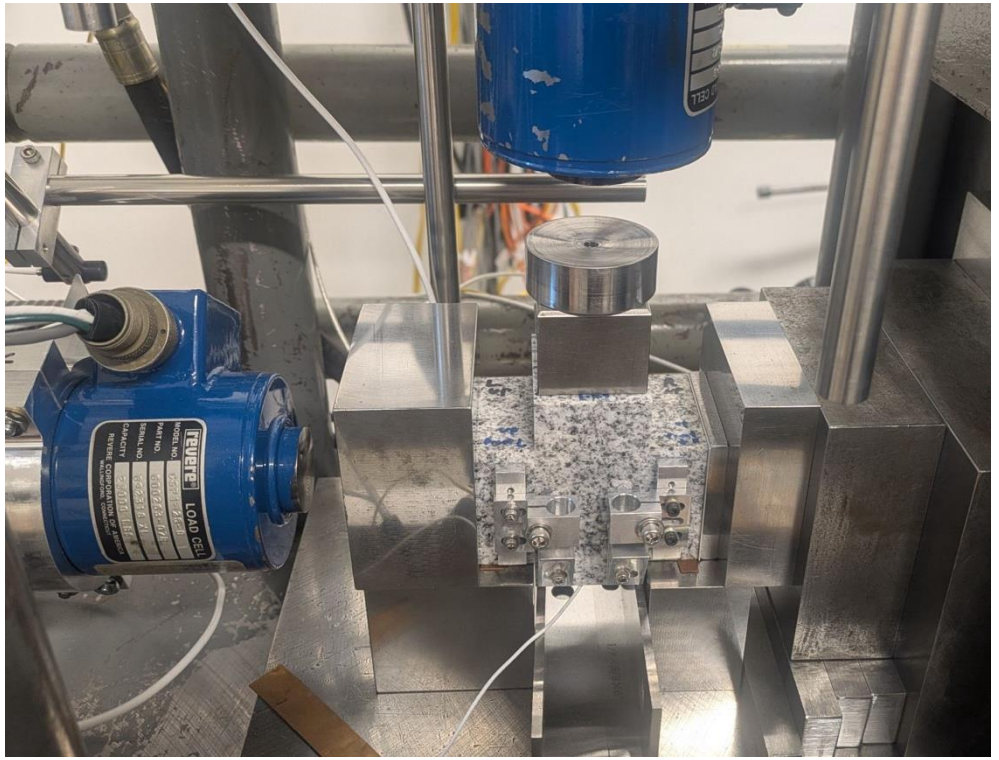
Cross-Laboratory Benchmarking of Fault Frictional Behavior

Srisharan Shreedharan (Utah State University)
Tamara Jeppson (USGS)
Heather Savage (UC Santa Cruz)

14 Oct. 2026
SCEC Dynamic Rupture Workshop

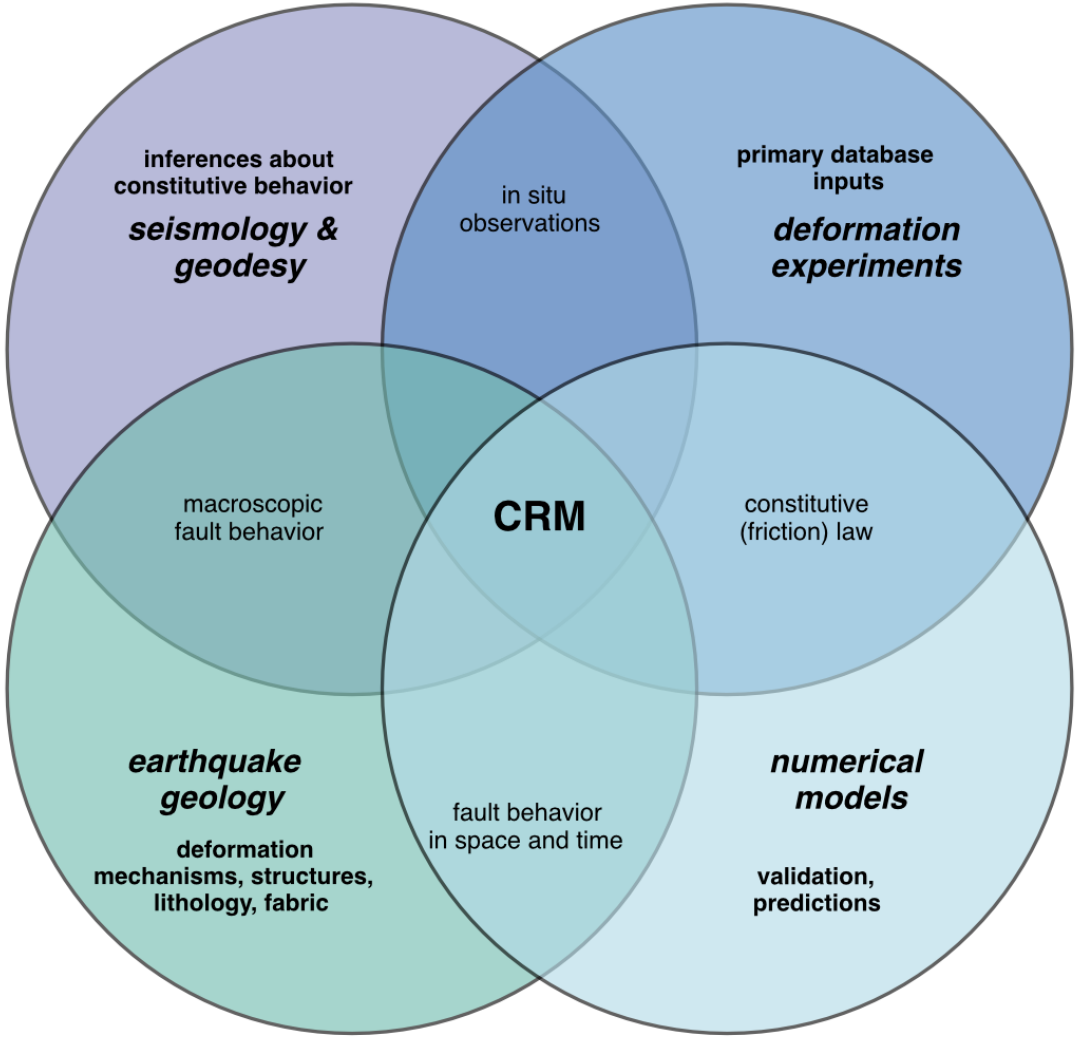


Statewide California Earthquake Center

SCEC award #26023

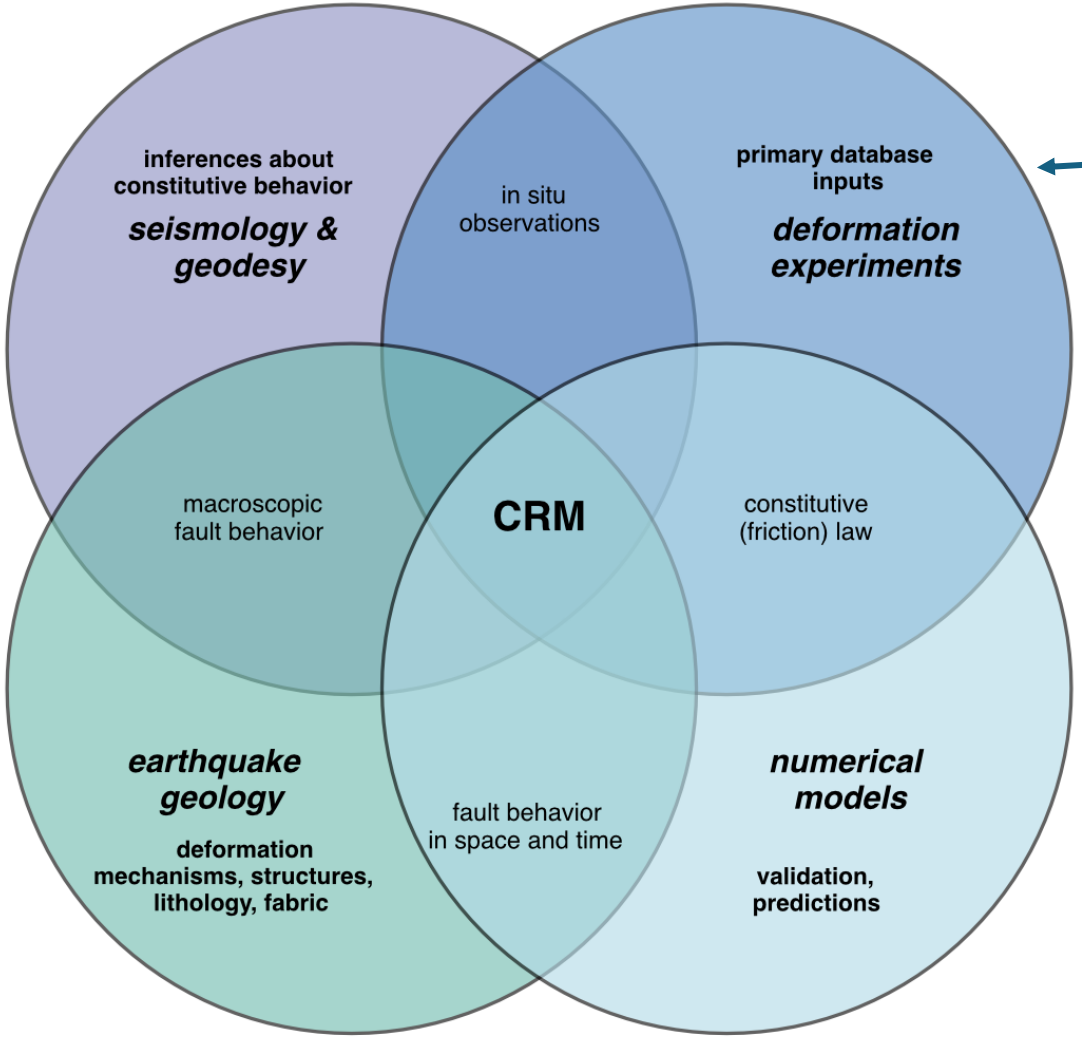
The ***need*** for benchmarking…

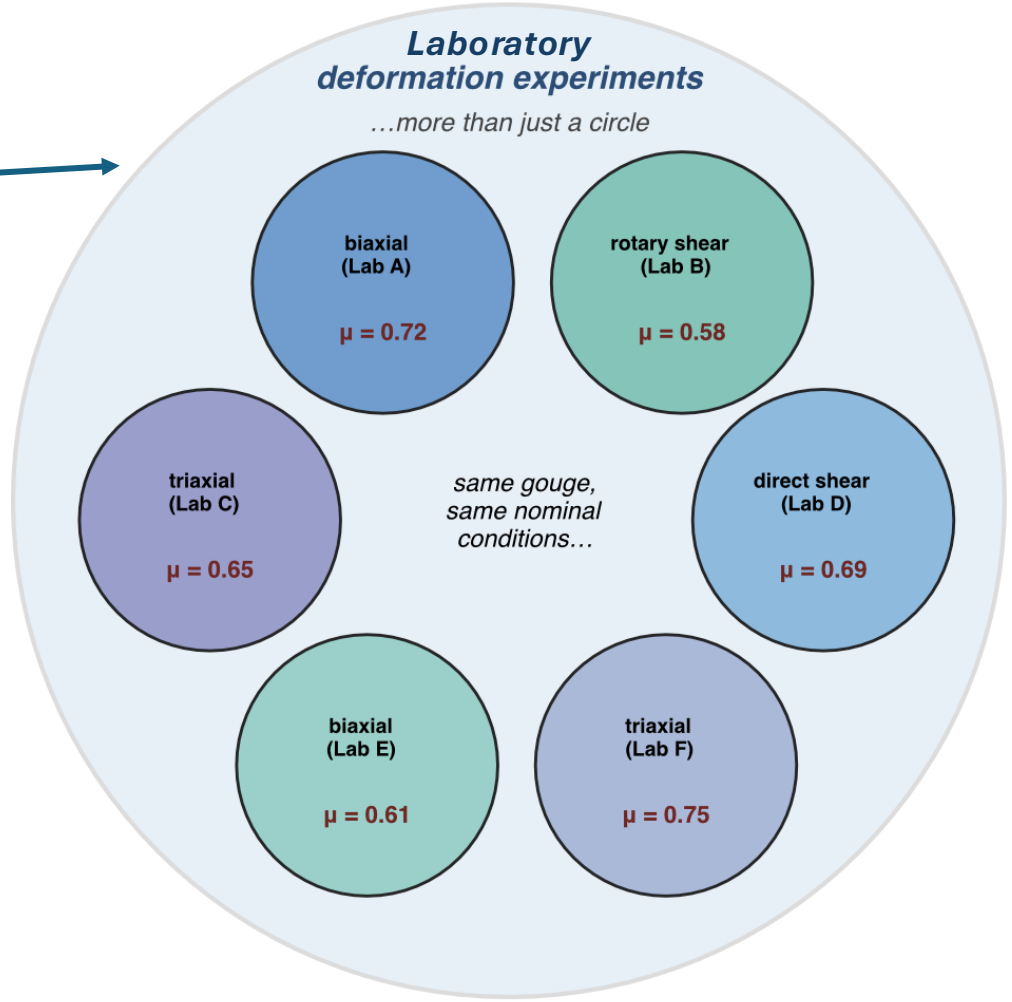
CRM = Community Rheology Model



Ault, Barbot, and Seyler (2025). SCEC CRM workshop report (SCEC award #25133)

The ***need*** for benchmarking…

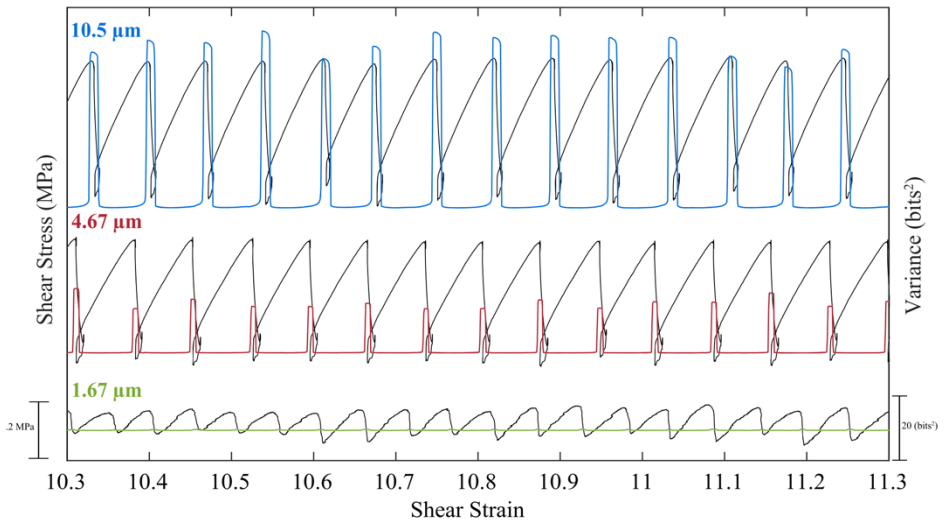




Which value enters the CRM? Without inter-lab benchmarks, apparatus effects and material behavior may be indistinguishable.

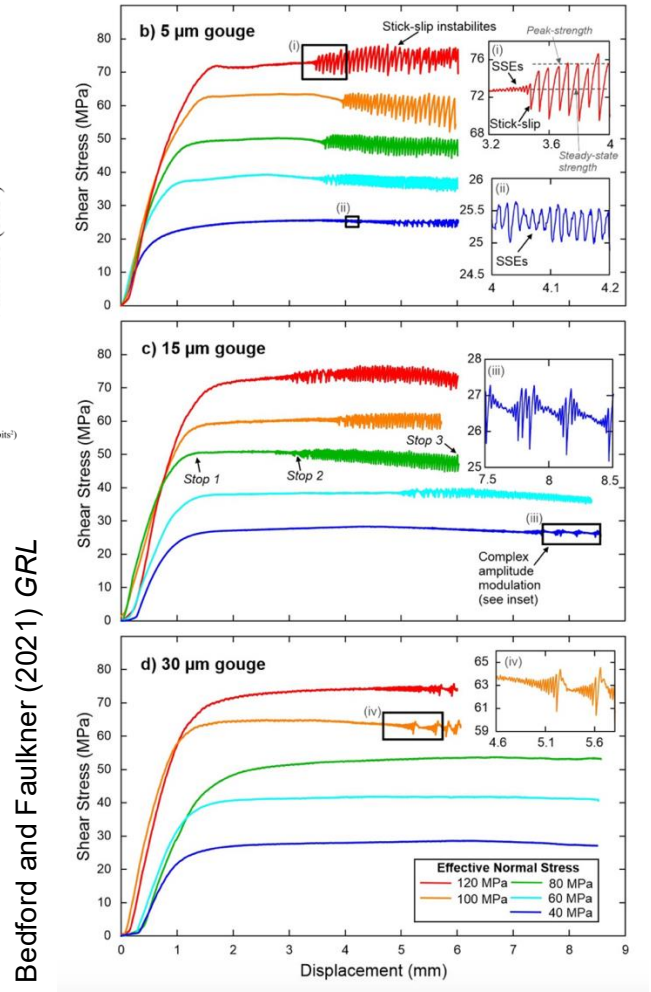
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The ***need*** for benchmarking: Example

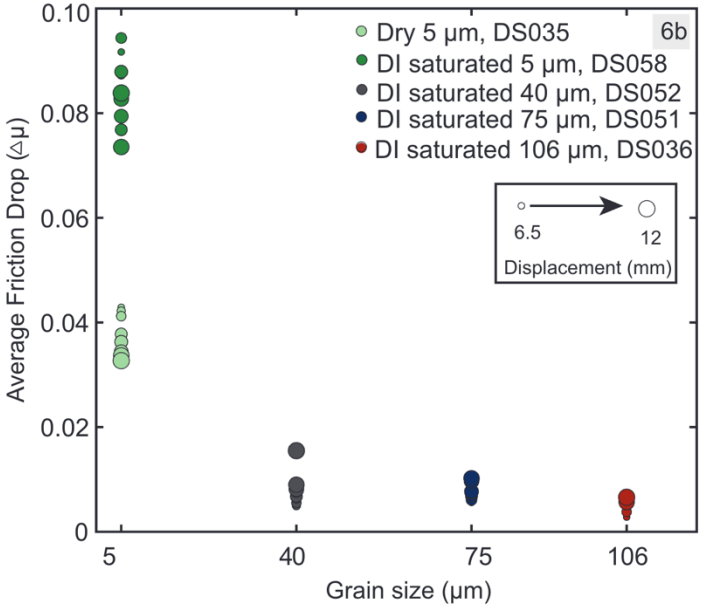


Bolton, Shreedharan et al. (2020) *JGR:SE*

Increasing grain size destabilizes faults in biaxial double-direct shear experiments and…..



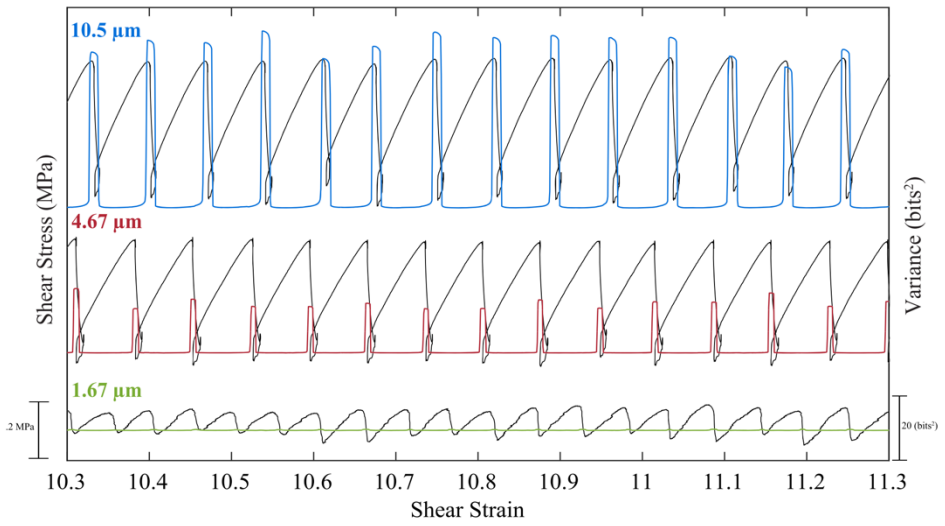
Bedford and Faulkner (2021) *GRL*



Regmi and Shreedharan (2025) *AGU Fall Meeting*

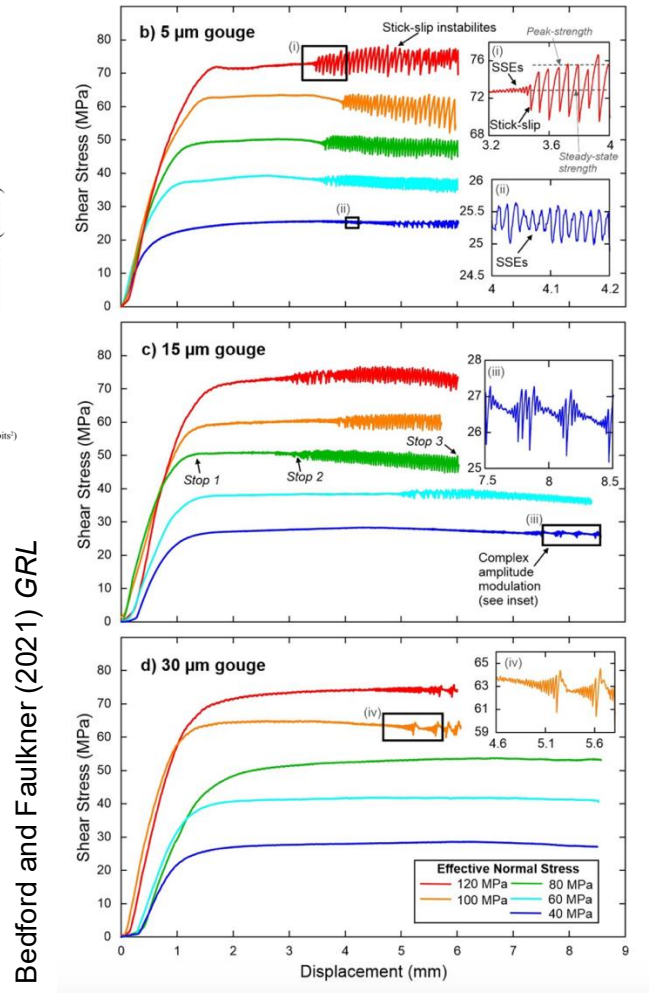
…stabilizes faults in triaxial and geotechnical single-direct shear experiments ***on the same quartz powders!***

The ***need*** for benchmarking: Example

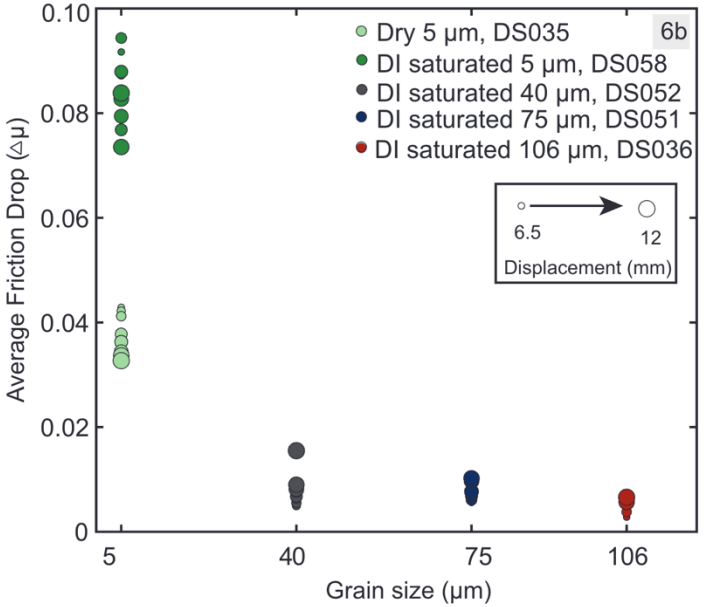


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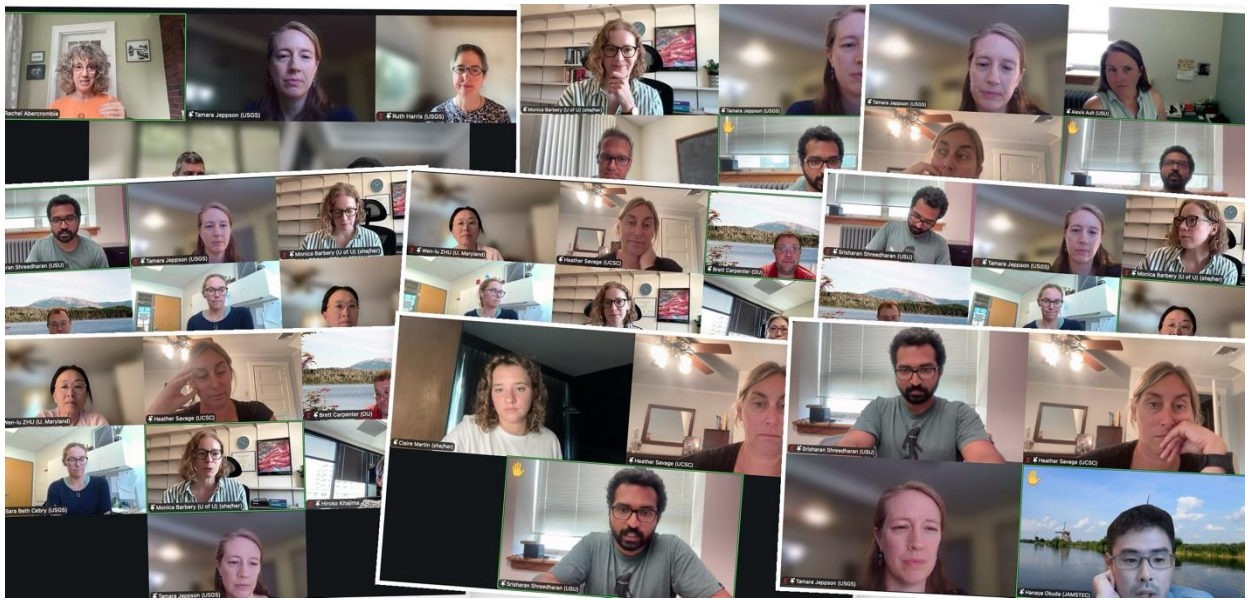


Regmi and Shreedharan (2025) *AGU Fall Meeting*

…stabilizes faults in triaxial and geotechnical single-direct shear experiments ***on the same quartz powders!***

….so what is the role of grain size on friction?

Part 1: Virtual workshop



80 participants (experimentalists, numerical modelers, seismologists, geologists, & other users of lab data)

Goals:

1. Characterize variability of friction between labs/apparatuses/studies
2. Define standard samples
3. Design benchmark problems to explain this variability of friction
4. Establish data-sharing and long-term archival protocols

Part 2: In-person working group



Goal:

- Finalize the first benchmarking exercise

2026 SCEC Cross-Laboratory Friction Benchmarking Workshop

Benchmark Experiment 1 (BE1) | DRAFT

S. Shreedharan, H. Savage, T. Jeppson — and community

DOCUMENT STATUS

This is a **discussion draft** for use at the 2026 SCEC Friction Benchmarking Workshop. It is **not** a finalized benchmark.

This worksheet is modeled on the SEAS Benchmark Problem 1 (Erickson & Jiang, 2018), the first community code-verification exercise for quasi-dynamic simulations of earthquake sequences, which we aim to emulate for experimental rock deformation.

1. Purpose and Scope

This worksheet outlines a proposed Benchmark Experiment 1 (BE1) for the experimental rock deformation community, targeting three foundational behaviors of fault friction:

- **Part A: Coulomb (steady-state) friction.** Measurement of the "kinetic" friction coefficient μ at a reference sliding velocity and normal stress: the basic shared metric across all laboratories.
- **[FOR DISCUSSION] Part B: Slide-hold-slide (SHS).** Measurement of frictional re-strengthening as a function of hold duration, yielding a (potentially logarithmic) healing rate β.

Benchmarking activities

First benchmark

- 3-4 experiments
  - Constant loading rate
    - Define system stiffness
  - Rate-stepping
  - Slide-hold-slide
  - + one repeat
- Quartz gouge
  - Saturated with DI water
- Normal stress

Next steps

- Finalize benchmark description (Oct. 31)
- Distribute samples (Dec. @ AGU)
- Combine and analyze data (Summer 2027)

Potential future benchmarks: normal stress steps, cyclic normal stress, elevated temperature, elevated pore pressure, bare surfaces with measured roughness, high slip rates, very low slip rates, and more!