DEEP SEGMENTATION FROM 2D FORWARD MODELING AND 3D TOMOGRAPHY OF THE MARANHÃO-BARREIRINHAS-CEARA MARGIN, NW BRAZIL

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RESUMO: 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 August-September 2012 by IFREMER, UnB, IDL/FCUL and Petrobras. The primary objectives were to understand the fundamental processes which lead to the thinning and finally to the breakup of the continental crust, in a specific context of a Pull-apart system with two strike-slip borders.

The offshore Barreirinhas Basin, was probed by a set of five intersecting deep seismic wide-angle profiles, with the deployment of short-period OBS's from the IFREMER pool. Three of the profiles were extended into land using stations from the Brazilian pool. The experiment was devised to obtain the 2D structure along the directions of flow lines (2 profiles E-W), parallel to margin segmentation (2 profiles SE-NW) and margin segmentation (1 profile SW-NE), from tomography and forward modeling. However, the OBS's deployed recorded also lateral shooting along two pairs of profiles, allowing a test for a 3D approach using first-arrival tomography complementing the results of 2D modeling mostly at deeper levels.

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 obtained 3D tomographic models consistency were assessed by tomographic models tests, like checkerboards, and by comparison with the obtained 2D forward models

The analysis of the full seismic data 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 Basin II and Basin III. The signature of the NW-SE 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. Although not observed in the sedimentary cover, 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 south (MC1, MC3) the mantle is much faster than on the north (MC1). 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 good agreement with the tomographic results, which indicate here a much more gradual transition of crustal velocities to mantle-velocities, than in the remaining segments. Modeling of wide-angle reflected phases from the continental lithospheric mantle indicate the presence of reflectors in the mantle at depths of 25 km beneath Basin II (MC3) and 50-60 km beneath Barreirinhas margin (MC4).

The intersection of Basin II, Basin 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. Furthermore, the large offset Pn arrivals recorded in-land in profile MC4 show a systematic seaward amplitude decrease at this point, where a deep layer with a velocity of 7.4-7.6 km/s pinches-out.

PALAVRAS-CHAVE: MARANHÃO-BARREIRINHAS-CEARÁ BASIN, PULL-APART, LOWER CONTINENTAL CRUST, MANTELLIC STRUCTURE, 3-D WIDE-ANGLE SEISMIC