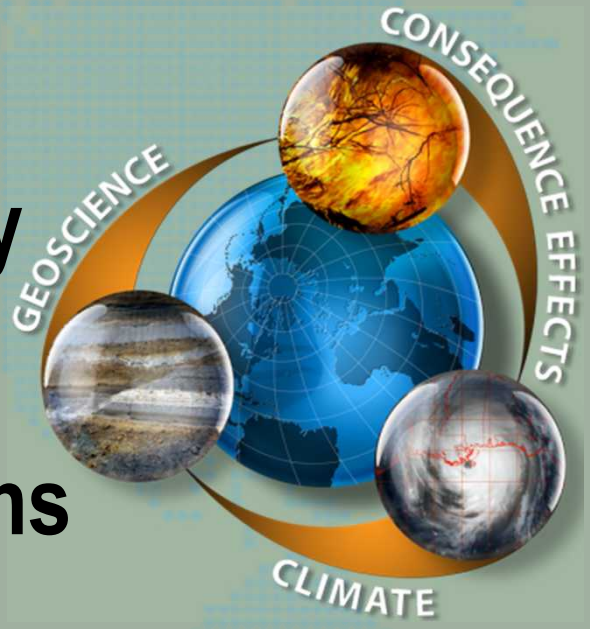
SAND2015-5076C

ARMA
american rock mechanics association

Helium-Mass-Spectrometry-Permeameter for the measurement of permeability of low permeability rock with application to triaxial deformation conditions



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National Nuclear Security Administration

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Two types of experiments using helium mass spectrometer:

Permeability estimations at a constant confining pressure

low differential pressures
low pressure gradient,
test times reasonable (hours)

Flow measurements during triaxial deformation

Starting materials

Permeability measurements

Devonian/Miss. Olentangy shale/Ohio drill core from about 670 m of depth.

20% quartz,

50% clay,

5% pyrite,

25% calcite

Deformation experiment

Shale 2

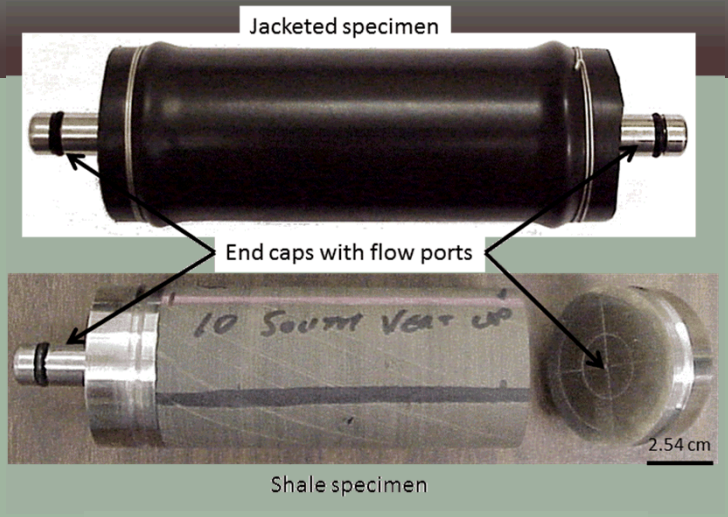
30 % quartz

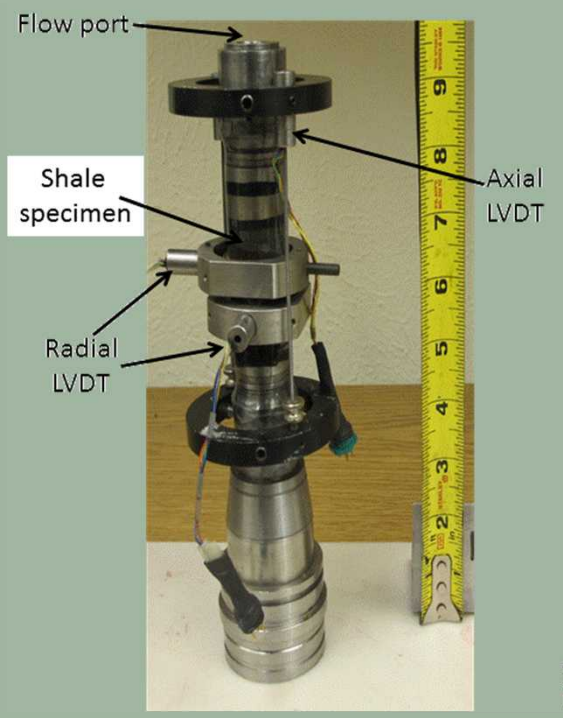
36% clay,

19 % calcite,

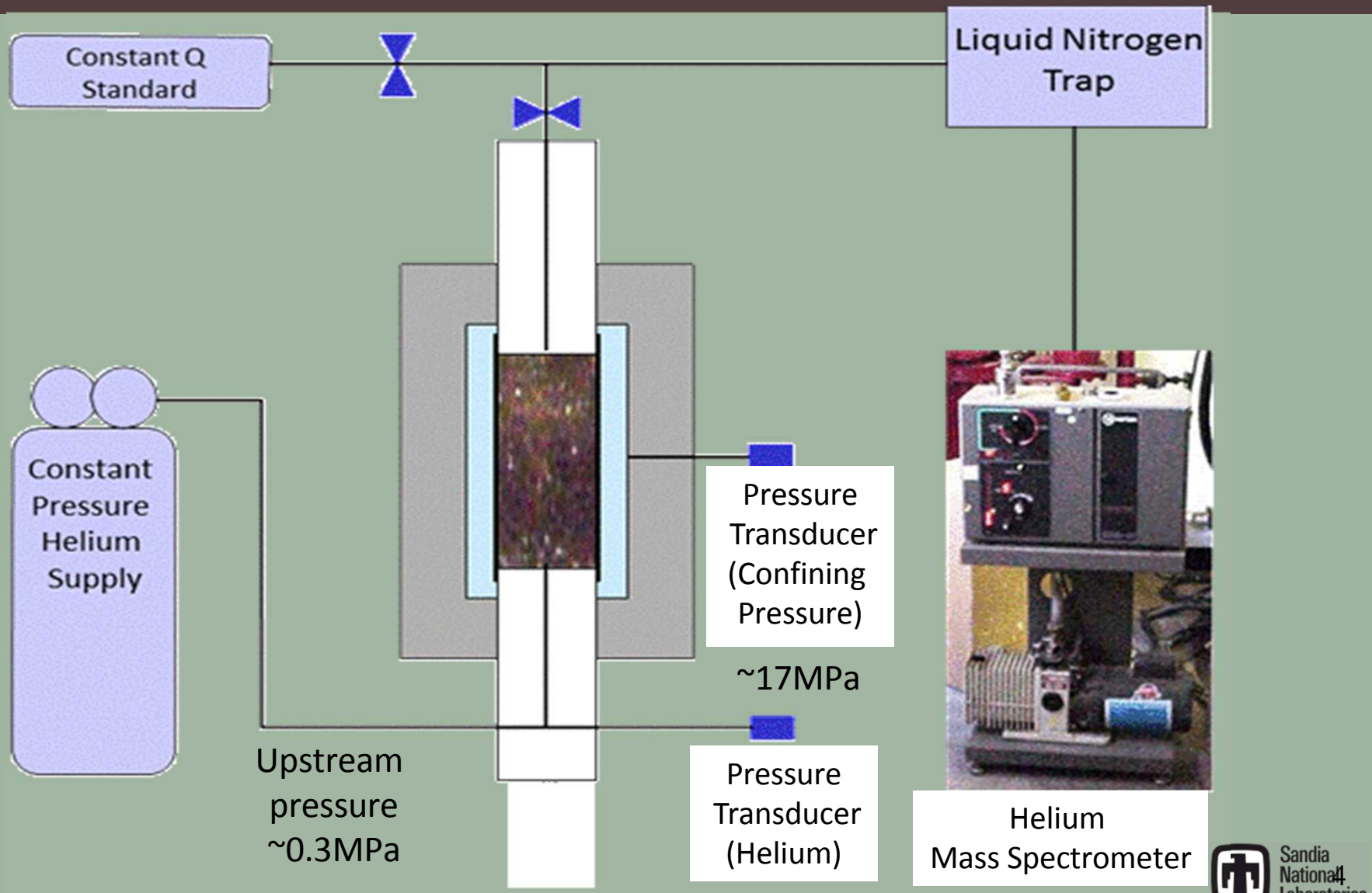
10 % feldspars,

5 % other

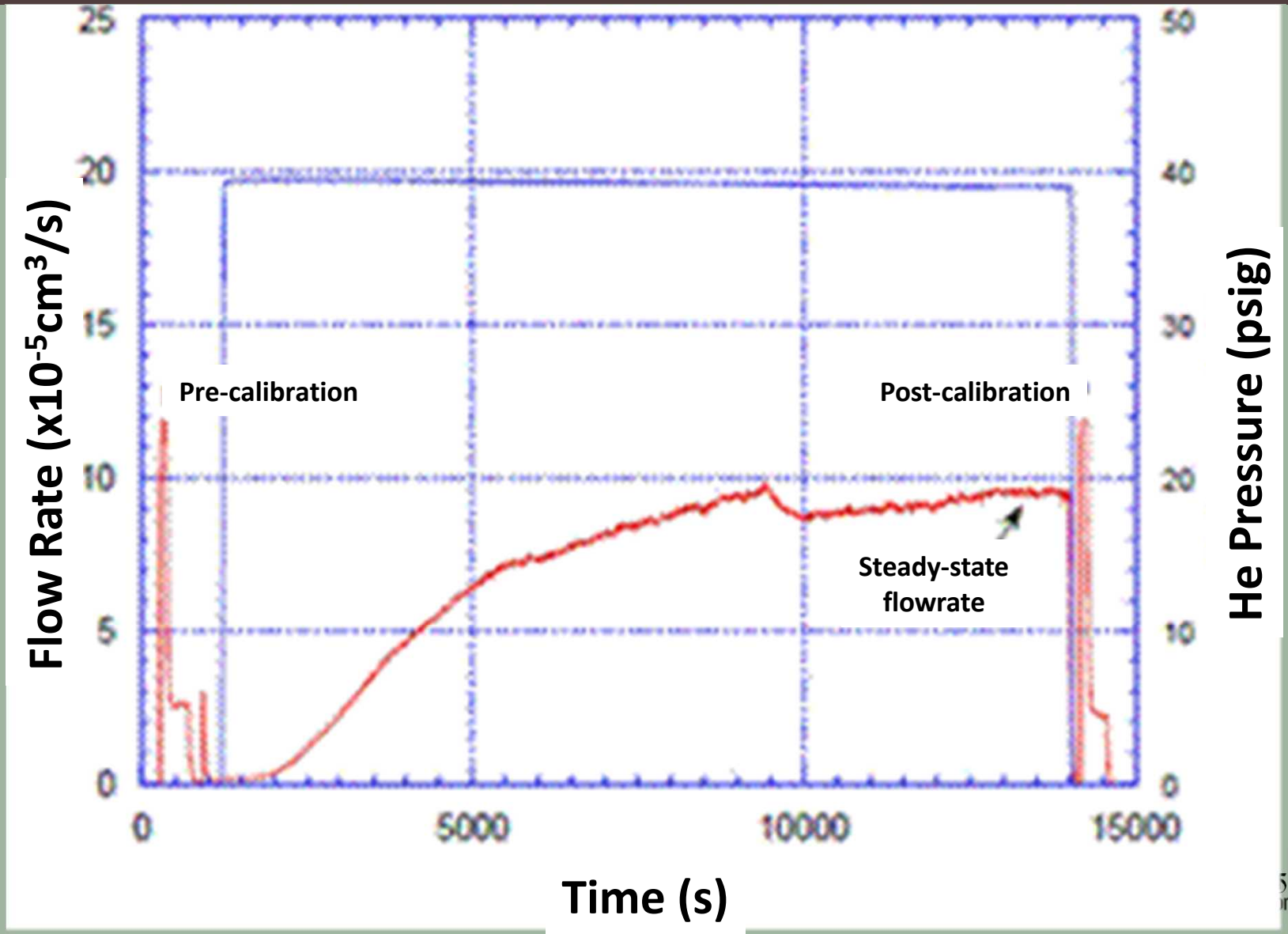




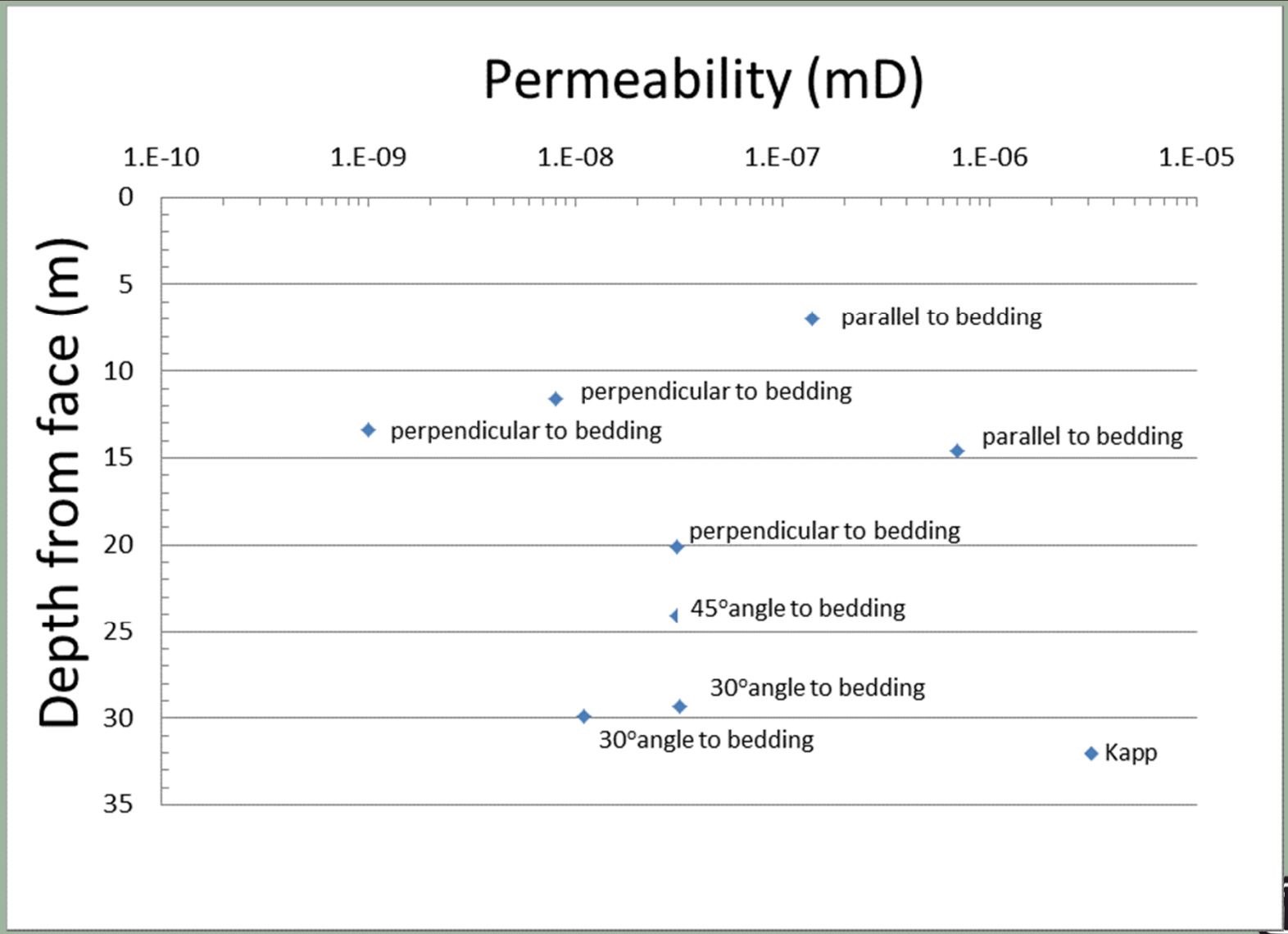
Permeability measurement set-up schematic using helium mass spectrometer



Perm measurements



Constant confining pressure perm



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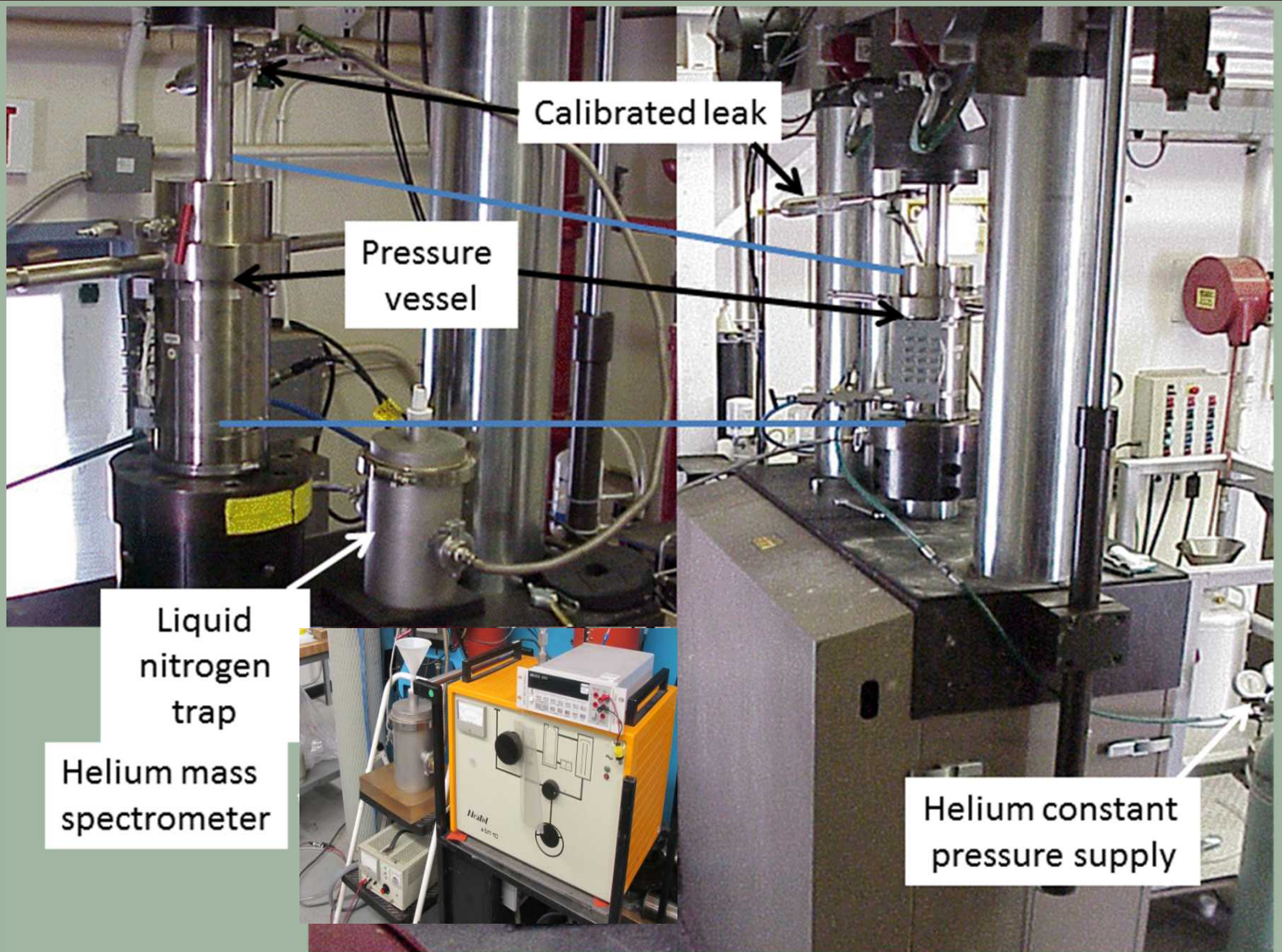
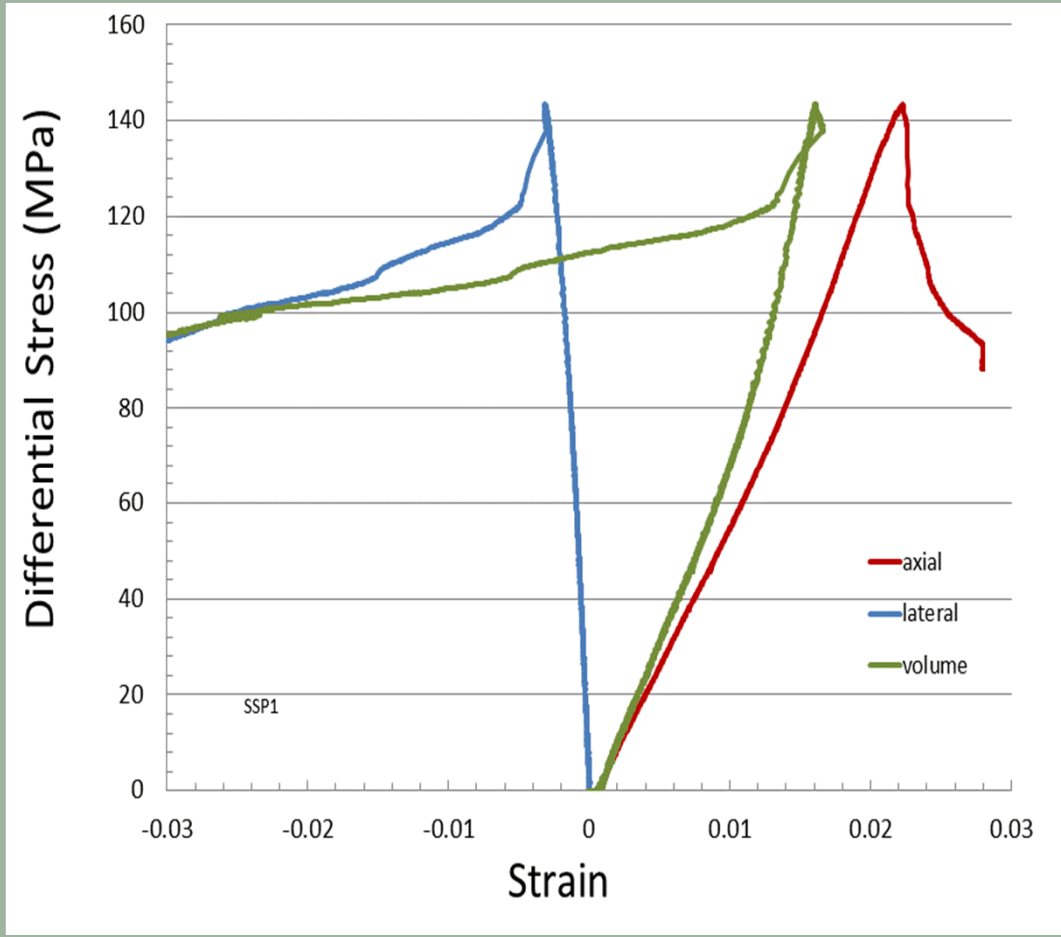
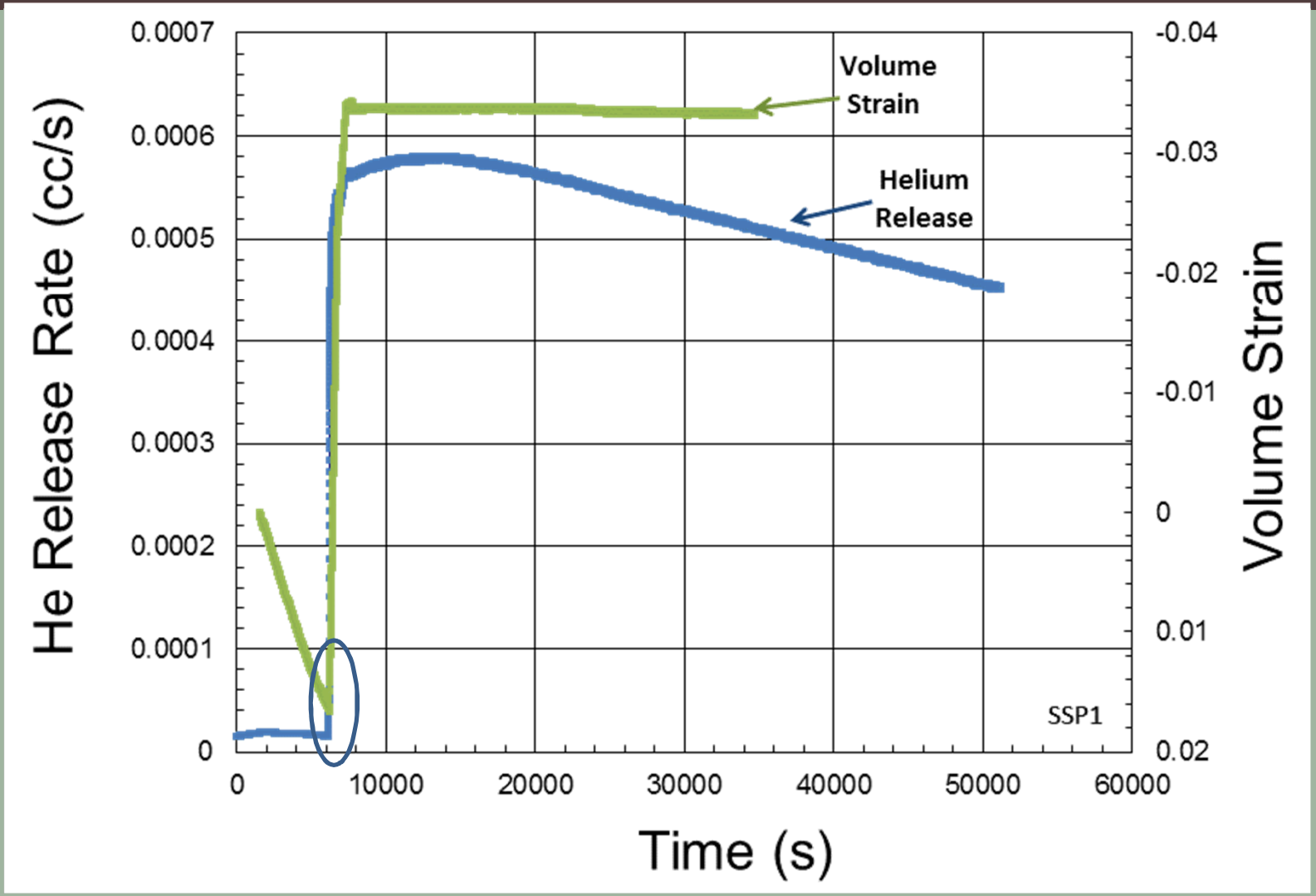
Test system for deformation experiment



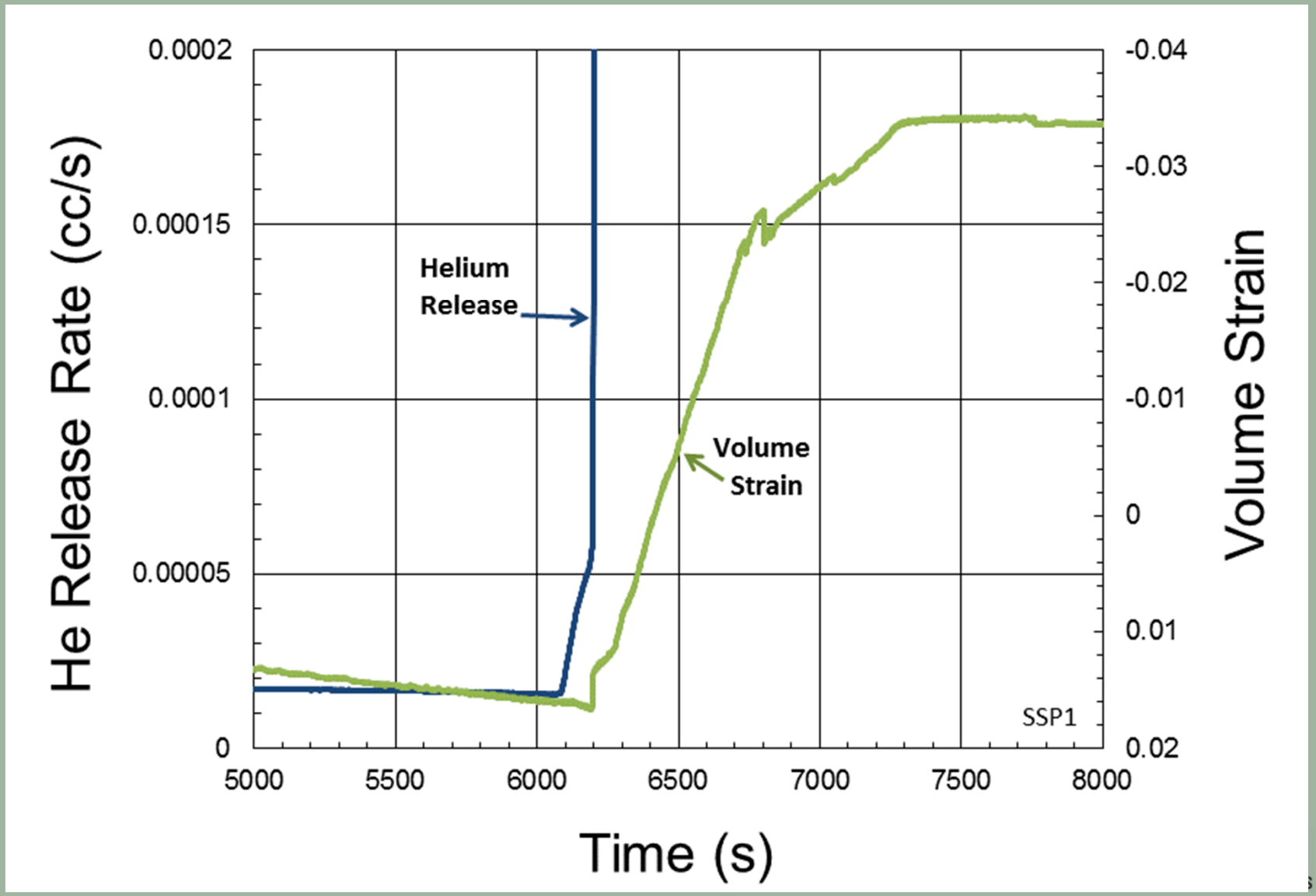
Triaxial deformation at ~20MPa confining pressure



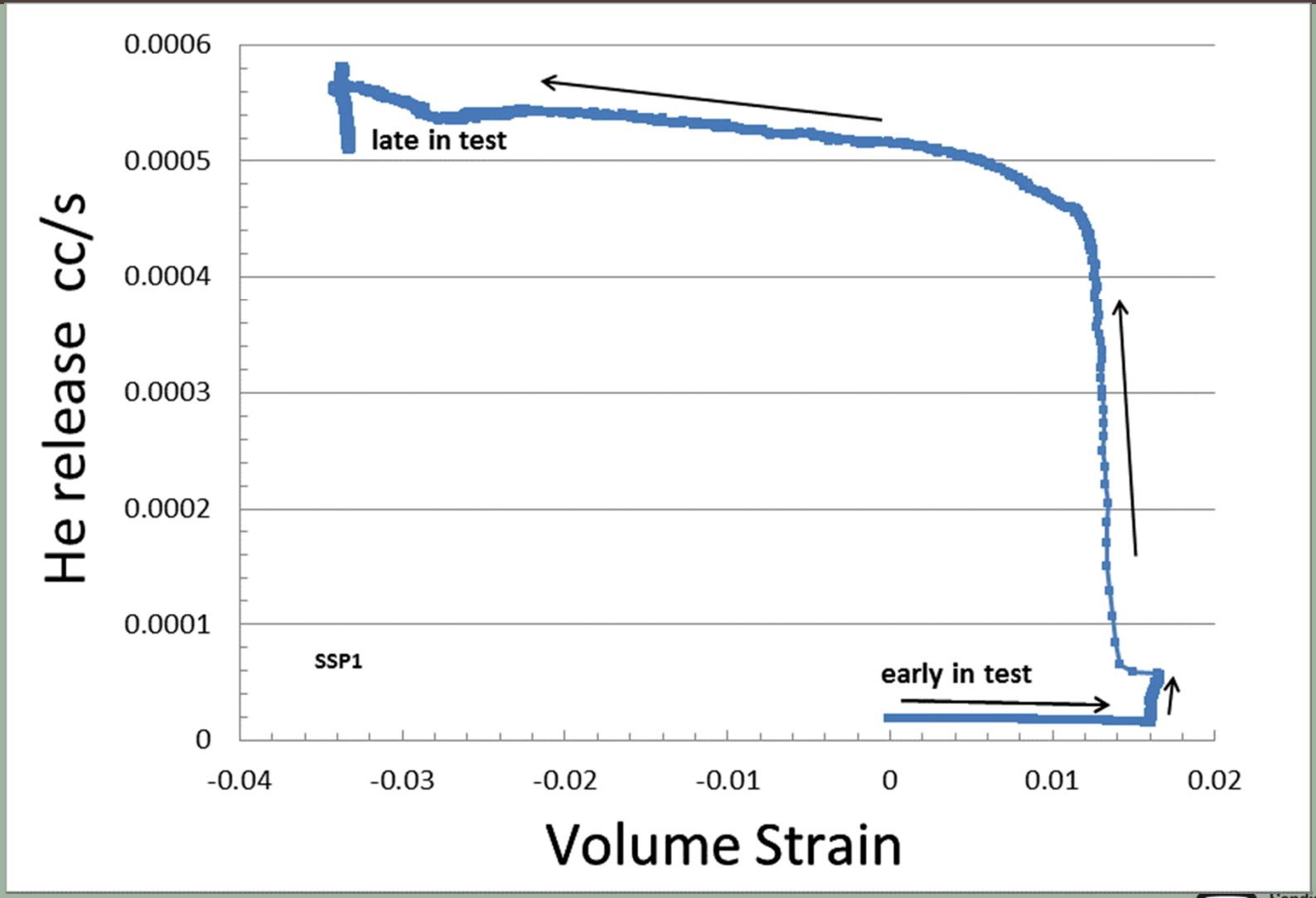
Volume strain and helium release vs time



Volume strain and helium release vs time



C


0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
He release cc/s
late in test
SSP1
early in test
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
Volume Strain

Concluding comments

- Helium mass spectrometer used to measure flow in low perm rock
  - low differential pressures; low pressure gradient,
  - test times reasonable (hours)
- During deformation
  - gas flow informs of microstructural evolution, crack presence and interconnectivity, in advance of macrofracture formation

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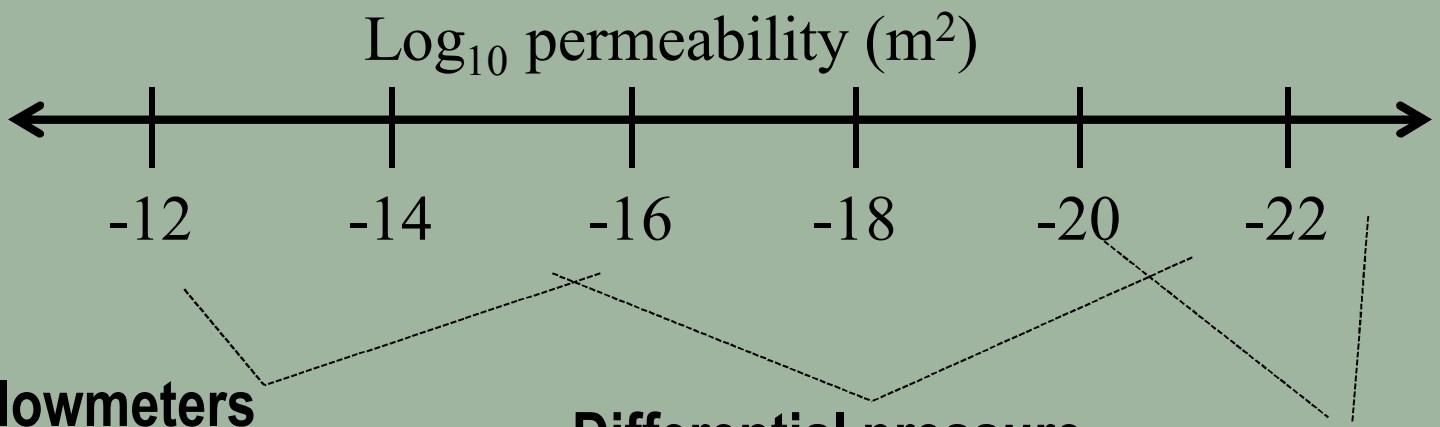
Thanks!

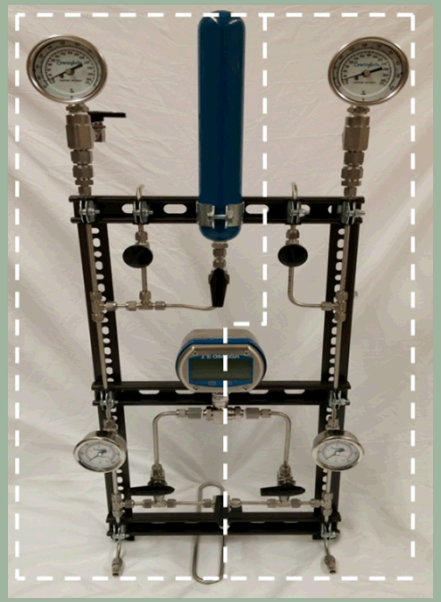
Questions?

Permeability system



Flowmeters

Differential pressure



Helium mass spectrometer

Solution/Impact