2007 New Albany Shale update

Bob Cluff
The Discovery Group Inc.
Denver, Colorado

Explorers Club luncheon
Denver, Colorado
21 June 2007
Outline

• Overview of Illinois basin geology & the New Albany
• Why all the sudden buzz?
• How does the New Albany stack up to other shale gas plays?
• Who’s hot & who’s not?
• Is there any opportunity left in this for me?
Southern margin shale plays

Schlumberger Shale Gas white paper

Major shale gas basins in the United States with total resource potential of 500 to 1,000 tcf.

Schlumberger, Shale Gas white paper
Regional geology

• New Albany shale is the major oil source in the basin
  – Upper Devonian age (mostly)
  – Woodford, Chattanooga equivalent
  – Sits on top of Hunton carbonates (Dev-Sil)
  – Thin limestone above (Rockford, Chouteau), then thick section of deep water limestone (Ft Payne) or silty shale (Borden)
The good...

- Positives
  - Shallow, benign drilling environment
    - ranges from 0 to 5300 ft
  - Generally dense LS below, low water risk
New Albany structure

GRI 00-0068, after maps published in 1976-1981 by ISGS, IGS, & KGS
**Ft Payne** – dense, cherty LS

**Grassy Creek** – high TOC
black shale

**Selmier & Blocher** – low
TOC gray shales and dark,
calcareous shales

**Middle Devonian LS** –
dense, micritic LS
– Widespread and thick section (up to 350 ft)
– Black shale facies is > 60% of section
New Albany thickness

GRI 00-0068, after maps constructed in 1976-1981 by ISGS, IGS, & KGS
– Known from DOE work in 1970’s the shale contains gas
  • desorbed gas contents > 1 scf/cf rock, or ~ 13-15 scf/ton
– Historically produces around the margins of the basin, yields gas shows widely
– TDG proprietary isotherm work in 1990’s indicate gas capacity as high as 150 scf/ton at 5300 ft
Historic producing areas
1994 isotherm work

proprietary figure
Gas in place

- NPC estimate in 1970’s was 86 TCFG
  - Based on the DOE core desorbed gas data
  - *Problem:* data were not corrected for lost gas and residual gas, many of the best samples leaked
- Discovery Group estimate in 1994 was >300 TCF based on adsorption isotherm model
- We were probably low - new data suggests storage capacity is greater than the 1994 data set
CoreLabs Consortium

• New Albany shale cores (to date)
  – Samson 1 Quad L Farms, Putnam Co, IN
  – Continental 1 Weatherholt, Spencer Co, IN
  – Vintage 1 Kemper, Crittenden Co, KY
  – Vintage 1 Wesmorland, Crittenden Co, KY
  – Continental 1-H Peyton, Hopkins Co, KY
  – Forest 2 Heine Bros, Union Co, KY
But there is some bad news too,

- Not as siliceous as the Woodford or Barnett
  - \( V_{qtz} \) from DOE work was 40-60% (XRD)
  - no chert zones like the Woodford
  - does contain radiolarians (thin section)
- Low reservoir pressure because its shallow & no known areas of overpressure
  - lower SCF/ton than some competing plays
& the downright ugly

– Small tracts, severed minerals, complicated title- this is OLD oil & coal country
  • high brokerage costs, goes slowly
  • “hand-to-hand combat”
  • but terms are reasonable, if short
  • high NRI in most areas
– Low maturity, all below Dan Jarvie’s line of death (< 1.2% Ro)
New Albany maturity (% Ro)

Base of oil window

At peak oil generation

GRI 00-0068; data from Barrows & Cluff, 1984
Why the sudden Buzz?

- *What changed* ...........
  - Gas prices rose dramatically
  - Technology advances in the Barnett play
  - Resulting in better reserves than ever expected
  - Gas-in-place is higher than we thought
  - New desorption data suggests shale is gas saturated
25 well program economics
fully loaded with gathering system, gas plant, line tap

Cost curves shift up and to the right as costs increase

improbable reserve outcomes

The dividing line shifts right/left depending on your ROI criteria

plausible reserve outcomes

wellhead gas price

EUR to breakeven (MMCFG)
Technology advances

• Huge water fracs
  – Work in Barnett as well or better than gel fracs
  – Substantially lower total cost
  – Open up enormous drainage areas to well bore

• Horizontal wells
  – Can now drill, steer, & frac a horizontal well in shale; shale is competent and stays open
  – 2X to 20X deliverability of vertical well
Barnett 2 BCF well
Typical Barnett re-frac
## Play comparisons

<table>
<thead>
<tr>
<th></th>
<th>Barnett</th>
<th>New Albany</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net tk “hot” shale</strong></td>
<td>300-600 ft</td>
<td>100-350 ft</td>
</tr>
<tr>
<td><strong>TOC</strong></td>
<td>1-12, avg 4%</td>
<td>1-25, avg 8%</td>
</tr>
<tr>
<td><strong>Maturity (Ro)</strong></td>
<td>0.6-1.6 %</td>
<td>0.5-1.0 %</td>
</tr>
<tr>
<td><strong>Vquartz</strong></td>
<td>~ 50%</td>
<td>~ 50%</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>6000 - 9000 ft</td>
<td>500 – 5000 ft</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>Overpressured</td>
<td>Normal press.</td>
</tr>
<tr>
<td><strong>Avg reserves/well</strong></td>
<td>1.0-2.5 BCF</td>
<td>0.15 - ?? BCF</td>
</tr>
</tbody>
</table>
New Albany RhoB vs TOC

EGSP data, 1976-1979
Corydon area type curve

IP30 ~90 MCFD
## General comparison to other plays

<table>
<thead>
<tr>
<th>Play</th>
<th>Thickness</th>
<th>Depth</th>
<th>Maturity</th>
<th>GIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ft Worth Barnett</td>
<td>&gt;</td>
<td>&gt;</td>
<td>&gt;</td>
<td>&gt;&gt;</td>
</tr>
<tr>
<td>Delaware Barnett-Wdfrd</td>
<td>&gt;&gt;</td>
<td>&gt;&gt;</td>
<td>&gt;</td>
<td>&gt;&gt;&gt;</td>
</tr>
<tr>
<td>Arkoma Woodford</td>
<td>~</td>
<td>&gt;</td>
<td>&gt;&gt;</td>
<td>&gt;</td>
</tr>
<tr>
<td>Arkoma Fayetteville</td>
<td>~</td>
<td>&gt;</td>
<td>&gt;&gt;</td>
<td>?</td>
</tr>
<tr>
<td>Blk Warrior Floyd-Neal</td>
<td>&lt;</td>
<td>&gt;</td>
<td>&gt;</td>
<td>&lt;</td>
</tr>
</tbody>
</table>
Who’s hot?

- Deep, thermogenic gas players
  - Forest Oil
  - Vintage, now Chesapeake
  - Bravo
  - Meridian Resources
  - Continental Resources
  - CNX, just arrived on scene
Deep basin activity

Meridian, Continental, CNX
Bravo, Chesapeake, Forest
• Shallow, biogenic gas players
  – El Paso/Pogo
  – Aurora
  – Elysium (Noble Energy subsidiary)
  – Diversified Operating
  – Samson Resources
  – Quicksilver
  – Approach/Hallador
Shallow biogenic activity

El Paso/Pogo, Aurora, Diversified, and Elysium

Samson

Quicksiver

Approach/Hallador
Why so much activity on the east side of the basin?

- Historic NAS production has all been in Indiana and Kentucky
  - Biggest are Shrewsbury, Corydon, Laconia
  - Lots of small fields in IN reef trend, e.g. Loogootee, with high reported gas rates
  - Several small fields south of Pennyrile fault zone in KY
Historic NAS production

Corydon & Maple Branch area

Shrewsbury

Christian & Todd Cty area (several small fields)
• Thick section of black shale in Kentucky
• Higher maturities to the west, approach the Barnett analog
• Extensive faulting might mean better fracturing & higher perm
• Open acreage, reasonable terms
• Major pipelines cross the area
And why not Illinois?

- Shawneetown N.F. blocks out a large part of the prospective area
- More problems with HBP lands & shallow production - hard to build large blocks to the north
- Less attractive lease terms (generally)
- Fewer shows & less encouragement from historic activity
Player reserve expectations

- Corydon-Laconia 0.1 to 0.3 BCF/well
- Maple Branch similar to Corydon
- Shrewsbury 0.1 to 0.2 BCF/well
- Daviess Cty, IN 0.5 BCF/well
- Deep basin 0.6-1.2 BCF/well
- Horizontal wells are a wildcard—generally hope to get 2-5X vertical well reserves, but could be even better
What’s in it for me?

- If you have acreage in the southern part of the basin, you’ve got mature New Albany under you
- GIP is sufficient to support the play
  - My opinion: the NA is fully saturated with gas
- Deliverability is the big question & risk
  - Lots of historically tight tests of the shale
  - Current testing just not far enough along
The future

- Future of the New Albany play is still uncertain, but is looking very, very positive.
- Deliverability & reserves to be determined.
- Activity in 2007 will be:
  - Consolidation of acreage positions
  - Several “science wells”
  - Horizontal wells to test the play
  - Drilling & completion optimization