



A New Generation of Well Integrity Evaluation Software

How is the next generation motivated by oil industry of 2015 in CEE region

Conference

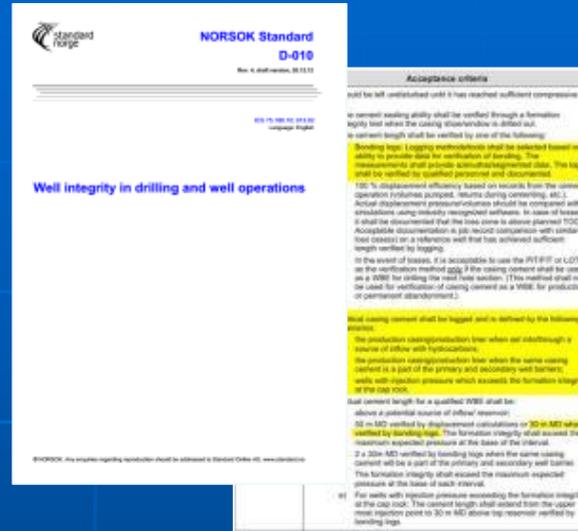
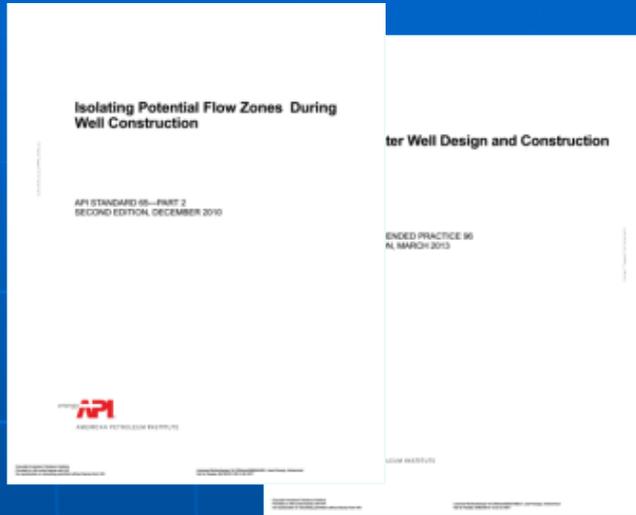
Suleyman Sari, Schlumberger
Visegrád, 19 November 2015

Society of Petroleum Engineers

Agenda

- Challenges in Well Integrity Evaluation
- Cement Barrier Verification
- Integrated Cement Evaluation Workflow (INVIZION)
 - Case Studies
 - Reports & Deliverables
- Benefits & Conclusion
- Q&A

Increased Focus on Well Integrity



Statewide Rule 13

New Requirements in SWR 13
Example Formation Table

Mitchell County		Shallow Top	Deep Top	Remarks
All listed formations require isolation if encountered in well	Santa Rosa	600	600	possible lost circulation overpressured, possible flows
	Yates	600	1,250	
	7 Rivers	1,300	1,300	high flows, H2S, erosive
	Tubb	2,000	2,000	
	San Andres	1,500	2,400	possible lost circulation
	Golieth	2,400	2,700	
	Wichita	3,300	3,300	
	Clearfork	2,500	3,400	
	Coleman Junction	3,100	3,600	
	Wolfcamp	4,800	5,300	
Strawn	3,200	5,850		
Oden	6,800	6,900		
Mississippian	6,300	7,900		
Elerburger	7,200	8,100		

API Standard 65 – part 2

- Industry accepted design & execution minimum requirement and recommended practices
 - Job QA/QC and Execute as per design
 - Objectives met Y/N.

API RP 96 – Deepwater Well Design & Construction

- Cemented riserless casing string to support well

NORSOK D-010

- Casing cement shall be verified to ensure a vertical and horizontal seal.
- Cumulative interval with acceptable bonding is required to act as a permanent external WBE.
- All cumulative intervals shall have formation integrity. Minimum accepted bonding interval length defined.

Railroad Commission of Texas

- Rule 13 Key provisions for logging
- Requires TOC over all productive/corrosive zones
- now defined by area

Challenges in Well Integrity

- Industry Drivers for Well Integrity
 - General Safety & Regulations: From “should do” to “must do”
 - Increased challenges during Well construction



- Avoid zonal communications
- Cross depleted zones (and/or face lost Circulation)
- Cover Salt zones
- Avoid APB/SCP

Well complexity requires

- Advanced planning
- Multidisciplinary team
- Cross Domain Data
- Reliable software platforms
- A new generation of well integrity evaluation



Cement Barrier Verification

Current Methods:

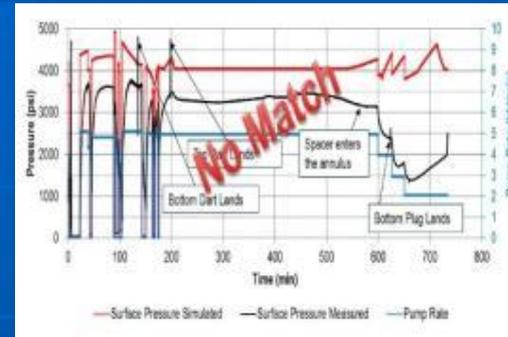
- Pressure Testing
- Inflow test/negative pressure test
- Pressure matching
- Monitoring returns to surface
- Temperature log
- Tagging (cement plugs)
- Sonic & Ultrasonic logs

What about other wellbore data?

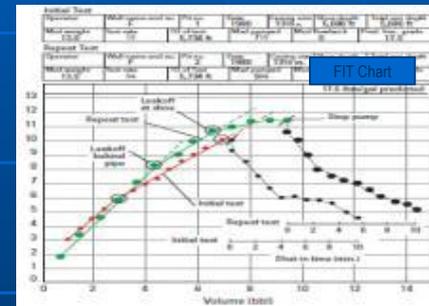
- Open hole logs: GR, caliper, survey, resistivity, etc
- Pore/frac gradients
- Formation tops, rock types, fractures zones

What if:

We could increase assurance of Cement Evaluation process by using all available operational elements to bring full a Well Integrity picture?

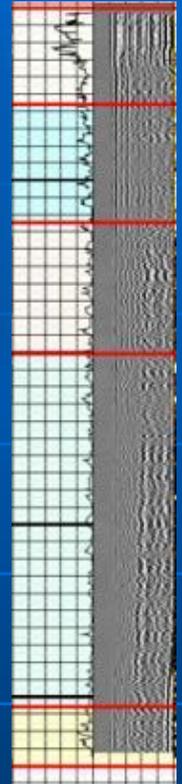


Was job executed as planned?



FIT passed or not?

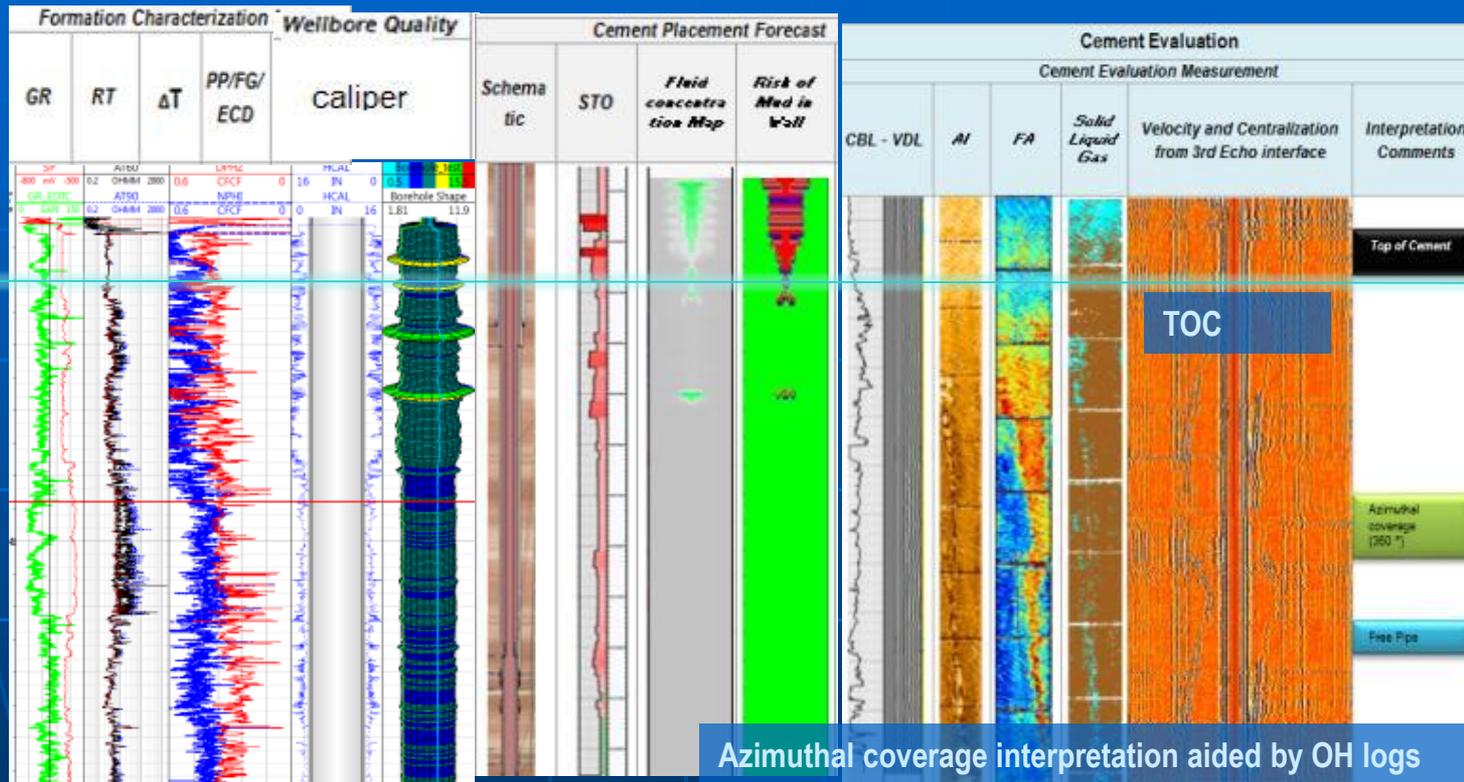
Does bond log indicate sufficient isolation?



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Integrated Cement Evaluation Workflow



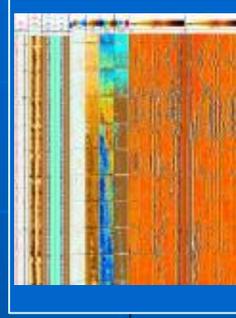
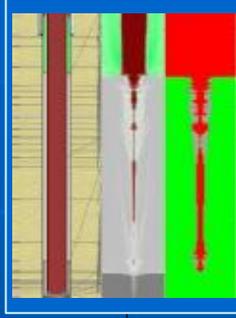
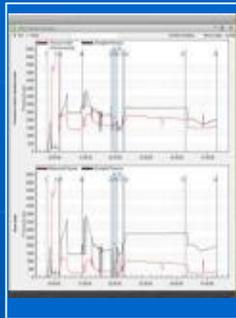
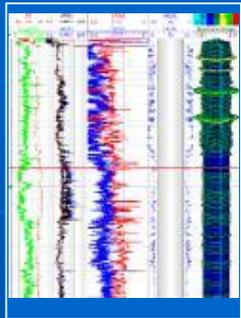
ANALYZE

FORECAST

MEASURE

Objectives, formation characterization, drilling, cement placement, acoustic logs: Now we can correlate and **Deliver interpretation with high degree of confidence (post job or while drilling)**

Integrated Cement Evaluation Workflow



Measurements

Operational

Simulated

Measurements

Interpretation

Recommendations
and Lessons
Learned

Wellbore Quality

Barrier Placement

Fluids Placement
Forecast

Cement Evaluation
logs

Integrated
Analysis

Objectives, Formation characterization, Drilling: What the hole is telling us?

Cement placement? Operational Events analysis
How is your barrier placed?
TOC based on Hydraulics.

Simulate annular fluid placement based on job acquired data.

Correlates all logs and fluid placement forecast.
TOC and vertical/horizontal seal interpretation

Increases Interpretation confidence by using all available elements to qualify WBE

Achieve Well Integrity objectives.
What is the real reason behind APB/SCP?
Improve investors' confidence

Schlumberger Private

Case Study Alaska - Optimize Drilling Operations

Challenge

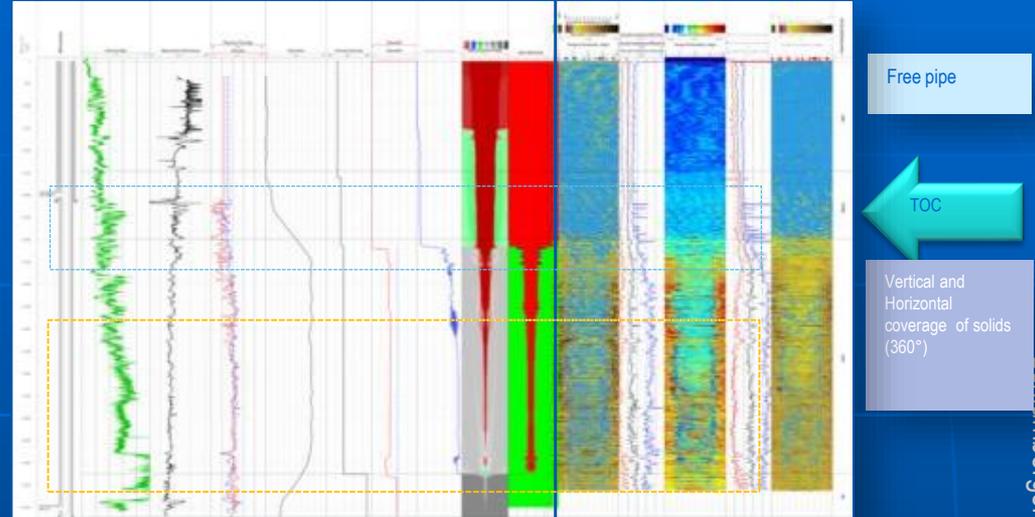
- Determine TOC and minimize rig waiting time. Low temperature around TOC.
- Small density contrast between fluids

Solution

- Use Invizion Evaluation workflow to predict TOC.
- Provide optimal time to log based considering contamination at TOL.
- Use ultrasonic wireline logging differentiate all solids behind casing.

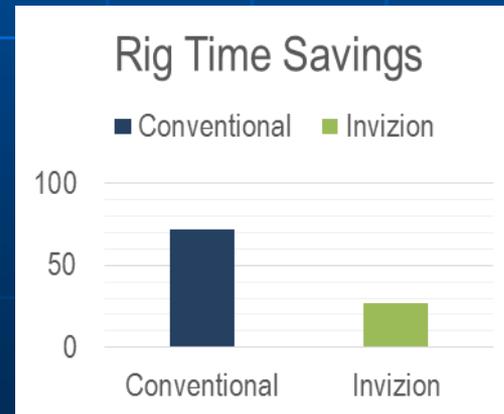
Result

- Logged the well 27 hrs. after cement job (typically 42 to 72+ hrs.)
- Saved ~15-45+ hours in WOC rig costs.



Completion- GR – Resistivity - Deviation-Fluid placement forecast simulation-USIT and IBC Cement evaluation logs

Mud: 10.4 ppg
Spacer: 11.0 ppg
Lead Slurry: 11.4 ppg



Case Study NAL – Channels Identification

Challenge

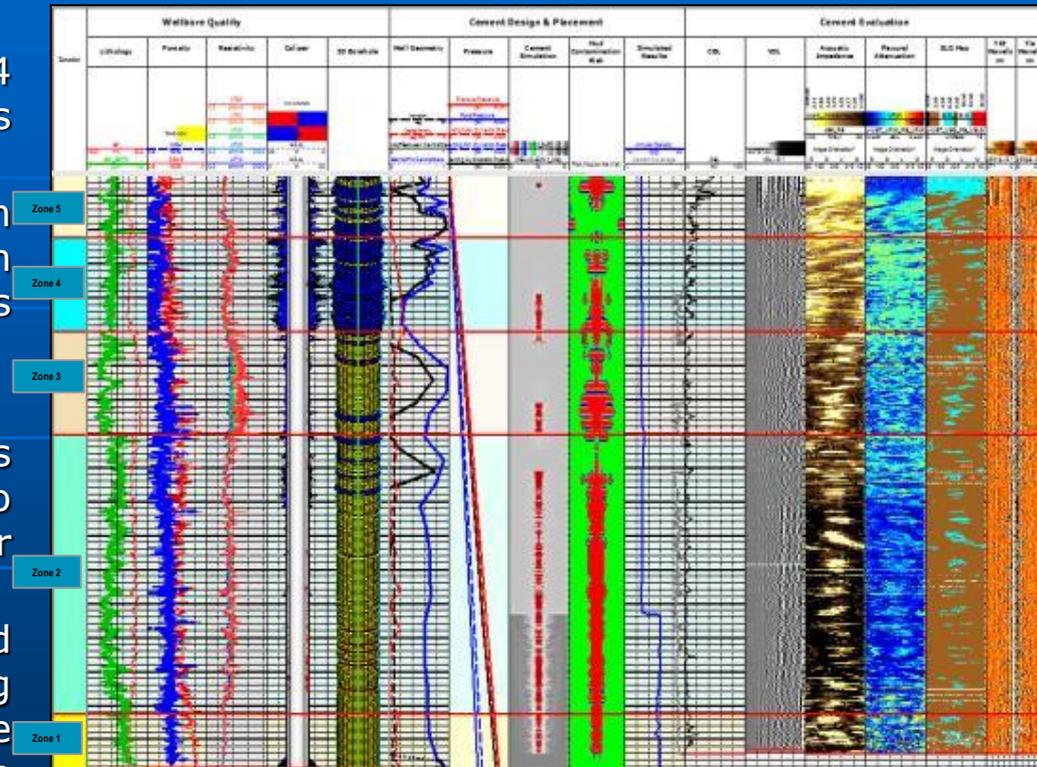
- Properly isolate gas bearing zone.

Solution

- Layout was generated within 4 hours of the Isolation Scanner logs being processed.
- Cementing placement information and OH logs already displayed in the same layout hence Top of solids was easily identified.

Result

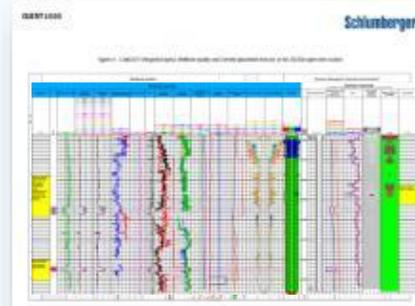
- Using high resolution IBC and cross domain expertise, it was possible to interpret a post placement water channel on the annular wide side
- Possible to interpret the lead and tail cement slurries transition along channels forecasted in the cementing predictive model of the workflow.
- No gas was observed in the string.
- Best practices for future cement job design and placement were used for future strings.



Deliverables – Integrated Evaluation Reports

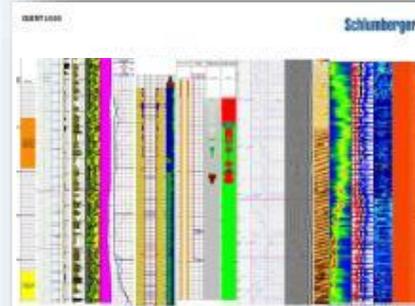
CemCAST – Cementing Placement Forecast

- Correlates basic real-time logs, hole shape, cementing simulation
- Fluids forecast when no acoustic logs are run



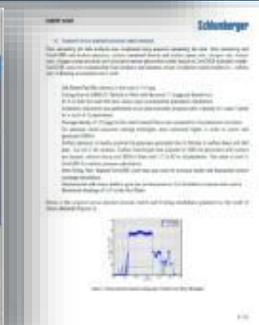
Invizion Integrated Cement Evaluation

- Can be started in advance and rapidly updated based on RT data
- TOC and Azimuthal Barrier verification compliance answer
- Assurance via patented and X Domain data correlation



Well Integrity Invizion Report:

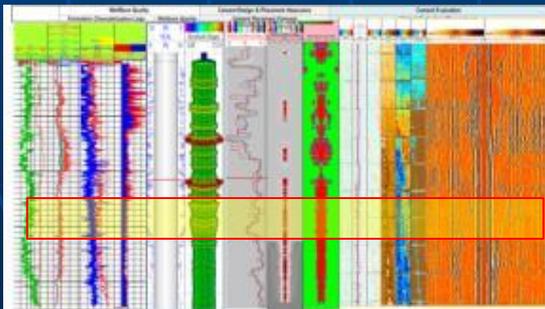
- Time bounded - Standard Template
- TOC validated from pressure matching
- Integrated Layout
- X-Domain interpretation from Petro technical Experts`



Evidence all available data relevant to zonal isolation has been used to comply with Cement Element Acceptance Criteria requirements
Well Integrity Data storage and retrieval at will even years after the well is drilled

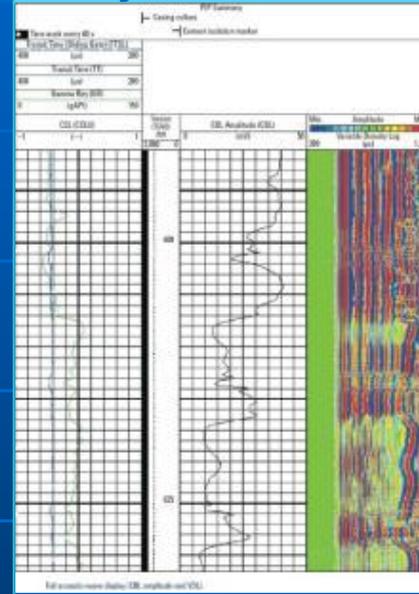
Conclusion

- Increased assurance on Cement Well Barrier Element qualification
- Regulatory compliance
- Design optimization from lessons learned
- Standardization and efficiency
- Accessible Well Integrity file
- The next generation of oilfield well integrity evaluation platform.

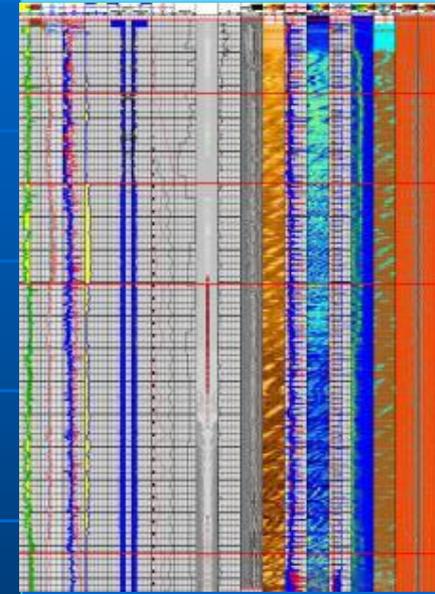


Underground risk characterisation

Today



Future



Improved confidence

Well Integrity Evaluation

Questions?