LOGGING REQUIREMENTS

*(This outline is provided as a companion to the **Logging Requirements** PowerPoint slide presentation.)*

TYPES OF LOGS

ELECTRIC LOG

(SLIDE NOS. 2-5)

Electric Log (E-log) – open hole logs used to help identify the base of the Underground Source of Drinking Water (USDW) and other formations of interest.

EXAMPLES

- Gamma Ray (GR)
- Spontaneous Potential (SP)
- Resistivity
- Density
- Neutron Porosity
- Caliper

REQUIREMENT

- Must run if unable to locate an electric log of a nearby well (within ¼-mile) that was run through the lowermost USDW
- If electric log is available and meets the above requirement, only need to run open-hole log just prior to setting long string casing

CEMENT BONG LOG

(SLIDE NOS. 6-14)

Cement Bond Log (CBL) – measures the loss of acoustic energy as it passes through casing. Used for detecting cement outside of casing.

REQUIREMENT

- Must run on all new-drills, conversions and zone changes
- Injection and Mining Division cannot accept the portion of a CBL that has been run "pipe-inside-pipe"

LOOKING FOR

- Minimum interval of continuous 60% bonded cement in a continuous confining shale
- Rule-of-Thumb: < 10 mV on amplitude curve for x-amount of feet

RADIOACTIVE TRACER SURVEY

(SLIDE NO. 16)

Radioactive Tracer Survey (RTS) – can detect RA "tagged" fluid movement through channels behind casing while on injection. Also used for locating other RA "tagged" material such as proppant, frac fluid, gravel pack, cement squeeze, etc.

TEMPERATURE LOG

(SLIDE NO. 17)

Temperature Log – sometimes used to locate top of cement in larger heavier casings. Can also locate channels behind casing and to determine the height of stimulation due to acidizing or fracturing.

OXYGEN ACTIVATION LOG

(SLIDE NO. 18)

Oxygen Activation Log – used to detect movement of water and for locating channels

DNR LOGGING GUIDELINES

(SLIDE NOS. 19-23)

The DNR Logging Guideline can be accessed by going to:

- http://dnr.louisiana.gov >>
- Conservation (Top Menu) >>
- Forms (Left Menu) >>
- Injection and Mining Division (Click on Button at the Top) >>
- Scroll down to Logging Guidelines

EXAMPLES

(SLIDE NOS. 24-54)

Three examples of CBLs (For the examples, assume all open hole logs and CBLs perfectly correlate).

EXAMPLE 1 (Refer to "Logs for Example 1" in back of handout)

(SLIDE NOS. 26-34)

USDW:	**300 feet**
Surface Casing:	**16" (84#/ft) set at 500 feet**
Long String:	**10 3/4" (40.5#/ft) set at 2,000 feet**
Proposed Zone:	**1,276 – 1,326 feet**

- How many feet of continuous cement will be required for external cement isolation of the proposed injection zone? _____
  - Top of Zone (TOZ): _____
  - Bottom of Zone (BOZ): _____
- At what depth above the TOZ would you call the bottom of the minimum required cement interval? _____
- What is the shallowest allowed packer depth? _____

EXAMPLE 2 (Refer to "Logs for Example 2" in back of handout)

(SLIDE NOS. 36-44)

USDW:	**480 feet**
Surface Casing:	**8 5/8" (24#/ft) set at 815 feet**
Long String:	**4 1/2" (11.6#/ft) set at 5,045 feet**
Proposed Zone:	**3,020 – 3,150 feet**

- How many feet of continuous cement will be required for external cement isolation of the proposed injection zone? _____
  - Top of Zone (TOZ): _____
  - Bottom of Zone (BOZ): _____
- At what depth above the TOZ would you call the bottom of the minimum required cement interval? _____
- What is the shallowest allowed packer depth? _____

EXAMPLE 3 (Refer to "Logs for Example 3" in back of handout)

(SLIDE NOS. 46-54)

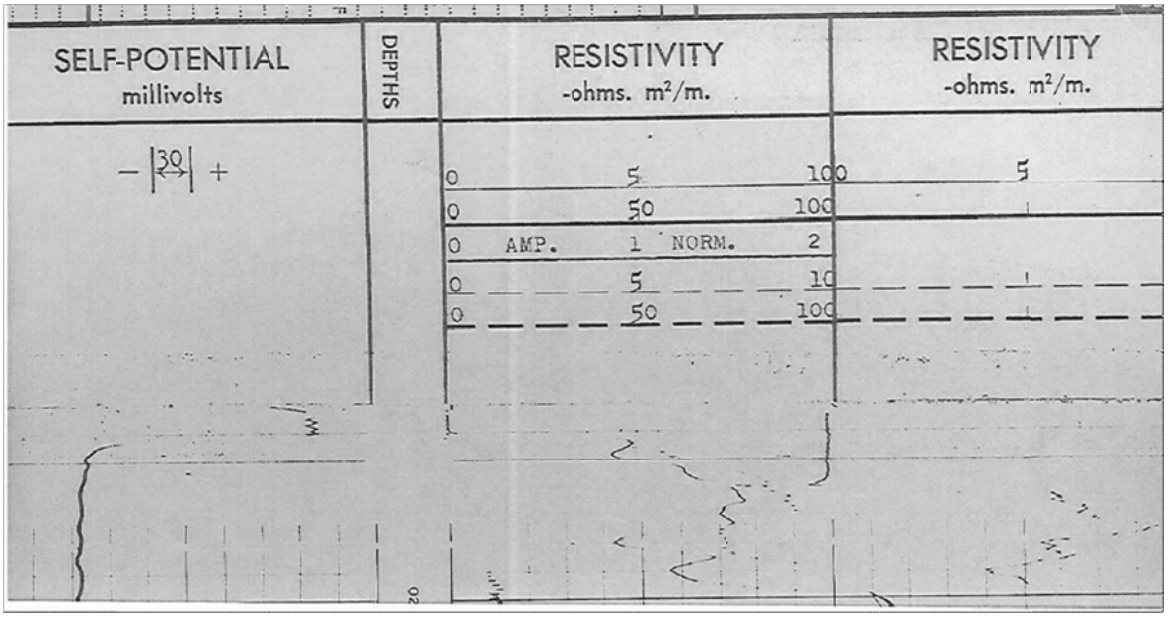
USDW:	**500 feet**
Surface Casing:	**9 5/8" (36#/ft) set at 975 feet**
Long String:	**7 5/8" (26.4#/ft) set at 3,500 feet**
Proposed Zone:	**2,780 – 2,960 feet**

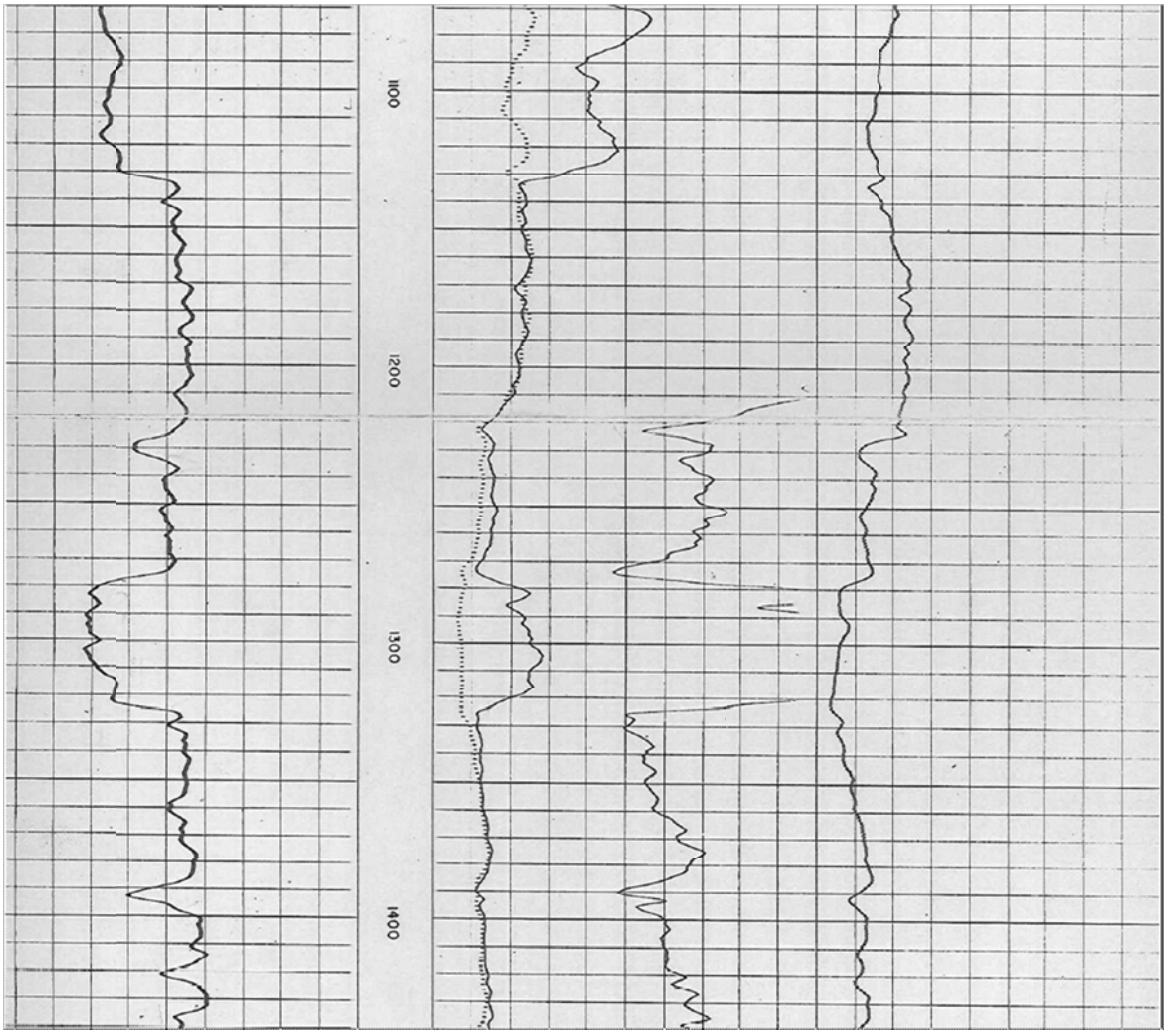
- How many feet of continuous cement will be required for external cement isolation of the proposed injection zone? _____
  - Top of Zone (TOZ): _____
  - Bottom of Zone (BOZ): _____
- At what depth above the TOZ would you call the bottom of the minimum required cement interval? _____
- What is the shallowest allowed packer depth? _____

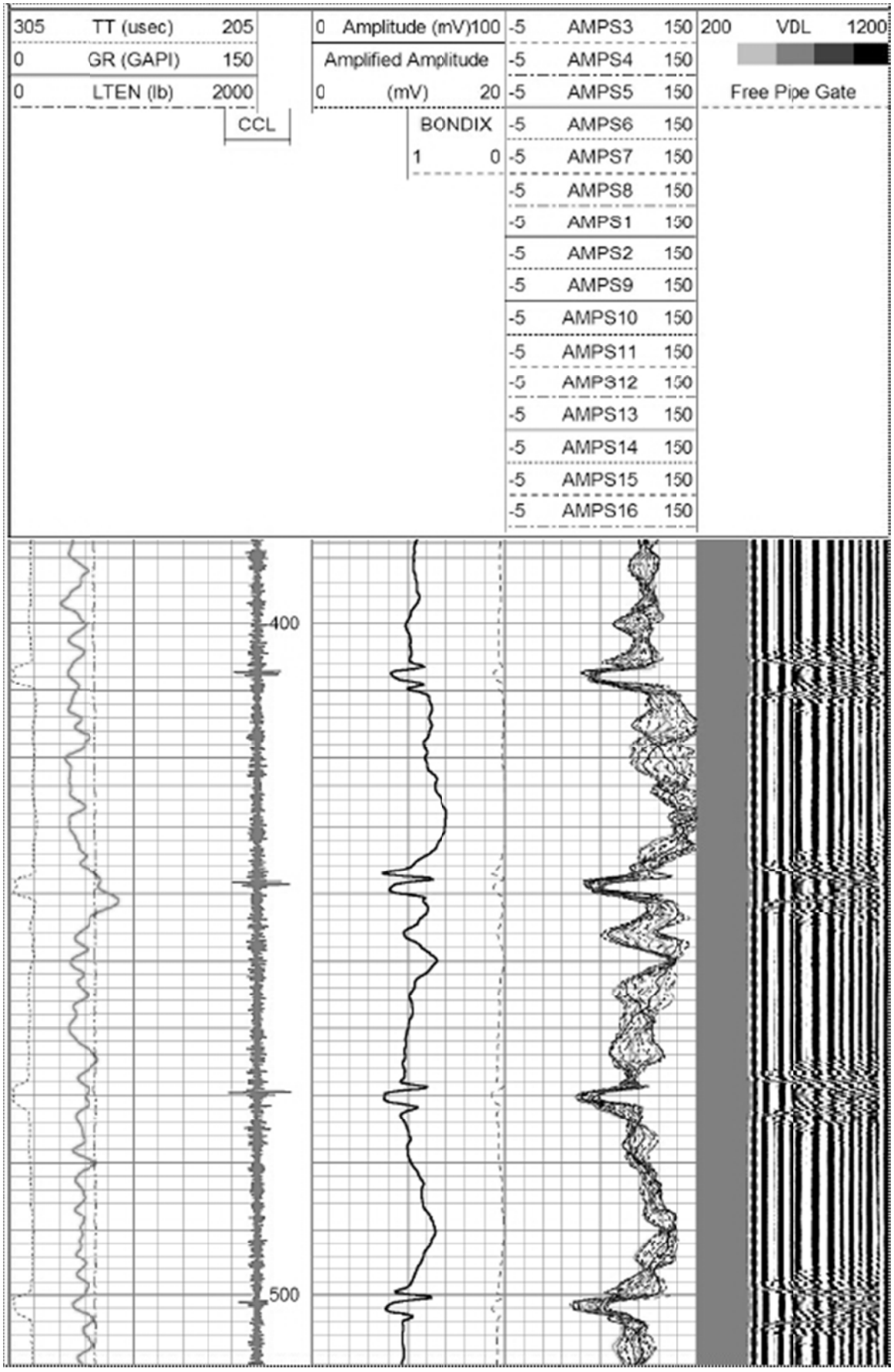
Cement Bond Log
Interpretation Guide

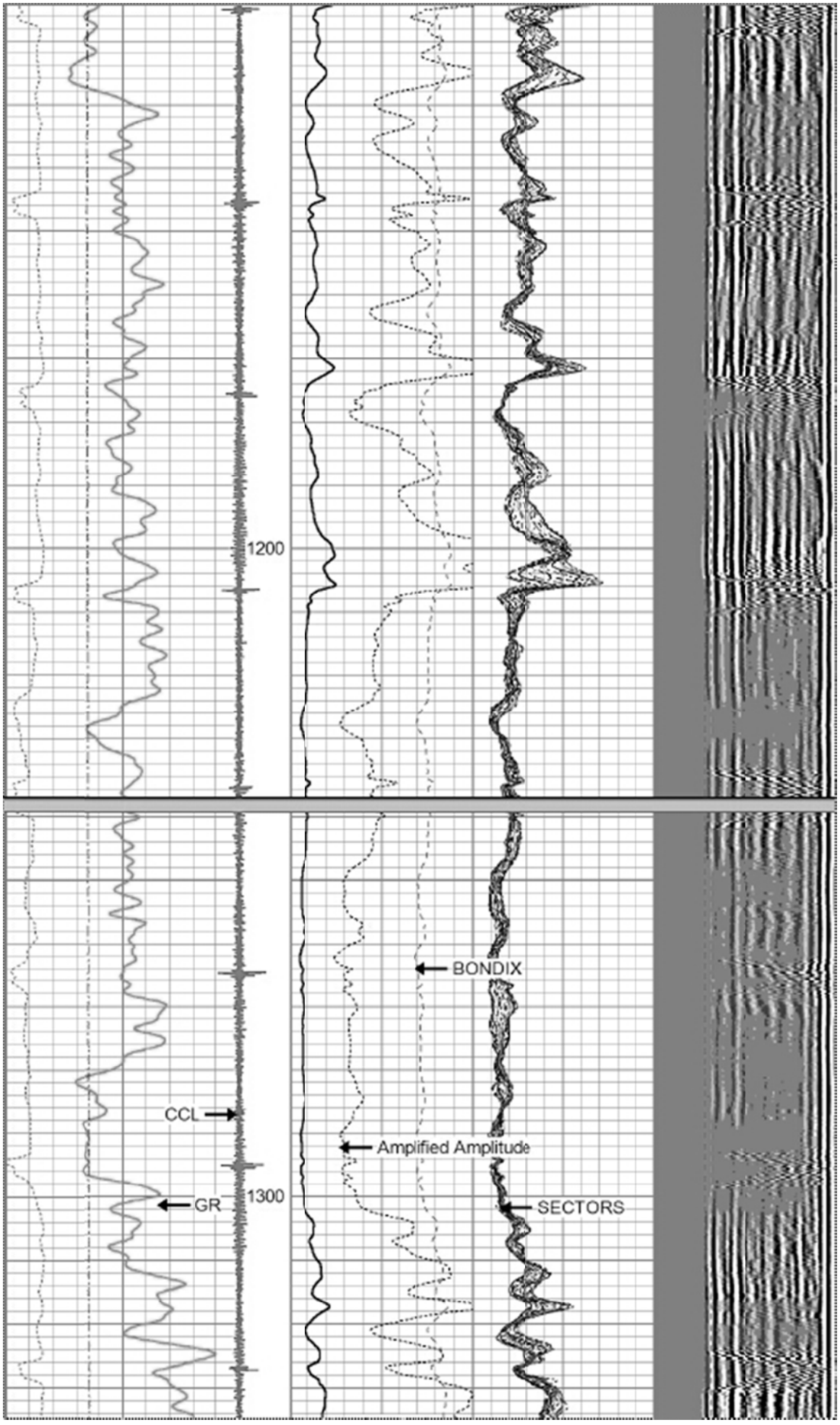
Casing Size	Weight	Travel Time μ-sec	Free Pipe Signal	Class H Cement 3000 psi 100% cmt	Class H Cement 60% bond cut off	Interval for Isolation
4 1/2"	9.5			0.2 mv	2.3 mv	
	11.6	254	81 mv	0.6mv	4.6 mv	5 feet
	13.5			1.0 mv	7.0 mv	
5"	15.0					
	18.0	258	76 mv	0.9 mv	5.5 mv	
	21.0			2.2 mv	10.0 mv	5 feet
				3.6 mv	15.0 mv	
5 1/2"	15.5			0.7 mv	4.8 mv	
	17.0			1.0 mv	5.0 mv	
	20.0	269	72 mv	2.1 mv	9.0 mv	6 feet
	23.0			3.5 mv	13.0 mv	
7"	23.0			1.0 mv	5.5 mv	
	26.0			1.7 mv	7.5 mv	
	29.0			2.4 mv	9.3 mv	
	32.0	289	62 mv	3.3 mv	13.0 mv	11 feet
	35.0			4.0 mv	14.0 mv	
	38.0			5.0 mv	15.0 mv	
	40.0			6.0 mv	17.0 mv	
7 5/8"	26.4			1.1 mv	5.5 mv	
	29.7			1.8 mv	7.5 mv	
	33.7	302	59 mv	2.6 mv	10.0 mv	12 feet
	39.0			3.5 mv	13.0 mv	
9 5/8"	40.0			1.8 mv	6.8 mv	
	43.5			2.2 mv	8.5 mv	
	47.0	332	51 mv	2.7 mv	9.0 mv	15 feet
	53.5			4.0 mv	12.0 mv	
10 3/4"	40.5			1.2 mv	5.1 mv	
	45.5			1.8 mv	6.5 mv	
	48.0			2.1 mv	7.6 mv	
	51.0	352	48 mv	2.5 mv	8.0 mv	18 feet
	54.0			2.7 mv	8.4 mv	
	55.5			2.8 mv	8.8 mv	

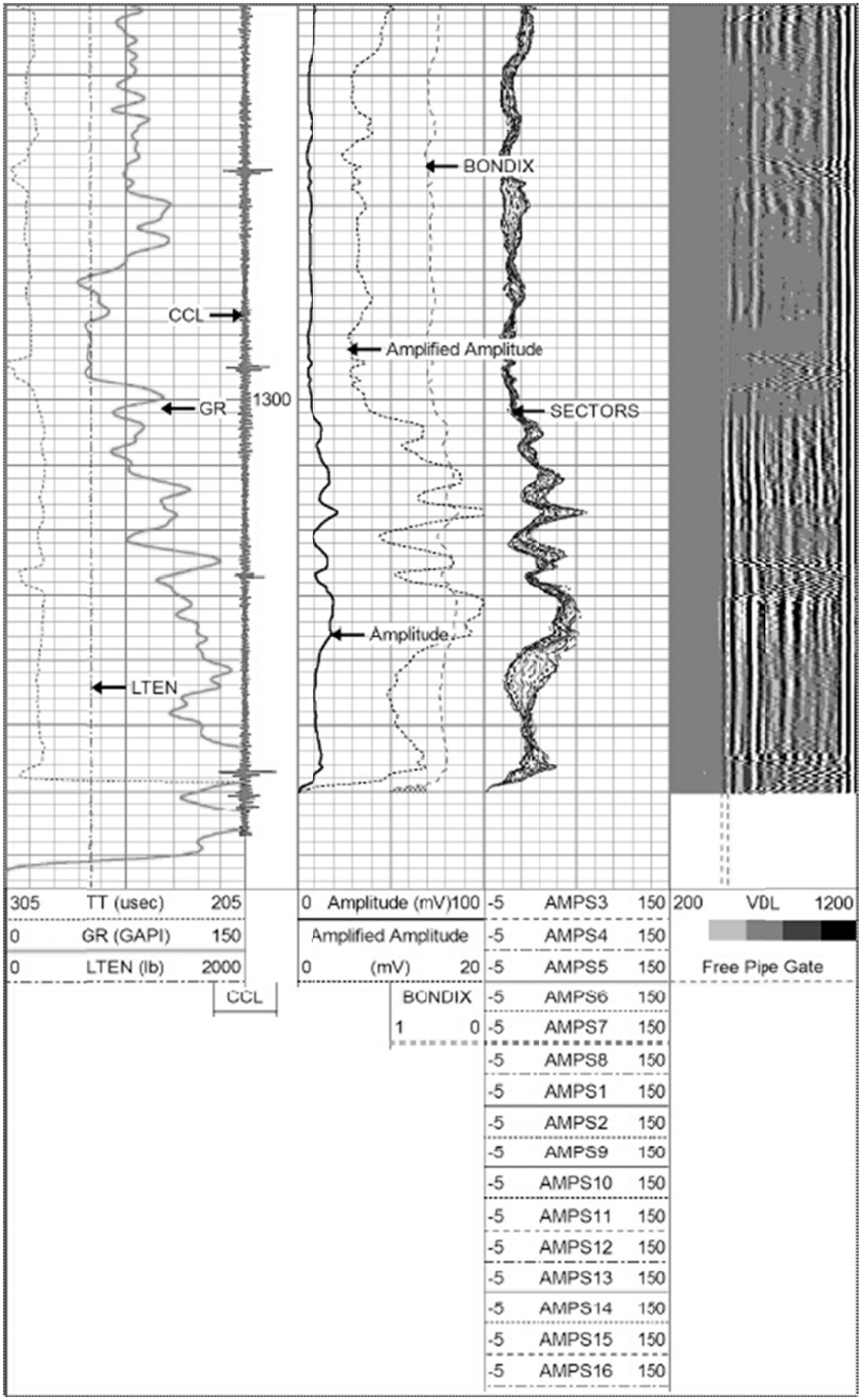
Logs for Example 1:



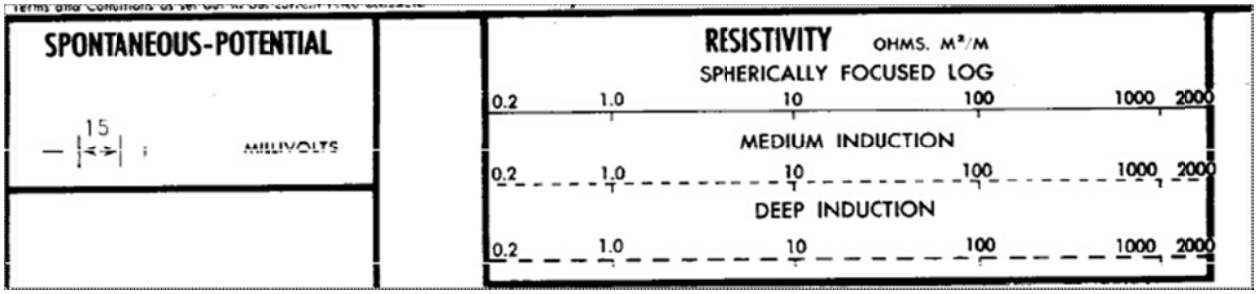


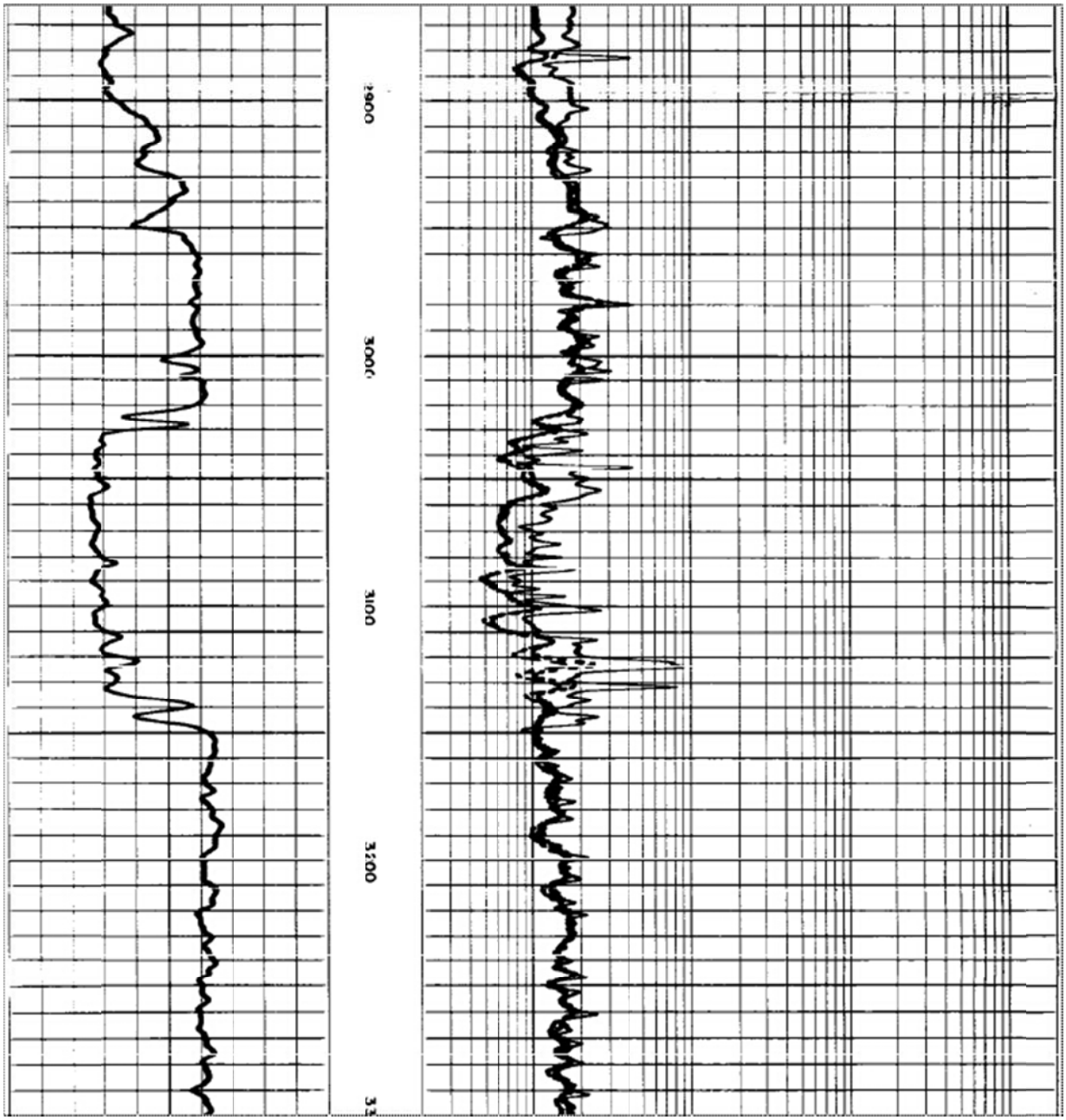

305 TT (usec) 205
0 GR (GAPI) 150
0 LTEN (lb) 2000
CCL
0 Amplitude (mV) 100
Amplified Amplitude
0 (mV) 20
BONDIX
1 0
-5 AMPS3 150
-5 AMPS4 150
-5 AMPS5 150
-5 AMPS6 150
-5 AMPS7 150
-5 AMPS8 150
-5 AMPS1 150
-5 AMPS2 150
-5 AMPS9 150
-5 AMPS10 150
-5 AMPS11 150
-5 AMPS12 150
-5 AMPS13 150
-5 AMPS14 150
-5 AMPS15 150
-5 AMPS16 150
200 VDL 1200
Free Pipe Gate
400
500

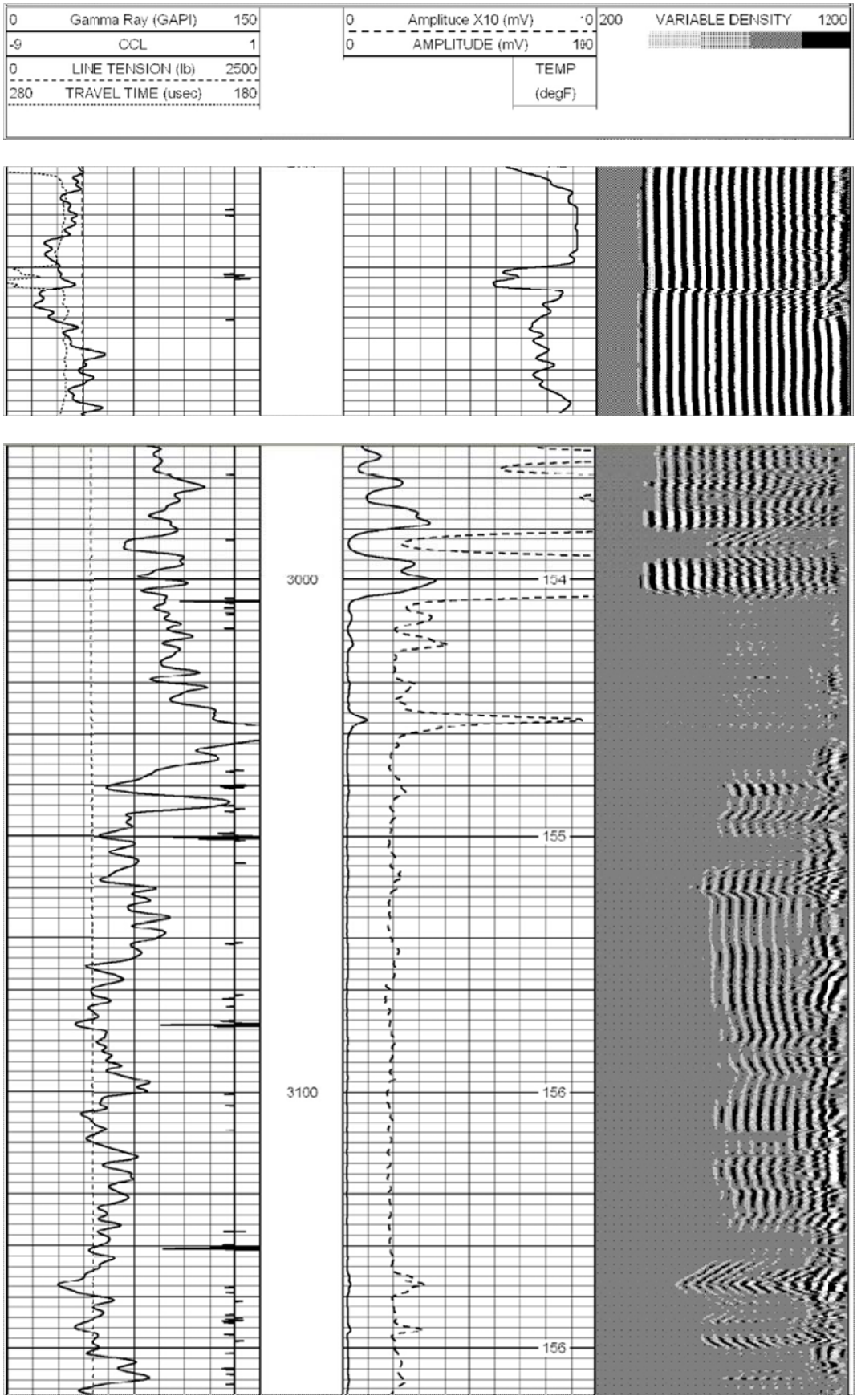

1200
BONDIX
CCL
Amplified Amplitude
GR
1300
SECTORS


CCL
GR
1300
LTEN
BONDIX
Amplified Amplitude
SECTORS
Amplitude
305 TT (usec) 205
0 GR (GAPI) 150
0 LTEN (lb) 2000
CCL
0 Amplitude (mV) 100
Amplified Amplitude
0 (mV) 20
BONDIX
1 0
-5 AMPS3 150
-5 AMPS4 150
-5 AMPS5 150
-5 AMPS6 150
-5 AMPS7 150
-5 AMPS8 150
-5 AMPS1 150
-5 AMPS2 150
-5 AMPS9 150
-5 AMPS10 150
-5 AMPS11 150
-5 AMPS12 150
-5 AMPS13 150
-5 AMPS14 150
-5 AMPS15 150
-5 AMPS16 150
200 VDL 1200
Free Pipe Gate

Logs for Example 2:



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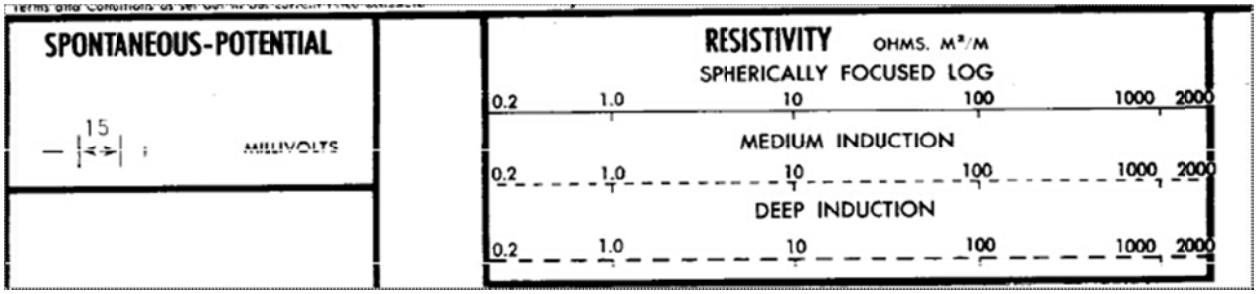
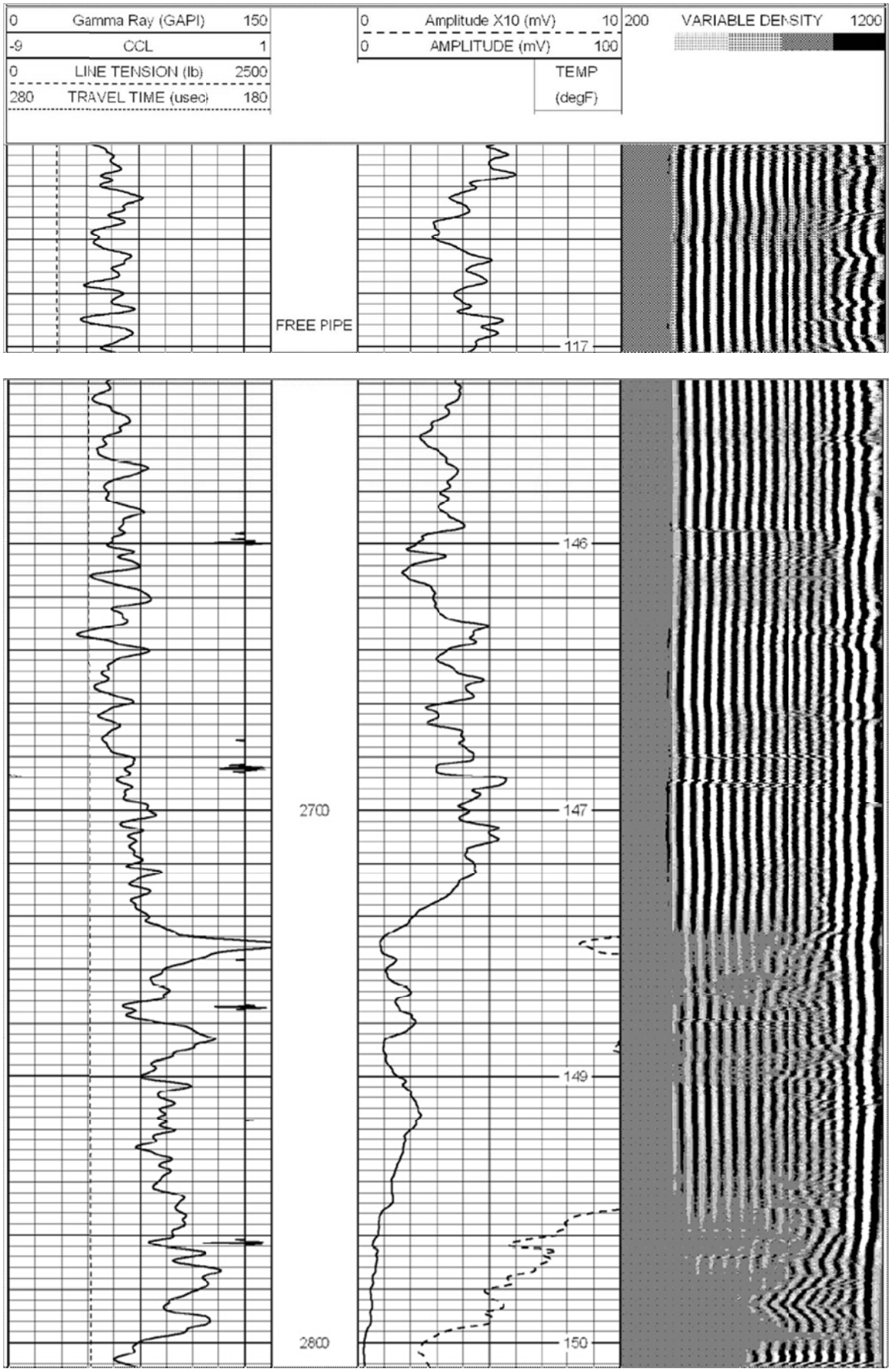
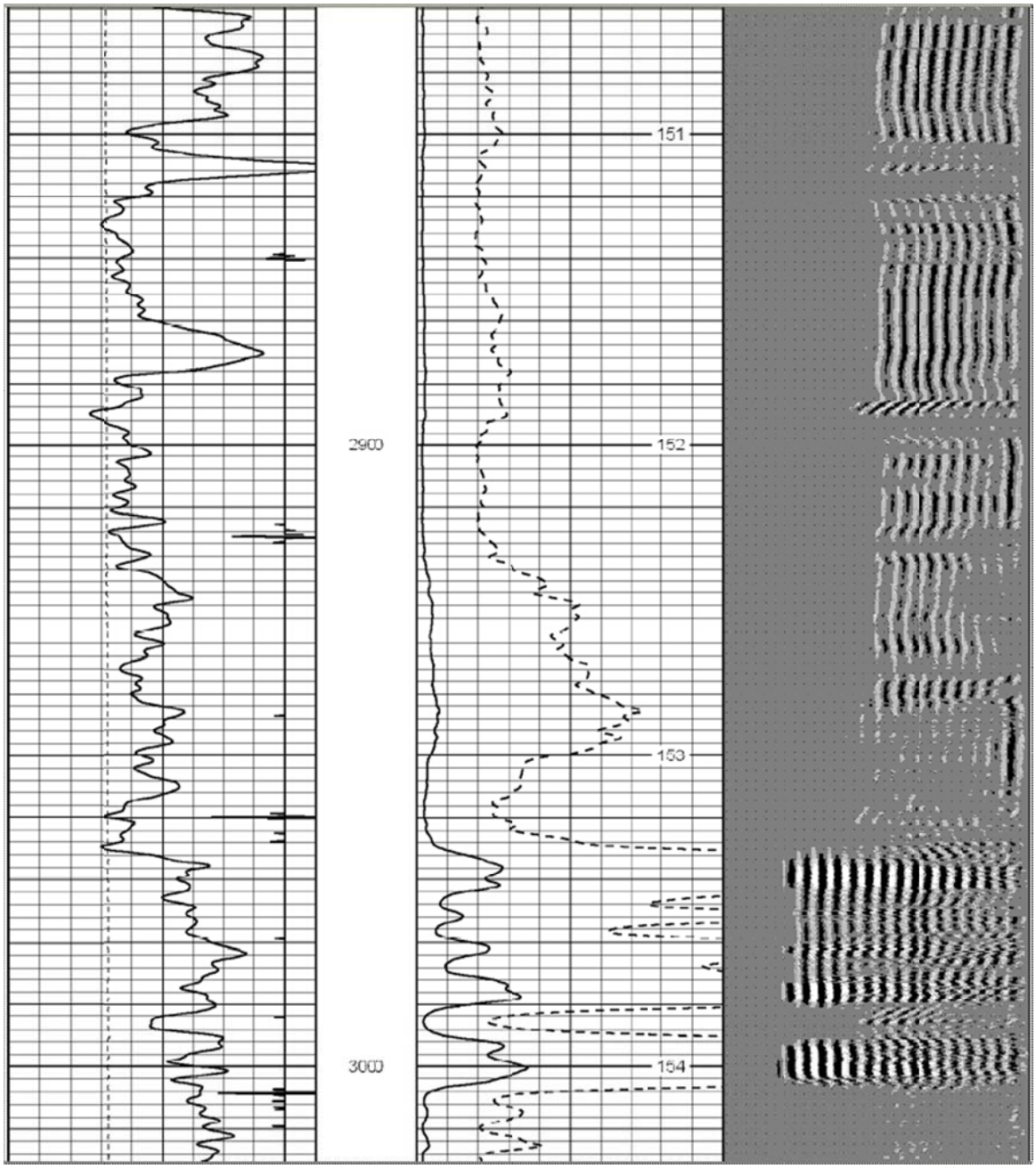
-9 CCL 1
0 LINE TENSION (lb) 2500
280 TRAVEL TIME (usec) 180
0 Amplitude X10 (mV) 10
0 AMPLITUDE (mV) 100
TEMP (degF)
200 VARIABLE DENSITY 1200
3000
3100
154
155
156
156

Logs for Example 3:




0 Gamma Ray (GAPI) 150
-9 CCL 1
0 LINE TENSION (lb) 2500
280 TRAVEL TIME (usec) 180
0 Amplitude X10 (mV) 10
0 AMPLITUDE (mV) 100
TEMP (degF)
200 VARIABLE DENSITY 1200
FREE PIPE
117
146
2700
147
149
2800
150


151
2900
152
153
3000
154