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Unraveling the Structure and Dynamics of the Borborema Province, NE Brazil, With Broadband Seismology

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The Borborema Province of NE Brazil comprises the northeasternmost corner of the Brazilian shield and can be regarded as a tectonic collage of basement rocks of Paleoproterozoic age. One of the most intriguing features of the Province concerns its Cenozoic magmatism and uplift. Cenozoic activity is arranged along the north-south trending Macau-Queimadas alignment (MQA) and consists of small-volume, alkaline magmatism with Ar-Ar dates that range between 50 and 7 Ma. The Cenozoic magmatism does not display a clear age progression and is coeval with the uplift of the Borborema Plateau, with average elevations around 400 m and peak altitudes over 1000 m. Recent geochronological studies have shown that small-scale convection at a cratonic edge might provide a plausible explanation for the origin of the Cenozoic magmatism, and gravity surveys have proposed that mafic underplating of the Borboreman crust could be responsible for the uplift. Preliminary seismic results obtained at temporary broadband stations, however, do not support the proposed uplift mechanism. Receiver functions have shown that bulk Vp/Vs ratios increase dramatically from 1.71 to 1.81 across the MQA and that no corresponding increase in crustal thickness is observed. Moreover, velocity-depth profiles from the joint inversion of receiver functions and dispersion velocities reveal that low-velocity zones, rather than mafic underplate, might be present. The seismic observations, nonetheless, are based on just a small number of scattered observations in the Province and tomographic images at lithospheric and sublithospheric depths are lacking. The deep structure of the Province is now being investigated through a temporary seismic experiment funded under the Instituto de Ciência e Tecnologia de Estudos Tectônicos of the National Council for Scientific and Technological Development (CNPq, Brazil). The experiment consists of a backbone seismic network of 20 broadband stations evenly spread throughout the Province complemented by a similar number of short-period stations. The combined network has an aperture of $\sim$400 km in the NE direction, $\sim$600 km in the NS direction, and an average inter-station spacing of $\sim$100 km, and it will be recording continuously for $\sim$2 years. Tomographic images based on fundamental model surface-waves dispersion as well as P- and S-wave travel-times, along with detailed crustal-velocity models, are now being developed under this effort. We expect that the new results, in combination with refined findings for the Borboreman crust, will shed light on the origin of the Cenozoic volcanism and uplift mechanism for the Borborema Province.