Coupled thermal-mechanical-hydrologic behavior of consolidating granular salt

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Collaboration between UNM and SNL

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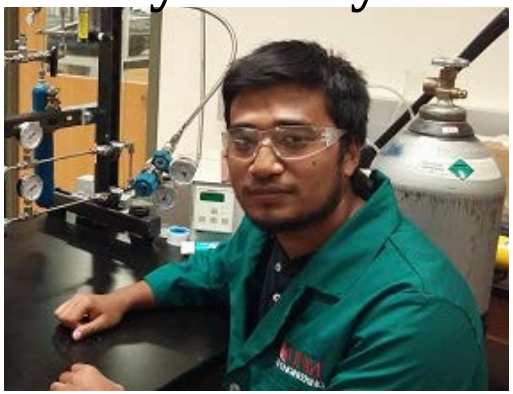

Laxmi Paneru

Timothy Lynn

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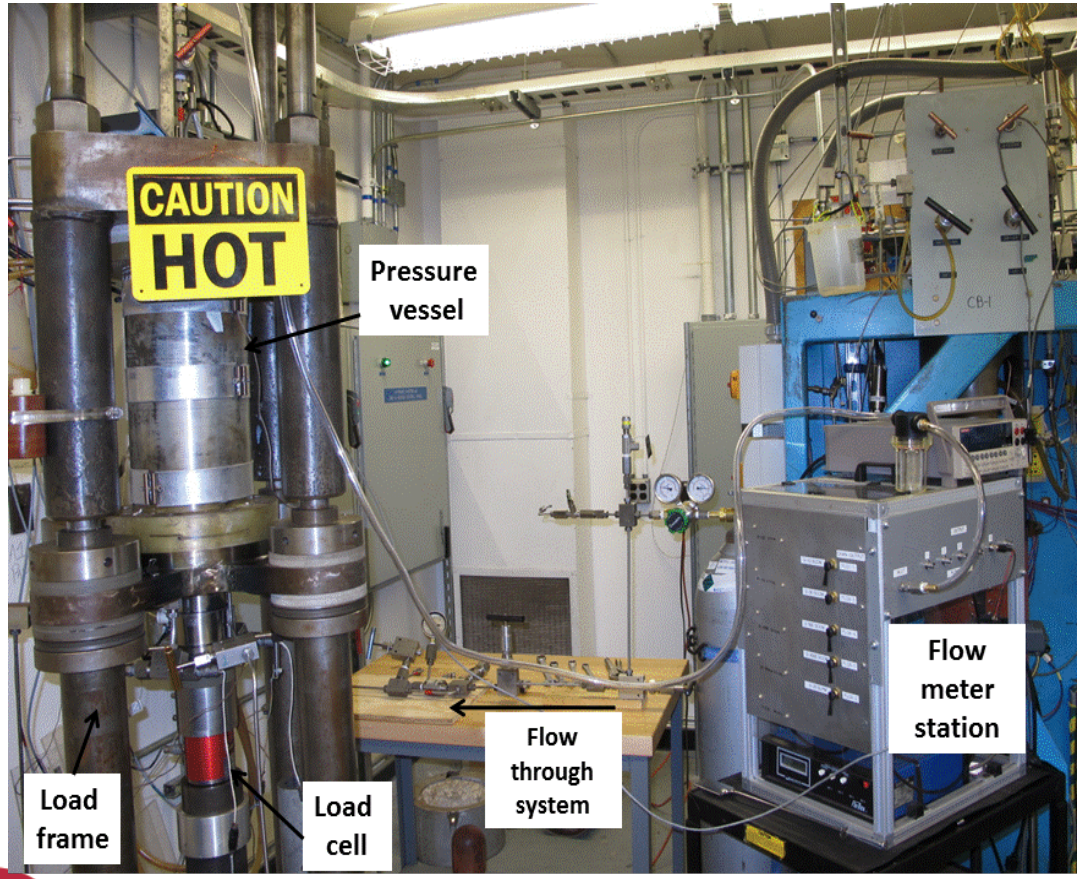
Consolidation measurements



Principal variables

- Temperature
- Stress state
- Moisture
- Time

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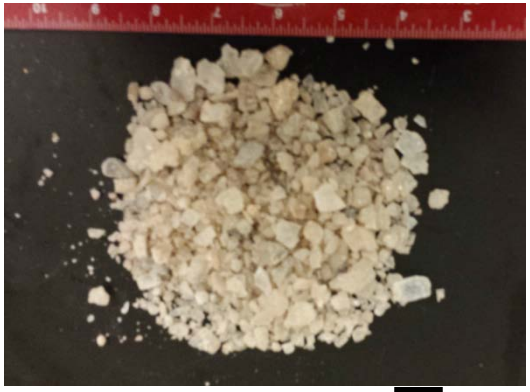
Consolidation transforms granular material into competent mass



Consolidation

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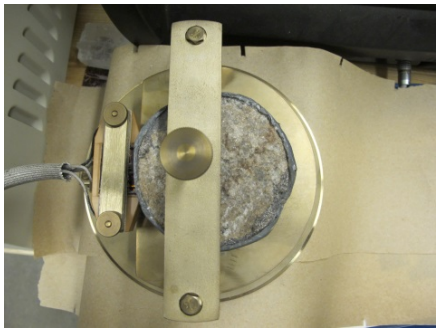
Post consolidation testing

Thermal properties measurements



Samples for microscopy and imaging

Permeability and porosity measurements

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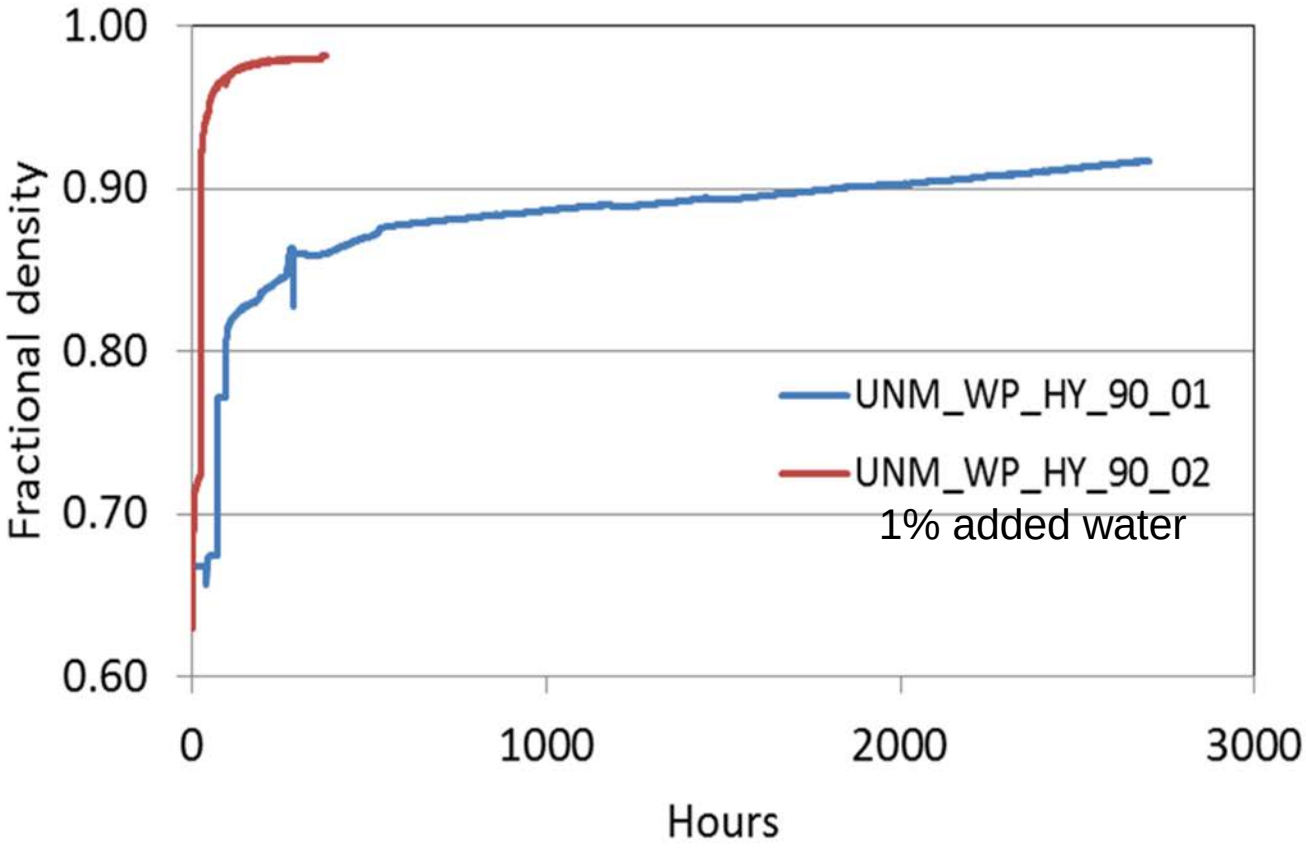
Existing constitutive model for salt consolidation

Evaluate ability to predict tests

Update data base for fitting parameters

Extend to include coupled behavior

Consolidation is strongly affected by moisture



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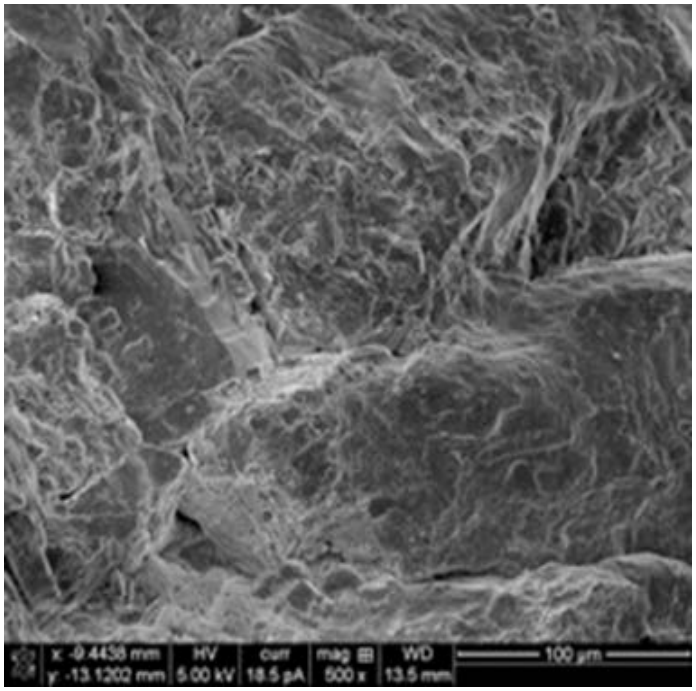
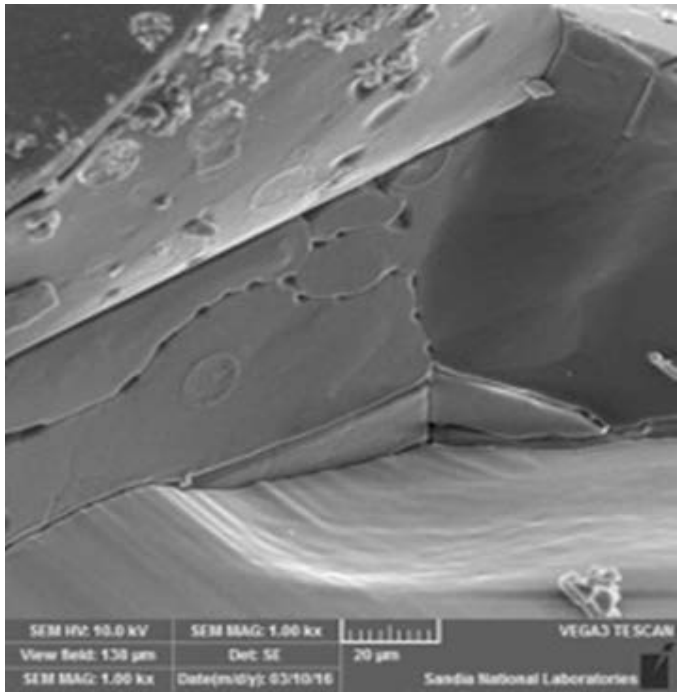
Consolidation is strongly affected by moisture



WP 90-01 no added moisture:
Abraded surfaces, low grain cleavage, no occluded fluid evidence



WP 90-02 1% added moisture:
Cleaved grain surfaces indicating higher cohesion at grain boundaries with canals of residual moisture

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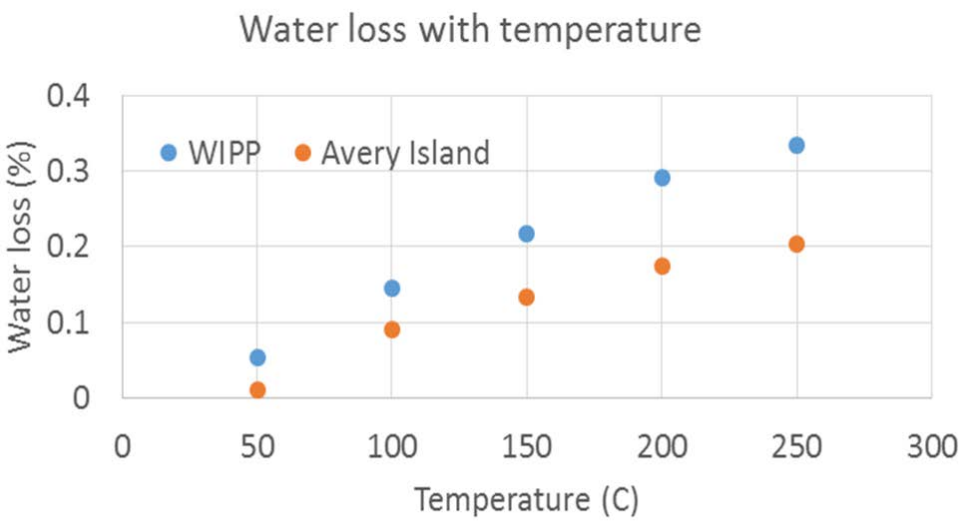
Granular salt contains some water that may aid consolidation at high temperatures



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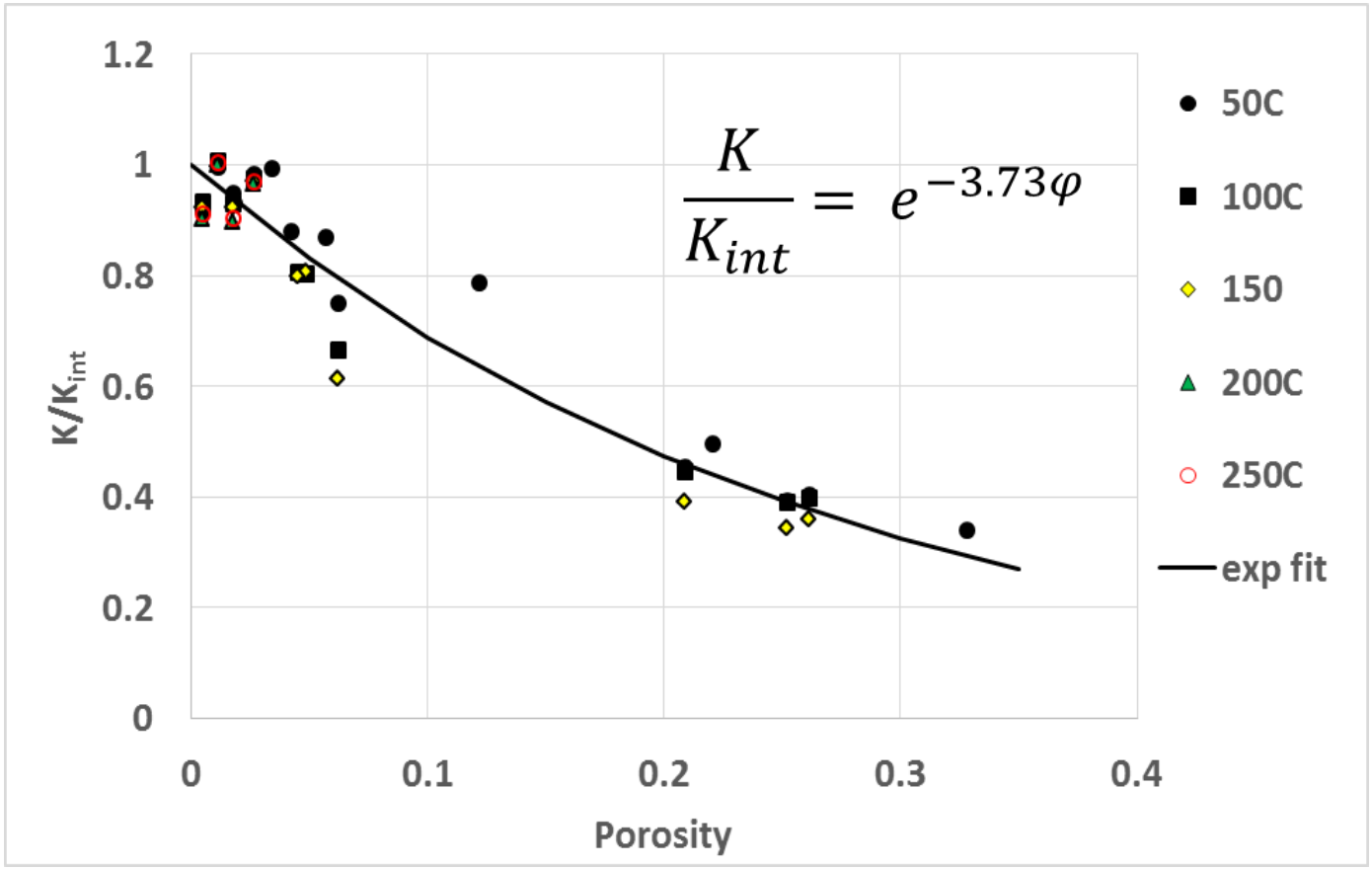
Thermal properties as function of porosity



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Comparison to other study

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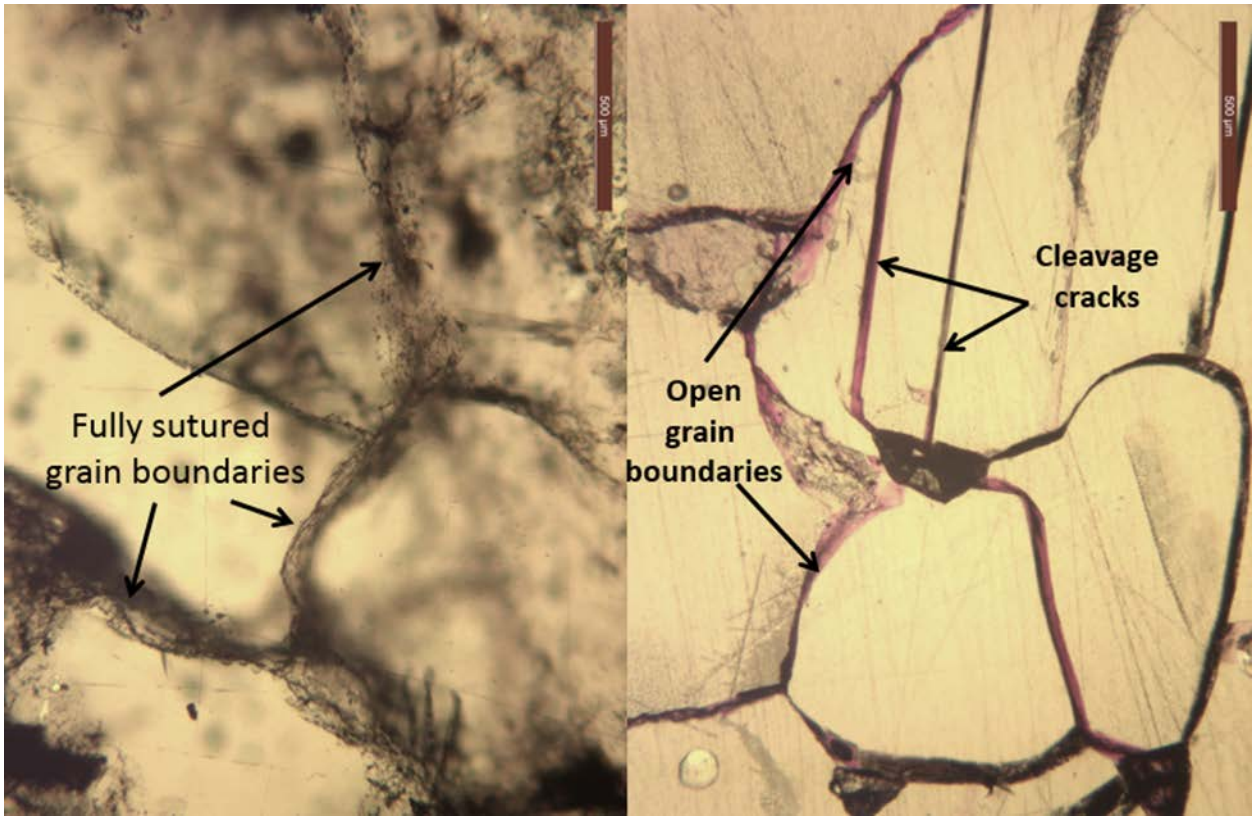
The nature of the porosity affects thermal properties.



Consolidated salt (left) and axially pressed salt (right) at comparable porosities of less than 0.02.

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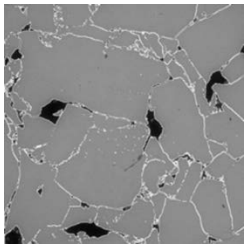
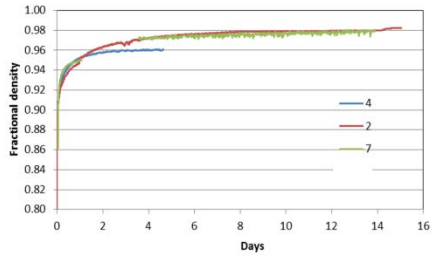
Porosity





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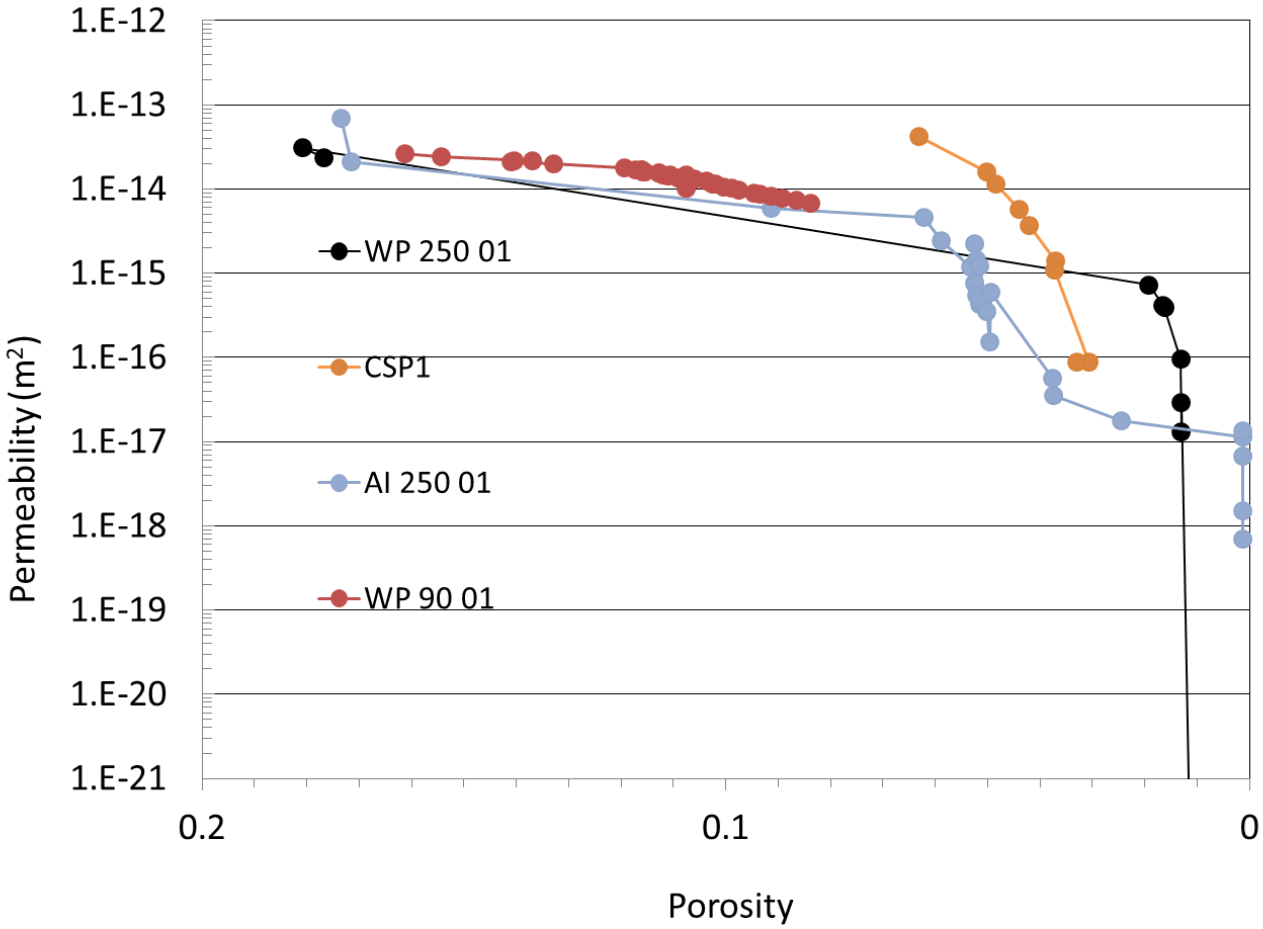
Permeability decreases orders of magnitude during consolidation



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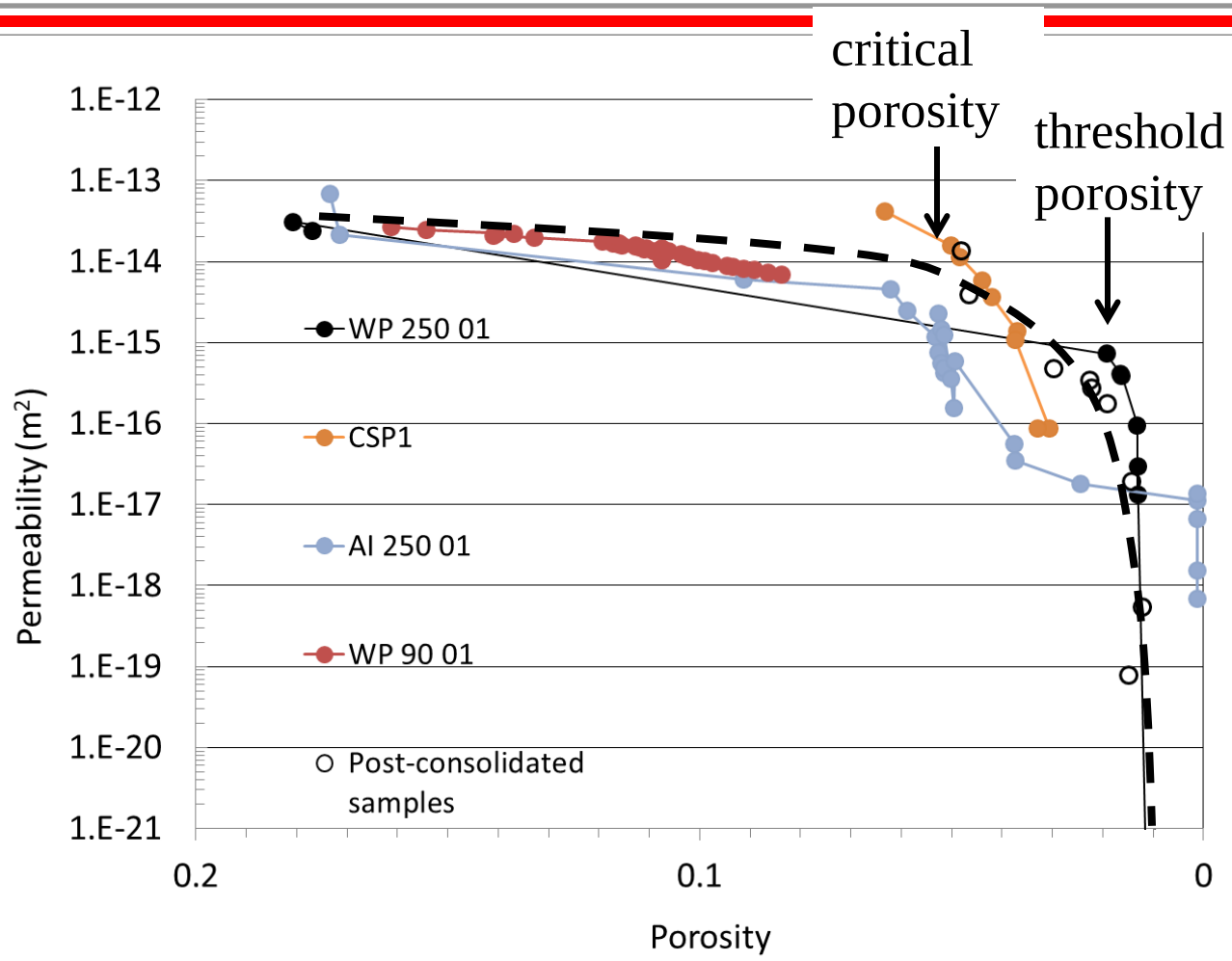

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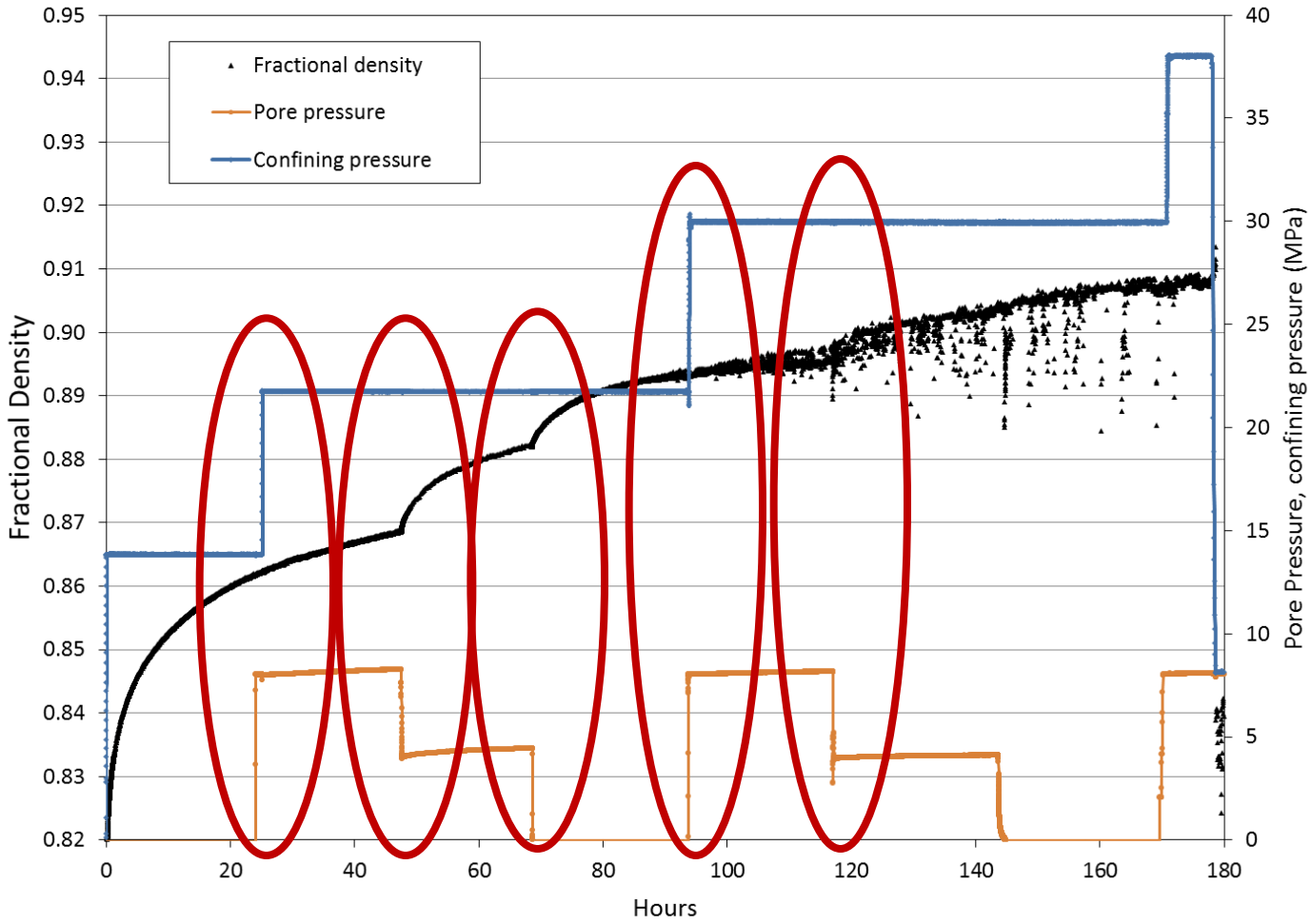
Pore pressure plays some role in consolidation



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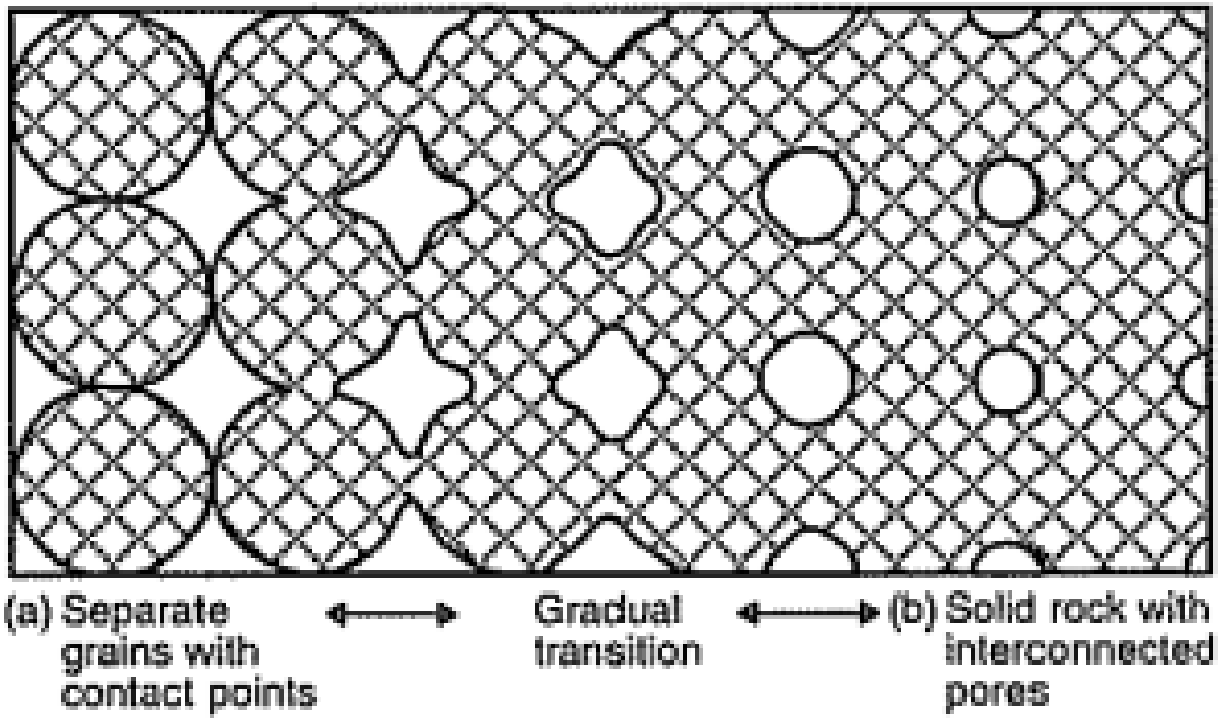
Constitutive model must accommodate mechanical-hydrologic coupling as salt transitions from granular to fully cemented state.



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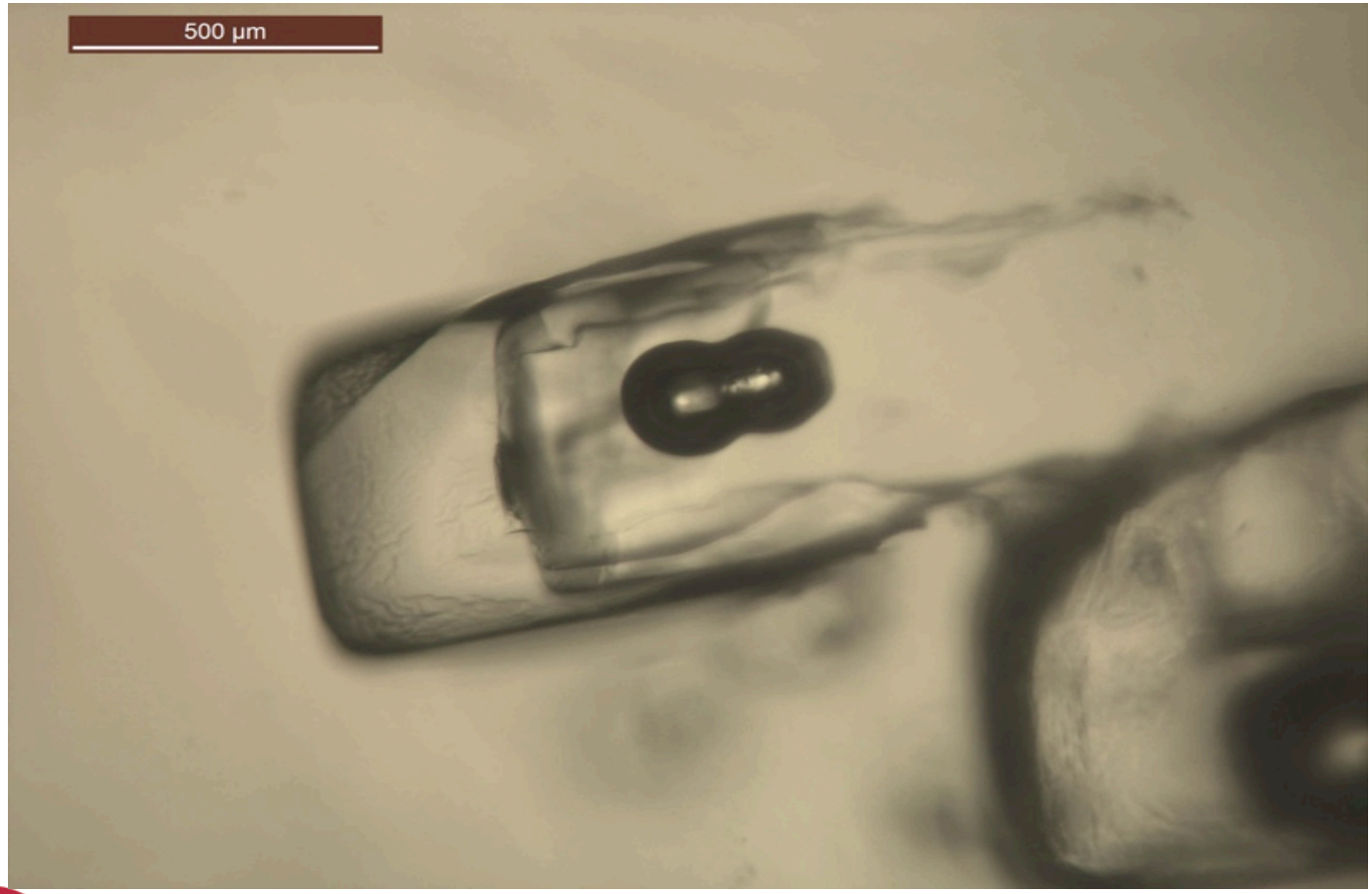
Going forward ……

Consolidation testing

Post-consolidation permeability and porosity testing and image analysis

Constitutive model development

Questions?



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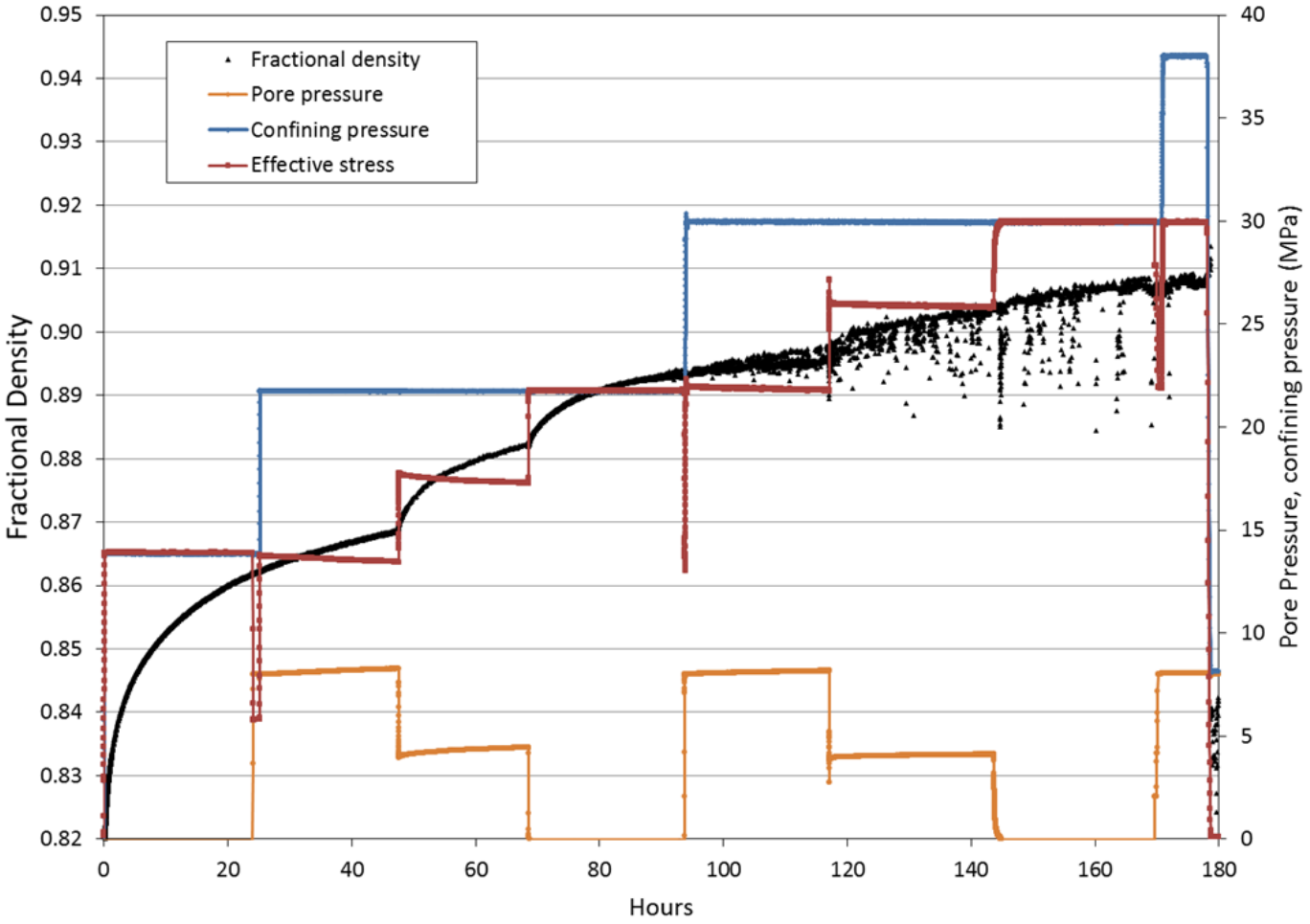

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