Spectrum of Fault Slip Meeting
Laboratory and Theory Discussion Group

October 13, 2010 – Wednesday Evening Breakout

(scribe: Harold Tobin)

This was a brainstorm session. These points are not necessarily consensus items!

Friction fundamentals

Fundamental friction experiments (like the plexiglass) – do these shed any light on EQ processes? How do we link scales and properly deal with heterogeneity of rocks?

What is friction and how does it work? What are the important scale lengths for understanding parameters like coeff of friction?

What is the real area of contact and how can we get at it? Both in lab scale and in real faults? Data is growing from lab studies for materials where b ~ 0 (~no state-dependent evolution)

Processes in the stability transition zone(s)

Under what conditions does rupture propagate into nominally creeping/stable zone? What is the structure of the zone of transition and conditional stability?

Are tremor, SSE, VLF, LFE, etc all manifestations of the same process … or not?

Is the stuff beginning to be observed around up-dip transition (e.g. accretionary prism) a "mirror" or the down-dip end? If there are VLF and tremor up there too, is there also slow slip?

Slip Zone Processes

What controls thickness of slip zones?

Is the apparently important process of <u>pressure solution</u> getting included sufficiently in the theory/lab studies? Challenge of how to incorporate into either rate/state theory & models and into experiments.

Pressure solution efficiently removes irregularities in a slip surface at slow rates, but not so much at fast rates.

What real physical property determines rupture speed and rupture propagation to depth?

What is effective stress as a function of depth?

Tremor

Mind the gap: Why does it seem that tremor zone is (in some places?) not directly adjacent to locked seis zone? Is the gap real? Is it everywhere? What's going on inside the gap?

Do tremor, long-term SSE and short-term SSE really occupy different locations on the plate interface (as Obara showed for Nankai)?

Triggering of tremor by small perturbations (e.g., tides, surface waves, maybe even storms): is that an indication that fault supports only those very small stresses (near-critically stressed everywhere) or can fault support high stresses too and these are localized?

Is tremor (made of superposed LFE??) observably different from "regular" earthquakes? Some say yes and others say no!

Why does tremor not scale with stress drop? Do the individual LFE events have a narrow magnitude distribution, and if so, why?

Is there truly a continuous spectrum of slip behaviors from LFE to slow slip events, or are there preferred bands for slip events? If so, what's the governing physics?

Needs and Suggestions for Effort

Linkages to other fields that deal with similar physics – e.g., magma migration, glaciers. Bridging these groups might identify synergies. Perhaps workshops that specifically bring them together?

Theoretical developments to address transitions between slow and fast slip, and also the brittle rupture to ductile flow transition.

Test dilation vs. compaction, porosity & pore pressure changes. We need to know a lot more about these competing processes. Lab work needed, and also try to find ways to test these *in situ*.

Observation of streaks of tremor begs a material property explanation. So, experimentalists are challenged to come up with the range of material properties that are capable of tremor behavior vs. not capable.

Need a lot more experiments on materials besides granite! It's getting going, but lots more needed for mudstones and sandstones, tuffs, gabbros, serpentinites, etc…

Numerical modelers are challenged to incorporate high resolution time and spatial scales for frictional behavior (motivated by experiments) while also dealing with very long time scales associated with e.g. migration of tremor or SSE.

Theory people can help focus the lab experiments – for example exploring the interactions that govern transition from friction to flow.

Although we hear the geologists' reminders that faults are complex, exp/theory still tend to work best when parameters are isolated as much as possible. Tailored experiments to investigate single phenomena carefully, and also ones targeted to models that others are doing.