GSA DATA REPOSITORY ITEM 2009149

Supporting Online Material

We implemented a Fourier transform solution to the two-dimensional elastic bending equation in which deflection of the flexing plate induces opposing basal normal tractions driven by a density contrast between the plate and a dense flowing lower layer. Under these circumstances, the deflection of the plate can be written as:

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)D\left(\frac{\partial^2 w}{\partial y^2}+2\frac{\partial^2 w}{\partial x \partial y}+\frac{\partial^2 w}{\partial x^2}\right)+(\rho_m-\rho_c)gw=\rho_c gh \qquad (1)$$

where w is the deflection of the plate, ρ_m and ρ_c are the densities of the mantle and crust, respectively, g is the gravitational acceleration, D is the flexural rigidity ($D = ET^2/(12*(1-\nu^2))$; E is the Young's modulus, T is the elastic thickness, and ν is Poisson's Ratio), and h is the height of the topographic load. Eq. 1 can be solved using a Fourier transform method (Hodgets et al., 1998) as:

$$W_{(u,v)}=R_{(u,v)}\cdot L_{(u,v)} \qquad (2)$$

where u and v are the wavenumbers in the x- and y- directions, W is the Fourier transform of w, L is the Fourier transform of $\rho_c gh$, and R is:

$$R_{(u,v)}=\frac{1}{(\rho_m-\rho_c)g+D(u^2+v^2)^2} \qquad (3)$$

We calculate W, and then use the inverse Fourier transform to calculate w in x, y space.

In our flexural modeling, we assumed densities for the crust and mantle of 2600 kg/m^3 and 3300 kg/m^3, and an elastic thickness of 15 km, as has been inferred for the area from other studies (Tassara et al., 2006; Tassara et al., 2007). To assess the sensitivity of our results to our choice of elastic thickness, we explored the effect on the calculated isostatically compensated (long wavelength component) and non-isostatically compensated (short wavelength component) topographic features (Figure S1). We varied T between 5 and 50 km, and found that our results and general conclusions regarding the relative roles of the short- and long-wavelength topography in defining the plateau morphology are only affected if T is less than ~5 km. Thus, while the magnitude of the short-wavelength topography does vary with T, the general features of plateau and foreland topography discussed in the text can be clearly identified, even in the case that T=5 km. Analysis of gravity data from the region favors a higher elastic thickness, supporting the view that much of the short-wavelength topography of the area is isostatically uncompensated.

Supplemental References:

Hodgetts, D., Egan, S. S., and Williams, G. D., 1998, Flexural modeling of continental lithosphere deformation: a comparison of 2D and 3D techniques, Tectonophysics, v. 294, p. 1-20.
Tassara, A., Götze, H.-J., Schmidt, S., and Hackney, R., 2006, Three-dimensional density model of the Nazca plate and the Andean continental margin: J. Geophys. Res., v. 111, p. B09404.
Tassara, A., Swain, C., Hackney, R., and Kirby, J., 2007, Elastic thickness structure of South America estimated using wavelets and satellite-derived gravity data: Earth and Plan. Sci. Let., v. 253, p. 17-36.

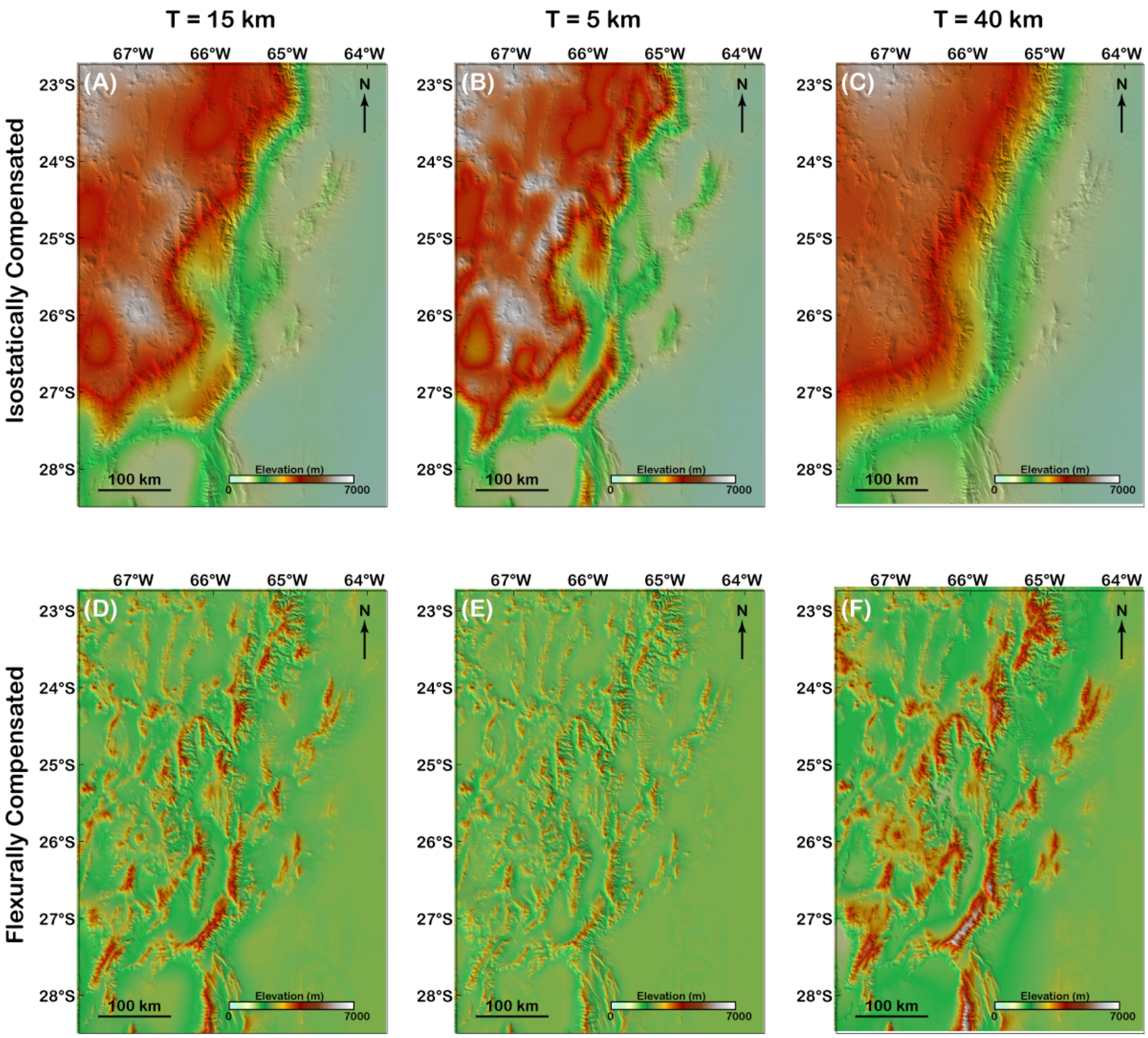

Figure DR1- Effect of varying elastic thickness (T) on the isostatically and non-isostatically compensated components of the topography within the Puna and along its eastern margin. (A-C) Long-wavelength topography expected to be isostatically compensated when (A) T=15 km, (B) T=5 km, and (C) T=50 km. (D-F) Short-wavelength topography expected to be isostatically uncompensated when (D) T=15 km, (E) T=5km, and (F) T=50 km. Note that panels A and D constitute Figure 2 in the main text.