Exploring the Missing Blind Zone in the Gulf of Mexico Shelf*

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Abstract

While onshore unconventional resources capture the headlines of supporters and rejectionists, an underexplored zone of low risk potential resources, on the shelf of the Gulf of Mexico (GOM) should be considered as another optimum choice. The abundance of geological, geophysical, engineering and infrastructure data and facilities on the shelf can make this missing zone a high exploration potential target.

Historically, finding hydrocarbons started early by mapping structures via well correlations. In the last five decades, seismic mapping, including attributes such as bright spots, DHI, AVO, etc., became the tools for assessing potential prospects. However, seismic represents the response of acoustic waves to the subsurface litho-hydrogeology and occasionally to the hydrocarbon fluid contents. At the geopressure transition zone, shale and sand velocities cross over, and reflectivity becomes very weak and cannot be recognized on the seismic stacking velocity (PSTM) lines (i.e. blind spot). However, this zone represents more than 50% of the early offshore shelf discoveries since the 1950’s.

Non-seismic methods of assessing, delineating and mapping this zone are introduced in this article. The concept of integrating the regional maximum flooding surfaces (MFS) and the top of geopressure (TOG) in a mappable fairways fashion is the foundation of this technique. The “Strat-Geopressure Fairway” represents the spatial belt surrounding the interception’s contours where stratigraphic top (MFS) and TOG are met. Incorporating the established producing horizons (from the offset wells) to these fairways provides an essential fast-track tool for pre-drilling appraisal of a play concept, lead and prospect. Moreover, it identifies the underexplored leads and untapped exploration targets. It also delineates the drilled bypassed pay zones and potential reservoirs and sheds light on areas of potential deeper exploration and exploitation of secondary targets. Furthermore, it defines casing and mud-weight programs for further drilling on the offset structural segments on any potential prospect. This method can be applied worldwide in any mature clastic basin.
Selected References


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Geopressure Analysis Services

G.A.S.
Acknowledgements:

- MICRO-STRAT INC
- Fairfield Industries
- MMS (now is BOEM. Gov)
- AAPG
Objective is to explore the underexplored trends in semi-mature areas

Outlines:

1. Some of the hydrocarbon discoveries are unintentionally found
2. Seismic sometimes does not represent the true subsurface geology
3. Why there is a seismic blind zone
4. How can the integration of geology and geopressure mitigates for this blind zone
5. How pore pressure profile can assess for AVO
6. Delineating risk and reduce the marginal cost
Before Freaking Out Over Plunging Oil Prices Remember These Charts

By Matt DiLallo

Energy Demand Outlook

Rising Marginal Cost of Crude

Expansion due to exploring the blind zone
The Relationship between Sequence Stratigraphy, Seals and Geopressure Compartmentalization as an Essential Exploration, Exploitation and Drilling Tool
Sequence Stratigraphy, Seals and Geopressure Compartmentalization as an Essential Exploration, Exploitation and Drilling Tool

G.A.S.
Sequence Stratigraphy, Seals and Geopressure Compartmentalization as an Essential Exploration, Exploitation and Drilling Tool

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The Strat-Geopressure (ST-GP) Model for a *specific* Stratigraphic Sequence

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Map of MFS (maximum flooding surface) of a stratigraphic sequence

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Map of the geopressure top in the area

Basin dominated by sandy facies

Possible deep seated Basement ridge with thick shale drape

Top Of Geopressure TOG

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The Strat-Geopressure fairway - seismically dim (blind) in stratigraphic sequence “A”

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Well #1(G01845), drilled in 1969

Several shows (15) were reported on the mud log between 9200 and 11300.

Pay and Possible Low Resistivity pay (LRP) in Rob L/M

Potential Disc B reservoir and LRP

Pay
Potential Pay
Wet Reservoir
Tight

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Production - Fairway
Strat - Geopressure

Zone A

ST-GP Fairway

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Potential Pay - Fairway
Strat - Geopressure
Zone A

ST-GP
Fairway

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Potential Reservoir - Fairway
Strat - Geopressure

Zone A

Wet sand that can be potential reservoirs in up dip structural segments.

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The optimum producing fairway

Zone B
So, Why this zone is Blind (Dim) especially if it is charged with hydrocarbon?
Relation of sand vs. shale velocities (porosity index) / burial depth and pore pressure

Zones

A
B
C
D

Top of Geopressure (TOG)
Hydrodynamic
Transitional
Geopressured

After Shaker, S., 2015, CSEG, RECORDER, v.40, No.01
“A new approach to pore pressure prediction”
Velocity relationship between wet sand – gas sand and shale

ABOVE TOG

Gal well #1

$y = 2 \times 10^{-16} x^{4.9714}$

<table>
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<tr>
<th>Depth (TVD)</th>
<th>0</th>
<th>2000</th>
<th>4000</th>
<th>6000</th>
<th>8000</th>
<th>10000</th>
<th>12000</th>
<th>14000</th>
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<tbody>
<tr>
<td>Vi kft/s</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Velocity slower in Gas sand relative to shale (above TOG)

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After Shaker, S. 2009. SEG annual meeting
Velocity relationship between wet sand – gas sand and shale
BELOW TOG

Velocity faster in Gas sand relative to shale (below TOG)

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After Shaker, S. 2009. SEG annual meeting
Velocity relationship between wet sand – gas sand and shale
WITHIN TOG zone

Velocities in the gas sand and shale are in proximity at the TOG zone
The seismically blind (dim) zone

After Shaker, S. 2009. SEG annual meeting
Data from several wells in offshore Galveston, High Island and West Cameron areas. Notice the shale and the gas sand velocities crossover at the Top of Geopressure zone.
Establish the Casing and Mud program in an area

Strat-Geopressure Map
(Zone X)

Hydrostatic

ST-GP Fairway

Geopressured

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Under Explored Blocks
Maximum Vertical Drilling Depth
At 500' +/- TOG

High Island - Galveston Areas
Offshore Texas, Gulf of Mexico

Integrating geology, well logs and geopressure can establish the underexplored blocks at different depths.

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Under Explored Blocks
Maximum Vertical Drilling Depth
500'-1500' Below TOG
High Island - Galveston Areas
Offshore Texas, Gulf of Mexico

Integrating geology, well logs and geopressure can establish the underexplored blocks at different depths.
Economic Feasibility Advantage

1. Shallow water

2. Abundance of infrastructure

3. Wealth of technical data including existing seismic

4. Drill only to the predicted TOG (area up dip of the ST-GP fairway) and set 9 5/8” casing only down dip.

5. Shallow hazards are scarce

6. Long term production (some of the shelf wells are producing for 40 years and beyond)
A well correlation cross section exhibits the pay zones (green circles) that are usually hovering around the Top of Geopressure (TOG). The dashed red lines represent the compaction trend (CT).

After Shaker, S. 2015. AAPG, Deep and Shelf Water, GTW
“Predicting the Seal failure in Deepwater”
Thank you