Elastic Strength of the crust as A link Between Quakes and Geodynamics?

As the state of stress changes with depth favoring vertical joints in the extrado and horizontal pressure up to lithostatic level, i.e. low effective strength, happens to be controlled by flexure. This model seems to apply at least for strike slip faults like the San Andreas Fault.

A Coincidence OR Not? The Facts...

The simplest rheological model for the crust in shear is:

Elastic Flexure Controls.... the fluid pathways

and therefore... .... the Fluid Pathways

The San Andreas Fault is a system of dextral strike slip faults which runs from the Gulf of California (Mexico) to the Mendocino triple junction (Washington, USA). This plate boundary has been initiated 30 My ago as the ridge, which separated the Farallon plate from the Pacific plate, collided with the North American Plate (Atwater and Stokely, 1998). The fault is segmented along strike and we are mainly interested with three segments which are located along the border of the Sierra Nevada micro-plate. In this area, the main fault is orthogonal to the regional maximum horizontal stress (Toward and Zoback 2001) and has therefore been recognized as a weak fault. However, the apparent frictional weakness of the fault does not prevent big earthquakes such as the one which destroyed San Francisco in 1906 to occur in the middle of these three seismic segments, a 150 km long segment is creeping seismically from Parkfield to San Juan Bautista. A question arises from these observations: what factor controls the apparent contracting behavior of the fault along strike.

MODELING IT

Localisation of the different models and observations

RESULTS OF THE 2D PLANE STRAIN THERMO-MECHANICAL MODEL

VARIATION OF JUMPING ALONG THE STRIKE OF THE SAF CAUSES THE CONTRASTING SEISMIC BEHAVIOR FROM ‘ASEISMIC’ CREEP TO DESTRUCTIVE EARTHQUAKES

RESULTS OF 2D PLANE STRESS MODEL DETERMINING FLEXURAL BENDING DUE TO CONVECTIVE INSTABILITY

PARAMETRIC STUDY OF THE EFFECT OF COUPLING AND PLATE THICKNESS

Application to the San Andreas Fault

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Faults and Quakes: A pseudo-static point of view

MECHANICAL STATEMENTS

Central mechanisms: Most faults have a thickness in which Mohr Coulomb plastic regime applies and displacement on the interface between the fault and surrounding media is compatible shear and normal component of the stresses in the fault plane are continuous, only the fault parallel stress component can be discontinuous.

Stress is allowed to rotate within the shear band, depending on the sense of rotation, the dynamic stress in the surrounding elastic media will rise (hardening) or drop (softening).

M.C. PLASTICITY FOR PREKINETIC FAULTS

Cited References

Effective friction, stress inversions

Inverting strain measurements issued from backslip, earthquake focal mechanism or microfracture one can get the orientation of principal stress axes in the surrounding of faults.

COMPETING this orientation to the orientation of the fault one finds the effective friction of the fault.

Effort and choice: Stress drop and favor slip instability.

However assuming continuity of stress there are many possible state possible inside the fault (red circle).

Therefore the effective friction does well anything about the strength of the fault (the radius of the red circle).

Feasibility: Using a full rheological computation instead of relying on easier criteria in possible to get more information.

Cited References

- Long-term strain path of the crust and sismogenesis, application to the San Andreas Fault (California) Laetitia Li Pourhiet, Evgeni Burkov
- Elastic strength of the crust as a link between quakes and geodynamics? The simplest rheological model for the crust in shear is: Elastic flexure controls the orientation of joints and therefore... the fluid pathways