EARTHSCOPE SEMINAR
PAPER SUMMARY
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PRESENTER: JEFFREY ROTH
Paper title: How Laramide-Age Hydration of North American Lithosphere by the Farallon Slab Controlled Subsequent Activity in the Western United States
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Overview

This paper seeks to provide a mechanism by which the broad scale uplift and tectonic and magmatic activity associated with the U.S. Cordilleran occurred. The authors hypothesize that water provided by the subducting Farallon slab hydrated the base of the western U.S. lithosphere, increasing its buoyancy and 'priming' it for subsequent melting. Removal of the Farallon slab allowed for asthenospheric contact, resulting in magmatism and additional buoyancy.

Data

A composite seismic dataset, consisting of: data from several line arrays of short-period vertical-component seismometers deployed in the New Mexico area; broadband seismic stations deployed during the 1992 Rocky Mountain Front (RMF) array; broadband seismic stations deployed during the 2000 Continental Dynamics of the Rocky Mountains (CDROM) line-array deployments.

Methods

- Tomographic inversion of delay times to obtain model of Vp structure
- "Squeeze" experiments to test for depth resolution
    - initial inversion; structure constrained to upper 200km (for example)
    - constraint relaxed for subsequent inversion iterations
    - if significant structure is imaged below 200km, then this argues strongly for deeper (>200km) structure

Results

- Strong correlation between imaged mantle structure and geologically defined regions.
- Low-velocity volumes imaged to depth of 200 km beneath the Rocky Mountains in Colorado and >100km depth beneath the Jemez volcanic trend in New Mexico
- High-velocity volumes imaged beneath the Great Plains and the Colorado Plateau

Implications

- Low-velocity mantle is partially molten, and related to the Laramide orogeny
- Uplift caused by crustal thickening in the Rocky Mountains, younging of the Farallon slab, and the creation of low-density hydrous minerals from dehydration of the slab
- Post-Laramide uplift caused by slab removal and lithospheric warming

- Low-velocity structures are result of presence of partial melt, caused by reduction in solidus temperature due to hydration of lithosphere from slab dehydration
- Rocky Mountain contraction occurred as the Colorado Plateau was driven northeast by basal tractions from Farallon slab contact with North America

Additional Thoughts

- Why not continue squeeze tests below 200 km?
- What is the mechanism for Farallon slab flattening and detachment?
- Possible impact of proposed Yellowstone plume impingement ~80Ma?