Effect of particle loss on soil behaviour

6th International Conference on Scour and Erosion

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Introduction

Soil can experience particle loss through degradation, dissolution, and erosion.

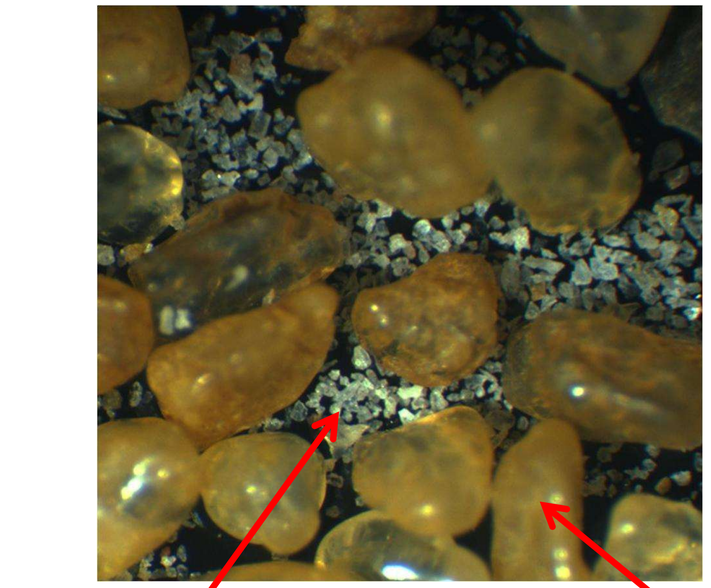
Research aim

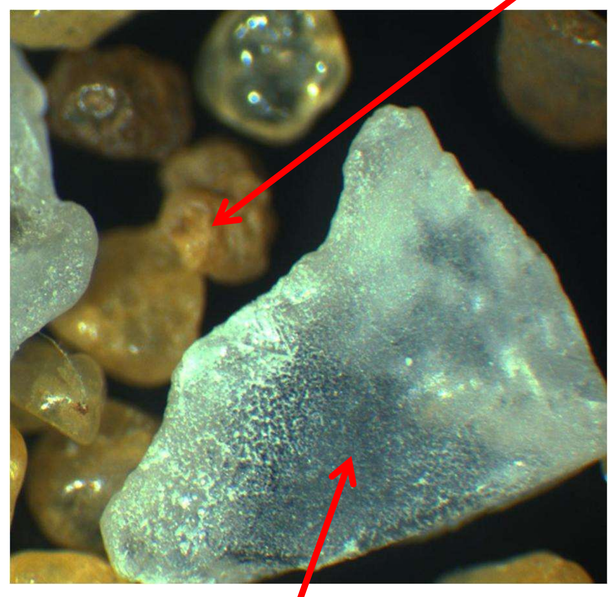
To examine the volumetric and strength changes that occur in a soil experiencing particle loss with special focus on the size and percentage of single sized particles.

Laboratory testing

- Oedometer tests – mixtures of Leighton Buzzard sand and salt
  - salt particle size (0.063, 0.125, 0.25, 0.5 & 1.0 mm)
  - amount (2%, 5%, 10% & 15%)
  - two vertical stresses (62 & 250 kPa). 40 tests.

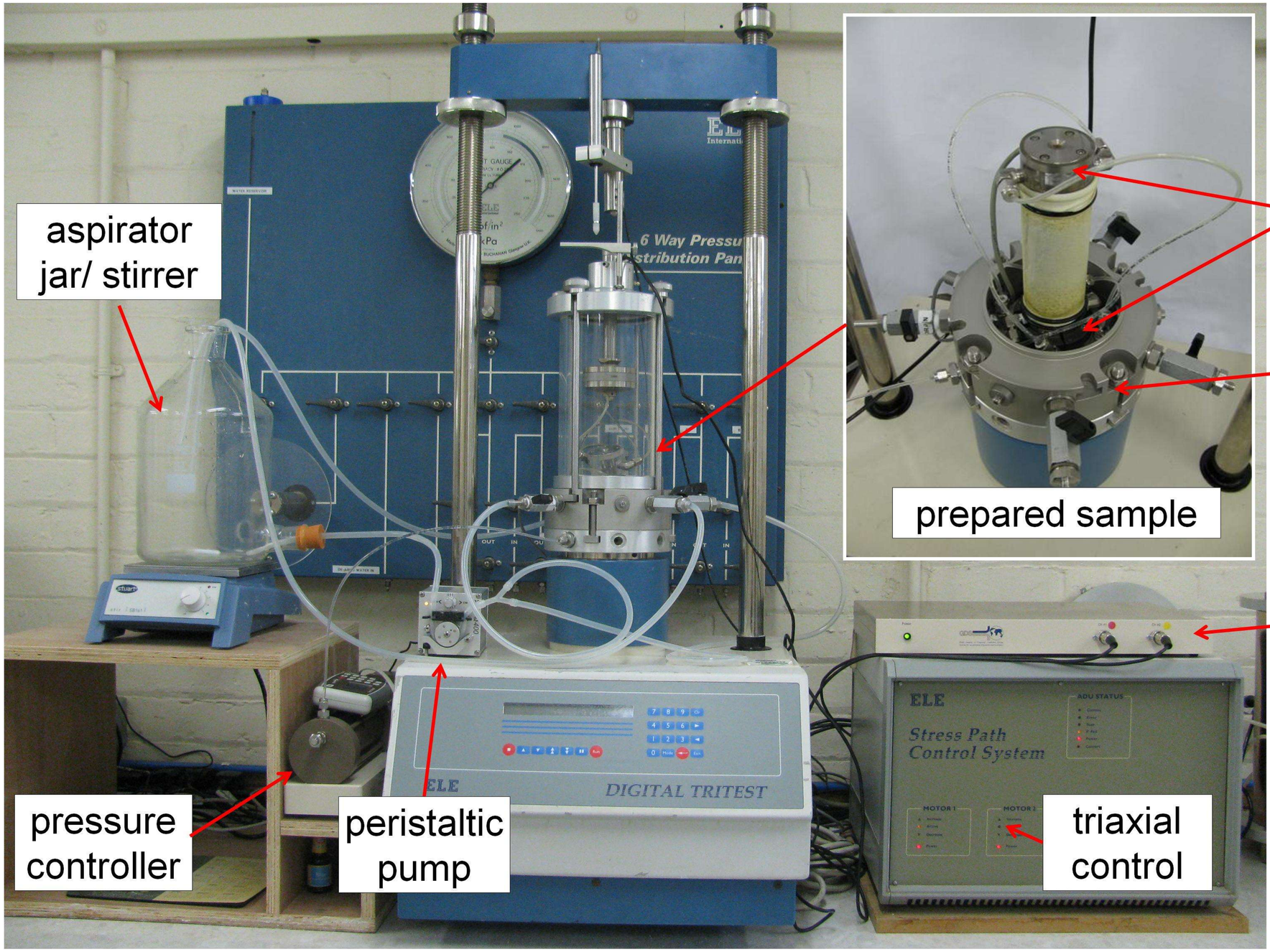
- Triaxial tests – mixtures of Leighton Buzzard sand and salt
  - salt particle size (0.063, 0.25, 0.5 & 1.0 mm)
  - amount (15%)
  - stresses (42, 84 & 168 kPa).



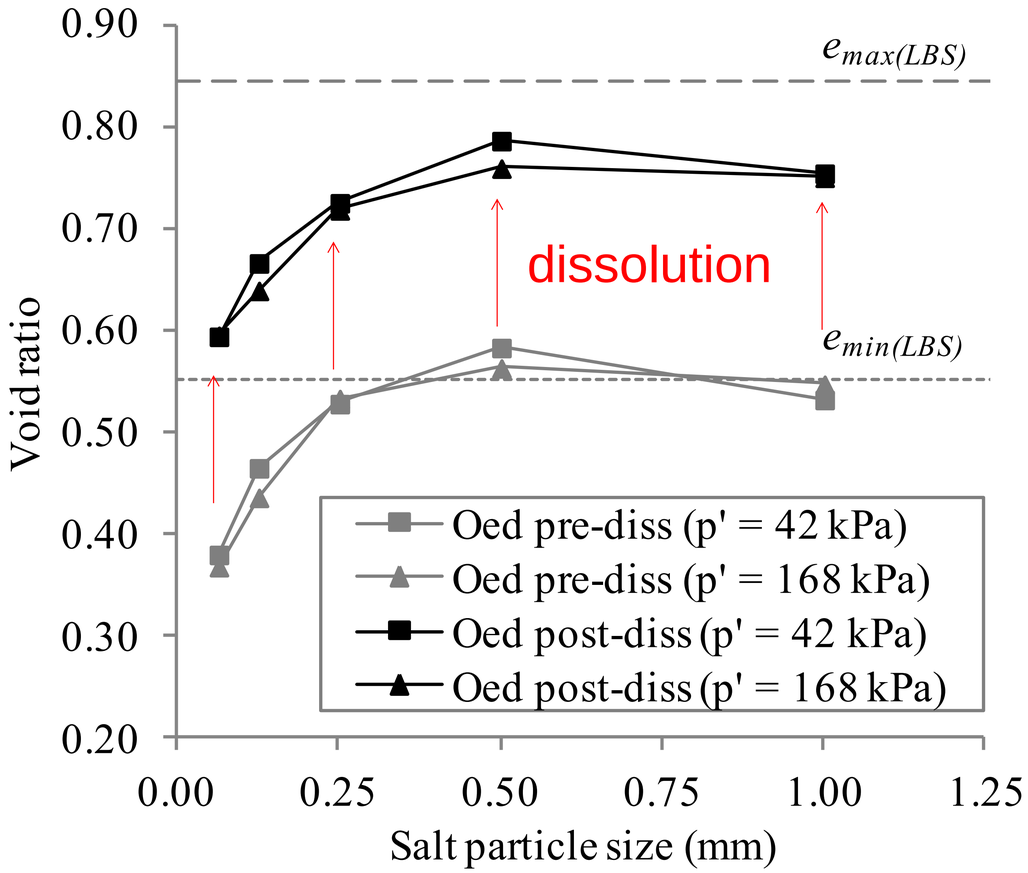


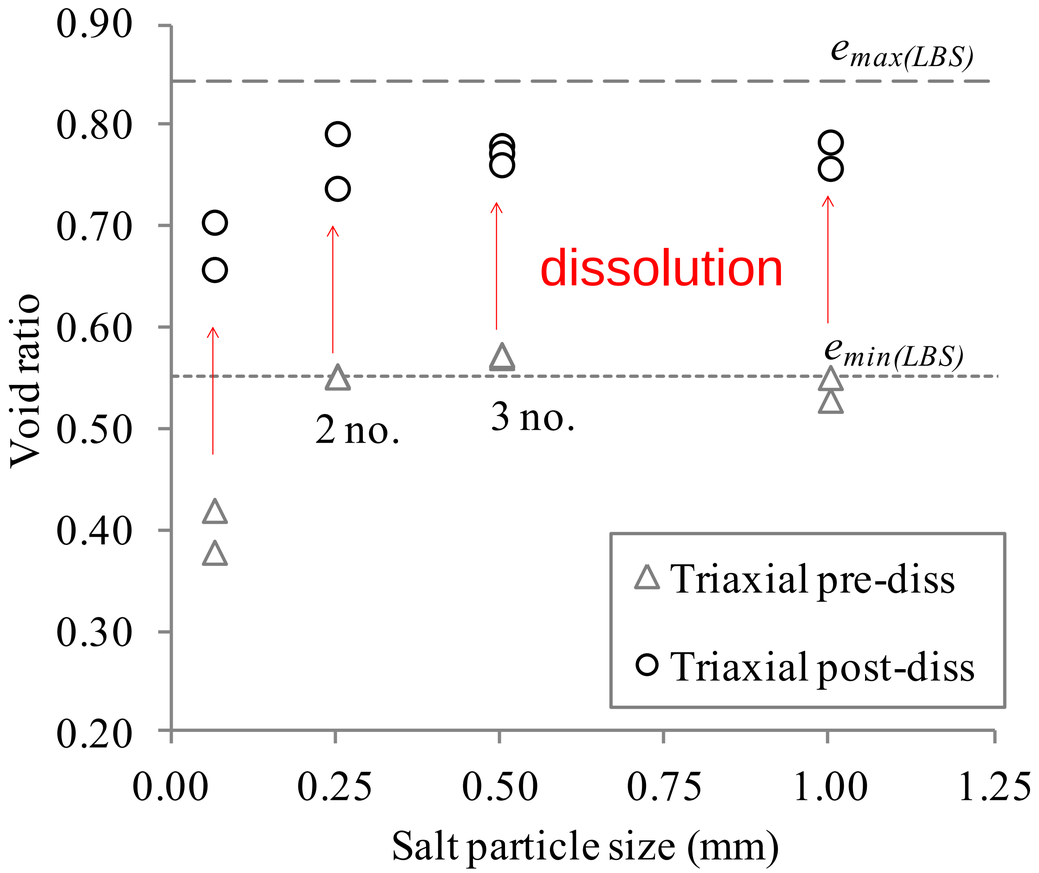
Triaxial/ bender element setup

Edinburgh Napier UNIVERSITY



Dissolution volume change

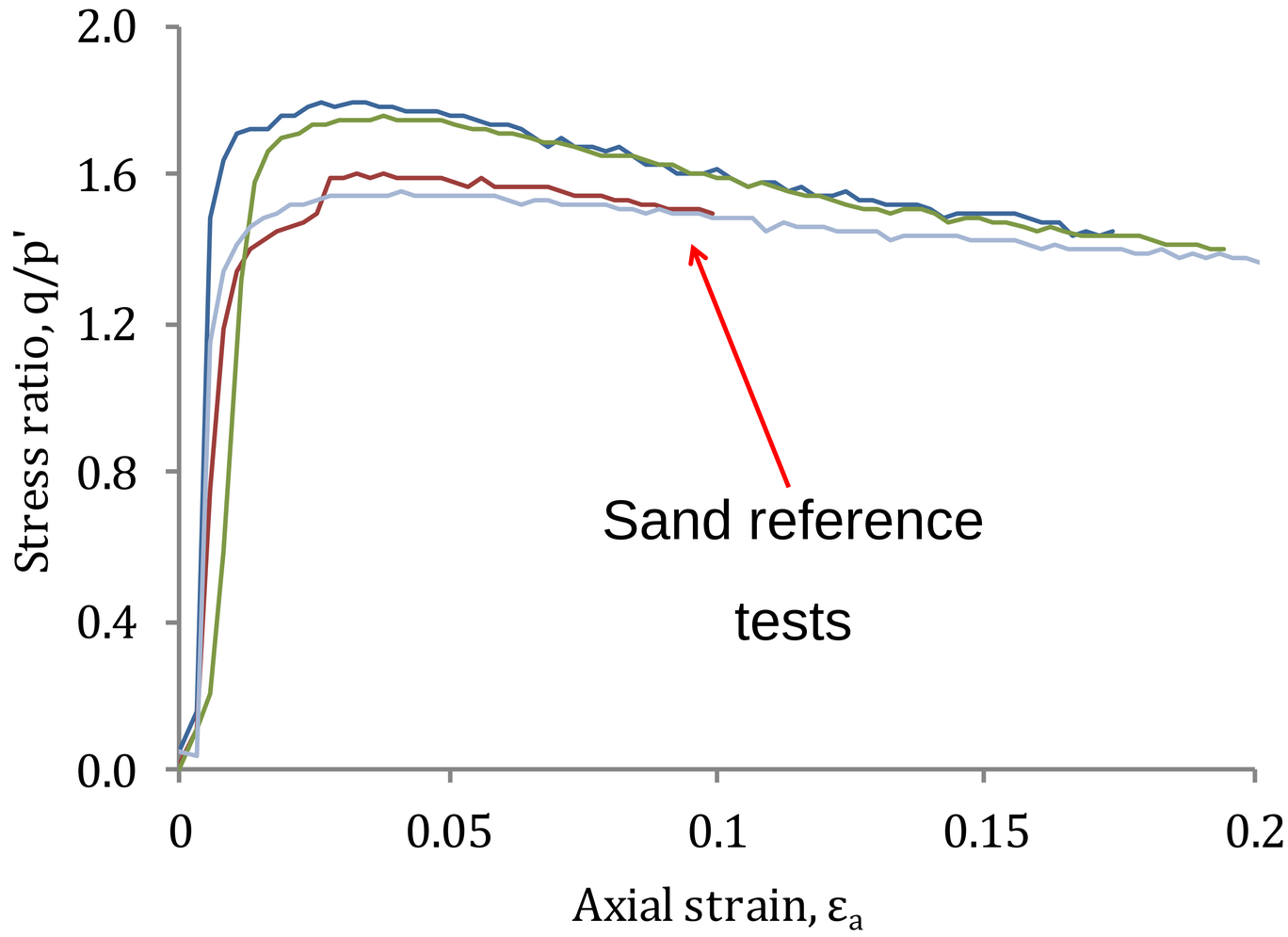




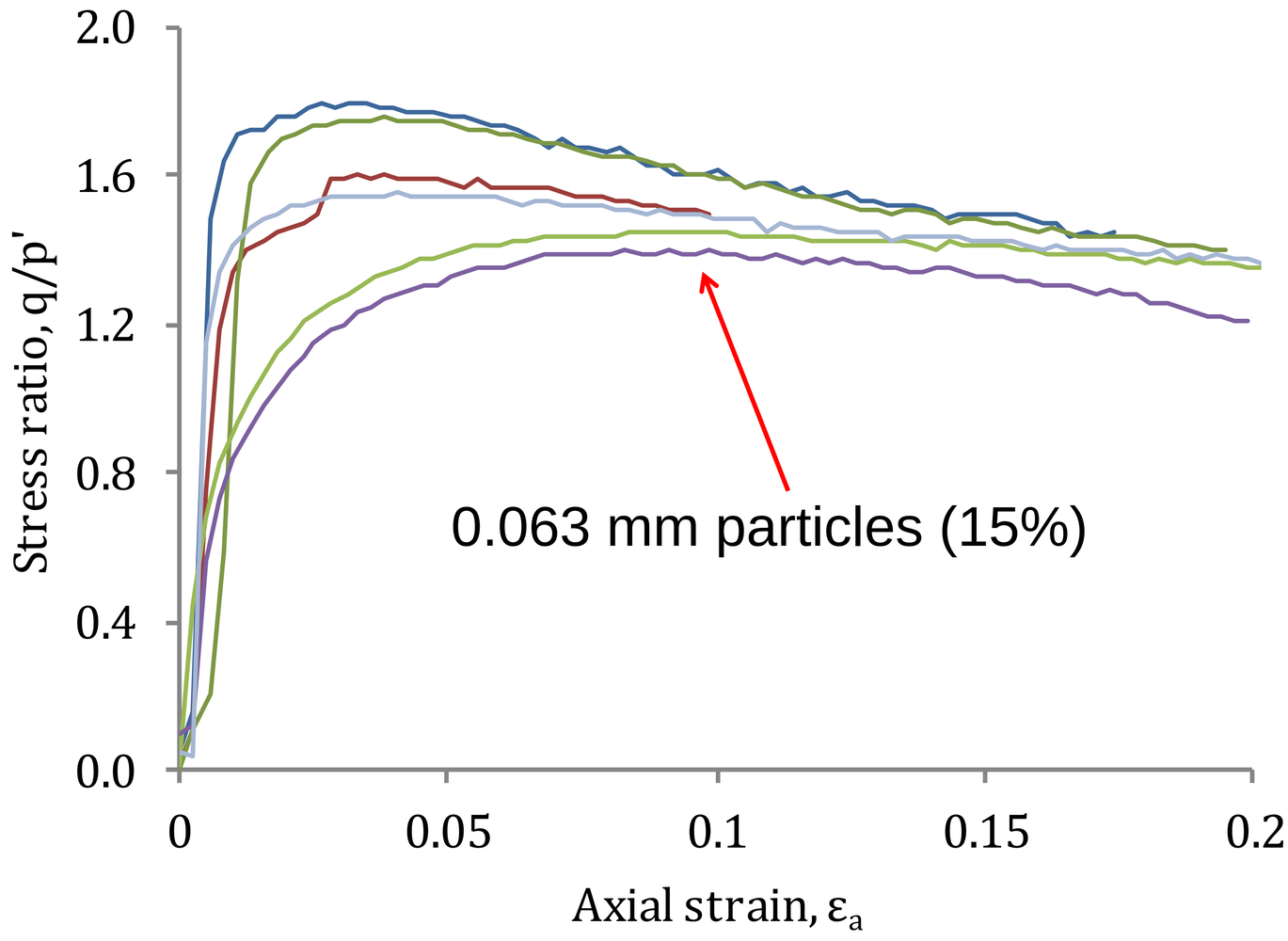
•Good agreement between oedometric and triaxial tests

•Void ratio change with dissolution independent of initial void ratio, particle size removed or applied stress.

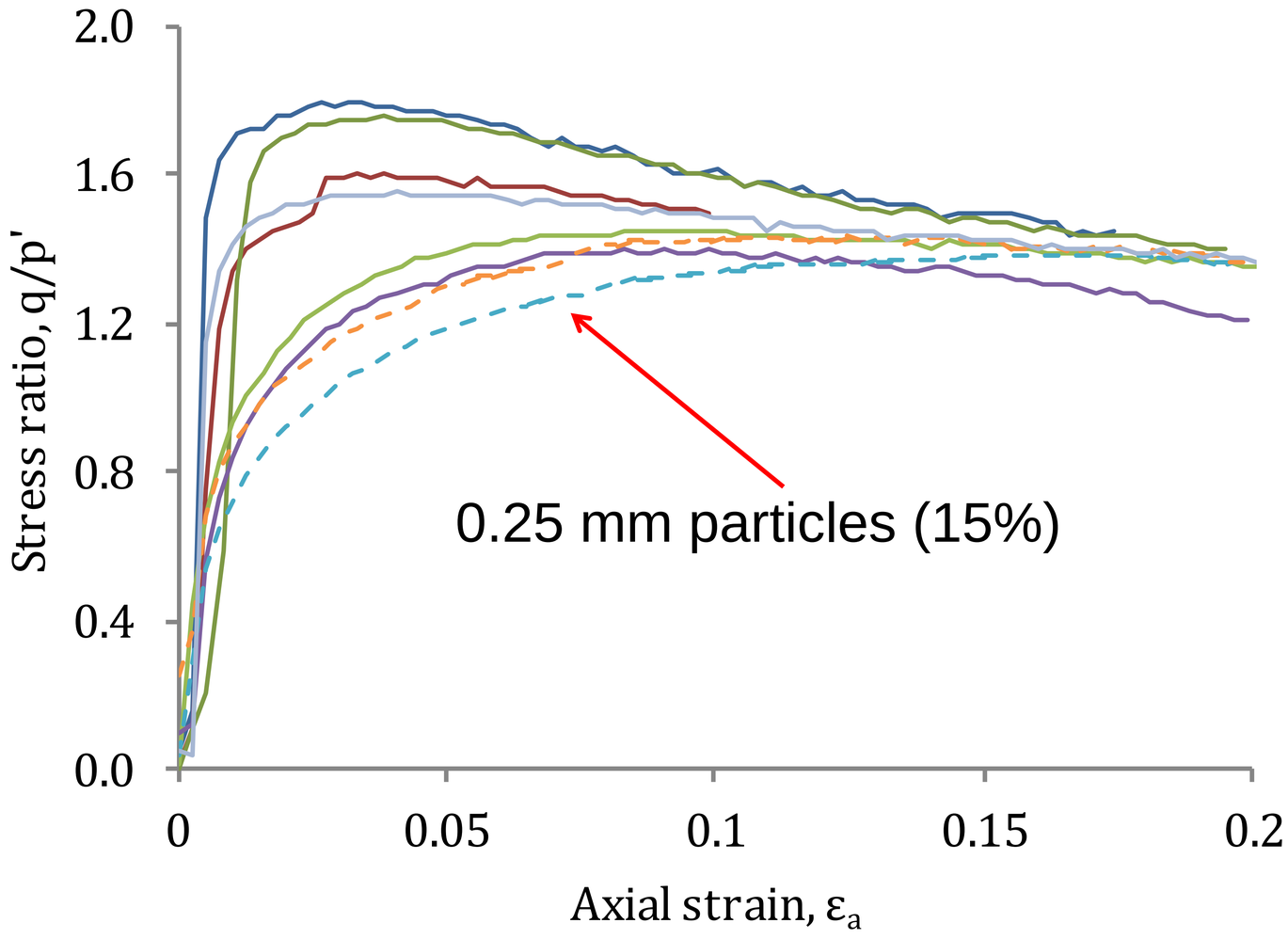
Triaxial strength data



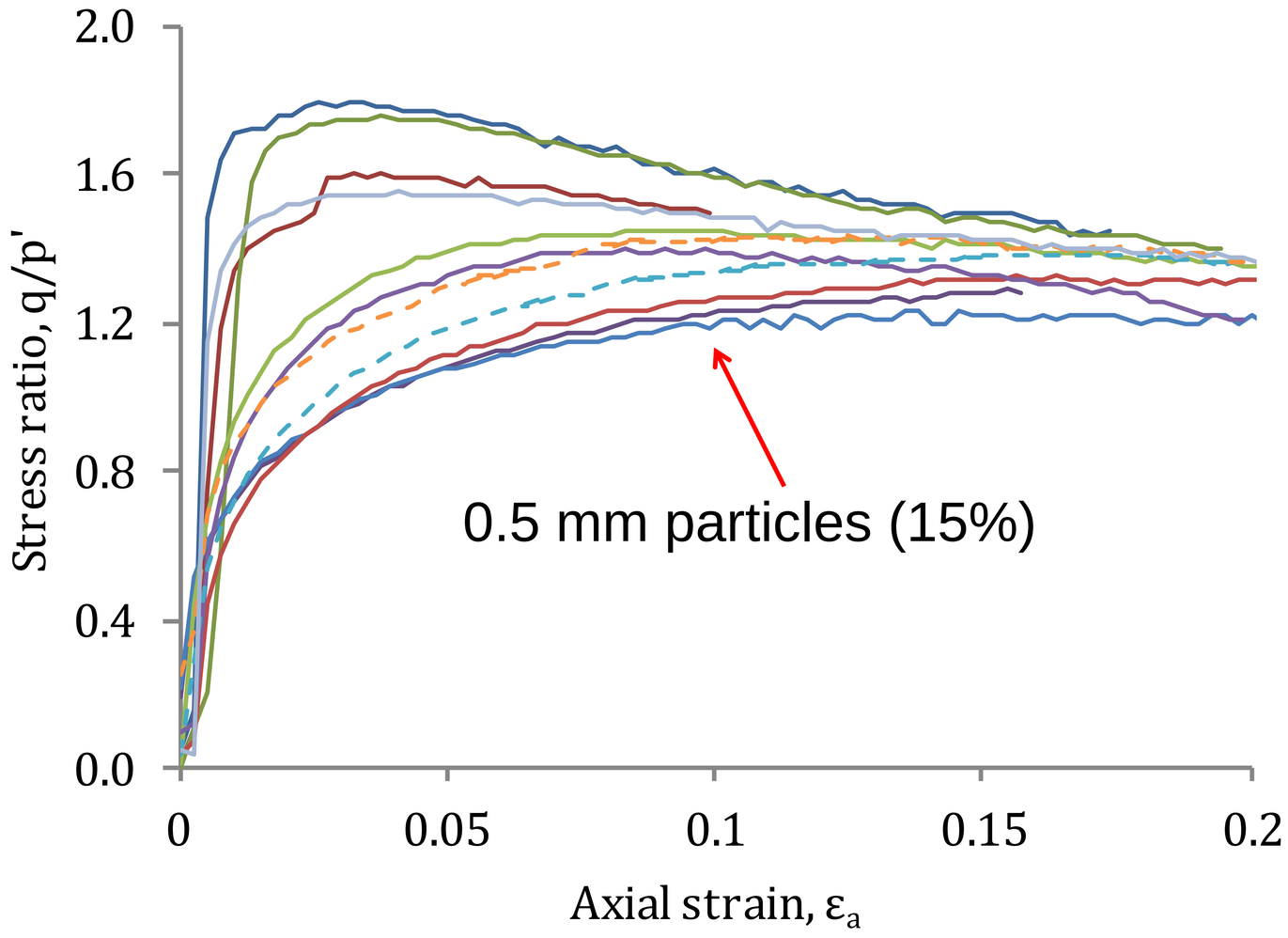
Post dissolution strength



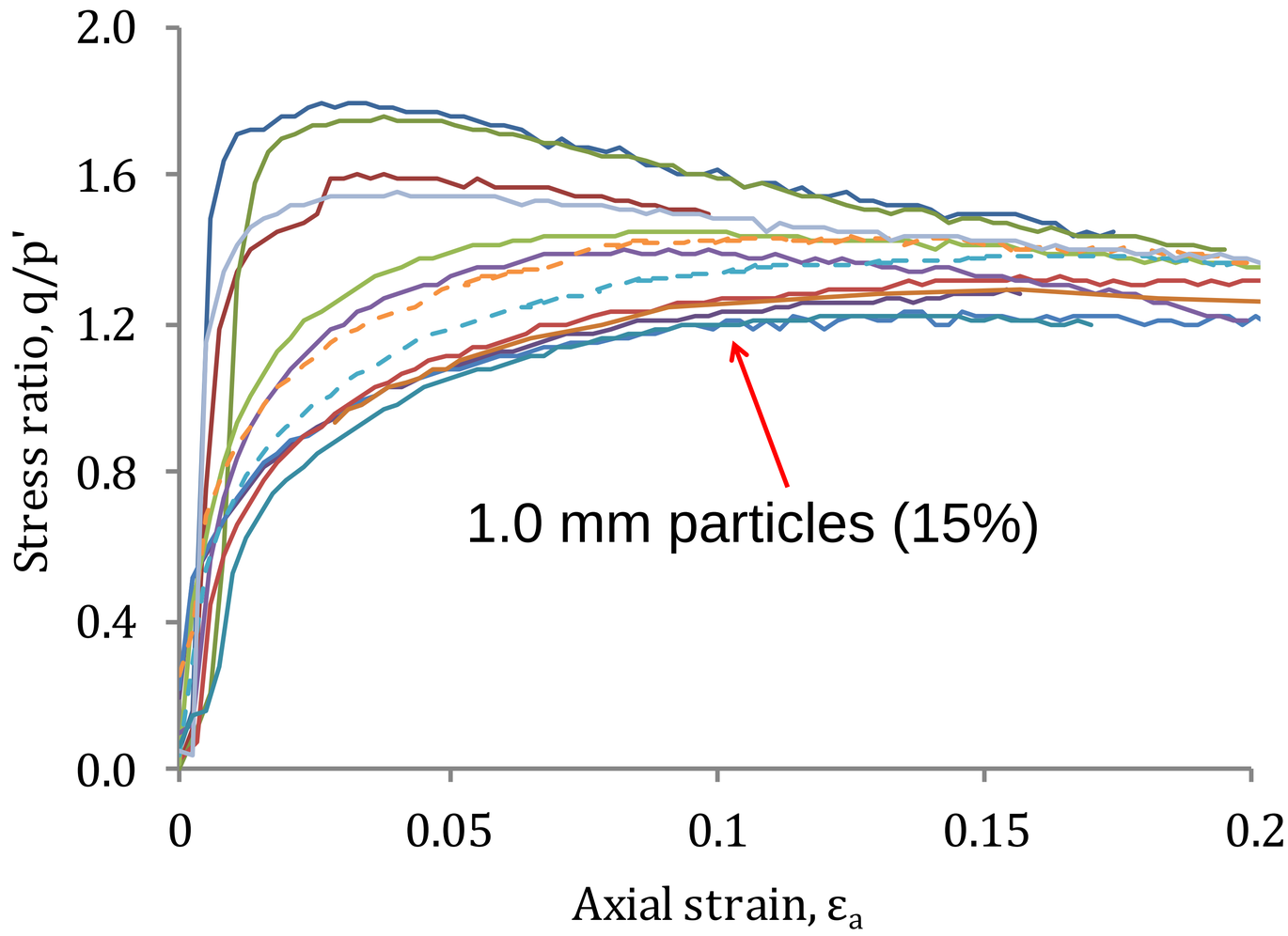
Post dissolution strength



Post dissolution strength

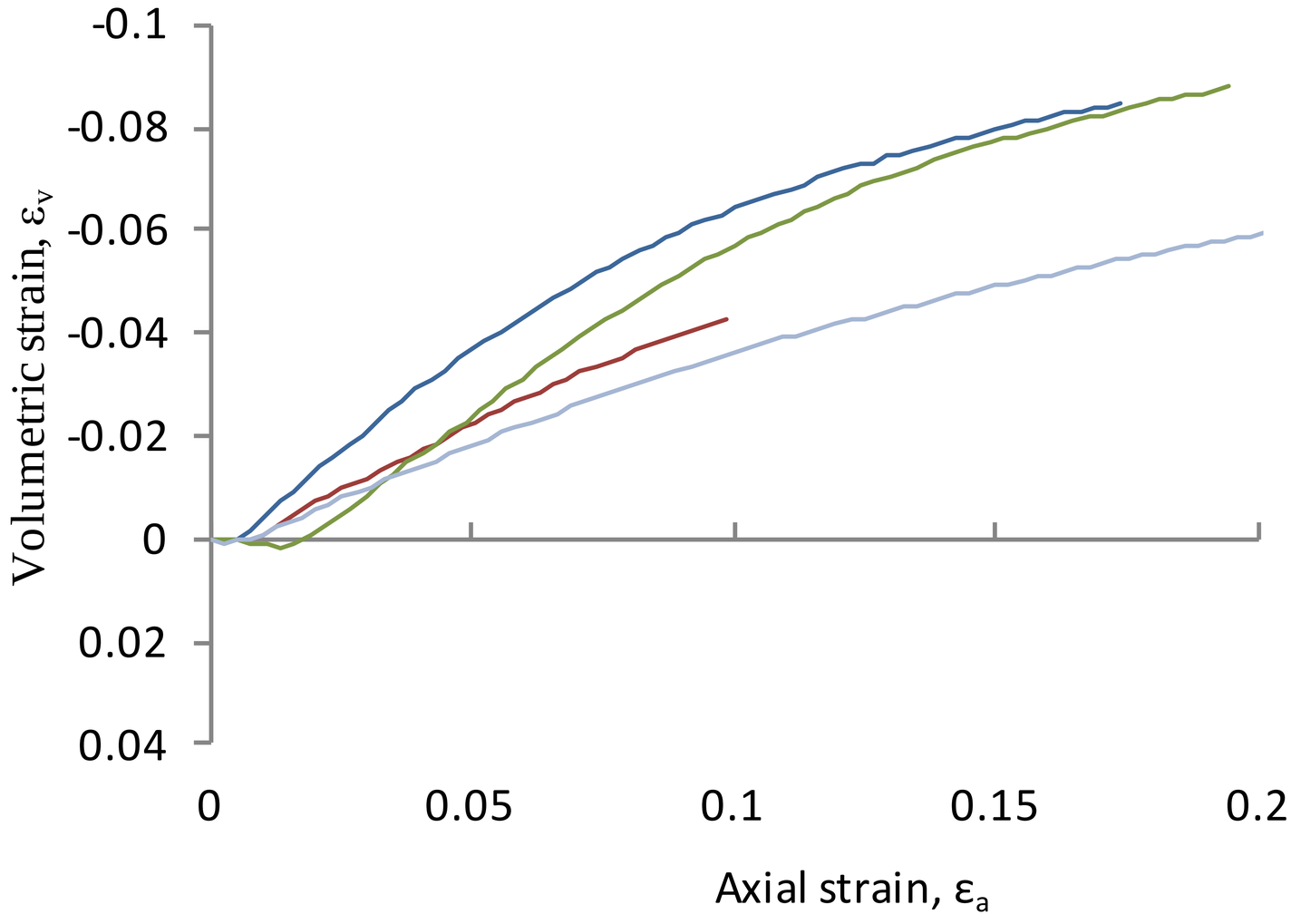


Post dissolution strength



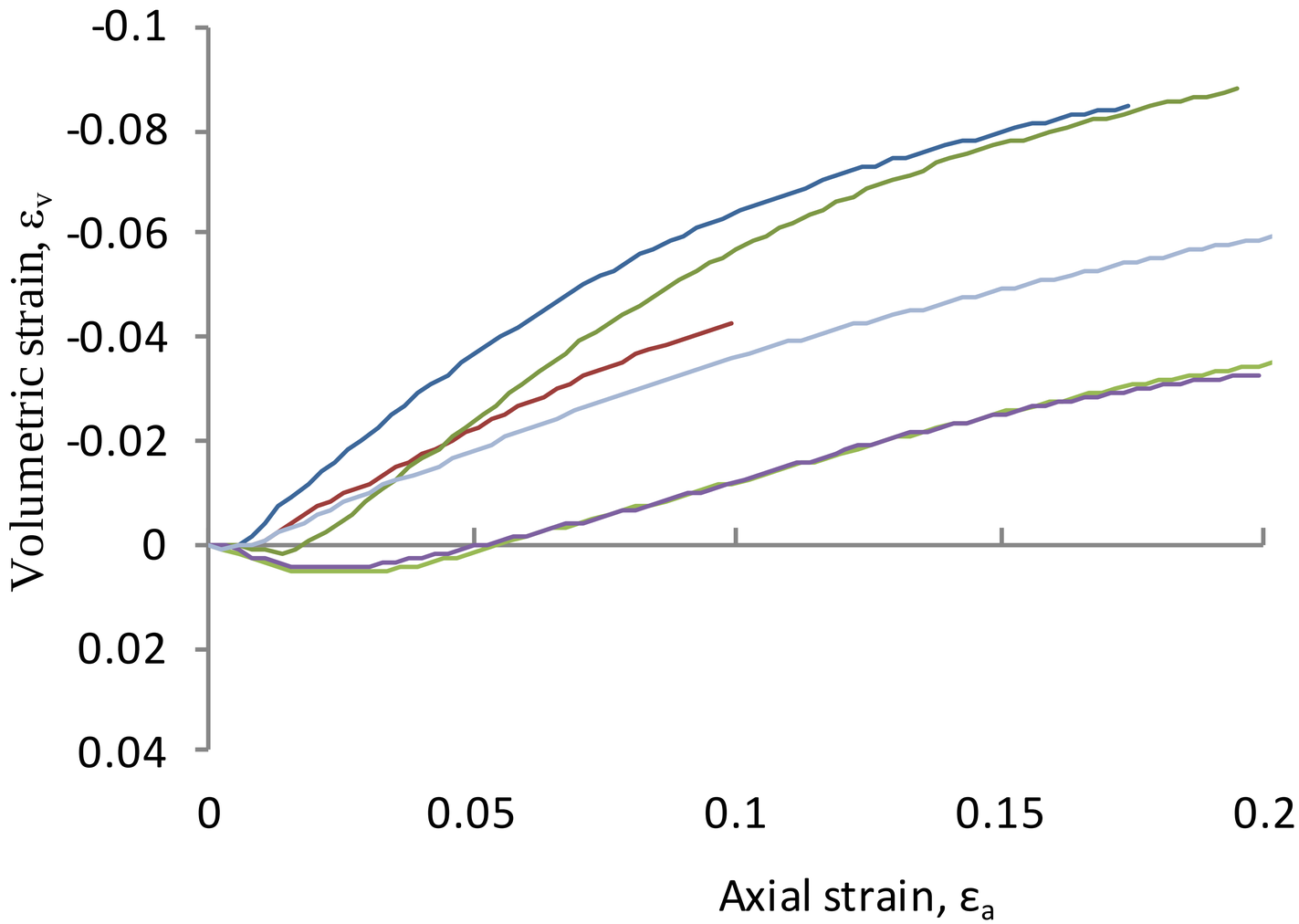
- Good convergence of strength data
- Post dissolution strength behaviour depends on the particle size removed
- Loose sand sample preparation

Triaxial volumetric data



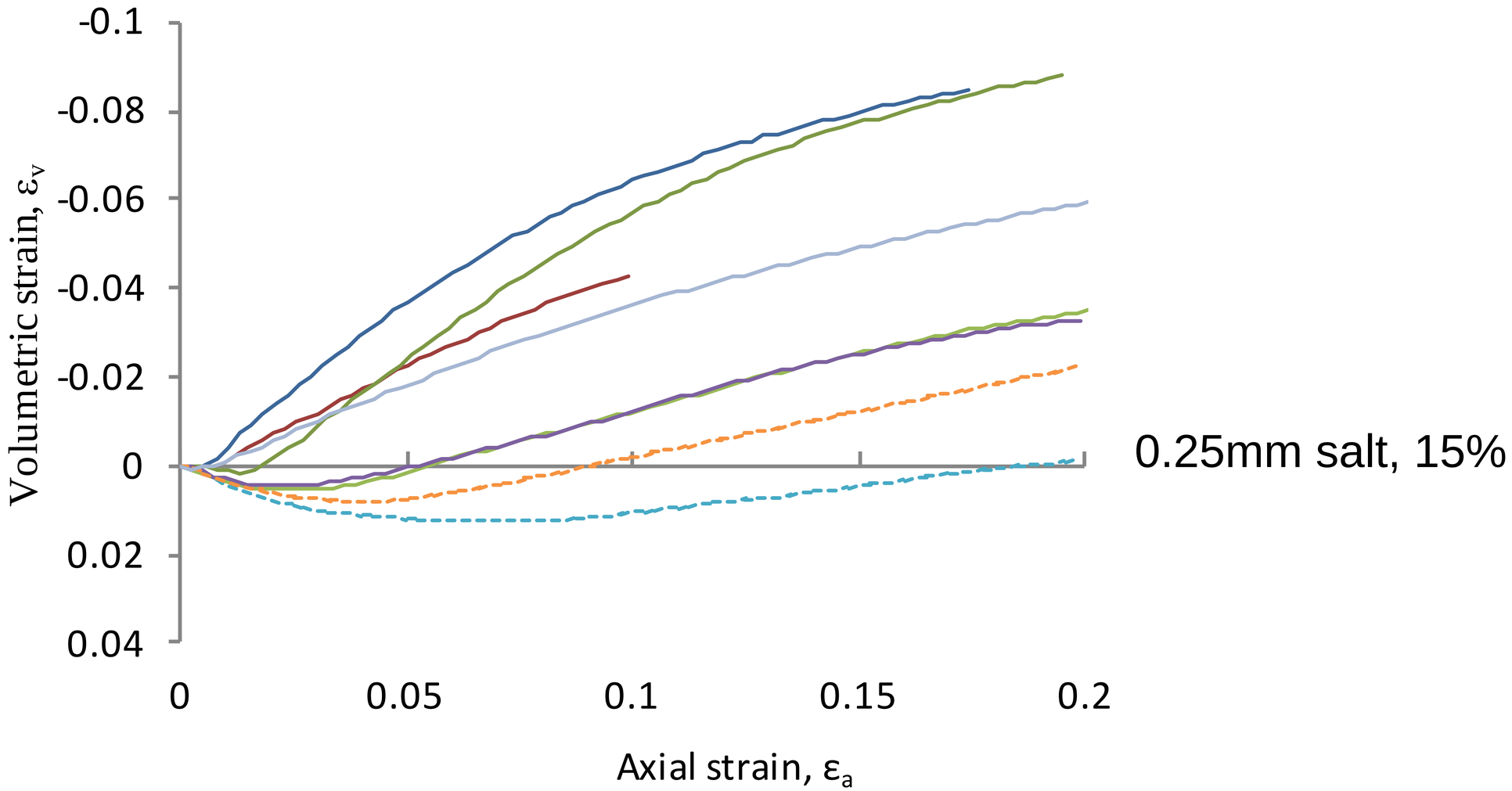
Sand reference tests

Triaxial volumetric data

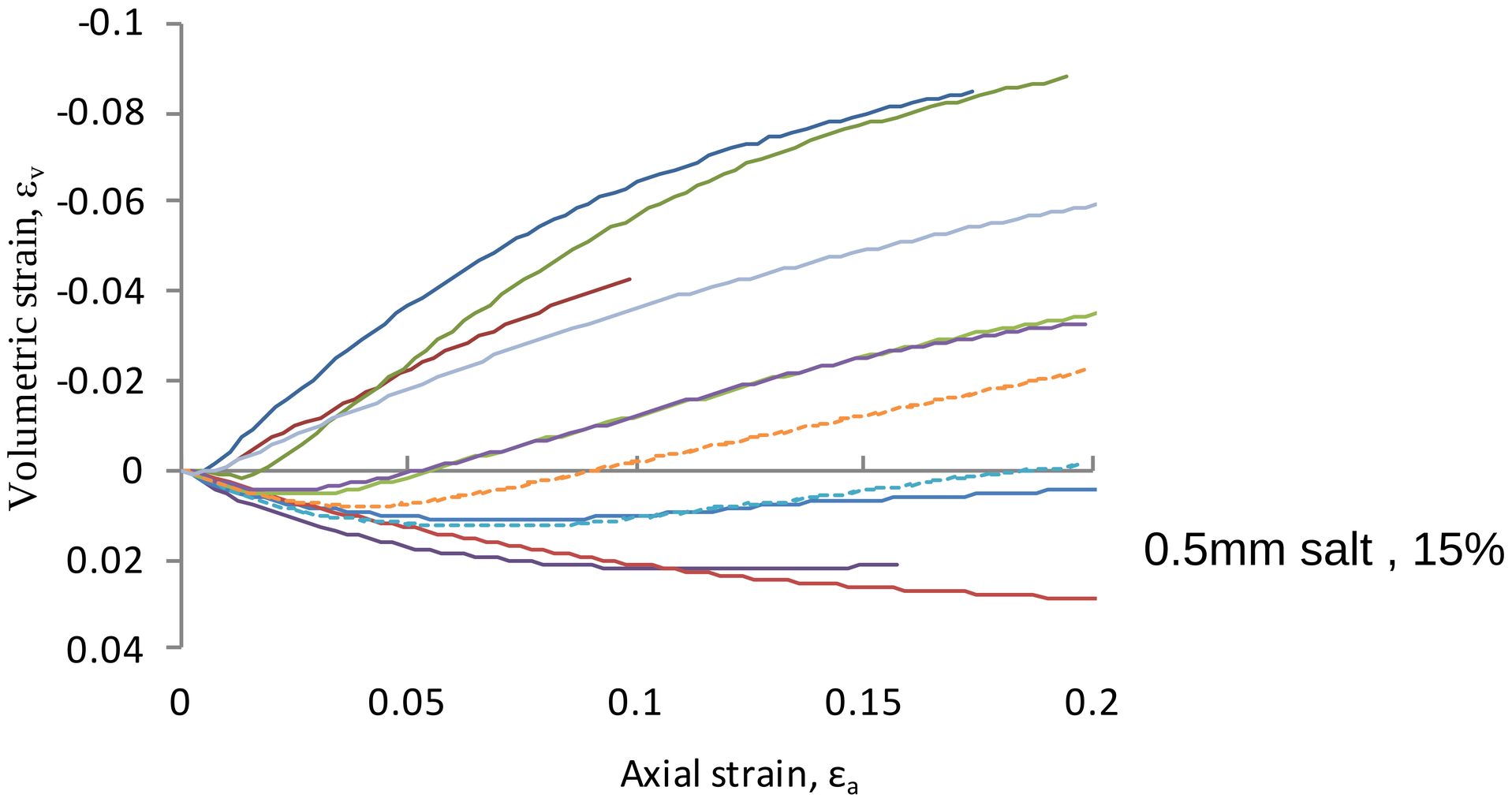


0.063mm salt, 15%

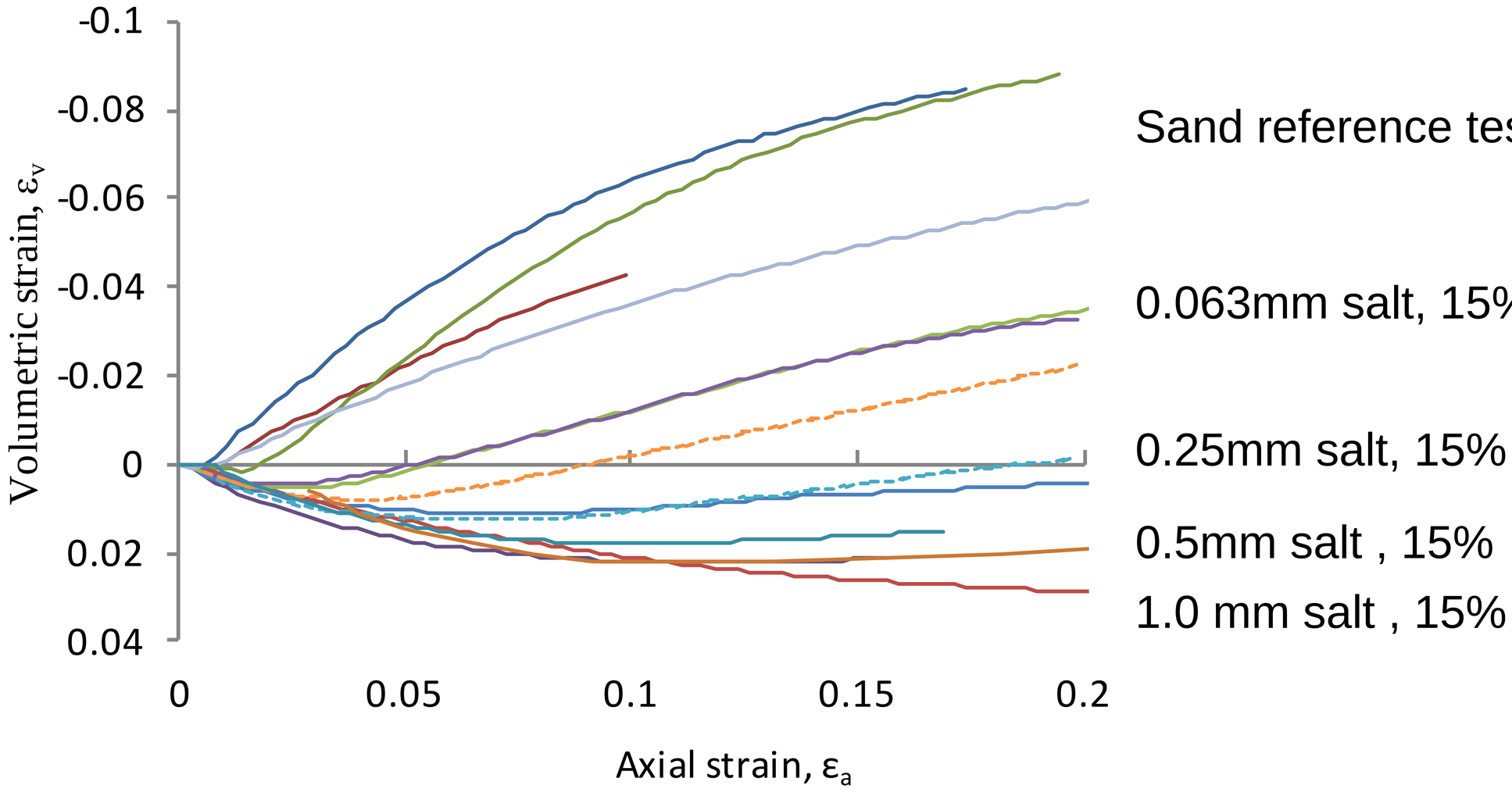
Triaxial volumetric data



Triaxial volumetric data

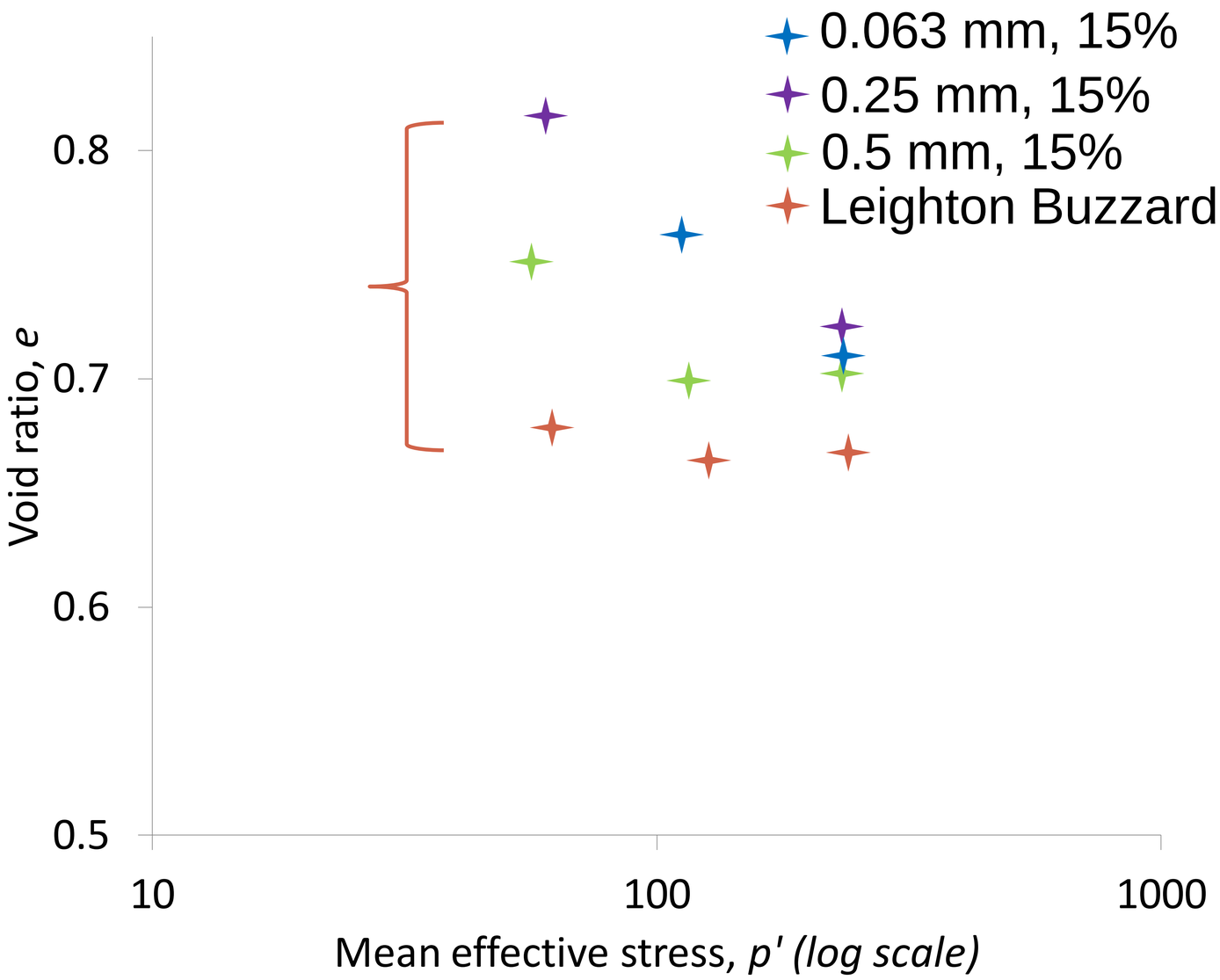


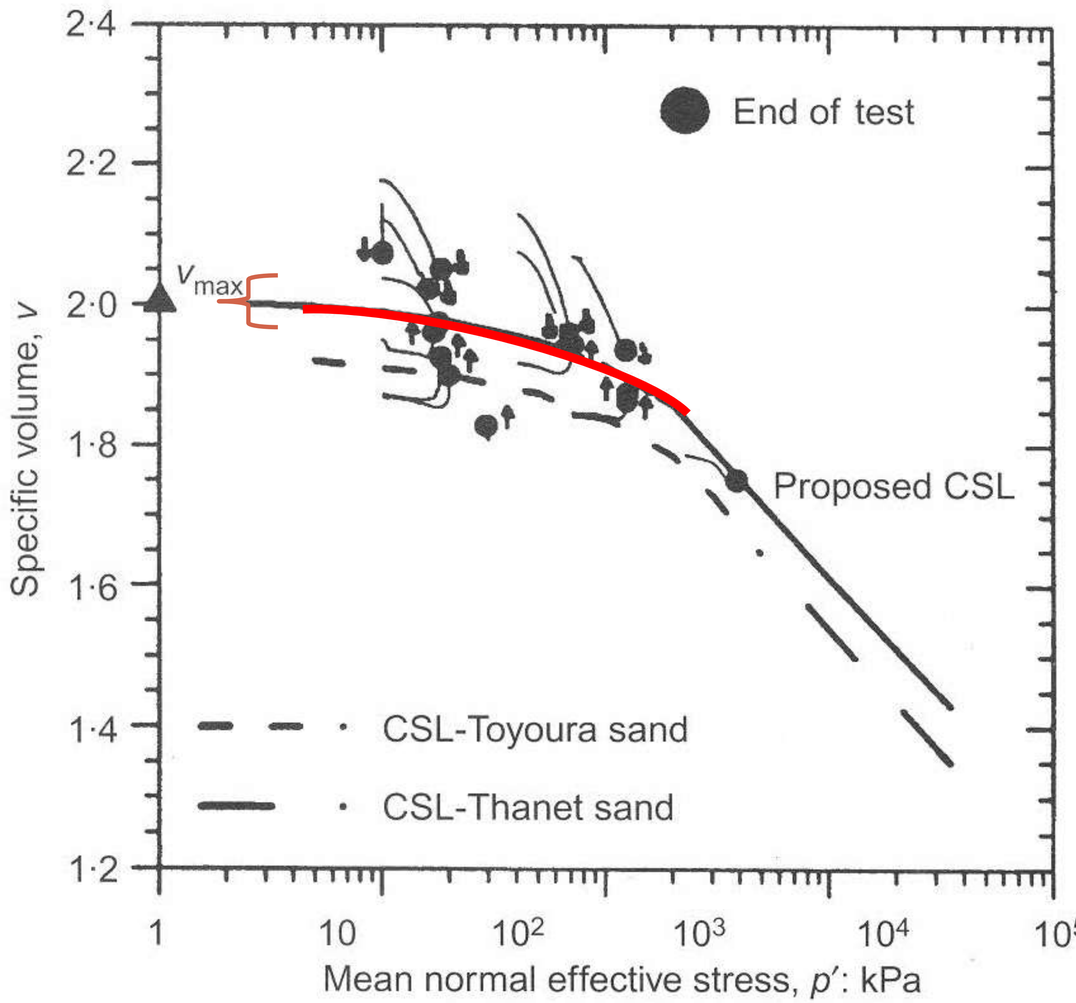
Triaxial volumetric data



- Volumetric behaviour related to particle size
- Post dissolution loose samples exhibit compressive behaviour to large strains followed by dilatancy

Critical state line



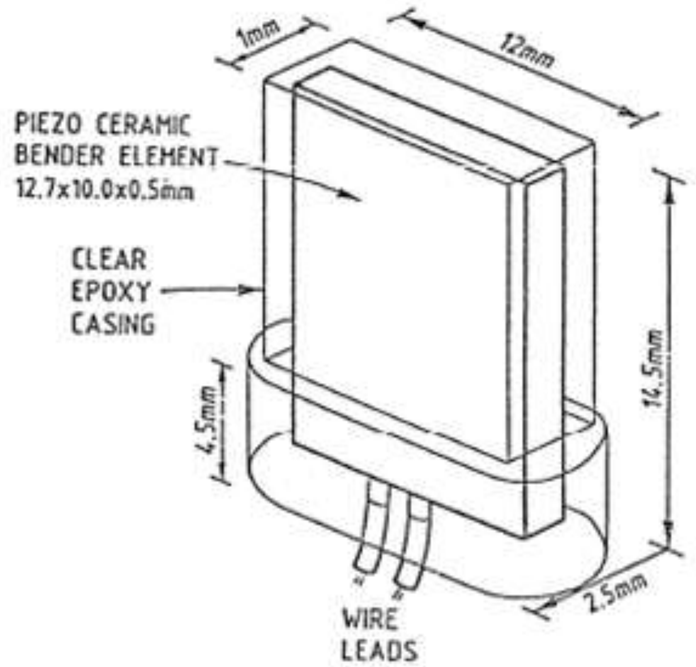


(Klotz &Coop, 2002)

- Errors in volume measurement at low pressures, or well documented difficulty in defining CSL at low stress?

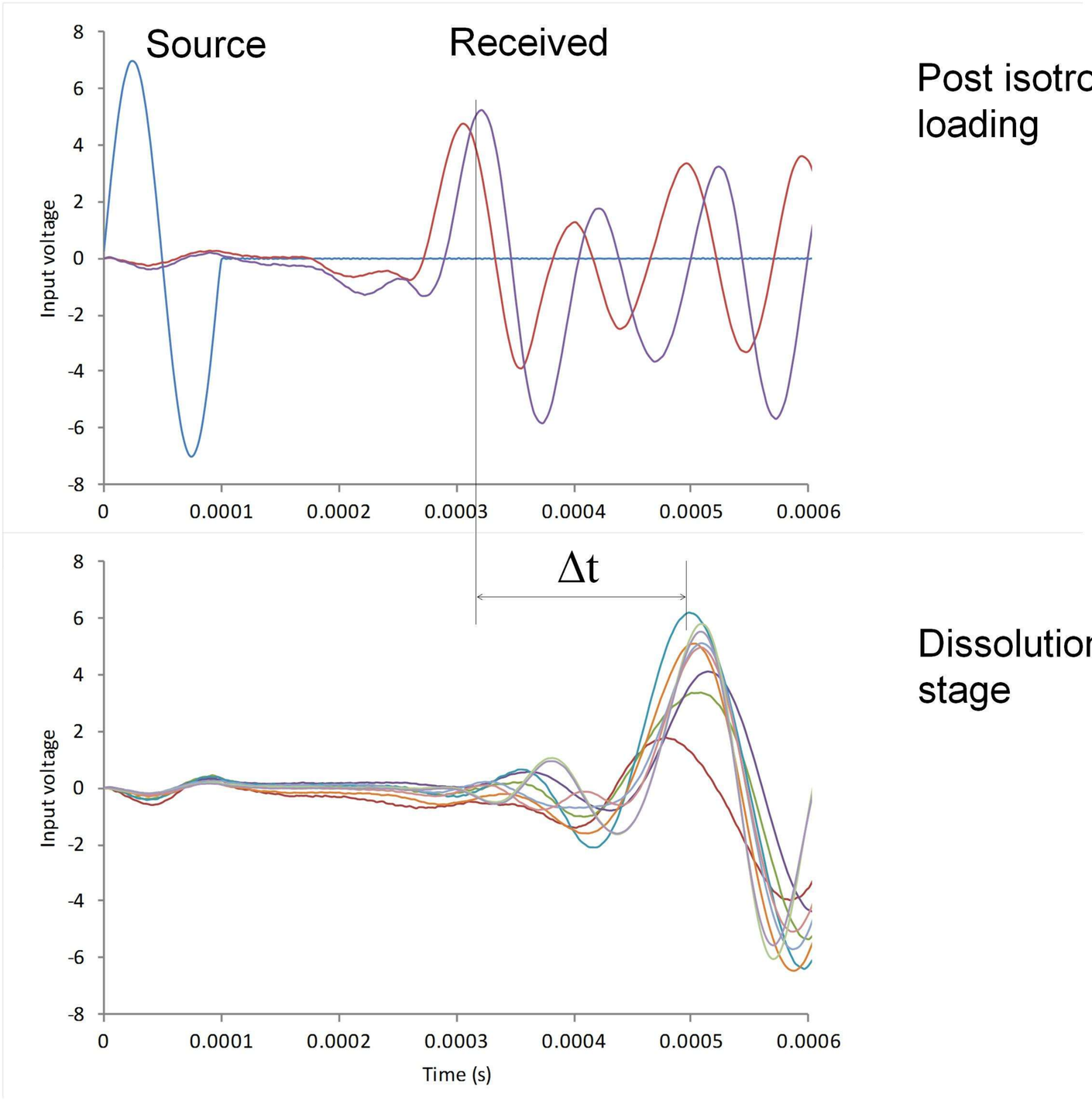
Bender elements (electro-mechanical transducers)

- Non-destructive testing method
- Small-strain stiffness determination, G_{max}
- G_{max} used to predict soil behaviour under dynamic loading



(Dyvik & Madshus, 1985)

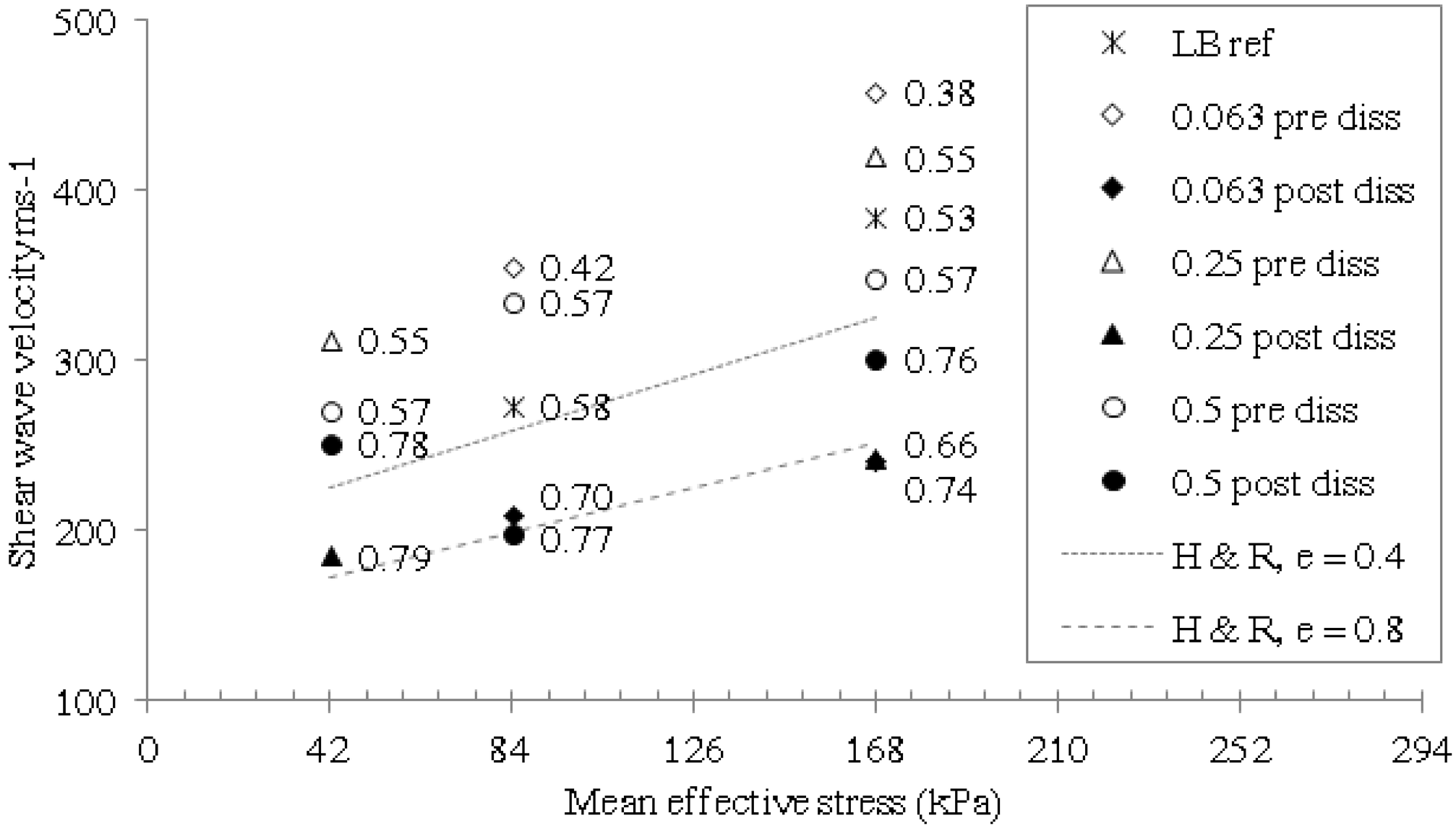
Shear wave data



Post isotropic loading

Dissolution stage

Shear wave velocities



Summary

- Testing apparatus successfully modified and testing procedure developed to allow dissolution tests be performed.
- Post-dissolution strength and volumetric behaviour varies from dilative to contractive depending on particle size removed.
- Good convergence of strength data on stress ratio graph.
- Loose sand sample preparation technique?
- Larger particles removed result in compressive behaviour over larger axial strains.
- Approximately 40% decrease in shear wave velocity apparently independent of salt particle size removed in 15% by mass dissolved.