Geophysical Research Abstracts
Vol. 14, EGU2012-3302, 2012
EGU General Assembly 2012

3D stratigraphic forward modelling of Shu'aiba Platform stratigraphy in the Bu Hasa Field, Abu Dhabi, United Arab Emirates.

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This paper presents the results of three dimensional sequence stratigraphic forward modelling of the Aptian age Shu'aiba Formation from Abu Dhabi, United Arab Emirates (UAE). The Shu'aiba Formation lies within the uppermost part of the Lower Cretaceous Thamama Group and forms one of the most prolific hydrocarbon reservoir intervals of the Middle East with production dating back to the 1960's. The Shu'aiba Formation developed as a series of laterally-extensive shallow-water carbonate platforms in an epeiric sea that extended over the northern margin of the African-Arabian Plate. This shallow sea was bounded by the Arabian Shield to the west and the passive margin with the Neo-Tethys Ocean towards the north and east (Droste, 2010). The exposed Arabian Shield acted as a source of siliciclastic sediments to westernmost regions, however, more offshore areas were dominated by shallow-water carbonate deposition. Carbonate production was variously dominated by Lithocodium-Baccinella, orbitolinid foraminifera and rudist bivalves depending on local conditions.

While there have been numerous studies of this important stratigraphic interval (for examples see van Buchem et al., 2010), there has been little attempt to simulate the sequence stratigraphic development of the formation. During the present study modelling was undertaken utilising the CARBONATE-3D stratigraphic forward modelling software (Warrlich et al., 2008; Warrlich et al., 2002)) thus allowing for the control of a diverse range of internal and external parameters on carbonate sequence development.

This study focuses on platform development in the onshore Bu Hasa Field – the first giant oilfield to produce from the Shu'aiba Formation in Abu Dhabi. The carbonates of the Bu Hasa field were deposited on the southwest slope of the intra-shelf Bab Basin, siliciclastic content is minor. Initially these carbonates were algal dominated with rudist mounds becoming increasingly important over time (Alsharhan, 1987).

Numerous simulations were undertaken, employing different sea level curves, platform geometries, etc. in order to accurately constrain and compare simulated facies geometries with those hypothesised from subsurface correlations. An initial low-angle ramp geometry was later overprinted by the development of localised relief through faulting and salt diapirism. Areas of bathymetric relief became sites of enhanced carbonate development with over-production resulting in aggradational geometries rapidly evolving to progradational systems. Several different regional, global and composite relative sea level curves were employed in the simulations in order to produce stratigraphic geometries comparable to those reported from previous studies.

We conclude that none of the published sea level curves produce facies geometries directly analogous to those hypothesised from the sub-surface. We infer that this disparity primarily results from previous models lacking sufficient accommodation space and employing unrealistic carbonate production rates.

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