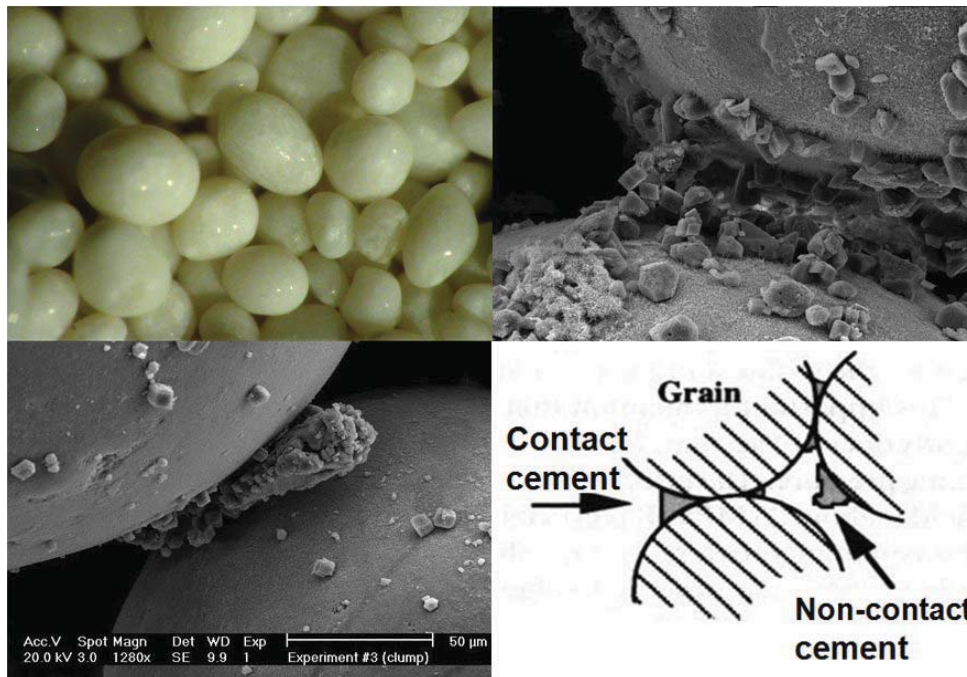


# ***Rock Fluid Interaction: Velocity Evolution during Controlled Precipitation and/or Dissolution***

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## **Project Purpose**

Carbonates are prone to diagenetic alterations that result in changes of the petrophysical properties. Small amounts of newly formed contact cement can stiffen the rock. Similarly, dissolution from slightly acidic formation waters or acid treatment during well completion can result in secondary porosity and increased permeability. Although these processes are well known, little data exists to quantify these changes and their influence on petrophysical properties. In this project, experiments that quantify both the chemical changes in the fluids and the diagenetic and petrophysical changes in the rocks are designed to enhance our understanding of the effects of chemical rock-fluid interaction. In particular, the study will capture changes of acoustic velocity and permeability during chemically controlled rock-fluid interaction that causes either precipitation or dissolution of the rock.



*Figure 1: Results of a pilot precipitation study. (Top right) Clean ooids before the experiment. (Top right and bottom left) Calcium carbonate crystals precipitated during the experiment. Precipitation occurs preferentially at the ooid-to-ooid grain contacts. These contact cements are responsible for increasing rock stiffness and thus acoustic velocity. (Bottom right) Illustration of contact vs. non-contact cement (from Dvorkin and Nur, 1996).*

## **Scope of Work**

Petrophysical properties will be observed before, during, and after altering the rock. Rock evolution and changes will be documented, particularly with respect to acoustic

velocity. One aspect will be to evaluate the effects of observed crystallization at grain-to-grain contacts on measured acoustic velocity. Another aspect will concentrate on the effect of dissolution in ooid grainstones on both acoustic velocity and fluid flow permeability.

A first suite of experiments will focus on acoustic velocity alterations during precipitation of  $\text{CaCO}_2$  (Figure 1). Several long-term experiments (1-4 weeks) are planned. During each experiment, acoustic velocity will be measured in one-hour intervals. Samples will be analyzed under SEM to determine where and how many crystals have formed during the experiment.

In the second phase, the focus will shift toward dissolution. Under-saturated solution will be circulated through the samples for several days. Fluid composition, acoustic velocity, and fluid flow permeability will be measured during the experiment. Changes in the rocks pore structure will be captured by high-resolution CT scans before and after the experiment. Changes in pore geometry will be analyzed in the context of changes in petrophysical parameters.

### **Precipitation Workflow**

1. Measure acoustic velocities of several samples of loose ooid grains in preparation for precipitation experiments.
2. Expose these samples to long-term infiltration with supersaturated solution, whose chemical composition will be constantly monitored and adjusted to the original composition.
3. Measure acoustic velocities in 1-hr intervals during the experiment.
4. Analyze the resulting rock under SEM to determine location and amount of precipitation.

### **Dissolution Workflow**

4. Perform high-resolution CT scan of several samples of variable texture (grainstone, packstone etc.) but similar porosity.
5. Measure acoustic velocities and permeability.
6. Expose these samples to long-term infiltration with an under-saturated solution.
7. Measure velocity and permeability at set intervals during infiltration experiment.
8. Sample and analyze downstream fluid line for chemical changes.
9. Perform high-resolution CT scan and compare pore structure changes.

### **Key Deliverables**

A data set will be generated that captures chemical changes of the pore fluid and the resulting changes in acoustic velocity and fluid flow permeability in the rock. High-resolution images using SEM and high-resolution CT scans will provide estimates of crystallization or dissolution during chemical rock-fluid interaction.