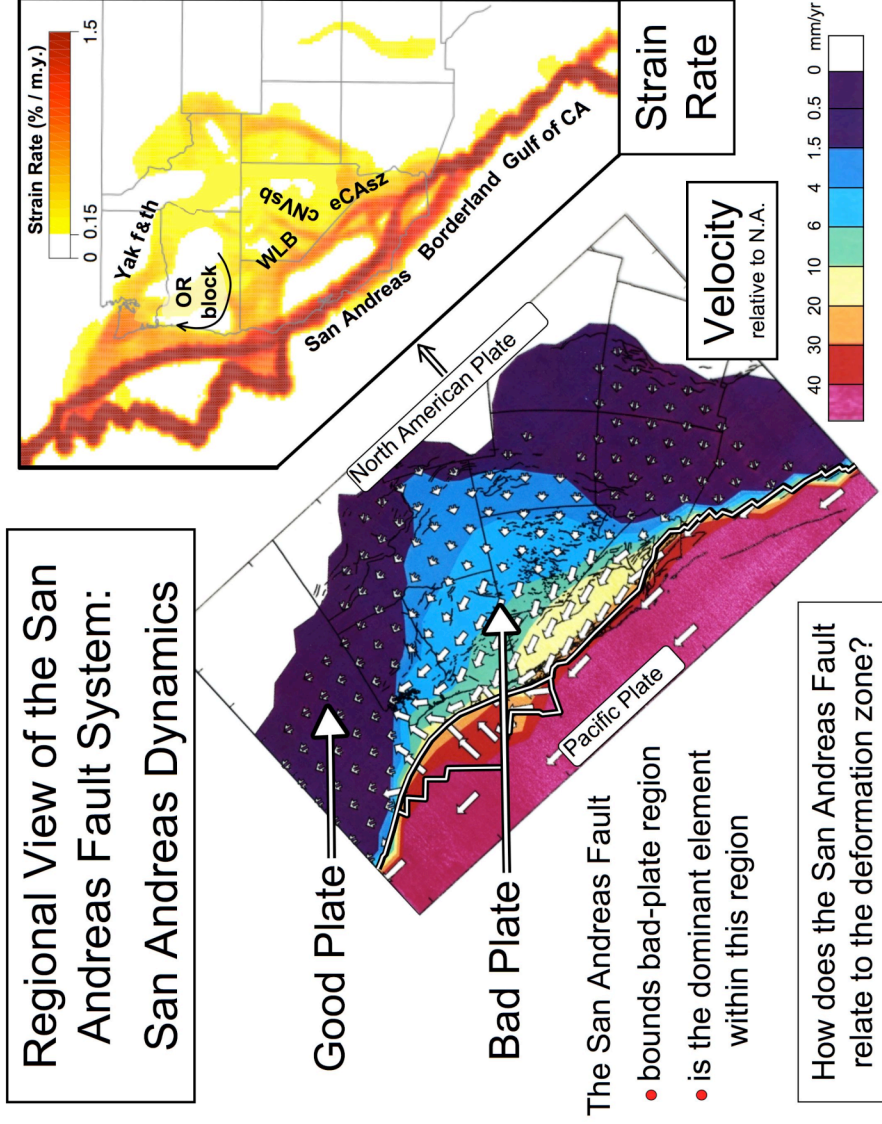
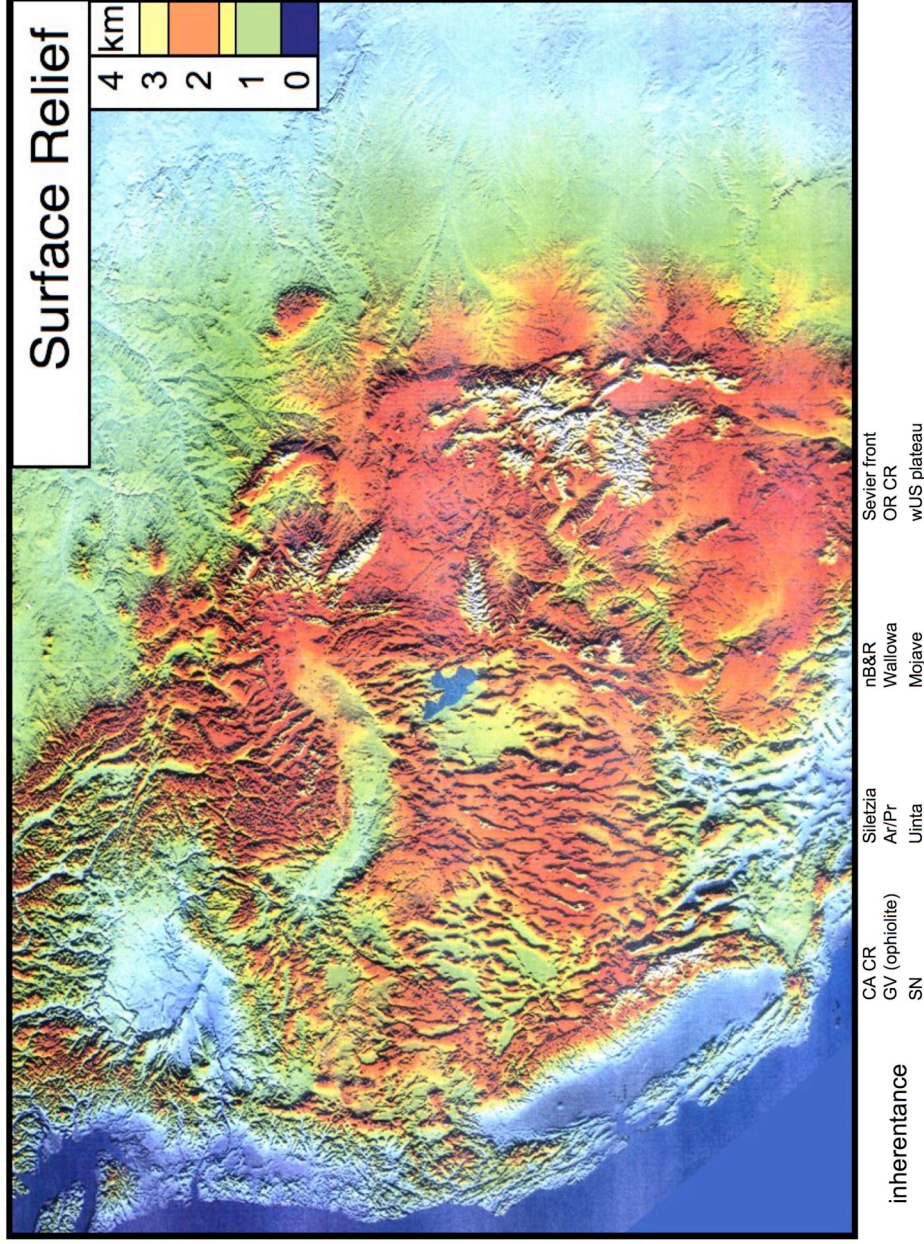
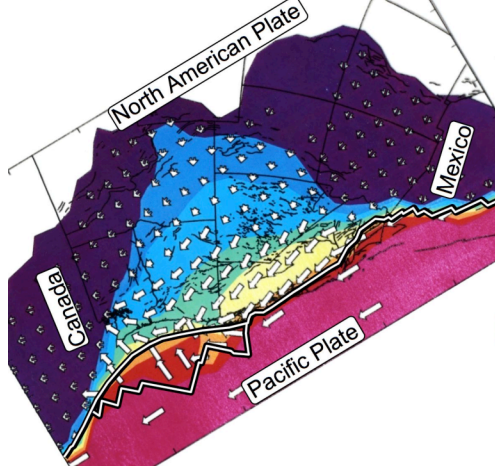




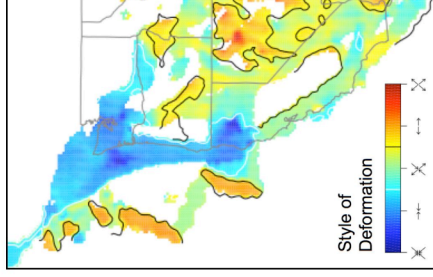
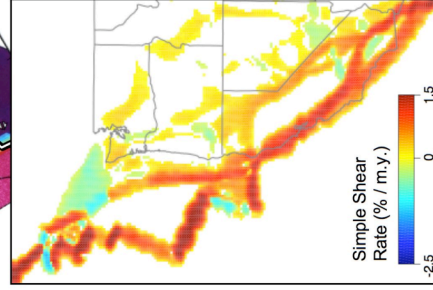
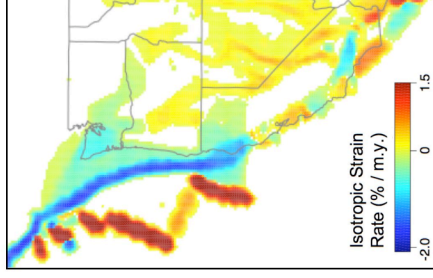
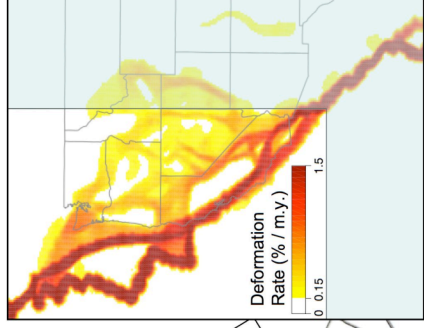


Western U.S. Deformation

Right-lateral shear is applied to western margin of North America except along Vancouver Island

Accommodating deformation is distributed across the continent except in the (now oceanic) Gulf of California

An interior shear zone has developed in response



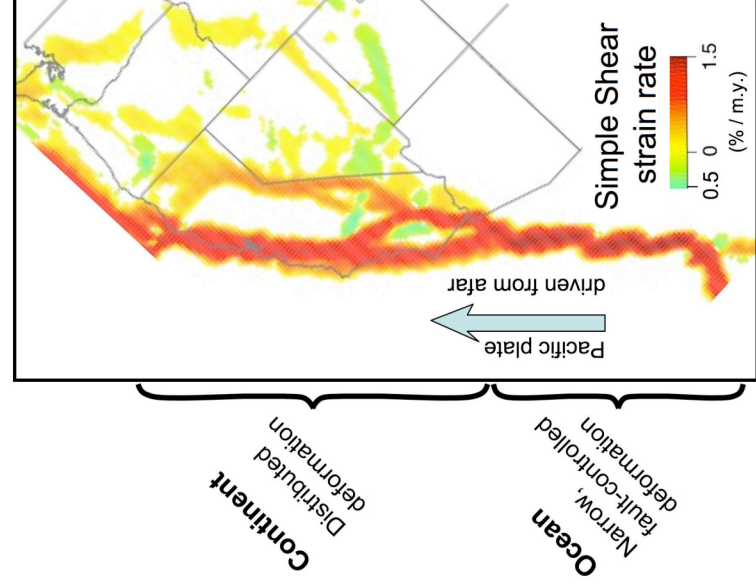
Distributed continental deformation

Western U.S. *shear* deformation

(the deformation that does not cause change of area)

As a transform boundary, the San Andreas system

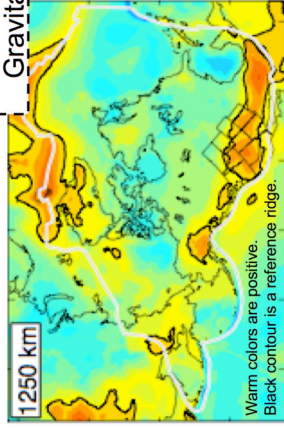
- > is driven by far-field forces
- > only resists deformation
- > distributes itself to minimize work



The question is:
What causes this ?

- > what forces
- > what strength distribution

The 3 types of force



Gravitational PE

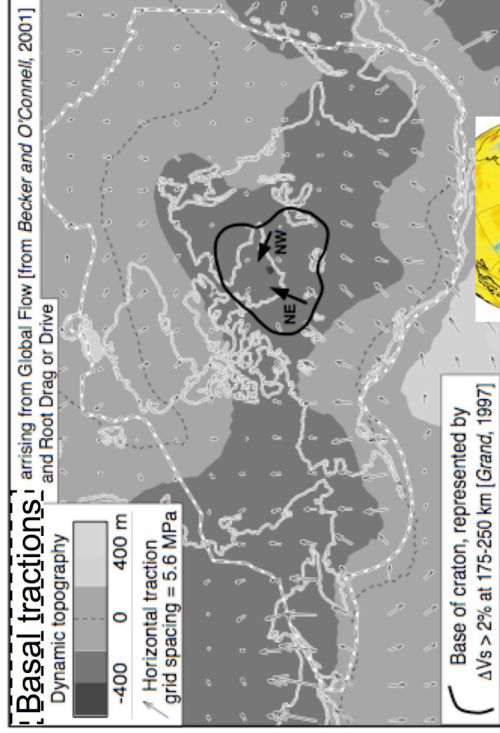
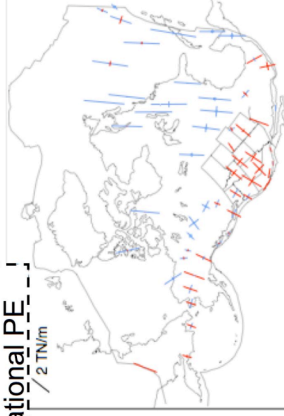
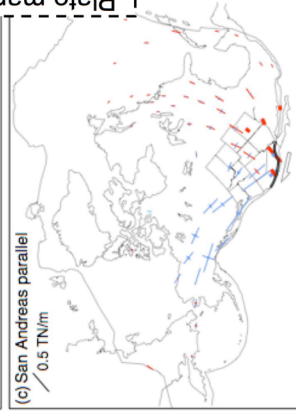
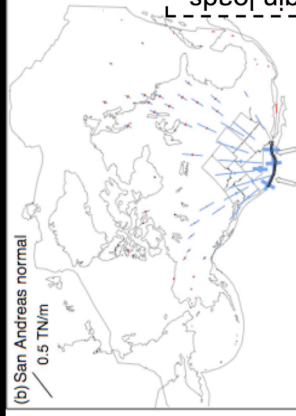
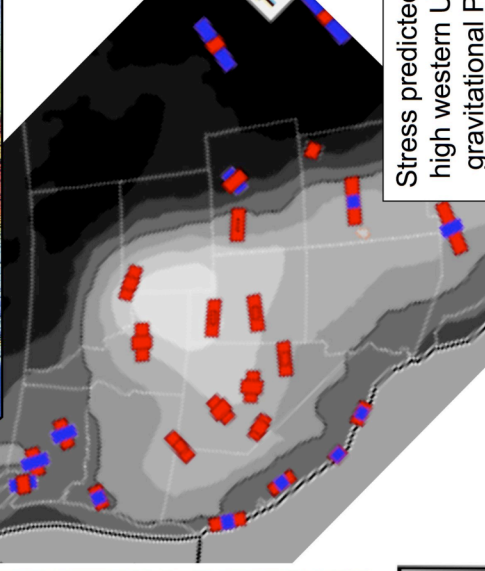
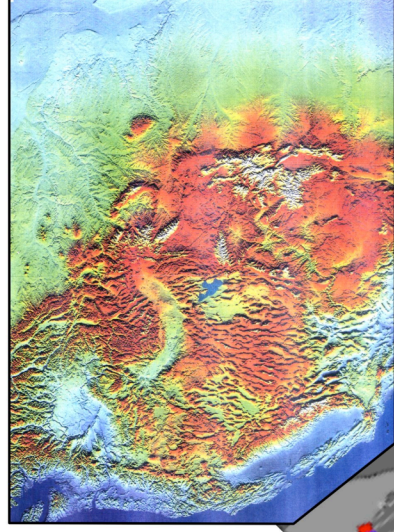
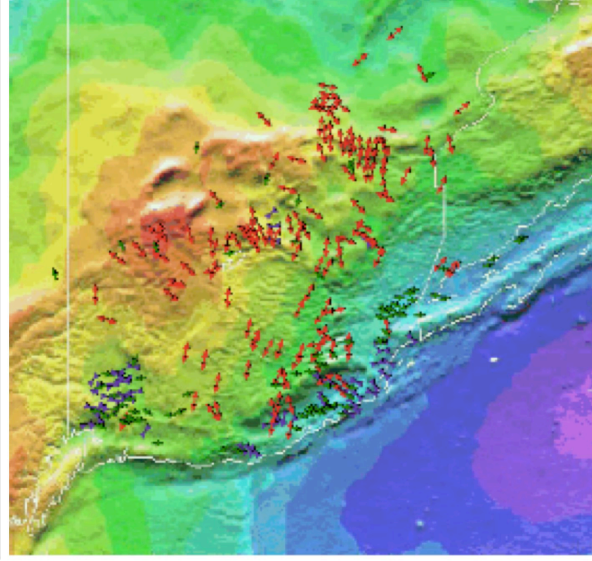


Plate margin loads



Unusual forces in western U.S.

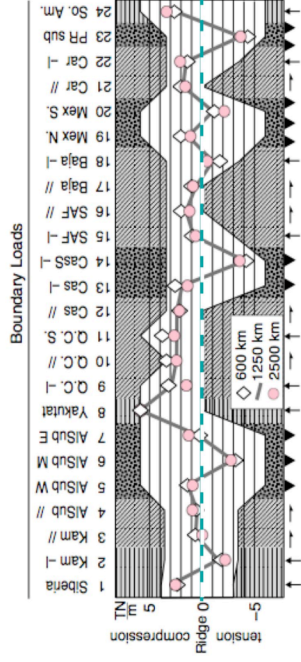
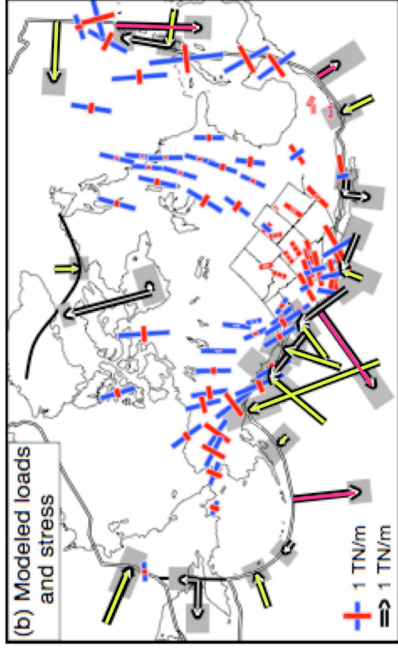
Extension of high-GPE western U.S.



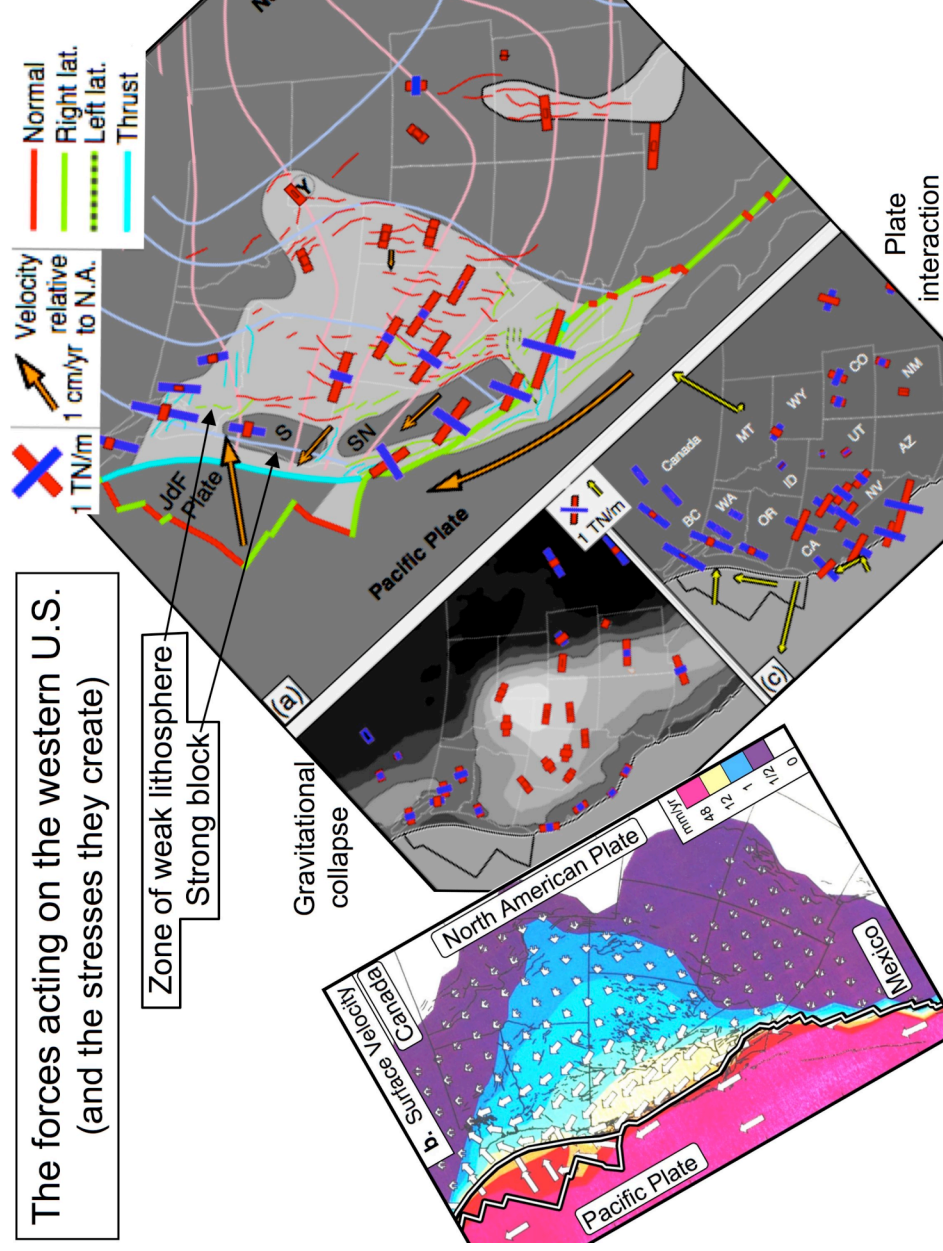
Stress predicted by high western U.S. gravitational PE

Loads acting on North America

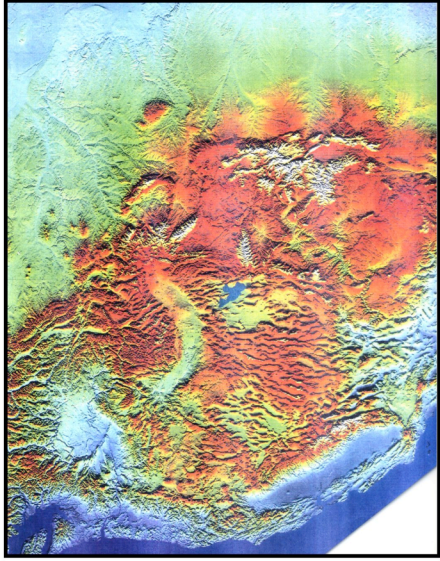
- Most loads compress North America (more than our reference ridge)
- Most subduction zones extend North America



The forces acting on the western U.S.
(and the stresses they create)



Unusual strength in western U.S.

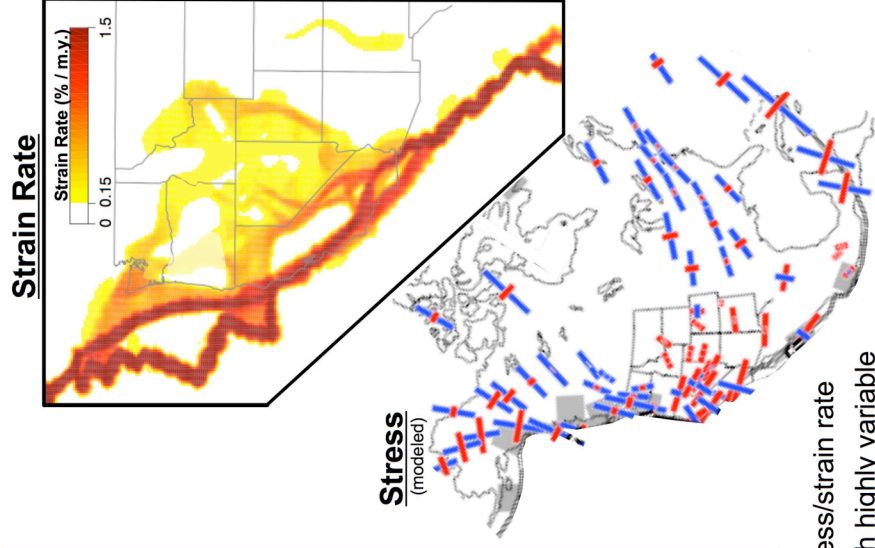


I. Abrupt transitions in distinctive provinces require abrupt transitions in strength (stress doesn't change abruptly).

The distributed shear system and the Great Basin are acting weak

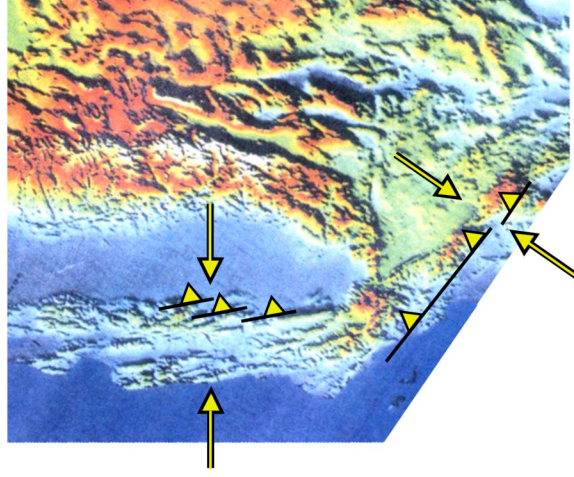
II. Stress $\approx$ constant
Strain rate highly variable

Strength $\approx$ stress/strain rate
 $\Rightarrow$ strength highly variable



Active elements within transform boundary

Evidence for tectonics driven by local density structure:
Local compression

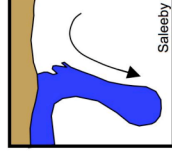


S. California's Drips

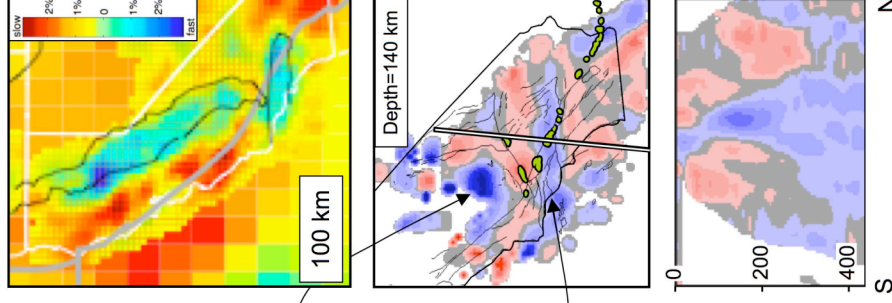
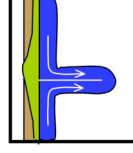
> Subduction ended ~ 25 m.y. ago.

Small-scale convection now is common beneath southern California:

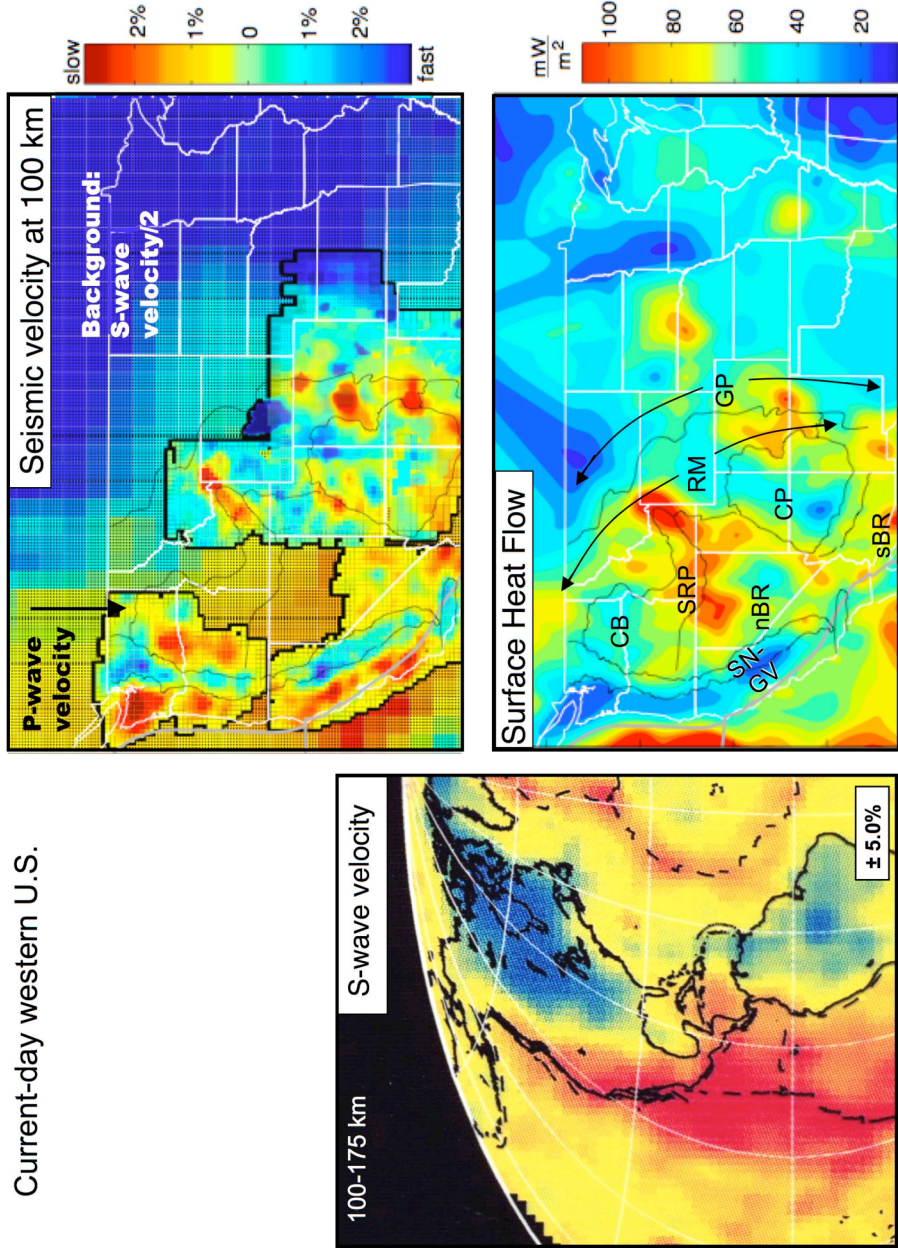
> Southern Sierra Nevada delamination of compositionally dense complement to the granitic pluton down to ~ 200 km depth (from xenolith story, Saleeby, Ducea, C-T Lee, etc.)



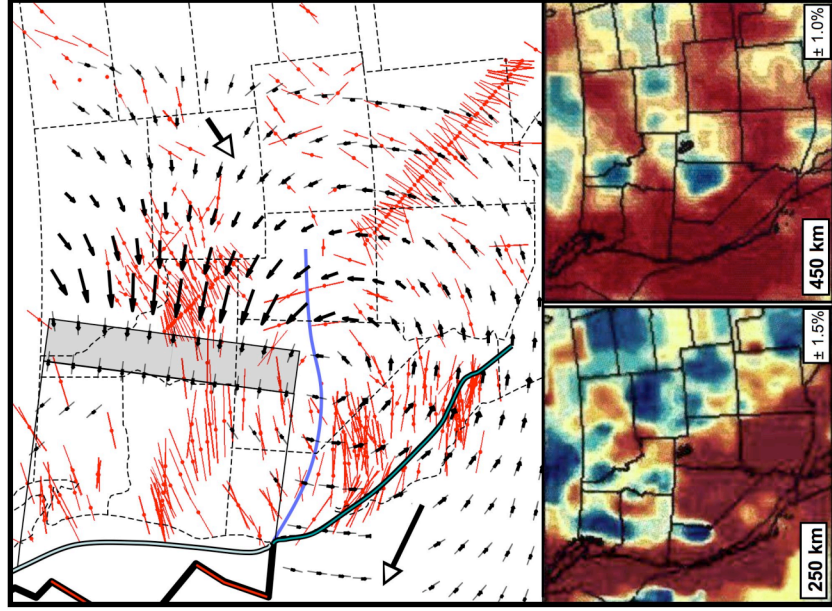
> Transverse Ranges downwelling of an abandoned slab fragment to more than 200 km depth (high-velocity body below Pelona schist suggests it is Farallon slab fragment, not N.A.)



Current-day western U.S.



Flow beneath NW US driven by slab rollback

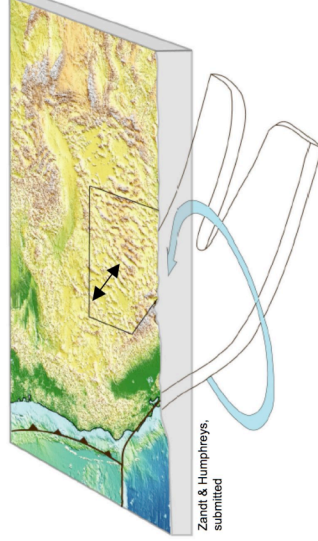


Asthenospheric swirl driven by the sinking Gorda-Juan de Fuca slab.

Slab is imaged where it is predicted by plate reconstruction models (blue line; arrows show trajectories of points).

Anisotropy (red lines) align with flow-model predictions (black arrows).

Possible effects on thermal and stress state:
 -flow beneath Great Basin could sweep away basal lithosphere; keep area hot & elevated
 -tractions could compress southern B&R and add N component of extension to n B&R.



Similar anisotropy results exist for southern Italy