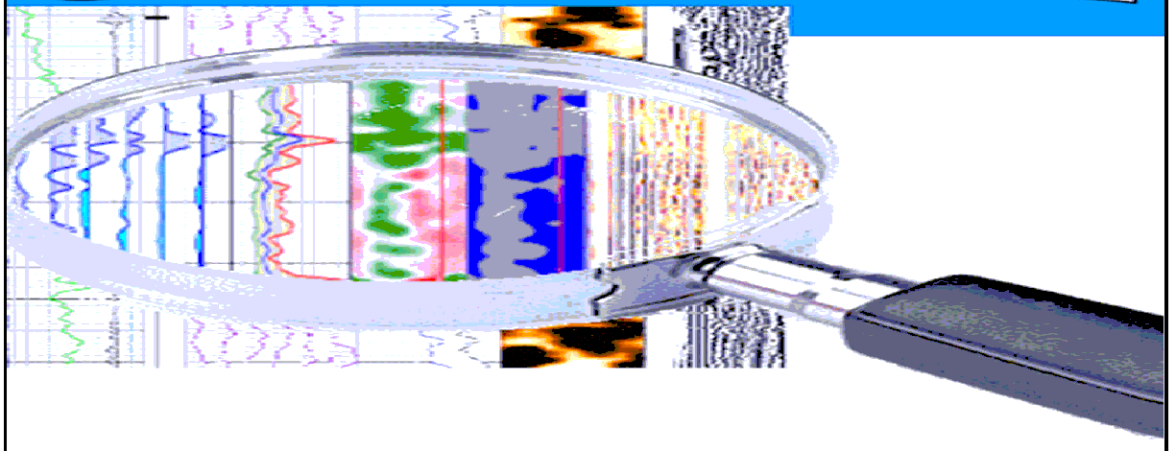
BAKER HUGHES

SBT® Bond



Cement Evaluation

COMPANY SOUTHERN CALIFORNIA GAS CO

WELL PORTER 44

FIELD ALISO CANYON

COUNTY LOS ANGELES **STATE** CALIFORNIA

LOCATION:

1720.78' S. & 2994.52' W

FROM STATION 84

ELEVATIONS:

KB 2204.5 FT **DF** _____ **GL** 2393.5 FT

DATE 16-Feb-2016 **S.O.** US105986J

IN MAKING INTERPRETATIONS OF LOGS OUR EMPLOYEES WILL GIVE THE CUSTOMER THE BENEFIT OF THEIR BEST JUDGEMENT. BUT SINCE ALL INTERPRETATIONS ARE OPINIONS BASED ON INFERENCES FROM ELECTRICAL OR OTHER MEASUREMENTS, WE CANNOT, AND WE DO NOT GUARANTEE THE ACCURACY OR CORRECTNESS OF ANY INTERPRETATION. WE SHALL NOT BE LIABLE OR RESPONSIBLE FOR ANY LOSS, COST, DAMAGES, OR EXPENSES WHATSOEVER INCURRED OR SUSTAINED BY THE CUSTOMER RESULTING FROM ANY INTERPRETATION MADE BY ANY OF OUR EMPLOYEES.

COMPUTATION PARAMETERS

COMPUTATION			
LOGS USED:	Main_Spliced.xtf	PROGRAM:	WFM/SBTVDLProc
CENTER:	RDS-Geoscience, US	LOG ANALYST: B. Harbstreit	DATE: 2/17/2016
LOCATION:	Houston, TX	ENGINEER: Sid Gornto	DATE: 2/16/2016

FIELD DATA									
FROM	TO	Casing OD	Weight	FPAT	FREEP	MAXATTN	MNCEMSTR	CEMSTR	
3775 FT	6798 FT	7.0	23	0.878	6.969	12.472	500	2500	
6798 FT	7615 FT	7.0	26	1.214	6.727	11.708	500	2500	

BOREHOLE RECORD

BIT SIZE	FROM	TO

CASING RECORD

SIZE	WEIGHT	GRADE	FROM	TO
11.75 IN	42 LB/F	H40	0 FT	530 FT
7.0 IN	23 LB/F	N80	0 FT	673 FT
7.0 IN	23 LB/F	J55	673 FT	4615 FT
7.0 IN	23 LB/F	S95	4615 FT	5019 FT
7.0 IN	23 LB/F	N80	5016 FT	6798 FT
7.0 IN	26 LB/F	N80	6798 FT	7805 FT
5.0 IN	15 LB/F		7639 FT	8039 FT

REMARKS

REMARKS

LOG CORRELATED TO DRESSER ATLAS CBL DATED 10 JAN 1973
TOOLSTRING CENTRALIZED WITH 3 GEMOCOS
2 POINTS OF INTEREST NOTED @ 4000' 4283'

EQUIPMENT DATA

RUN	TRIP	TOOL	SERIES NO.	SERIAL NO.	POSITION
2	1	CCL	2346XA	11973967	CENT
2	1	GAMMA RAY	1309XA	078625	CENT
2	1	ELECTRONICS	1633EA	11803614	CENT
2	1	SBT	1424XA	11857476	CENT
2	1	VDL	1424PA	11788058	CENT

Source File: C:\Ape_Project\Socal_Potter_44\Plotting\Southern_California_Gas_Potter_44_SBT_Bond_2016 Report.txt

SBT DATA QUALITY :

1. The SBT results over the 7.0" 23 lb/ft and 26 lb/ft casing indicate that the tool performed as expected and each of the tool pads were reading around the +/- 2 db/ft range.

2. The SBT data is of good quality and suitable for analysis.

3. The dtmn and dtmx curves stack closely with a total spread of less than ~4 us/ft, therefore indicating that there is no eccentricity or pad contact issues. The average reading is very close to the expected travel time of 57 us/ft for Steel.

INTERPRETATION :

1. The solid red/green/blue lines in the Channel Indicator track (min/avg/max attenuation) are the measured minimum, average and maximum attenuation recorded at each level. Average= (sum[ATCi])/6, the average of the ATC for each pad.

2. The Channel Indicator track contains the primary SBT quality checks.
   a. A narrow yellow fill between the minimum and maximum attenuation indicates a consistent measurement by all of the pads
   b. A wide yellow fill between the minimum and maximum attenuation may indicate a possible channel, spotty cement or varying cement quality.

3. The dashed red/green/blue lines in the Channel Indicator track are the modeled free pipe attenuation, minimum acceptable cement strength, and the modeled cement strength, all in dB/ft. These quality curves indicate the attenuation and consequently also represent the following:

   7.0 in casing 23 lb/ft and 26 lb/ft

23lb/ft	Attenuation	Cement Strength
a. Free Pipe	0.878 dB/ft	0 Psi
b. Minimum Cement Threshold,	6.969 dB/ft	500 Psi
c. Measured Cement Strength	12.472 dB/ft	2500 Psi
26 lb/ft		
a. Free Pipe	1.214 dB/ft	0 Psi
b. Minimum Cement Threshold,	6.727 dB/ft	500 Psi
c. Measured Cement Strength	11.708 dB/ft	2500 Psi

4. The Apparent Cement Strength 'green/red' map has a cut-off set to twice the minimum acceptable compressive strength of 500 psi, or 1000 Psi. Therefore, following the color bar from left to right:
   a. Below 500 Psi is red (free pipe) shading to white
   b. At 500 Psi the image is white, transition point between free pipe and cement
   c. Above 500 Psi white shading to green (good cement)

5. The Apparent Cement Strength 'grey/blue' map reports the presence of cement using only the SBT pad data:
   a. Blue is below the minimum acceptable cement strength (Value = 0)
   b. Grey is above the minimum acceptable cement strength (Value = 1)

GEOSCIENCE REMARKS :

This evaluation is based on a minimum compressive strength of 500 psi and a cement compressive strength of 2500 psi based off field data. The well was possibly cemented back in 1955 according to the client.

1. 3775 - 3855 FT : Poor Cement Bond. The average attenuation curve is below the minimum acceptable attenuation value for 500 psi compressive strength cement. The cement also shows poor cement and the VDL shows strong casing arrivals.

2. 3855 - 3945 FT : Partial Cement Bond. Average attenuation is following the minimum acceptable

attenuation curve closely, the cement map shows partial cement and the VDL showing weaker casing arrivals with formation arrivals noted. Indicating some partial casing to formation bonding is occurring. The span between the minimum attenuation and maximum attenuation curves have increased, but DTMN & DTMX remain close probable indication of a channel or a micro annulus.

3. 3945 - 4315 FT : Overall Good Cement Bond. Average attenuation curve is higher than the minimum acceptable attenuation value for 500 psi compressive strength. The cement map shows good cement with some areas of channeling or micro annulus, example 4050 - 4070 FT, 4130 - 4175 FT. The VDL shows weak or no casing arrivals, formation arrivals are seen indicating casing to formation bonding.

4. 4315 - 5285 FT : Poor Cement - Free Pipe . The average attenuation curve is below the minimum acceptable attenuation value for 500 psi compressive strength cement and is tracking close to the free pipe attenuation value for 7.0", 23lb casing. The cement map also shows no cement and the VDL has strong casing arrivals, clear chevron pattern can be seen at each collar connection, another indication of free pipe.

5. 5285 - 6015 FT : Poor Cement Bond. The average attenuation curve is below the minimum acceptable attenuation but above the free pipe attenuation value. Cement map also shows poor to no cement. The VDL shows strong casing arrivals with casing collars evident in the VDL as well. There are a few areas that show evidence of some sectors of probable cement that is close or just a little over the minimum acceptable compressive strength for 500 psi (similar to channeling) Example: 5400 - 5450 FT, 5600 - 5790 FT. The VDL response is showing possibly some weak formation signal also and with the casing arrivals this may be an indication of a micro annulus, however without a pressure pass this cannot be confirmed and is speculation only.

6. 6015 - 6340 FT : Partial Cement Bond: The average attenuation curve is tracking than the minimum acceptable attenuation value for 500 psi compressive strength cement. The cement map also shows partial cement bond with channeling or a micro annulus present. The VDL shows weak or missing casing arrivals and formation arrivals can be seen indication that partial casing to formation bonding is probable.

7. 6340 - 6445 FT ; Good Cement Bond. Average attenuation curve is higher than the minimum acceptable attenuation and is close to the maximum attenuation value throughout this section. The cement map also agrees that there is good bond over this interval and above the 500 psi minimum acceptable compressive strength. VDL - weak casing arrivals, formation arrivals can be seen over this interval indicating bond between casing and formation.

8. 6445 - 6865 FT : Partial Cement Bond: The average attenuation curve is tracking or slightly lower than the minimum acceptable attenuation value for 500 psi compressive strength cement The cement map also shows spotty to partial cement with channeling or a micro annulus present. The VDL shows weak or missing casing arrivals and formation arrivals can be seen indication that partial casing to formation bonding is probable. A good example of possible channeling where the span between minimum and maximum attenuation has increased is from 6715 - 6755 FT.

9. 6865 - 6925 FT: Poor cement Bond: The average attenuation curve is below the minimum acceptable attenuation but above the free pipe attenuation value. Cement map also shows poor to no cement. The VDL showing casing arrivals also.

10. 6925 - 7085 FT : Partial Cement Bond: The average attenuation curve is tracking the minimum acceptable attenuation value for 500 psi compressive strength cement. The cement map shows that channeling is probable. The VDL shows weak or missing casing arrivals along with some formation arrivals.

11. 7085 - 7575 FT : Good to Partial Cement Bond. Average attenuation curve is higher than the minimum acceptable attenuation. The cement map also agrees that there is good bond over this interval and above the 500 psi minimum acceptable compressive strength and shows narrow channeling or a micro annulus. Example: 7170 - 7275 FT, 7350 - 7370 FT, 7450 - 7500 FT
VDL - weak casing arrivals, formation arrivals can be seen over this interval indicating bond between casing and formation.

12. 7575 - 7615 FT : Poor to Partial cement. Average attenuation curve is tracking or slightly lower than the minimum acceptable attenuation value. The cement map also shows poor to partial cement and the VDL is showing casing arrivals with minimal formation signal.

Created by : Post Acquisition Tool Suite (PATS), v7.0.17.0

Plotted by : BHI PATS Well Log Data Viewer, v7.0.17.0

BAKER HUGHES

Company : SOUTHERN CALIFORNIA GAS CO

Well : PORTER 44

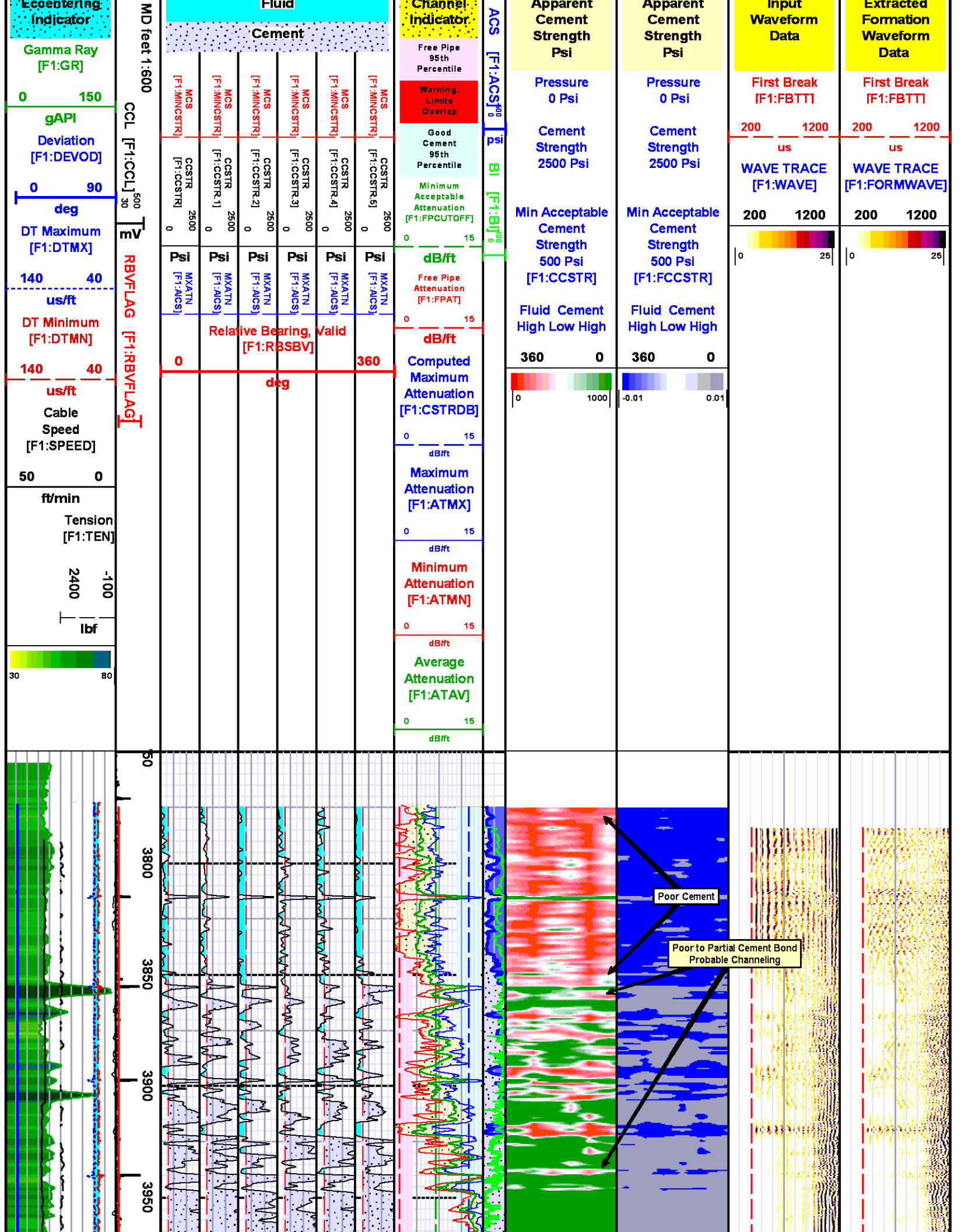
File Name : c:\ape_project\socal_potter_44\BVP_D_220_GS_SBT_Case_1.xtf

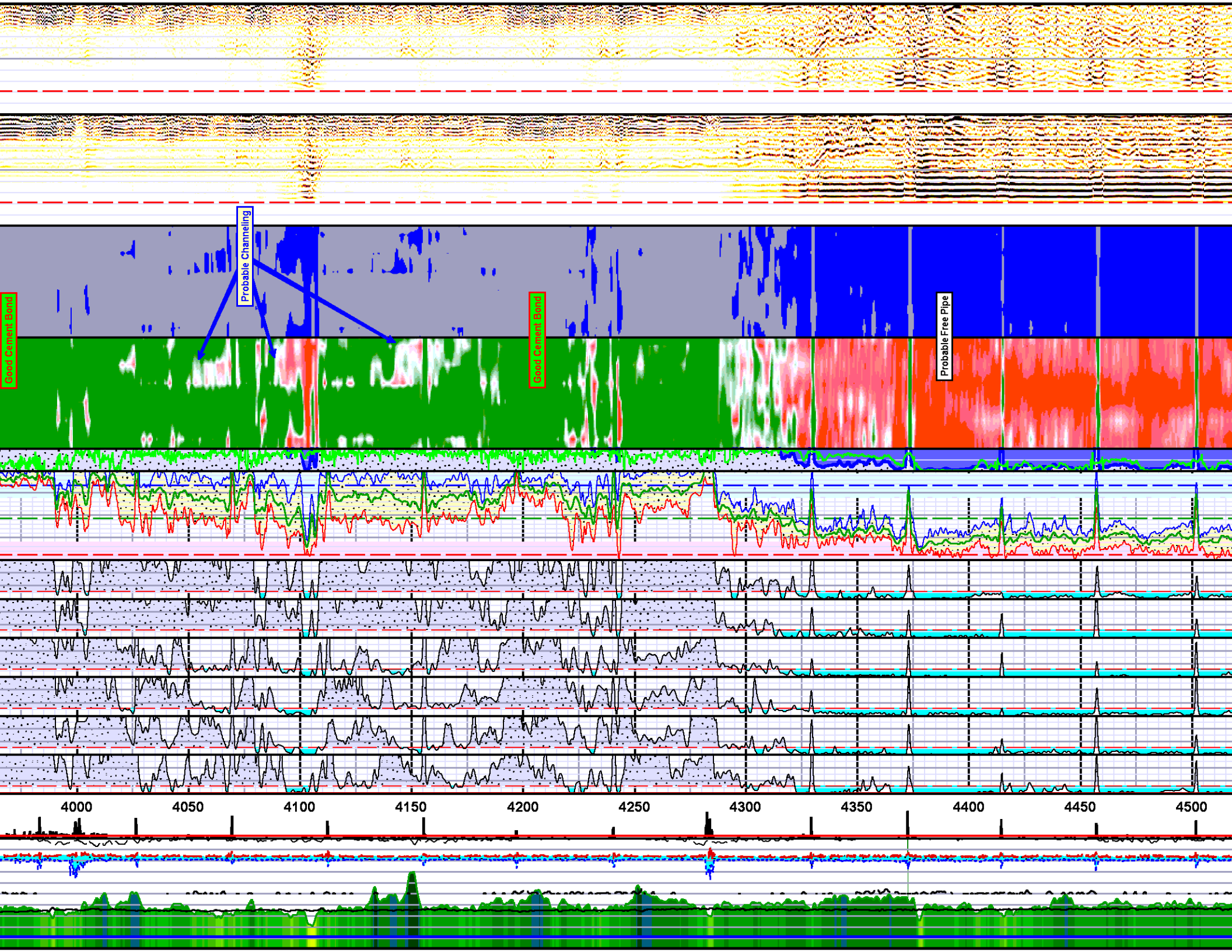
Mode : Log Viewer

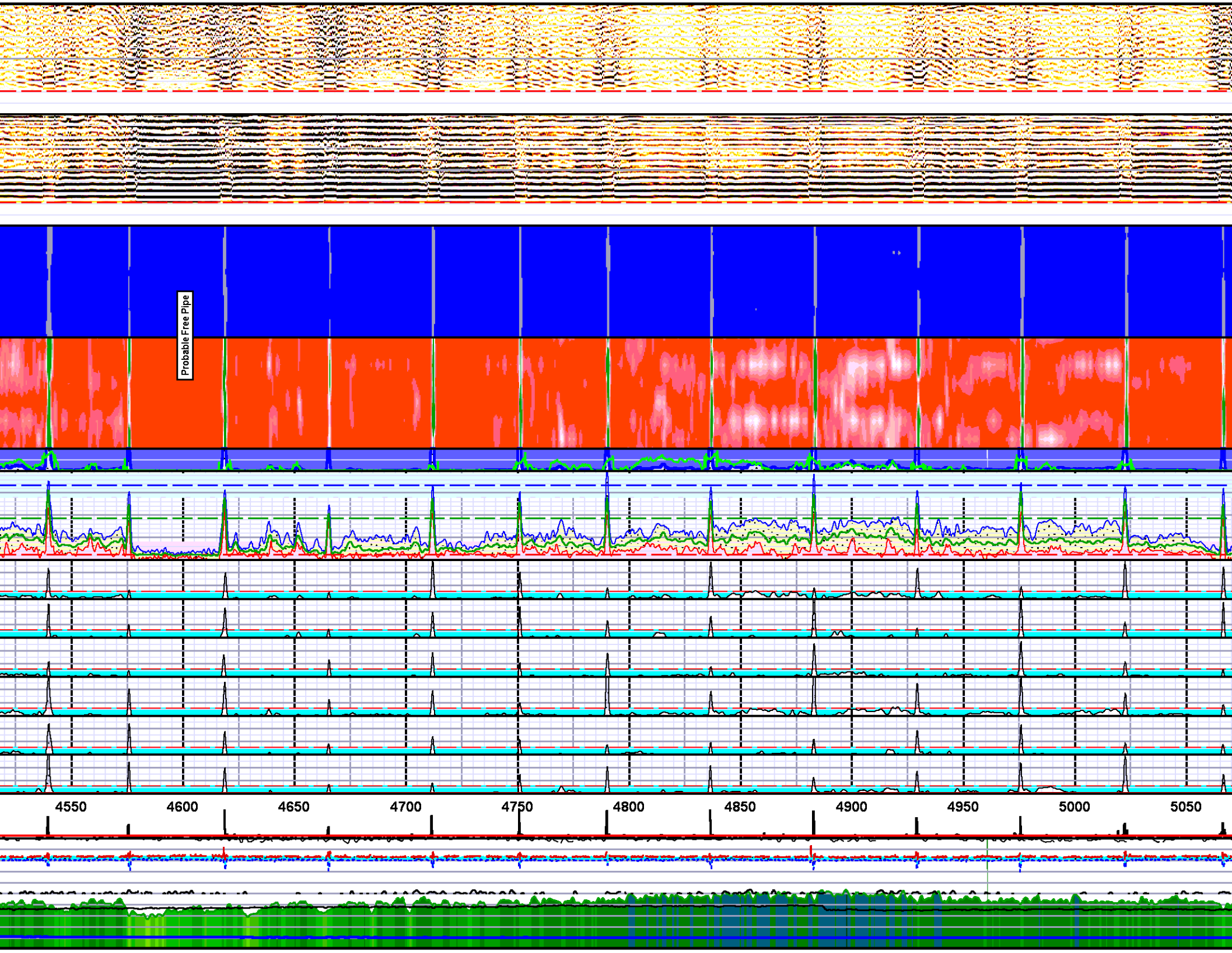
Interval : 3750.00 - 7630.00 feet UP

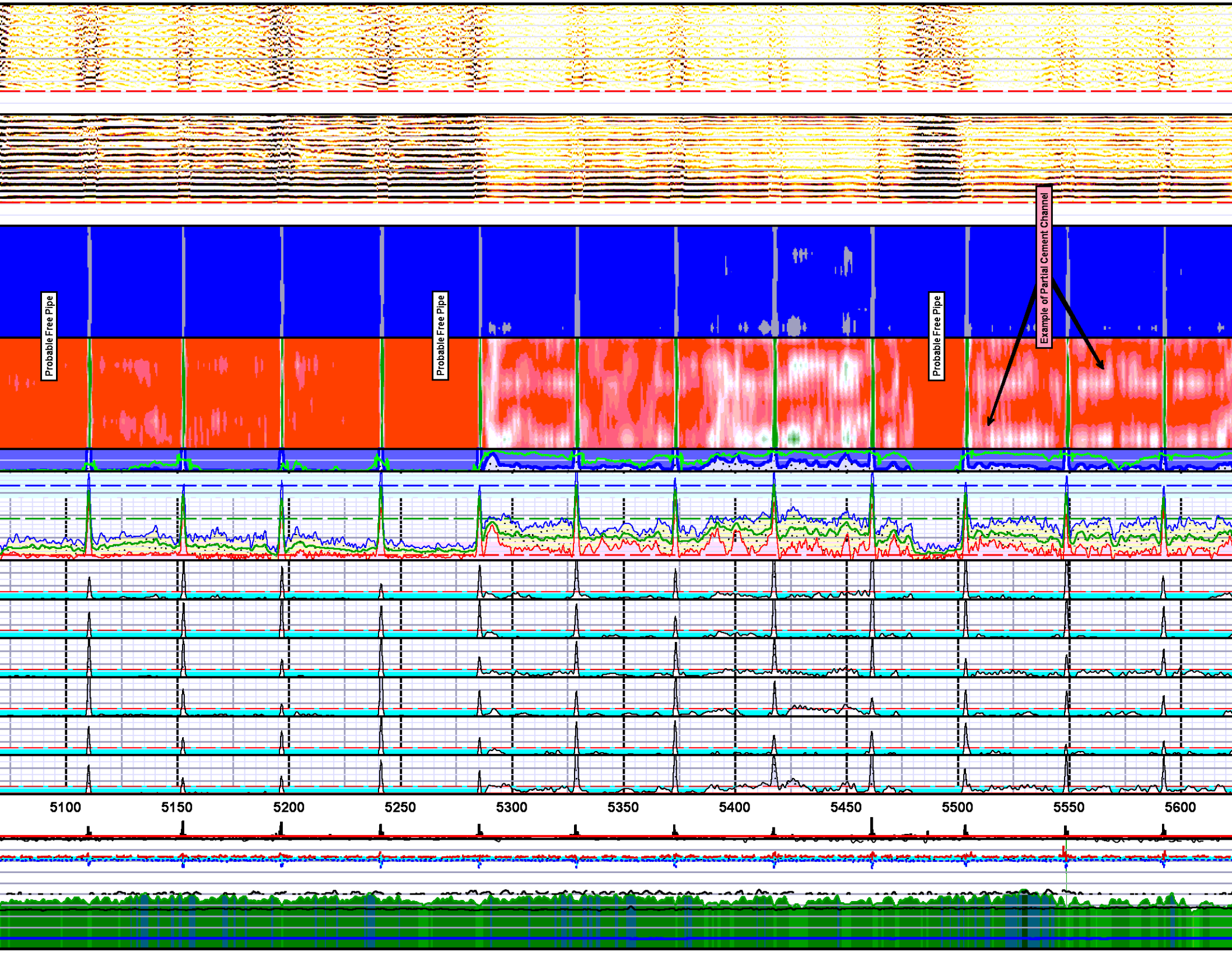
Created : 2/16/2016 11:18:44 AM

SBT-Bond Cement Evaluation


Eccentering Indicator
Gamma Ray [F1:GR]
0 150
gAPI
Deviation [F1:DEVOD]
0 90
deg
DT Maximum [F1:DTMX]
140 40
us/ft
DT Minimum [F1:DTMN]
140 40
us/ft
Cable Speed [F1:SPEED]
50 0
ft/min
Tension [F1:TEN]
2400 -100
lbf
30 80
MD feet 1:600
CCL [F1:CCL] 500 30
mV
RBVFLAG [F1:RBVFLAG]
Fluid
Cement
MCS [F1:MINCSTR]
CCSTR [F1:CCSTR]
CCSTR [F1:CCSTR.1]
CCSTR [F1:CCSTR.2]
CCSTR [F1:CCSTR.3]
CCSTR [F1:CCSTR.4]
CCSTR [F1:CCSTR.5]
0 2500
Psi
MXATN [F1:ACS]
Relative Bearing, Valid [F1:RBSBV]
0 360
deg
Channel Indicator
Free Pipe 95th Percentile
Warning: Limits Overlap
Good Cement 95th Percentile
Minimum Acceptable Attenuation [F1:FPCUTOFF]
0 15
dB/ft
Free Pipe Attenuation [F1:FPAT]
Computed Maximum Attenuation [F1:CSTRDB]
Maximum Attenuation [F1:ATMX]
Minimum Attenuation [F1:ATMN]
Average Attenuation [F1:ATAV]
ACS [F1:ACS] 600 0
psi
BI [F1:BI] 100 0
Apparent Cement Strength Psi
Pressure 0 Psi
Cement Strength 2500 Psi
Min Acceptable Cement Strength 500 Psi [F1:CCSTR]
Fluid Cement High Low High
360 0
0 1000
Apparent Cement Strength Psi
Pressure 0 Psi
Cement Strength 2500 Psi
Min Acceptable Cement Strength 500 Psi [F1:FCCSTR]
Fluid Cement High Low High
360 0
-0.01 0.01
Input Waveform Data
First Break [F1:FBTT]
200 1200
us
WAVE TRACE [F1:WAVE]
200 1200
0 25
Extracted Formation Waveform Data
First Break [F1:FBTT]
200 1200
us
WAVE TRACE [F1:FORMWAVE]
200 1200
0 25
3800
3850
3900
3950
Poor Cement
Poor to Partial Cement Bond Probable Channeling


Probable Channeling
Good Cement Bond
Good Cement Bond
Probable Free Pipe
4000
4050
4100
4150
4200
4250
4300
4350
4400
4450
4500

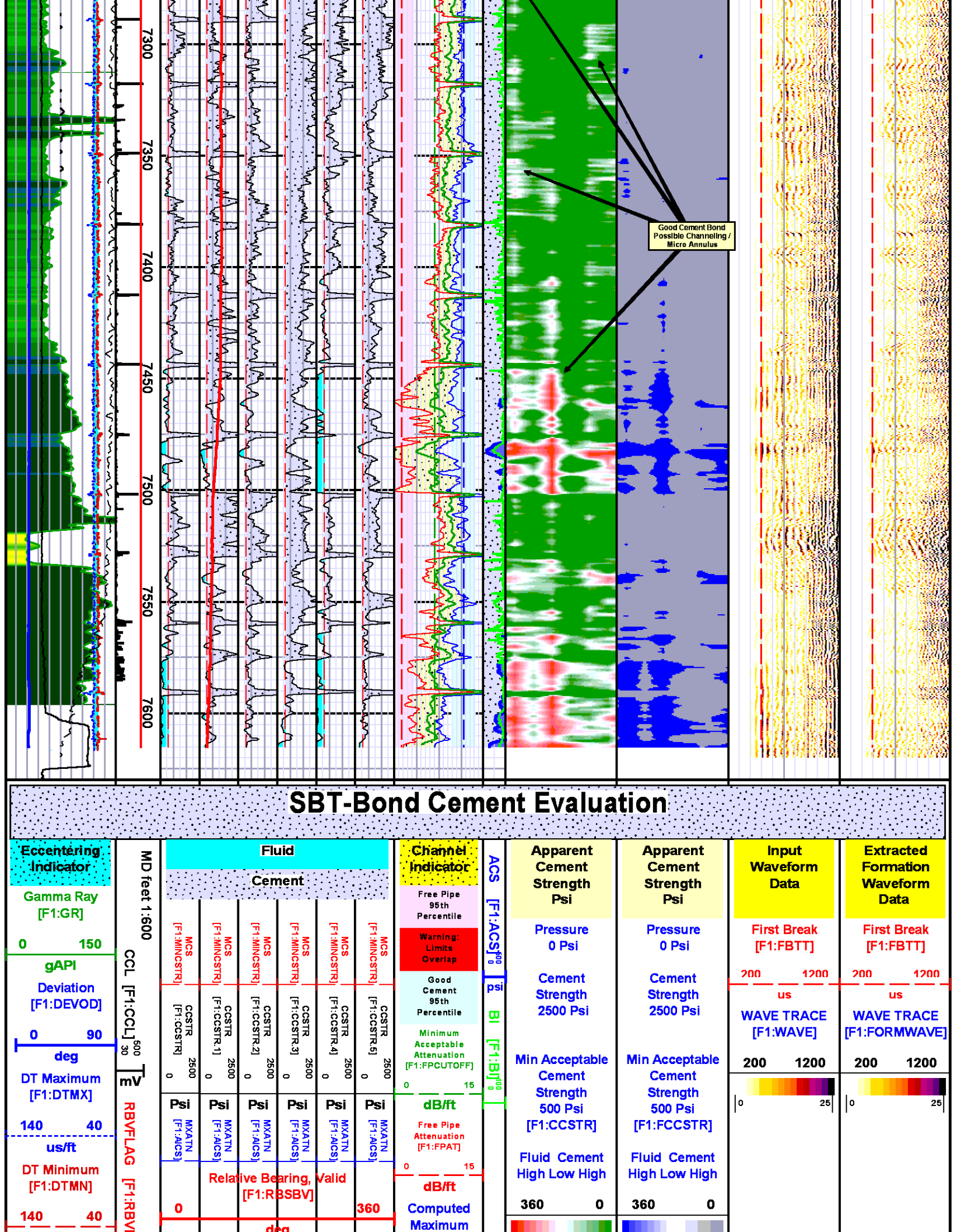

Probable Free Pipe
4550
4600
4650
4700
4750
4800
4850
4900
4950
5000
5050


Probable Free Pipe
Probable Free Pipe
Probable Free Pipe
Example of Partial Cement Channel
5100
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600

5650
5700
5750
5800
5850
5900
5950
6000
6050
6100
6150
Example of Partial Cement Channel
Probable Free Pipe
Partial Cement Bond
Possible Channeling /
Micro Annulus

6200
6250
6300
6350
6400
6450
6500
6550
6600
6650
6700
Partial Cement Bond
Possible Channeling /
Micro Annulus
Good Cement Bond
Partial Cement Bond
Possible Channeling /
Micro Annulus
Poor to Partial Cement Bond
Possible Channeling /
Micro Annulus

6750
6800
6850
6900
6950
7000
7050
7100
7150
7200
7250
Weight Change from 23lb to 26lb
Poor Cement Bond
Possible Channeling /
Micro Annulus
Partial Cement Bond
Possible Channeling
Good Cement Bond
Possible Channeling /
Micro Annulus


SBT-Bond Cement Evaluation
Eccentering Indicator
Gamma Ray [F1:GR]
0 150
gAPI
Deviation [F1:DEVOD]
0 90
deg
DT Maximum [F1:DTMX]
140 40
us/ft
DT Minimum [F1:DTMN]
140 40
MD feet 1:600
CCL [F1:CCL]
mV
RBVFLAG [F1:RBVFLAG]
7300
7350
7400
7450
7500
7550
7600
Fluid
Cement
MCS [F1:MINCSTR]
CCSTR [F1:CCSTR]
CCSTR [F1:CCSTR.1]
CCSTR [F1:CCSTR.2]
CCSTR [F1:CCSTR.3]
CCSTR [F1:CCSTR.4]
CCSTR [F1:CCSTR.5]
0 2500
Psi
MXATN [F1:AICS]
Relative Bearing, Valid [F1:RBSBV]
0 360
deg
Channel Indicator
Free Pipe 95th Percentile
Warning: Limits Overlap
Good Cement 95th Percentile
Minimum Acceptable Attenuation [F1:FPCUTOFF]
0 15
dB/ft
Free Pipe Attenuation [F1:FPAT]
0 15
dB/ft
Computed Maximum
ACS [F1:ACS]
psi
BI [F1:BI]
Apparent Cement Strength Psi
Pressure 0 Psi
Cement Strength 2500 Psi
Min Acceptable Cement Strength 500 Psi [F1:CCSTR]
Fluid Cement High Low High
360 0
Apparent Cement Strength Psi
Pressure 0 Psi
Cement Strength 2500 Psi
Min Acceptable Cement Strength 500 Psi [F1:FCCSTR]
Fluid Cement High Low High
360 0
Good Cement Bond Possible Channeling / Micro Annulus
Input Waveform Data
First Break [F1:FBTT]
200 1200
us
WAVE TRACE [F1:WAVE]
200 1200
0 25
Extracted Formation Waveform Data
First Break [F1:FBTT]
200 1200
us
WAVE TRACE [F1:FORMWAVE]
200 1200
0 25

us/ft

Cable Speed [F1:SPEED]

50 0

ft/min

Tension [F1:TEN]

2400 -100

lbf

30 80

FLAG

Attenuation [F1:CSTRDB]

0 15

dB/ft

Maximum Attenuation [F1:ATMX]

0 15

dB/ft

Minimum Attenuation [F1:ATMN]

0 15

dB/ft

Average Attenuation [F1:ATAV]

0 15

dB/ft

0 1000

-0.01 0.01

BAKER HUGHES

SBT Bond

COMPANY	SOUTHERN CALIFORNIA GAS CO		FILE NO:
WELL	PORTER 44		
FIELD	ALISO CANYON		API NO:
COUNTY	LOS ANGELES	STATE CALIFORNIA	04-037-00731

LOCATION:

1720.78' S. & 2994.52' W

FROM STATION 84

ELEVATIONS:

KB 2204.5 FT

DF

GL 2393.5 FT

DATE 16-Feb-2016