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Deep Segmentation from 2D Forward Modeling and 3D Tomography of the Maranhão-Barreirinhas-Ceará Margin, NW Brazil

Nuno Afonso Dias (1,2), Alexandra Afilhado (1,2), Philippe Schnürle (3), Flora Gallais (3,4), José Soares (5), Reinhardt Fuck (5), José Cupertino (6), Adriano Viana (6), Maryline Moulin (3), Daniel Aslanian (3), Luís Matias (2), Mikael Evain (3), and Afonso Loureiro (2)

(1) Instituto Superior de Engenharia de Lisboa, IPL, Lisbon, Portugal, (2) Instituto Dom Luiz, FCUL, Lisbon, Portugal, (3) IFREMER, Dept. Géosciences marines, Plouzané, France, (4) JAMSTEC, CEAT, Yokohama, Japan, (5) Instituto Geociencias, Universidade Brasilia, Brazil, (6) PETROBRAS, Petróleo Brasileiro S.A., Rio de Janeiro, Brazil

The deep crustal structure of the North-East equatorial Brazilian margin, was investigated during the MAGIC (Margins of brAzil, Ghana and Ivory Coast) joint project, conducted in 2012. The main goal set to understand the fundamental processes leading to the thinning and finally breakup of the continental crust, in a context of a Pull-apart system with two strike-slip borders.
The offshore Barreirinhas Basin, was probed by a set of 5 intersecting deep seismic wide-angle profiles, with the deployment of short-period OBS's from IFREMER and land stations from the Brazilian pool. The experiment was devoted to obtain the 2D structure along the directions of flow lines, parallel to margin segmentation and margin segmentation, from tomography and forward modeling. The OBS's deployed recorded also lateral shooting along some profiles, allowing a 3D tomography inversion complementing the results of 2D modeling.
Due to the large variation of the water column thickness, heterogeneous crustal structure and Moho depth, several approaches were tested to generate initial input models, to set the grid parameterization and inversion parameters. The assessment of the 3D model was performed by standard synthetic tests and comparison with the obtained 2D forward models.
The results evidence a NW-SE segmentation of the margin, following the opening direction of this pull-apart basin, and N-S segmentation that marks the passage between Basins II-III. The signature of the segmentation is evident in the tomograms, where the shallowing of the basement from Basin II towards the oceanic domain is well marked by a NW-SE velocity gradient. Both 2D forward modeling and 3D tomographic inversion indicate a N-S segmentation in the proto-oceanic and oceanic domains, at least at the shallow mantle level. In the southern area the mantle is much faster than on the north. In all profiles crossing Basin II, a deep layer with velocities of 7-4-7.6 km/s generates both refracted as well as reflected phases from its boundaries, in agreement with the 3D model, which indicate a much more gradual transition of crustal velocities to mantle-velocities, than in the remaining segments.
The intersection of Basins II, III and proto-oceanic crust is well marked by the absence of seismic energy propagation at deep crust to mantle levels, with no lateral arrival being recorded.
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