

HALLIBURTON

Advanced Cement Evaluation

CAST-M Circumferential Acoustic Scanning Tool

Client: WPX Energy
Well: State of Colorado KP 422-9
Field: Kokopelli
County: Garfield
State: CO

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DATA, RECOMMENDATIONS, INTERPRETATIONS LIMITATIONS

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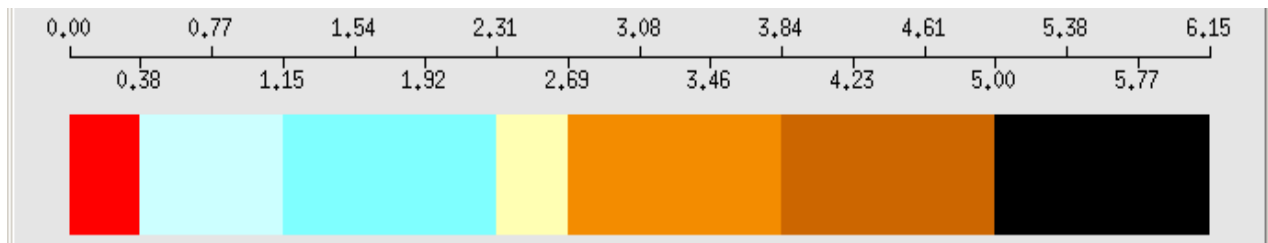
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Executive Summary

1. ACE Technology

CAST-M stands for Circumferential Acoustic Scanner Tool – Monocable. It uses a single rotating transducer that operates in the ultrasonic frequencies. It measures the impedance of material directly behind casing, and therefore can accurately describe the casing to cement bond quality. Even in low weight cement, it can differentiate between bonded pipe and fluid behind pipe by observing the statistical variability of the measured impedance. Water or mud behind pipe will have very low variability in the impedance measurement, while cement, regardless of the weight, will have significantly more variability.

Circumferential Acoustic Scanning Tool (CAST) impedance values for fluids are very consistent and manifest as a straight line on the log. Cement slurries, are more variable and show up as curves with much more activity or variability. By analyzing the value and the character of the impedance curves, it is possible to successfully evaluate the cement quality of conventional and lightweight cements. Typical impedance values for common materials or fluids are:



Gas or air	<0.38	high activity curve response
Fluid	0.38-2.31	flat consistent curve response
Drilling Mud	1.5 – 3	flat consistent curve response
Lightweight Cements	<1 – 6	high activity curve response
Conventional Cements	2 – 6	med to high activity curve response – slurry dependent

As shown in figure 1, for the rotating scanner to receive the reflected signal back from the casing, the tool must be well centralized.

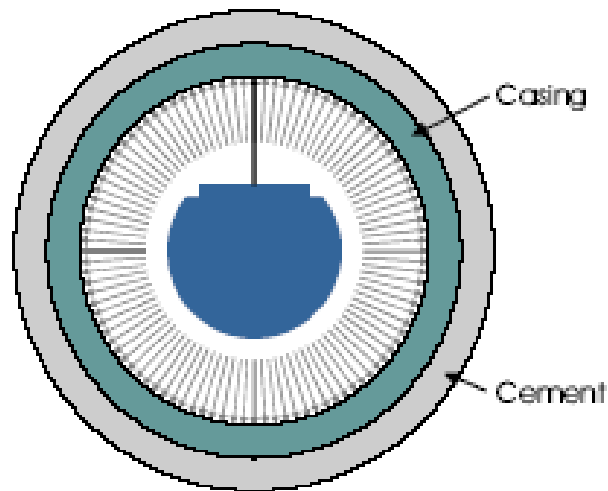


Figure 1

If the tool is not properly centralized, the impedance values in the long axis to be lower than those in the short axis, and in extreme cases, the transmitted signal will not return to the transducer as shown in figure 2. This will result in readings of zero impedance and resulting in what would appear to be channeling in the image, and in extreme cases. The acceptable value for eccentricization for the CAST-M tool is < 0.2 inch.

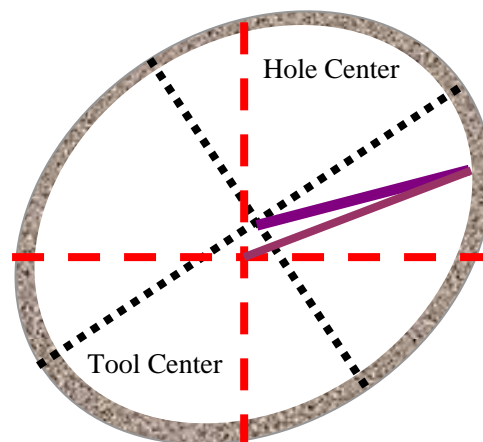


Figure 2

Halliburton's patented ACE processing examines the variability as well as the value of the impedances broken out in 9 different segments around the wellbore as shown in figure 3.

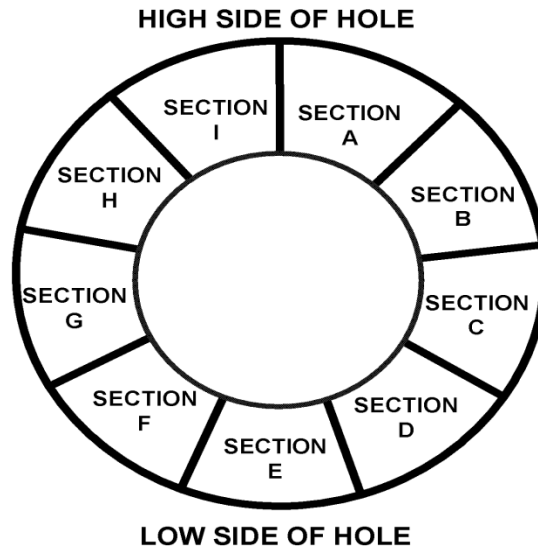


Figure 3

3. Well Intervention Objectives

- Ran Advanced Cement Evaluation
Tools: CASTM-CBL-GR-CCL

4. Well Information

- Borehole Record

BIT	Depth
13.5"	0'-959'
8.75"	959'-6156'
- Casing /Weight & Depth Record

Casing	Depth
9.625" 32.3#	0'-959'
5.5" 17#	0'-6156'

5. Logging Information

- Logged Date: August 31, 2014
- Logged Interval: 100'-6065'
- Log Engineer: Denis Solis

6. Conclusion

Advanced Cement Evaluation:

State of Colorado KP 422-9 was cemented with a light weight lead and conventional tail. Beginning at the bottom of the log two zones from 6020'-5940' and 5865'-5800' appear to be poorly bonded (Figure 4). However, the sections between the two zones and above 5800' appear to have well bonded cement up to 5600'. At 5600' channels appear and continue up to 5400' (Figure 5). From 5400' to about 4130' cement bond appears to be good but at 4130' channels become apparent again and can be seen up to 3670'. From 3670'-3150' the CAST image indicates decent cement to casing bond. From 3150'-2600' cement bond becomes progressively worse and from 2600' to 1400' cement bond is patchy at best. From 1400'-100' while impedances are higher CBL amplitudes are very strong indicating low density material, probably fluid in the annulus.

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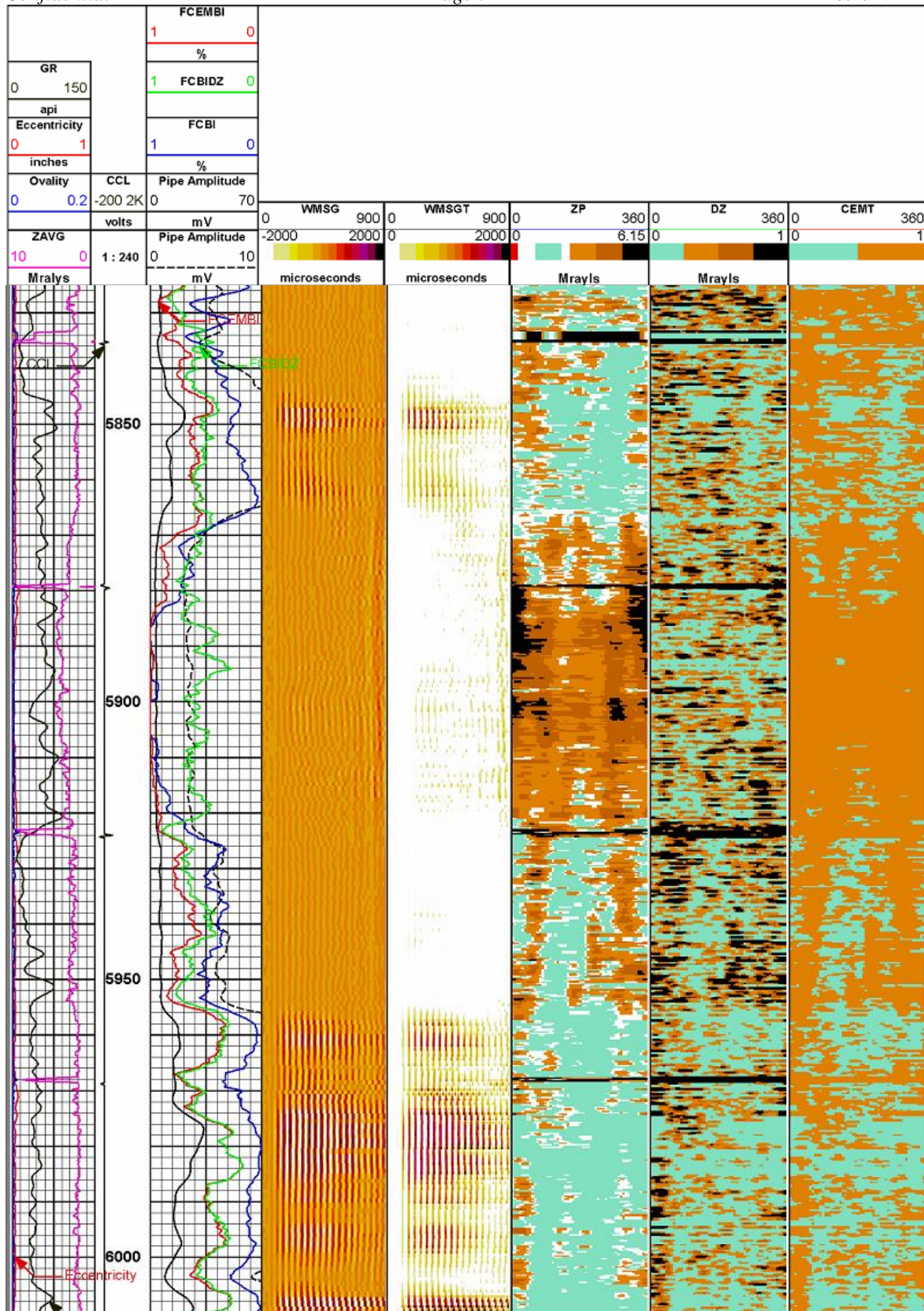


Figure 4: Poor bond form 6020'-5940' and 5865'-5800'.

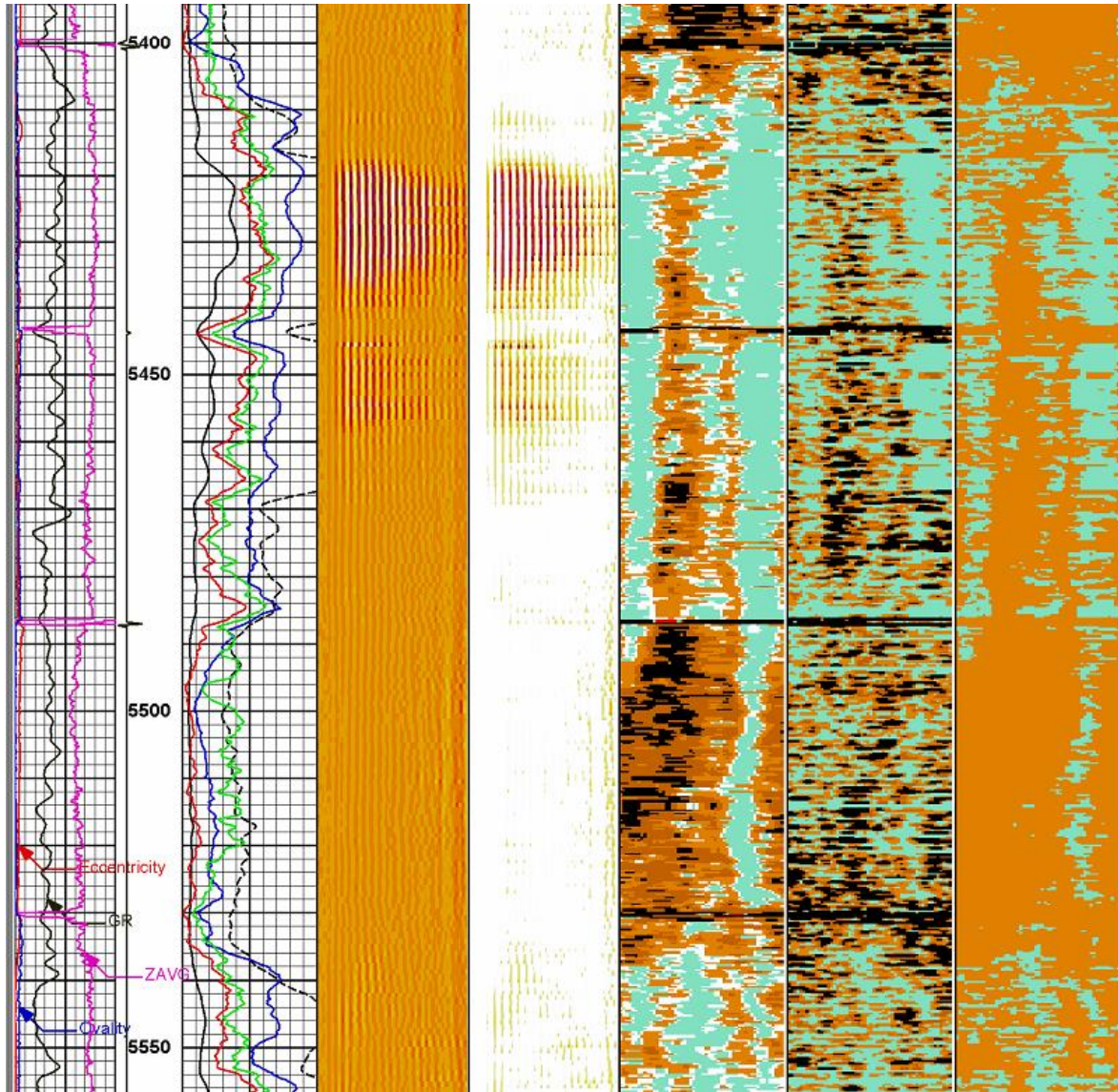


Figure 5: Channeled cement from 5600'-5400'.

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