Late Triassic – Late Neocomian Paleogeography and Petroleum Potential of the Florida-Cuba-Bahamas Collision Zone

Robert Erlich[1], James Pindell[2], and Leon Dzou[3]

[1]*Cayo Energy L.P., Richmond, Texas*
[2]*Tectonic Analysis Inc., West Sussex, England*
[3]*BP America Exploration, Houston, Texas*

Abstract

The stratigraphic and structural evolution of the Florida-Cuba-Bahamas collision zone has historically been highly generalised when incorporated into plate tectonic models. Recent integration of publicly accessible well, seismic, and geochemical data has led to a better understanding of the palaeogeographic history and petroleum potential of the area.

Structural deformation and lithologic units within the collision zone have been described previously but bear repeating here. The area can be partitioned into three distinct zones:

1. A southerly zone from southern to central Cuba, characterised by arc and back-arc collapse features and dominated by basic igneous rocks;
2. A central zone extending from central Cuba to the Florida-Cuba-Bahamas coastal zone, characterised by highly duplexed arc, fore-arc, and Bahamian passive margin rocks, and;
3. A northerly foreland zone located between Cuba and Florida and the Bahamas, characterized by longer wavelength, lower amplitude fault-bend folds, hanging-wall anticlines, and normal faults, involving only Bahamian passive margin rocks.

Deformation within the collision zone continued until the Late Eocene and strongly influenced the hydrocarbon prospectivity of the region.

Regional hydrocarbon prospectivity can best be evaluated via the critical assessment of standard play risk elements. Main petroleum systems elements include:

1. Reservoirs: Primary reservoirs consist of widespread, immature Upper Triassic to Lower Jurassic quartz-rich sandstones; secondary reservoirs may be present in Upper Neocomian carbonates.
2. Sources: Three main sources include Lower Cretaceous (Neocomian) basinal limestones and marls, Upper Jurassic (Oxfordian-Tithonian) basinal limestones and shales, and Middle (?) Jurassic or older estuarine/lacustrine shales.
3. Charge Volume and Timing: Hydrocarbon charge to potential traps has likely been effective only in areas of good charge focus and documented top seals; expulsion has occurred primarily from below the collision zone and into both the pre-collision and post-collision portions of the foreland basin towards the north.
4. Seals: Upper Jurassic Punta Alegre evaporites and Lower Cretaceous evaporites and shales provide effective regional seals.

5. Traps: Primary traps in the foreland include hanging wall anticlines and fault bend folds, sub-thrust fault traps, and domes over uplifted basement horsts.

Principal below ground risks include:

a. Reservoir presence (low risk: .9) and deliverability (moderate/high risk: .6).
b. Trap/seal integrity (moderate risk: .7).
c. Charge access/volume (moderate: .5) and product type (oil vs gas: low).

The geologic chance of success for the play is assessed at 19%. Although risky, the deep Jurassic sandstone/carbonate play in the foreland likely contains hydrocarbon volumes that will support a costly exploration program.

It is hoped that this new work will help to serve as a foundation for additional data-driven studies of the geologic history of the region. We also hope that this type of work will help to constrain future plate tectonic models involving the southeastern Gulf of Mexico and northwestern Caribbean, and to foster renewed interest in hydrocarbon exploration in the region.