Crustal Structure of Northeastern North America from Constrained Models of Potential Field Data

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The Adirondack mountain region, the surrounding St. Lawrence seaway, the Charlevoix region, and Lake Ontario region are zones of persistent seismicity in the Eastern United States. However, only scant knowledge exists of the location and geometry of faults, suture zones, or crustal thickness variations that may localize strain in the crust beneath sections of Northeast North America. Our aim is to determine the crustal density and magnetic susceptibility contrasts (e.g., steep faults, intrusive bodies, Moho topography) which give rise to anomaly patterns and to place constraints on their geometries and locations. With a better understanding of these structures, we will examine how the distribution of the faults and steep contacts throughout the region compare with zones of active seismicity.

We create forward and inverse models of North American gravity and magnetic anomaly compilation that are constrained by Euler deconvolution and wavelet based inversions of potential field data to locate steep contrasts at crustal depths. Additionally, our models are constrained by independent observations of crustal thickness variations from receiver functions and controlled source seismic data. These models are then tested with available seismic reflection and structural data. This yields predictive and inverse models of the subsurface structures thay give rise to potential field anomalies.

In the U.S.-Canada border region of Lake Ontario our model demonstrates that complex Moho topography alone does not fully represent the intermediate wavelength gravity anomaly, and a fault bounded sedimentary basing of 3-5 km in depth is also needed to explain the observed Bouguer gravity anomaly patterns. In the areas surrounding the Adirondack Mountain region and north Appalachian suture zone where thick skinned faulting occurred, we observe geometric and depth correlations between our inversion methods in the form of thrusts, Iapetus fault contacts, and possible intrusive bodies. Initial results show strong correlations between basement involved structure and seismicity.

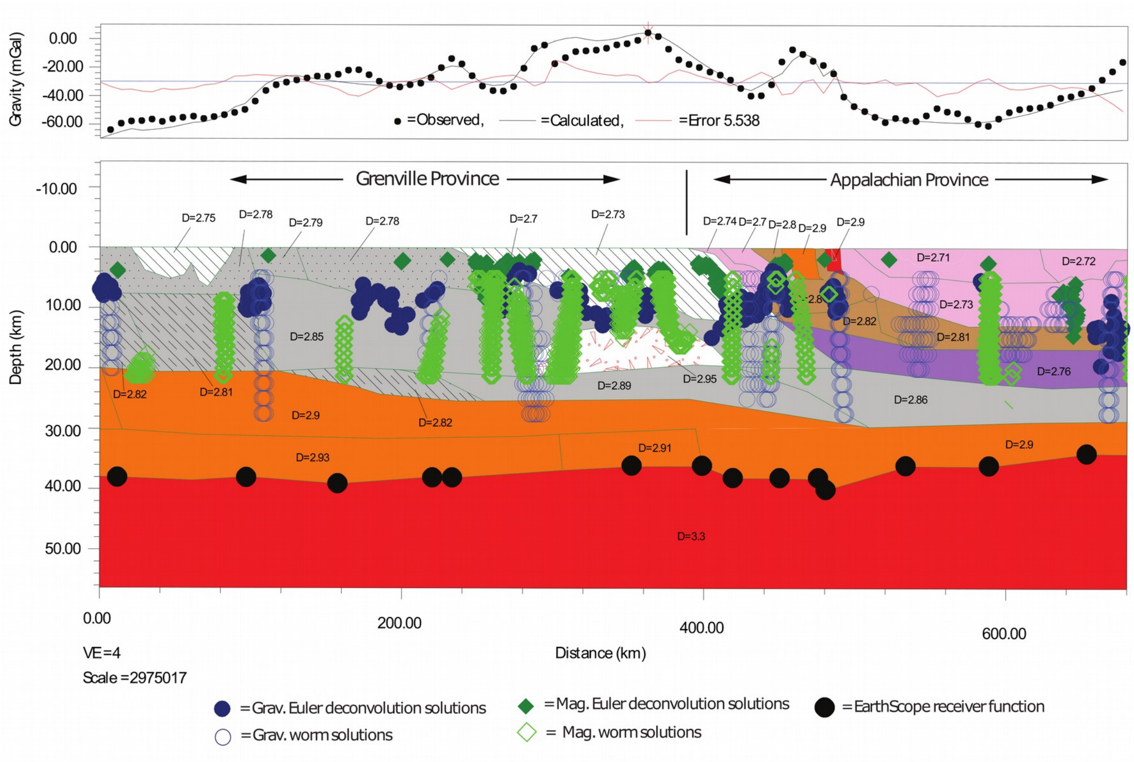

Figure: Comparison of predicted and observed Bouguer anomaly (top) from a model of lateral boundaries in mass density and magnetic susceptibility along a transect of the lower St. Lawrence seismogenic zone and Adirondack Mts (bottom). Crustal thickness is constrained by EarthScope receiver functions, and density derived from controlled source seismic (Musacchio et al., 1997). Hollow circles and diamonds are locations of Poisson wavelet multiscale edges "worms", which induce an inversion of delineating lateral density and magnetic susceptibility contrasts (e.g. Hornby et al., 1999; 2002).