Well Design:
Improving Well Integrity
Solving the Challenge of Sustained Casing Pressure

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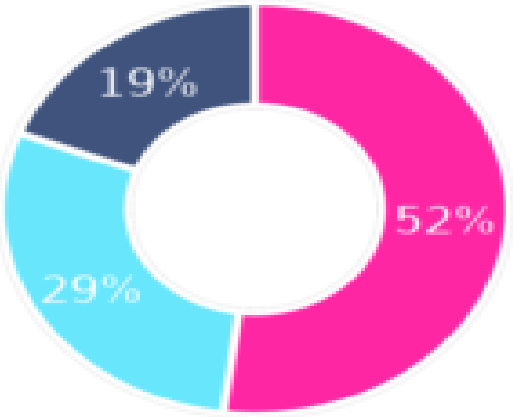
Welltec®

We Know the Problem

Cement failure is a common cause of barrier failure

- Cement failures are well understood and have many causes
  - Poor job execution, channelling, micro annulus, thermal or hydraulic shock, contamination, poor sealing to casing and / or to formation etc.
- There are many documented reports with frequency of occurrence
  - e.g. 96 cement operations reviewed where the objective was to establish a min of 200m hydraulic isolation

Overview Cement bond results



Findings:

- Barrier verification in half of the cement jobs fails!!

Need:

- Improved methods for cementing and barrier verification

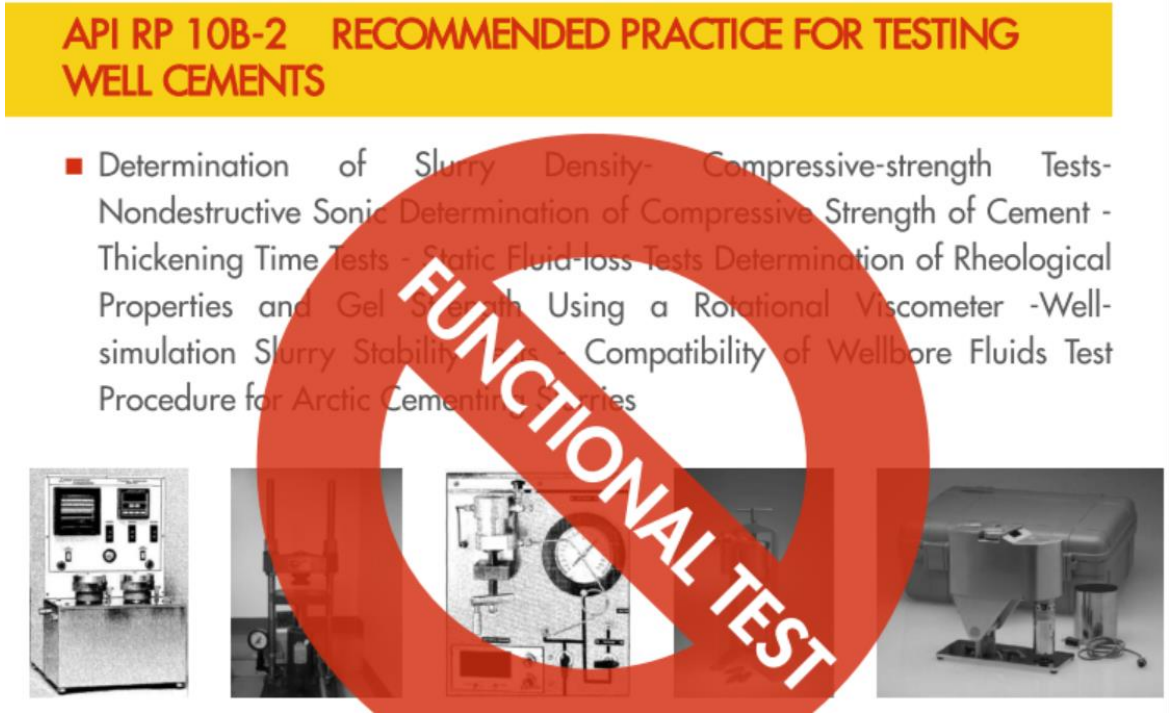
Exellent + Acceptable bond

Insuffficient bond - Operational challenges

Insufficient bond - Other challenges

Do we Know the Limitations?

- Cement has only recently been exposed to functional testing – evaluation of seal integrity
- Ref 3rd Annual Well Integrity Cong 1st July 2015 Uk

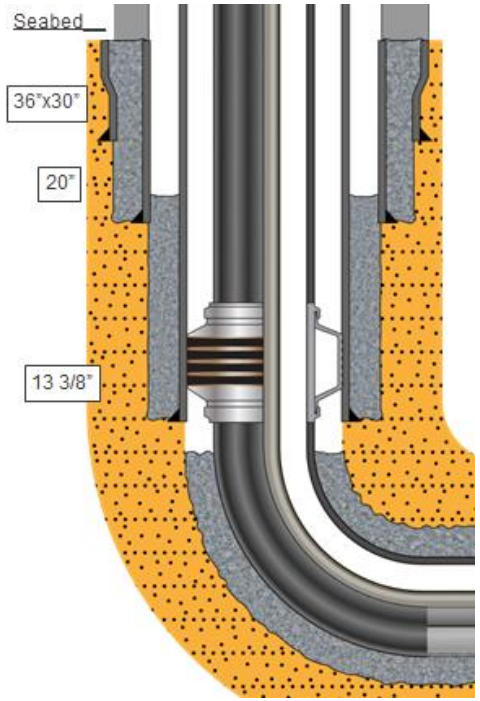


- Functionally test cement under controlled downhole conditions to evaluate cement within the annulus and cement as a cement plug
  - Is there a relationship between strength and sealing capability?
  - Is there a relationship between shear bond and sealing capability?
  - Is there a relationship between hydraulic bond sealing capability?
  - Is there a relationship between ~~shrinkage~~ Volumetric change and sealing capability?
  - Ultimately the sum of these parameters is measured in a functional test
  - Downside functional test is difficult and costly
- Cement alone s not adequate to met the industry needs
- Combined solutions will deliver improved well integrity

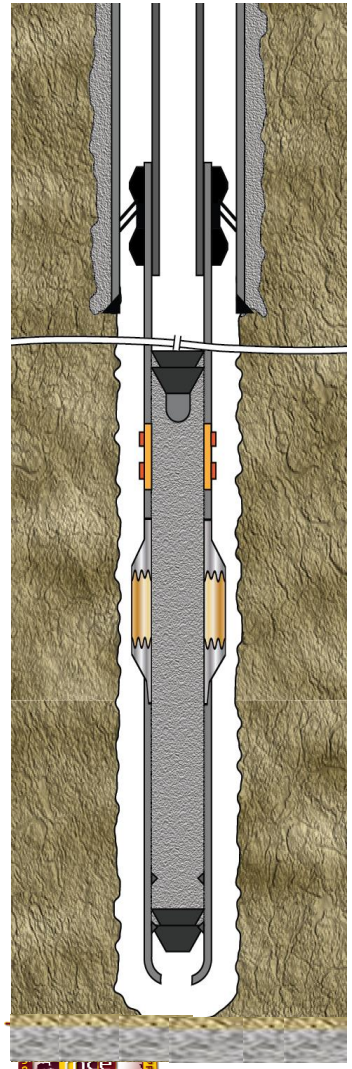
Improving Integrity

- Subsurface challenges and limited ECD windows requiring multiple casing strings
- Failure of primary cement jobs resulting in squeeze jobs or sidetracks (channeling, contamination, centralization, cross flow etc)
- Micro-annuli due to pressure and temperature cycling with subsequent migration of gas
- Life of field reliability due to gas migration in nearby wells, subsidence and anti-collision requirements
- Verification and independence of barrier elements

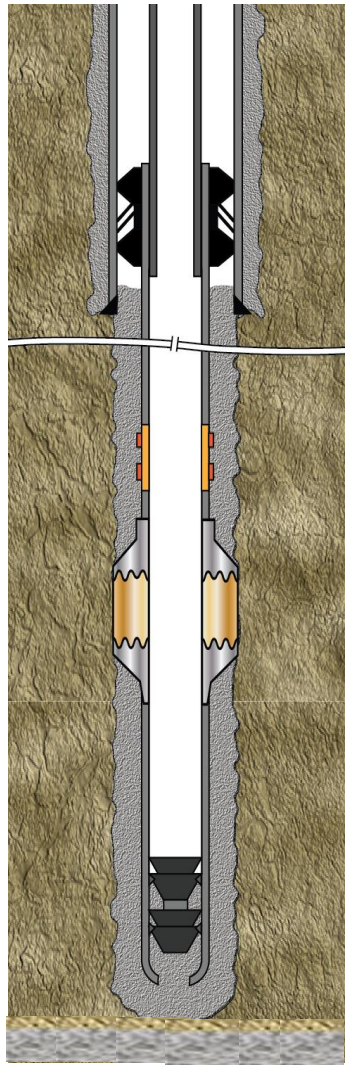
- ISO 14310 Qualified metal expandable well barrier, compliments or substitutes cement
- Delivers B (or C) Annulus protection
  - Positioned within the open hole below the 9 5/8” casing OR
  - Positioned within the 13 3/8” casing above top of cement
- Position above and below future side track depth
- Positioned deeper than the well abandonment depth

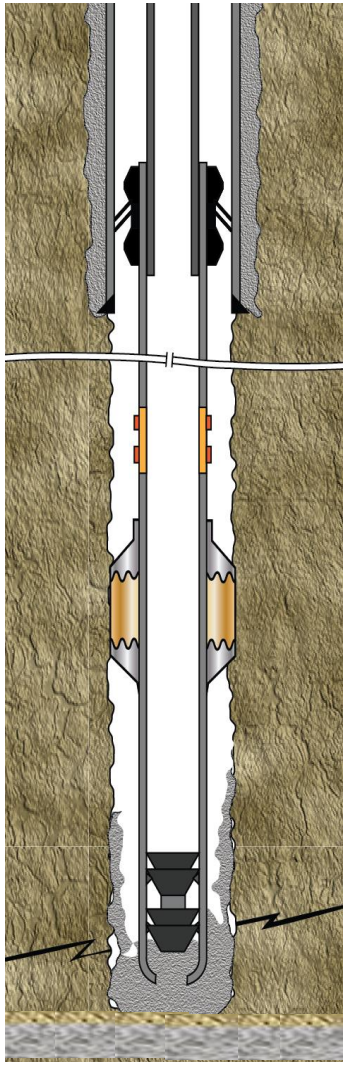


Securing the Primary Barrier

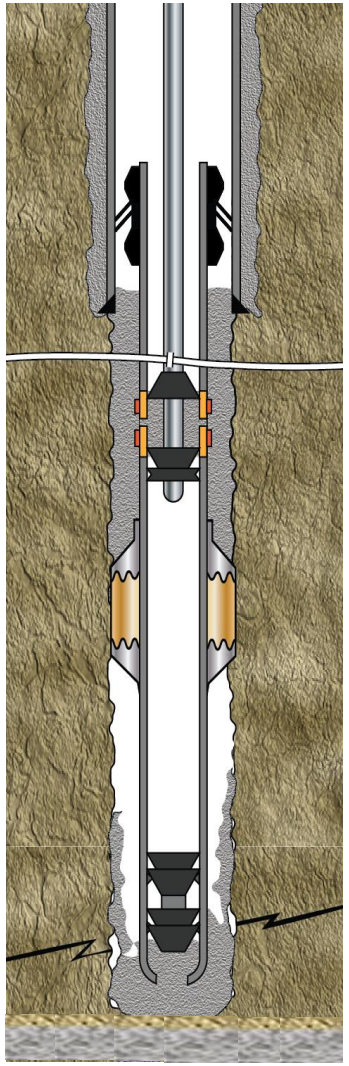


- Pick up 9 5/8” liner with WAB and Port Collar.
- Run liner, rotating and circulating as required
- Set liner hanger, Pump cement, Bump plug
- Pressure up and expand WAB in wet cement
- Set top packer
- Evaluate primary cement barrier (records, CBL etc).
- Pressure test shoe, if good, drill ahead.

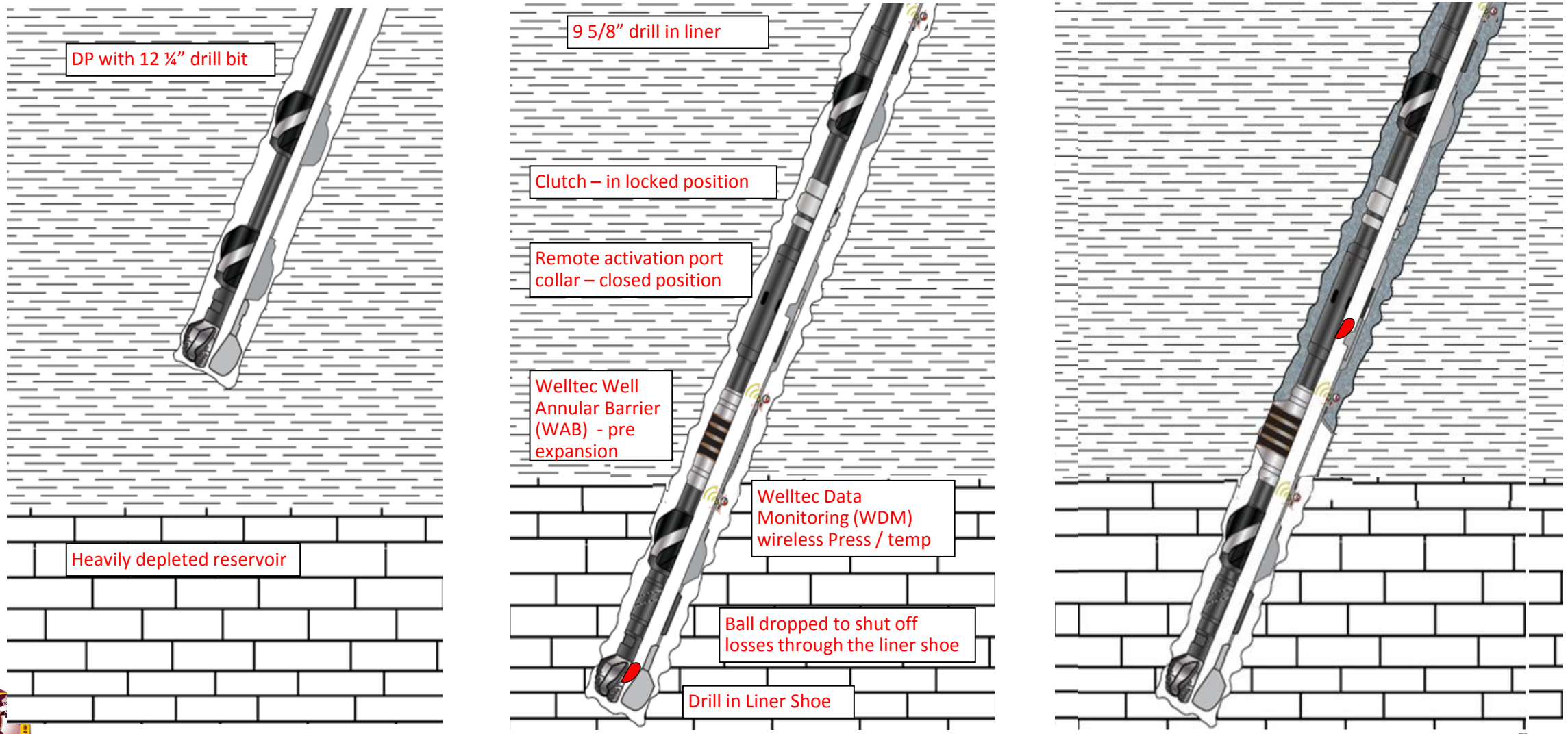




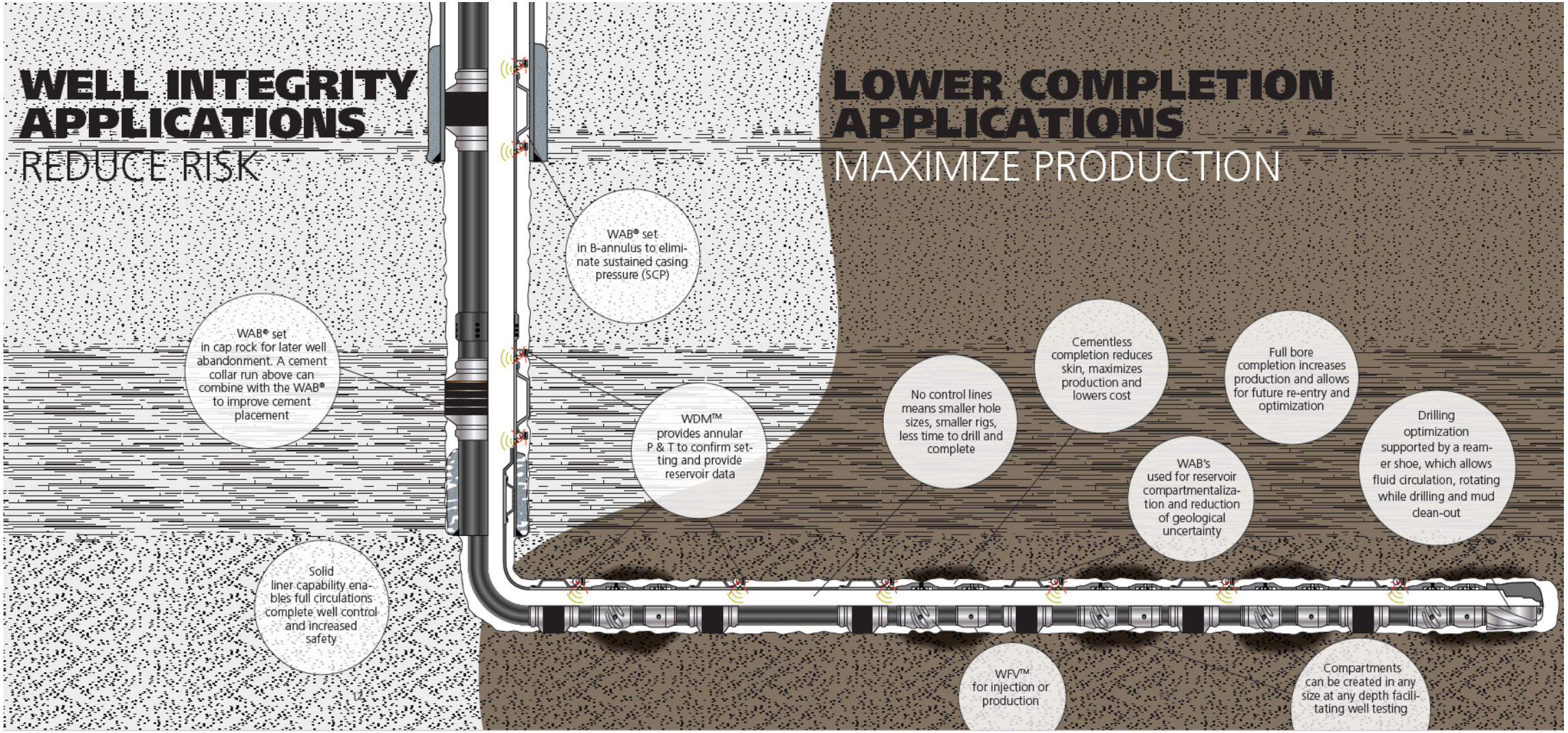
- Log evaluation indicates poor cement and the cement barrier has not been established
- Perform second stage cement tool operation.



Drilling Into a Depleted Zone



Questions?


WELL INTEGRITY APPLICATIONS
REDUCE RISK
WAB® set in B-annulus to eliminate sustained casing pressure (SCP)
WAB® set in cap rock for later well abandonment. A cement collar run above can combine with the WAB® to improve cement placement
WDM™ provides annular P & T to confirm setting and provide reservoir data
Solid liner capability enables full circulations complete well control and increased safety
LOWER COMPLETION APPLICATIONS
MAXIMIZE PRODUCTION
No control lines means smaller hole sizes, smaller rigs, less time to drill and complete
Cementless completion reduces skin, maximizes production and lowers cost
Full bore completion increases production and allows for future re-entry and optimization
WAB's used for reservoir compartmentalization and reduction of geological uncertainty
Drilling optimization supported by a reamer shoe, which allows fluid circulation, rotating while drilling and mud clean-out
WFV™ for injection or production
Compartments can be created in any size at any depth facilitating well testing