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Structure and Facies Development in the Niger Delta Resulting from Hydrocarbon Maturation

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A new depositional model relates the formation of Niger Delta toe thrusts and growth faults to source rock maturation. Specifically, it is proposed that an oil prone source rock at early maturity generates enough fluid and pressure to initiate major fault movement by gravity sliding.

Recently acquired, high quality deepwater seismic data show a well-defined decollement surface that links toe thrusts, growth faults, and counter-regional faults in the progradational wedge. It is believed the decollement occurs in an Aptian source rock known to be present in West Africa and Brazil.

Regional cross-sections were constructed through the delta, using the published positions of shorelines through time and assuming a maximum post-Aptian sediment wedge of eight kilometers. Maturation modeling was performed and the results at various times from Late Cretaceous to Recent were plotted and compared to paleopositions of the shelf edge and toe of slope. The modeling illustrates how the maturation of an Aptian source rock may have significantly influenced structural development and facies distribution in the delta.

The present-day time slice shows a

strong correlation between the location of the early mature window of the proposed source rock and the position of the leading toe thrust in the delta. A similar correlation is found between the location of the post gas-mature window and the position of significant fluvial facies accumulation. The fluvial facies occurs as the result of shoreline advance caused by the loss of source-related lubrication of the decollement surface.

Biographical Sketch

Brian R. Frost is presently the Domestic Opportunity Evaluator for Conoco's Advance Exploration Organization. His 16-year exploration career has principally involved estimating the petroleum potential and geologic risk associated with international new ventures. His current exploration interests are defining the petroleum system of the Gulf of Mexico and evaluating the role source rock maturation plays in the structural and stratigraphic development of passive, transform, and convergent margins.

Brian earned a B.S. degree in Geophysical Engineering from the Colorado School of Mines in 1978. He began his career as an exploration geophysicist

with Phillips Petroleum in the Rocky Mountains and then learned to process land and marine seismic data at Phillips' headquarters in Bartlesville. He was transferred to Southeast Asia and later to Guangzhou, Peoples' Republic of China, where he was a member of the exploration team that made the Xijiang 24-3-1AX discovery in the Pearl River Mouth Basin. With Phillips, he also conducted basin studies in South America and Africa. In 1990, he joined Conoco and in 1992, named the Regional Coordinator for Africa Exploration. Brian is a Registered Professional Geologist and a member of the AAPG, HGS, and SEG.



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