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The Effect of Undrained Fluid Boundary Conditions on Fault Stability

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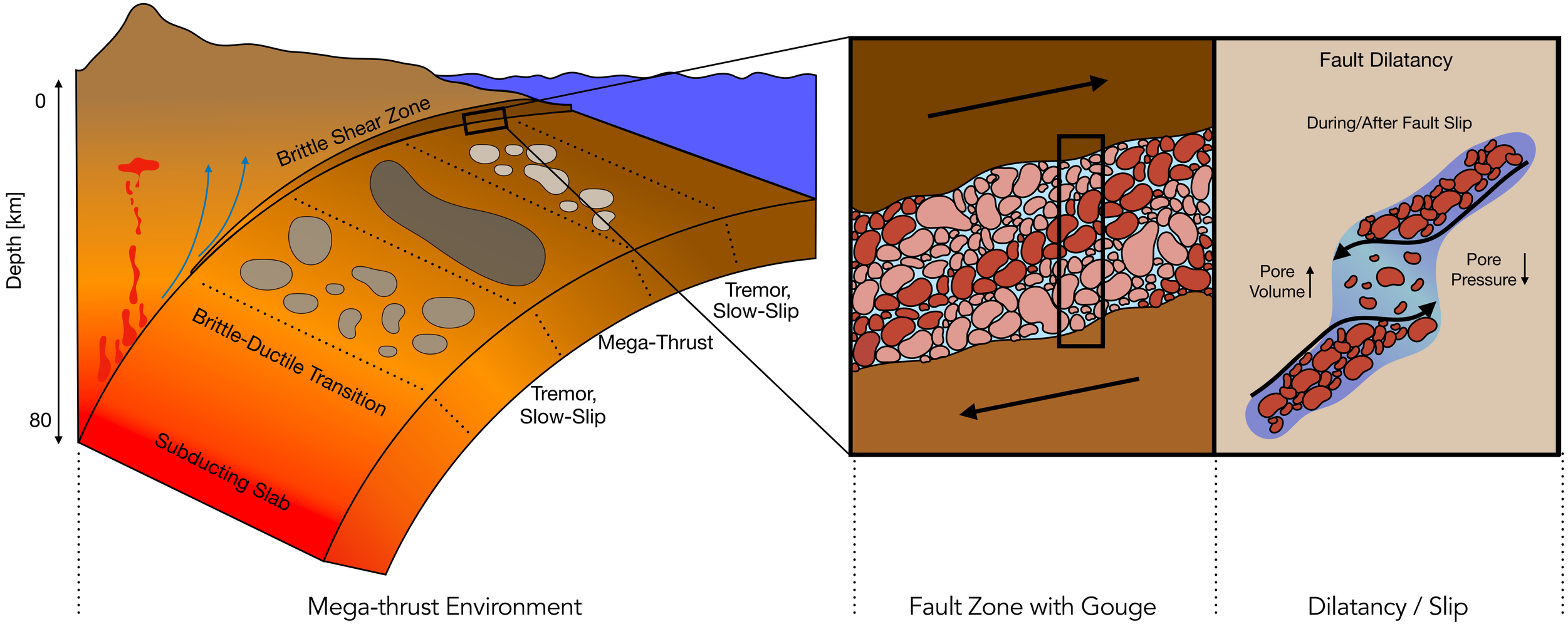
Conceptual Model

How do we picture fault slip in mature fall zones?



Motivations and Fundamental Research Questions

Why do earthquakes occur in a range of modes from slow-slip to dynamic failure?

What is the role of pore fluids on fault slip?

Drained Experiments

Does the absolute value of pore pressure influence the mode of fault slip?

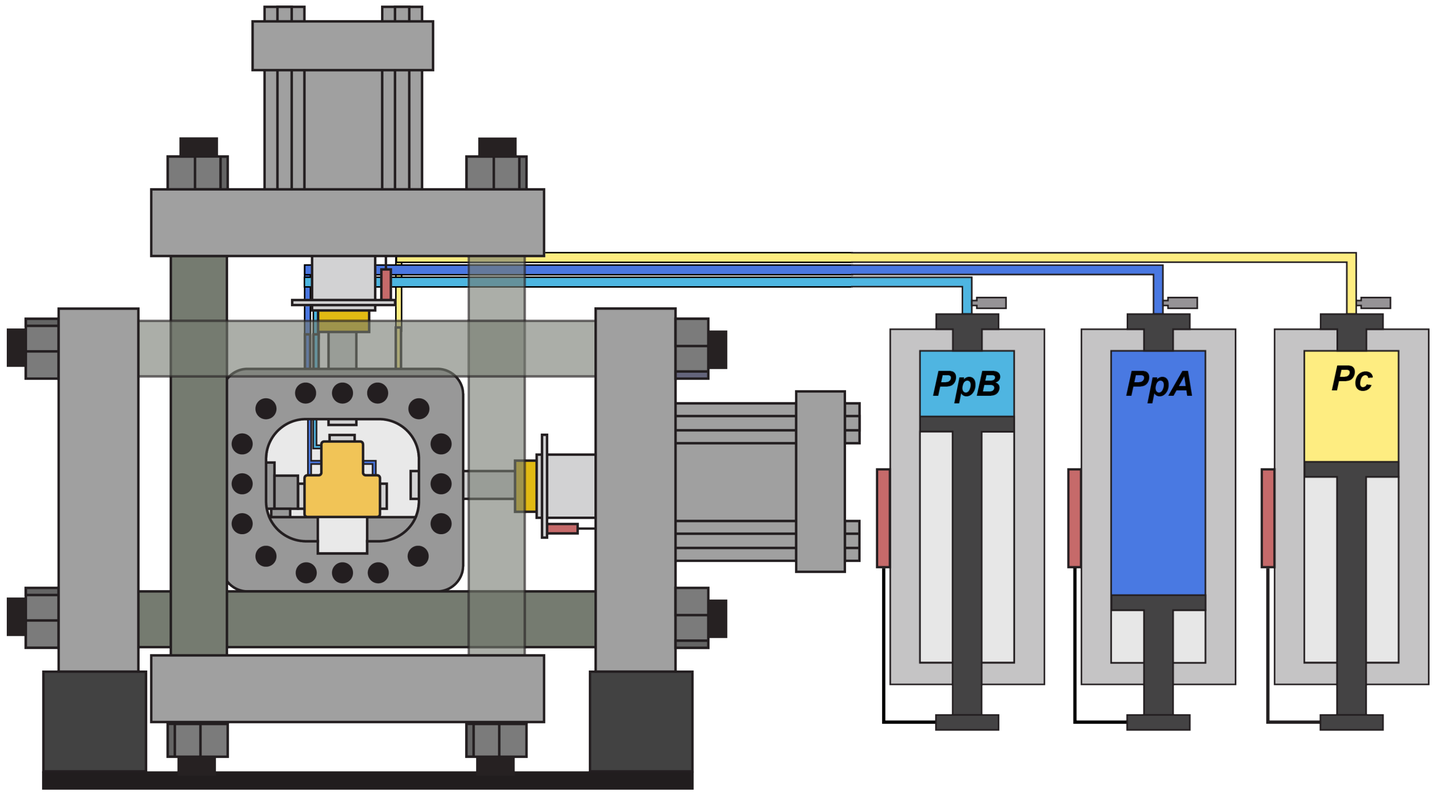
Fluid Pressure Fixed, Fluid Volume Free

Undrained Experiments

Is dilatancy-strengthening a mechanism for slow-slip in mature fault zones?

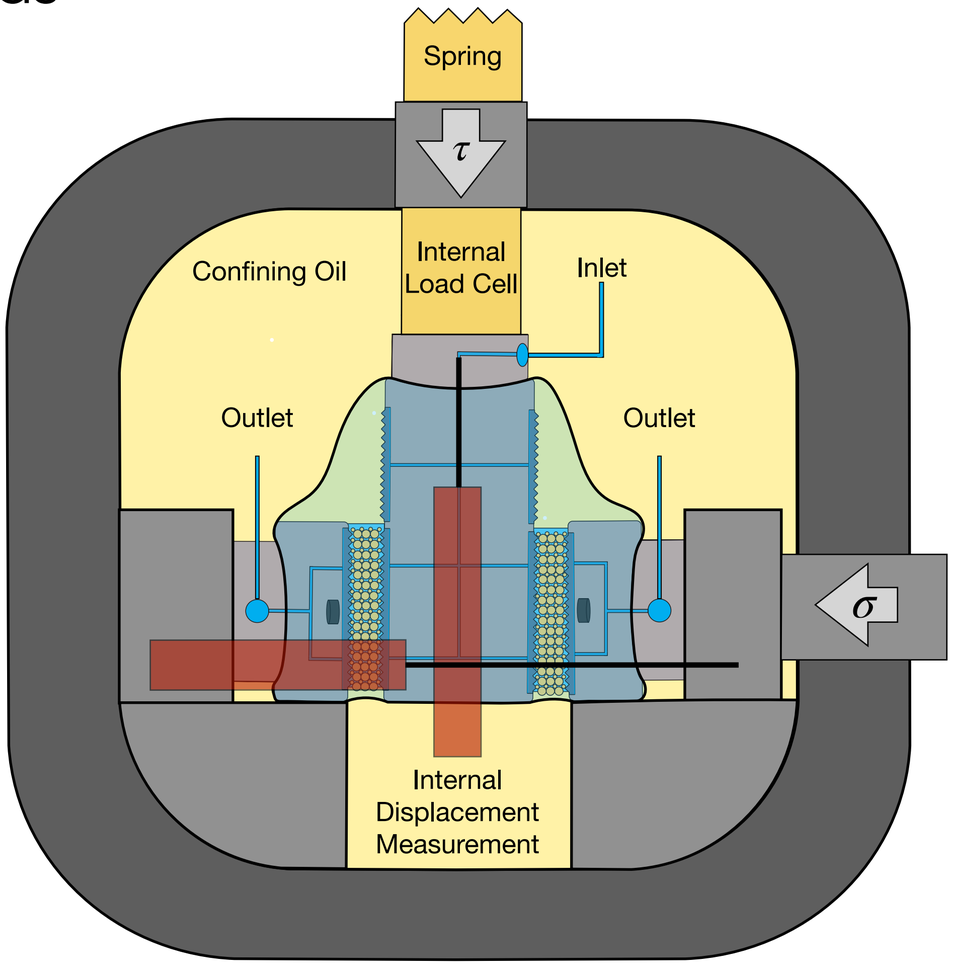
Fluid Pressure Free, Fluid Volume Fixed

Experimental Methods



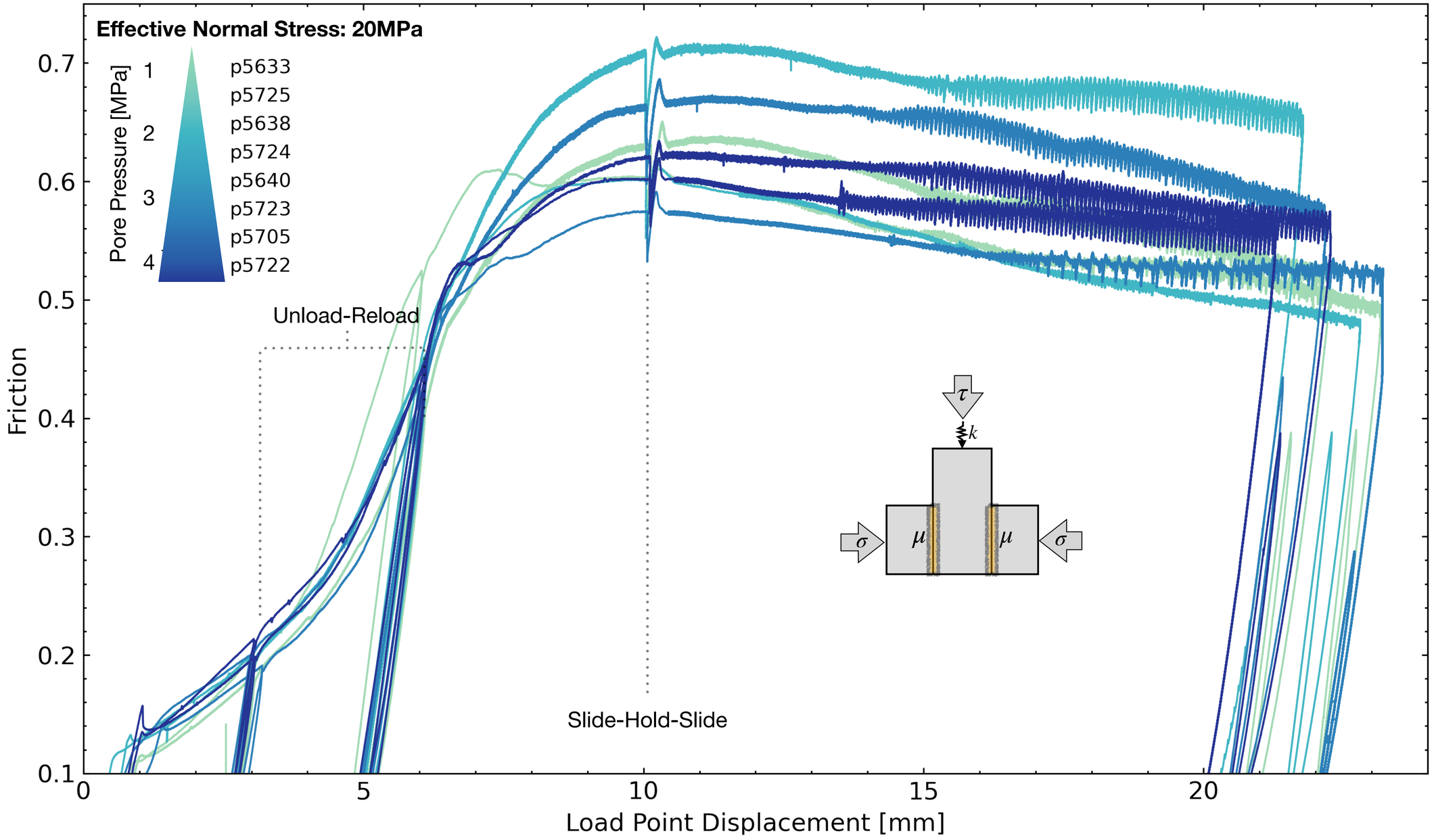
Biaxial Deformation Apparatus

Pressure Vessel and Fluid Pressure Intensifiers

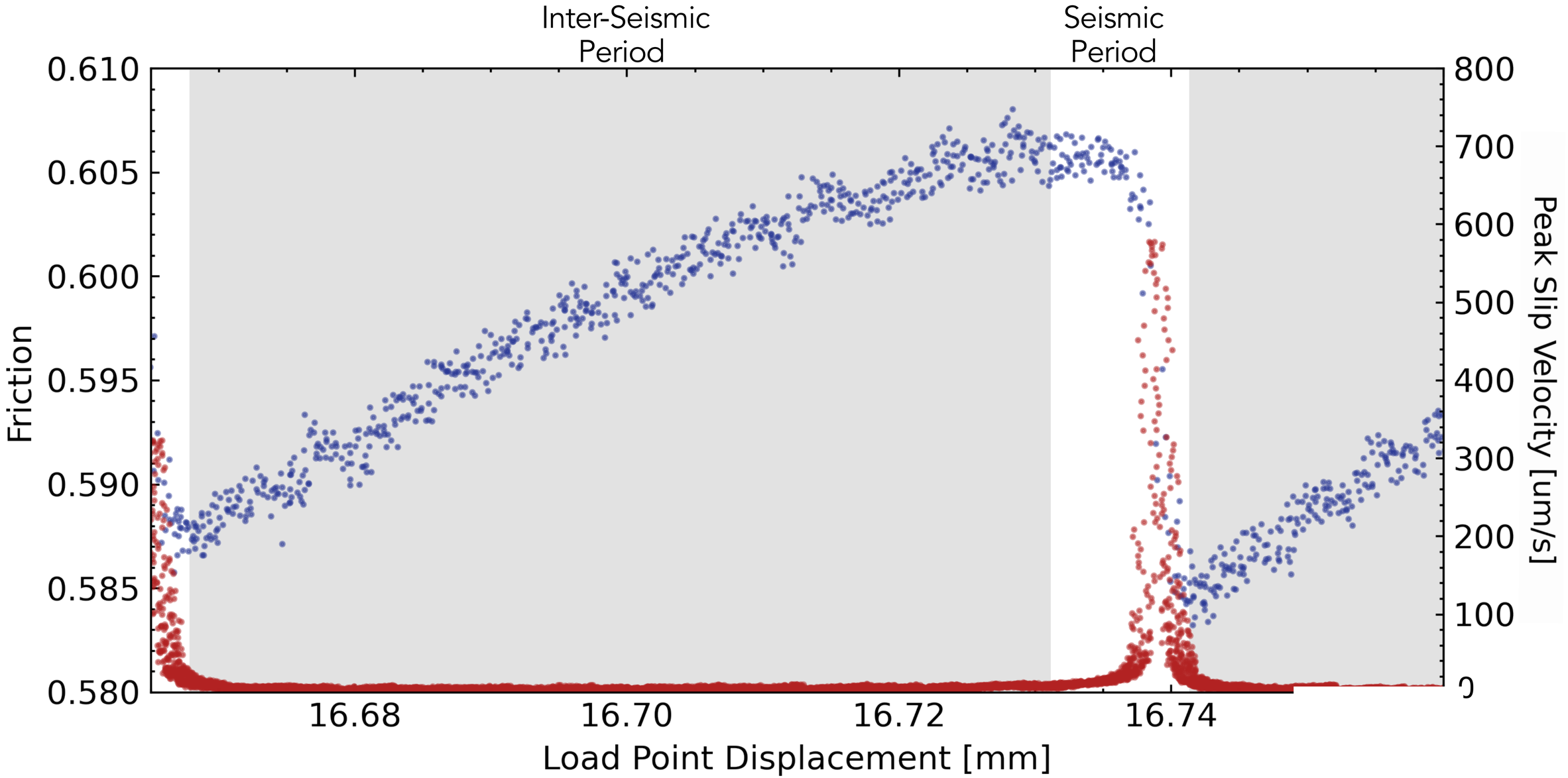


Double-Direct Shear Sample Configuration inside Pressure Vessel

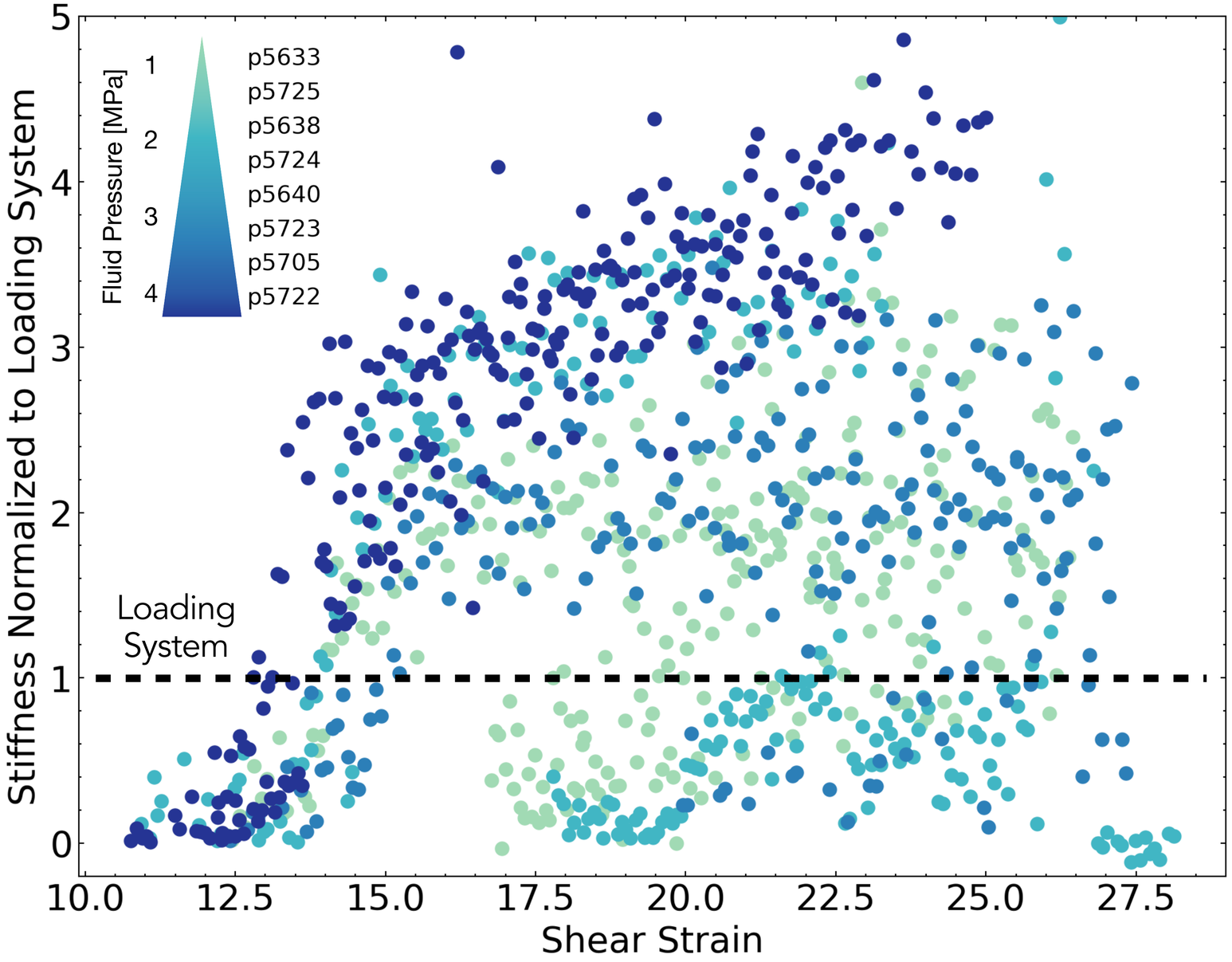
Experimental Overview



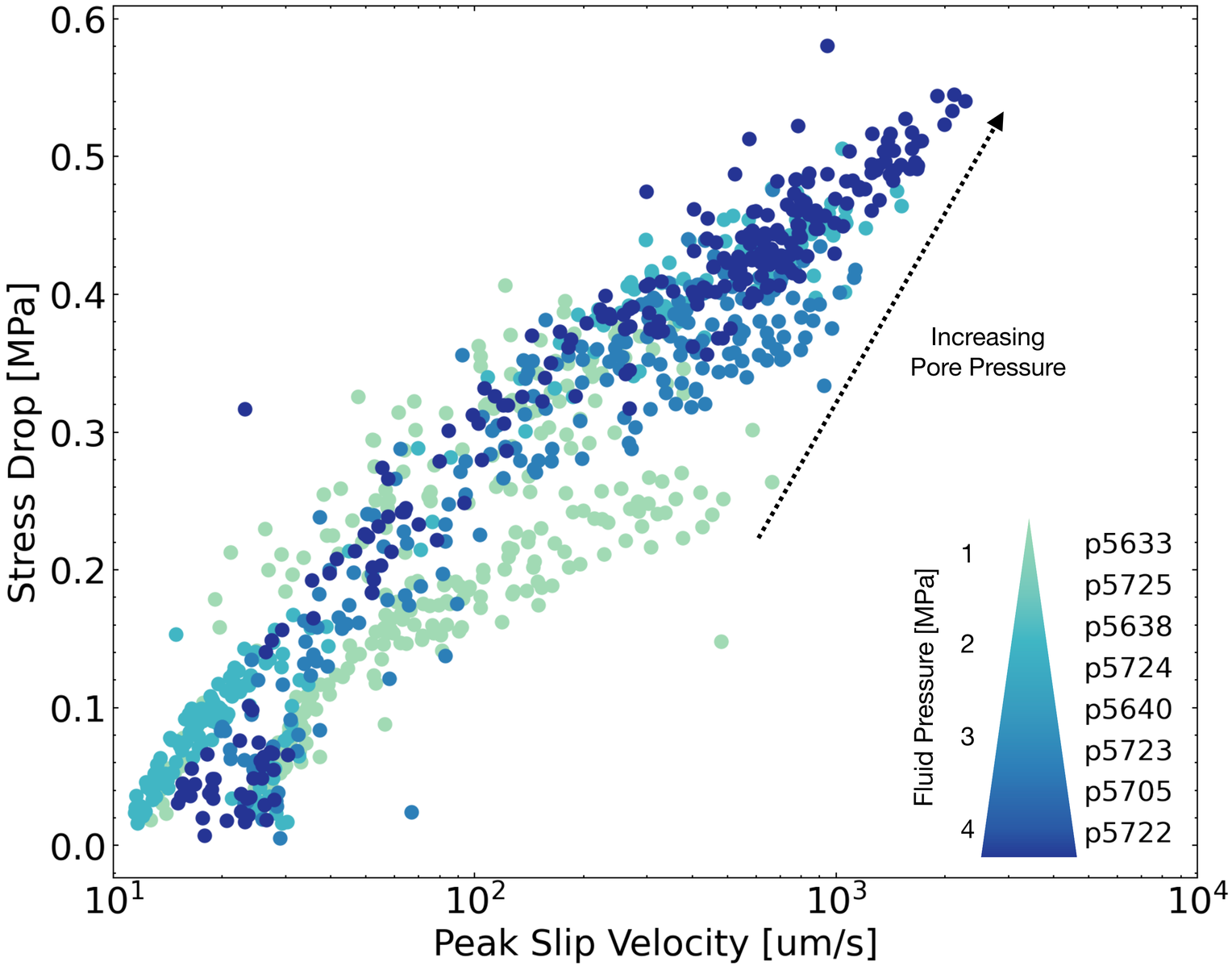
Stick-Slip Profile



Stiffness Evolution of Fault Material



Stick-Slip Velocity and Stress Drop Relation



Summary and Key Findings

Drained Experiments

Does the absolute value of pore pressure influence the mode of fault slip?

Fluid Pressure Fixed, Fluid Volume Free

When pore fluid volume is unbounded, static pore fluid pressure up to 20% of the effective normal stress appears to have a minor effect on the onset and evolution of stick-slips. However, Pore fluid pressure may lead to increased magnitudes of stress drop and slip velocity.