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The Palaeo-bathymetry of Base Aptian Salt Deposition on the Angolan Rifted Margin: Constraints from Flexural Backstripping and Reverse Post-Breakup Thermal Subsidence Modelling

Leanne Cowie (1), Ricardo Angelo Dos Santos Silva (2), Nick Kusznir (1), and Gianreto Manatschal (3)

(1) University of Liverpool, Earth, Ocean and Ecological Sciences, Liverpool, United Kingdom (l.cowie@student.liv.ac.uk), (2) ConocoPhillips, Houston, TX 77079, USA, (3) CNRS-EOST, Université de Strasbourg, 1 rue Blessig, F-67084 Strasbourg, France

The bathymetric datum with respect to global sea-level for Aptian salt deposition in the S. Atlantic is hotly debated. Some models propose that salt was deposited in an isolated ocean basin in which local sea-level was 2-3 km below the global level. In this study we determine the palaeo-bathymetry of base Aptian salt deposition on the Angolan rifted continental margin using reverse post-breakup thermal subsidence modelling.

The reverse post-breakup thermal subsidence modelling process consists of sequential flexural isostatic backstripping of the post-breakup sedimentary sequences, decompaction of remaining sedimentary units and reverse modelling of post-breakup lithosphere thermal subsidence. The assumptions underlying the prediction of base salt palaeo-bathymetry using reverse post-breakup thermal subsidence modelling are valid if the base salt is either late syn-rift or early post-rift. The reverse modelling of post-breakup lithosphere thermal subsidence is carried out in 2D and requires 2D knowledge of the rifted continental margin lithosphere beta stretching factor which is determined from gravity inversion. The analysis has been applied to the ION-GXT CS1-2400 deep long-offset seismic reflection profile and the P3 and P7+11 seismic cross-sections of Contrucci et al. (2004) offshore N Angola. A compaction controlled sediment density is assumed for non-salt lithologies. The gravity inversion used to determine the lithosphere beta stretching factor profiles is carried out in the 3D spectral domain and includes a correction for the lithosphere thermal gravity anomaly generated by elevated geothermal gradients within stretched continental margin and adjacent ocean basin lithosphere. Moho depths determined from the gravity inversion are in good agreement with those determined from the seismic refraction seismology of Contrucci et al. (2004) and ION –GXT deep long-offset reflection seismology.

Reverse post-breakup subsidence modelling restores the proximal autochthonous base salt to near sea-level at breakup time but not the most distal base salt. In contrast the predicted bathymetries (water-loaded) for the base distal salt are much greater ranging between 1.0 and 3.0 km. The predicted bathymetries of the first unequivocal oceanic crust are approximately 2.5 km as expected for newly formed oceanic crust of normal thickness. Several interpretations of these results are possible. One is that all Aptian salt in the Angola margin study areas was deposited at or near global sea-level but that the distal salt was formed during late syn-rift and the crust under it was being actively thinned during salt deposition resulting in additional tectonic subsidence. This is consistent with seismic evidence which shows that the base distal salt is extensionally faulted while in contrast the proximal salts were formed in a region where crustal thinning had already taken place but had ceased. Another interpretation is that the distal salt moved down-slope while breakup occurred to its present position in much deeper water (and is para-autochthonous). Although a structural barrier in the south is not dismissed, we believe that there is no definite requirement to invoke an isolated ocean basin for the deposition of the Aptian salts on the Angolan rifted margin.