

**SMALL-SCALE CONVECTION BENEATH THE TRANSVERSE RANGES, CALIFORNIA:  
IMPLICATIONS FOR INTERPRETATION OF GRAVITY ANOMALIES**

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Tomographic inversion of upper mantle P wave velocity heterogeneities beneath southern California (Humphreys et al., 1984) shows two prominent features: an east-west trending curtain of high velocity material (up to 3% fast) in the upper 250 km beneath the Transverse Ranges and a region of low velocity material (up to 4% slow) in the 100 km beneath the Salton Trough. We interpret these seismic velocity anomalies as due to small-scale convection in the mantle. Using this hypothesis and assuming that temperature and density anomalies are linearly related to seismic velocity anomalies through standard coefficients of proportionality, leads to inferred variations of  $\sim \pm 300^{\circ}\text{C}$  and  $\sim \pm 0.03\text{ g/cm}^3$ .

We use the "observed" density contrasts to construct a very simple 3-D model of flow and stress beneath southern California using an elastic lithosphere over a uniform viscosity half space. The model shows upwelling beneath the Salton Trough and downwelling beneath the Transverse Ranges, consistent with the seismically inferred density anomalies. Shear tractions of about 100 bars drive an overall NW-SE motion with convergence in the Transverse Ranges.

The gravity anomaly produced by the seismically-inferred density contrasts alone reaches + 50 mgal over the Transverse Ranges. The effects of surface downwarping due to density-driven mantle flow add an opposing gravity contribution that reduces this amplitude and can even reverse its sign, depending on the flexural rigidity of the lithosphere. A 20 km thick elastic lithosphere results in a gravity field with no net gravity anomaly along the axis of the Transverse Ranges, flanked by a low of about -30 mgal. This is generally consistent with the observed isostatic gravity map.

Although the flow model is certainly oversimplified, it shows that sublithospheric loads (and the accompanying mantle response) have an important influence on short-wavelength gravity anomalies. They also demonstrate that gravity anomalies of the type to be measured by GRM can result from subcontinental small-scale convection.

Reference

Humphreys, E.D., R.W. Clayton and B.H. Hager, A tomographic image of mantle structure beneath Southern California, *Geophys. Res. Lett.*, 11, 625-627, 1984.