Continental Growth in the Vicinity of the Eastern Tennessee Seismic Zone During the Grenville Orogeny: Mapping an Ancient Plate Boundary in the Lithosphere

A model for the growth of continental lithosphere in the vicinity of the active eastern Tennessee seismic zone (ETSZ) is proposed based upon an integrated interpretation of seismic tomography, potential fields, geochemistry and paleomagnetic reconstructions. Earthquakes in the ETSZ occur in Grenville-age basement rocks located below the southern Appalachian decollemont and most activity occurs SE of a prominent gradient in the aeromagnetic field termed the New York – Alabama (NY-AL) magnetic lineament. The NY-AL magnetic lineament probably represents a major basement fault that played an important but enigmatic role in the construction of the supercontinent Rodinia during the Grenville orogeny. Recent high-resolution velocity models determined for the ETSZ reveal the presence of a sharp velocity contrast associated with the vertical projection of the NY-AL magnetic lineament that extends to depths of at least 24 km. A roughly 26 km wide zone of anomalously low P- and S-wave velocities are present to the NW of the lineament and characterize the near-vertical fault zone. Interpretation of the velocity model is aided by recent paleomagnetic reconstructions for Rodinia in which transpressive motion of the Amazon craton is responsible for all of the Grenvillian deformation of Laurentia. Following this reconstruction, the NY-AL magnetic lineament depicts a major basement fault that accommodated left-lateral motion of the Amazon craton during the Grenville orogeny in much the same way that extensive strike-slip faults, such as the Alpine fault in New Zealand, accommodate oblique convergence along active plate margins today. This model is in agreement with recent isotope geochemistry studies demonstrating that the southern and possibly central Appalachian basement is exotic to Laurentia. Determining the lithospheric expression of this ancient plate boundary is an excellent target for the TA deployment and is presently being studied using ambient noise tomography. Results of this study are presented to the public in the Center for Earthquake Research and Information Public Earthquake Resource Center.