March 30, 2010

Surface motions and deformation: DISCUSSION

Edward Garnero, ASU
Peiying Patty Lin, ASU
EarthScopeSeminarClass

Figures and information referenced from various internet sources
1: Subcontinental-scale crustal velocity changes along the Pacific-North America plate boundary


**DATA:**
Continuous GPS data (1996~2005)

**RESULT:**
A sharp boundary near the centre of the BR oriented parallel to N-NW relative plate motion vector.

*From Patty’s March 3 presentation*
Paper 1: “sharp boundary”... WHY?

If explanation is Earth (as opposed to method):

- Non-tectonic: e.g., crustal deformation due to hydrological & atmospheric loading and local soil movement (however: not observed locally)
- Post-seismic relaxation to 20\textsuperscript{th} century Eqs may explain Nevada site velocities
- Deep crustal or lithospheric source: episodically creeping 500 km wide detachment horizon at base of crust
- Others?
Base of crust detachment horizon

- Mantle translates or stretches smoothly below horizon: creates a westward component of shear traction on base of crust before 1997 to 2000.
- To east of ‘boundary’, plastic deformation $\rightarrow$ internal stretching, crustal movement eastward
- Thus, contrast in lithospheric properties on either side of boundary (Vs: partial melt to west of bdy?)
- Large scale strain transfer, starts in east, propagates west over $\sim$ 1 yr time scale
2: Rotation and place locking at the southern Cascadia subduction zone


DATA:
GPS vectors and surface tilt rates

RESULT:
Rotation of western Oregon and plate locking on the southern Cascadia subduction thrust fault

From Patty’s March 3 presentation
Paper 2: “plate locked offshore, Oregon rotates”

- Plate locked offshore may explain periodic great earthquakes inferred from geology.
- Rotation may be driven by shortening of NW Washington station from collapse of BR (w/ extension in OR, contraction in WA)
- Favorite quotes: “details of the earthquake history ... are sketchy”, “upper plate deformation ... remains poorly quantified”.
Inland locked zone: artifact

- Base of lithosphere: assumed NO SLIP boundary (produces unrealistically high resistance to trench-perpendicular contraction of lithosphere)
- Steep reduction in surface velocities above down-dip edge of coupled zone (contradicts w/ F.E. modeling)
- Thus: only oceanic area assumed LOCKED.
CASE A: $v_{HS} > v_{APM}$

CASE B: $v_{HS} = v_{APM}$

CASE C: $v_{HS} < v_{APM}$

(Kreemer, 2009)