

Seismic anomalies in the southeastern North American asthenosphere as characterized with body wave travel times from high-quality teleseisms

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Previously-published tomographic images show low-velocity anomalies (shear velocity up to 5% slow relative to the AK135 Earth model) in the asthenosphere beneath the southeastern margin of North America, including the Northern Appalachian (New England), the Central Appalachian (Virginia), and the Northern Gulf (Texas-Louisiana coast) Anomalies. Travel time anomaly ratios and attenuation indicate that they are thermal anomalies associated with mantle upwelling. We use teleseismic P and S wave differential travel times, as determined by cross-correlation of USArray data, and ratios of compressional-to-shear wave travel time fluctuations to characterize the South Coastal Anomaly (SCA), a fourth, weaker anomaly (about half as strong as these others) that stretches from Georgia to Virginia. P-wave tomography indicates that the SCA is about 800 km long in its north-south dimension and at least 300 km wide in its east-west dimension (its eastern edge is not imaged) and it is strongest ($\Delta V_P \approx -0.1$ km/s) in the 100-250 km depth range. Its western edge strikes north-south, parallel to the edge of the Laurentian Craton (LC). The maximum P and S wave travel time anomalies of the SCA are 1.09 ± 0.05 (95%) s and 4.20 ± 0.10 (95%) s, respectively, relative to the LC. The ratio of P-to-S wave differential travel time anomalies is 3.84 ± 0.10 (95%), a value close to the value of ~ 3.3 predicted for a thermal anomaly and very different from the value of ~ 1.8 predicted for a compositional anomaly. The compressional velocity is up to 0.41 km/s slower than the LC, which corresponds to a maximum temperature difference of about 700 °C, using a sensitivity of 1713 K-s/km. In the shallow asthenosphere, the SCA appears distinct from the Central Appalachian Anomaly, being weaker in magnitude and more tabular in shape, but the two anomalies may merge below ~ 250 km depth. Our findings support the notion of the vigorous edge convection along much of the eastern continental margin.

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