Geophysical Research Abstracts,
Vol. 11, EGU2009-6543, 2009
EGU General Assembly 2009

Instantaneous dynamics of the cratonic Congo basin, central Africa

N. Downey and M. Gurnis
Seismological Laboratory, California Institute of Technology, Pasadena, CA, USA

The rheological and compositional structure of the continental lithosphere is not well understood. In particular, it has been difficult to quantify the viscous, compositional and density structure of cratonic lithosphere. An understanding of cratonic lithosphere structure can be inferred from study of the epirogenic motions within cratons that result in the formation of intracratonic basins. Unfortunately, intracratonic basin formation is itself a poorly understood process because these basins exhibit a variety of subsidence rates and styles, often have multiple subsidence episodes and sediment deposition is subject to the varying influences of tectonics and eustasy. Our poor understanding of intracratonic basin formation also stems from the rarity of currently active intracratonic basins. One mechanism of intracratonic basin formation is lithospheric instability resulting in mantle downwelling and depression of the cratonic surface. Admittance modeling indicates the presence of such a downwelling beneath the intracratonic Congo basin, providing the opportunity to test the lithospheric instability hypothesis at a geodynamically active basin, and use the results to constrain the structure of the lithosphere. The Congo basin is approximately 1000 km across, has had several subsidence events since the early Paleozoic and overlies crustal rift structures. The Congo basin is unique because it is coincident with a 70 mGal long-wavelength free-air gravity low, overlies a high shear wave velocity structure in the uppermost mantle, as imaged in seismic tomography, and its most recent subsidence deposited continental sediments by a previously unknown mechanism. We created dynamic models of the Congo downwelling that are tightly constrained by the gravity and topography of the basin and are consistent with the results of seismic imaging. The long wavelength of the basin simplifies model formulation because we can ignore lithospheric flexure. We parameterize several different models of lithospheric density and viscosity structure and do a search over these parameters to find the instantaneous models that best fit geophysical observations. We find that the observations at the Congo basin can be explained by a high-density anomaly viscously supported within the uppermost mantle. The best fitting models predict a 30-60 kg/m3 positive density anomaly situated at a depth of 100 km. The large magnitude of this anomaly suggests it has a compositional rather than a thermal origin.