EARTHSCOPE SEMINAR
PAPER SUMMARY
APRIL 23, 2007
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PAPER TITILE: Raising the Colorado Plateau
AUTHORS: Nadine McQurrie, Clement G. Chase

Overview

This paper proposed a new model to explain the elevation of the Colorado Plateau. The authors suggested that Colorado Plateau was elevated by intracrustal flow from an overthickened Sevier orogenic hinterland. Then they tested their model in three ways: isostatic balance, viscosity and topographic gradient estimates and geologic evidence.

Data

- Combine balanced cross sections with sedimentation and provenance studies of the Sevier foreland to estimate paleocrustal thicknesses.
- Use paleobotanical evidence to estimate paleoelevation of Sevier Plateau.
- Use metamorphic rocks to estimate the pressure and temperature of the intracrustal flow
- Use metamorphic core complex to constrain time and pressure of extension in Sevier hinterland during Cretaceous

Methods

They test their model in three ways:

- Isostatic possibility of changing elevation by varying crustal thickness
- Reasonable viscosity and topographic gradients
- Geological evidence

Results

- A three-layer elevated Colorado Plateau model thickened by injection of a 14.5km mobile crust.
- Estimated viscosity and temperatures of the intracrustal flow.
- A range of elevation of Colorado Plateau caused by intracrustal flow.

Implications

- Changes of foreland-basin geometry
- Application to the high-elevation of Rocky Mountain region.
- Sevier fold –and-thrust belt and Laramide uplifts are merely different expressions of strain that developed in response to the same driving mechanism.
- Uplift and outward growth of the east margin of Tibet may be also caused by a intracrustal flow.

Comment from Kevin T. Kilty

- The crucial test of their model requires a prediction of how upper crust behaves in their model
- The upper crust should have rigidity to the flow in a longitudinal direction and must therefore support shear stress on the wall. But deformation from such a stress hasn't been found.
- Laramide uplifts as a response of ductile flow should cause the Colorado Plateau to resist gargantuan normal forces. These forces should result in deformation or high-angle faults.
- There is no recent uplift following this ductile flow mechanism occurs in the western United States.
- Overall, their model seems a less likely mechanism of uplift of the Colorado Plateau.

Reply to the Comment by Nadine McQuarrie and Clement G. Chase

- The conclusions from evaluating stresses in the upper crust by Kilty are inconsistent with the geology of the Laramide and Colorado Plateau region.
  - → the magnitude of the stresses agrees with the magnitude of regional stressed in contractional areas
  - → the crustal flow provided a mid-crustal detachment and allowed for the eastward propagation of contractile strain in the form of Laramide uplifts.
- The crustal flow process is not limited to the Colorado Plateau but also includes much of the Wyoming and Montana region as well.