Dynamic Topography of Borborema Province and Surrounding Regions of Brazil

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The Borborema Province is a Precambrian domain located in the northeastern corner of the Brazilian Shield. It has experienced a complex tectonic evolution that involves orogenic cycles during Precambrian times as well as continental break-up during Mesozoic times. Thermochronologic studies suggest that this region underwent Late Cretaceous-Cenozoic epeirogenic uplift, which is broadly coeval with basaltic volcanism. This uplift is manifest by marine Albian limestones, which crop out at 700 m altitude within the Araripe Basin, and by emergent Holocene marine terraces along the coastline. Despite its elevation, the Borborema Plateau is underlain by thin (30–35 km) crust and has a long-wavelength (> 700 km) positive free-air gravity anomaly. Both observations imply that some degree of sub-crustal support is required. Offshore, oceanic lithosphere adjacent to the Borborema Province has positive residual depth anomalies with amplitudes of hundreds of meters. We infer that sub-plate mantle convective processes have played a significant role in generating and maintaining plateau elevation. Here, a multi-disciplinary approach is used to analyze the causal relationship between surface topography, crustal thickness and crustal density with a view to constraining the residual topography of the Borborema province and surrounding regions. A combination of legacy active and passive source seismic experiments, comprising receiver function studies and deep seismic refraction profiles, were used to determine crustal velocity structure. The relationship between crustal velocity and density is investigated by analyzing a global compilation of rock physics measurements for a full range of crustal lithologies. In this way, the average density of Borborema crust is calculated and used to estimate residual topography by carrying out an isostatic balance between continental lithosphere and a typical mid-oceanic ridge. Positive residual topographic anomalies are obtained for the entire region that are consistent with the amplitude and sign of off-shore residual depth measurements. The aim of this project is to develop a quantitative understanding of the spatial and temporal evolution of the Borborema Plateau. Future work will focus on analyzing exhumed sedimentary basins that transect the plateau, on modeling the geochemistry of Neogene basalts, on inverting fluvial drainage networks, and on interrogating emergent marine terraces along the adjacent coastline.