THE BORBOREMA DEEP MAGNETOTELLURIC AND SEISMIC (BODES) EXPERIMENT: INVESTIGATING BASIN INVERSION UNDER ARARIPE.

Julià, J.[1]; García, X.[2]; Nemocon, A.M.[1]

[1]Universidade Federal do Rio Grande do Norte; [2]Institut de Ciències del Mar, CSIC

ABSTRACT: The Araripe Basin of NE Brazil is regarded as an aborted rift basin that developed under the Mesozoic extensional stresses that split Africa from South America. The basin presently stands at 800-1000 m above mean sea level, and forms and elevated plateau known as the Chapada do Araripe. Two competing models have been put forward in order to explain the anomalous elevation of this basin: (i) topographic inversion, by which elevated topography would have resulted from regional epeirogenic uplift followed by differential erosion; and (ii) tectonic inversion, by which uplift would have resulted from a predominantly EW-oriented regional stress field triggered by the Mid-Atlantic Ridge and the Andean range pushes. In 2015, a temporary network of 10 collocated seismic and magnetotelluric (MT) stations was deployed in the western Province, from Pedra Branca/CE to Ponto Novo/BA, forming an approximately North-South arrangement crossing the basin. The seismic stations consisted of broadband sensors sampling at 100 Hz and recording continuously for a period of ~2 years; the MT stations consisted of long-period magnetotelluric systems, sampling at 1 Hz and 4 Hz, and recording for a period of ~2 weeks. Interstation spacing and total length was ~70 km and ~600 km, respectively, for both profiles. Resistivity models (3D) developed from the inversion of the full impedance tensor and tipper at the MT sites, revealed high conductivities (~27 Ωm) below 120 km depth centered under the Araripe Basin flanked by resistive (120 Ωm) material immediately to the North and South; at crustal levels, a number of conductive anomalies were identified, coinciding with the location of major Precambrian shear zones and subducted paleomargins. The deep, highly conductive body was found consistent with the presence of melt and aqueous fluids, and was interpreted as shallow asthenospheric mantle bounded by thicker lithosphere. Seismic S-velocity models (1D) developed from the joint inversion of receiver functions and surface-wave dispersion, on the other hand, revealed the crust thins from 43-44 km in the São Francisco craton (South) to 35-37 km in the Borborema Province (North), with lower crustal velocities kept under 4.0 km/s; at upper mantle levels, the top of a low velocity zone (from 4.6 to 4.3 km/s) was observed to shallow from ~150 km depth under the craton to ~120 km under the Province, suggesting a similar thinning of the seismic lithosphere. We propose that extensional stresses in the Mesozoic stretched and thinned the lithosphere under the Araripe basin, causing passive upwelling of asthenospheric material, and that the shallow asthenosphere was preserved over time through feeding from (distant) lateral flows. Further erosion of the lithosphere under the basin and displacement by ductile flow towards the flanks, would have effectively thickened the lithosphere immediately north and south of the basin. Tectonic inversion would have thus resulted from compressional stress concentration in the overlying, thinned lithosphere and from thermal doming by the underlying, hot asthenosphere.

KEYWORDS: LITHOSPHERIC EROSION; TECTONIC INVERSION; ARARIPE BASIN.