

Technological Solutions for Effective Carbon Capture and Storage monitoring



CCUS Challenges

- Reducing Cost of Storage (rigless approach, use of legacy wells)
- Qualifying suitability of Legacy Wells (well integrity)
- Investigate and monitor flow potential between overburden units and store
- Monitoring corrosion and flow conformance (target vs out of zone injection) in active wells
- Barrier Verification

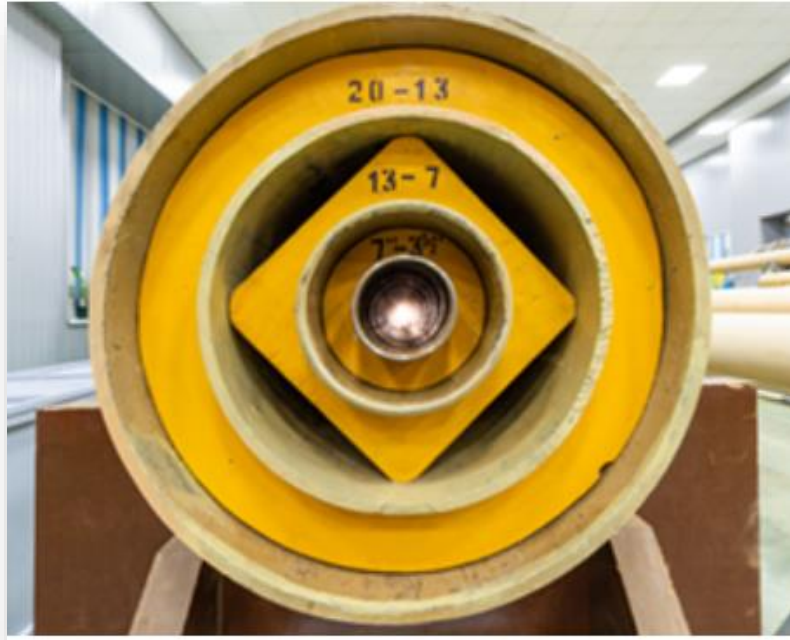


Solutions

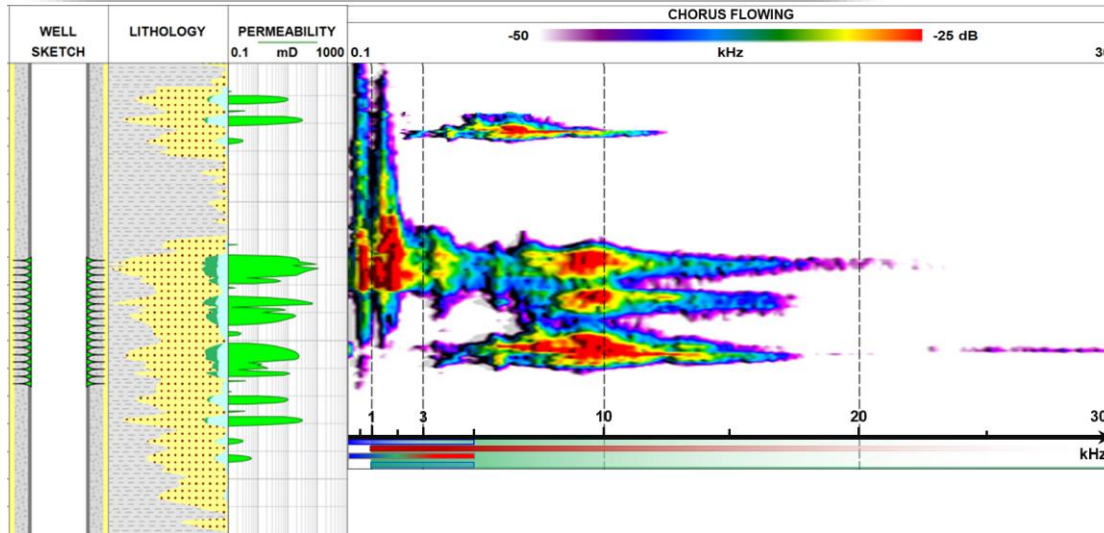
Technologies for providing measurements;

- Measurements to be compatible with Gas filled borehole
- Through-tubing corrosion evaluation of multiple casing strings
- Identifying presence of formation and annular flow behind multiple pipes

EM and Passive Acoustic Technology

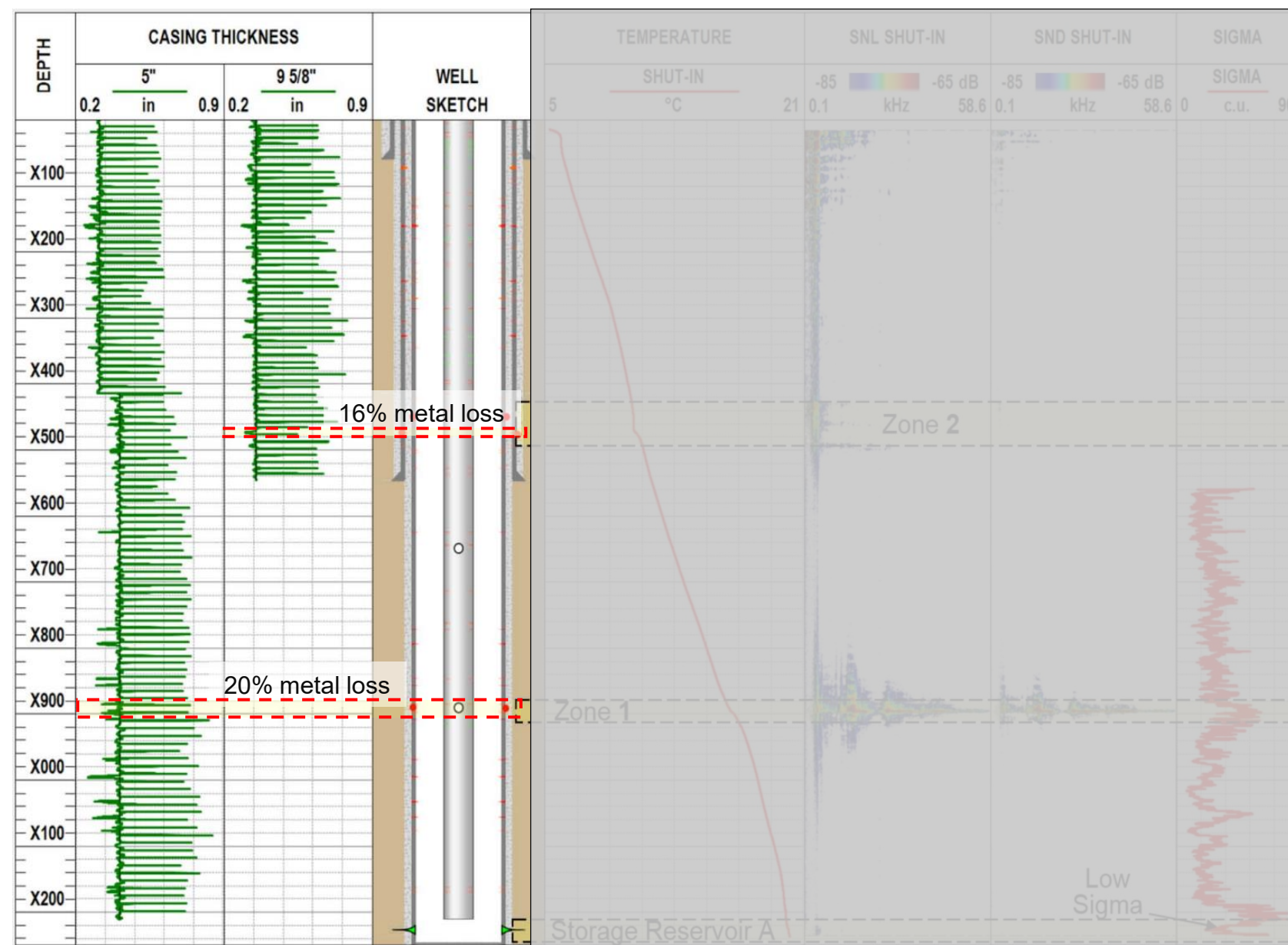


- EM; Through tubing evaluation providing individual thicknesses of 4 concentric pipes
- Run in gas filled borehole



- Spectral Acoustics; Detects flow within formations and annulus behind multiple barriers
- Run in gas filled borehole

Qualifying Legacy Gas Storage Wells

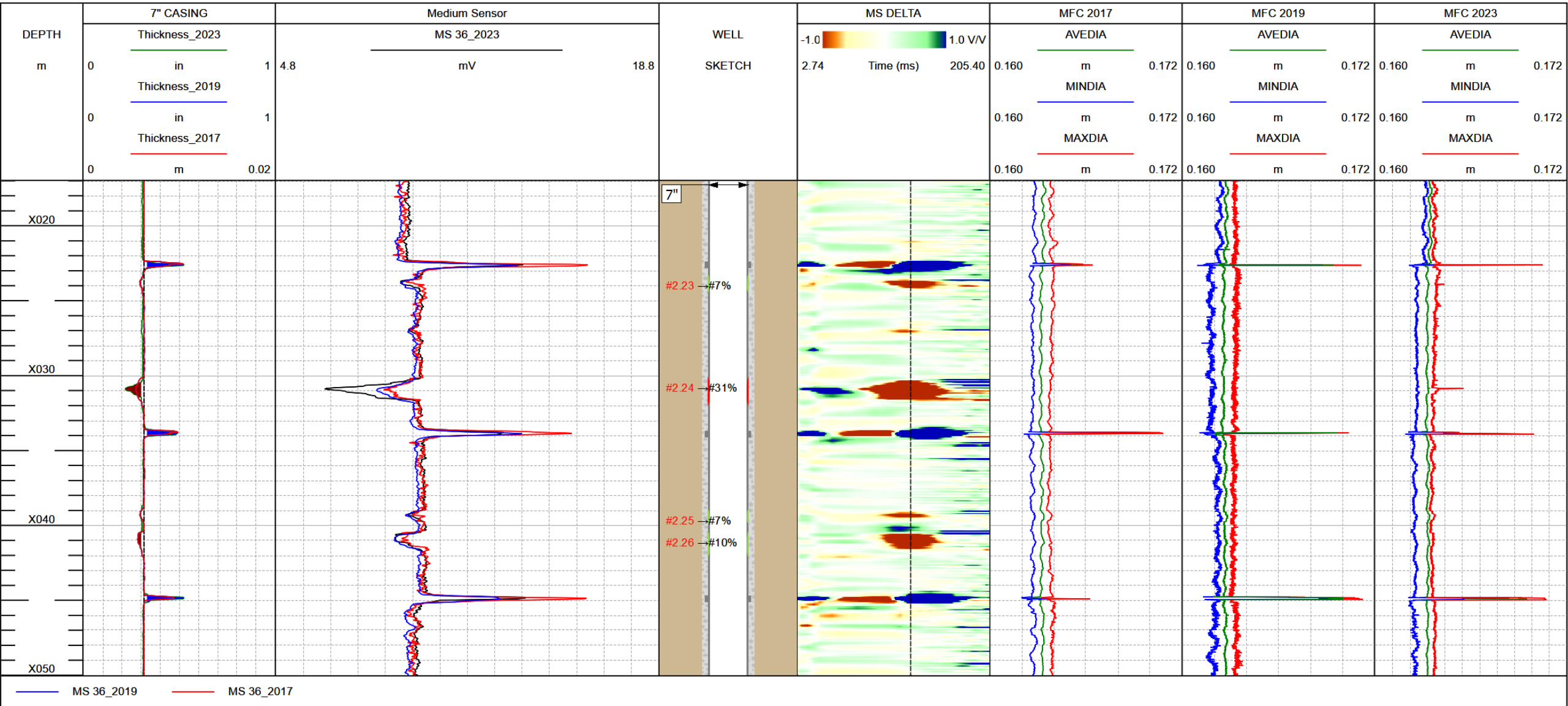


20 year old observer well, now completed and perforated

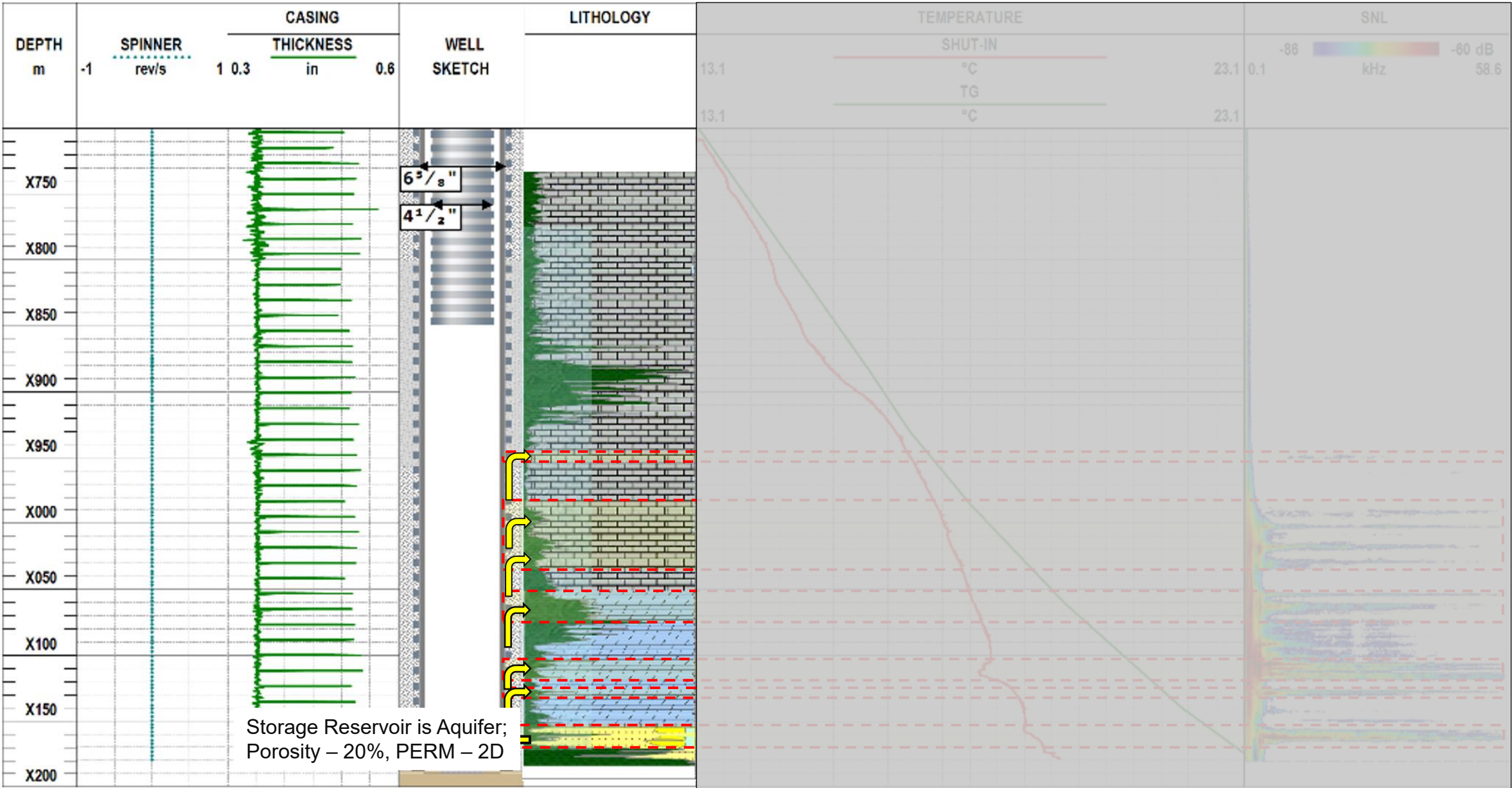
- Metal loss evaluation through tubing identified multiple corrosion zones
- Leaks confirmed with spectral acoustic log

Evaluation carried out on slickline (memory mode) without need to pull tubing

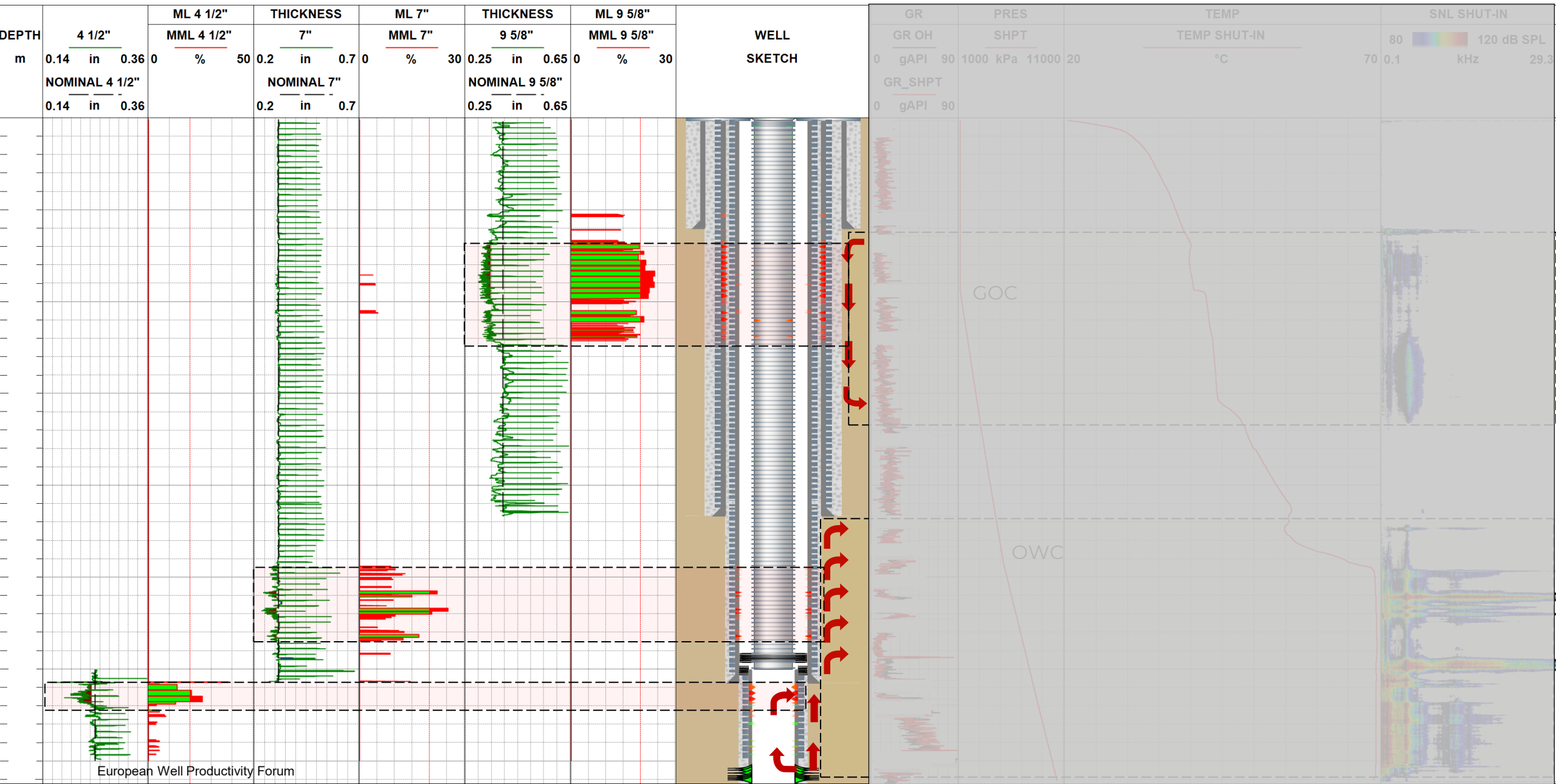
Proactive Corrosion Monitoring



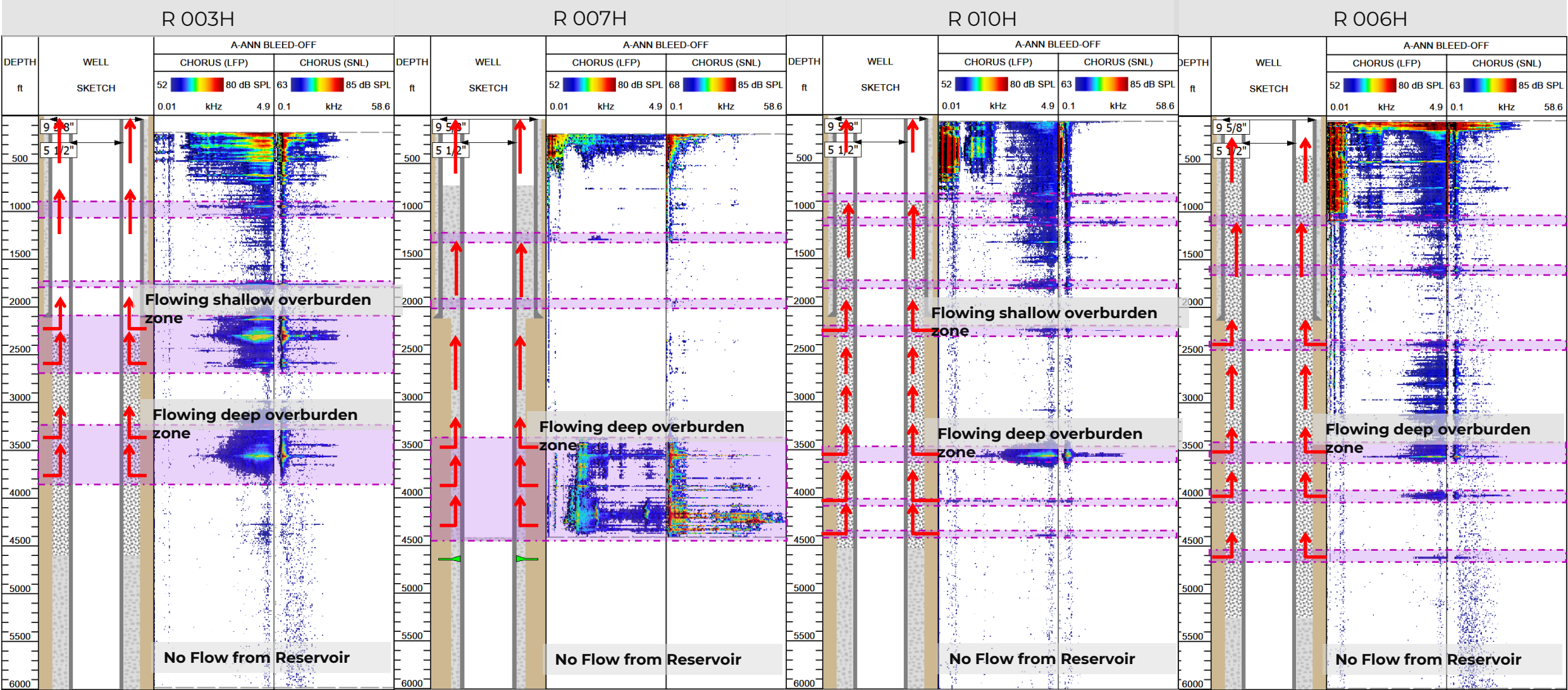
Flow Potential of Formations in “New” Gas Storage Well (>10 year old store)



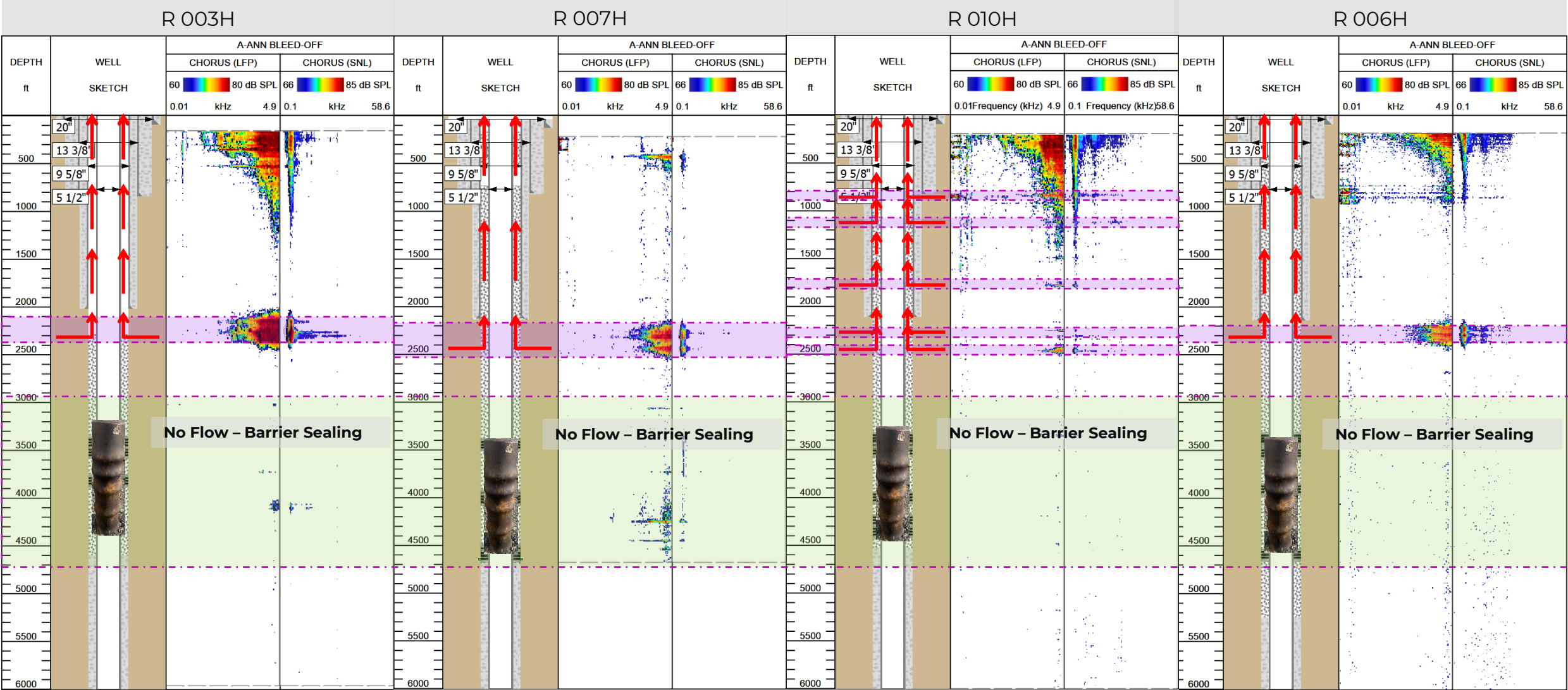
Evaluating Flow from Reservoir & Overburden Units



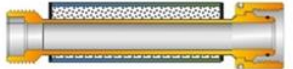
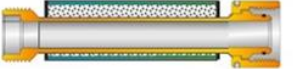
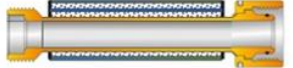
Finding Unwanted Flow Behind Pipe



Fixing Unwanted Flow Behind Pipe and Confirming Isolation

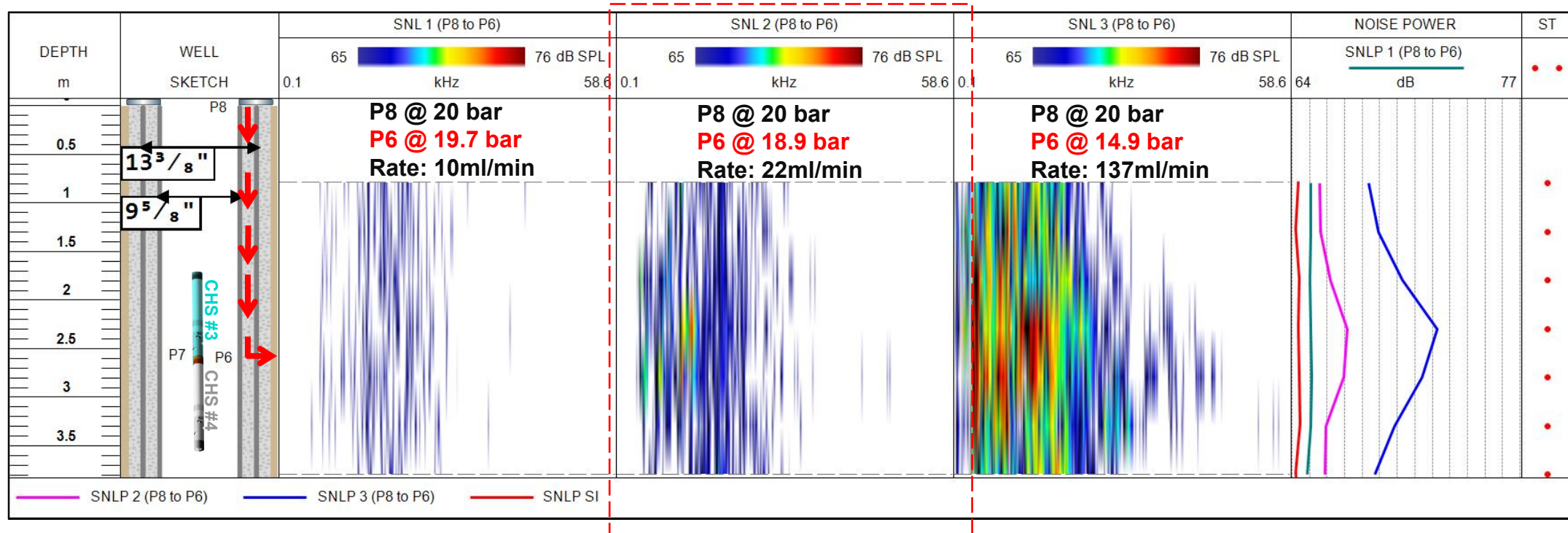


Verifying WBE Material for CO2 Isolation

No cement • 7" tubing + 9 5/8 casing • Tubing eccentricity: 10.4mm (9.6%)	 Test Section Length: 284cm Make-up Length: 330cm	
Cemented - free of defects • 7" tubing + 9 5/8 casing • Tubing eccentricity: 10.4mm (9.6%) • Class G cement (expanding), 1.92 s.g.	 Test Section Length: 148cm Make-up Length: 187cm	
Cemented - microannulus • 7" tubing + 9 5/8 casing • Effective micro-annulus: 56µm • Tubing eccentricity: 10.4mm (9.6%) • Class G cement (regular), 1.92 s.g.	 Test Section Length: 172cm Make-up Length: 263cm	
Cemented - hole mid cement • 7" tubing + 9 5/8 casing • 5 mm axial hole • Tubing eccentricity: 10.4mm (9.6%) • Class G cement (expanding), 1.92 s.g. • Sealed control lines	 Test Section Length: 150cm Make-up Length: 180cm	



Qualifying Technologies to Evaluate Leakage



Cement sealing failure
identified at **22 mL/min**
leak rate

*IADC/SPE-194075-MS

Barrier Verification during Plug and Abandonment Using Spectral
Noise Logging Technology, Reference Cells Yard Test





Summary

- Reducing Cost of Storage;

Rigless approach & Use of legacy wells

Through-barrier integrity and flow diagnostics, compatible in Gas

- Qualifying suitability of Legacy Wells
- Investigate and monitor flow between formation and overburden
- Monitoring corrosion and flow conformance (target and out of zone injection) of active wells



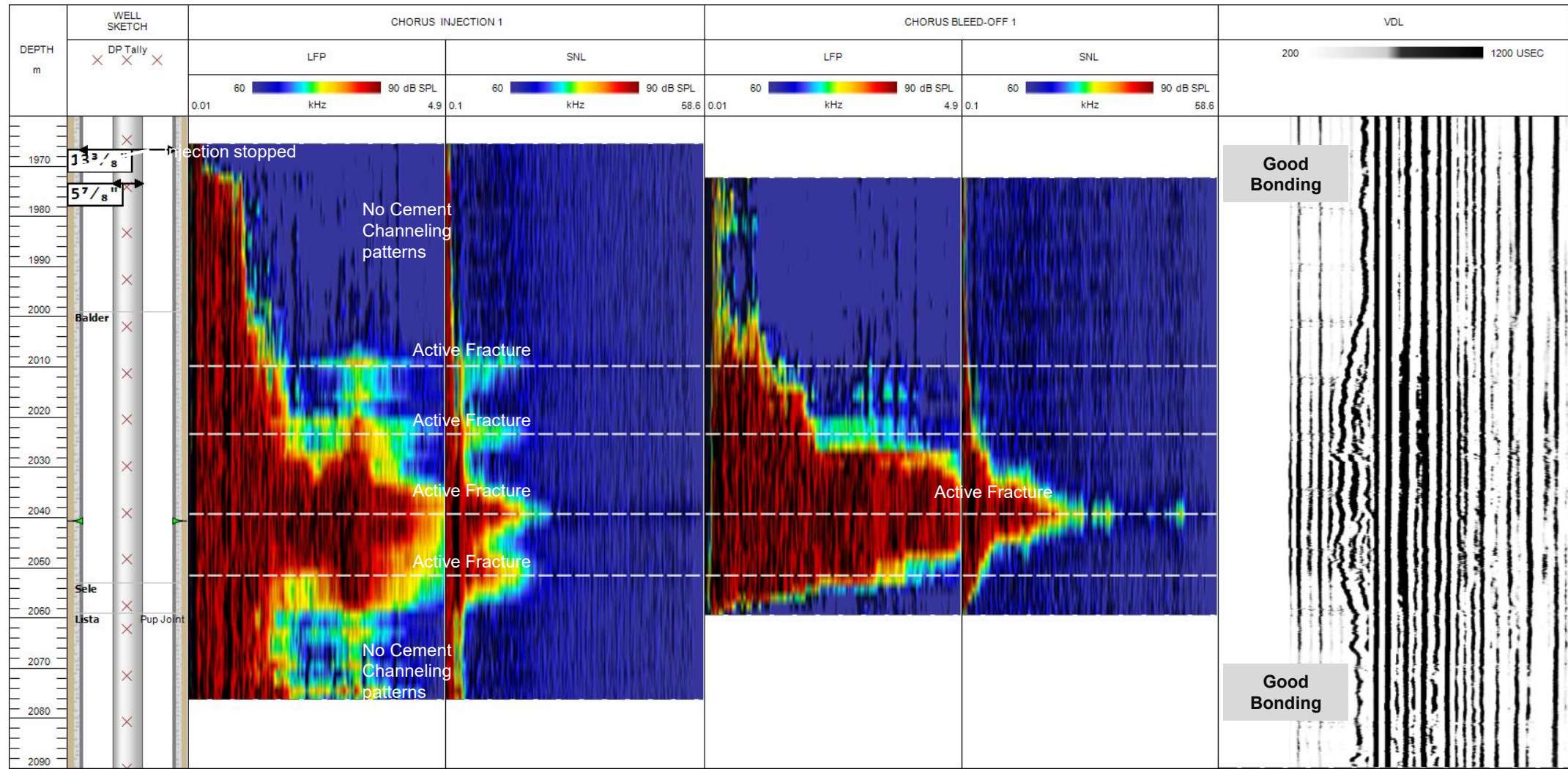




Barrier verification



Chorus Data – during XLOT



Verifying the cement barrier through tubing

