

The Northern Gulf Anomaly (NGA): Characterizing a Continental-edge Asthenospheric Upwelling Using Seismic Velocity Perturbations

Zoe Krauss¹, William Menke²

¹Colorado College, ²Lamont-Doherty Earth Observatory

We study the Northern Gulf Anomaly (NGA), a region of extremely low (~10% lower than the neighboring craton) asthenospheric seismic velocities first identified in continental-scale geotomography. This anomaly may represent present-day or past small-scale convective upwelling near the southeastern edge of the North American continent. Differential *P* and *S* wave arrival times from teleseisms at a variety of back-azimuths, observed on Transportable Array stations near the US Gulf Coast, are used to define the spatial extent and character of the anomaly. Differential travel time anomalies, relative to the AK135 earth model, are calculated via cross-correlation of vertical (for *P*) and radial (for *S*) component seismograms, corrected to account for the effect of the kilometers-thick sedimentary cover in the region. The NGA is most intense at the southernmost coast of Louisiana and East Texas (with an eastern edge at 89° W) and smoothly tapers away in a triangular wedge that extends inland as far as 300 km. It has sharper edges and a smaller areal extent (by ~50%) than previously-published geotomography has indicated. Maximum delays are ~3.2 s for *P* waves and ~7.2 s for *S* waves, relative to the southern part of the North America craton in Arkansas. It is not possible to achieve this magnitude of delays with a solely compositional anomaly, and therefore the NGA likely has a thermal origin. The unusually large *P* wave delay (compared to *S*) can be explained in part by mantle anisotropy with a vertical fast axis, caused by strong downwelling beneath the craton, as has been predicted by mantle flow models. While giving rise to an especially fast *P* wave, and therefore increasing the relative maximum *P* delay, this anisotropy would not much affect *S* wave travel times. Thermal models indicate that the traveltimes gradient at the eastern edge of NGA could be the result of up to 200 million years of cooling of an initially sharp edge. Thus, the possibility that the NGA was created during the opening of the Gulf of Mexico around 180 Ma (the most recent large scale tectonic event in the region) cannot be ruled out.