LOWER MARMATON AGENDA

- What is it?
- Where is it?
- What makes it different?
- What was done before?
- What have we done?
  - Round 1,2, and 3/4 results
- What is next?
- Questions
CORDILLERA ACQUISITION (CEPIII)

- Apache purchase – close May 1st, 2012
  - 254,000 net mineral acres
  - Acreage position filled in our Anadarko Gaps
    - Roger Mills, OK
    - Ellis, OK
    - Hemphill, OK

- 12 rigs w/ 1 month over-lap

- Picked up mostly:
  - Tonkawa
  - Cleveland
  - **Lower Marmaton**
  - Upper Marmaton
BASIN MAP AND TECTONIC SETTING

Modified from Blakey (2005) and Ambrose & Hentz (2011)
Cleveland Sand

Deese Shale

Oswego?

Lower Marmaton

Granite Wash
LOWER MARMATON

SINGLE WELL DATA:
Formation: Lower Marmaton
Vertical Depth: 11,200-500'
Lateral Length: 4,800'
Completed Cost (MM$):
Reserves (BCF/MBO/MNGL):
30 day IP (MCFD/BOPD):
WI / NRI

DRILLING ECONOMICS
ROR (%):
FC ($/NEMCF):
PV12 (M$):

Skyy 2-33HC (½ lateral)
IPF 15.2 MMCF, 1150 BOPD,
27/64", 3500# FCP
EUR 7.4 BCF, 310 MBO

Bombay 2-32HD-N

Screaming Eagle 1-16HC

Lippencott 1-21HA

Galileo 2-3HA (½ lateral)
EUR 3.4 BCF, 142 MBO

Lower Marmaton Production
Lower Marmaton Net Isopach C.I. 10'

Over Pressured

Apache
INITIAL WELLBORE DIAGRAM

- Water-depth: 26” w/ 20” casing
- Intermediate: 17½” w/ 13-3/8” casing @ Anhydrites
- KOP: 12¼” Intermediate / 9-5/8” @ 10,450’
- Production: 8⅞” Curve & lateral / 5.5” @ TD
  - Contingency 7” Liner / 5.5” by 4.5”
INITIAL DAYS VERSUS DEPTH

Why the flat time and side-tracks?!
INVESTIGATION

Galileo 2-4H

OIL/SYNTHETIC BASED DRILLING FLUIDS

<table>
<thead>
<tr>
<th>Time Sample Taken</th>
<th>Depth (ft)</th>
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<td>11177</td>
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<tr>
<td>13:30</td>
<td>11154</td>
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Remarks: RAISED WT. TO 12.1#GAL, CIRCULATE AND REAM TIGHT HOLE. RECOVERING SMALL FLAT, SHARP SHARDS OF SHALE ACROSS SHAKER, MINOR TO MODERATE IN VOLUME, DO NOT APPEAR TO BE DRILLED CUTTINGS.

Skyy 2-33HC

OIL/SYNTHETIC BASED DRILLING FLUIDS

<table>
<thead>
<tr>
<th>Time Sample Taken</th>
<th>Fluid Type</th>
<th>Oil-based</th>
<th>Depth (ft)</th>
<th>TVD (%</th>
<th>Msd Weight (pdp)</th>
<th>Funnel Vis (sce/100)</th>
<th>Plastic Vis (cP)</th>
<th>Yield Point (lb/100ft²)</th>
<th>API</th>
<th>HPHT 250F (ml)</th>
<th>Water % (V)</th>
<th>Other Fluid % (V)</th>
<th>Non Aqueous % (V)</th>
<th>Solids % (V)</th>
<th>Oil/Water Ratio</th>
<th>Electrical Stability (Volts)</th>
<th>POM (VSA)</th>
<th>Evaporate Lime (bbl)</th>
<th>CIOM (mg/L)</th>
<th>Water Phase Salinity (ppm)</th>
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</thead>
<tbody>
<tr>
<td>04:00</td>
<td>stuck</td>
<td>32</td>
<td>73 40 12 19 0 6 11 85 24 68/14 1163 3.8 4.682 34000 326022</td>
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<td>32 40 12 19 0 6 11 85 24 68/14 1163 3.8 4.682 34000 326022</td>
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Remarks: stuck @ 13,833, work free, rig up to lay down casing.

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<tr>
<td>04:00</td>
<td>Lost 200 bbl washing casing in hole. Delivered 630 bbl to location. Rig up C.R.T. equipment, casing stopped at 13,000 ft. Rig up to lay down casing.</td>
<td>32</td>
<td>13835 11143 1320</td>
<td>32</td>
<td>40</td>
<td>12 19 0 6 11</td>
<td>85</td>
<td>24</td>
<td>68/14</td>
<td>1163</td>
<td>3.8</td>
<td>4.682</td>
<td>34000</td>
<td>326022</td>
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PORE PRESSURE PREDICTION – MERCURY 1-5
REQUIRED MUD WEIGHT ASSUMING FISSION ROCK BEHAVIOR

Wellbore Stability

- $S_v = 21.337$ PPG
- $S_{H\text{max}} = 18.745$ PPG
- $S_{h\text{min}} = 15.9$ PPG
- Azimuth of $S_{H\text{max}} = 90$ degree
- Pore Pressure = 10.91 PPG
- Biot Coefficient = 1
- Poisson’s Ratio = 0.3168
- Dip = 0 degree
- Dip Azimuth = 0 degree
- Cohesion = 386 PSI
- Sliding Friction = 0.6516
- Failure Criterion = Lade modified
- Internal Friction = 0.6516
- UCS = 4743 PSI
- Failure Width = 0 degree
- True Vertical Depth = 11100 feet
GEO-MECHANICS RECOMMENDATIONS

- Deese Shale is over-pressured. Likely fissile shale.
- Minimum of 13.7 ppg ESD beyond 75° in curve.
- >13.95 ppg is preferred to suppress the roof collapse.
- Losses higher in the borehole is seen as a potentially increased risk with higher mud weight. A losses prevention strategy may also be required.
- Large differences between ECD and ESD are also a cause for instability. Increases in ESD to combat instability have reduced efficacy if the pumps-on/pumps-off pressure differential (ECD – ESD) is increased too.
END OF THEORY – TIME TO DRILL

▶ Same basic casing plan as before.

▶ Run 7” liner – no contingency about it.

▶ Weight up in curve.

▶ Study shale shakers for the warning signs
ROUND 1: MERRITT #1-28HA

- Issues running 20” casing
  - Parted, fished, weight-up, ran to bottom.
- Remainder of vertical went quite well.
  - One-stage cement job achieved 7,000’ of lift.
- Landed curve on depth & 7” liner successfully run.
  - Weight-up schedule established. It worked.
- Lateral was slow, painfully at times.
  - Found shale streak. Difficult to get out of streak.
  - Mud weight in lateral needed for shale stability – Zero bbl lost
- No good options to rotate production casing.
- End result: 74 days, 4,023’ lateral, $7.0 million
ROUND 2 CHANGES

- Vertical
  - Higher MW on 20” casing.
  - Two-stage cement job on 9-5/8”
- Run 7-5/8” liner through curve
  - Allows for 6-3/4” hole & 5” long string.
  - Try rotating near-bit stab to help hole geometry
- Reduce likelihood of encountering shales
  - Azimuthal Resistivity
ROUND 2: FRANK #1-34HA

- Issues running 20” casing
  - Higher MW, stopped short, pulled casing, cleaned-up, re-ran
  - Remainder of vertical went quite well.
  - Two-stage 9-5/8” cement went well.
- Landed curve on depth & 7-5/8” liner successfully run.
  - Weight-up schedule worked again.
- Azimuthal resistivity helped, but eventually found shale
  - First 1,000’ of lateral were great – feet on desk.
  - Losses started.
  - Some Mud weight in lateral needed for shale stability.
- End result: 87 days, 3,450’ lateral, $8.0 million
  - TD 400’ early and casing stopped 700’ short.
ROUND 3/4 CHANGES

- Vertical
  - Even Higher MW on 20” casing.

- Well set-up out of section.
  - Significant tangent in vertical.
  - Casing wear issues?
  - Continue 7-5/8” liner; 6-¾” hole & 5” long string.
  - Try Hybrid bit in curve.

- Continue Azimuthal Resistivity
  - Frac in shales has been ok.
  - May back off from well placement fight.

- Steer around well in lateral.
ROUND 3/4: MAMIE #5-4H & HAWKINS #1-6H

- Issues running 20” casing
  - Higher MW, few hang-ups. Casing run to 20’ of bottom.
  - Remainder of vertical went quite well.
- Landed curve on depth & 7-5/8” liner successfully run.
  - Weight-up schedule worked again.
- Azimuthal resistivity helped, but eventually found shale
  - Some losses encountered.
  - Some Mud weight in lateral needed for shale stability.
- End result: ?
  - 1,500’ to TD on Mamie 5-4H
  - 3,000’ to TD Hawkins 1-6H
CONCLUSIONS

- We started with a good plan from Cordillera Geo-Mechanics review reduced issues
  - Over-pressure in Deese Shale
  - Pressure + trajectory are very bad
  - Must maintain MW to have stability

- 7-5/8” Liner simplifies completion with 5” long string

- Azimuthal Resistivity has helped geo-steer reservoir
NEXT CHALLENGES

- Move onto BLM Land
  - Permitting lead times
- Improve 6¾” lateral bits
- Attempt 6-1/8” lateral again
  - Engineered 5.5” by 4.5” casing cross-over
- Can I remove a string of casing?
- Review need for Azimuthal Resistivity
- Two Apache data points is not enough
  - Holistic review of 4 completed wells
RESULTS THUS FAR

- Apache Lower Marmaton A
  - 27% more lateral per well
  - 36% lower cost per well
  - 97% Premium for Apache

- Perfect?  Far from it.
THANK YOU.

QUESTIONS.