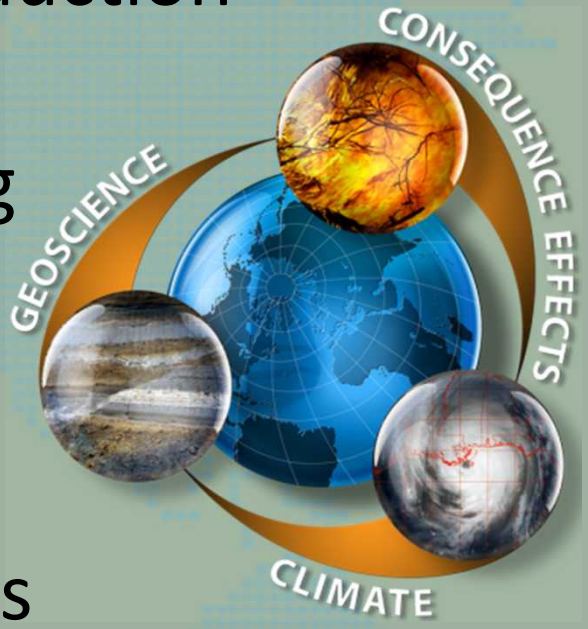
SAND2014-19963C

Compaction and Permeability Reduction of Castlegate Sandstone under Pore Pressure Cycling



SJ Bauer
Geomechanics
Sandia National Laboratories

National Nuclear Security Administration

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Outline

- Rationale
- Castlegate Sandstone
- Methods
- Results
- Interpretation

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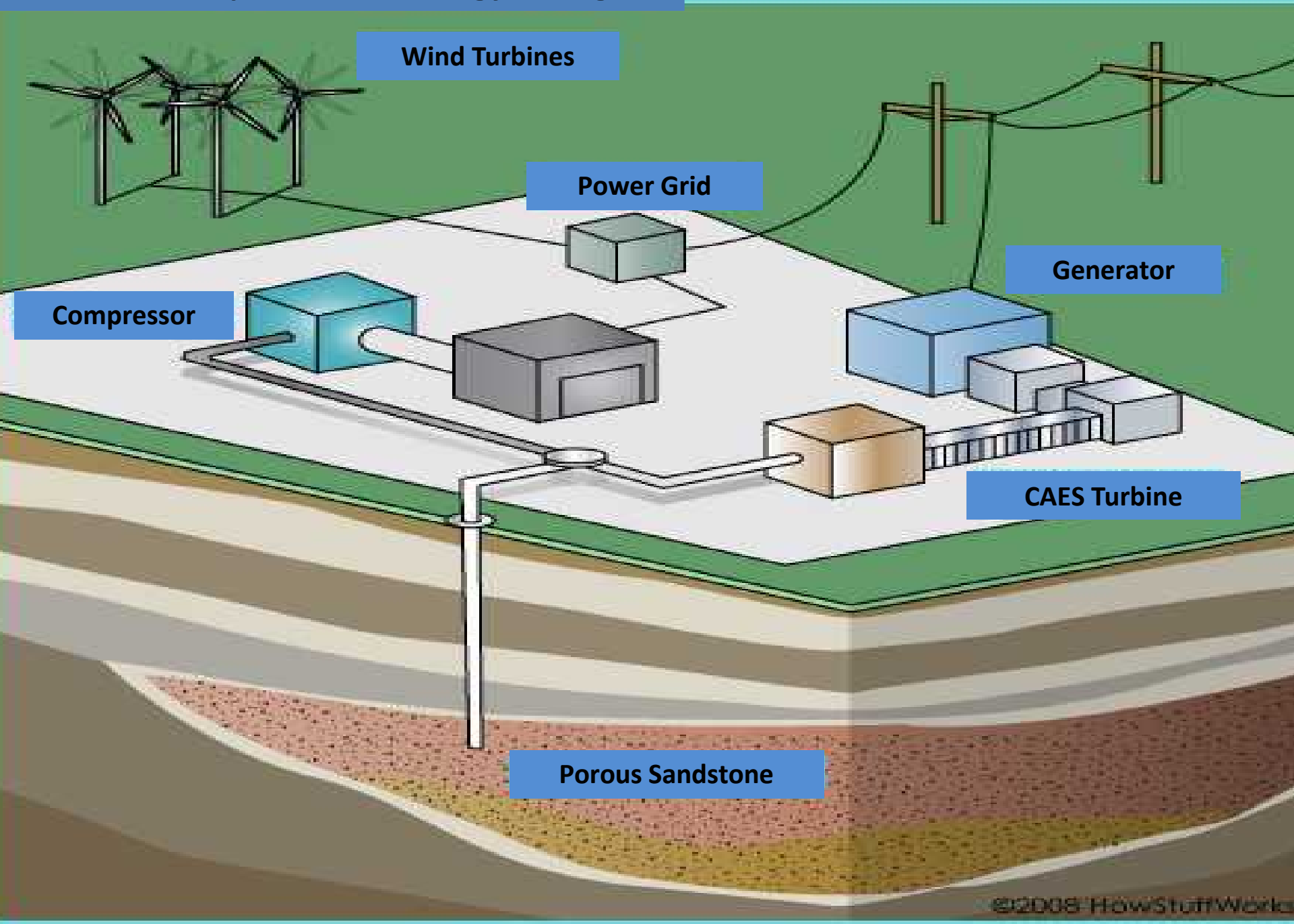
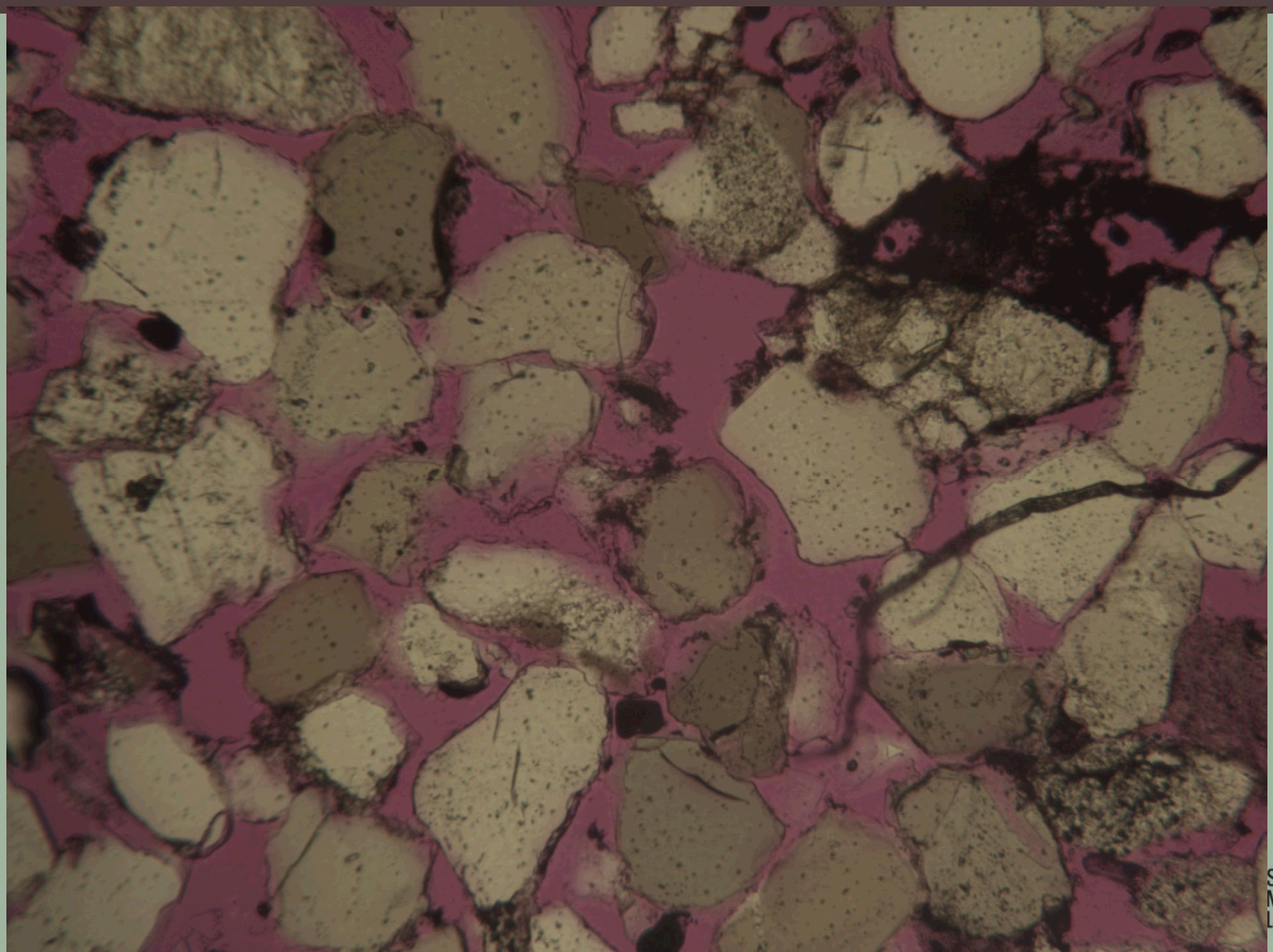
Rationale: Compressed Air Energy Storage



Castlegate Sandstone



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Methods

- Apply confining pressure, saturate rock with tap water
- Conduct flow tests during confining pressure increase to 20.8 Mpa; flow rate of 0.8cc/s
- Cycle pore pressure; P_p range: 6.9-10.3 MPa
- Measure dimensional displacements during cycling (calculate volume strain)
- Measure flow at intervals (calculate permeability)

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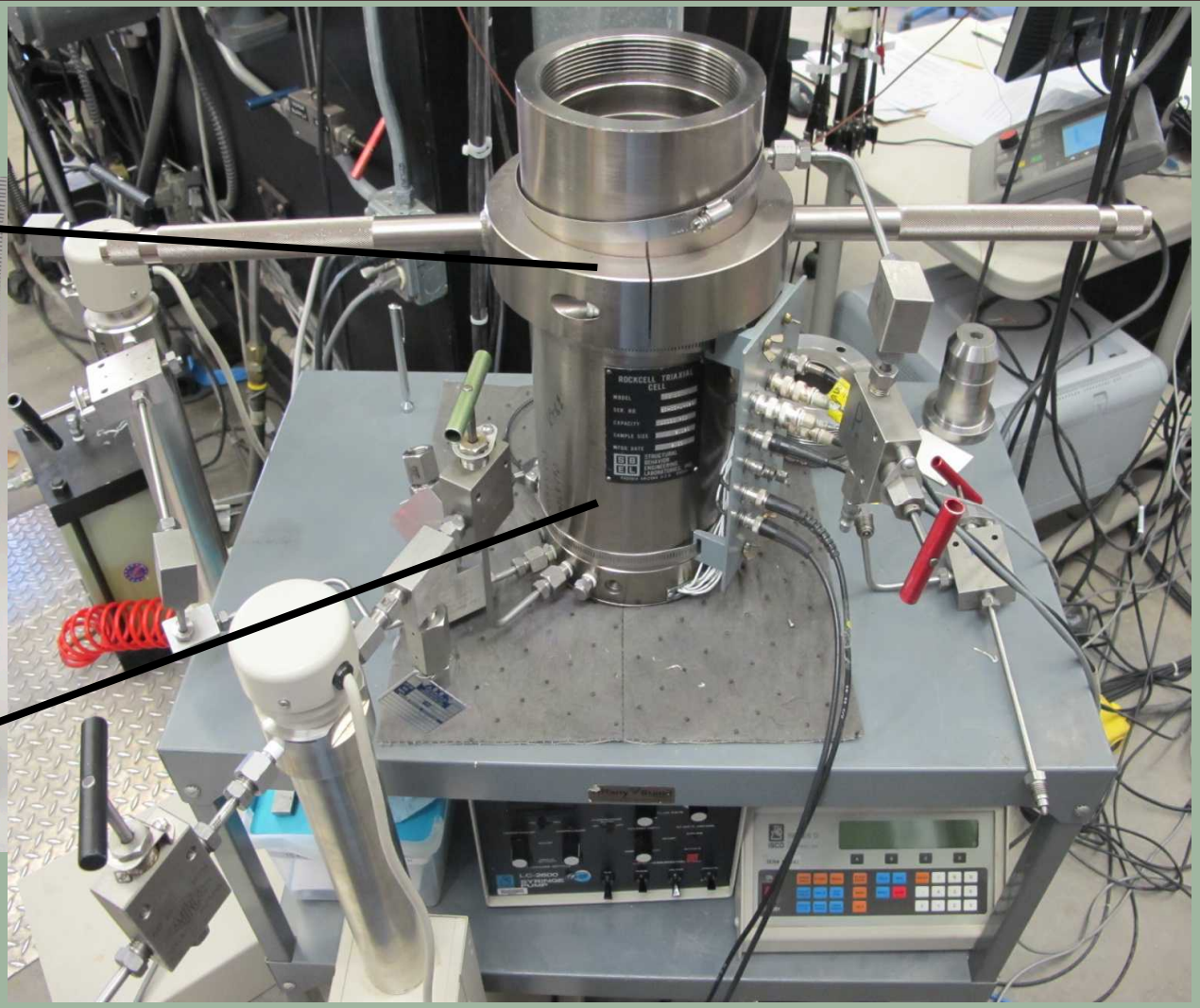
Methods



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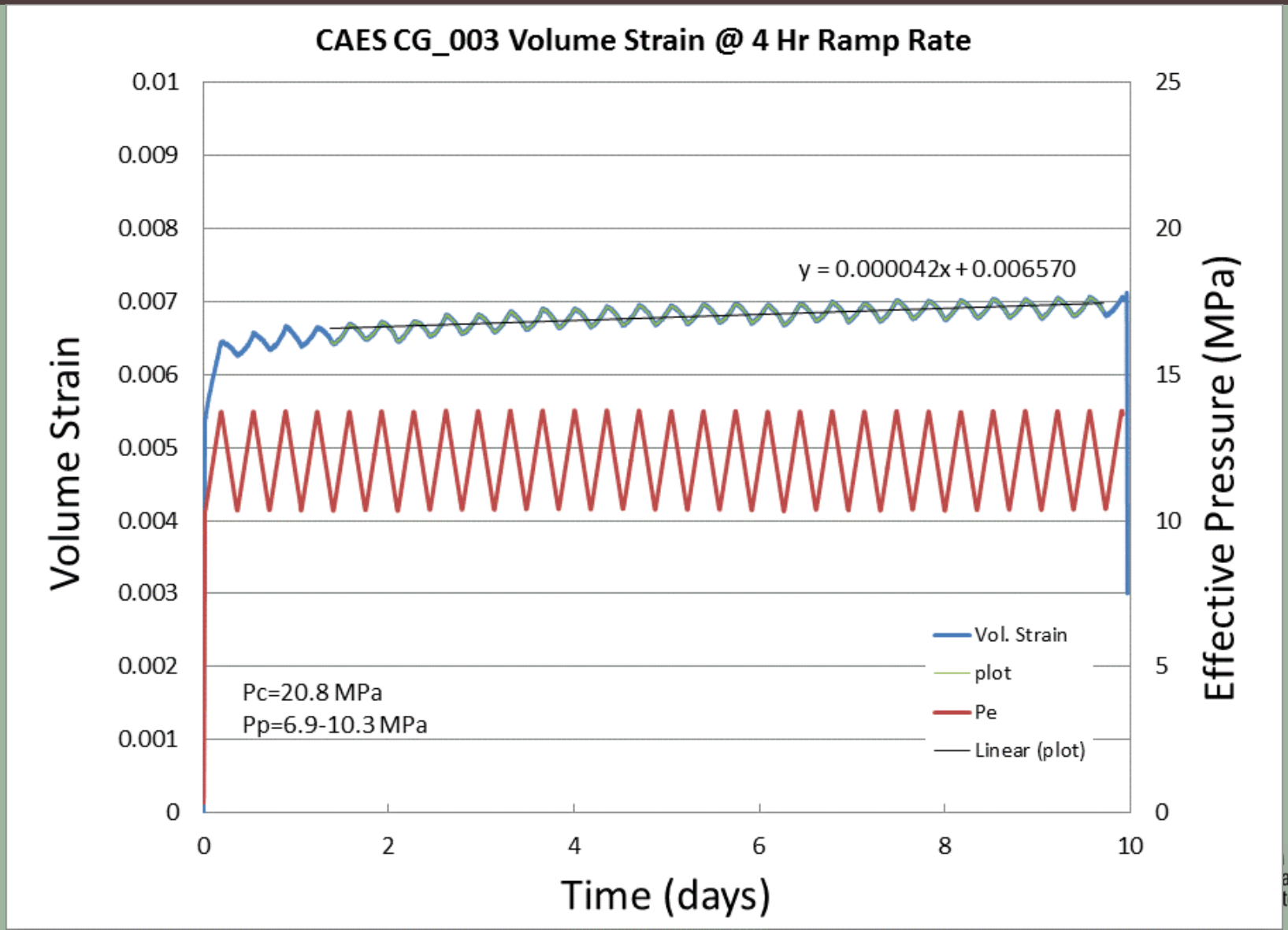
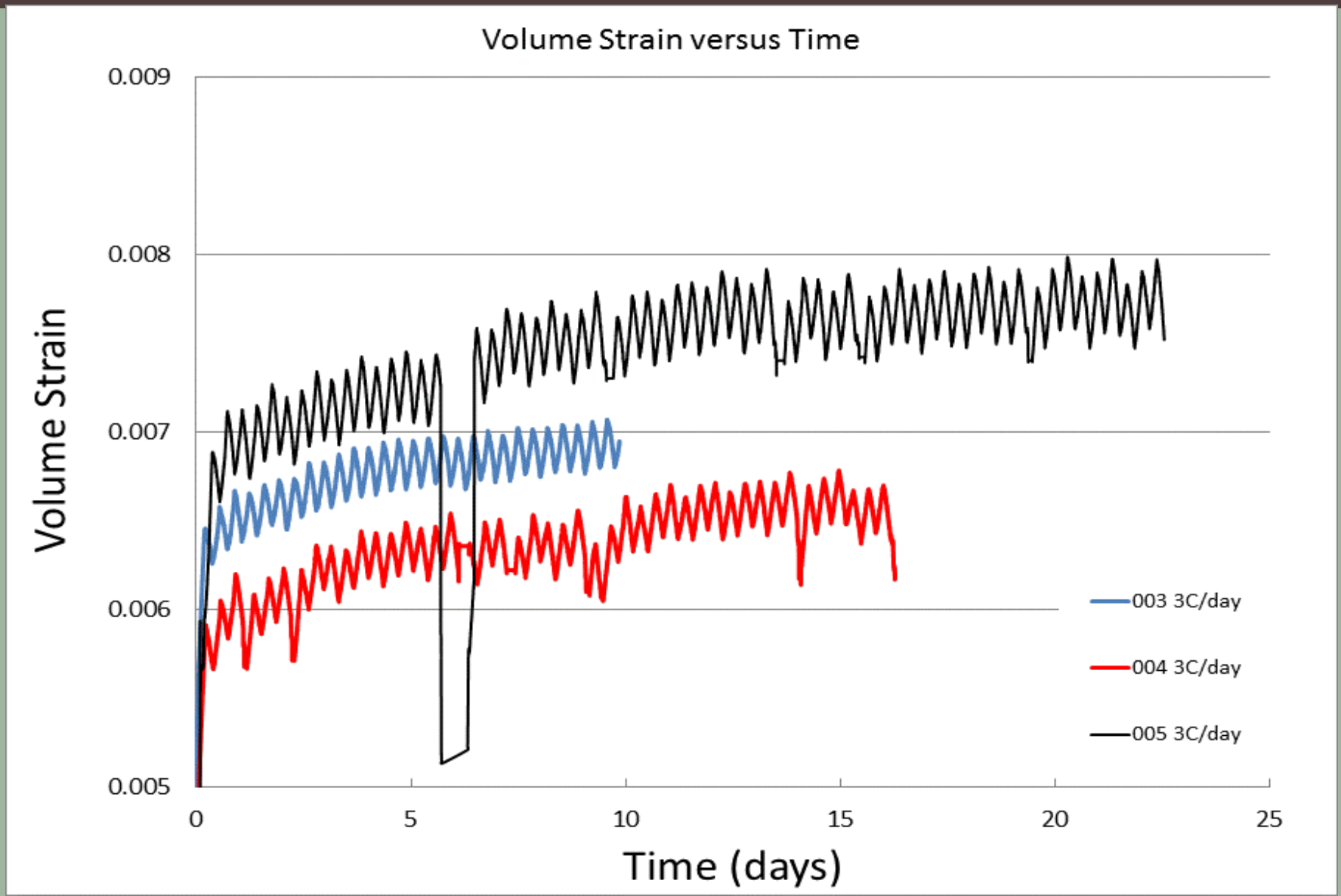
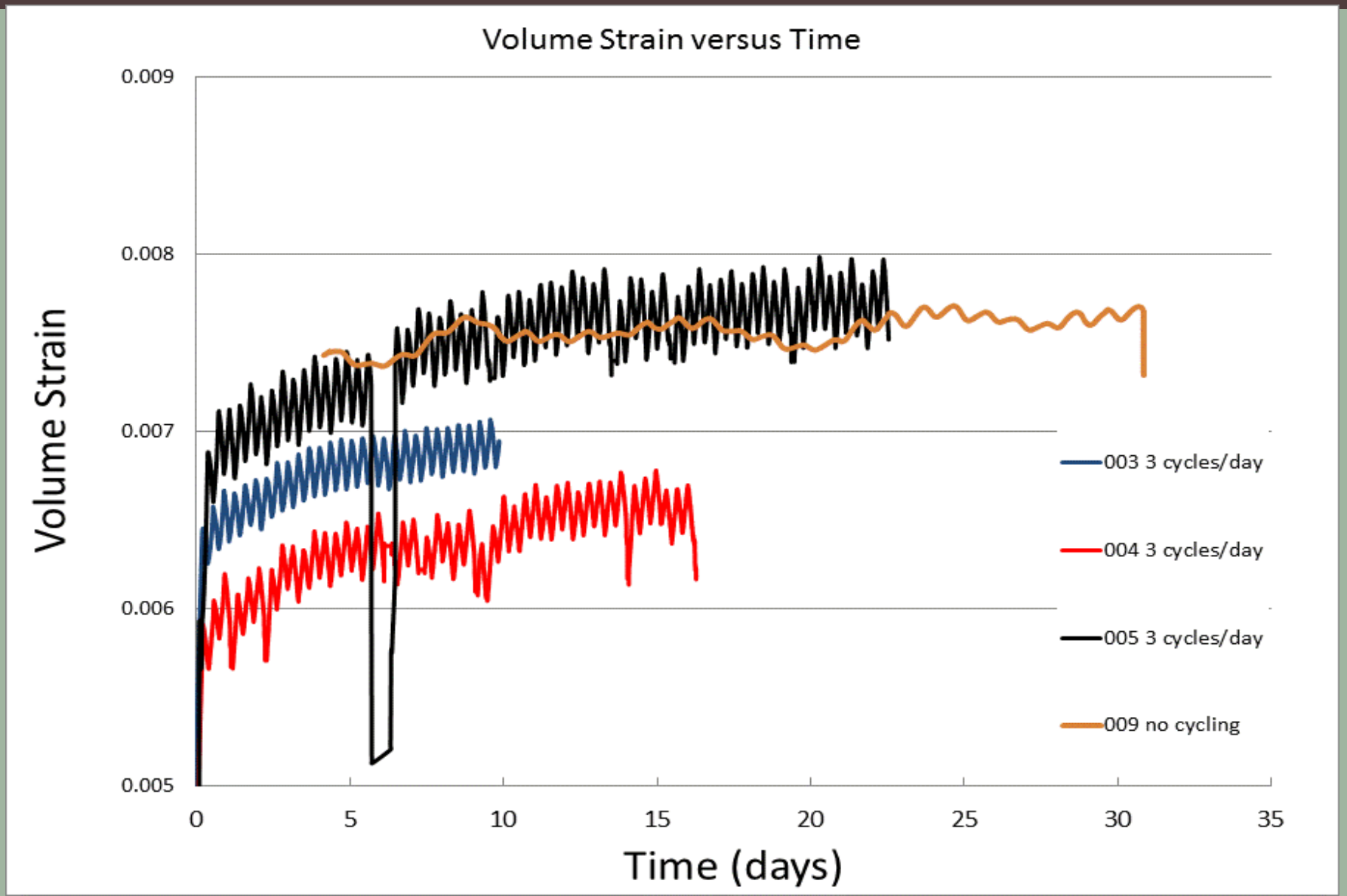
Methods


CAES CG_003 Volume Strain @ 4 Hr Ramp Rate
Volume Strain
Effective Pressure (MPa)
Time (days)
y = 0.000042x + 0.006570
Pc=20.8 MPa
Pp=6.9-10.3 MPa
Vol. Strain
plot
Pe
Linear (plot)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
25
20
15
10
5
0
0
2
4
6
8
10

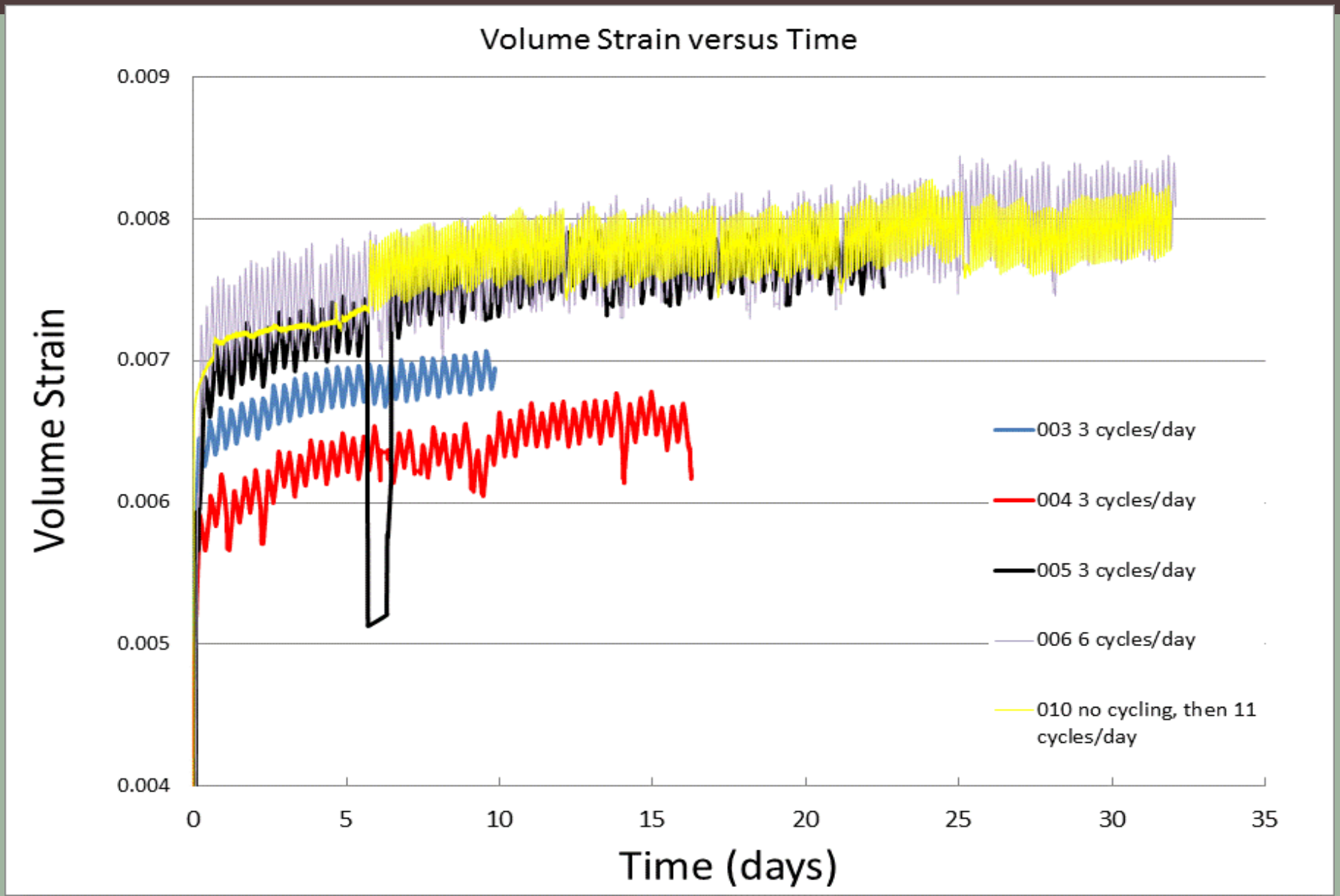
Results


Volume Strain versus Time
0.009
0.008
0.007
0.006
0.005
Volume Strain
0
5
10
15
20
25
Time (days)
003 3C/day
004 3C/day
005 3C/day

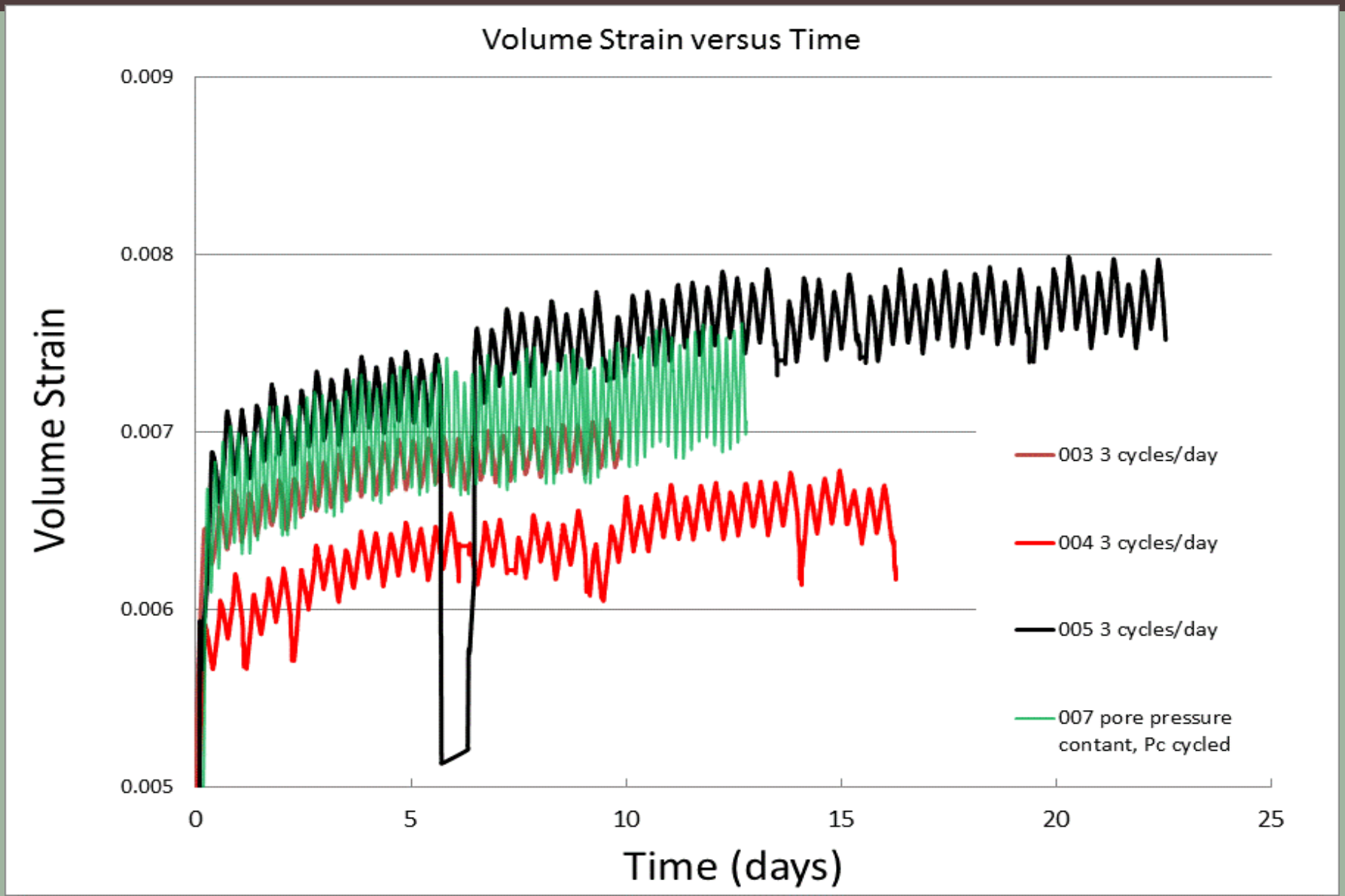
Volume strain cycling vs not



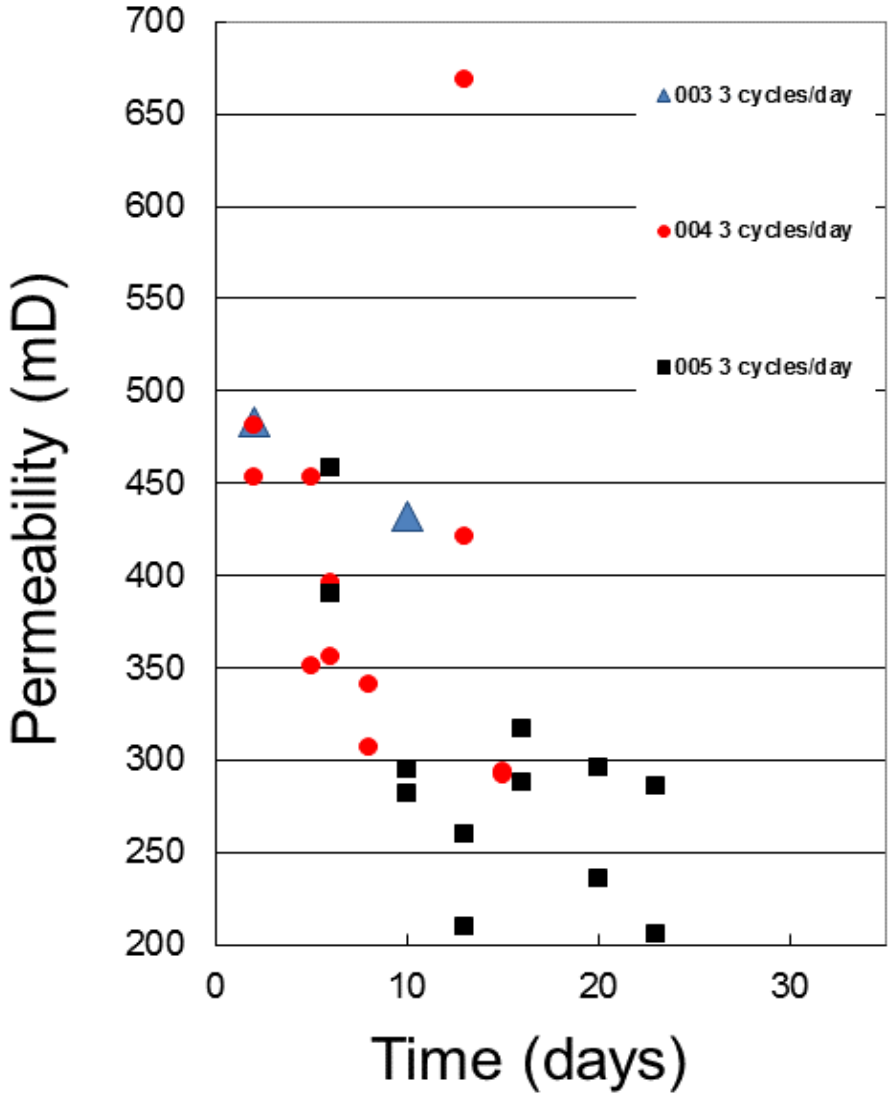
Volume strain, rate effect

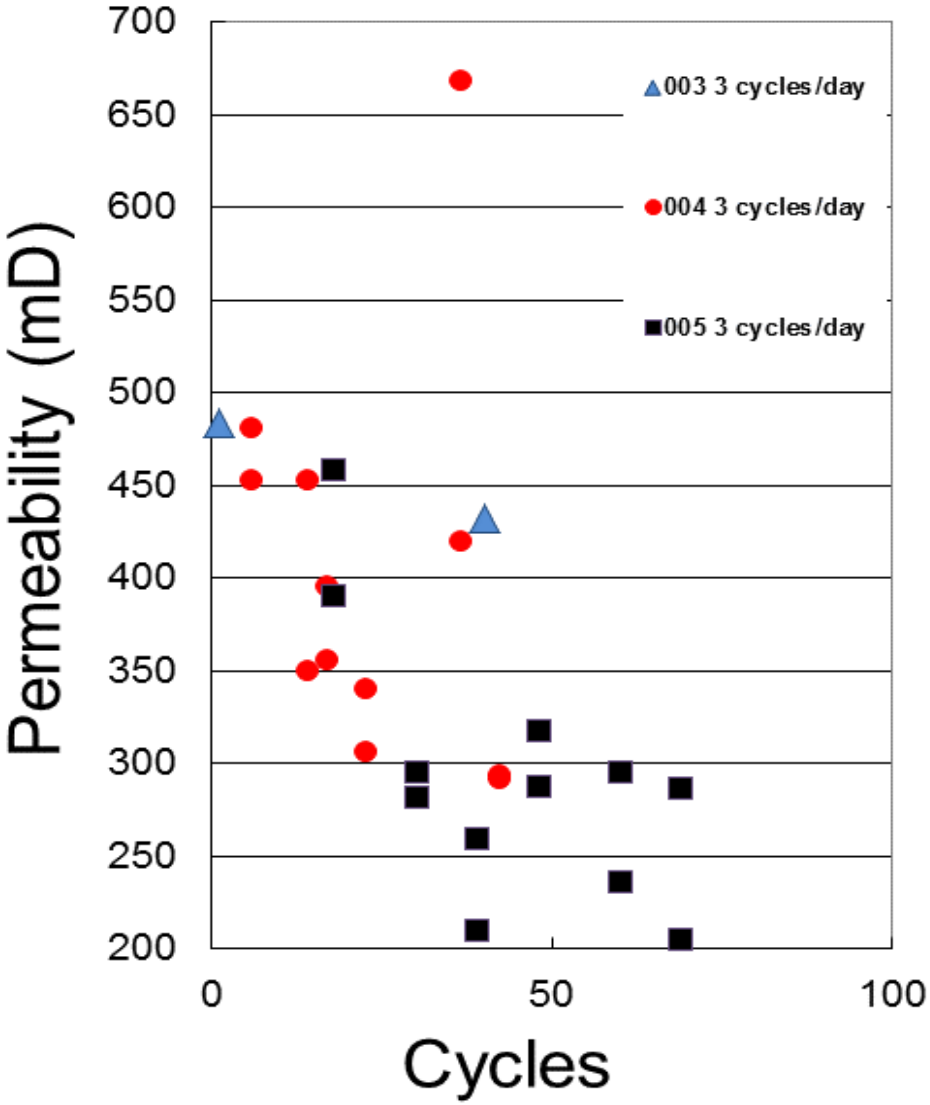


Volume strain, Pc cycles

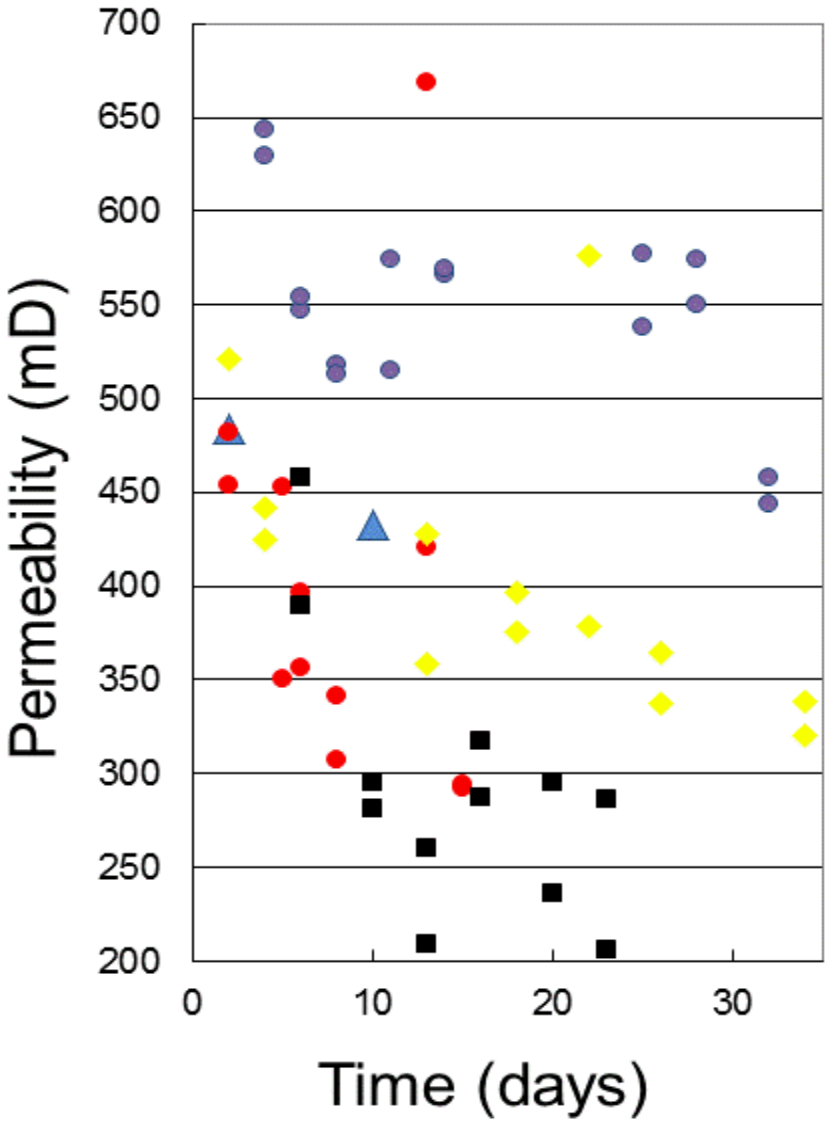


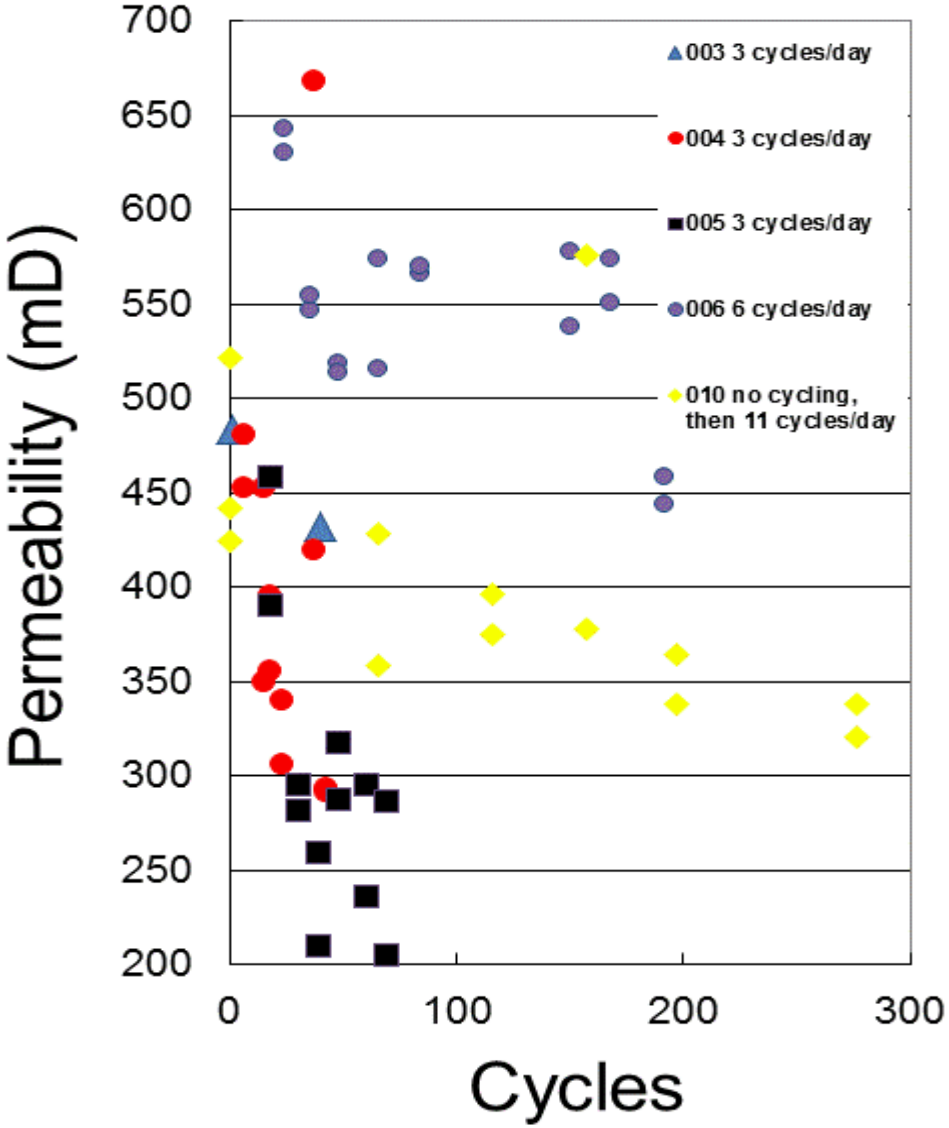
Permeability decrease: time, cycles



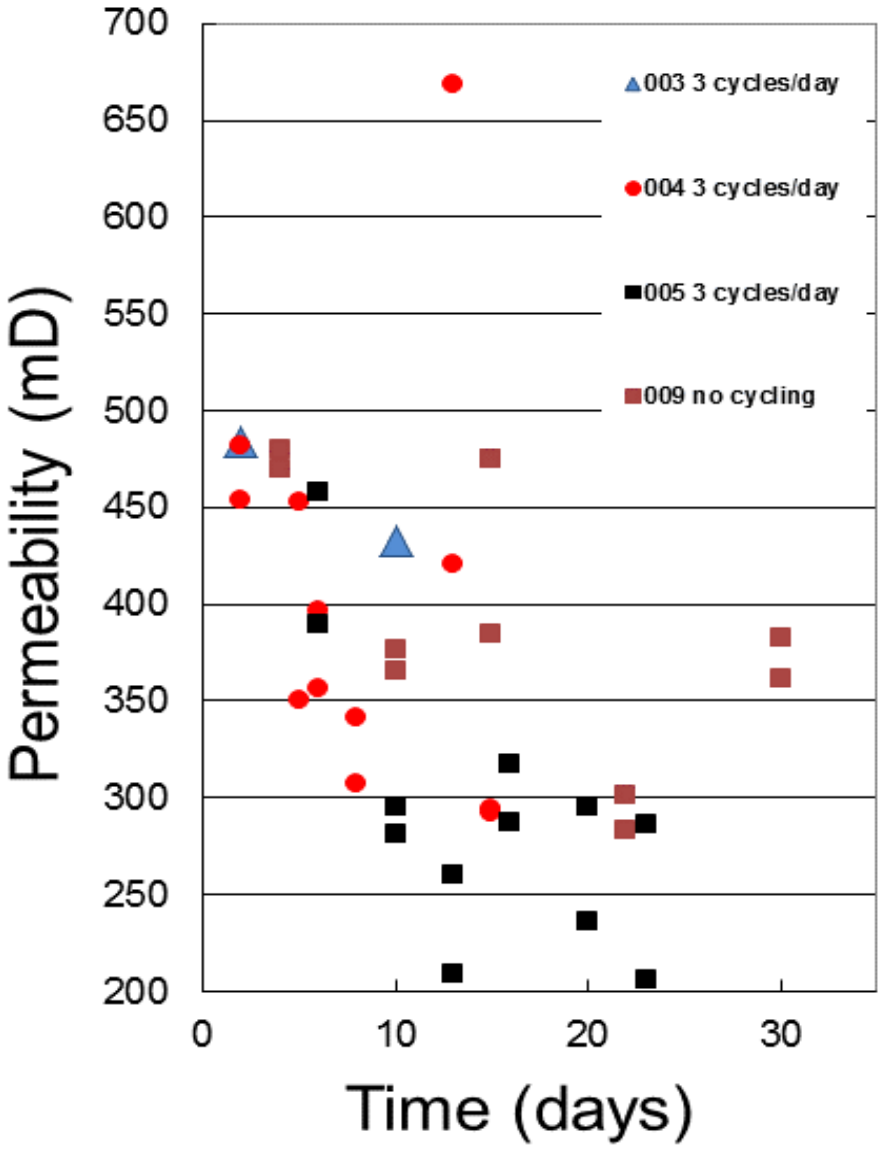


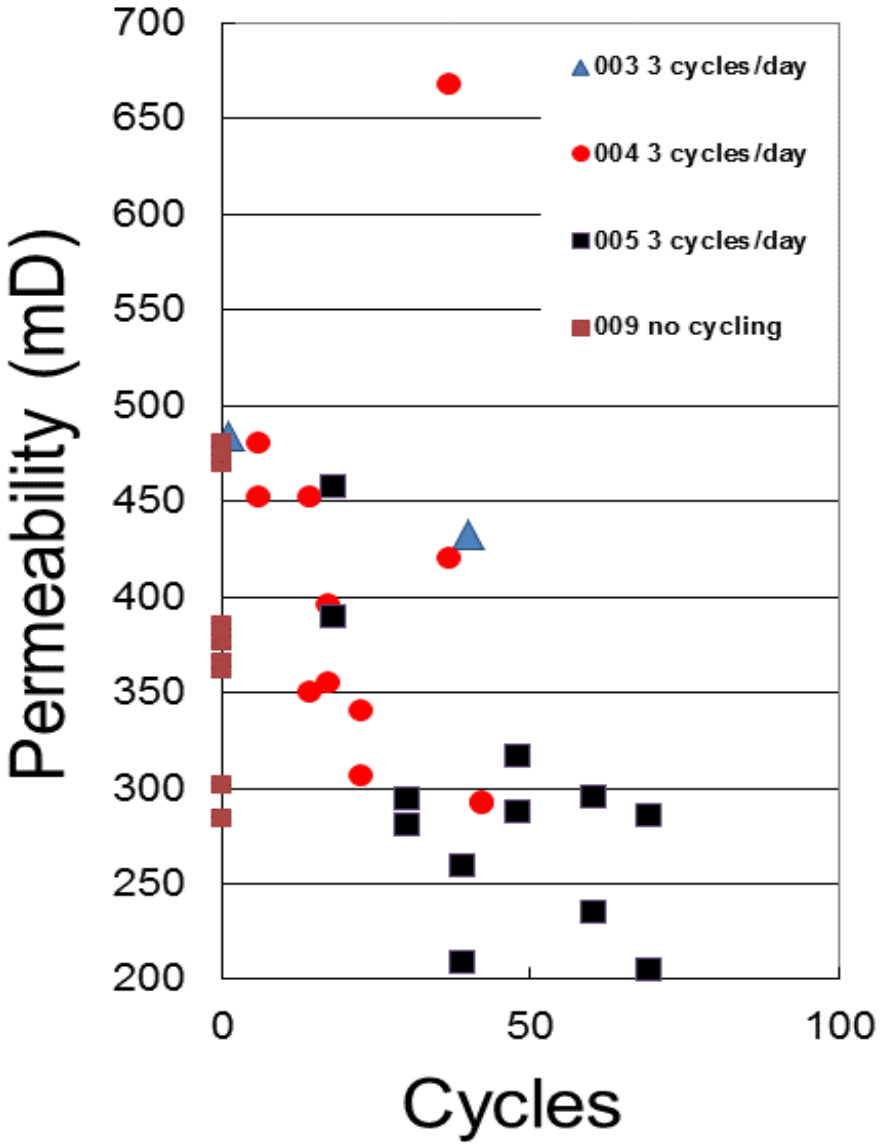
Permeability decrease time, cycles; rate effect



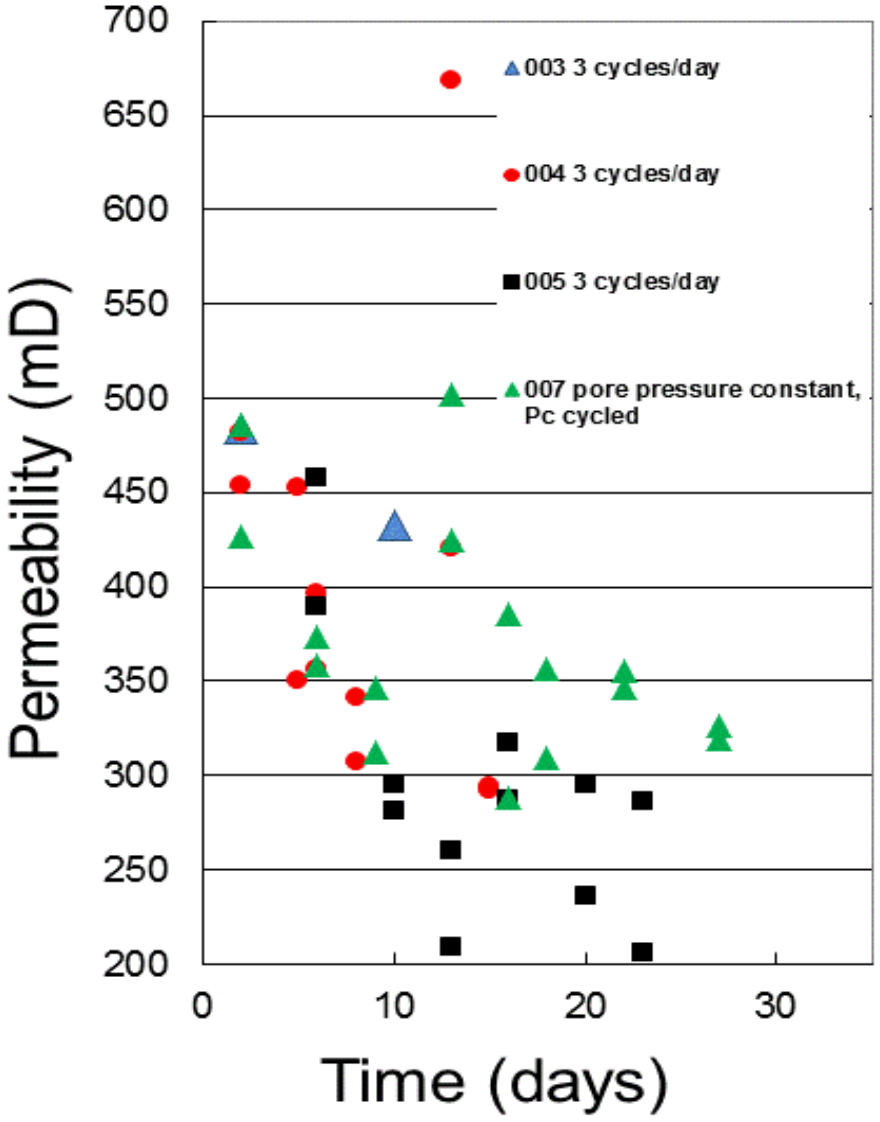


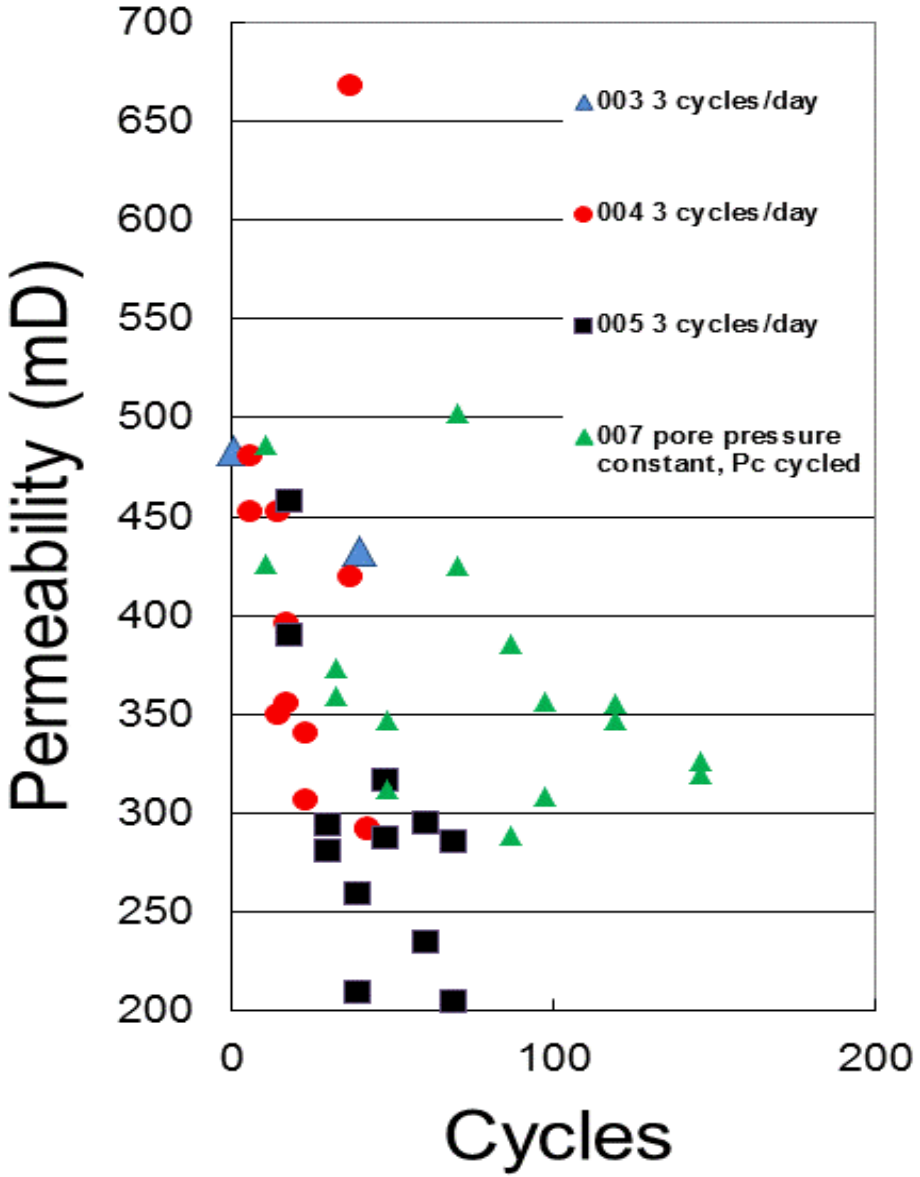
Permeability decrease cycle VS not



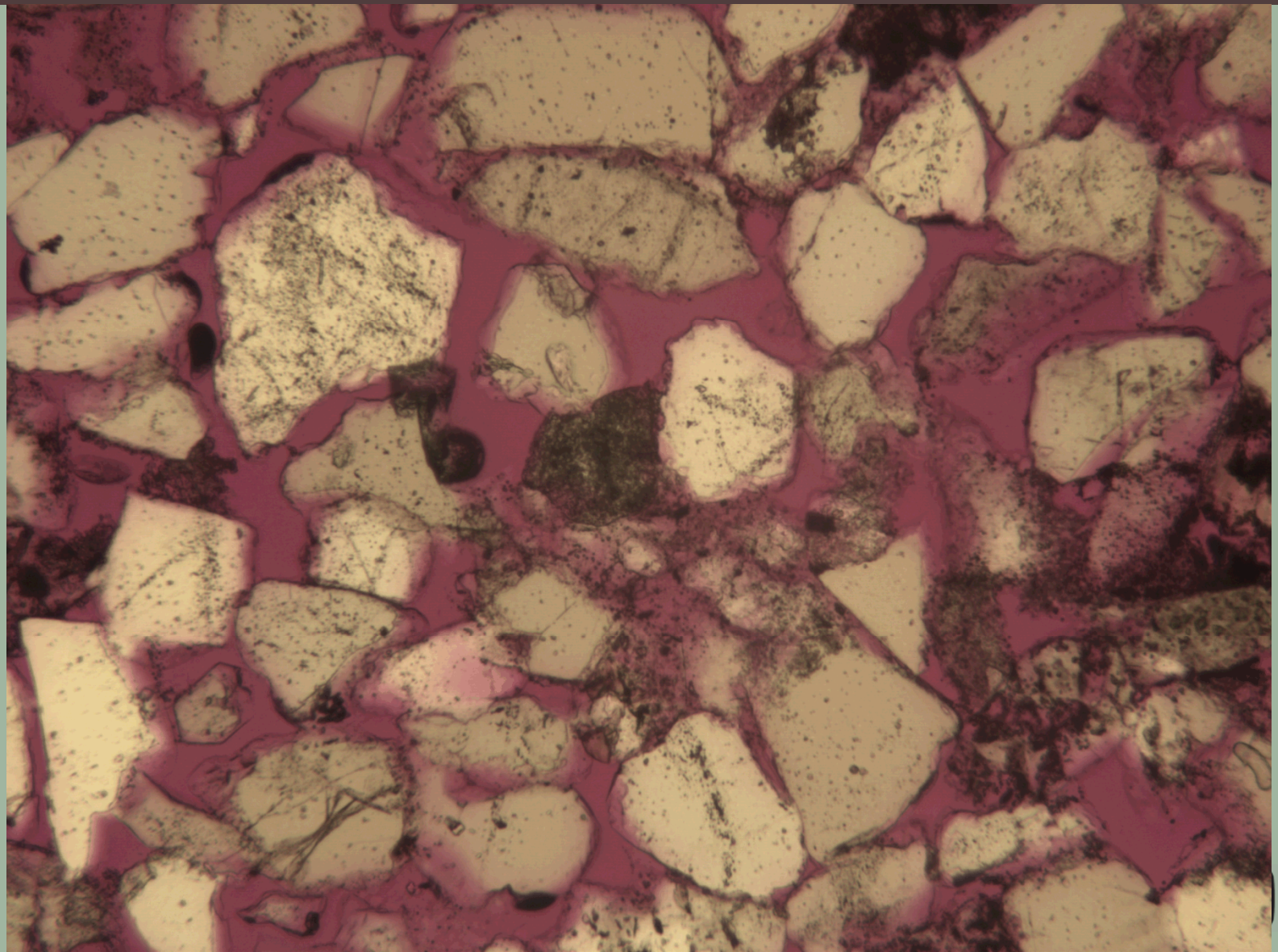


Permeability decrease time, cycles; Pc cycles





Results



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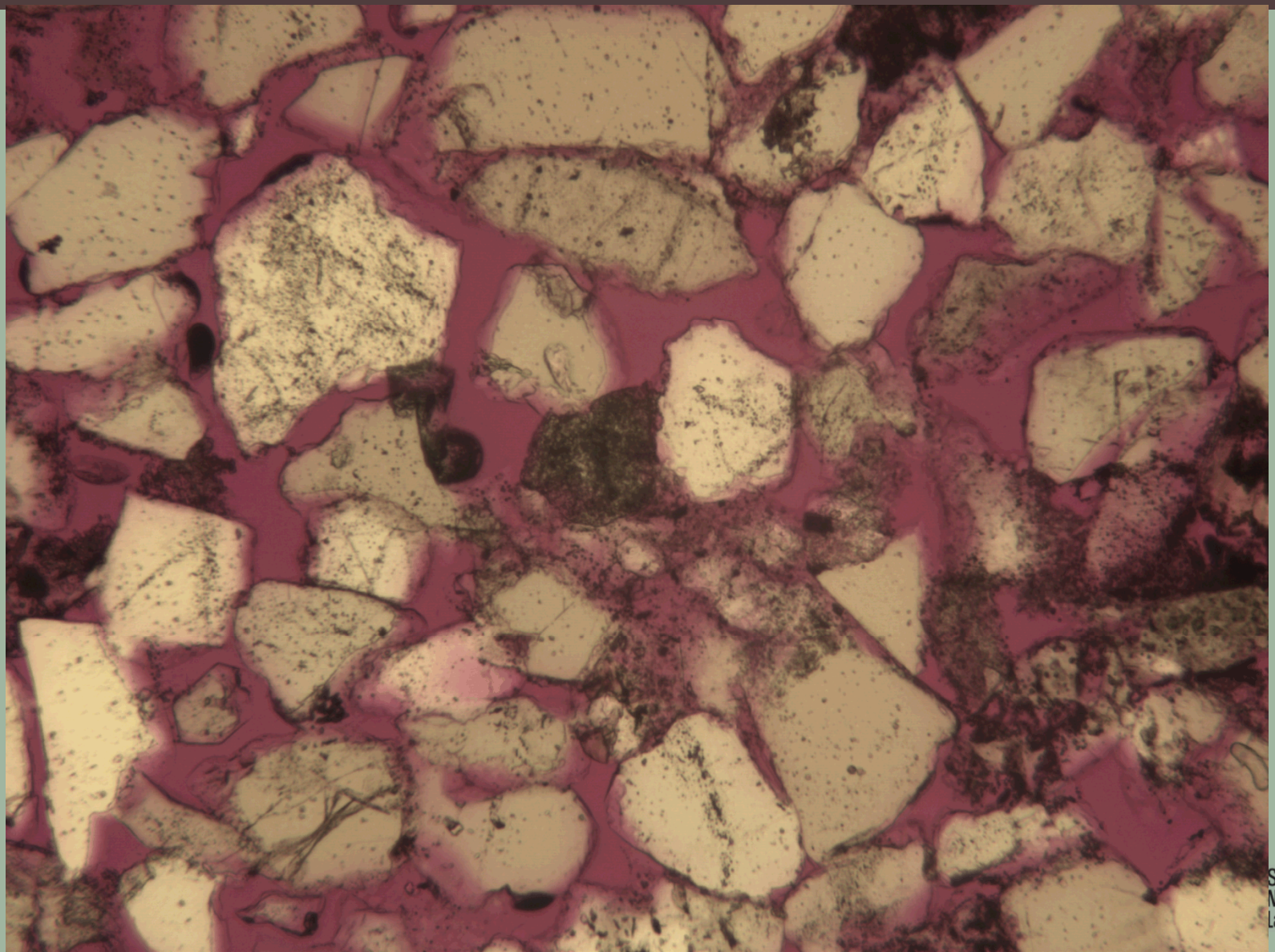
Interpretation



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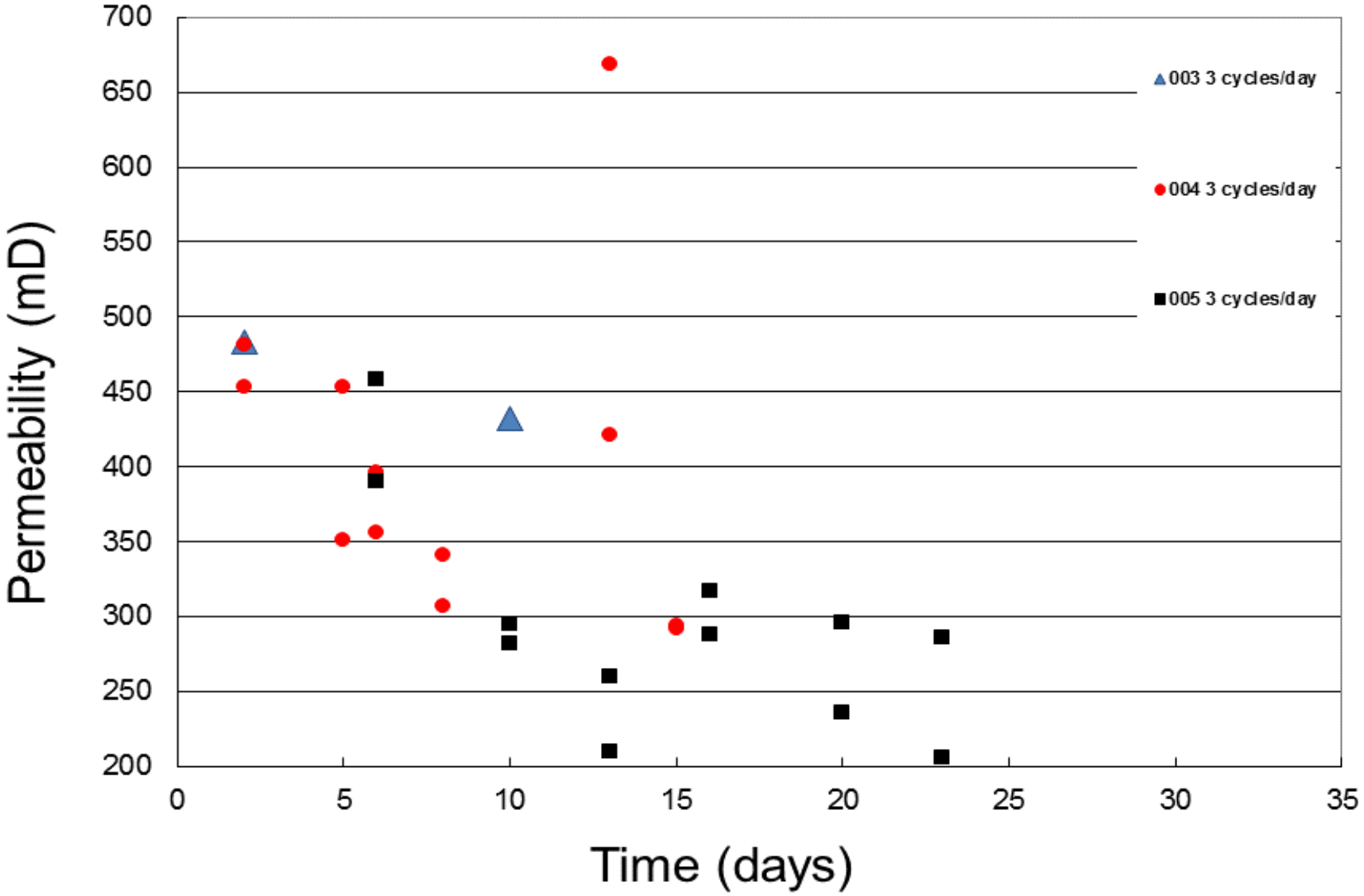
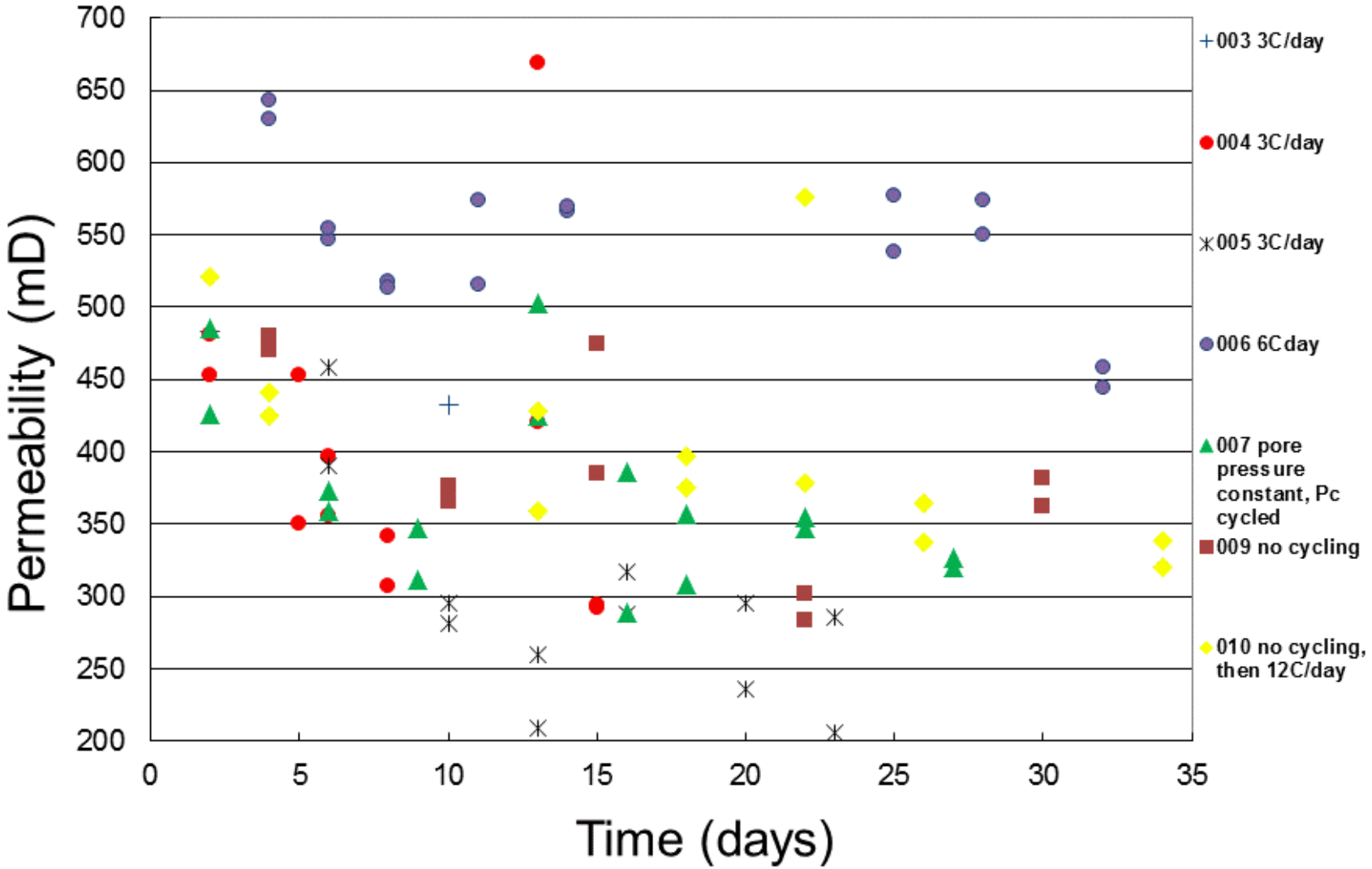
Thanks!

Questions?

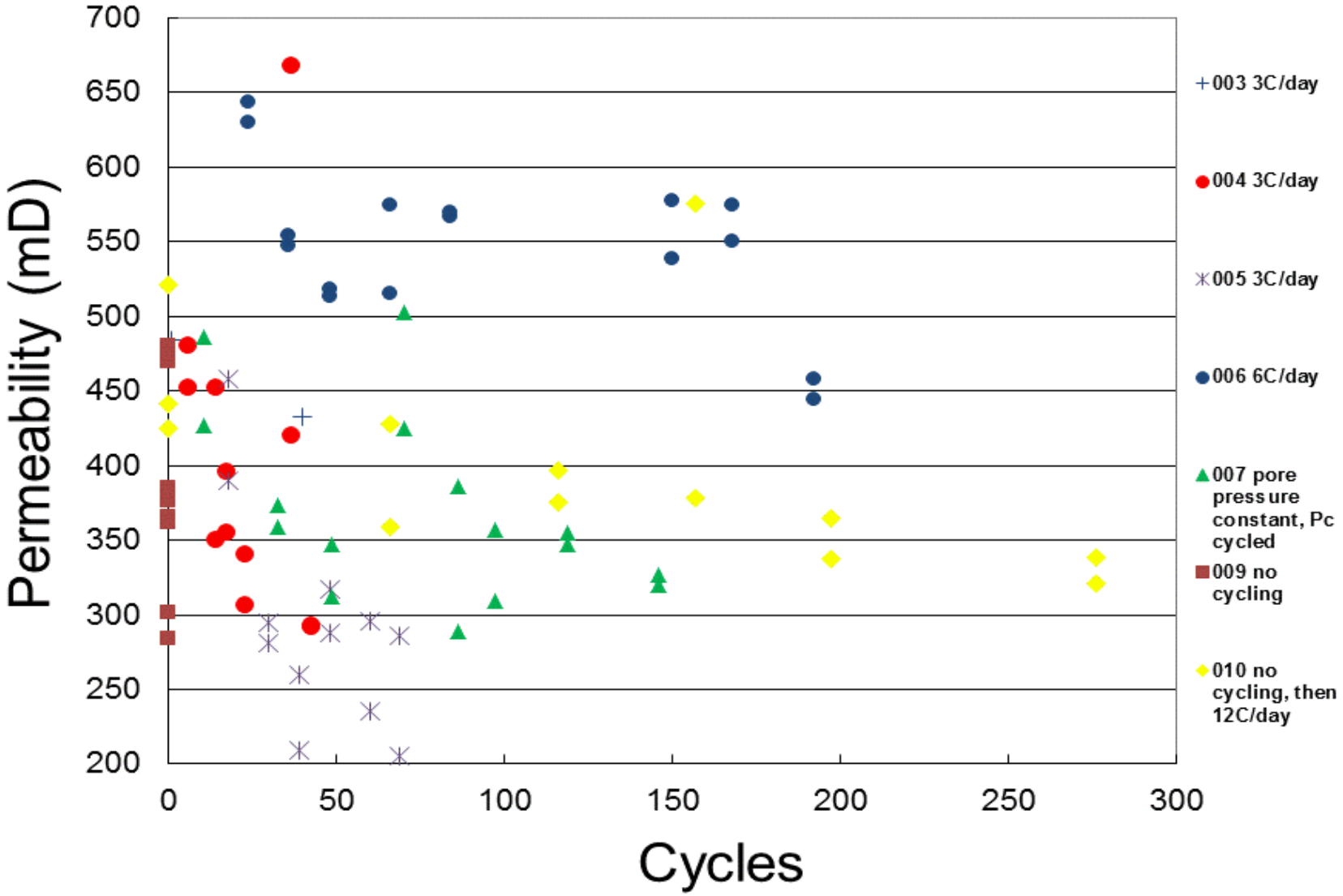
Permeability decrease with increasing time



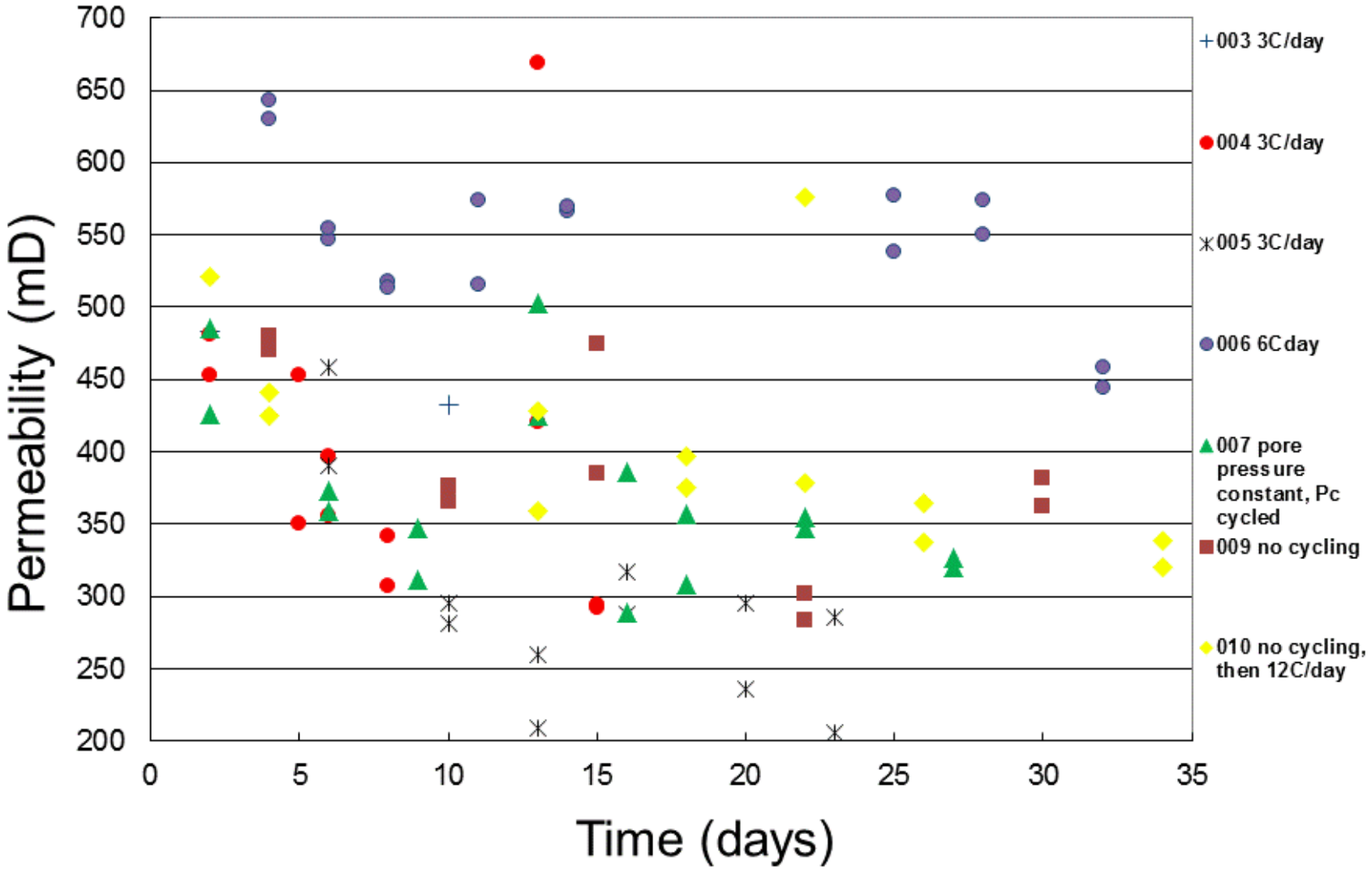
Permeability decrease with increasing time



Permeability decrease with increase cycles



Permeability decrease with increasing time



Results: Permeability change during pressure increase