Mississippi Lime Drilling Team

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Mississippi Lime Overview

Miss. Lime Core Area

Anadarko

Gulf Coast Onshore
Mississippi Lime Overview

- Acquired Eagle Energy acreage in 2012
- First Midstates drilled well in 2013
- Design and operational changes in 2014
- Capital efficiency in 2015
Mississippi Lime Overview

Cherokee Shale

Mississippian Lime Potential Target Intervals
Design Initiative – Addressing The Problem

Design Directives:
- Maintain full-section laterals (± 4,900’)
- Place ESP as low as possible in wellbore to reduce hydrostatic head at intake
- Pad drill wells to utilize existing infrastructure (location, tanks, SWD)

Issues:
- High incident rate of stuck pipe from packoff events
  • How can we change design to mitigate wellbore instability?
- High incident rate of catastrophic downhole tool failure
  • How can we adjust operational procedures to mitigate catastrophic failures?
The Problem - Stuck Pipe

Stuck pipe frequency by depth

Packoff events in the curve
The Problem – Stuck Pipe

- Cherokee Shale is predominately Illite Clay
  - Extremely dispersive shale
The Problem – Stuck Pipe – Caliper Log

20”+ Hole

5’ TVD

Gauge Hole
The Solution – Stuck Pipe

- Cherokee Shale is predominately Illite Clay
  - Extremely dispersive shale
  - Tangent was drilled for 200’ in the Cherokee Shale
    - Approx. 50° - 60° Tangent Angle

- Changed ESP tangent angle to 75°
  - Reduced exposure to dispersive shale
  - Maintained lower hydrostatic head for Production at intake
  - Pushed tangent downhole changed lithology
    - Tangent now drilled in top of the Mississippi Lime

- Sodium Silicate WBM
  - Chemical inhibition to shale – similar inhibition to OBM
  - Drill gauge hole through curve for better cleaning

  Ultimately, changing tangent angle was more beneficial than Silicate WBM
The Curve and Hole Cleaning – Casing Time

Casing run times prior to tangent adjustment and Hole Cleaning initiative

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<tr>
<td><strong>Average</strong></td>
<td><strong>12.90625</strong></td>
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<tr>
<td><strong>Standard Deviation</strong></td>
<td><strong>6.252579255</strong></td>
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Histogram for 7" Casing Run Time

7" Casing Run Histogram

- Frequency
- Average
- \( \sigma \)
- \( \sigma \)
The Curve and Hole Cleaning – Casing Time

Histogram for H2 7" Casing Run Time

<table>
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<tr>
<td>More</td>
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</tbody>
</table>

Average: 10.09659091
Standard Deviation: 2.119411879
The Curve and Hole Cleaning – Casing Time

- Changed ESP tangent angle to 75°
  - Reduced exposure to dispersive shale
  - Maintained lower hydrostatic head for Production at intake
  - Pushed tangent downhole changed lithology
    - Tangent now drilled in top of the Mississippi Lime

- Reduced 7” Casing Time Average and Train Wrecks!
  - Average running reduced 2.8 hours
    - Previous average was 12.9 Hours
    - New average is 10.1 Hours
  - Longest casing run was 13.5 hours
    - No pulled casing strings!
    - Previous longest casing time was 41 Hours
      - Pulled casing and multiple conditioning runs
The Problem – Catastrophic DHT Failures

- DHT failures were persistent issues
  - Catastrophic failures – resulting in sidetracks
  - Near-catastrophic – success retrieving tools
  - Undiagnosed failure – TOOH for new assembly

- Why were so many tools breaking?
The Problem – DHT Failure Cost

Cost vs. Directional Tool Failure Date of Incident

Catastrophic Failures

- 16 -
The Solution – Catastrophic DHT Failures

- DHT failures were persistent issues
  - Catastrophic failures – resulting in sidetracks
  - Near-catastrophic – success retrieving tools
  - Undiagnosed failure – TOOH for new assembly

- Why were so many tools breaking?

- Implement DHT guidelines and procedure rollout
  - Clearly define the issue at hand
  - Clearly state the operational parameters
  - Training, training, training!
    - Engineer, Company Man, driller, and DD **MUST** work together!

- Document failures
  - Learn from the mistakes
  - Keep it in the open so it’s not forgotten!

- “It’s not the hole you make, it’s the hole you keep!”
The Solution – DHT Failures

Cost vs. Directional Tool Failure Date of Incident

Directional tool failure analysis and action plan instituted
Address capital efficiency

Mitigate slow ROP and “yo-yoing” in high chert areas

Work diligently to “stay in pay”

Proactive measures during a runaway cost scenario
Thank you for listening

Questions?