

**AAPG Annual Meeting
March 10-13, 2002
Houston, Texas**

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Post-rift Tectonic Subsidence and Palaeo-water Depths in the Northern Carnarvon Basin, Western Australia: Implications for Modelling Hydrocarbon Generation and Migration

Recent work in the Northern Carnarvon Basin suggests that, following Jurassic rifting, the main phase of accommodation creation occurred in the Late Jurassic to Early Cretaceous by simple thermal sag. Therefore, in areas of sediment starvation, Tertiary sedimentation was a deep-water infill system with no rapid Tertiary tectonic subsidence.

In the past, palaeo-water depth estimates for Jurassic to Recent sediments were based on interpretations of depositional environments from biostratigraphy, and matching identified time breaks to the eustatic sea level curve. This usually led to the application of shallow water models with a maximum of 200 to 300 m from the Late Jurassic to Tertiary. However, along the more distal regions of the Northern Carnarvon Basin, the application of a simple thermal sag model indicates that the water depths were approximately 800 to 1000 m. These water depths are similar to the accommodation space indicated by the height of Tertiary foresets noted on depth converted seismic. Arrival of the Tertiary progrades infilled the accommodation space causing a general shallowing to present-day levels.

The application of these deep-water models has been shown to have a significant impact on our estimations for the timing of potential hydrocarbon generation. The timing of potential hydrocarbon generation has been noted to vary by up to 50 Ma between the use of a shallow-water (or constant present-day water depth) model and that of the model taking the deeper water depth into account. Failure to correctly estimate the palaeo-water depths of a region may also significantly affect our understanding and reconstruction of hydrocarbon migration pathways by incorrectly modelling the changes in structural dip related to the timing of creation of accommodation space due to tectonic subsidence.