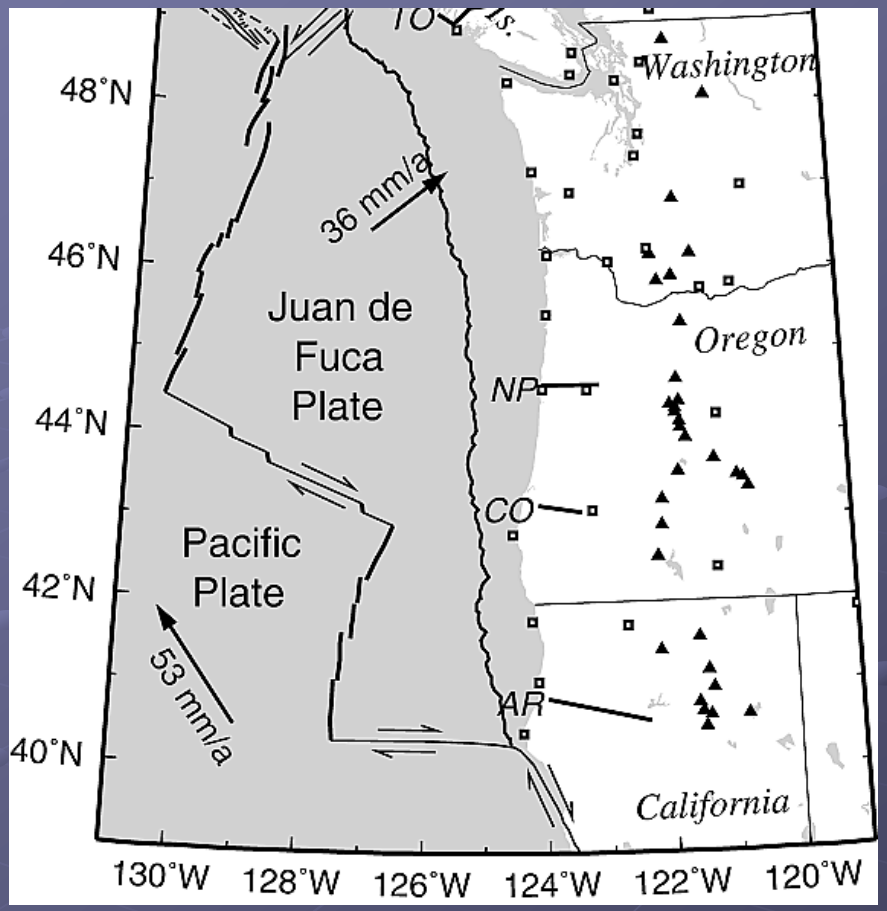
Rotation and plate locking at the southern Cascadia subduction zone

McCaffrey, Long, Goldfinger, Zwick, Nabelek, Johnson, and Smith, *Geophysical Research Letters*, October 1, 2000

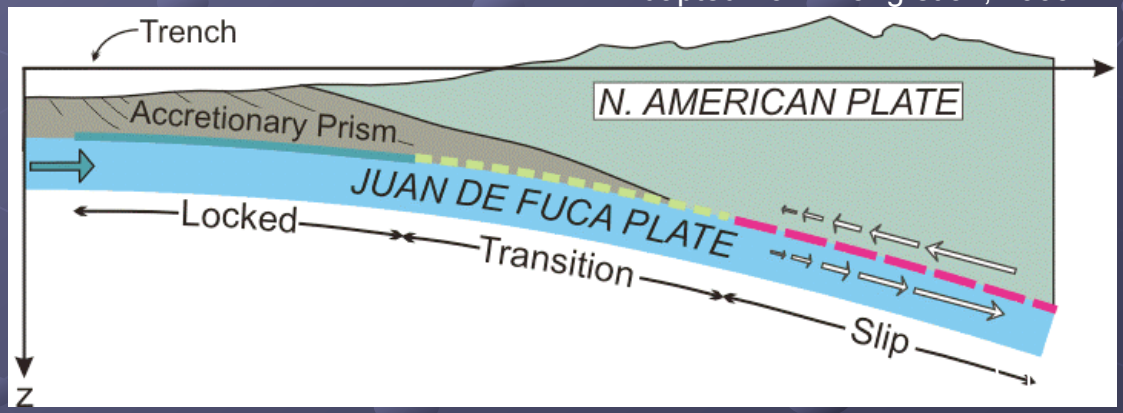
John D. West

EarthScope seminar, March 19, 2007

Motivation: Pacific Northwest Tectonics



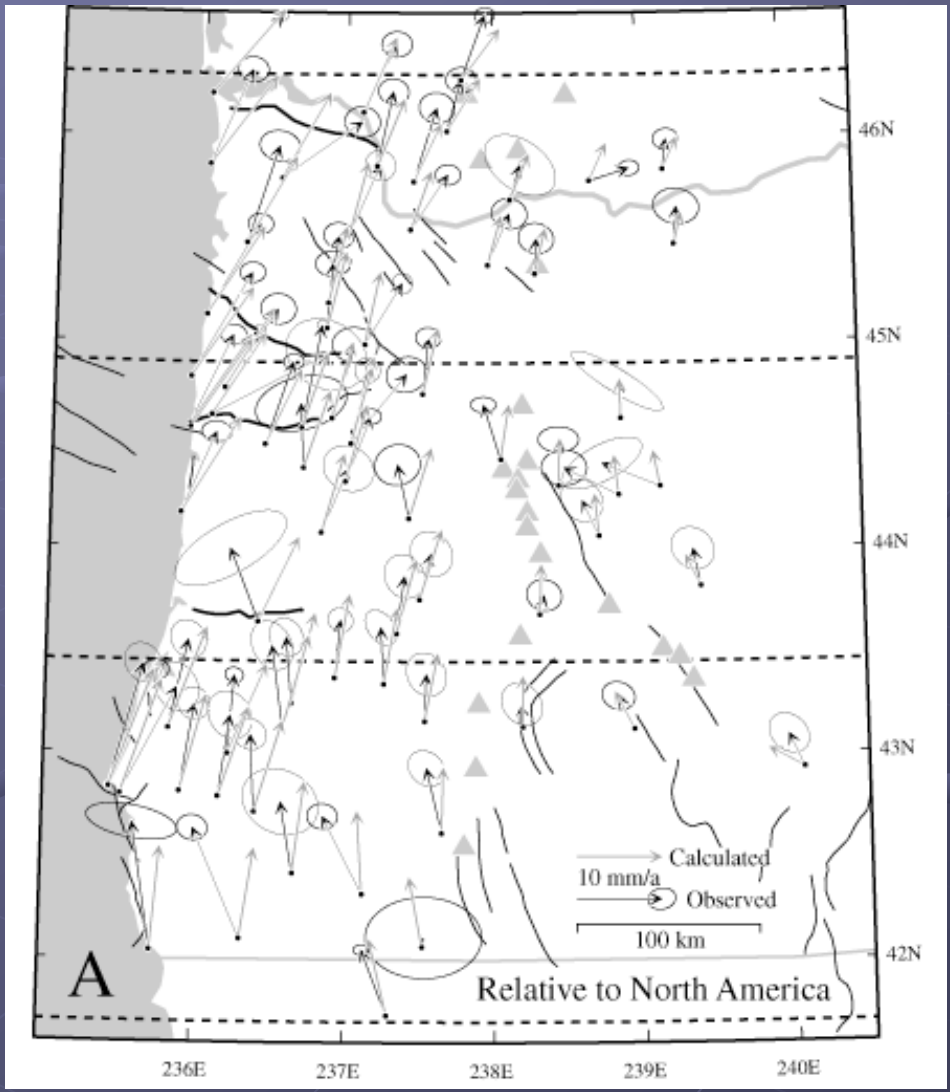
Adapted from Wang et al., 2003



Data: GPS and tilt

Observed and calculated Oregon GPS velocities.

Ellipses show measurement uncertainty (3σ)



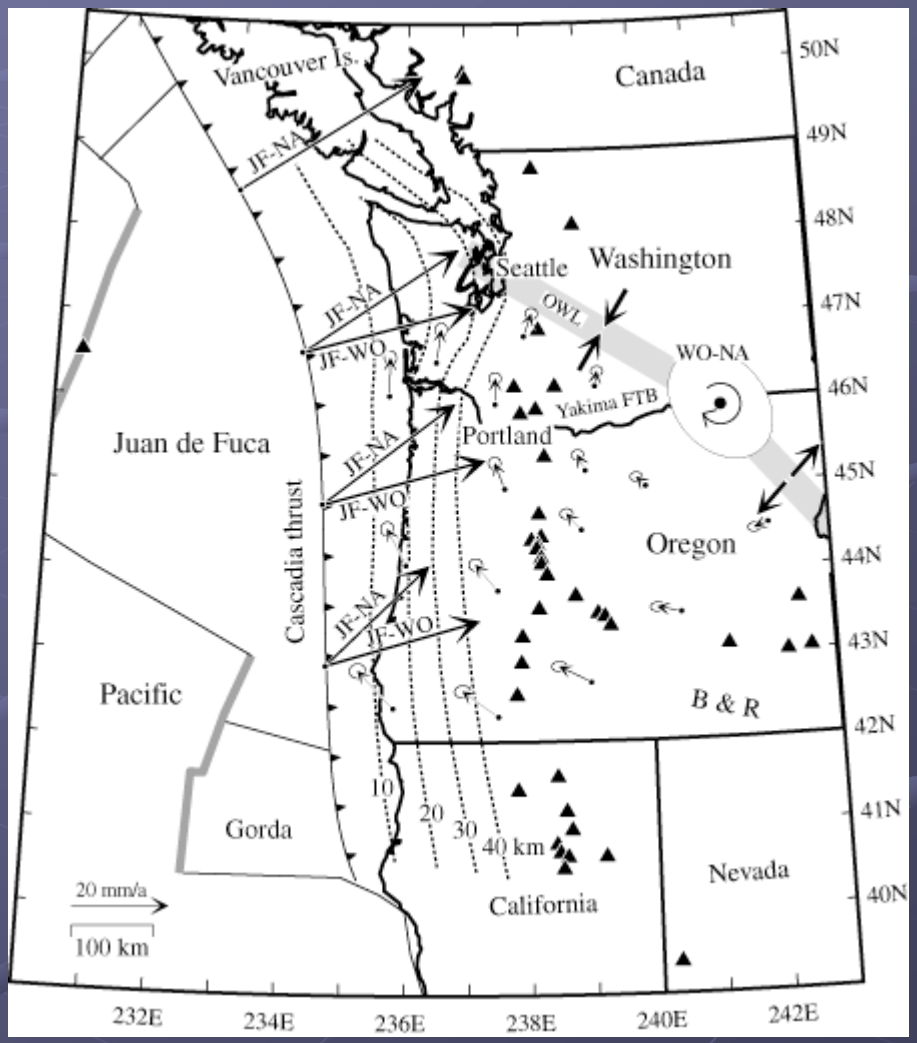
McCaffrey et al. 2000

Method

Simultaneous inversion for Oregon Block rotation and plate locking along the Juan de Fuca subduction zone

Results: Rotation

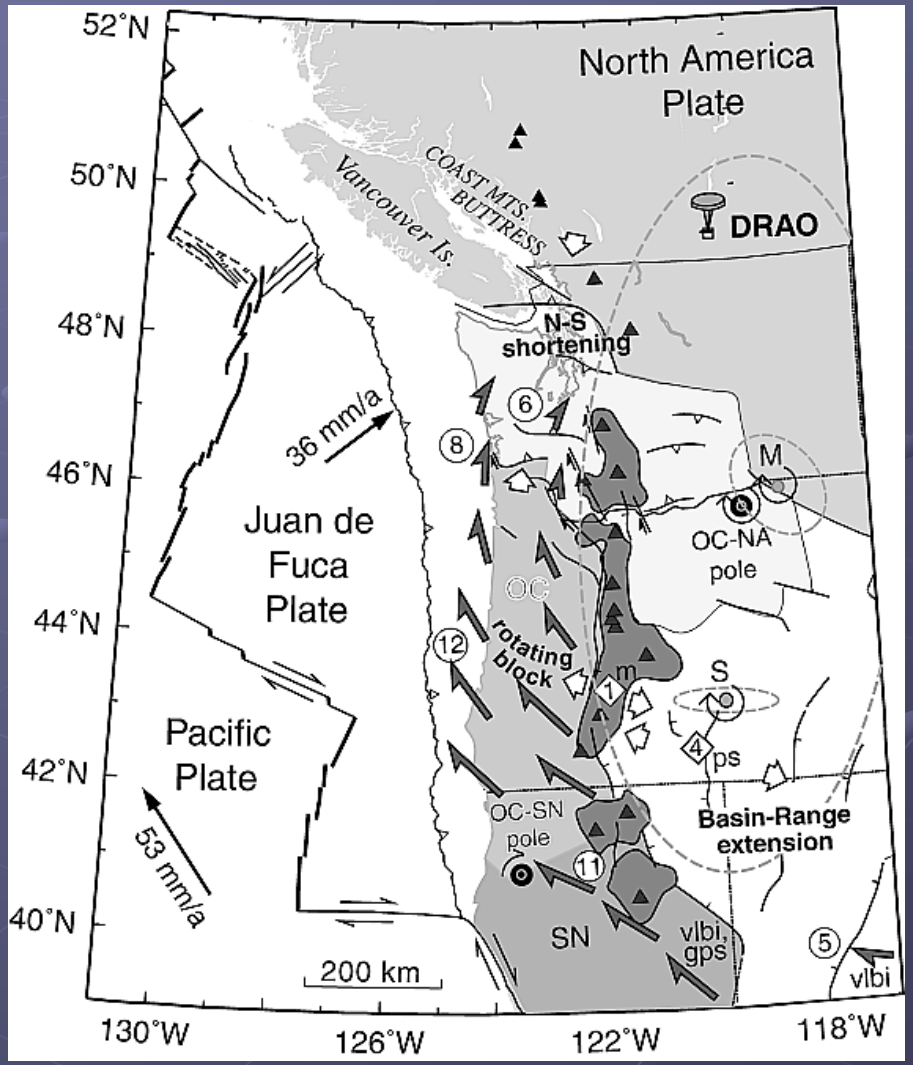
Clockwise rotation with pole on OWL (Olympic-Wallowa Lineament) near Oregon-Washington border



McCaffrey et al. 2000

Rotation results confirmation

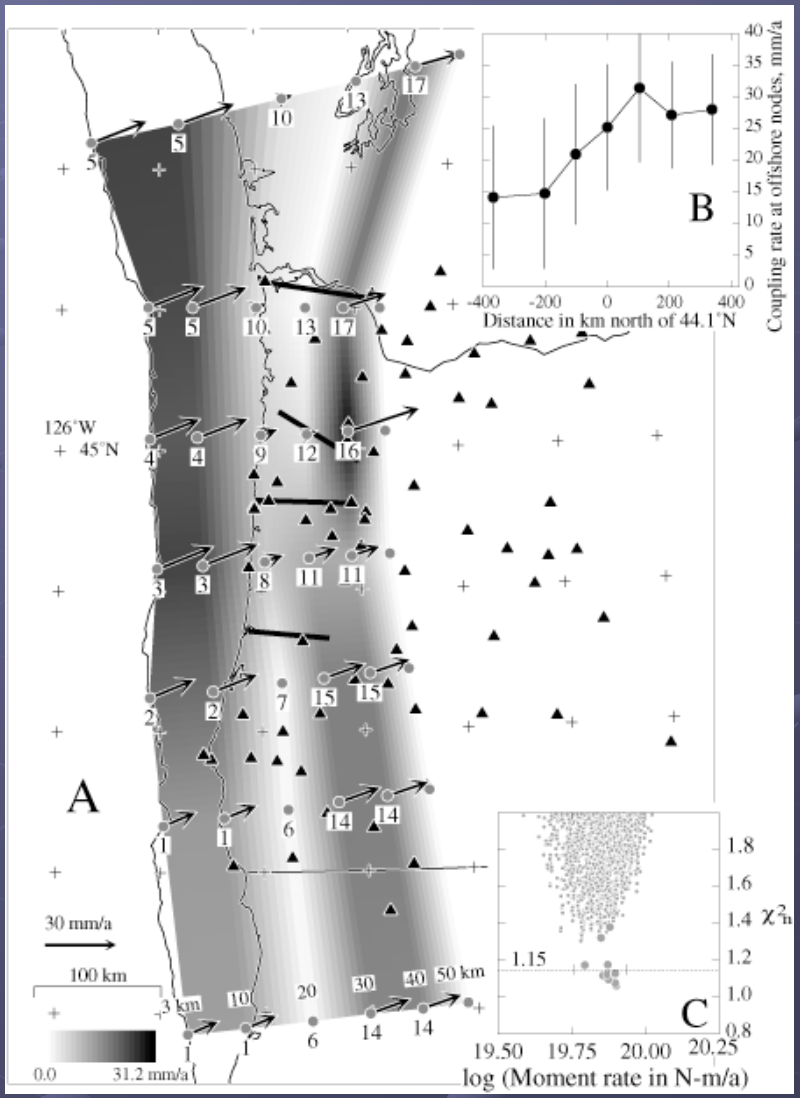
2003 Wang et al. also showed block rotation for western Oregon, and found a rotation pole (OC-NA) very close to the one found by McCaffrey (M)



Wang et al. 2003

Results: Plate Locking

- Two bands of locking: off-shore and in-shore
- Locking increases to the north
- Authors think in-shore locking band may be artifact of model



McCaffrey et al. 2000

Implications/Conclusions

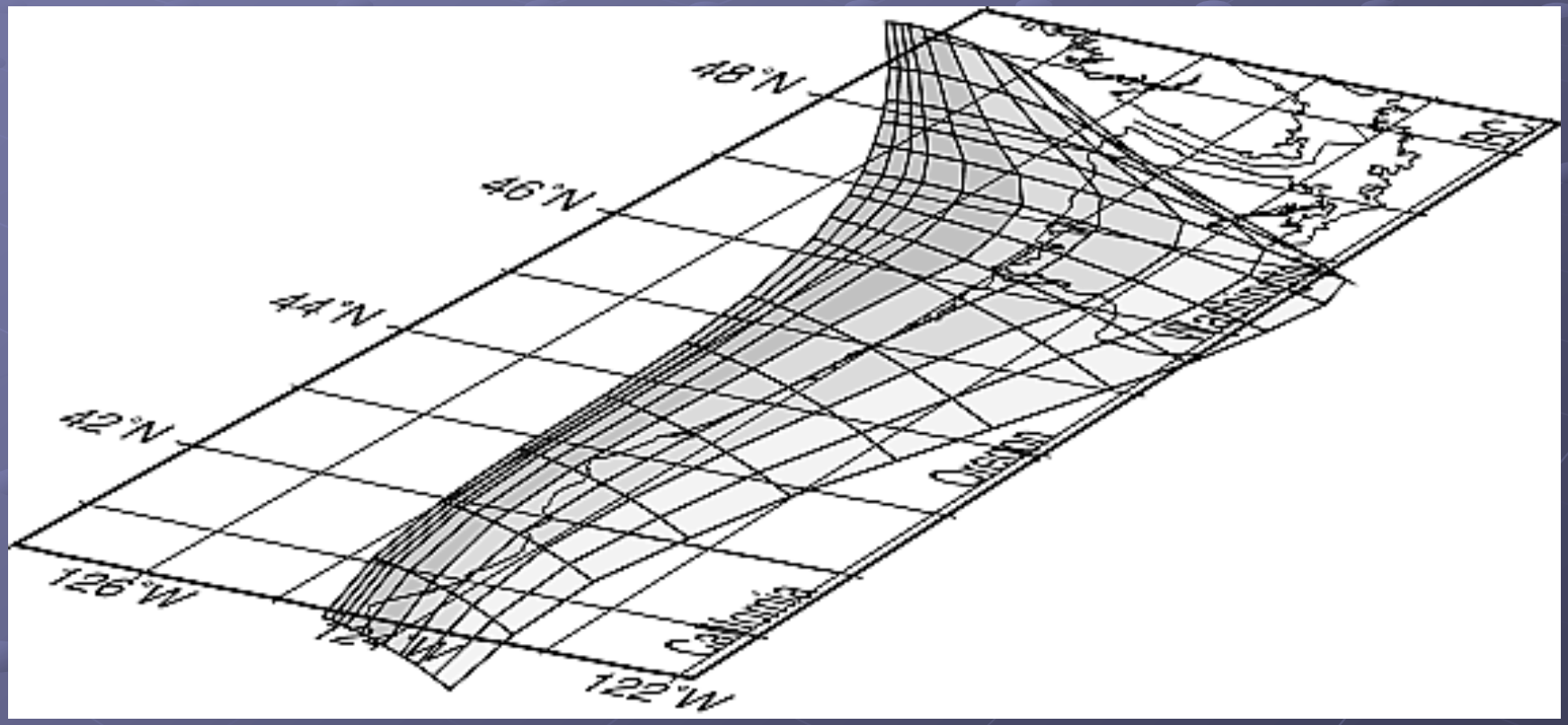
- Block boundary is along the OWL
- Rotation of Oregon block is primarily due to Basin and Range Extension rather than western edge forces
- Moment analysis of plate locking does not match well with historic or predicted earthquakes

Additional Thoughts

- Why doesn't the moment analysis match geologic earthquake record?
- If rotation is being driven by Basin and Range extension, what is driving Basin and Range extension?
- How significant are further constraints on tilt? More data=better model?

Locked Zone

Figure from Wang et al.



Wang et al. 2003