

Bitumen Deposits in the Dahomey Basin: Biostratigraphic and Geochemical Evidence for the Link with the Emerging Cenomanian – Coniacian Petroleum System in the Gulf of Guinea

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Abstract

The Benin (Dahomey) Basin is a rift related Cretaceous - Tertiary depocenter contiguous with the Ivory Coast, Tano, Saltpond, and Keta Basins in the Gulf of Guinea. Large reserves of tar sands containing > 40 bbl of heavy oil are reservoired in poorly sealed sandstones of the Campanian – Maastrichtian Araromi Formation in the basin.

Biostratigraphic and geochemical studies from seven exploration wells penetrating black shales of the Cenomanian to Coniacian Afowo Formation and the Campanian – Maastrichtian Araromi Formation were carried out. The shales of the Afowo Formation on a southern traverse contain large abundance of planktic foraminifera e.g. *Rotalipora greenhornesis*, *Hedbergella delrioensis*, *Hedbergella planispira*, *Heterohelix moremani*, *Heterohelix cenomana*, *Heterohelix globulosa*, *Whiteinella inonata*, *Praeglobotruncana* sp. and no significant benthic foraminifera. This diverse assemblage was deposited under deep water, euxinic environment of the neritic to upper bathyal, probably not deeper 250m. A north easterly shoaling of marine conditions is characterised by large population of benthic foraminifera e.g. *Anomalinoidea* sp., *Bolivina* sp. and *Lenticulina*.

An assemblage of the planktonic *Globigerina* with *Heterohelix* sps, associated with large varieties of benthic foraminifera e.g. *Bolivina* sp., *Lenticulina*, *Orthokastina* sp. dominated the shales from the Campanian – Maastrichtian Araromi Formation on the shallower northern traverse.

Fifty shales of the Afowo Formation in three wells have Total Organic Carbon (TOC) contents from 0.52 to 4.31% (mean -2.07wt%), S₂ values from 2.27 to 11.63 (mean – 5.45), Hydrogen Index (HI) values from 322 to 667 (mean 437) ,Vitrinite reflectance (Ro) 0.68 to 1.1% and dominated by Type II marine oil prone kerogen.

Thirteen shales of the Araromi Formation have TOC contents from 0.61 to 2.75% (mean -1.28wt %), S₂ values from 0.1 to 5.18 (mean 1.29), HI values from 16 to 202 (mean - 73) and Ro – 0.45 to 0.51 % and dominated by Type III gas prone kerogen. The VRo values here suggest immaturity and hence the heavy oil was not generated from the adjacent sediments but perhaps from the deeper (matured) Cenomanian – Coniacian Afowo source rocks.

We conclude that the Cenomanian – Coniacian marine shales with Type II oil prone kerogen are good to excellent source rocks related to the world wide Oceanic Anoxic Event -2 (OAE 2) and an integral element of the petroleum system of the regionally extensive coastal basins of the Gulf of Guinea.