faster from brittle to ductile
- All sizes exhibit ascending-descending behavior
  - Level of brittleness increases as size increases up to a characteristic point, after which ductility increases as size increases
  - (in this case, 50mm)



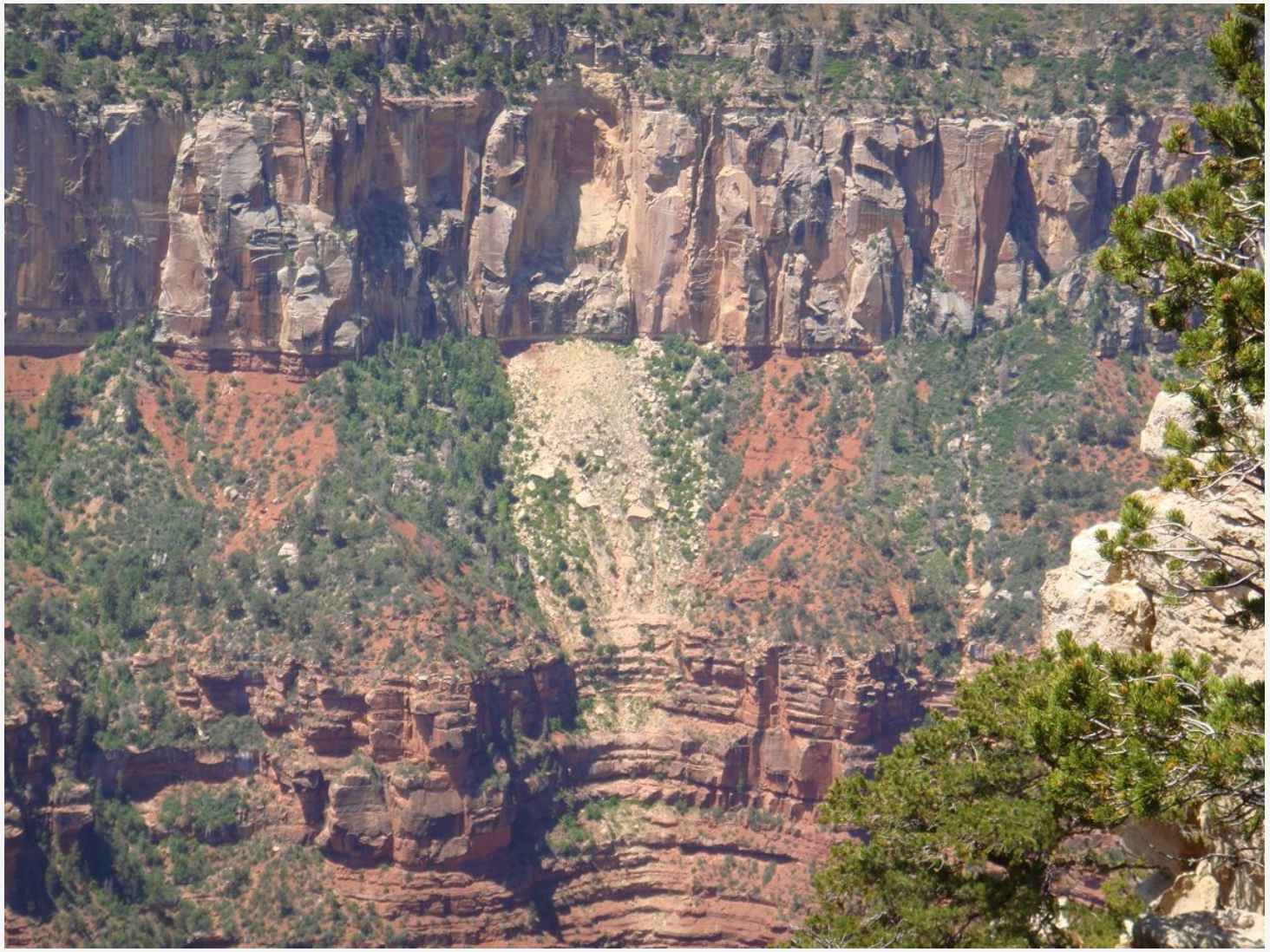
Shear Band Angle

- Decreases as confinement increases
- 25mm diameter is much lower than 50mm and 96mm
- 50mm and 96mm show similar trend to Brittle-Ductile Transfmoration



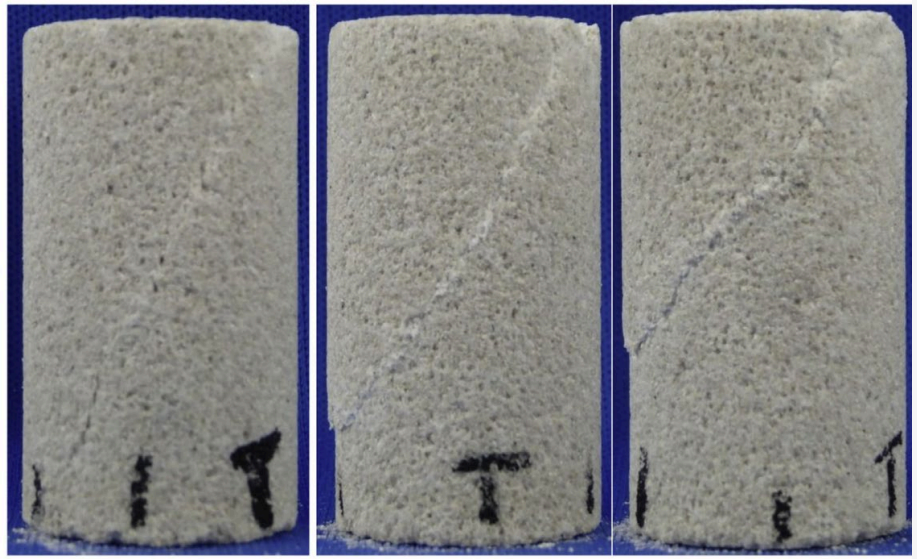
Friction coefficient of formed fractures

- Studies in the past used saw-cut samples, as opposed to solid samples.
- Saw-cuts do not represent early stages of brittle fault formation
- "From peak stress onward during the softening stage rock will experience disintegration towards the residual stress" (Byerlee, 1967)
- Friction coefficient increases as sample size increases up to a characteristic point.



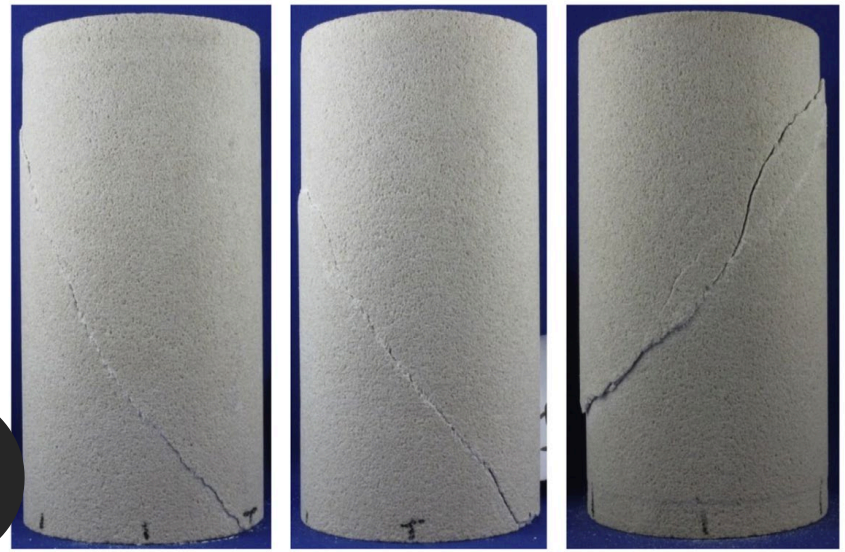
What does this mean?

- Brittle-ductile transition, shear band angle, and friction coefficients are size-dependent
- Theory of thermodynamics is reached before ultimate failure of the rock, meaning rock mechanics can be used to extrapolate large scale deformation from small.



a) 10MPa b) 20MPa c) 20MPa

Fig. A5. Typical fracture patterns resulted from triaxial tests on 25 mm diameter samples at different confining pressu



a) 10MPa b) 20MPa c) 30MPa

Fig. A3. Typical fracture patterns resulted from triaxial tests on 96 mm diameter samples at different confining pressures.

Future studies

- Define the characteristic point at which rocks of a larger size act more ductility
- Look closer at the thermodynamic limits of small samples
  - Small samples have multiple shear bands that are not much closer than the total diameter of the sample (<55mm)
  - Explore the grain-grain interactions in these small samples using simulations or other theoretical means

Questions?