APPLICATION OF ISOLATION SCANNER WITH SPECIAL TRANSDUCER FOR CEMENT EVALUATION IN HEAVY MUD SYSTEMS

SPE Abandonment Seminar
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Reserves: Our use of the term "reserves" in this presentation means SEC proved oil and gas reserves.

Resources: Our use of the term "resources" in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Resources plays: our use of the term 'resources plays' refers to tight, shale and coal bed methane oil and gas acreage.

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OBJECTIVE & CONTENT

Objective

- Present an example of how new technologies enabled the evaluation of the cement profile in a difficult well environment.

Content

- Application of cement bond logs
- Case study background
- Log planning, execution and results
- Conclusions
- Q&A
APPLICATION OF CEMENT BOND LOGS

- 21 cement bond logs during operations in 2014
- 15 logs were carried out with standard ultrasonic tools
- **New technologies** were required in the following instances:
  - Requirement of solids characterisation in cutting re-injection wells
  - Evaluation of elastic cements
  - Casing thickness oversized
  - Heavy Oil Based Mud (OBM) with high solids content.
<table>
<thead>
<tr>
<th>Feature</th>
<th>USIT™ &amp; IBC™ TM (Newer generation)</th>
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<tbody>
<tr>
<td>Cement type</td>
<td>Standard Cements</td>
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<td>Flexible cements/low acoustic impedance</td>
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<td>Casing type</td>
<td>&gt; 25% Chrome</td>
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<td>Casing thickness</td>
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<td>0.8 in</td>
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<td>Mud weight</td>
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<td>USIT™ &amp; IBC™ TM</td>
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<td></td>
<td>8.4 ppg</td>
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<td>11 ppg</td>
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**Logging objectives - abandonment phase:**

- Evaluate TOC and cement quality in 9 7/8in for zonal isolation
- Evaluate casing integrity, potential restrictions and determine top of solids to optimise milling operations (if required)

**Impact:**

Decision of whether or not milling would be required prior to setting the internal plug $$$
1. Evaluate incremental value of additional service of new generation tools

2. Simulation – tool selection/confirmation

3. Tools check/calibration at surface conditions

4. Tool calibration in the wellbore (free pipe section)

5. Job execution - main pass
OUTPUT OF NEW GENERATION TOOLS

Combines acoustic impedance measurement with flexural attenuation measurement.

Provides indications of the casing conditions – internal radius and casing thickness.

1. Flexural Attenuation

2. Acoustic impedance (Z)

Additional information: http://www.slb.com/
Simulation was carried out to demonstrate that high solids content in mud would interfere with the measurements.

The simulation suggested that:

- Good quality data cannot be acquired with standard transducers. The attenuation to the pulse-echo and flexural is high (Attenuation > 30dB).

- **Power Transducers required!**
Objective:

- Check the response of IBC-Power Tx™ in 15.1 ppg Enviromul mud system (high solids content)

Equipment required:

- IBC™ with Power Tx™
- SFT-358 pressure vessel system
- 8.625in casing – Thickness 0.315
- Water 8.34 ppg
- Enviromul 15.1 ppg (Supplied by mud provider)
RESULTS IN OBM

1. No processing flags
2. Measured ID/OD/Thickness as expected
3. SLG (solid-Liquid-Gas) map shows 100% liquid as expected

Test was done by varying signal power from 7v to 120v
Good Signal level obtained at low power of 40v
TOOL CALIBRATION IN THE WELLBORE (FREE PIPE)

1. Tool ECCE - Ok
2. No processing flags
3. Measured ID/OD/Thickness as expected
4. Flexural attenuation and acoustic impedance indicate free pipe

Raw acoustic impedance
Raw flexural attenuation
## MAIN PASS – CEMENT BOND RESULTS

<table>
<thead>
<tr>
<th>Reference (ft)</th>
<th>Ultrasonic cement Evaluation</th>
<th>SLG map</th>
<th>CBL</th>
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- **TOS from IBC™**
- **TOC from CBL™ and IBC™**
- **TTOC – Cement report**
- **Channels**
- **Solid/cement**
- **Transition zone**
- **Free pipe**
- **13.75in**
MAIN PASS – CASING INTEGRITY

Anomaly
SUMMARY

Business application

- IBC™ with power transducer enabled the evaluation of the cement bond, casing integrity and top of solids in heavy mud weight.
- Assisted the decision of whether or not milling was required prior to setting the internal plugs.
- Allowed the optimisation of the milling times.
- De-risk abandonment decisions

Petrophysical value

- SLG map (IBC output) provided cement/solid distribution information for TOC, TOS and channelling identification. The latter is not possible with standalone acoustic tools such as CBL-VDL.
- Higher resolution of the annular solids profile reduced the uncertainty of the interpretation.
Thank you

Questions?
STEP 1. STANDARD ULTRASONIC MEASUREMENTS

- Indications of the casing condition – internal radius and casing thickness
- Acoustic impedance (Z)