Summary of 2014 Crustal Deformation Modeling Workshop

Community Stress Model Related Information

Brad Aagaard

October 27, 2014

2014 Crustal Deformation Modeling Workshop

CIG/SCEC sponsored workshop

Agenda with links to presentations:
`http://geodynamics.org/cig/events/calendar/2014-cdm-workshop/meeting-info/agenda/`

- June 23–27 at Stanford University with ∼80 participants
- PyLith tutorials: Mon–Tue
- Science talks and discussions: Wed–Fri
- Attempt to address three action items from CSM workshop
  - Development of stressing rate models from strain rate models derived from geodetic observations
  - Comparison of methods for determining perturbations in the lithostatic overburden associated with gravitational body forces due to topography and lateral density variations
  - Discussing the potential for developing a Community Rheology Model of the crust and upper mantle

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    Stress in the lithosphere over the earthquake cycle
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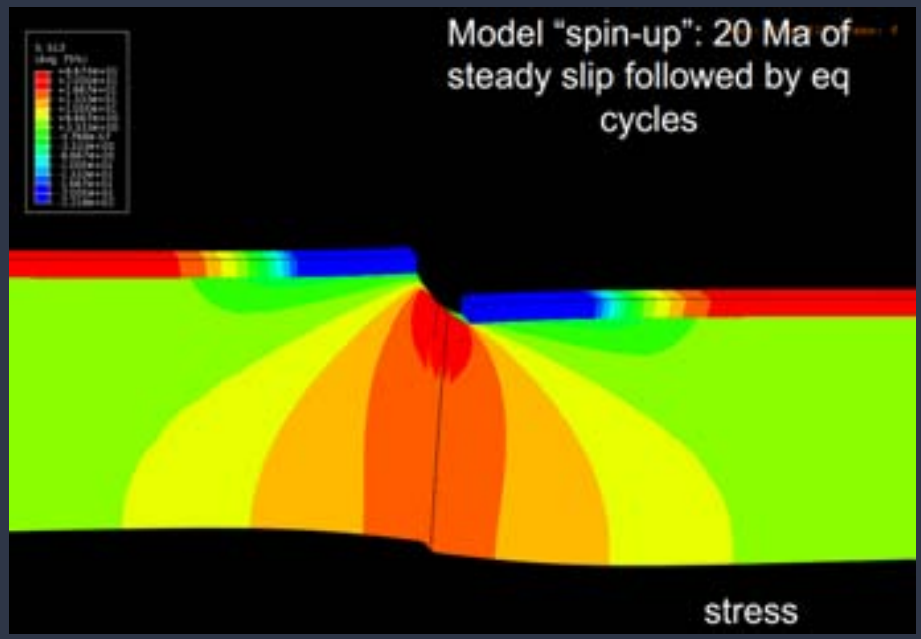
Stress in the Lithosphere over the Earthquake Cycle

- Yuri Fialko
  - Lab-derived rheologies give rise to permanent localization of strain in deep roots of major strike-slip faults
  - Ductile strength of the lithosphere is of the order of 50 MPa, only weakly dependent on composition, water content, and geotherm in good agreement with petrologic data



- Elizebeth Hearn

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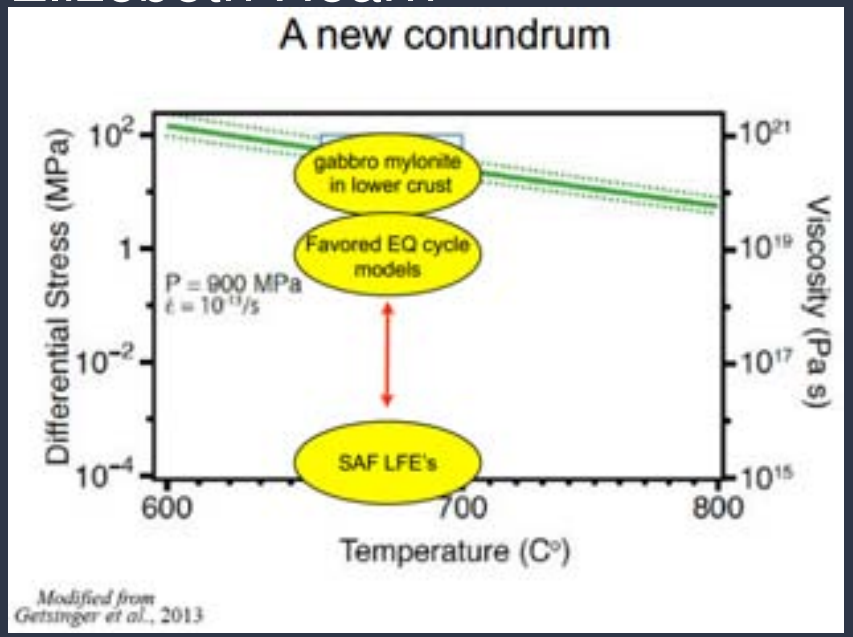
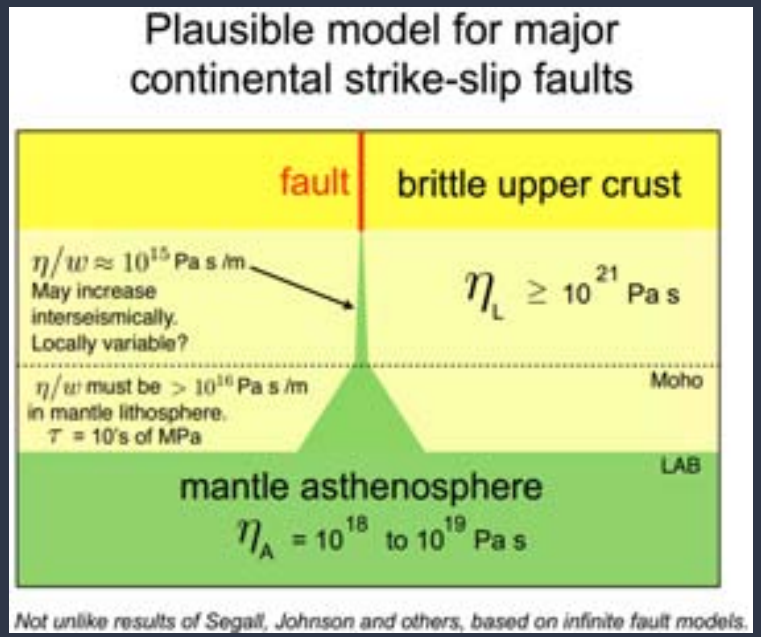


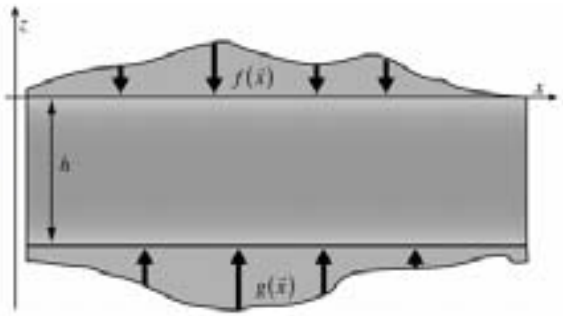


Stresses from Topography and Gravity

- Bridget Smith-Konter: Absolute Stress in Southern California

  3-D stress within a thick elastic plate

  - Calculate critical failure stress in crust in a thick elastic plate loaded with surface topography and Moho topography
  - Semi-analytic (pseudo-spectral)
    - Green's function for elastic plate loaded with non-identical point loads
    - Convolve with short-wavelength (< ~ 350 km, SH 100°-140°) topography at surface and Moho
    - Moho depth constrained by receiver functions (h ~ 35 km), shape constrained by gravity (~ 5 km)



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- Charles Williams: Gravitational Stresses in FE Simulations

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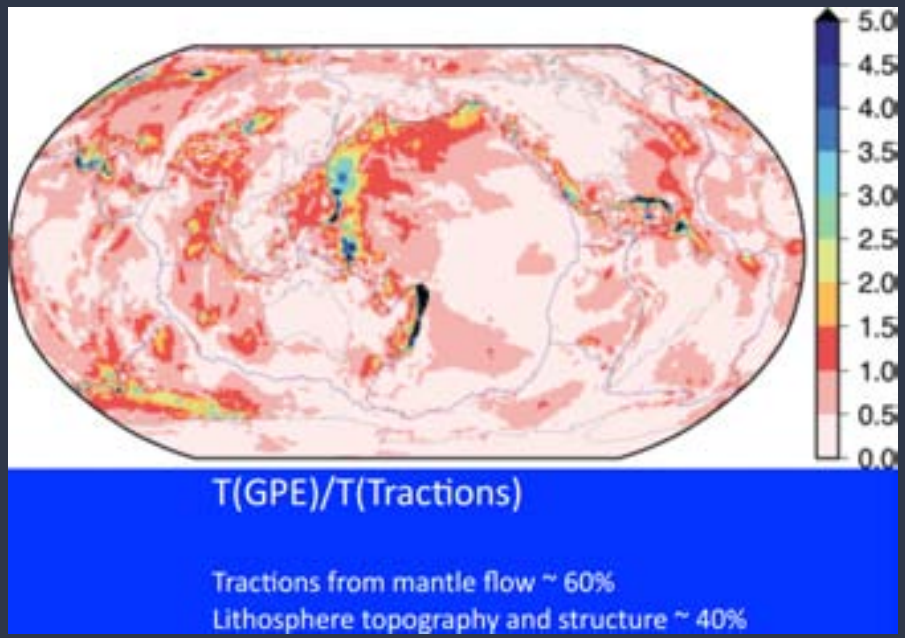

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  - Use initial stresses matching gravitational body forces with small strain formulation
  - Gravity + viscoelasticity + free surface $\rightarrow$ “drunken sailor” or “sloshing” instability
  - Courant condition (Kaus et al., 2010) prescribes a time step smaller than the “standard” stable time step

Community Rheology Model

Will require a champion to push it forward

- Use cases
  - Forward prediction of postseismic deformation (loading of other faults) and time-dependent stress changes
  - More realistic loading of faults in earthquake simulators
  - Prediction of geologic structure in southern California
  - Provide link b/t Community Stress Model and Community Geodetic Model
- Model construction
  1. Collection of input data and assembling reasonable flow laws
  2. Preliminary model developed by a PI or group of PIs
  3. Group effort to improve and extend model (similar to CVMs)
- Inputs: 3-D descriptions of
  - Temperature
  - Composition
  - Water content
  - Laboratory flow laws to define the constitutive behavior

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