Geophysical Research Abstracts
Vol. 20, EGU2018-13341, 2018
EGU General Assembly 2018

Palaeo-datum and Tectonic Context of Salt Deposition at Rifted Margins: The N Angolan Example

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While Messinian analogues involving 2-3 km deep desiccated ocean basins have often been invoked to explain salt deposition on the S. Atlantic rifted margins, we show that the palaeo-datum with respect to global sea-level for Aptian salt deposition on the N. Angolan margin was no more than 0.8 km.

In the proximal region of the N. Angolan margin, Aptian salt is underlain by a thick sag sequence which is in turn underlain by syn-rift sediments of Barremian age or older. We show that reverse post-breakup subsidence modelling restores the base of proximal salt to between 0.4 and 0.8 km below global sea level at the time of breakup depending on the age of proximal rifting. This restoration technique consists of the sequential flexural isostatic backstripping of the post-breakup sedimentary sequences, decompaction and reverse modelling of post-breakup lithosphere thermal subsidence constrained by lithosphere β factors from gravity inversion. In the distal region, reverse post-rift subsidence modelling restores the base Aptian salt at breakup time to between 2 and 3 km below global sea-level, much deeper than the proximal salt of the same age.

Our preferred interpretation is that both proximal and distal Aptian salt were deposited between approximately 0.4km and 0.8km below global sea level, and that the inner proximal salt subsided by post-rift (post-tectonic) thermal subsidence alone. In contrast the outer distal salt formed during syn-tectonic crustal thinning, prior to breakup, resulting in additional tectonic subsidence. Gravity inversion giving crustal thickness, residual depth anomaly (RDA) analysis and subsidence analysis show that the distal Aptian salt is underlain by hyper-extended continental crust with some magmatic addition rather than exhumed mantle or oceanic crust. Our analysis argues against Aptian salt deposition on the Angolan margin in a 2-3 km deep isolated ocean basin, and supports salt deposition on hyper-extended lithosphere crust formed by diachronous rifting which migrated distally, culminating in late Aptian breakup.

We use a kinematic forward structural and stratigraphic model of continental lithosphere stretching and thinning leading to lithosphere breakup and rifted margin formation to test the above interpretation. The model incorporates the flexural isostatic response to extensional faulting, crustal thinning, lithosphere thermal loads and sedimentation. The forward model predicts, as observed, a relatively thin proximal salt overlying sag and syn-rift sequences, and a distal salt which is much thicker, syn-tectonic and underlain by extensional faults. We propose that the distal salt is thicker than the proximal salt because syn-tectonic crustal thinning generated faster subsidence and more accommodation space in the distal region than proximal post-rift thermal subsidence. We also suggest that while some of the distal salt is allochthonous, it is mainly autochthonous, i.e. it was deposited in the distal region.