Initial Results of a Six Horizontal Well Drilling Program Targeting Mississippi (Osagean) Reservoirs in Northeast Oklahoma

Acknowledgement for Technical Contribution

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- Dennis Webb
- Greg Flournoy
- Randy Keller
- Kurt Marfurt
- John Miesse
- Sal Mazzulo
- Al Siemens
Presentation Outline

- Project History
- Geological Model
- Drilling, Logging and Completion Methodology
- Production Results to Date
- New Ideas
- Conclusion

Project History

- Strong history of exploitation of “Mississippi Chat” reservoirs
- November 2008: Completion of the DK 1-13 (SW/4 Sec 13 T25N R5E)
  - perforation and light stimulation of “Mississippi Lime” beneath “Mississippi Chat”
  - 180 mcf, 1 bopd, 20 bwpd
- December 2009 Completion of 44 mi^2 3D seismic NE Oklahoma
  - Complex structural fabric illustrating left lateral wrench tectonics
  - Integration of Seismic Attributes, Potential Field Geophysics, and Field Geology
    - Regional fracture and jointing network in Paleozoic sedimentary section
    - Deep seated basement structures with evidence of reactivation
- May 2009 Mississippi Chat Completion of Whiles D2 (NE/4 Sec 18 T25N R6E)
  - Positive results of DST on “Mississippi Chat” warranted additional data capture
  - First Schlumberger FMI run for Spyglass in NE Oklahoma
    - Image log + PEX clearly illustrated interbedded chert and lime lithology (“Boone”)
- January 2010 Mississippi “Dense” horizontal test
  - Single stage IP 196 BOPD, 3400 BWPD (45’ perfs over 400’ of lateral)
- February 2011 Drilled to TD six Mississippi “Dense” horizontal wells
The Mississippian (Kinderhook to Osagean) section of NE Oklahoma can be correlated directly to the Mississippian Outcrop Belt of the Ozark Plateau.

Image Logs run on 8 full Mississippi penetrations offered unprecedented opportunity for detailed subsurface stratigraphic correlations and regional depositional system to be modeled.

Image Logs allow for confident identification of Intra-Osagean unconformities (tectonic vs. eustatic).

Silica content in subsurface is very significant in the Osagean section:
- Understood early and well by geologists working the section
- Sets up trapping mechanisms previously unrecognized

Geophysical data integrated with Well Log and Surface Geology established clear evidence of tectonic history resulting in fracture creation.
Seismic Section HW 60 Trend

Base Pennsylvanian

Weathered Reeds Spring: Interbedded Chert, Lime and Tripolite

Osagean Reeds Spring: Interbedded Chert and Lime (note PE)

Pierson Limestone

Kinderhook – Compton Limestone and Northview Shale

Base Mississippi / Top Arbuckle
Type HW 60 Tripolite
Chat Core Photo (2913 – 2931)

Chat Core Photo (2895 – 2913)
Shaw 5A-8
Triple Combo/FMI Correlation

Hickory Creek 2A-22
Triple Combo/FMI Correlation
Horizontal Drilling, Logging and Completion Methodology

- Drilled To TD Six Horizontal Mississippi Wells
- 100’ Tangent at 45 degrees
- 7” Casing at 60 degrees
- Build to 90 +/- for Lateral
  - Smith XR40Y Tri-Cone Bits
- Schlumberger Logging
  - 2 Latches – Single Run
    - Den/Neutron, RXOZ, PE, FMI
- 3 wells left open hole
- 3 wells cemented liner

Arsaga 3H-25 - DXI
**Hickory Creek Dome 1A-22H – MD 3580 - 3750**

![Graph](image)

**Horizontal Well Surface and Bottom Hole Locations**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Well Number</th>
<th>Ground Elevation</th>
<th>SHL Northing NAD27</th>
<th>SHL Easting NAD27</th>
<th>BHL Northing NAD27</th>
<th>BHL Easting NAD27</th>
<th>Status</th>
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<tbody>
<tr>
<td>Arsaga</td>
<td>3H-25</td>
<td>1233</td>
<td>688947</td>
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<td>Bird Creek</td>
<td>1A-15H</td>
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<td>Salt Water Disposal</td>
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<td>Hickory Creek Dome</td>
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<td>Hickory Dome</td>
<td>2A-22 SWD</td>
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<td>Salt Water Disposal</td>
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<td>NW Strohm</td>
<td>1A-29H</td>
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<td>2417942</td>
<td>627704</td>
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<td>NW Strohm</td>
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<td>Salt Water Disposal</td>
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<tr>
<td>Shaw</td>
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<td>668428</td>
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<td>Horizontal</td>
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<tr>
<td>Shaw</td>
<td>5A-8 SWD</td>
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<td>665590</td>
<td>2415911</td>
<td>Horizontal</td>
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</tbody>
</table>
## HZ and SWD - Well Drilling, CLAT/TD, Status

**Spyglass Energy Group - Pearsonia West Concession - Mississippi Lime Development Wells**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Well Number</th>
<th>Section</th>
<th>Township</th>
<th>Range</th>
<th>Completable Lat Length / TD</th>
<th>Drilling Data</th>
<th>Log Data</th>
<th>Status</th>
<th>Production Test History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaw</td>
<td>1A-8H</td>
<td>8</td>
<td>27</td>
<td>7</td>
<td>2228 (6 bits)</td>
<td>WWD, ML, Crown Geo</td>
<td>DenPor FMI</td>
<td>Cemented 4.5'</td>
<td>2 Stages tested independently</td>
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<tr>
<td>Shaw</td>
<td>4A-8H</td>
<td>8</td>
<td>27</td>
<td>7</td>
<td>2832 (6 bits)</td>
<td>WWD, ML</td>
<td>DenPor FMI</td>
<td>Cemented 4.5'</td>
<td>None; DR tool failed during cement job resulting in cemented liner to kick off point; liner situation limits pump size that can be placed in tangent section</td>
</tr>
<tr>
<td>Arsga</td>
<td>3H-25</td>
<td>25</td>
<td>28</td>
<td>7</td>
<td>2867 (3 bits)</td>
<td>WWD, ML, Crown Geo</td>
<td>DenPor FMI</td>
<td>Cemented 4.5'</td>
<td>Open Hole No Stimulation; Tested 2500 BWPD, 255 MCFD, Began cutting oil (4 BOPD) before running liner. 3 stage frac scheduled for May 30th</td>
</tr>
<tr>
<td>Bird Creek</td>
<td>1-15H</td>
<td>15</td>
<td>27</td>
<td>7</td>
<td>3135 (3 bits)</td>
<td>WWD, ML</td>
<td>NONE</td>
<td>Cemented 4.5'</td>
<td>5 stage frac completed last week April 2011</td>
</tr>
<tr>
<td>NW Strohm</td>
<td>1-29H</td>
<td>29</td>
<td>26</td>
<td>7</td>
<td>1546 (3 bits)</td>
<td>WWD, ML</td>
<td>NONE</td>
<td>Open Hole</td>
<td>Pending MIT</td>
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<tr>
<td>Hickory Creek Dome</td>
<td>1-22H</td>
<td>22</td>
<td>28</td>
<td>7</td>
<td>2905 (6 bits)</td>
<td>WWD, ML, Crown Geo</td>
<td>DenPor FMI</td>
<td>Open Hole</td>
<td>Estimate 2nd Week of May for first production test</td>
</tr>
<tr>
<td>Shaw</td>
<td>1A-8 Pilot</td>
<td>8</td>
<td>27</td>
<td>7</td>
<td>Top Arbuckle</td>
<td>ML, Crown</td>
<td>PEX, FMI, Dipole</td>
<td>Cemented back</td>
<td>This well was drilled as pilot for the 1A-8H; Well TD top Arbuckle, logs run, cemented back and kicked off up hole to build curve for hz</td>
</tr>
<tr>
<td>Shaw</td>
<td>8A-8 SWD</td>
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<td>27</td>
<td>7</td>
<td>Basement</td>
<td>ML</td>
<td>PEX, FMI, SWRC</td>
<td>Active SWD</td>
<td>Permitted 15K Vacume</td>
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<tr>
<td>Arsga</td>
<td>1-25 SWD</td>
<td>25</td>
<td>28</td>
<td>7</td>
<td>400' into Arbuckle</td>
<td>ML</td>
<td>DenPor, Res, Micro</td>
<td>Active SWD</td>
<td>Permitted 15K Vacume</td>
</tr>
<tr>
<td>Bird Creek</td>
<td>1-25 SWD</td>
<td>15</td>
<td>27</td>
<td>7</td>
<td>Basement</td>
<td>ML</td>
<td>PEX, FMI, Mit</td>
<td>Pending MIT</td>
<td>Permitted 15K Vacume</td>
</tr>
<tr>
<td>NW Strohm</td>
<td>1-29 SWD</td>
<td>29</td>
<td>26</td>
<td>7</td>
<td>Basement</td>
<td>ML</td>
<td>PEX, FMI</td>
<td>Active SWD</td>
<td>Permitted 15K Vacume</td>
</tr>
<tr>
<td>Hickory Creek Dome</td>
<td>2-22 SWD</td>
<td>22</td>
<td>28</td>
<td>7</td>
<td>600' in Arbuckle</td>
<td>ML</td>
<td>PEX, FMI, Mit</td>
<td>Pending MIT</td>
<td>Permitted 15K Vacume</td>
</tr>
</tbody>
</table>

### Production History to Date

- **Shaw 1A-8H**
  - Two Single Stage Tests
    - Stage 1 - two 5' perf clusters, 2 spf, 5,600 BW, 50K# 20/40, 60 BPM; IP 45 BOPD, 4500 BWD
    - Stage 2 - nine 5' perf clusters, 2 spf, 10,000 BW, 21K# 20/40, 45 BPM; IP 196 BOPD, 3400 BWPD
- **Arsga 3H-25**
  - Open hole natural completion
  - IP 5 BOPD, 225 MCF, 3400 BWPD
- **NW Strohm 1-29H**
  - Open hole natural completion
  - 250 BOPD, 5 MMCFPD, 2500 BWPD
- **Bird Creek 1-15H**
  - 5 Stage Frac; 400' Interval, 100’ perf spacing, 0.3#/gal, 10K BW/stage, 50 BPM with ball sealers
- **Hickory Creek Dome 1-22H**
  - Open hole natural completion
New Ideas

- Land Base Penn at 60 degrees
  - Drill Penn Section with PDC
- Rotate Tangent then Build to 90
- Set 8.5” Intermediate at 90 degrees
- 5.5” Liner

Conclusions

- Successful Exploration Strategy
- Inter-Osagean traps, seals, and source
- Drilling Environment Understood
- Multiple Productive Facies
- Prospective Regional Scale to Local Scale
- Complex Fill and Trapping Mechanisms
- Infrastructure Development Proceeds Horizontal Drilling