Geophysical Research Abstracts
Vol. 15, EGU2013-6248, 2013
EGU General Assembly 2013

Challenges (and Promise) of In-Situ Lithospheric Rheology from Isostatic Strength Analyses

Anthony R. Lowry (1), Thorsten W. Becker (2), Janine S. Buehler (3), Meghan S. Miller (2), Marta Pérez-Gussinyé (4), Derek L. Schutt (5), and Lisa L. Seunarine (1)

(1) Department of Geology, Utah State University, Logan UT United States (Tony.Lowry@usu.edu), (2) Department of Earth Sciences, University of Southern California, Los Angeles, CA USA, (3) Scripps Institution of Oceanography, University of California-San Diego, La Jolla, CA USA, (4) Department of Earth Sciences, Royal Holloway-University of London, UK, (5) Department of Geosciences, Colorado State University, Ft. Collins, CO USA

Measurements of effective elastic thickness, T_e, from flexural isostatic modeling are sensitive to flow rheology of the lithosphere. Nevertheless T_e has not been widely used to estimate in-situ rheology, partly owing to methodological questions regarding the measurement of T_e and partly because of uncertainties in other in-situ properties of temperature, composition, water content and state-of-stress of the lithosphere. Dense seismic and other geophysical arrays such as EarthScope's USArray are providing a wealth of new information about physical state of the lithosphere, however, and the relationships of these data to T_e promises new insights into lithospheric rheology and deformation processes. For example, new estimates of subsurface mass distributions derived from seismic data enable us to examine various controversial assumptions about the nature of lithospheric loads. Variations in crustal composition evident in bulk crustal velocity ratio, v_P/v_S, contribute a surprisingly large fraction of total loading, and elevation models better match observations if Moho flexure is not forced to match surface flexure, indicating that lower crustal flow and other crustal mass transfer processes are significant. Perhaps the most interesting new information on physical state derives from imaging of uppermost mantle velocities using refracted mantle phases, P_n and S_n, and depths to negative velocity gradients imaged as converted phases in receiver functions (seismic lithosphere-asthenosphere boundary, "LAB"). We will compare T_e measurements to thermal models derived from these seismic fields, and discuss their implications for lithospheric rheological controls and thermal processes.