KS/OK Mississippian Completions

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For
Mississippian and Arbuckle Workshop
10/31/2012
Outline

- Mississippian Completion & Permit Review
- Geological Review
- Historical Trends
- Completion and Stimulation Data
- Challenges & Solutions
OK/KS Mississippian Production
2010-2011
2011-2012
2012 - Present
Mississippian Overview Summary

- The Mississippian formation is actually an age of rock consisting of
  - Chester Lime (Manning)
  - Mississippi Chat
  - Meramac Lime (St. Louis)
  - Mississippi Lime (Solid)
  - Osage (Sycamore Lime)

Figure 2. Stratigraphic column for Osage County. Extracted from Zeller (1953), Thorman and Hilpshman (1979), and Franseen et al., 2004.
Woods County Sample Cross-Section w/ Typical Vertical Well Completions
Example Woods County Stratigraphic Column

<table>
<thead>
<tr>
<th>Depth</th>
<th>Lithology</th>
<th>Correlation</th>
<th>Resistivity</th>
<th>Porosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>ORG_SHL</td>
<td>GR</td>
<td>Resist(RT60)</td>
<td>PHIN_C</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>1500</td>
<td>2.2</td>
<td>2000.3</td>
</tr>
<tr>
<td>0.0</td>
<td>VSHL_C</td>
<td>GR_C</td>
<td>RT</td>
<td>PHID_C</td>
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<tr>
<td></td>
<td>1.000</td>
<td>1500</td>
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<td>2000.3</td>
</tr>
<tr>
<td></td>
<td>Shale</td>
<td>PEF_C</td>
<td>Resist(RT90)</td>
<td>Invasion</td>
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<tr>
<td></td>
<td>0.000</td>
<td>1000</td>
<td>2.2</td>
<td>2000</td>
</tr>
</tbody>
</table>
Mississippi Play Extrapolated Vertical Thickness-GeoAtlas
Mississippi Chat Vertical Thickness
Avg Total Proppant per Stage
Avg Total Acid Gal per Stage

- 2006: 1500.00
- 2007: 1000.00
- 2008: 1400.00
- 2009: 1000.00
- 2010: 1200.00
- 2011: 2600.00
- 2012: 2800.00
Woods County - Mississippi Lime Production

- 30 day Avg
- 60 day Avg
- 90 day Avg
- 120 Day Avg
- 180 Day Avg
- 240 Day Avg

BOPD

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Alfalfa County - Mississippi Lime Production

- 30 day Avg
- 60 day Avg
- 90 day Avg
- 120 Day Avg
- 180 Day Avg
- 240 Day Avg

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Kay County - Mississippi Production

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- 30 day Avg
- 60 day Avg
- 90 day Avg
- 120 Day Avg
- 180 Day Avg
- 240 Day Avg

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Payne County - Mississippian Production

- 30 day Avg
- 60 day Avg
- 90 day Avg
- 120 Day Avg
- 180 Day Avg
- 240 Day Avg

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Challenges & Solutions

Sleeve Systems

- Reduce Completion Time & Cost
- Cemented & Open Hole Systems Available
- Production Analysis Needed
Challenges & Solutions

MRIL® and WSST® in the Mississippian

- Major issues for log interpretation in the Miss are:
  - is there sufficient permeability for production
  - Identification of fluid type to minimize water production
  - Identify ability to initiate fracture treatment and the ability to maintain treatment geometry

- MRIL® identifies permeability and fluid type.
- WSST® identifies brittleness and rigidity of the formation
Miss Section with Oil Water Contact
Miss Section with Transition from Oil to Water
Miss Low Porosity Permeability
Where is Best Landing Horizon?
Miss Low Porosity Permeability
T1 Hydrocarbon Definition
Fracture Treatment Barriers must be defined and planned for

- Vertical properties define ease of breakdown
- Three Dimensional properties define the quality of placement
- Considered together, these maximize the efficiency of fracture treatment
DISCUSSION?