MONITORING THE INTEGRITY OF DEEP WATER WELLS BEHIND CASING

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SMI and MI@NUS workshop

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Some Common Issues

Casing corrosion

- due to exposure to corrosive material, e.g. H_2S

Casing deformation

- due to formation stress

Cement degradation

Channelling

- channels forming behind cement or within cement

Leakage

- due to channelling or other poor bonding

Barite settlement

- from drilling mud

Consequences

Blowout

Casing collapse or sheared off

Environmental damage from leakage

contamination of ground water or soils

Production disruption

Human, environmental, and financial costs can be very significant

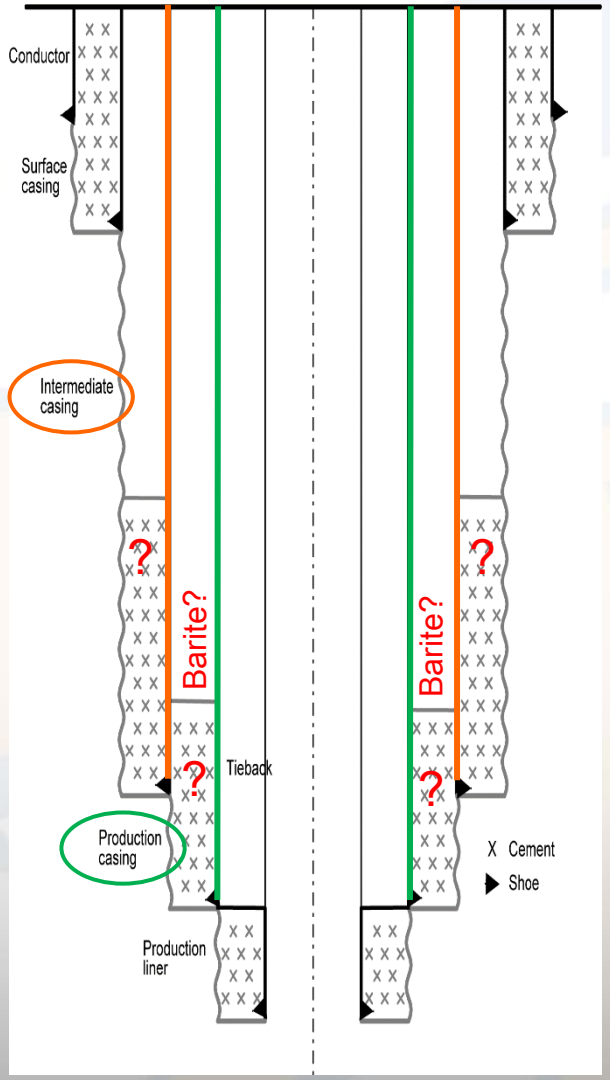
US Coast Guard Image

Plug and Abandonment

Estimated over 25,000 wells needs to be P/A over the next decade

Need to know:

- cement condition behind production casing
- possible barite settlement instead of cement
- cement condition behind intermediate casing



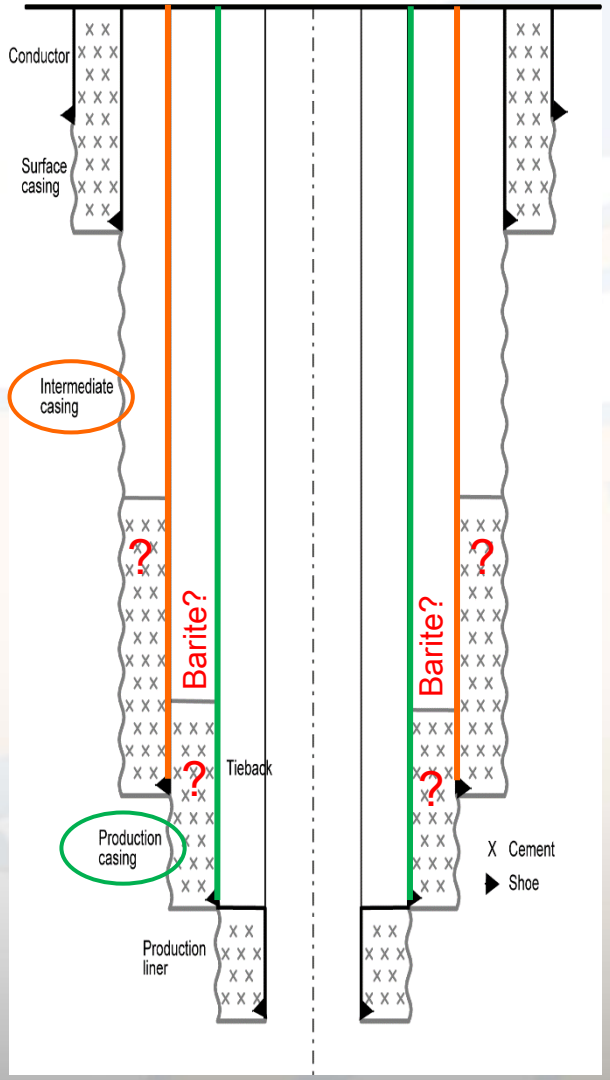
From PetroWiki.org

Plug and Abandonment

Currently it is necessary to pull production casing in order to evaluate cement behind intermediate casing

Deep water operations can cost USD 1M per day

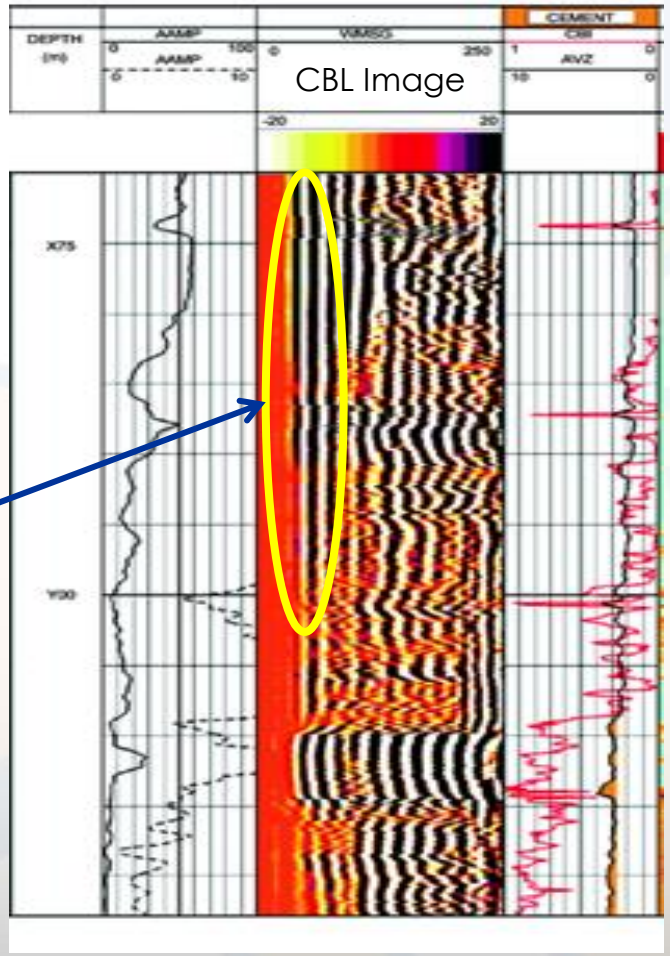
The ability to image behind two casing strings (i.e. evaluate cement behind intermediate casing without pulling production casing) saves significant time, thus cost



From PetroWiki.org

Cement Evaluation – Current Status

Current Cement Bond Log lacks resolution and gives only qualitative results (attenuation, bond quality) with limited azimuthal resolution

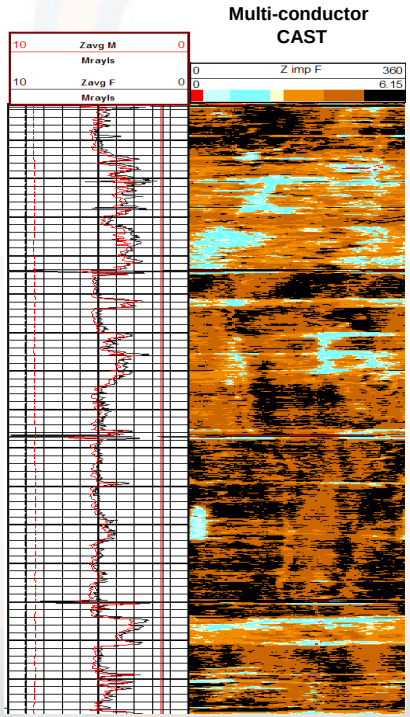


Courtesy Halliburton

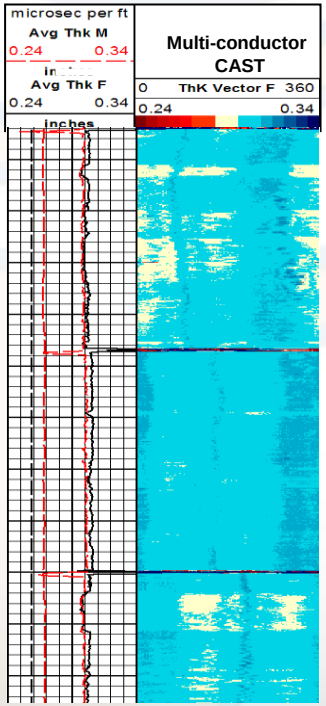
Cement Evaluation – Current Status

Ultrasonic pulse-echo tools provide image and approximate impedance at the casing/cement interface, as well as casing thickness, with 360° azimuthal resolution

Ultrasonic tool CAST™



Impedance Image



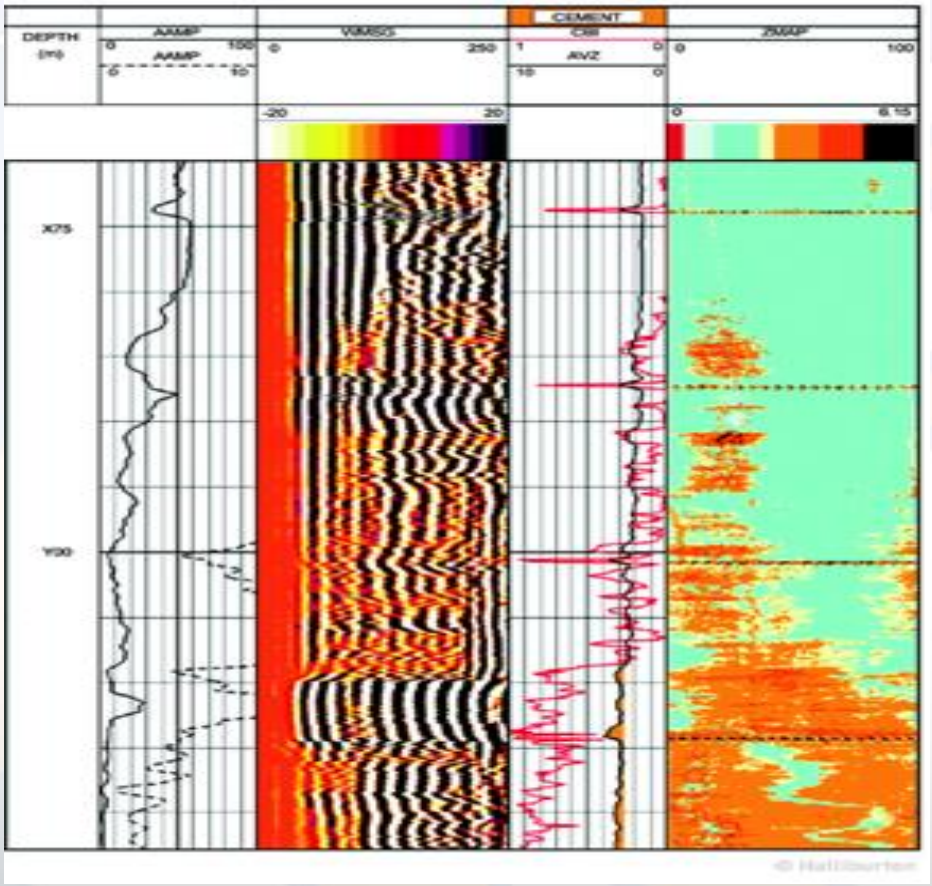
Thickness Image

Courtesy Halliburton

Cement Evaluation – Current Status

Combining CBL with ultrasonic impedance image allows for better interpretation

Need higher resolution image within the cement for detection of voids and channels



CBL Image

Impedance Image

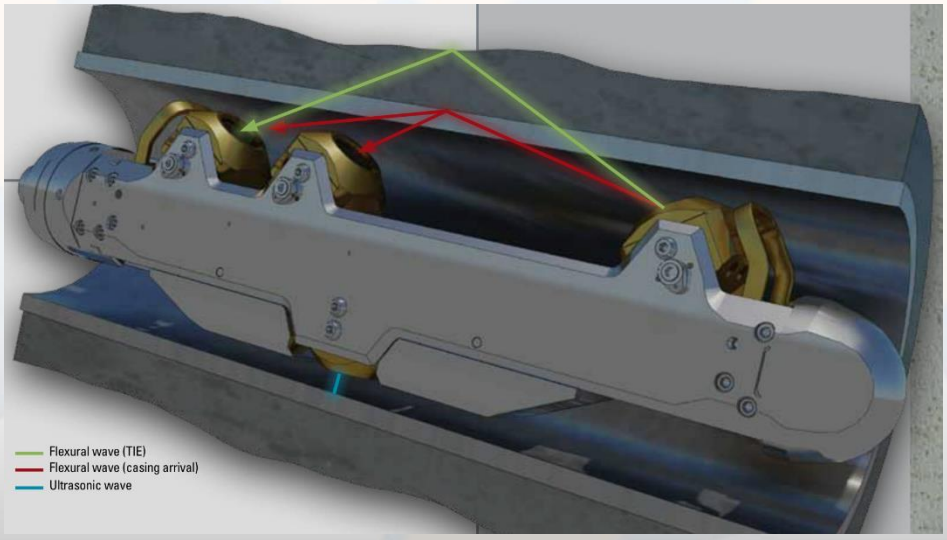
Courtesy Halliburton

Cement Evaluation – Current Status

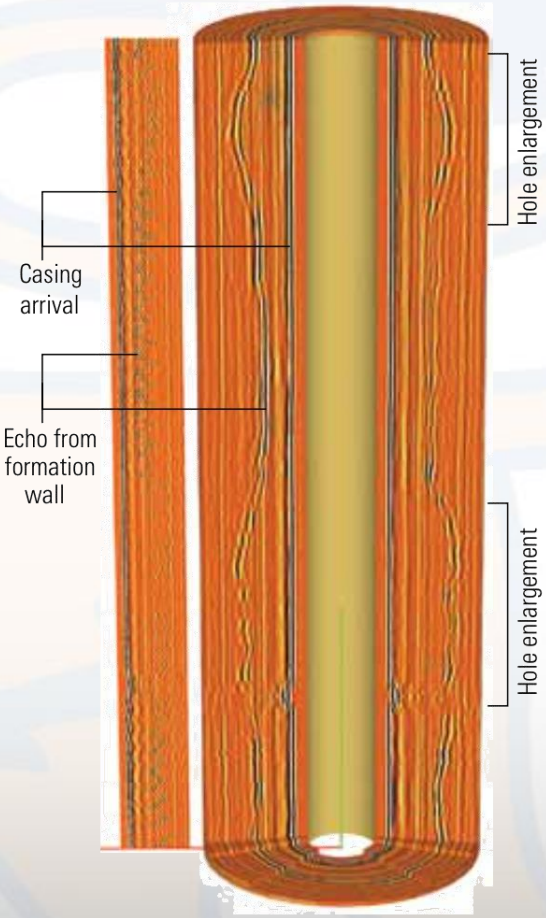
Ultrasonic propagation tool produces waveforms which can be constructed as a 3D image for interpretation

Example: Schlumberger Isolation Scanner™

Challenge: seeing behind second casing string



Isolation Scanner™



Waveform Image from Schlumberger

Some Future Directions

"Smart" Cement

additives to change cement into piezoelectric material

(Vipulanandan, OTC, 2014)

Chip in Cement

microchips to measure various properties of cement

Fibre optic cable

embedded fibre optic cable to measure pressure and temperature changes, as well as possible communications link from embedded sensors to the surface

These do not address the issue of existing wells

We need to develop technology to properly evaluate the integrity of cement and casing in existing wells, starting by understand the proper measurement physics needed

THANK YOU