

Igniting flare-up events in Cordilleran arcs

Mihai N. Ducea Mark D. Barton

Problem: Crustal thickness = ±Strain + ±Mass - Erosion





## Cyclicity in Cordilleran orogenic systems

Peter G. DeCelles\*, Mihai N. Ducea, Paul Kapp and George Zandt



## Sierran batholith: Frassetto et al. in review





Cin-Ty Lee et al. : Continental crust formation at arcs, the "garnet pyroxenite" delamination cycle, and the origin of fertile melting anomalies in the mantle



## Proposed lithospheric column for the central Sierra Nevada ~100-10 Ma



Xenolith study from 12-0 Ma volcanics: Ducea and Saleeby (1998)

Modified from Ducea and Saleeby (1998). Schematic lithospheric column for the central Sierra Nevada batholith based on outcrop and xenolith studies.

Behn and Keleman, The stability of arc lower crust: Insights from the Talkeetna Arc section, south-central Alaska and the seismic structure of modern arcs



## Density and wave-speeds





Test 'dense intact root' model with respect to shear velocity at >30 km depth



## New Seismic images

En-Jui, Chen, So. Cal. Local/ambient waves, in prep.
Buehler and Shearer, Pn TA tomograms, in review
Schmandt, Humphreys, So. Calif. Body tomograms, in review
Frassetto et al., 2010, Pds SNEP waves, Geosphere, review.
Moschetti et al., TA ambient/eq surf-wave data, JGR, review.
Li et al., California local Earthquake model, BSSA, 2010.
Yang et al., Ambient and earthquake waves, JGR, 2008.



## How to improve imaging? More stations = higher Data Fold.





## P/S body tomograms: Schmandt and Humphreys (in review)



•Best P/S teleseismic body wave tomograms.

•Has regional array data in the image (other's do not).

Slow P/S >>> high Vp/Vs Fast P/S >>> low Vp/Vs

•Isabella Anomaly goes to 200 km depth.



Abt et al., in review: Lithospheric thickness from S<sub>lab</sub>P



## Heat flow



## Isostatic gravity



Color Isostatic Residual Gravity Anomaly upward continued 10 km, viewed on shaded topography

## STOP Ken >>> Start Josh









# Lower crust advection to west under Whitney Block where delamination is ongoing



Not an inversion pathology as this wide
Moho gradient is not found elsewhere in model.

•Delamination requires weak lower crust to decouple sub-Moho flow (Gurnis paper).

Mushroom's east side has
bent downwards to bring
up asthenosphere as
Ducea and Saleeby (1998)
found.

•North Owens valley and Long Valley volcanics correlation with upwelling asthenosphere.











km









КЧ





## Depth slices



## Depth slices



## Depth slices

![](_page_28_Figure_1.jpeg)

## Summary

- \* Isabella Anomaly is still there
- \* Delamination ongoing under Whitney Block
- \* Favor slab-window model, southern edge of Farallon moved north
- \* southern Sierra lithospheric mantle removed
- \* Is 4.3 km/s "arclogite" or old lithosphere?
- \* High resolution Vs model Best in the world...almost
- \* Simple parameterization, no Moho biases
- \* Crust-mantle boundary on avg. 15km Vs gradient at 42km depth
- \* Some strong similarities with scattered wave images
- \* Inconsistencies with scattered wave images need to be reconciled

## Zandt: Gravity models

![](_page_30_Figure_1.jpeg)

## Crustal thickness and P<sub>m</sub>s amplitude

![](_page_31_Figure_1.jpeg)