Variation in Crustal Extension and its Implication for Hydrocarbon Habitat in the Dakar – Rufisque Area, Senegal

ABSTRACT

Variation in Crustal Extension and its Implication for Hydrocarbon Habitat in the Dakar – Rufisque Area, Offshore Senegal.

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This poster postulates that the variation in post-rift hydrocarbon habitat in the Dakar – Rufisque area of offshore Senegal is primarily controlled by the variation in syn-rift crustal extension between different sectors of the continental margin. These compartments are correlatable with major oceanic transforms.

It is postulated that, during rifting of the Atlantic in the Triassic – Lower Jurassic, the sector of the Senegal margin between the Rufisque and Cayar Fracture Zones (the "Dakar Compartment") suffered a higher degree of crustal extension than the sectors to the north and south. As a result, when post-rift sediments loaded the more highly extended crust in Albian – Upper Cretaceous times, the Dakar Compartment subsided more rapidly, accumulated a greater thickness of sediment, and was also intruded by basic igneous rocks (reflecting the thinned crust and 'leaky' nature of the transforms).

In Santonian times, North-South directed compression caused uplift of the rigid, less extended Rufisque Compartment to the south of the Rufisque transform. The Rufisque Compartment subsided little during Senonian – Palaeogene times, in contrast to the Dakar Compartment, to the north.

In the Oligo – Miocene, the Dakar-Cayar-Rufisque area suffered a regional hypabyssal – volcanic igneous event, with pronounced intrusion into the shallow section in the Dakar-Cayar area. This resulted in a thermally driven inversion of the pre-existing Late Cretaceous and Paleogene basins, which has resulted in the present topographic expression of the Dakar Penisula. Well data from the Rufisque High indicates anomalously high present-day temperatures, but the wells encountered no igneous rocks, implying Quaternary deep-seated magmatism.

Several basin-scale observations are postulated to be directly related to the compartmentalisation of the margin and the more highly extended crust in the Dakar Compartment:

- Post-rift passive continental margin depositional systems and facies reflect the additional accommodation space within the Dakar Compartment. This is most spectacularly demonstrated by the lateral offset, across the Rufisque transform, of the Late Jurassic-Early Cretaceous carbonate bank sequence, coeval to that of the Scotian Shelf.
- Upper Cretaceous source rock bearing sequences are thicker within the Dakar Compartment as a result of the greater accommodation space created over the thinned crust at the time of deposition.
- Outboard of the Late Jurassic-Early Cretaceous carbonate margin, around the Dakar High, source rocks are thermally over-mature (within the gas generation window) due to their greater depth of burial and higher heat flow over the extended crust. The same source rocks in the compartments north and south of the Dakar Compartment are thinner and geochemical modeling suggests they are marginally mature.
- The present Dakar Peninsula is the topographic expression of an east-west, thermally-driven, Neogene inversion of the Dakar Compartment. The inversion is clearly expressed on offshore seismic data and is accomplished through the contrast in rigidity between the thinned crust under the Dakar Compartment and the adjacent more rigid (thicker) crustal compartment of Rufisque.
- The Cayar Dome, an igneous edifice of presumed Tertiary age, is located on the northern accommodation zone of the Dakar Compartment, as are the Cape Verde Islands further offshore, illustrating the importance of the Cayar Transform as a crustal scale feature.
- Neogene inversion of the Dakar Compartment may have resulted in avulsion of drainage of the Senegal River Basin from the Dakar area northward to its present position, and rejuvenation of the Banjul River of The Gambia.

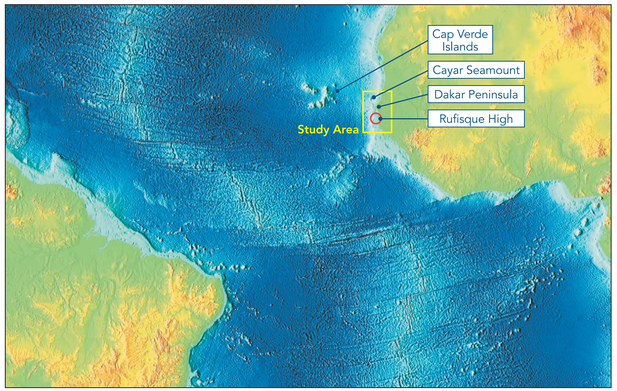
Syn-rift compartmentalisation of the shelf to deep water sectors of the Senegal margin is postulated to have a profound effect on the petroleum geology, by influencing:

- reservoir fairways and facies / diagenesis distribution within the post-rift section;
- destruction (or preservation) of effective reservoirs (primarily by differential burial and igneous intrusion);
- thickness and quality of source rocks (variation in accommodation space);
- heat flow, and hence maturity, of source sequences.

Recognition of these factors can enable the prediction of optimal areas for hydrocarbon exploration through an integrated model of source rock distribution, timing of maturation, expulsion pathways and accumulation in favourable reservoir facies, and can also improve the prediction of hydrocarbon phase.

Known occurrences of oil and gas within the study area are consistent with the proposed model.

Sea Floor Topography of Central Atlantic: Location Map



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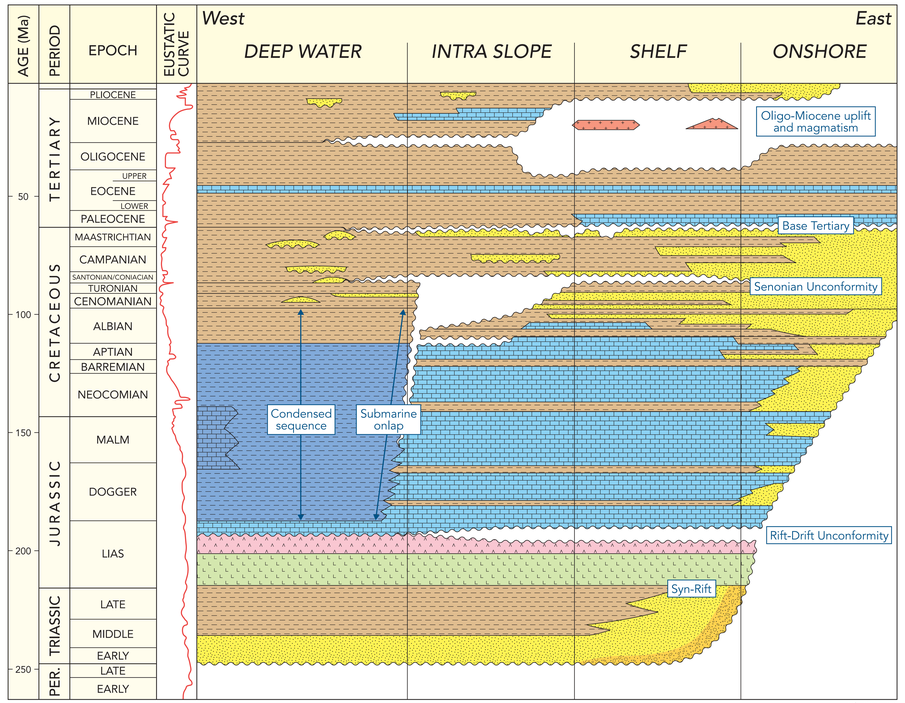
Chrono-stratigraphic Profile: Rufisque Compartment, Senegal



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