

Interactive comment on “Lithospheric and sub-lithospheric deformation under the Borborema Province of NE Brazil from receiver function harmonic stripping” by Gaelle Lamarque and Jordi Julià

Fernando Ornelas Marques

fomarques@fc.ul.pt

Received and published: 2 April 2019

On lines 13 to 31 of p. 4, the authors acknowledge uplift in NE Brazil: “During the Mesozoic, opening of the south Atlantic separated the Borborema Province from its African conjugate (de Matos, 1992). Continental rifting resulted in significant crustal thinning in the region (Santos et al., 2014; Lima Neto et al., 2013; Luz et al., 2015b), forming both marginal (e.g. Ceará, Potiguar, Pernambuco-Paraíba, Sergipe-Alagoas) and intra-continental (e.g. Araripe, Tucano) sedimentary basins (Figure 1). The post Gondwana breakup evolution of the Borborema Province is characterized by recurrent

C1

magmatism (Knesel et al., 2011) and postulated episodes of uplift in the Borborema Plateau (Morais Neto et al., 2009; de Oliveira and Medeiros, 2012) and the Araripe basin (Assine, 2007; Marques et al., 2014) ... Cenozoic uplift was inferred from both relative dating of elevated sediments of the Serra dos Martins formation in the northern Borborema Province and absolute dating from apatite fission-track analysis of granitic-gneissic samples (Morais Neto et al., 2009; de Oliveira and Medeiros, 2012). Although some sort of tectonic uplift and/or inversion of the Araripe basin seems to be widely accepted (Marques et al., 2014; Peulvast and Bétard, 2015; Garcia et al., 2019), uplift in the Borborema Plateau is more debated.” Besides the evidence of inversion in the Araripe Basin, there is more evidence of inversion and uplift in NE Brazil. Coblentz and Richardson (1996) showed that the South American continent is under approximate E-W compression, which can lead to the inversion of previous structures favourably oriented. Current seismicity (Assumpção, 1998; Bezerra and Vita-Finzi, 2000; Bezerra et al., 2007, 2011, 2014; Ferreira et al., 1987, 1998, 2008; Lopes et al., 2010; Neto et al., 2013; Takeya et al., 1989) and deformation of Pleistocene or later sediments in the Taubaté Basin (Riccomini et al., 1989) provide evidence for ongoing compression in NE Brazil. Riccomini et al. (1989) and Cobbold et al. (2001) concluded that inversion(?) uplift(?) of the Brazilian Plateau (tectonic uplift of the eastern Brazilian margin, with greater expression at Serra do Mar close to the coast) is likely due to neotectonic activity. Morais Neto et al. (2009), Cogné et al. (2011, 2012, 2013) and Japsen et al. (2012) used AFTA to analyse episodic burial and exhumation in NE Brazil after the opening of the South Atlantic. Cogné et al. (2012), in particular, concluded that there has been synchronicity of the cooling phases in NE Brazil with the Steinman’s Andean phases of tectonic uplift, and assumed a plate-wide compressional stress that reactivated inherited structures. Hegarty et al. (2002) used AFTA for a more local study, i.e. to analyse episodic burial and exhumation in the Araripe Basin. The reported results show two cooling events: (1) one at ca. 100–90 Ma, and (2) another from 30 to 0 Ma. The above evidence means that the latest stage of inversion is Quaternary, consistent with the works of Nóbrega et al. (2005), Morais Neto et al. (2009), Cogné

C2

et al. (2011, 2012, 2013), Japsen et al. (2012), Gurgel et al. (2013) and Nogueira et al. (2015).

All this evidence of the stress state in South America and the inversion of inherited structures should be given in the Introduction of the ms. to adequately write the rationale of the paper.

References Assumpção, M., 1998. Seismicity and stresses in the Brazilian passive margin. *SSA Bull.* 88, 160–169. Bezerra, F.H.R., do Nascimento, A.F., Ferreira, J.M., Nogueira, F.C., Fuck, R.A., Brito Neves, B.B., Sousa, M.O.L., 2011. Review of active faults in the Borborema Province, intraplate South America integration of seismological and paleoseismological data. *Tectonophysics* 510, 269–290. Bezerra, F.H.R., Rossetti, D.F., Oliveira, R.G., Medeiros, W.E., Brito Neves, B.B., Balsamo, F., Nogueira, F.C.C., Dantas, E.L., Aandrades Filho, C., Góes, A.M., 2014. Neotectonic reactivation of shear zones and implications for faulting style and geometry in the continental margin of NE Brazil. *Tectonophysics* 614, 78–90. Bezerra, F.H.R., Takeya, M.K., Sousa, M.O.L., Do-Nascimento, A.F., 2007. Coseismic reactivation of the Samambaia fault. *Tectonophysics* 430, 27–39. Bezerra, F.H.R., Vita-Finzi, C., 2000. How active is a passive margin? Paleoseismicity in northeastern Brazil. *Geology* 28, 591–594. Cobbold, P.R., Meisling, K.E., Mount, V.S., 2001. Reactivation of an obliquely rifted margin, Campos and Santos Basins, southeastern Brazil. *AAPG Bull.* 85, 1925–1944. Coblenz, D.D., Richardson, R.M., 1996. Analysis of the South American intraplate stress field. *J. Geophys. Res.* 101, 8643–8657. Cogné, N., Cobbold, P.R., Riccomini, C., Gallagher, K., 2013. Tectonic setting of the Taubaté Basin (southeastern Brazil): insights from regional seismic profiles and outcrop data. *J. S. Am. Earth Sci.* 42, 194–204. Cogné, N., Gallagher, K., Cobbold, P.R., 2011. Post-rift reactivation of the onshore margin of southeast Brazil: evidence from apatite (U–Th)/He and fission-track data. *Earth Planet. Sci. Lett.* 309, 118–130. Cogné, N., Gallagher, K., Cobbold, P.R., Riccomini, C., Gautheron, C., 2012. Post-breakup tectonics in southeast Brazil from thermochronological data and combined inverse forward thermal history modelling. *J.*

C3

Geophys. Res. 117, B11413. <http://dx.doi.org/10.1029/2012JB009340>. Ferreira, J.M., Bezerra, F.H.R., Sousa, M.O.L., Do Nascimento, A.F., Sa, J.M., Franca, G.S., 2008. The role of Precambrian mylonitic belts and present-day stress field in the coseismic reactivation of the Pernambuco lineament, Brazil. *Tectonophysics* 456, 111–126. Ferreira, J.M., Oliveira, R.T., Takeya, M.K., Assumpção, M., 1998. Superposition of local and regional stresses in northeast Brazil: evidence from focal mechanisms around the Potiguar marginal basin. *Geophys. J. Int.* 134, 341–355. Ferreira, J.M., Takeya, M., Costa, J.M., Moreira, J.A., Assumpção, M., Veloso, J.A.V., Pearce, R.G., 1987. A continuing intraplate earthquake sequence near João Câmara, Northeastern Brazil – preliminary results. *Geophys. Res. Lett.* 14, 1402–1405. Gurgel, S.P.P., Bezerra, F.H.R., Corrêa, A.C.B., Marques, F.O., Maia, R.P., 2013. Cenozoic uplift and erosion of structural landforms in NE Brazil. *Geomorphology* 186, 68–84. Hegarty, K.A., Morais Neto, J.M., Karner, G.D., 2002. The enigma of the Araripe Plateau: new constraints on its uplift and tectonic history using AFTA. *XLI Congresso Brasileiro de Geologia, Extended Abstract*. Japsen, P., Bonow, J., Green, P.F., Cobbold, P.R., Chiossi, D., Lilletveit, R., Magnavita, L.P., Pedreira, A., 2012. Episodic burial and exhumation in NE Brazil after opening of the South Atlantic. *GSA Bull.* 124, 800–816. Lopes, A.E.V., Assumpção, M., do Nascimento, A.F., Ferreira, J.M., Menezes, E.A.S., Barbosa, J.R., 2010. Intraplate earthquake swarm in Belo Jardim, NE Brazil: reactivation of a major Neoproterozoic shear zone (Pernambuco Lineament). *Geophys. J. Int.* 180, 1303–1312. Morais Neto, J.M., Hegarty, K.A., Karner, G.D., Alkmim, F.F., 2009. Timing and mechanisms for the generation and modification of the anomalous topography of the Borborema Province, northeastern Brazil. *Mar. Pet. Geol.* 26, 1070–1086. Neto, H.C.L., Ferreira, J.M., Bezerra, F.H.R., Assumpção, M.S., do Nascimento, A.F., Sousa, M.O.L., Menezes, E.A.S., 2013. Upper crustal earthquake swarms in São Caetano: reactivation of the Pernambuco shear zone and trending branches in intraplate Brazil. *Tectonophysics* 608, 804–811. Nóbrega, M.A., Sá, J.M., Bezerra, F.H.R., Hadler Neto, J.C., Lunes, P.J., Guedes, S., Tello Saenz, C.A., Hackspacher, P.C., Lima-Filho, F.P., 2005. The use of apatite fission track thermochronology to constrain fault movement

C4

and sedimentary basin evolution in northeastern Brazil. *Radiat. Meas.* 39, 627–633.

Nogueira, F.C.C., Marques, F.O., Bezerra, F.H.R., de Castro, D.L., Fuck, R.A., 2015. Cretaceous intracontinental rifting and post-rift inversion in NE Brazil: insights from the Rio do Peixe Basin. *Tectonophysics* 644-645, 92-107.

Reis, A.F.C., Bezerra, F.H.R., Ferreira, J.M., do Nascimento, A.F., Lima, C.C., 2013. Stress magnitude and orientation in the Potiguar Basin, Brazil: implications on faulting style and reactivation. *J. Geophys. Res. Solid Earth* 118, 1–14. <http://dx.doi.org/10.1002/2012JB009953>.

Riccomini, C., Peloggia, A.U.G., Saloni, J.C.L., Kohnke, M.W., Figueira, R.M., 1989. Neotectonic activity in the Serra do Mar rift system (southeastern Brazil). *J. S. Am. Earth Sci.* 2, 191–197.

Takeya, M.K., Ferreira, J.M., Pearce, R.P., Assumpção, M., Costa, J.M., Sophia, C.M., 1989. The 1986–1987 intraplate earthquakes sequence near João Câmara, northeast Brazil – evolution of seismicity. *Tectonophysics* 167, 117–131.

F.O. Marques, F.H. Bezerra, F.C. Nogueira

Interactive comment on *Solid Earth Discuss.*, <https://doi.org/10.5194/se-2019-41>, 2019.