

# Discovery Thinking in Gulf of Mexico Petroleum Systems: Fresh Ideas for Exploration, Development, and Production Geologists

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## Abstract

Several decades ago, risks associated with what we now call ‘the Petroleum System’ were considered negligible in the Gulf of Mexico since geologists considered mudrocks to be ‘impermeable’ and therefore argued that each reservoir must be charged by adjacent mudstones.

We have come a long way in the recognition that, with exceptions like the Eagle Ford–Woodbine petroleum and Smackover–Norphlet systems, mudstones adjacent to reservoirs rarely possess sufficient source potential and or have not reached adequate thermal stress levels to have charged adjacent reservoirs: migration happens!

Still uncomfortable with the idea of cross-stratal vertical migration, many geologists tried to ‘help’ the fluids migrate by proposing faults and salt-sediment interfaces as charge pathways where source rock and reservoir may be separated by many thousands of feet/meters of interburden. Others have puzzled at the recognized mismatch between fluid maturity / gas-oil ratio (GOR) in the reservoir vs. the significantly higher maturity of underlying source rocks, especially in the shelf and deep water areas.

This talk is designed to aid ‘discovery thinkers’ looking to break old paradigms and develop new exploration concepts based on first principles, not outdated ‘oilfield legend.’ It presents a unified picture of Gulf of Mexico (and indeed all) petroleum systems, bringing together concepts such as:

- Rates of volume creation in the source bed are the rate-limiting step in migration and accumulation, pushing the oil and gas fronts slowly through the basin.
- Cross-stratal vertical migration occurs across overpressure gradients through mudrocks; demonstrably not via ‘designer’ pathways such as faults and salt.
- The roles of faults and salt in creating trap containers.
- Column limitation by capillary pressure—think ‘valves’, not ‘seals’!—is the mechanism for the stacked pays that are so important in building resource density. There are no ‘blown seals’!
- Understanding the importance of biogenic / bacterial gas in the system, especially on the shelf where the current assumption is of deep thermal gas flushing.