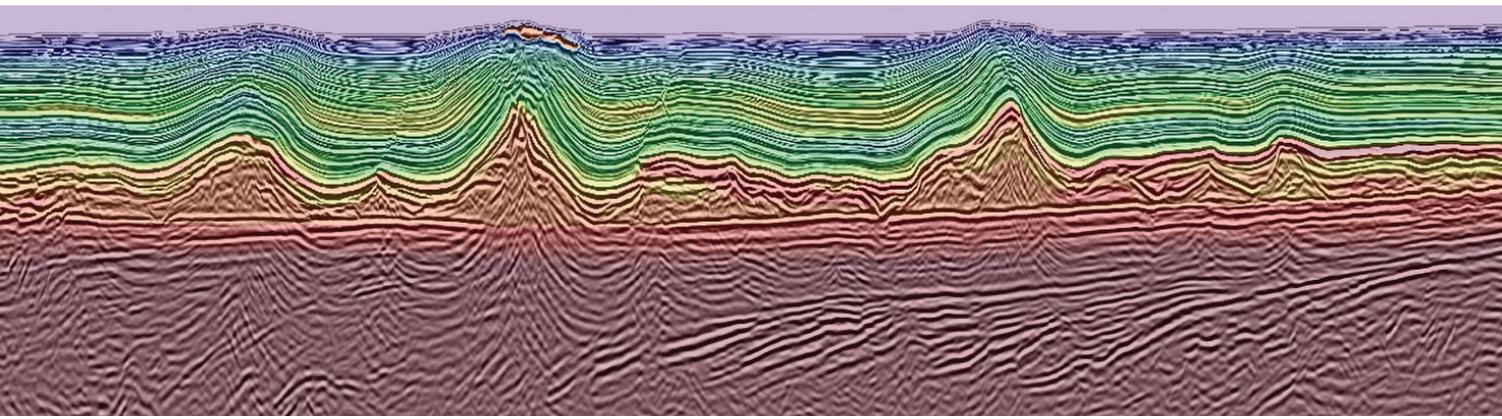


South Atlantic Pre-salt Objectives in the Gulf of Mexico?

Tectonic expert Jim Pindell examines the hydrocarbon potential of the pre-salt Gulf of Mexico



3-D reflection image, Campeche Bay, Mexico, showing active salt-cored detachment folds, the planar base-salt unconformity, the layered sag section, and possible SDRs or a rotated syn-rift sedimentary section. Courtesy ION Geophysical; prepared by Andrew Hartwig.

The U.S. Gulf of Mexico often receives attention for its hydrocarbon potential in the Upper Jurassic and younger rocks in deep and shallow water.

Increasingly more people are looking to another potential habitat for hydrocarbons, the syn-rift and associated sections, also known as the Gulf of Mexico pre-salt.

Geological Potential

Jim Pindell, owner of Tectonic Analysis, has been studying the pre-salt geology of the Gulf of Mexico since his days as a State University of New York at Albany graduate student in the early 1980s.

"For much of this time people have been concerned about general things, such as the amount of extension, thickness of red beds, and if any marine section might be present," he said.

Pindell expanded his knowledge of the pre-salt when he started working with ION in 2011.

"Our collaboration has allowed us to

integrate this deep new world visible in ION's data sets with a mature understanding of the basin as a whole," he said.

Also in 2011, Pindell launched the Tectonic Analysis onshore Mexico study program, funded by exploration companies with material assistance and offshore data sets provided by Pemex and Mexico's National Hydrocarbon Commission.

Pindell and his ION colleagues have spent the last few years working seismic data to increase their knowledge of the area. They interpreted sediment flow directions, possible SDRs or syn-rift prograding sediment packages, thick, fluvial sag sections and found that the base salt unconformity is surprisingly planar.

"This has been very enlightening. The GoM has a long syn-rift and sag history that was essentially capped off by the salt," he said.

Pindell is passionate about his work.

"The pre-salt geology fascinates me because modern seismic is allowing it to be recognized as a very new world for exploration,

many kilometers of new section right beneath an exploration region that is otherwise so well known," he said. "It's like finding after 20 years that your house has a semi-finished basement floor!"

Comparisons to Brazil

Upon hearing the term "pre-salt," many people think not of Mexico, but of recent massive discoveries in Brazil, whose lacustrine source rocks and microbialite reservoirs (non-marine patch reefs) have produced massive volumes of hydrocarbons in recent years. Pindell noted that comparisons between the GoM and the pre-salt South Atlantic are compelling.

"The two basins are of different age, of course, but genetically they are similar, with the same types of stratigraphy below the salt, and both in low paleo-latitude settings," he said.

"In a nutshell, both regions had sub-sea level accommodation for deposition,

meaning that any fluvial run-off from flanking landmasses was not always allowed to reach the global ocean outside the basins. Therefore, lacustrine strata can be expected whenever the paleoclimate was wet enough during the 50 or so million years of pre-salt history, possibly with intermittent cycles of marine beds too. The physical isolation of the basin and the propensity of lacustrine systems to produce good source rocks is a recipe that explorationists cannot ignore," he added.

Pindell recognized, however, that explorationists must continue to work hard to discover all that the GoM's pre-salt might have to offer.

"While the potential for the increasingly-understood types of carbonate reservoirs on paleo-highs in the early South Atlantic is also strong in the GoM, we are still in the early days," he said.

Hydrocarbon Potential

Pindell is cautious when asked if there are hydrocarbons in the GoM pre-salt.

"We must stick to 'could be' at present, as it was in Brazil 25 years ago. Onshore Mexico, we can measure flow directions in apparent pre-salt strata showing that significant fluvial systems flowed toward the early GoM," he said.

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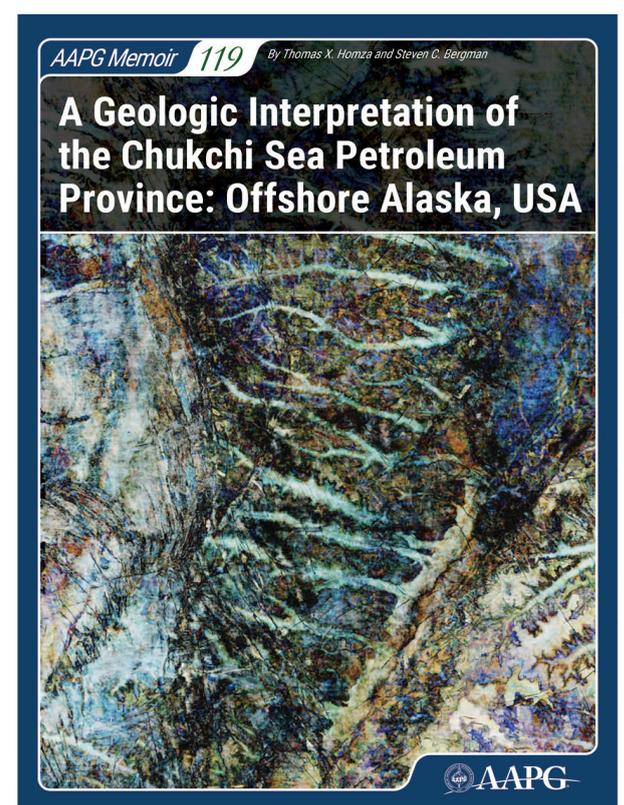
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Upper Todos Santos Formation with possible syn-depositional faults, north flank of the granitic Chiapas Massif, comprising interpreted alluvial fan systems interfingering (elsewhere) with high-energy fluvial sandstone beds. Traditionally viewed as pre-salt deposits, these beds may in fact interfinger with the Campeche Salt and form a coeval clastic fringe rimming the salt basin. Dating efforts are currently underway to help resolve this question. Photo courtesy Tectonic Analysis Cordilleran Research Program.

◀ Continued from previous page

“That water either evaporated while en-route to the depositional pockets, or it reached a variety of possible lacustrine settings with good source potential. And we can see in seismic that the sag sections around the GoM are sandy, fluvial systems, possibly fluvial-lacustrine systems, also heading downdip to more distal parts of the GoM. All it takes is a classic interfingering of lacustrine source and sandy progradational reservoirs at the right burial depths today, and the game is on. The fact that salt overlies these systems can only help by providing seal,” Pindell explained.

Complications

Pindell noted that a challenge for hydrocarbon potential in the GoM is the amount of sediment, which tends to be much greater than the sediment found in the South Atlantic margins.

“Much of the area which might be predicted to have received much of this early fluvial runoff in lacustrine systems now lies beneath 10 km or more of younger sediment, especially in the northern (US) GoM margin. Pre-salt source rocks there will have entered maturity back in the Paleogene, and any oil generated may be lost. This forces pre-salt exploration to focus on the shallower margins, such as along the NE GoM states in the USA, much of the Campeche margin of Mexico, and the proximal fringe along eastern Mexico,” he said.

The Mexican side of the margin tends to have less total depositional thickness than the US side, giving Mexico an advantage for development of the pre-salt areas.

Opportunities for Mexico

Pindell noted that while international operators are not drilling the pre-salt areas of Mexico, they are taking notice of the area’s potential.

“Although they are openly chasing the Norphlet play in the northeast Gulf of Mexico, it would be surprising if geologists and geophysicists are not also considering the pre-salt in that area,” he said.

“Pemex has drilled at least one well through the autochthonous salt near the famous Cantarell Field, and may be considering pre-salt targets elsewhere, as well,” he said.

Pindell had some advice for operators interested in exploring the pre-salt region.

“Because of the extreme overburden issue mentioned above, we need to be looking for perched or stepped pockets of lacustrine deposits lying well above the ultimate deepest parts of the early GoM rift basin. The places mentioned above are among those where today’s maturation window should cross the

pre-salt section,” he said.

He noted that pre-salt discoveries could provide a boost to the Mexican oil and gas industry and to Mexico itself.

“Adding a new play to any country’s hydrocarbon inventory is always a good thing. It provides time and means that overall exploration can proceed more carefully and thoughtfully, with less short-term dependency on oil prices and overall revenue for the country as a whole,” he said. “Having been independent for so long, there is a tide of nationalist feeling concerning exploration among the Mexican people that understandably may never subside entirely, but that may diminish with time as benefits to Mexico from international collaboration become recognized.”

Spreading the Knowledge

Pindell will share his work next month at “Geology and Hydrocarbon Potential of the Circum-Gulf of Mexico Pre-Salt,” an AAPG Hedberg Conference held in Mexico City.

The three-day conference includes more than 40 oral and poster presentations covering topics including plate tectonics and paleogeographic evolutions; geological and geophysical characterization and comparison of the GoM syn-rift/pre-salt section to other areas including the South Atlantic, eastern North America, and East Africa.

Pindell will open the conference with a talk providing an overview of pre-salt elements of the South Atlantic and illustrating which aspects might apply to the GoM. His presentation integrates new onshore work by his research program with ION seismic interpretations of pre-salt geology offshore, as portrayed in a new set of paleo-tectonic maps completed this year. The new Bajocian strontium isotope ages on salt that Pindell’s group has determined from the Hockley salt mine near Houston, the onshore Veracruz Basin and the offshore Campeche are also incorporated.

In addition to sharing his regional perspective with colleagues, Pindell looks forward to hearing from other experts working in the circum-GoM pre-salt section.

“I want to learn more about the entire regional setting, onshore, offshore, pre-salt sediment source areas and flow directions, magmatic activity, faulting that may have cut salt, possible pre-salt basement highs, models for the origin of the seawater that fed the GoM salt, all kinds of things. Every detail can become part of the whole. This is how science progresses, and it is how we as researchers may progress together,” he said.

The Hedberg Conference will take place at the Marquis Reforma Hotel in Mexico City on Feb. 4-6, 2020. For additional information contact latinamerica@AAPG.org.

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