Earthscope and Bermuda: A Small-Scale Convection Link?

Scott D. King, Margaret H. Benoit, and Maureen D. Long

The islands of the Bermudas sit atop a 1500-km rise on 100-140 Ma ocean crust that lies 640 km ESE of Cape Hatteras, North Carolina. The mechanism of formation of Bermuda rise is unresolved. Drill core from DSDP Sites 386 and 387 records mid-Eocene (48.6-37.2 Ma) mixed bioclastic/terrigenous turbidites that are assumed to indicate the beginning of uplift. While Bermuda has been described as a hotspot, 1) an age progressive chain associated with Bermuda is less than obvious; 2) the present-day location of the plume, based on the age of volcanism of Bermuda, is an area of the central Atlantic with no anomalous sea mounts or topography; and 3) there is no anomalous topography along the adjacent mid-Atlantic ridge, as would be expected if the hypothesized plume had jumped to the mid-Atlantic ridge. An alternative hypothesis for the formation of Bermuda is that it lies atop the upwelling limb of a small-scale convection cell whose downwelling limb corresponds to the eastern edge of the North American cratonic interior.

We have investigated the seismic structure of the upper mantle and transition zone beneath Bermuda using data from permanent broadband station BBSR. Preliminary receiver function stacks provide evidence for transition zone that is ~25 km thinner than the global average. Preliminary SKS, SKKS, and PKS splitting measurements provide evidence for an apparently isotropic upper mantle beneath BBSR, with high-quality null *KS arrivals over a wide range of backazimuths. These observations suggest that that the upper mantle beneath Bermuda is either isotropic or exhibits a vertical axis of fast anisotropic symmetry, as might be expected for vertical mantle flow (i.e. upwelling). The simplest interpretation of the transition zone thickness is that hotter than average mantle extends through the transition zone beneath Bermuda. Both of the sets of seismic observations are consistent with a mantle plume beneath Bermuda; however, this interpretation leaves unresolved the question of why there is no clear age progressive volcanic track and why the upwelling appears to move with the Atlantic plate rather than remaining fixed within the mantle, as is the case with many other plumes. As the Transportable Array (TA) component of USArray reaches the east coast of North America, it provides a further opportunity to test the predictions of the edge-driven convection model for Bermuda.

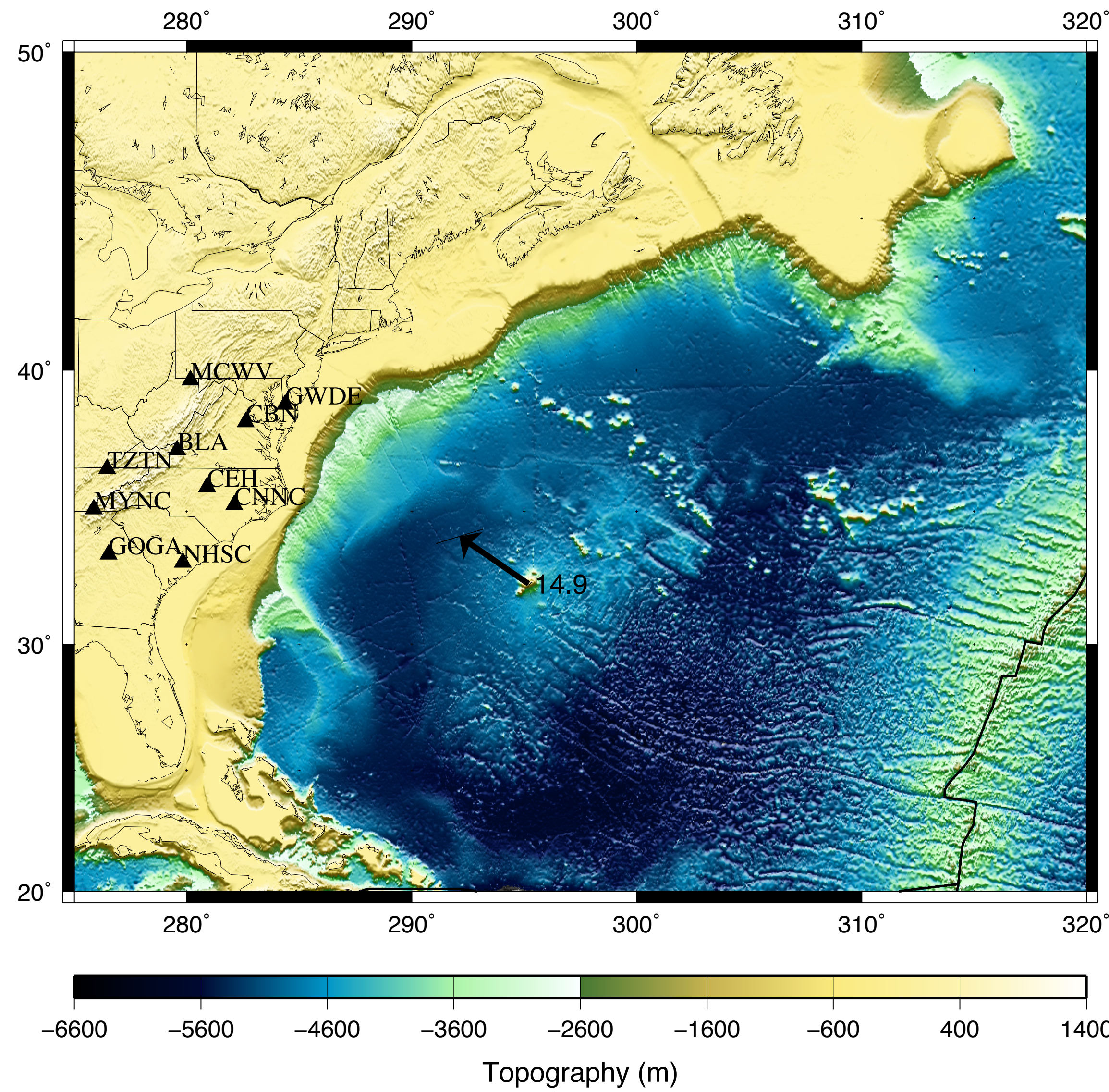

Figure 1: The topography of eastern North American and western Atlantic. Including broadband (permanent) seismometers in the southeastern US. North American plate motion in the HS3-Nuvel1a frame shown at Bermuda.