



Decommissioning and Restoration – Fostering Excellence through Regulations, Innovation, and Sustainable Practices

30–31 JULY 2024 | BANDAR SERI BEGAWAN, BRUNEI



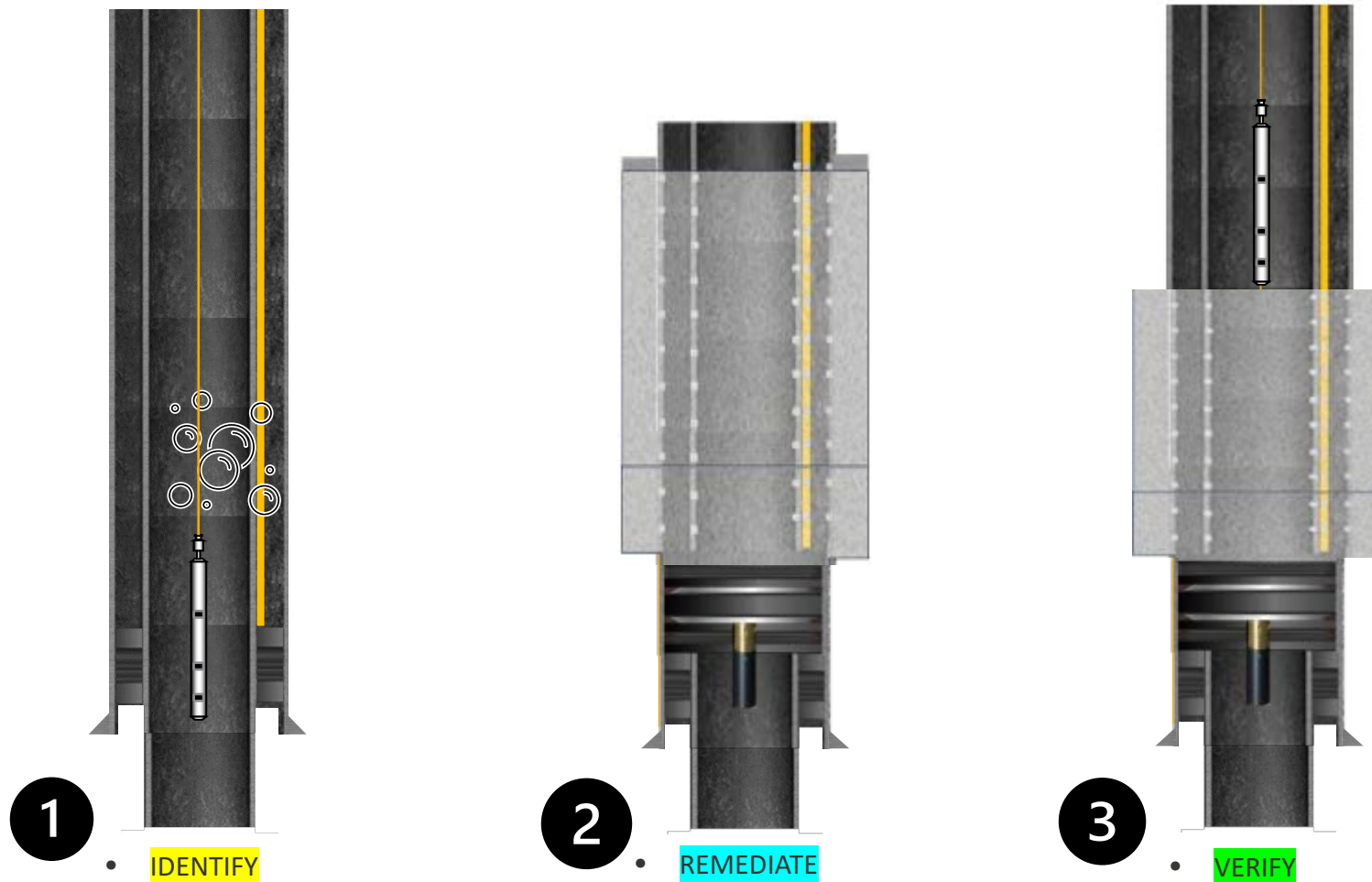
Identify, Remediate and Verify Cross Sectional Cement Barriers for Permanent Well P&A

Sathish Kumar Batumelai

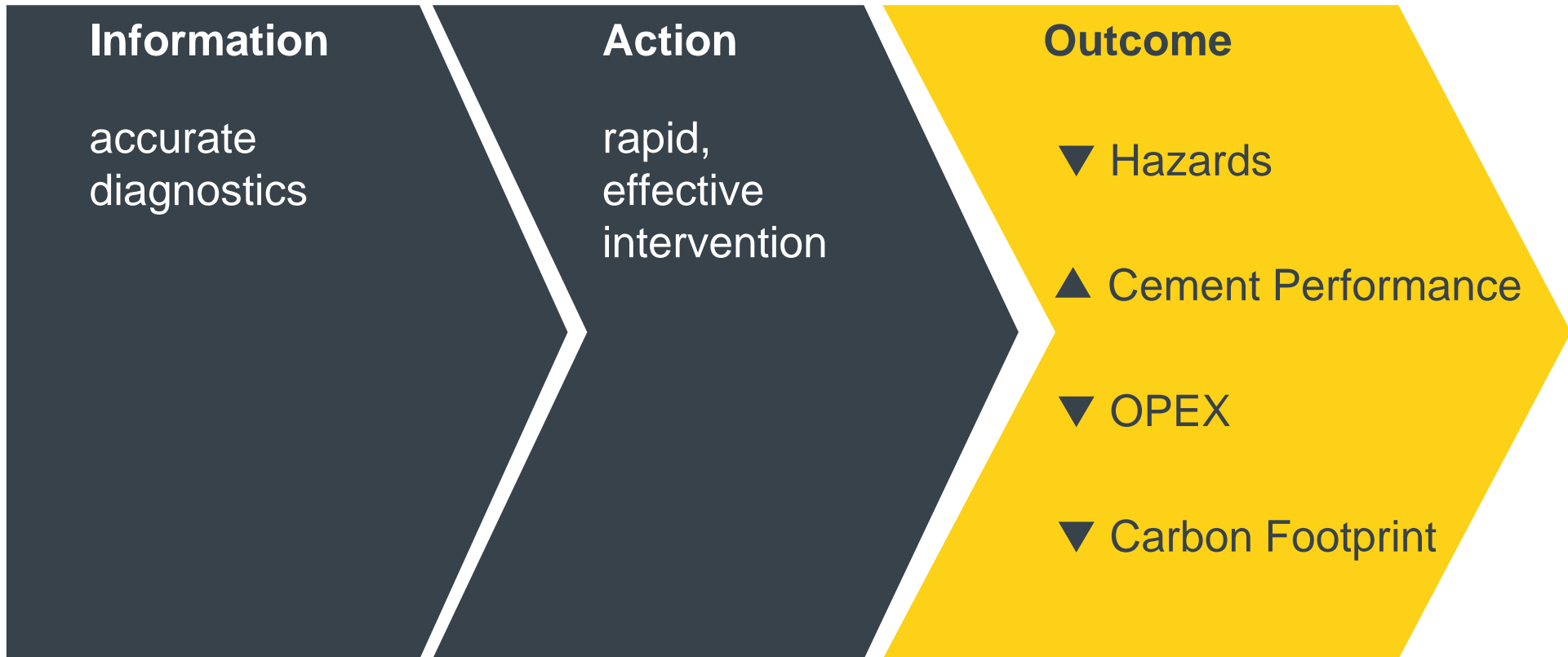
Archer

Archer

Identify, Remediate and Verify cross sectional cement barriers for permanent well P&A



Better data, better decisions



Acoustics logging technology for diagnostics

A well is a complex system – multiple potential failure modes

Barrier leaks

- Fluid movement from one side of a barrier to the other
- Tubing
- Production casing
- Outer casing strings

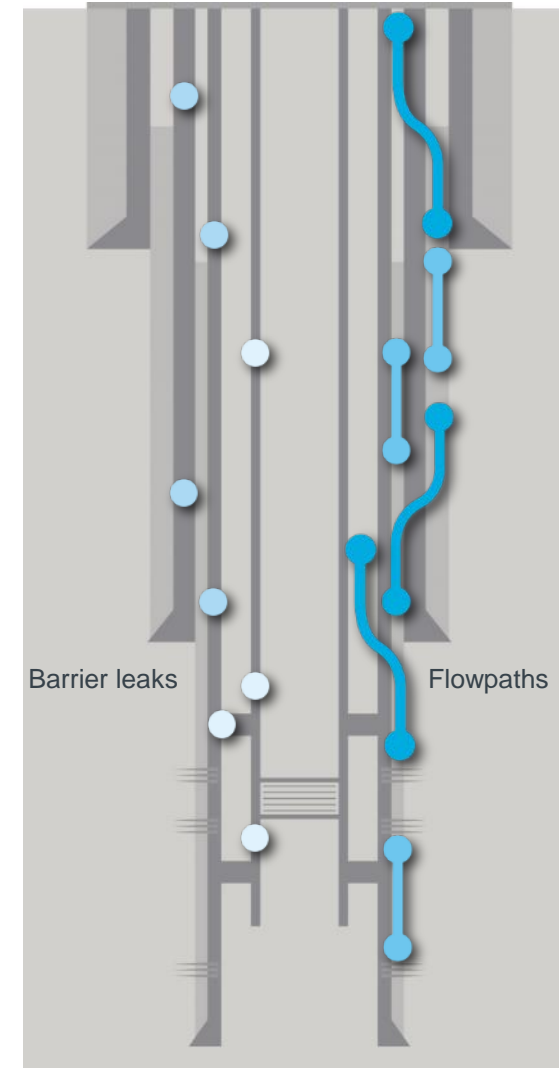
Flowpaths

- Fluid movement along the wellbore
- May be behind multiple casing strings
- A full flowpath may include a barrier leak

The acoustic energy at the tool will depend on many factors:

- Fluid type
- Differential pressure
- Leak rate
- Frequency of sound produced
- Proximity of the source

Full bandwidth - full information



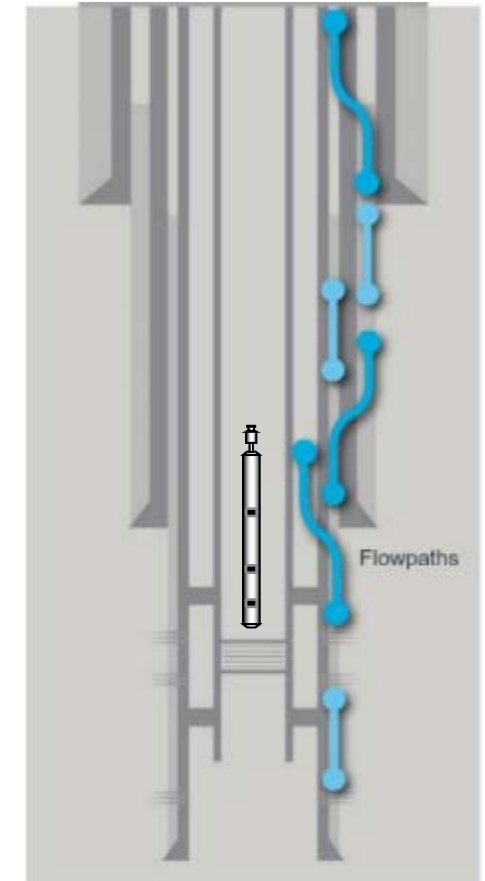
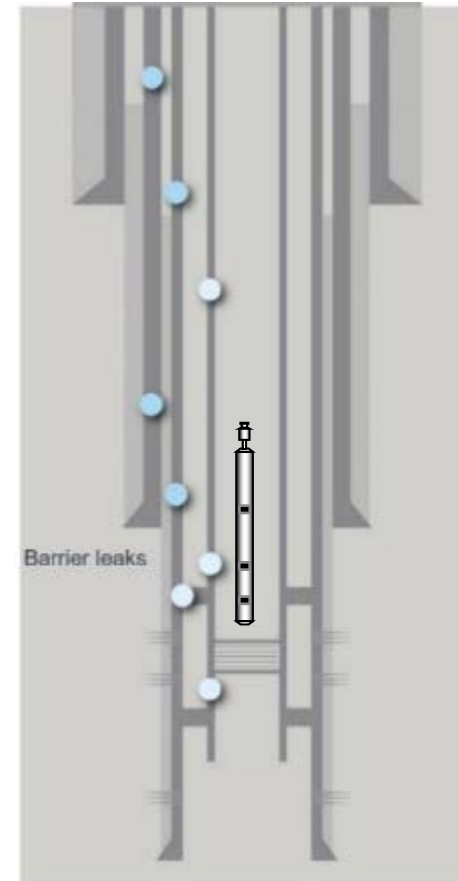
1. "Identify" Well Leaks with acoustic logging techniques for diagnostics

Active acoustic-cement condition

- First barrier
- Further barriers?

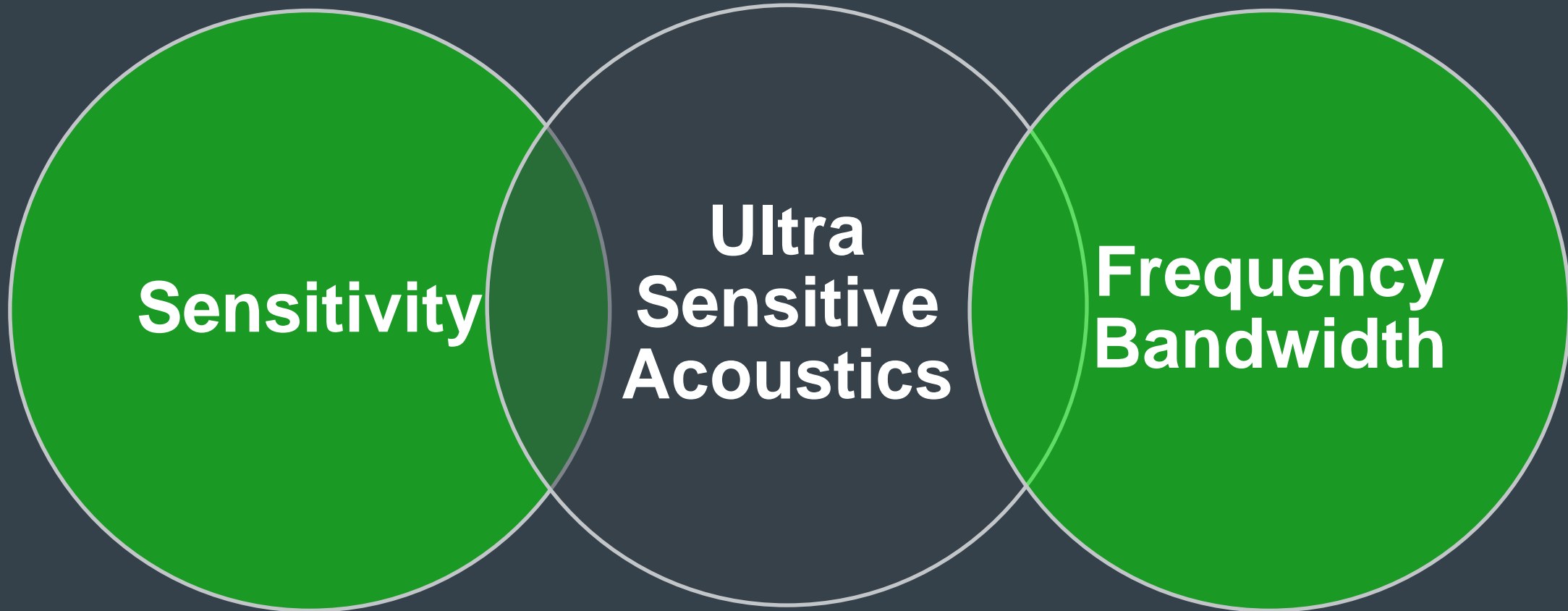
Passive acoustic-cement performance

- First barrier
- Further barriers ✓
- Complex leak paths

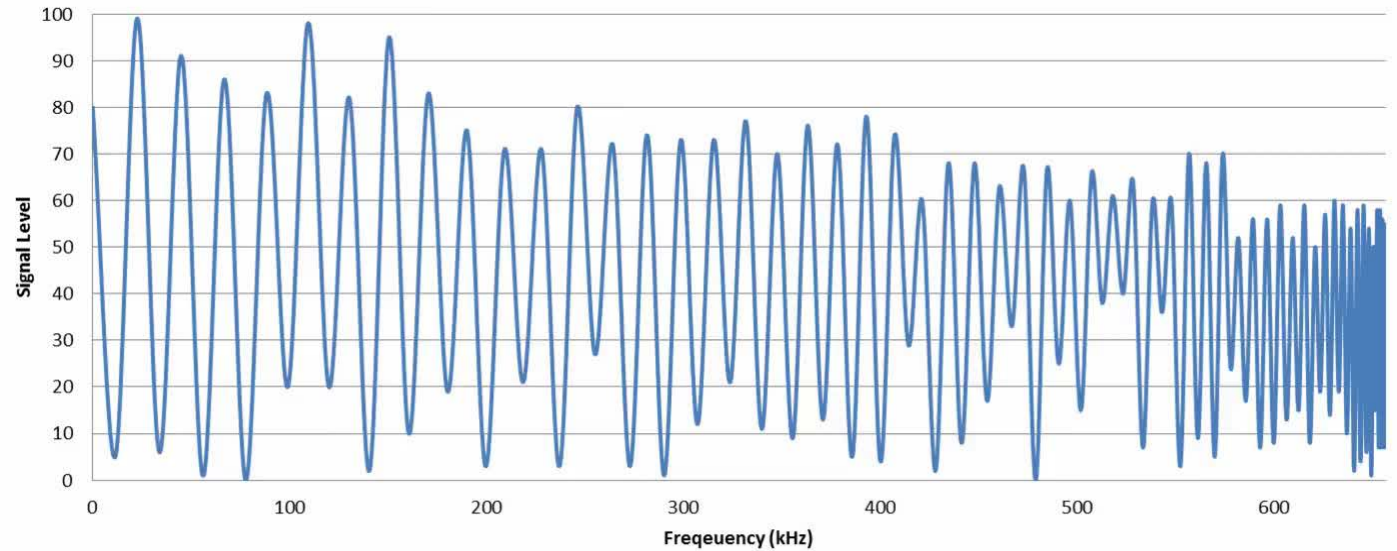
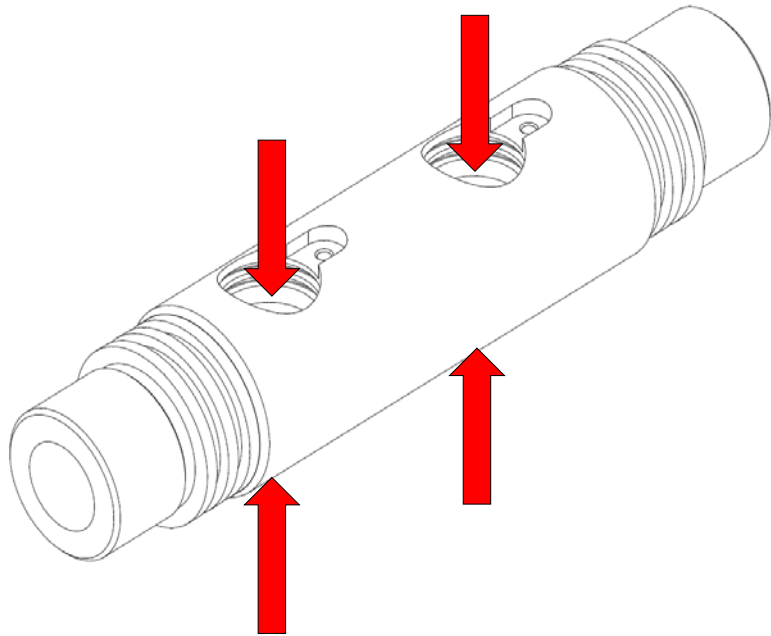


- IDENTIFY
- REMEDIATE
- VERIFY

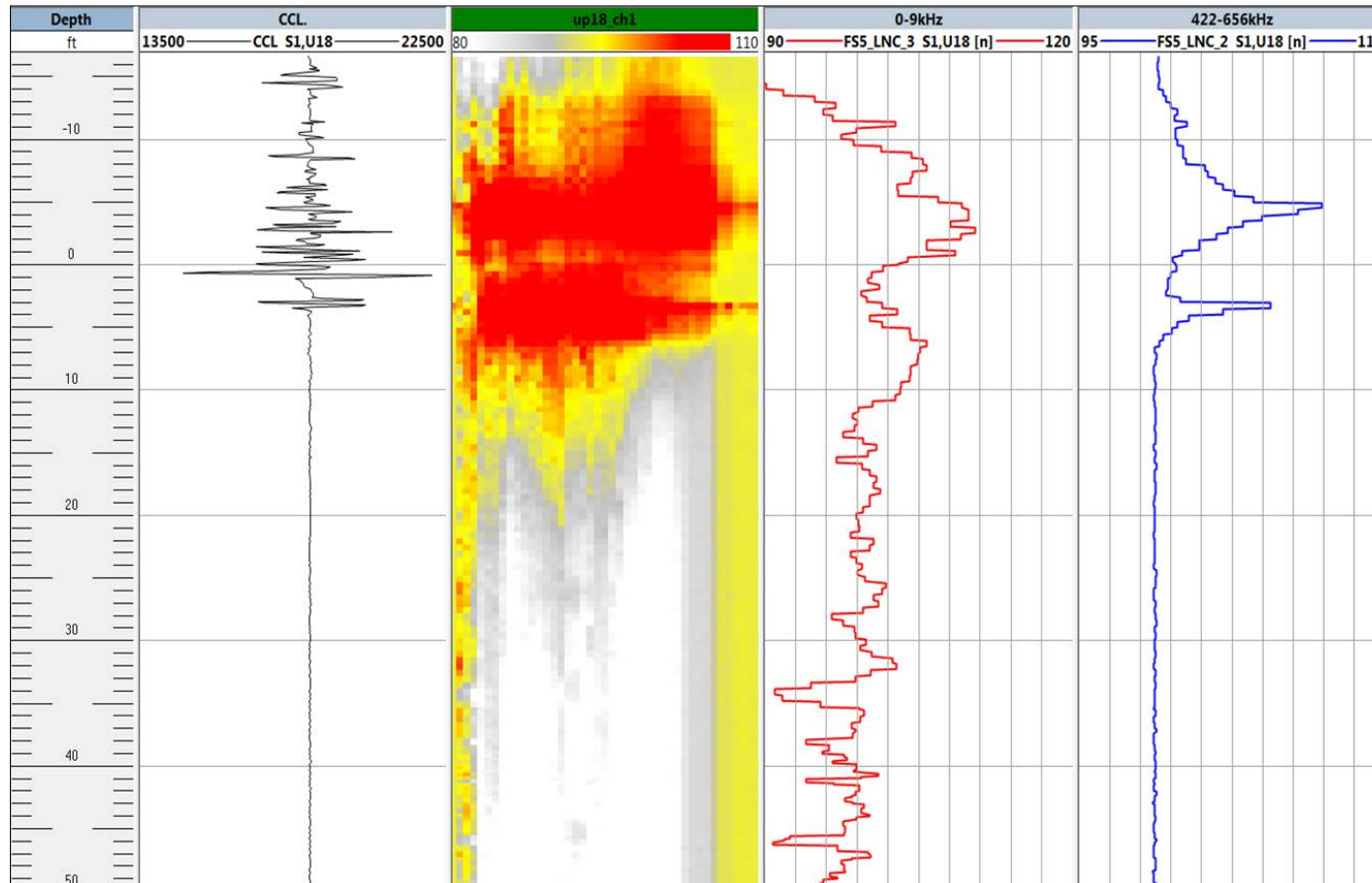
Unique Value Proposition of ultra sensitive acoustics diagnostics



Patented sensor for sensitivity & broad bandwidth diagnostics



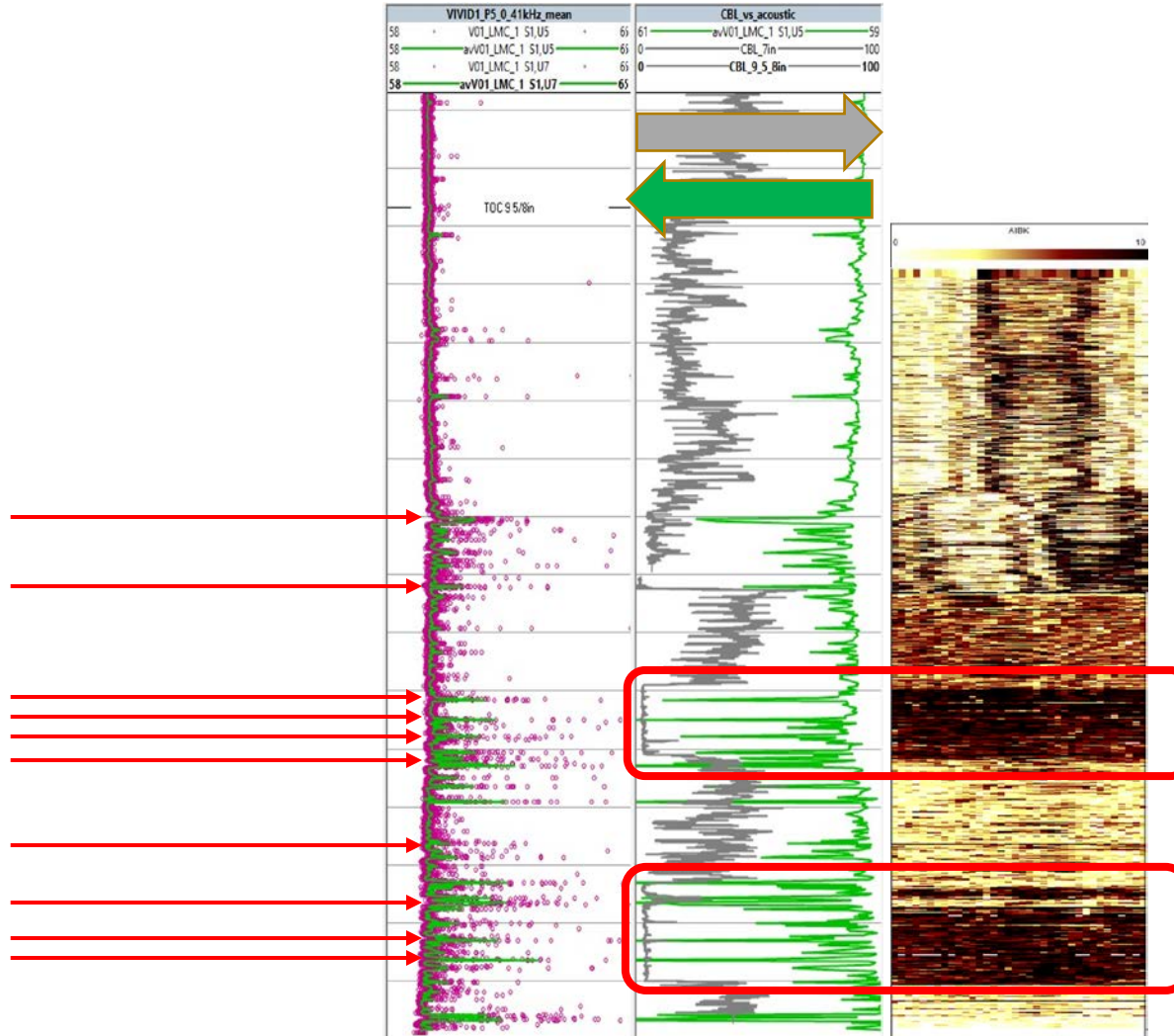
Comprehensive downhole acoustics diagnostics



- Acoustics event more evident at 422-656kHz for this leak
- Absence of broad frequency bandwidth is detrimental

Cement performance & condition

Full details in SPE-212889-MS



- Zone of interest
- Temperature
- Acoustic
- Bond log with passive acoustic
 - CBL Amplitude
 - Time-averaged Noise
- Impedence map
- “Good” Cement
 - Low CBL amplitude
 - 360° coverage – no channels
- Clear leak path
- 250m “good” cement **LEAKING**

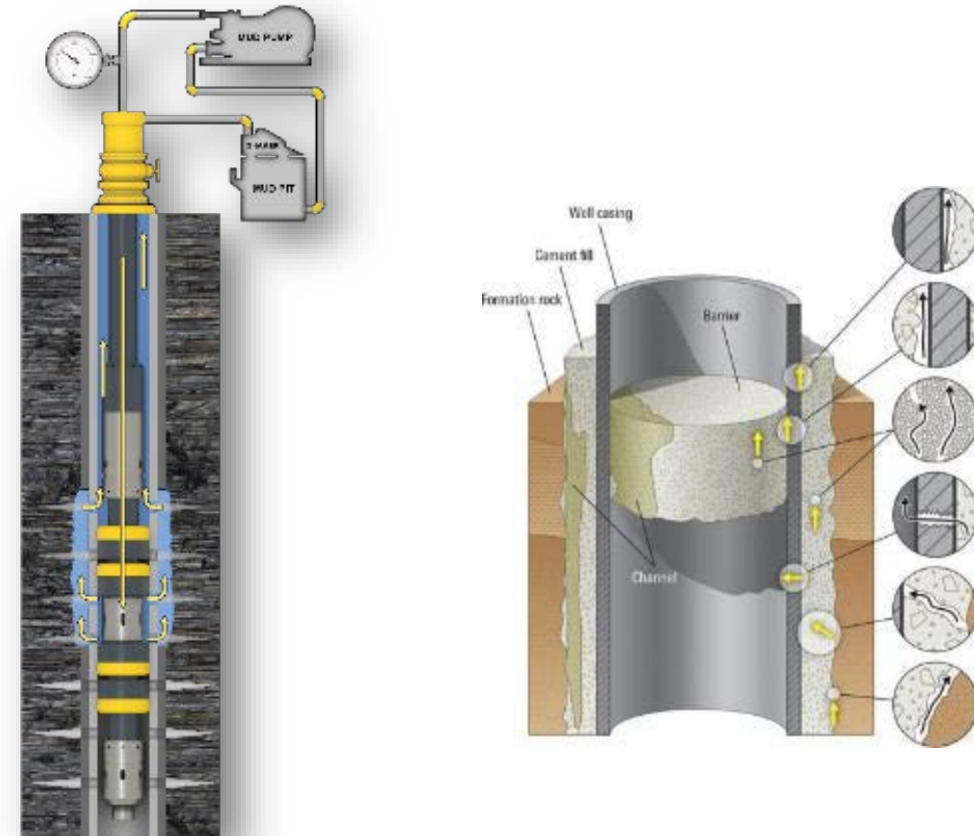
1. “Remediate” Annulus Cement Sealing with Close Loop Perf, Wash and Cement

Features and Benefits

- Time-saving alternative to Section Milling
- Closed loop system for optimum use of hydraulic energy
- Traditionally used for loose annulus content
- Continuous service quality improvement

Typical length of interval

- Combining Primary and Secondary Barrier
 - 80 m to cover min 2 x 30 m
- Single Barrier
 - 50 m to cover min 1 x 30 m



- IDENTIFY
- **REMEDiate**
- VERIFY

5. **“Remediate”** Cement in dual casing 7” x 9 5/8” CFD and Testing validated by Successful Job

Challenge

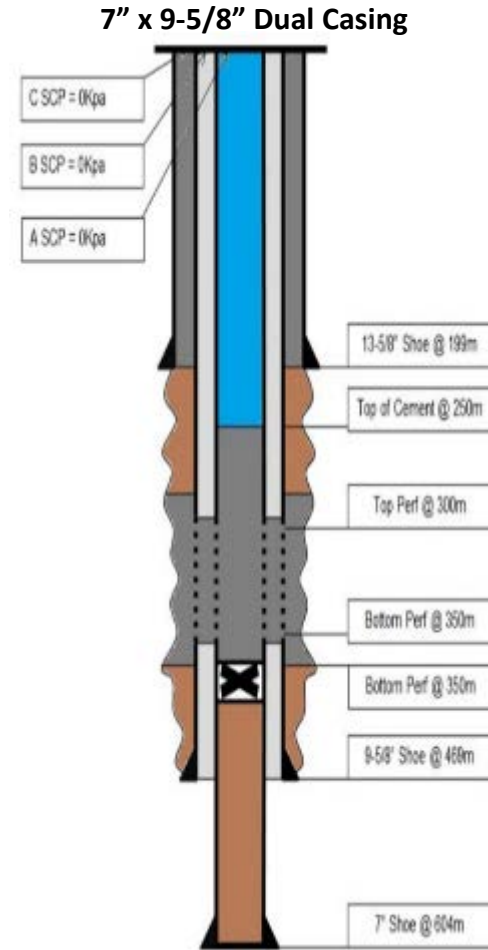
Pressure had been observed on the B annulus between 7” 29# and 9 5/8” 40# casing of up to 1100 kPa. Gas was clearly migrating through a poor foam cement job.

Solution

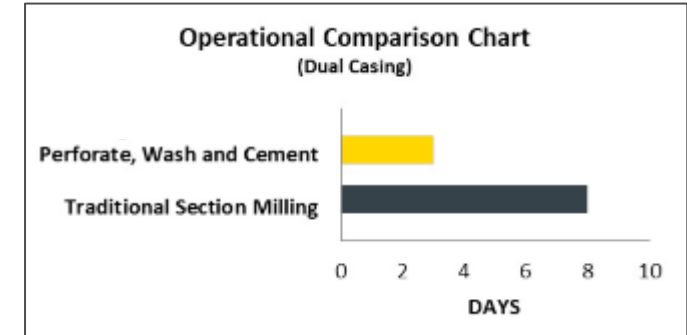
A thorough wash through 7”x 9 5/8” into 12.5” bore hole with 10,4ppg weighted mud followed by a systematic spacer/cementing pump and pull process weighted 12.5ppg Class E + and 15.8ppg Class G respectively. The close loop system with opposing swab cups allowed us confidently to displace the cement exactly into the target zone through the perforations.

Result

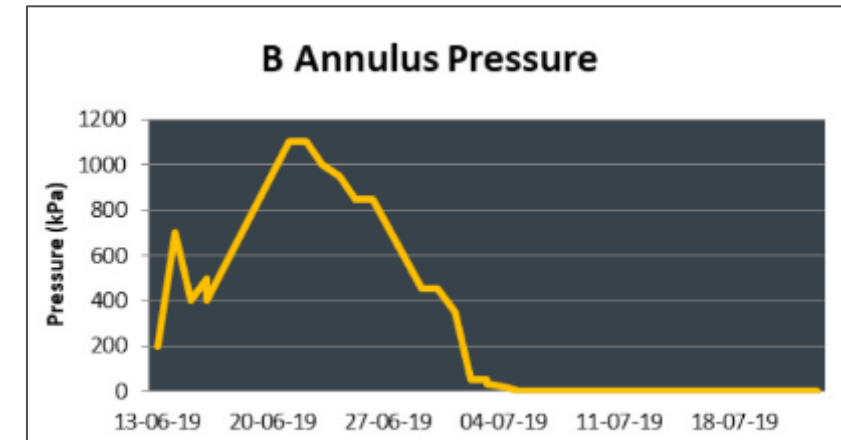
A solid rock to rock barrier replacing the original poor foam cement. Gas migration to surface has now ceased, allowing surface casing pressure to read 0 kPa after final bleed off inside of the B annulus. The well now no longer requiring constant manual bleed down by well integrity operators to keep below the MAASP rating of 1500 kPa. Six months on from the operation being conducted and pressure at surface remains at 0 kPa



Job Duration Dual Casing



SAP is Cured



- IDENTIFY
- **REMEDiate**
- VERIFY

Verification of barrier – Cement Performance Evaluation

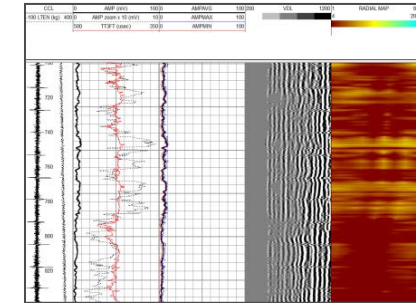
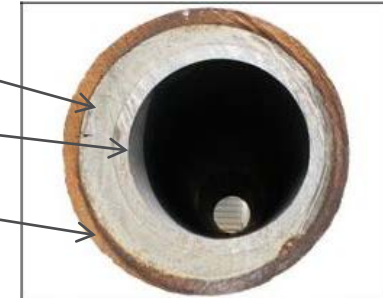
- Condition vs performance
- Test cells designed
- Good cement bond log



Expanding Class G cement

7" tubing

9-5/8" casing

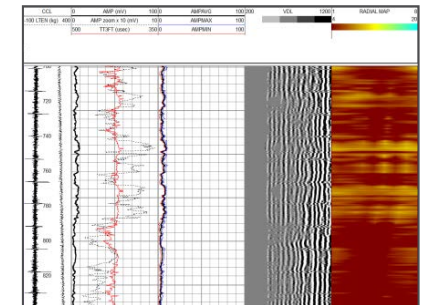
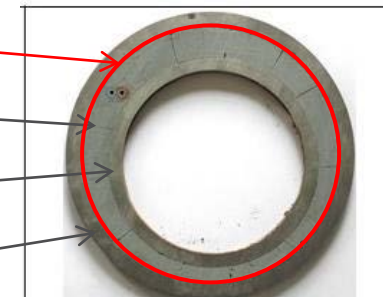


Exterior micro-annulus

Standard Class G cement

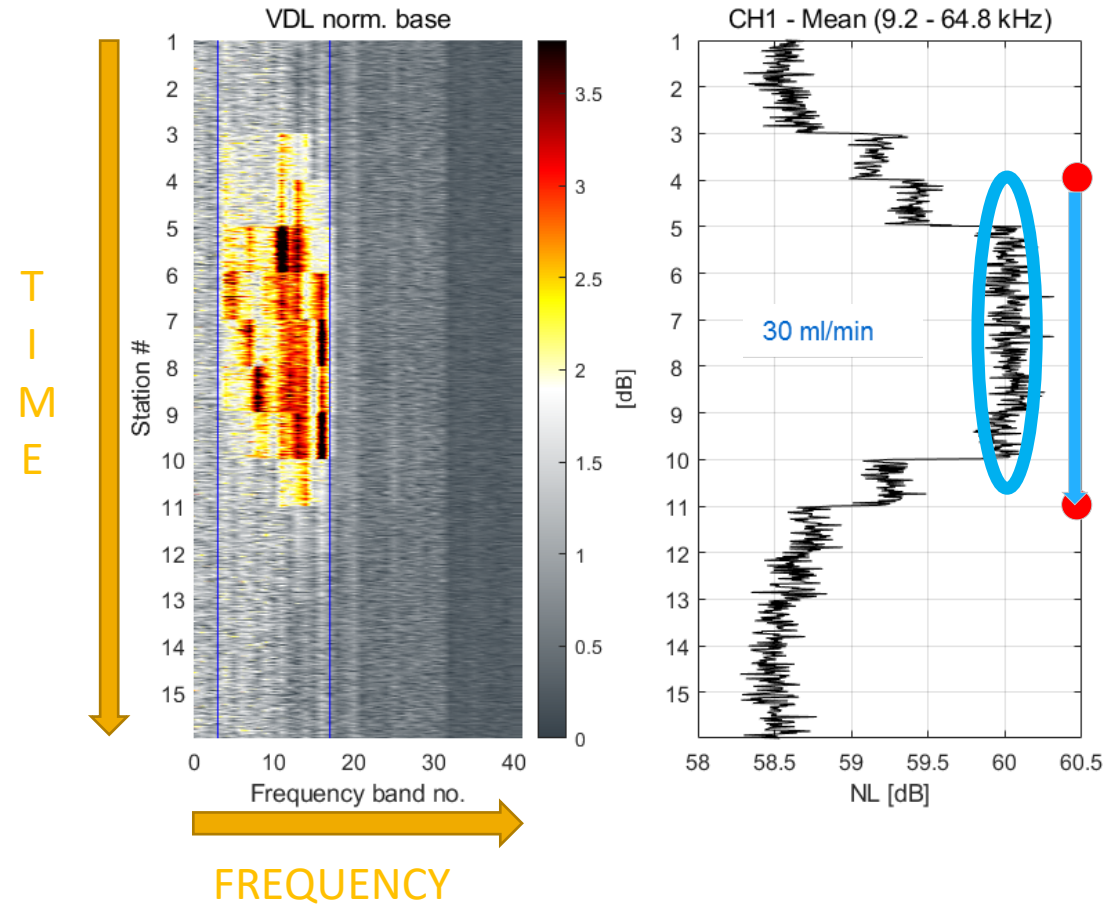
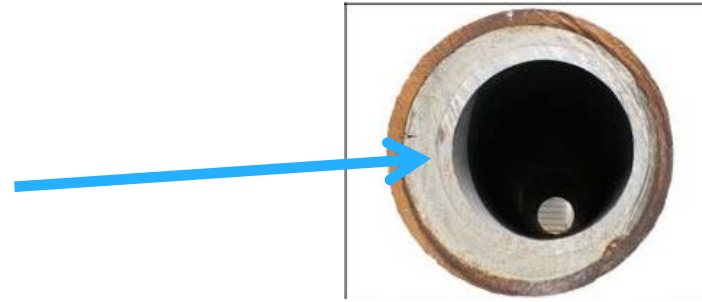
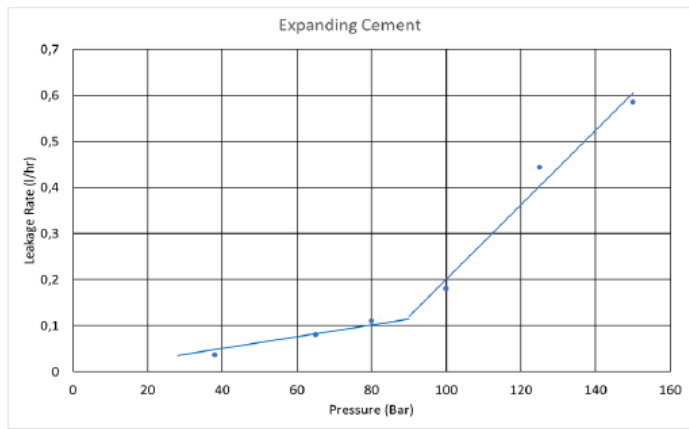
7" tubing

9-5/8" casing

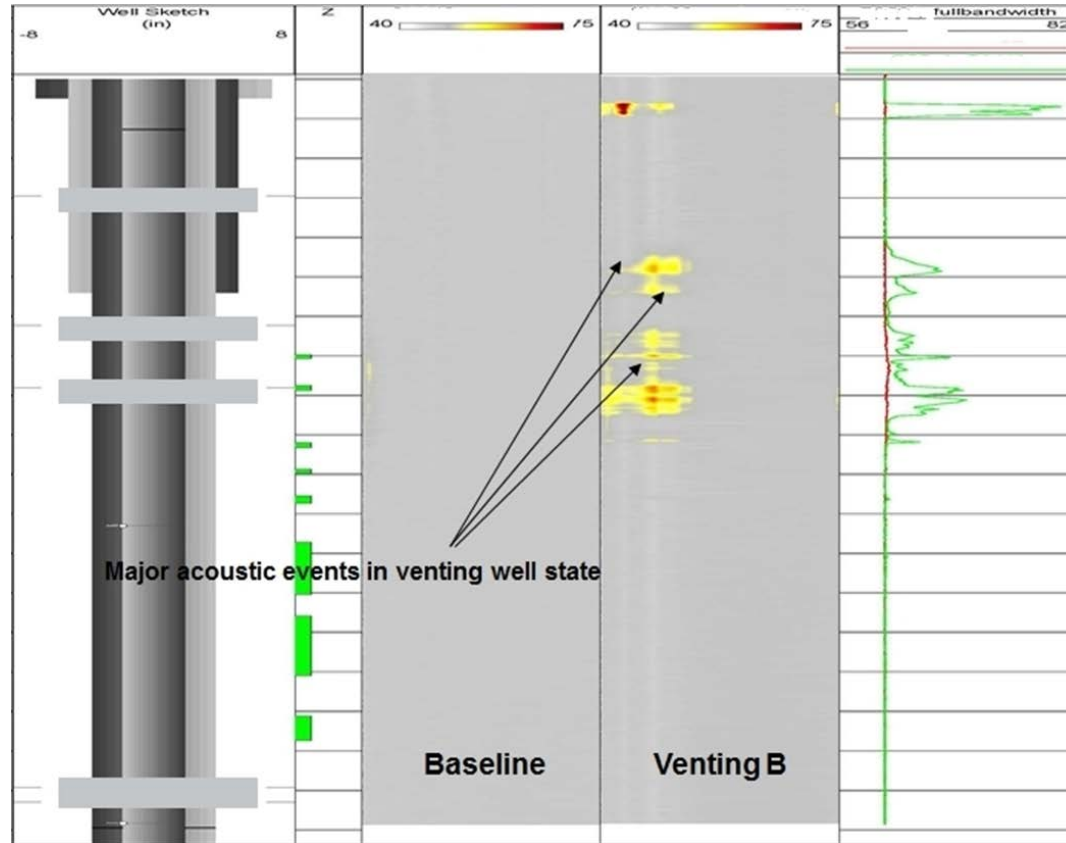


Good cement?

- Water pumped into cemented annulus
- Cement debonding at high pressure
- Data recorded for 1 minute every 25cm
- Elevated noise through test section
- Metered at 30ml/min (0.008gpm)

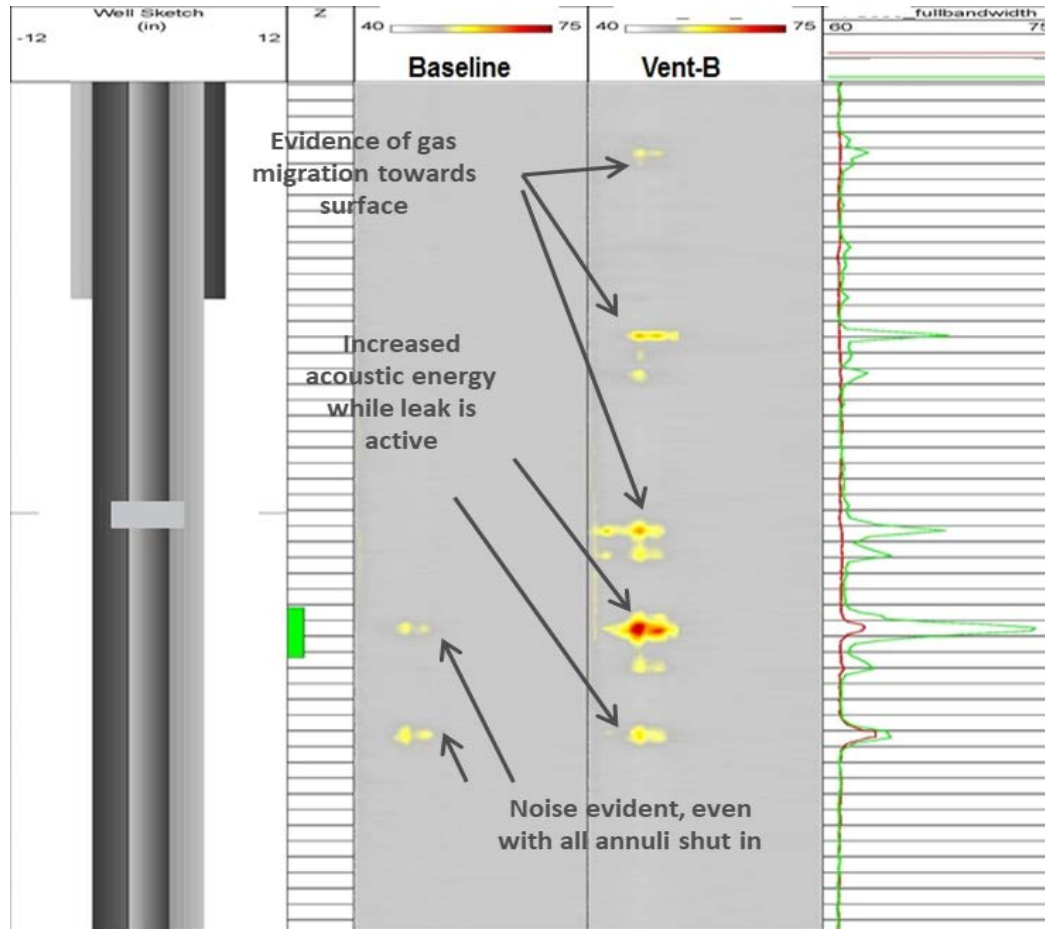


Cement Performance Evaluation



- Build-up around 70psi per day
- Venting B annulus activates flow
- Mapping of the migration to surface possible

Cement Performance Evaluation



- Baseline log shows acoustic energy
- Venting B annulus increases energy – revealing probable source of charging
- Gas migration path to surface

Conclusion

- **Identification and verification of barriers** are key to ensure **successful P&A operations**
- **Over 18 years experience** in Malaysia Waters with **over 1000 wells** logged at **98.7% success rate**.
- Ability for **integrated remediation** capability delivers **operational efficiency**
- Besides cost saving, operational efficiency also delivers **reduction in carbon footprint** by optimizing the rig time

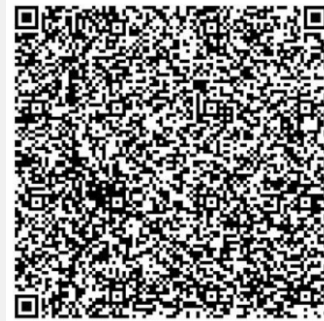
Thank You

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- IDENTIFY
- REMEDIATE
- VERIFY