

Company: Noble Energy Inc

Well: Larson A23-645

Field: Wattenberg

County: Weld

State: Colorado

Neutron Log

County: Weld

Field: Wattenberg

Location: SWNW 19-6N-63W

Well: Larson A23-645

Company: Noble Energy Inc

Location: Permanent Datum: SWNW 19-6N-63W  
Log Measured From: 2397 FNL & 535 FWL  
Drilling Measured From: Elev.: K.B. 4679.00 ft  
G.L. 4649.00 ft  
D.F. 4679.00 ft

API Serial No. 05-123-45515

Ground Level Kelly Bushing Kelly Bushing

Section: 19

Township: 6N

Range: 63W

Logging Date	17-Jun-2018		
Run Number	UltraSonic - Nuutron		
Depth Driller	18040.00 ft		
Schlumberger Depth	18040.00 ft		
Bottom Log Interval	5990.00 ft		
Top Log Interval	100.00 ft		
Casing Fluid Type	Water		
Salinity			
Density	8.4 lbm/gal		
Fluid Level	8.00 ft		
BIT/CASING/TUBING STRING			
Bit Size	8.50 in		
From	1970.00 ft		
To	18040.00 ft		
Casing/Tubing Size	5.5 in		
Weight	20 lbm/ft		
Grade	N/A		
From	0.00 ft		
To	18025.60 ft		
Max Recorded Temperatures	185.6 degF		
Logger on Bottom	17-Jun-2018	12:02:00	
Unit Number	Location: OSLC-EA 2377	Ft. Morgan	
Recorded By	L. Awalt		
Witnessed By	B. Mansfield		

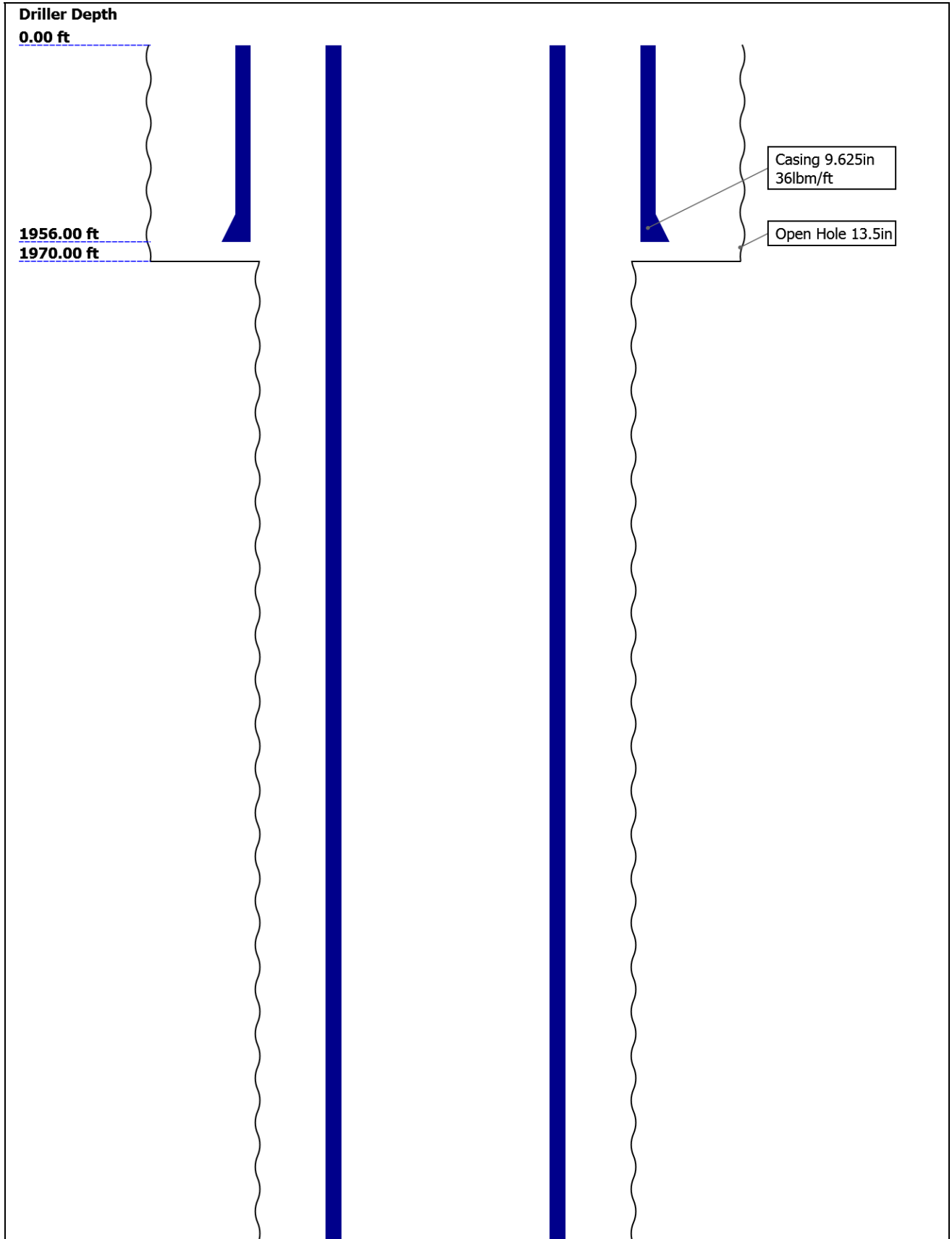
Disclaimer

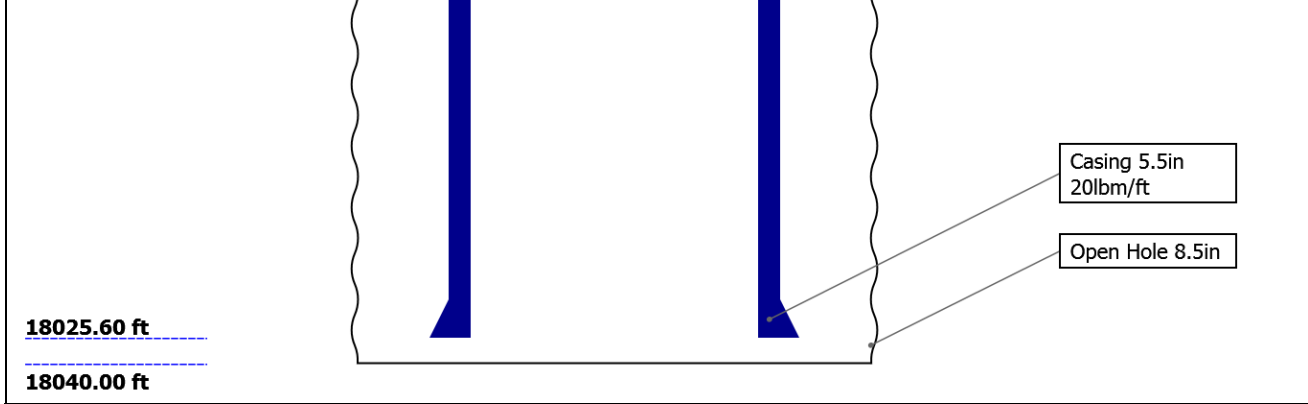
THE USE OF AND RELIANCE UPON THIS RECORDED-DATA BY THE HEREIN NAMED COMPANY (AND ANY OF ITS AFFILIATES, PARTNERS, REPRESENTATIVES, AGENTS, CONSULTANTS AND EMPLOYEES) IS SUBJECT TO THE TERMS AND CONDITIONS AGREED UPON BETWEEN SCHLUMBERGER AND THE COMPANY, INCLUDING: (a) RESTRICTIONS ON USE OF THE RECORDED-DATA; (b) DISCLAIMERS AND WAIVERS OF WARRANTIES AND REPRESENTATIONS REGARDING COMPANY'S USE AND RELIANCE UPON THE RECORDED-DATA; AND (c) CUSTOMER'S FULL AND SOLE RESPONSIBILITY FOR ANY INFERENCE DRAWN OR DECISION MADE IN CONNECTION WITH THE USE OF THIS RECORDED-DATA.

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## Well Sketch



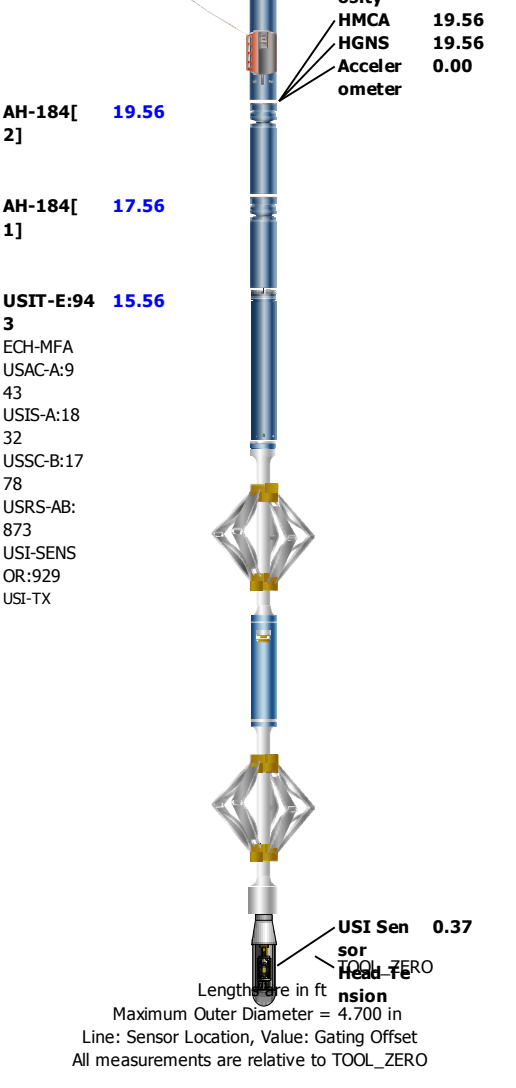


Borehole Size/Casing/Tubing Record

Bit						
Bit Size ( in )	13.5	8.5				
Top Driller ( ft )	0	1970				
Top Logger ( ft )	0	1970				
Bottom Driller ( ft )	1970	18040				
Bottom Logger ( ft )	1970	18040				
Casing						
Size ( in )	9.625	5.5				
Weight ( lbm/ft )	36	20				
Inner Diameter ( in )	8.921	4.778				
Grade	N/A	N/A				
Top Driller ( ft )	0	0				
Top Logger ( ft )	0	0				
Bottom Driller ( ft )	1956	18025.6				
Bottom Logger ( ft )	1956	18025.6				

Remarks and Equipment Summary

UltraSonic - Nuetron: Toolstring				UltraSonic - Nuetron: Remarks		
<div><div>Equip nameLengthMP nameOffset</div><div>LEH-QT38.38LEH-QT</div><div>EDTC-B:8478EDTH-BEDTG-AEDTC-B:8478</div><div>CTEM31.97ACCZ0.00HV0.00Gamma30.1RayTelStatus28.97Temperature28.94GR28.23</div><div>HGNS-H28.97HGNHNSR-F:5203NPV-NHACCZ-H:4168HMCA-HHGNS-H</div><div>CNL Porosity21.89</div></div>	Thank you for choosing Schlumberger!					
	Log run for casing and cement evaluation					
	Tools run centralized as per tool sketch					
	Log run in combination with nuetron log					
	USRS-AB sub run with USI-TX transducer					
	Crew: Doug Robinson, Gary Lapp					



Depth Summary			
UltraSonic - Nuetron			
Depth Measuring Device			
Type	IDW-B		
Serial Number			
Calibration Date			
Calibrator Serial Number			
Calibration Cable Type			
Wheel Correction 1	0		
Wheel Correction 2	0		
Tension Device			
Type	CMTD-B/A		
Serial Number			
Calibration Date			
Calibrator Serial Number			
Number of Calibration Points	0		
Logging Cable			
Type	7-46NT-XS		
Serial Number			
Length	24000.00 ft		
Conveyance Type	Wireline		

Rig Type		
UltraSonic - Nuetron:Depth Control Parameters		Depth Control Remarks
Log Sequence	First Log In the Well	
Rig Up Length At Surface		
Rig Up Length At Bottom		
Rig Up Length Correction		
Stretch Correction		
Tool Zero Check At Surface		

## UltraSonic - Nuetron

## Nuclear

## Integration Summary

Output Channel(s)	Output Description	Input Parameter	Output Value	Unit
ICV	Integrated Cement Volume	GCSE_UP_PASS, FCD	0	ft3
IHV	Integrated Hole Volume	GCSE_UP_PASS	0	ft3

## Software Version

Acquisition System	Version
Maxwell 2017 SP3	7.3.92069.3100
Application Patch	Wireline_NPD-ICE2-2017SP3_7.3.93033
	Wireline_Hotfix-RTDLIS-2017SP3_7.3.92363
	Wireline_Hotfix-SML-2017SP3_7.3.101161
	Wireline_TestKit-CMR-NG-2017SP3_7.3.96073

## Pass Summary

Run Name	Pass Objective	Direction	Top	Bottom	Start	Stop	DSC Mode	Depth Shift	Include Parallel Data
UltraSonic - Nuetron	Log[3]:Up	Up	59.89 ft	6034.41 ft	17-Jun-2018 12:20:22 PM	17-Jun-2018 1:33:10 PM	ON	3.65 ft	Yes

All depths are referenced to toolstring zero

## Log

Company:Noble Energy Inc      Well:Larson A23-645

UltraSonic - Nuetron: Log[3]:Up:S002

Description: AIT Basic Log Two    Format: Log ( Noble Nuclear )    Index Scale: 5 in per 100 ft    Index Unit: ft    Index Type: Measured Depth    Creation Date: 17-Jun-2018 14:39:23

Channel	Source	Sampling
GR	EDTC-B:EDTC-B:EDTC-B	6in
ICV	Borehole	6in - RT
IHV	Borehole	6in - RT
NPOR	HGNS-H:HGNS-H:HGNS-H	6in
TENS	WLWorkflow	6in
TIME_1900	WLWorkflow	0.1in

TIME\_1900 - Time Marked every 60.00 (s)

—IHV - Integrated Hole Volume every 10.00 (ft3)

—IHV - Integrated Hole Volume every 100.00 (ft3)

└ ICV - Integrated Cement Volume every 10.00 (ft3)

— ICV - Integrated Cement Volume every 100.00 (ft3)

Cable Tension (TENS)

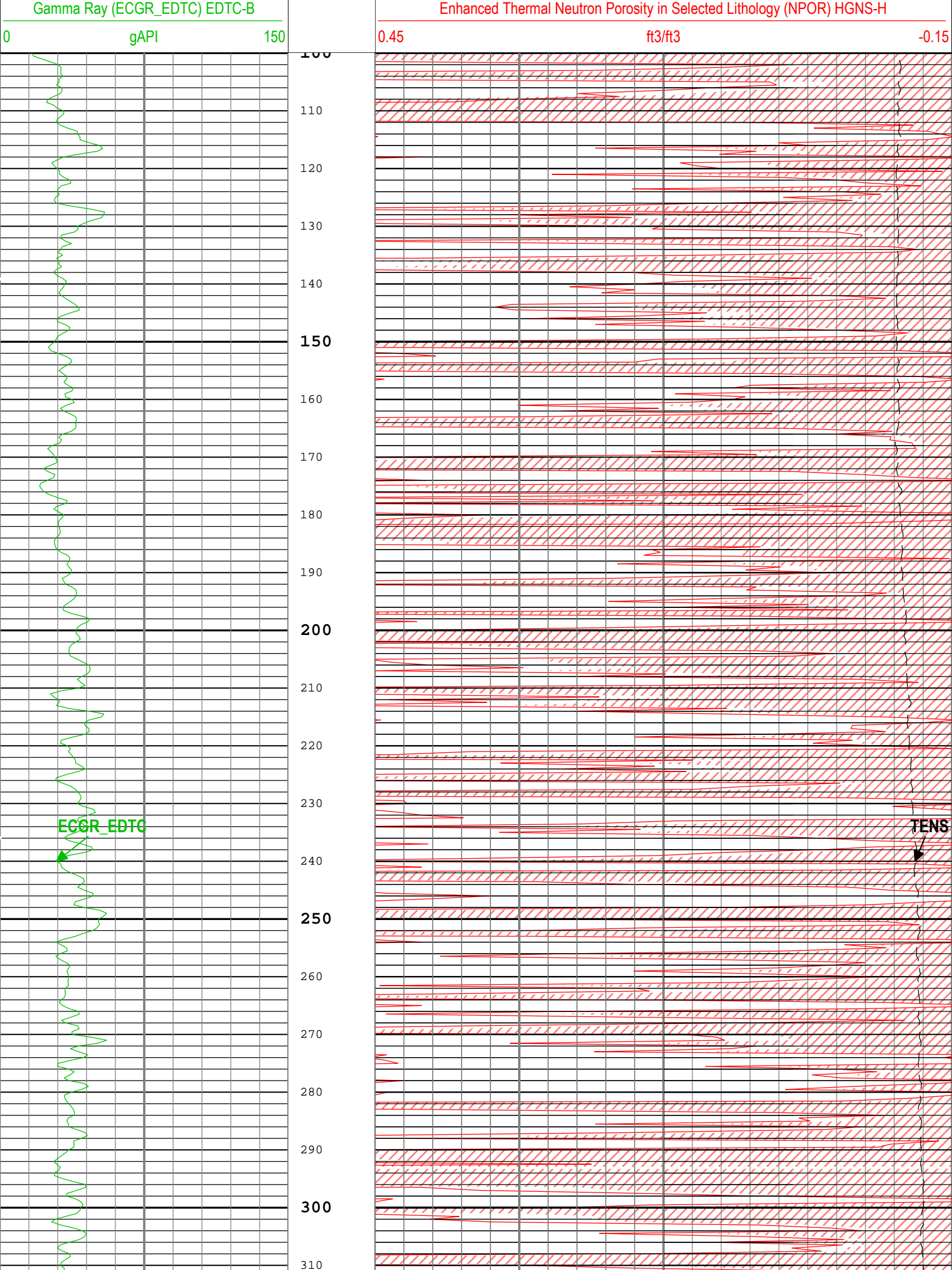
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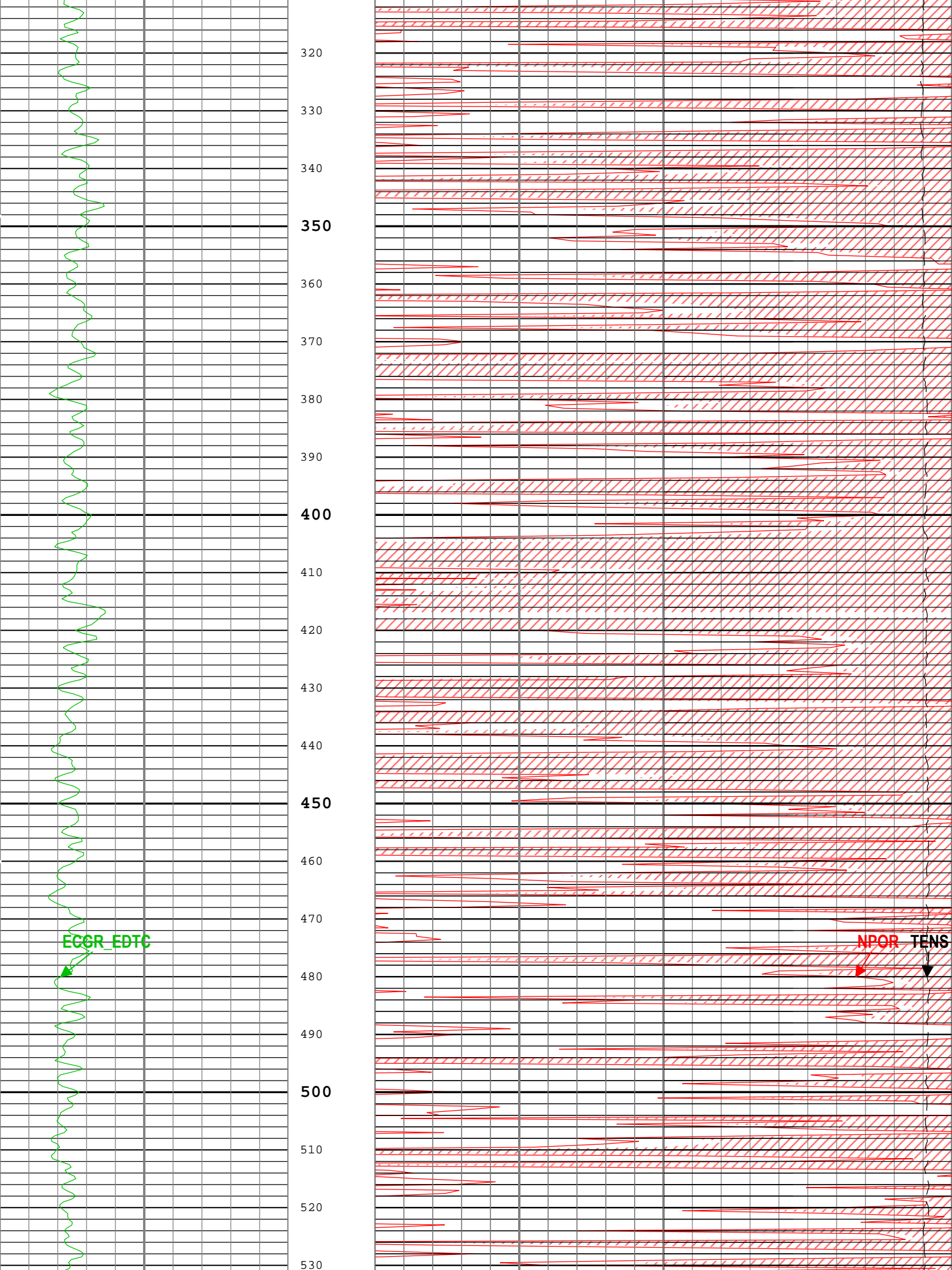
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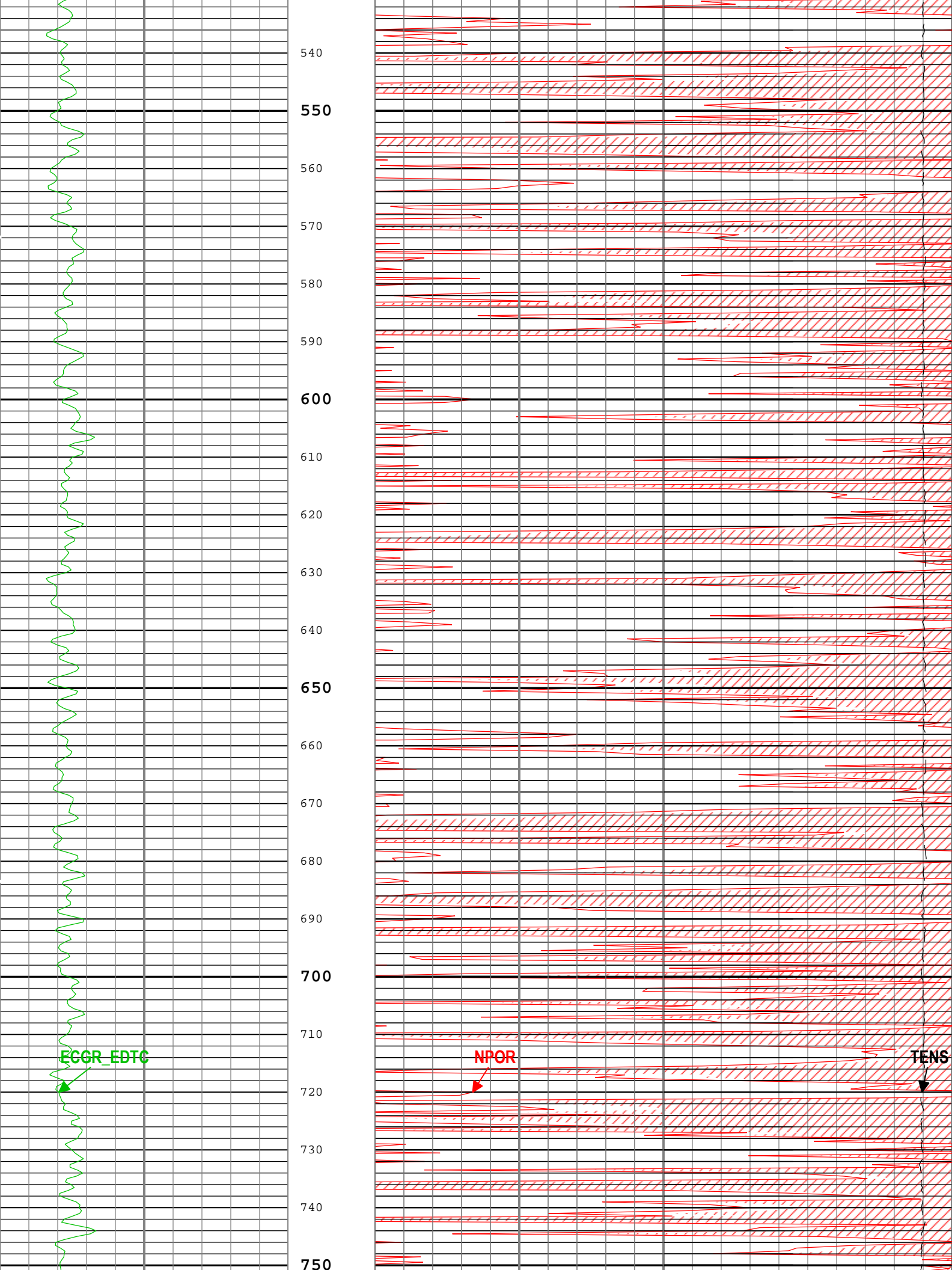
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## GR Backup

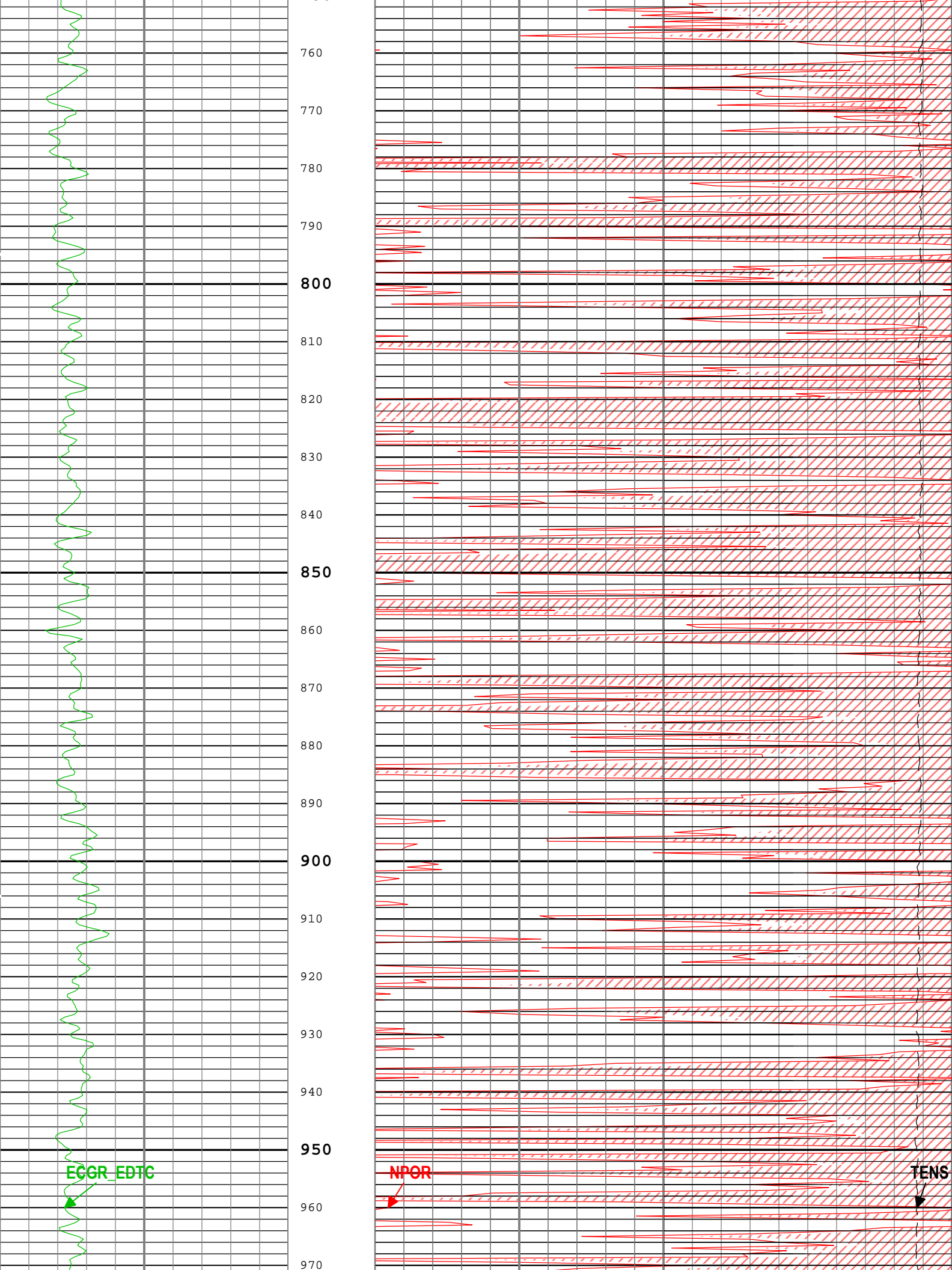
**NPOR Backup**

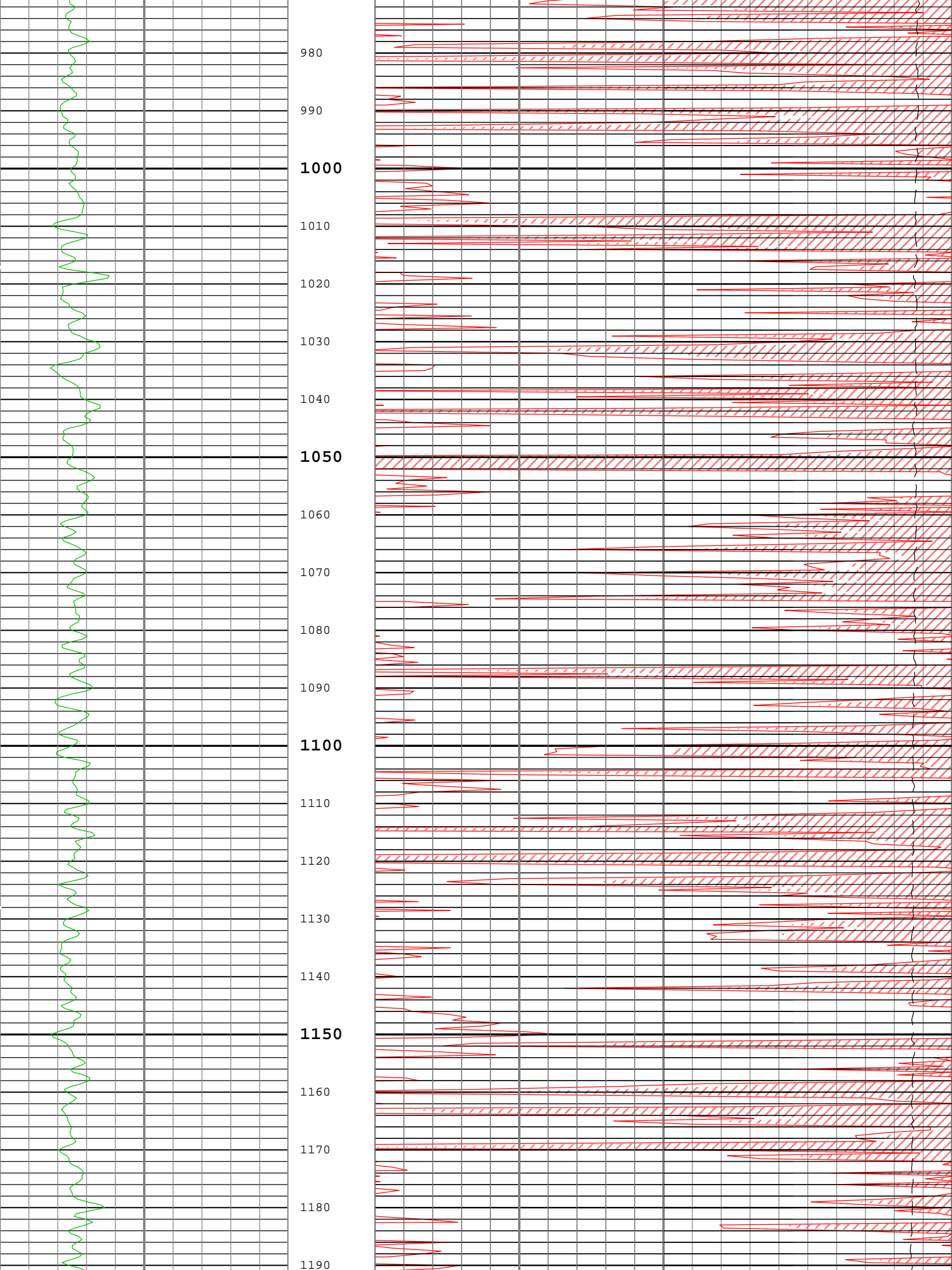


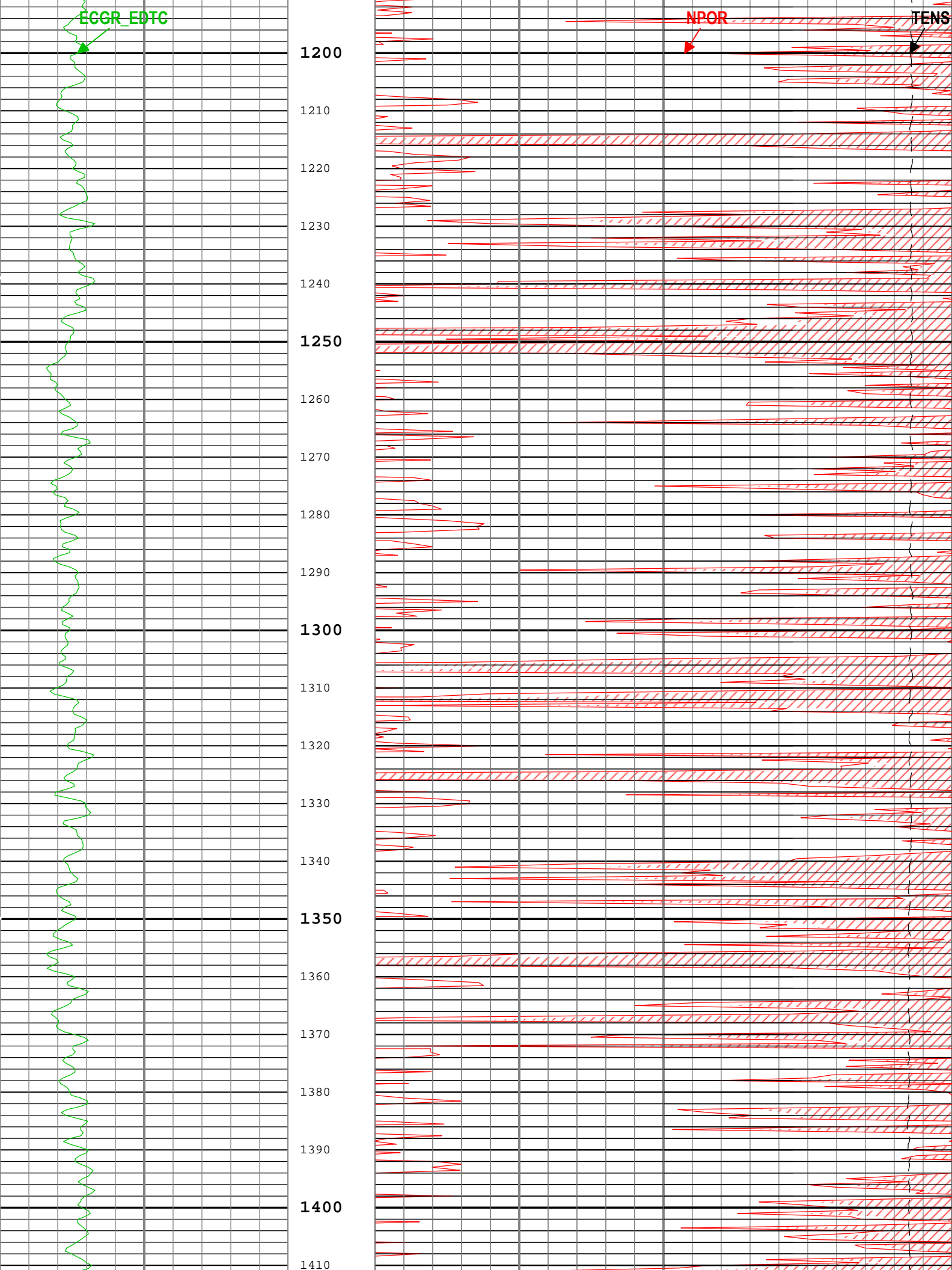


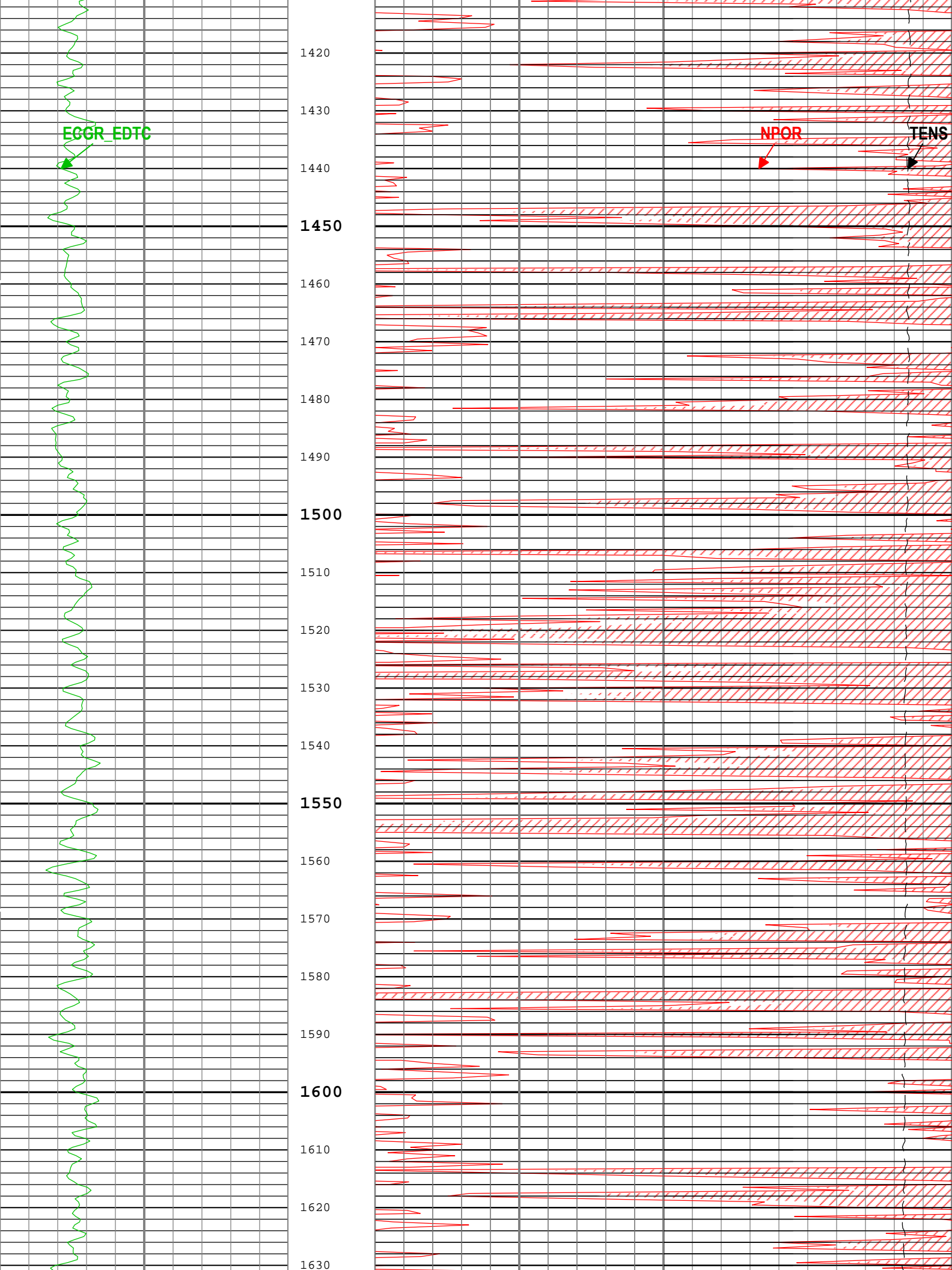


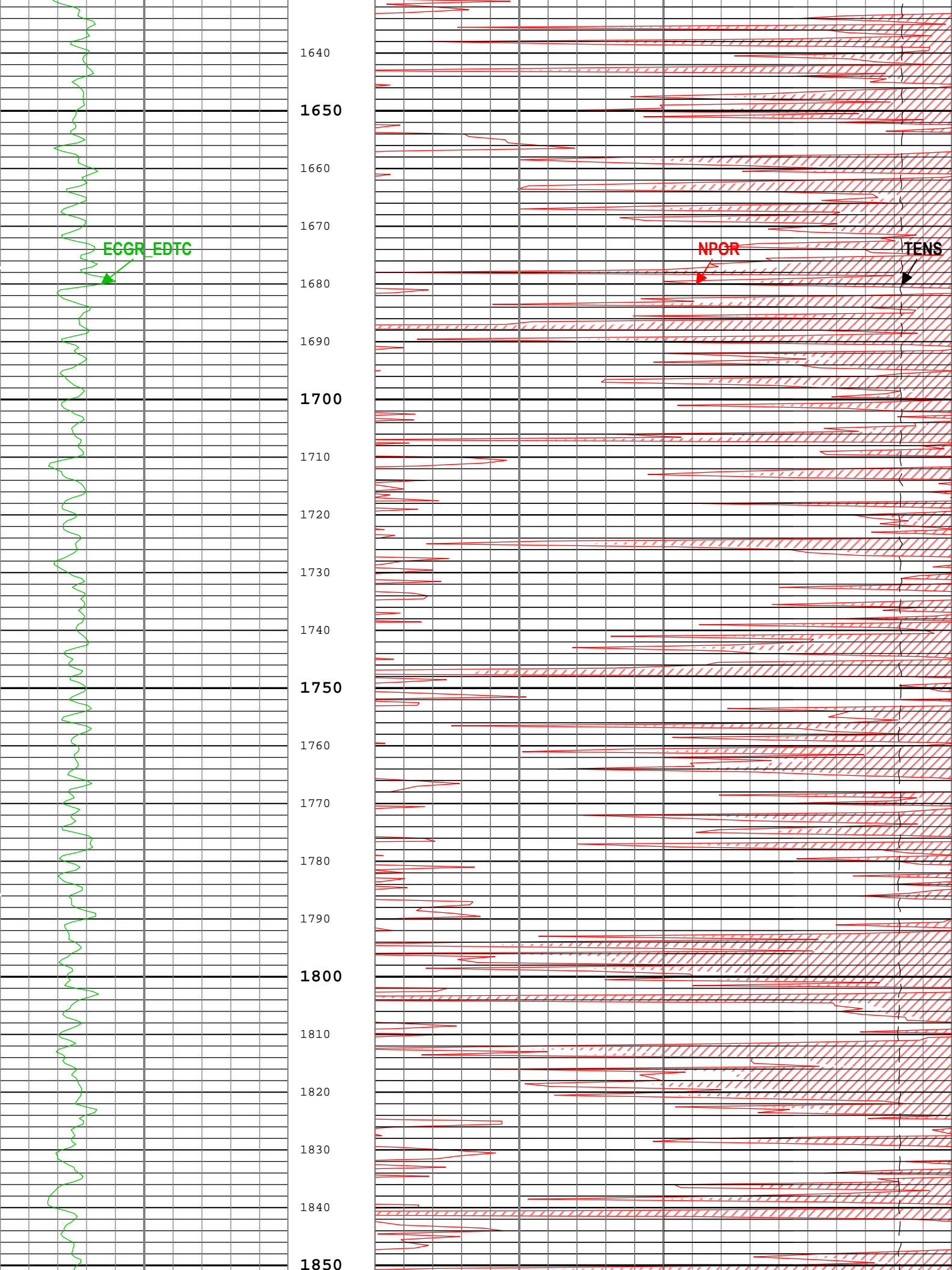


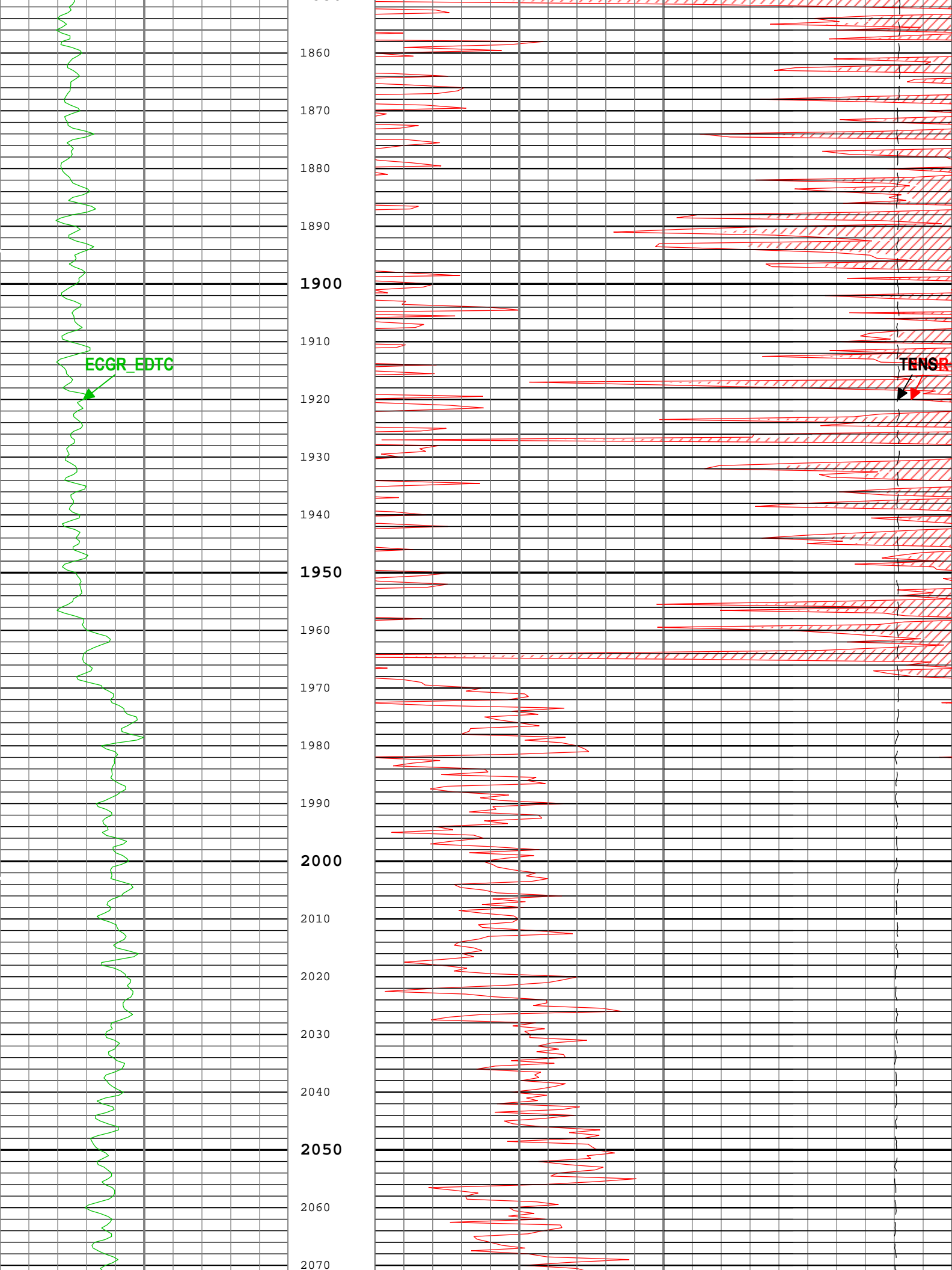


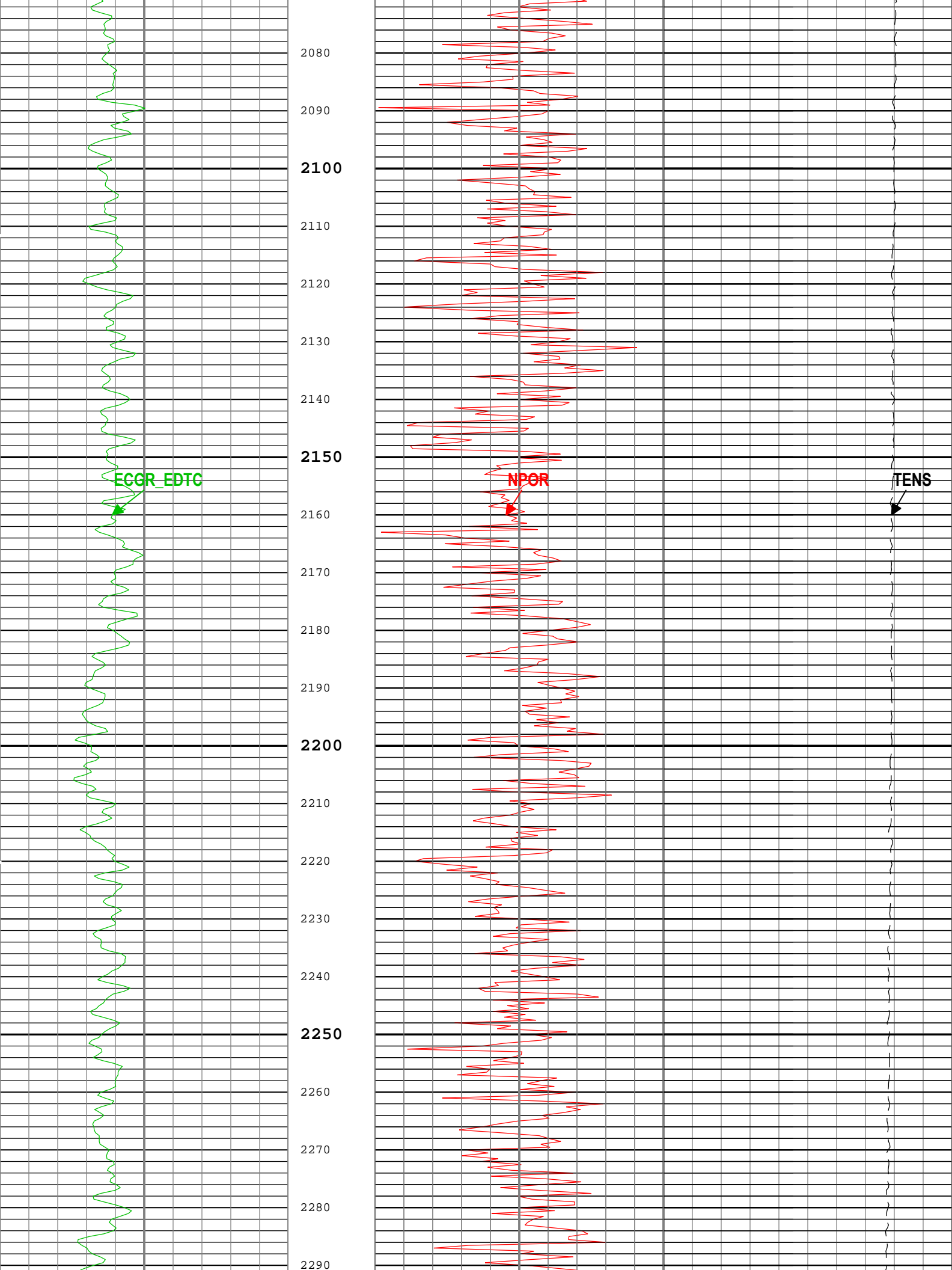


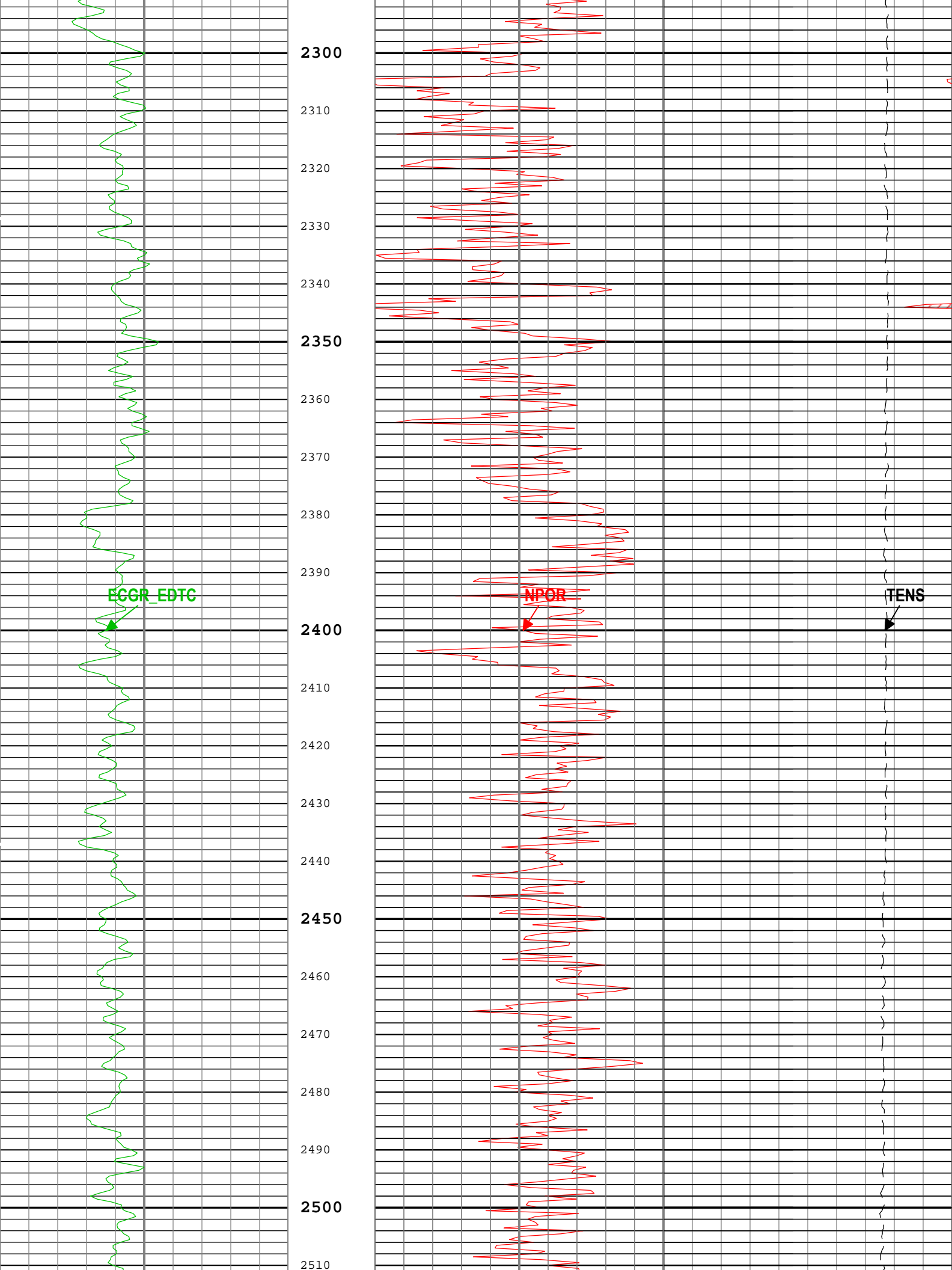




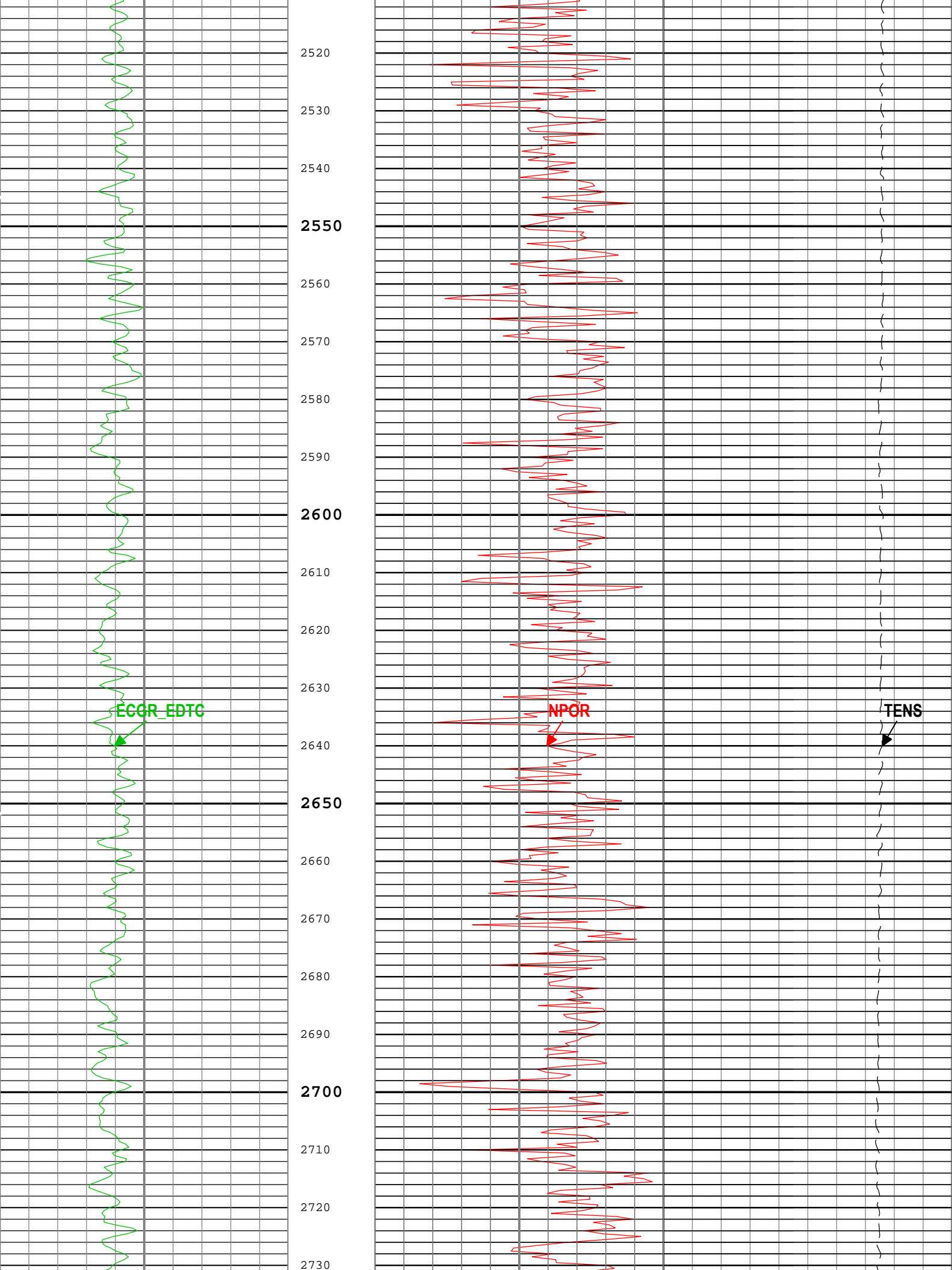


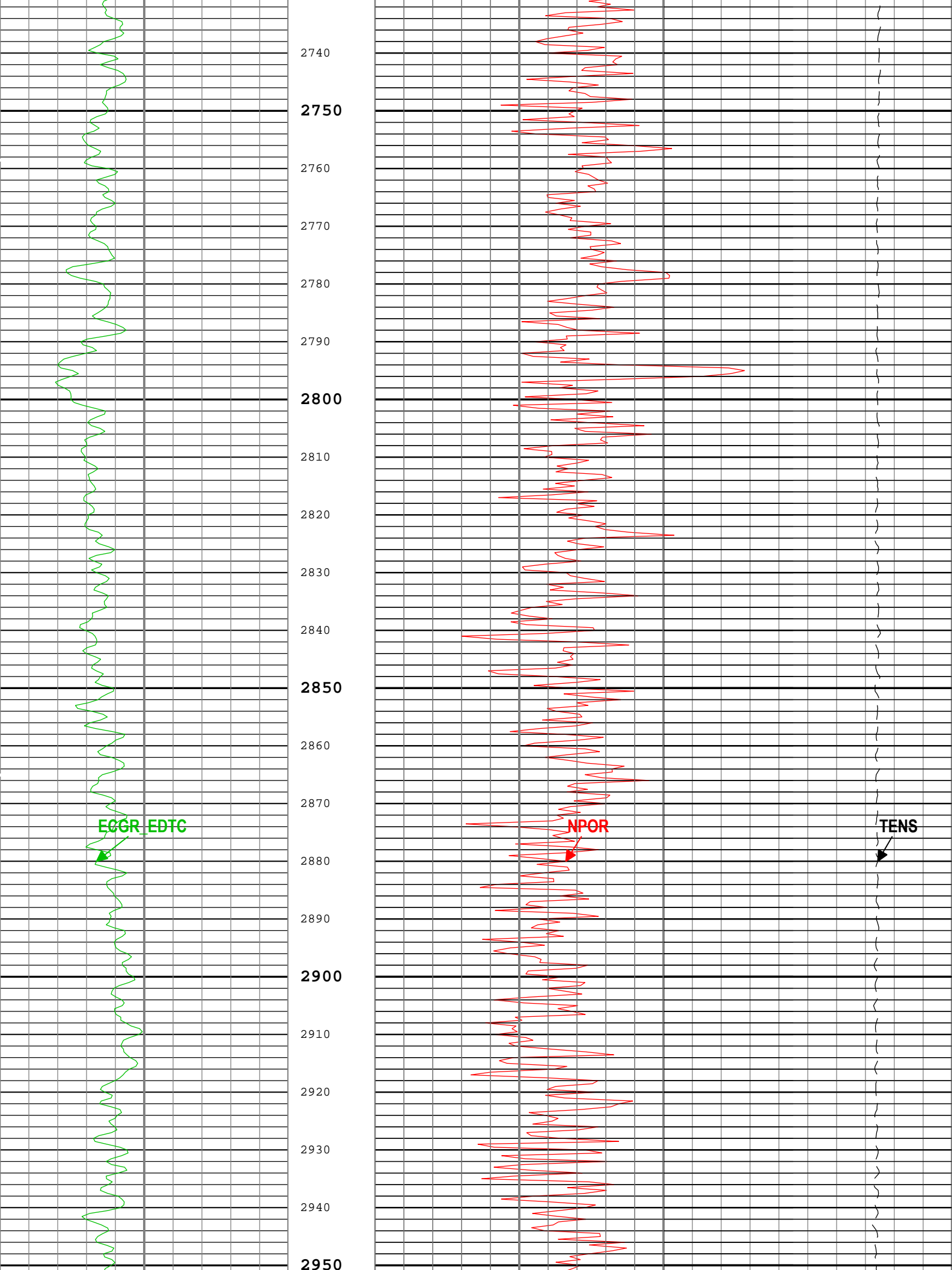


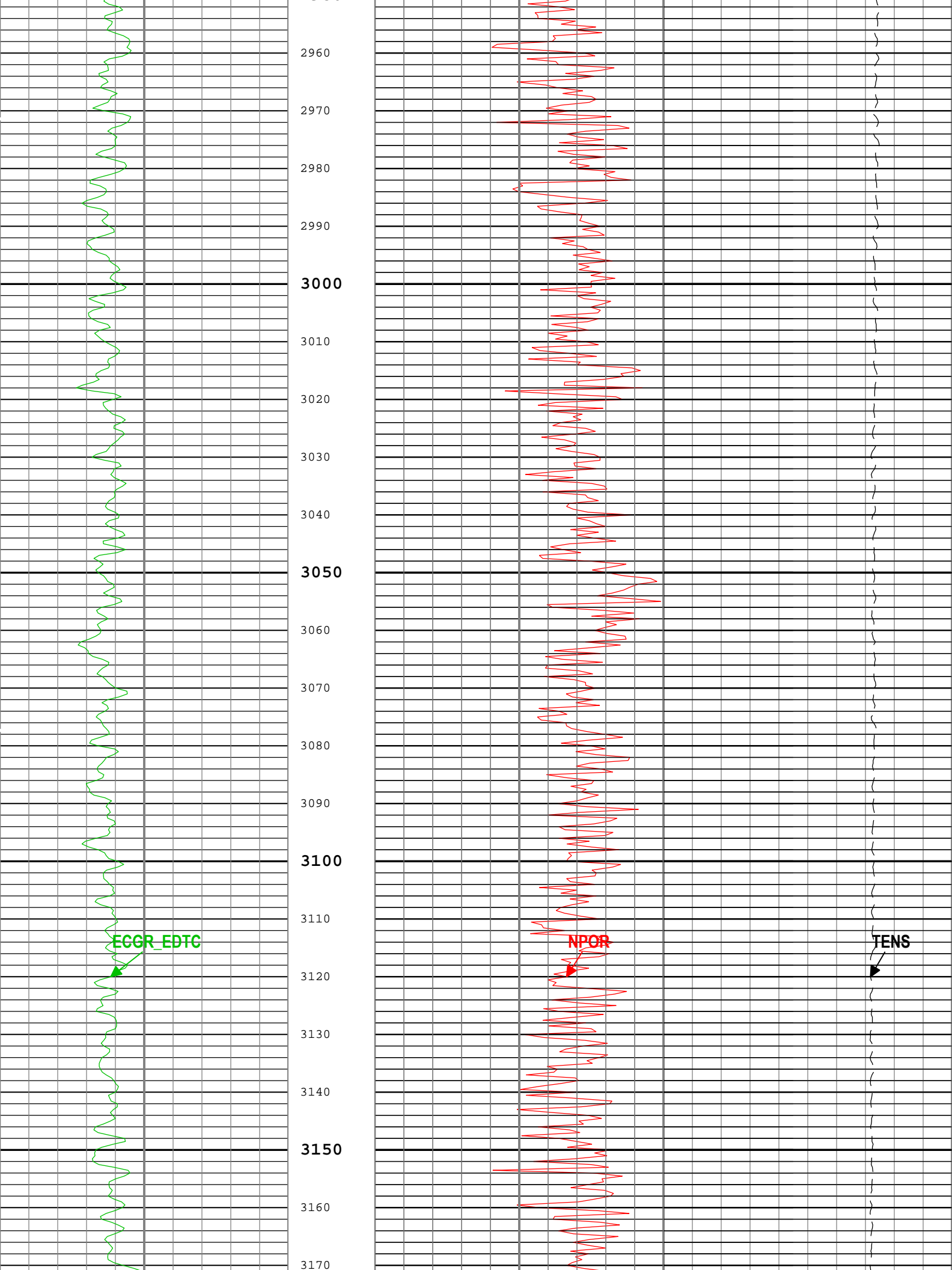


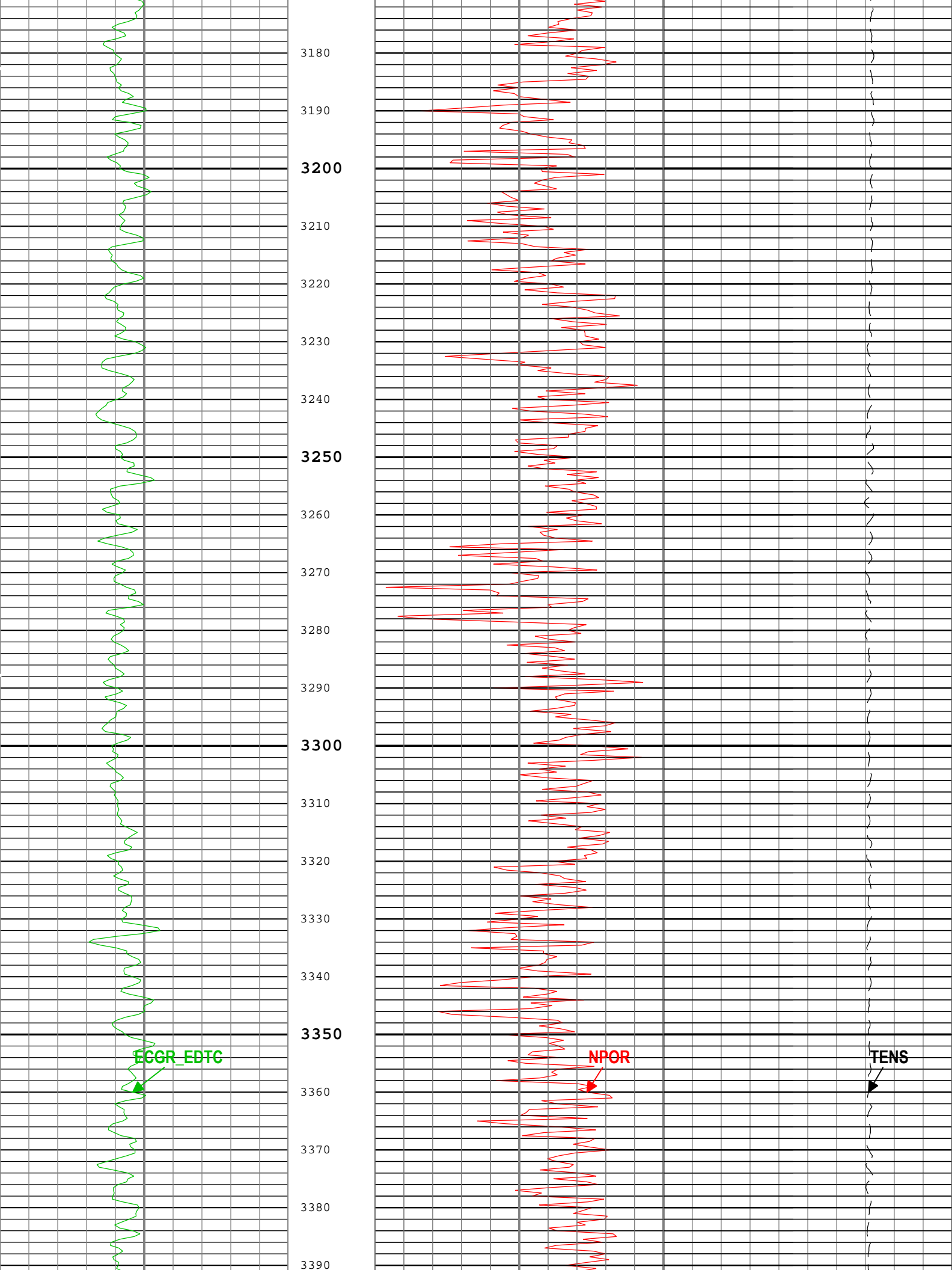


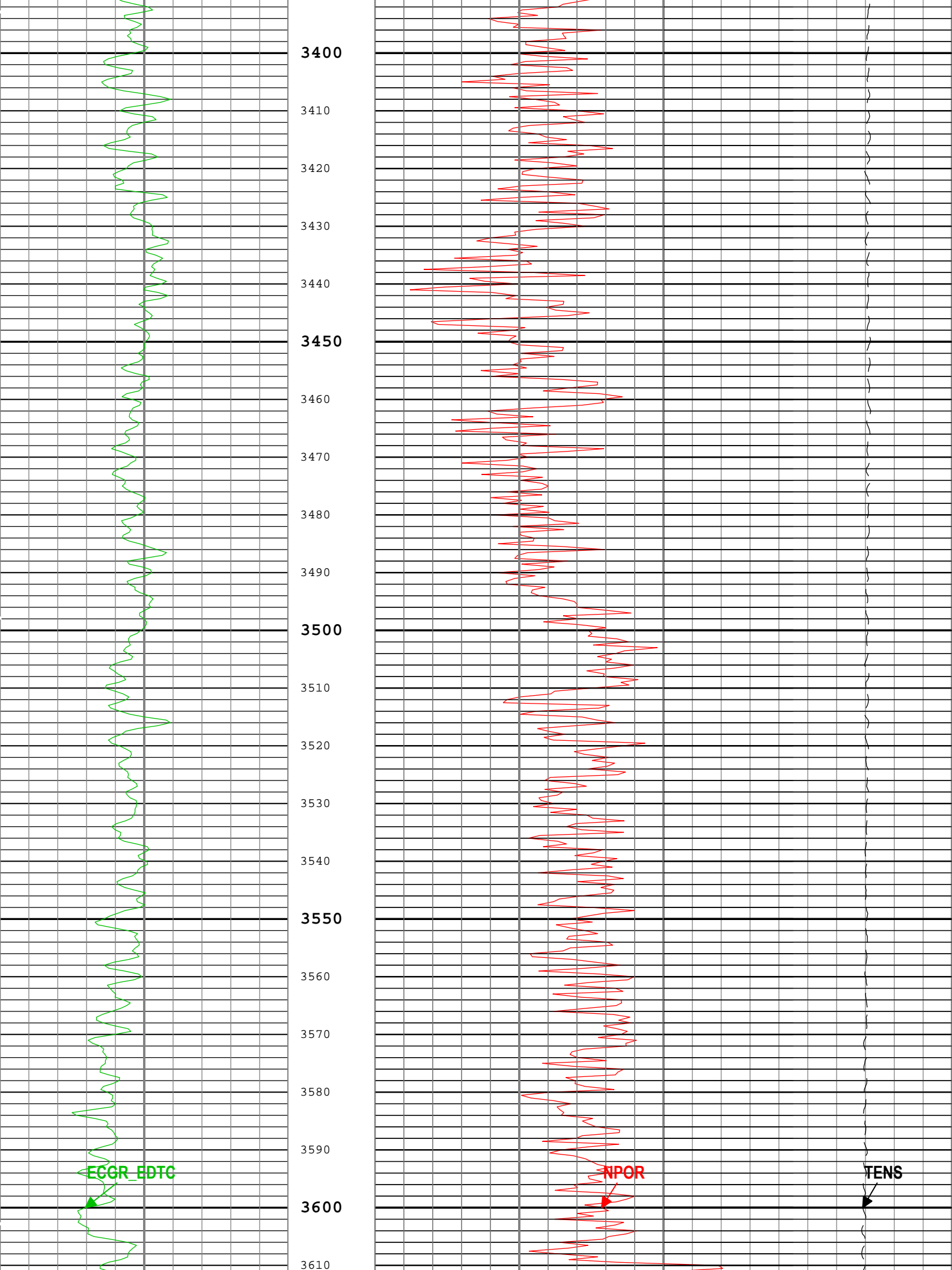


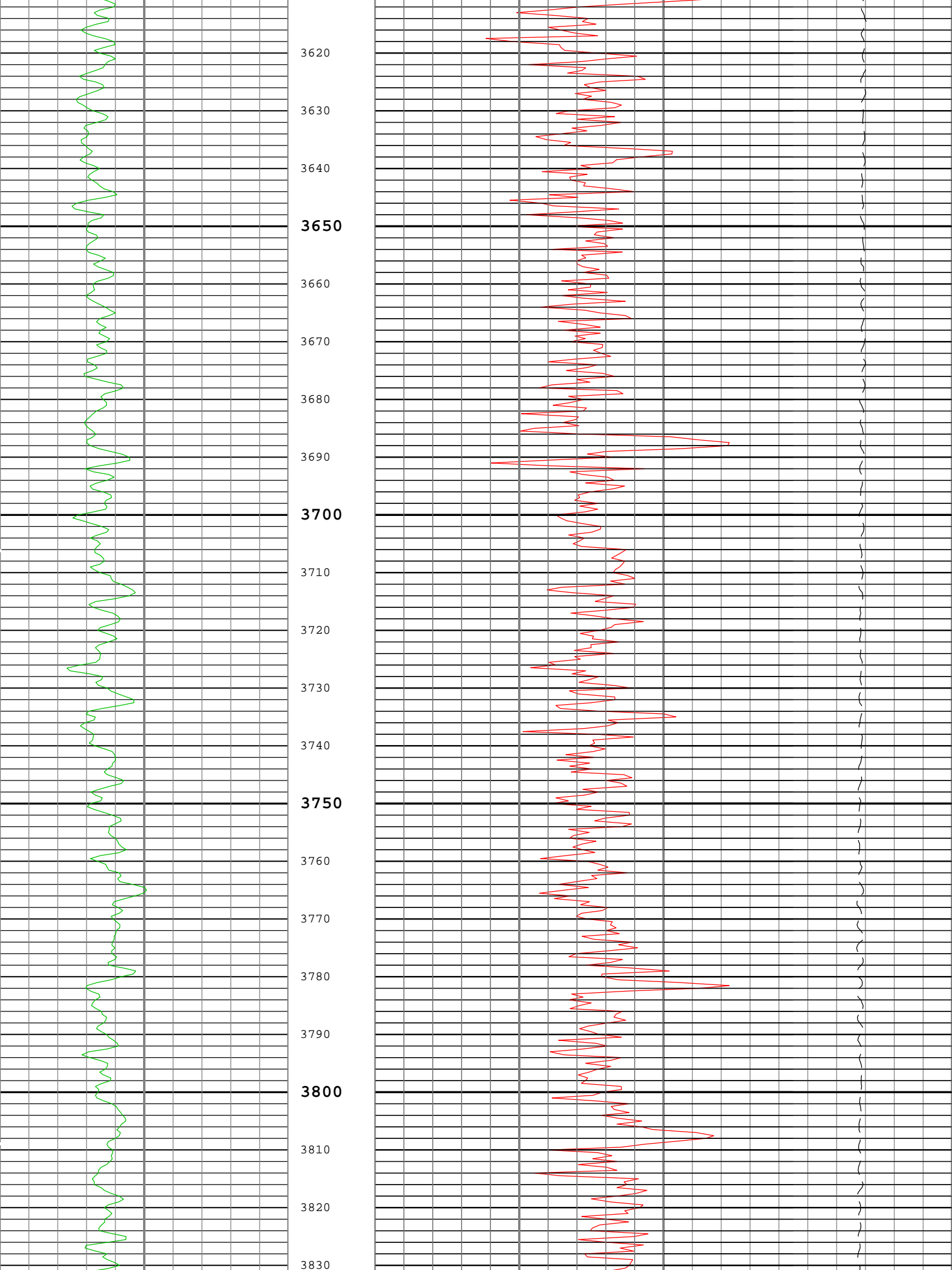


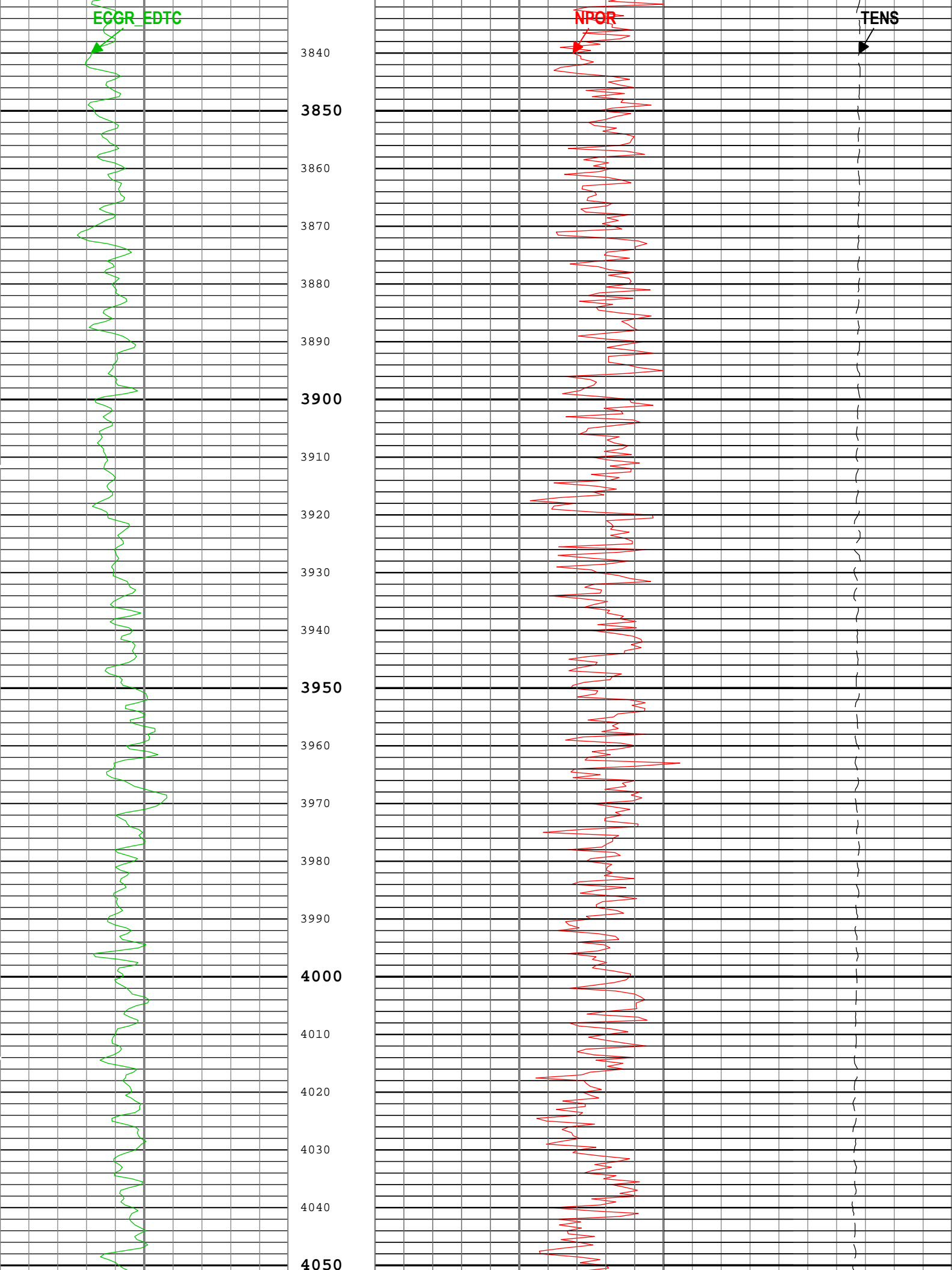


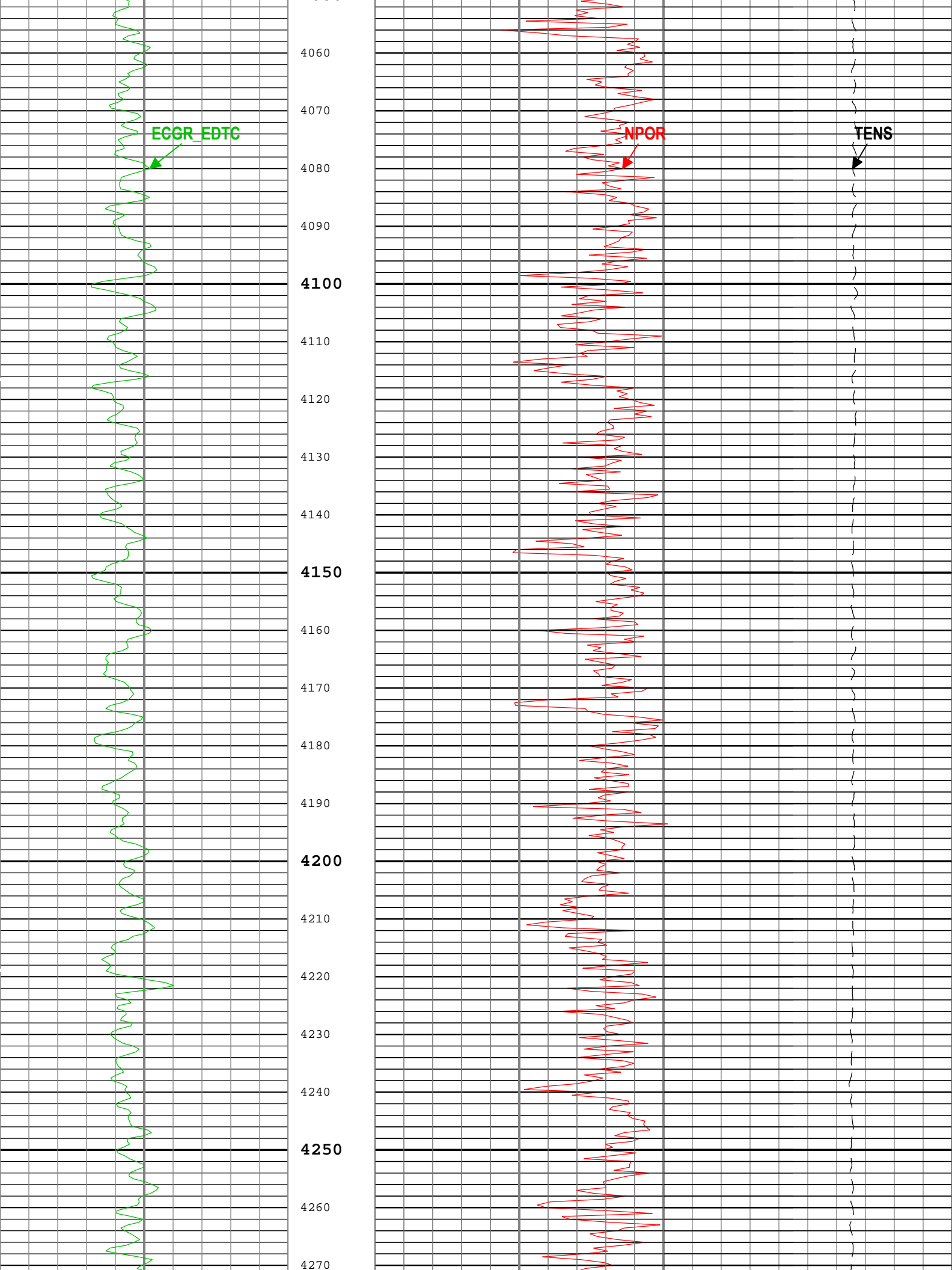




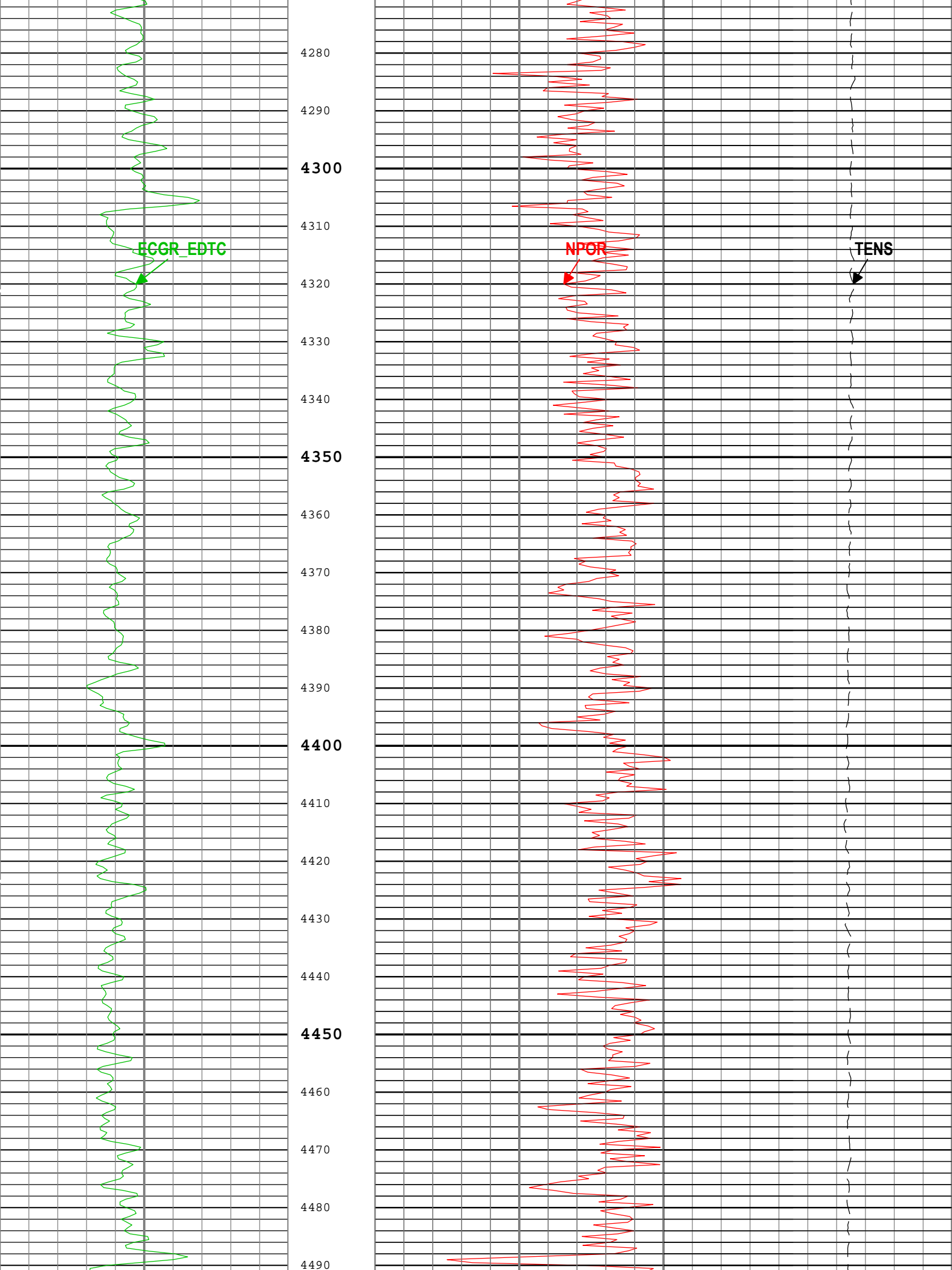


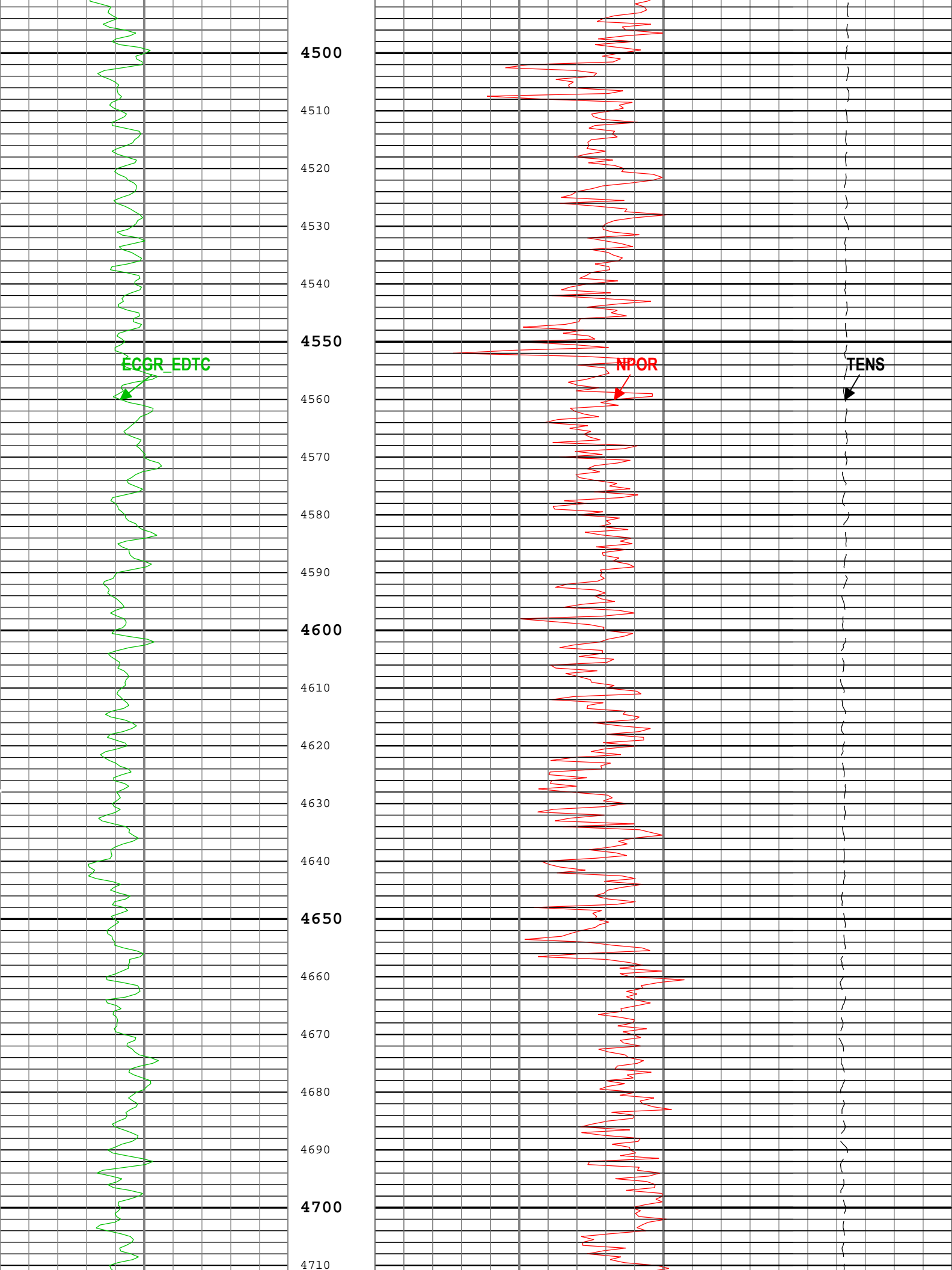


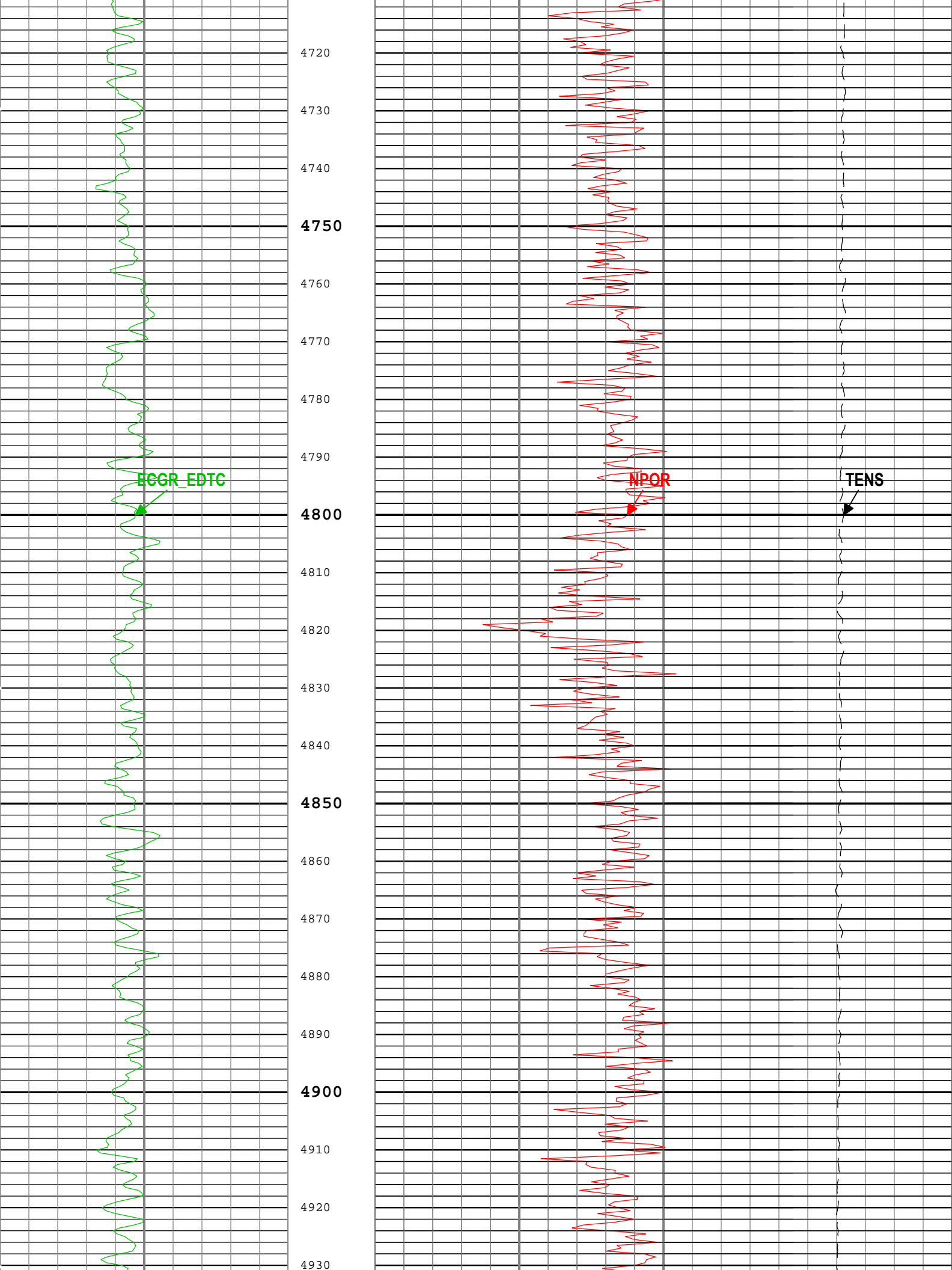


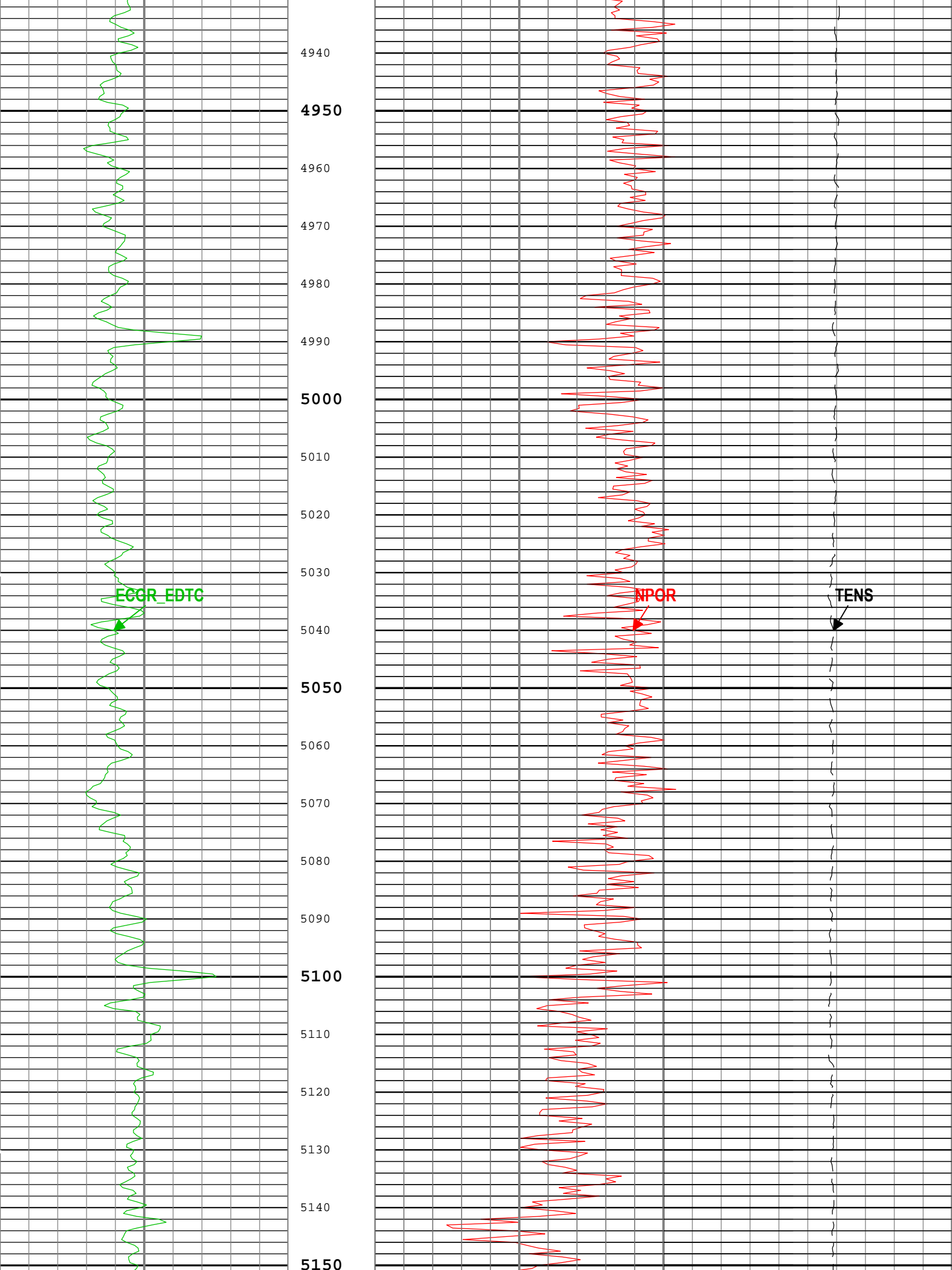


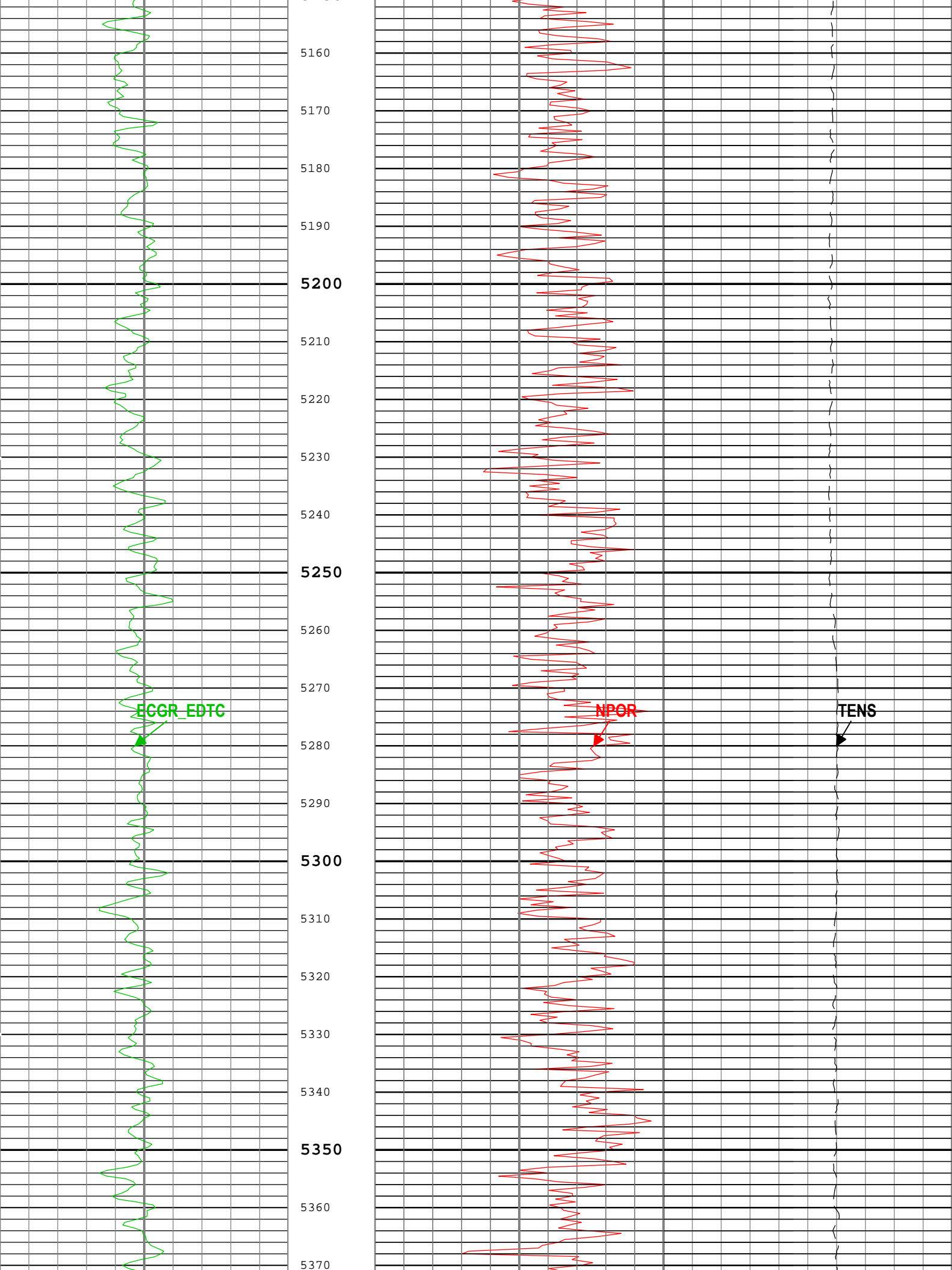


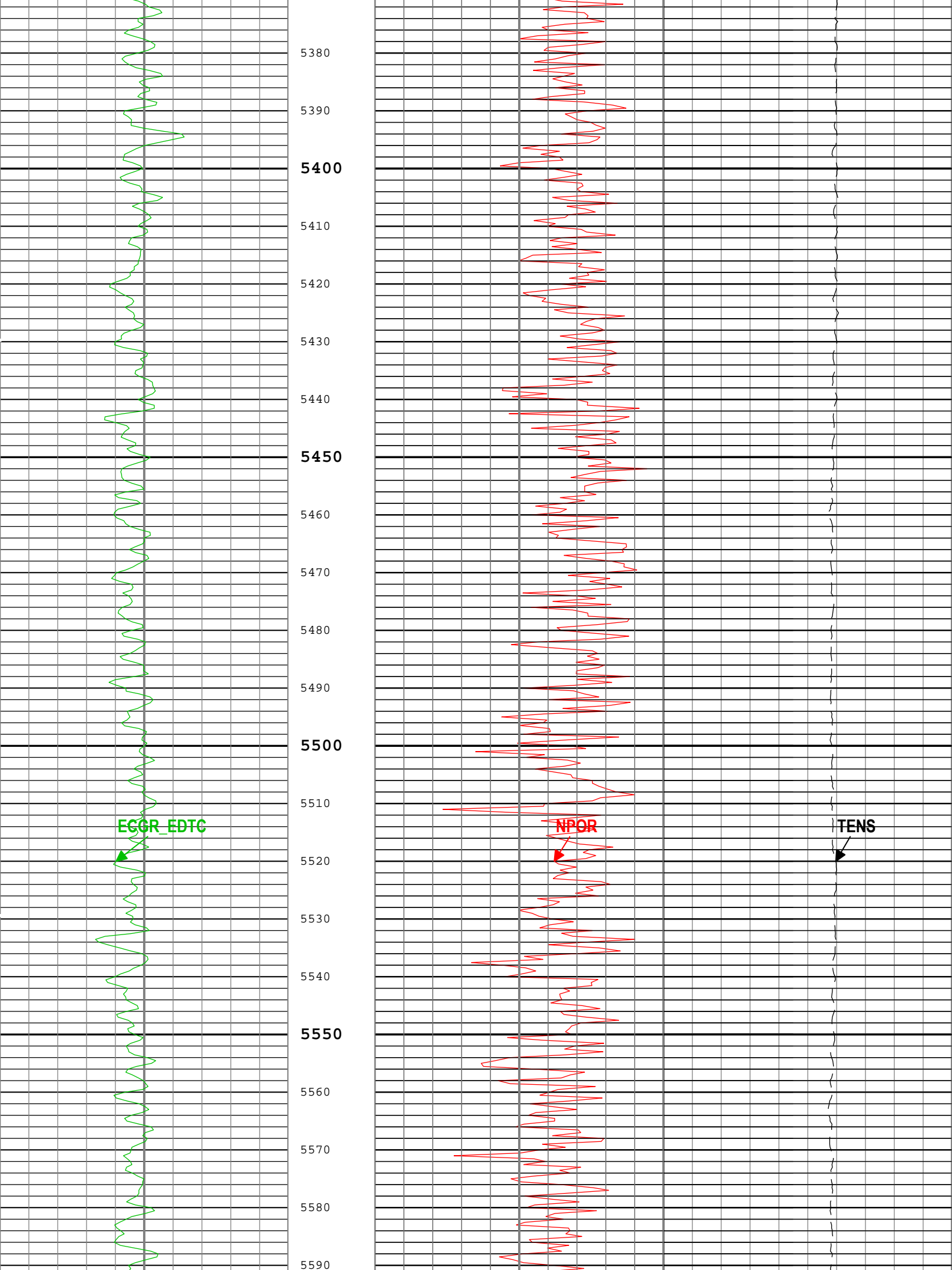


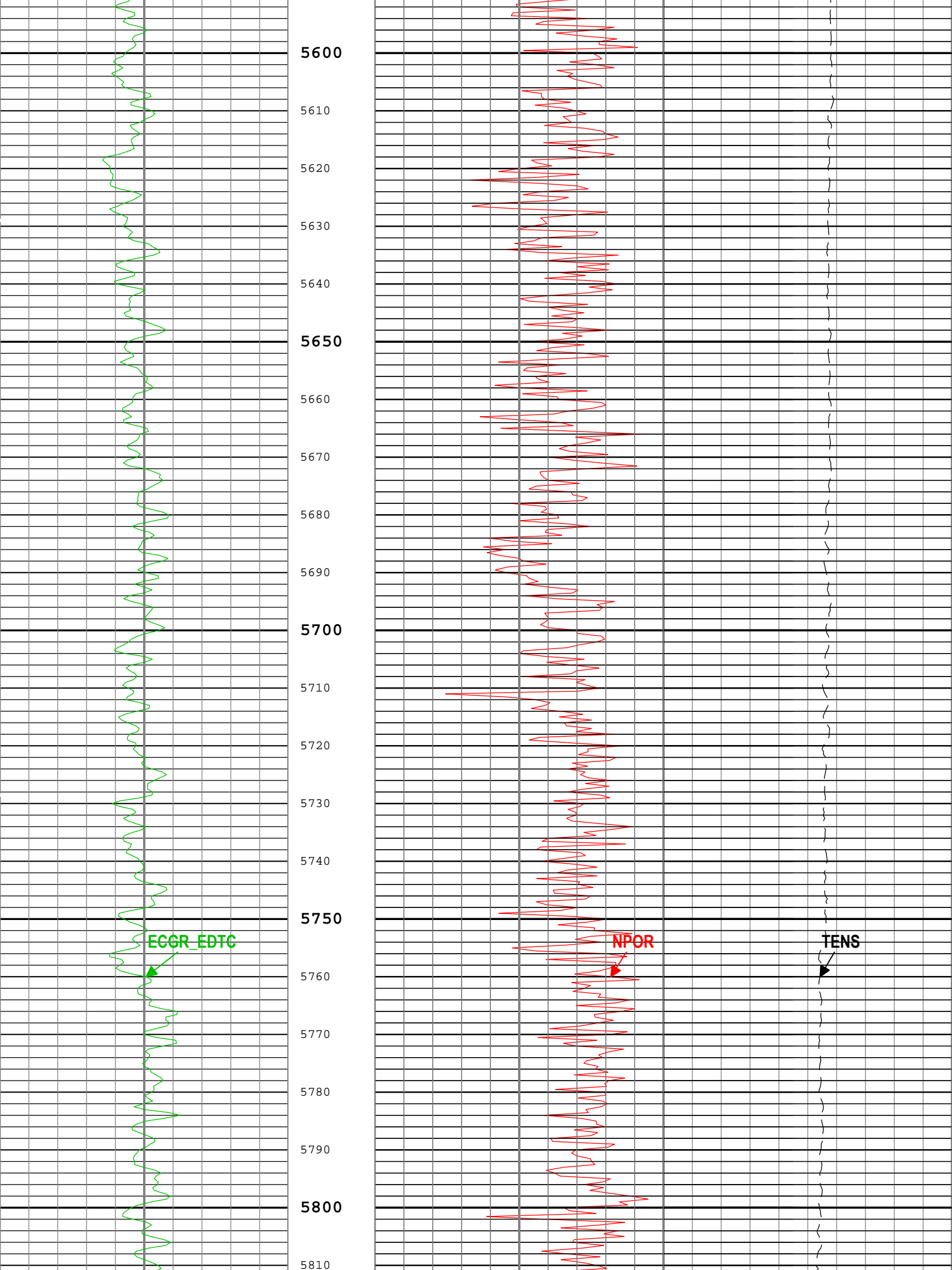


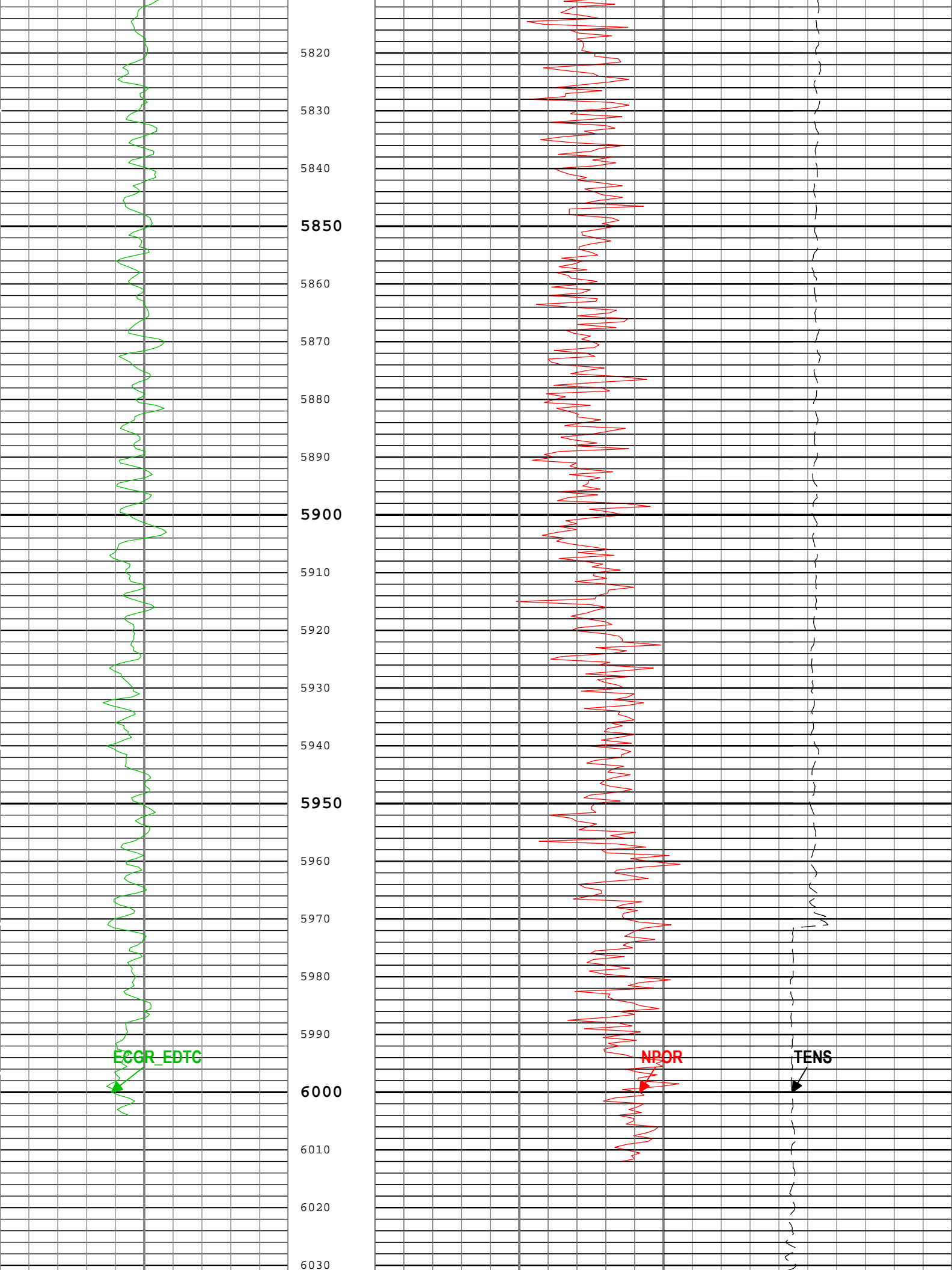














GR Backup										NPOR Backup									
Gamma Ray (ECGR_EDTC) EDTC-B										Enhanced Thermal Neutron Porosity in Selected Lithology (NPOR) HGNS-H									
0gAPI150										0.45ft3/ft3-0.15									
										Cable Tension (TENS) 5000lbf0									
<div> <div>ICV - Integrated Cement Volume every 100.00 (ft3)</div> <div>ICV - Integrated Cement Volume every 10.00 (ft3)</div> <div>IHV - Integrated Hole Volume every 100.00 (ft3)</div> <div>IHV - Integrated Hole Volume every 10.00 (ft3)</div> </div>																			
TIME_1900 - Time Marked every 60.00 (s)																			
Description: AIT Basic Log Two										Format: Log ( Noble Nuclear )									
17-Jun-2018 14:39:23										Index Scale: 5 in per 100 ft									
										Index Unit: ft									
										Index Type: Measured Depth									
										Creation Date:									

Channel Processing Parameters				
UltraSonic - Nuetron: Parameters				
Parameter	Description	Tool	Value	Unit
ISSBAR	Barite Mud Presence Flag	Borehole	No	
BHS	Borehole Status (Open or Cased Hole)	Borehole	Cased	
BHT	Bottom Hole Temperature	Borehole	212	degF
BS	Bit Size	WLSESSION	Depth Zoned	in
BSAL	Borehole Salinity	Borehole	0	ppm
CBLO	Casing Bottom (Logger)	WLSESSION	18025.6	ft
CDEN	Cement Density	EDTC-B	2	g/cm3
CMTY(U-USIT_CEMT)	Cement Type	USIT-E	Regular Cement	
CSODDRL	Casing Outer Diameter - Zoned along driller depths	WLSESSION	5.5	in
DC_MODE	Depth Correction Mode	DepthCorrection	Real-time	
DFD	Drilling Fluid Density	Borehole	8.4	lbm/gal
DFT_CATEGORY	Drilling Fluid Type	Borehole	Water	
FSAL	Formation Salinity	Borehole	0	ppm
GCSE_DOWN_PASS	Generalized Caliper Selection for WL Log Down Passes	Borehole	BS(RT)	
GCSE_UP_PASS	Generalized Caliper Selection for WL Log Up Passes	Borehole	BS(RT)	
GRSE	Generalized Mud Resistivity Selection, from Measured or Computed Mud Resistivity	Borehole	REMS(RT)	
GTSE	Generalized Temperature Selection, from Measured or Computed Temperature	Borehole	CTEM	
HSCO	Hole Size Correction Option	HGNS-H	Yes	
IMAR	Image Rotation	USIT-E	Off	
MATR	Rock Matrix for Neutron Porosity Corrections	Borehole	LIMESTONE	
MFST	Mud Filtrate Sample Temperature	Borehole	68	degF
MST	Mud Sample Temperature	Borehole	68	degF
RMFS	Resistivity of Mud Filtrate Sample	Borehole	0.15	ohm.m
RMS	Resistivity of Mud Sample	Borehole	0.2	ohm.m
U-USIT_DFSZ	Drilling Fluid Specific Acoustic Impedance	USIT-E	0.1	Mrayl
USI_FVEL_SEL	USI Fluid Velocity Selection	USIT-E	Automatic	
USI_ZMUD_SEL	USI Mud Impedance Selection	USIT-E	Theoretical	

Depth Zone Parameters			
Parameter	Value	Start ( ft )	Stop ( ft )
BS	13.5	100	1970
BS	8.5	1970	6034.5

All depth are actual.

Tool Control Parameters

UltraSonic - Nuetron: Parameters

Parameter	Description	Tool	Value	Unit
HMCA_BOARD_TYPE	HMCA Board Type	HGNS-H	1	
MAX_LOG_SPEED	Toolstring Maximum Logging Speed	WLSESSION	3600	ft/h
ULOG	Logging Objective	USIT-E	MEASUREMENT	
UPAT	USIT Emission Pattern	USIT-E	Pattern 375 KHz	
UWKM	USIT Working Mode	USIT-E	Uncompressed 10 deg at 6.0 in	

UltraSonic - Nuetron

Nuclear Repeat Analysis

Software Version

Acquisition System	Version
Maxwell 2017 SP3	7.3.92069.3100
Application Patch	Wireline_NPD-ICE2-2017SP3_7.3.93033
	Wireline_Hotfix-RTDLIS-2017SP3_7.3.92363
	Wireline_Hotfix-SML-2017SP3_7.3.101161
	Wireline_TestKit-CMR-NG-2017SP3_7.3.96073

Pass Summary

Run Name	Pass Objective	Direction	Top	Bottom	Start	Stop	DSC Mode	Depth Shift	Include Parallel Data
UltraSonic - Nuetron	Log[1]:Up	Up	2001.77 ft	2512.84 ft	17-Jun-2018 12:03:49 PM	17-Jun-2018 12:07:49 PM	ON	1.95 ft	Yes
UltraSonic - Nuetron	Log[3]:Up	Up	59.89 ft	6034.41 ft	17-Jun-2018 12:20:22 PM	17-Jun-2018 1:33:10 PM	ON	3.65 ft	Yes

All depths are referenced to toolstring zero

Log

Company:Noble Energy Inc    Well:Larson A23-645  
UltraSonic - Nuetron: Log[3]:Up:S002

Description: AIT Basic Log Two    Format: Noble Nuclear RA    Index Scale: 5 in per 100 ft    Index Unit: ft    Index Type: Measured Depth    Creation Date: 17-Jun-2018 14:39:33

- IHV - Integrated Hole Volume every 10.00 (ft3)

— IHV - Integrated Hole Volume every 100.00 (ft3)
- TIME\_1900 - Time Marked every 60.00 (s)
- ICV - Integrated Cement Volume every 10.00 (ft3)

— ICV - Integrated Cement Volume every 100.00 (ft3)

Main To Repeat

Repeat To Main

Cable Tension (TENS)

5000      lbf      0

Main To Repeat

Repeat To Main

Gamma Ray (ECGR\_EDTC) EDTC-B

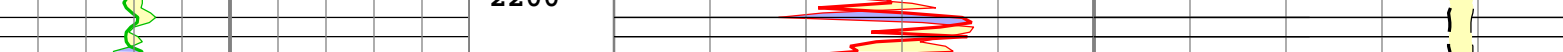
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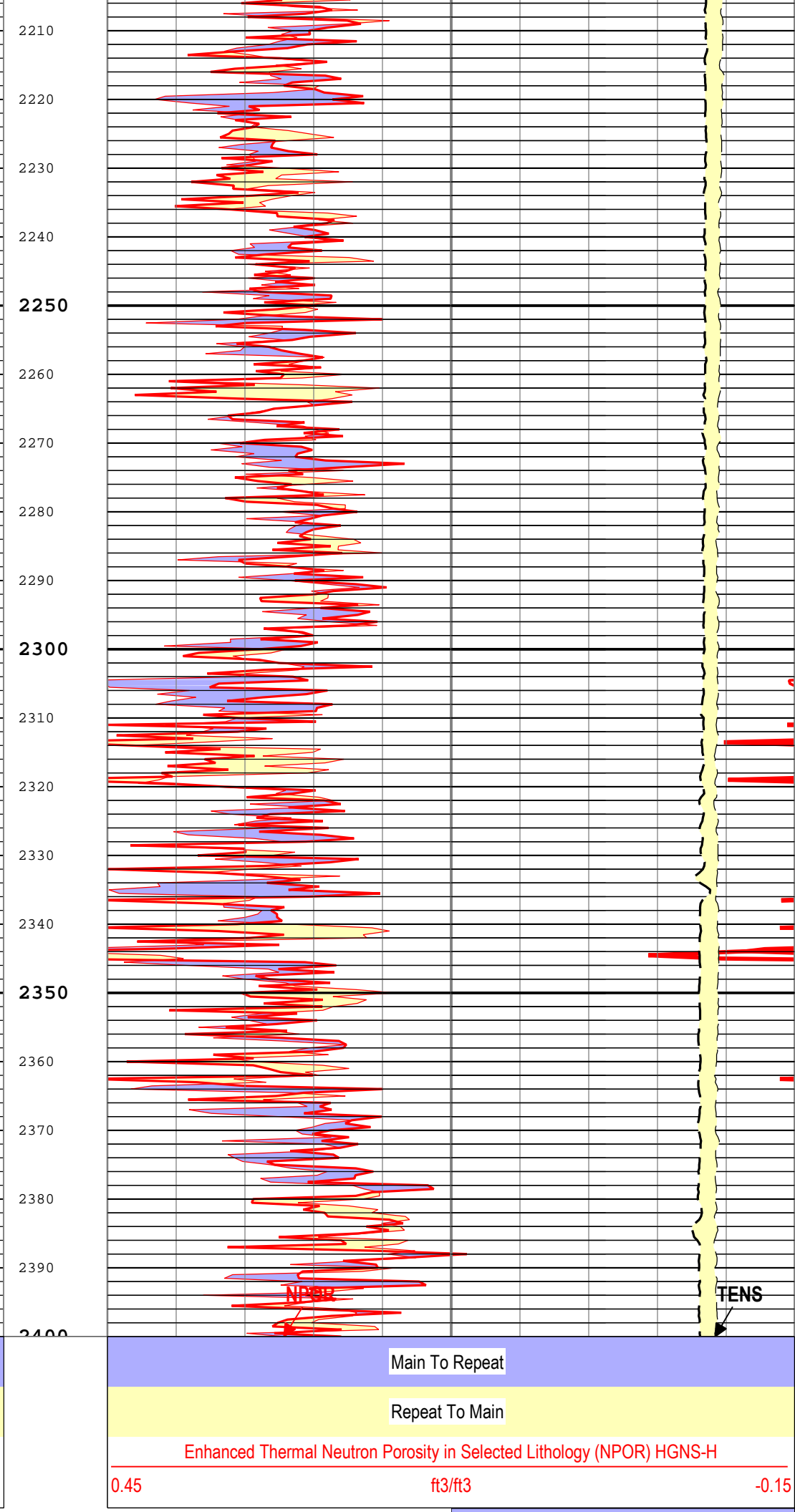
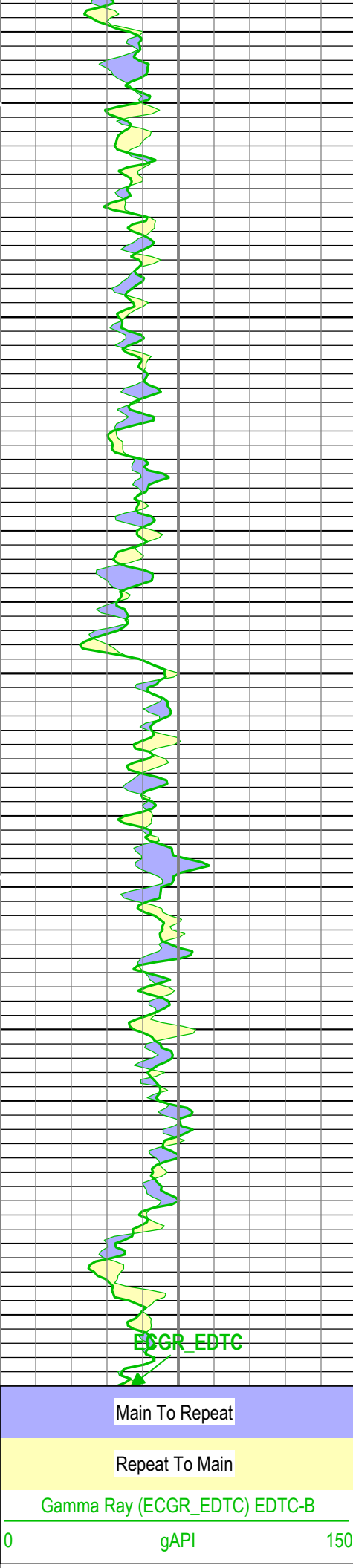
Main To Repeat

Repeat To Main

Enhanced Thermal Neutron Porosity in Selected Lithology (NPOR) HGNS-H

0.45      ft3/ft3      -0.15





Main To Repeat

Repeat To Main

Cable Tension (TENS)

5000lbf0

ICV - Integrated Cement Volume every 100.00 (ft3)

ICV - Integrated Cement Volume every 10.00 (ft3)

TIME\_1900 - Time Marked every 60.00 (s)

IHV - Integrated Hole Volume every 100.00 (ft3)

IHV - Integrated Hole Volume every 10.00 (ft3)

Description: AIT Basic Log Two    Format: Noble Nuclear RA    Index Scale: 5 in per 100 ft    Index Unit: ft    Index Type: Measured Depth    Creation Date: 17-Jun-2018 14:39:33

Channel Processing Parameters				
UltraSonic - Nuetron: Parameters				
Parameter	Description	Tool	Value	Unit
ISSBAR	Barite Mud Presence Flag	Borehole	No	
BHS	Borehole Status (Open or Cased Hole)	Borehole	Cased	
BHT	Bottom Hole Temperature	Borehole	212	degF
BS	Bit Size	WLSESSION	8.5	in
BSAL	Borehole Salinity	Borehole	0	ppm
CBLO	Casing Bottom (Logger)	WLSESSION	18025.6	ft
CDEN	Cement Density	EDTC-B	2	g/cm3
CMTY(U-USIT_CEMT)	Cement Type	USIT-E	Regular Cement	
CSODDRL	Casing Outer Diameter - Zoned along driller depths	WLSESSION	5.5	in
DC_MODE	Depth Correction Mode	DepthCorrection	Real-time	
DFD	Drilling Fluid Density	Borehole	8.4	lbm/gal
DFT_CATEGORY	Drilling Fluid Type	Borehole	Water	
FSAL	Formation Salinity	Borehole	0	ppm
GCSE_DOWN_PASS	Generalized Caliper Selection for WL Log Down Passes	Borehole	BS(RT)	
GCSE_UP_PASS	Generalized Caliper Selection for WL Log Up Passes	Borehole	BS(RT)	
GRSE	Generalized Mud Resistivity Selection, from Measured or Computed Mud Resistivity	Borehole	REMS(RT)	
GTSE	Generalized Temperature Selection, from Measured or Computed Temperature	Borehole	CTEM	
HSCO	Hole Size Correction Option	HGNS-H	Yes	
IMAR	Image Rotation	USIT-E	Off	
MATR	Rock Matrix for Neutron Porosity Corrections	Borehole	LIMESTONE	
MFST	Mud Filtrate Sample Temperature	Borehole	68	degF
MST	Mud Sample Temperature	Borehole	68	degF
RMFS	Resistivity of Mud Filtrate Sample	Borehole	0.15	ohm.m
RMS	Resistivity of Mud Sample	Borehole	0.2	ohm.m
U-USIT_DFSZ	Drilling Fluid Specific Acoustic Impedance	USIT-E	0.1	Mrayl
USI_FVEL_SEL	USI Fluid Velocity Selection	USIT-E	Automatic	
USI_ZMUD_SEL	USI Mud Impedance Selection	USIT-E	Theoretical	
Tool Control Parameters				
UltraSonic - Nuetron: Parameters				
Parameter	Description	Tool	Value	Unit
HMCA_BOARD_TYPE	HMCA Board Type	HGNS-H	1	
MAX_LOG_SPEED	Toolstring Maximum Logging Speed	WLSESSION	3600	ft/h

ULOG	Logging Objective	USIT-E	MEASUREMENT	
UPAT	USIT Emission Pattern	USIT-E	Pattern 375 KHz	
UWKM	USIT Working Mode	USIT-E	Uncompressed 10 deg at 6.0 in	

## Calibration Report

### HGNS-H (HILT Gamma-Ray and Neutron Sonde, 150 degC) Calibration - Run UltraSonic - Nuetron

#### Primary Equipment :

HILT Gamma-Ray and Neutron Sonde, 150 degC HGNS-H

#### Auxiliary Equipment :

HGNS Accelerometer, 150 degC HACCZ-H 4168

AmBe Neutron Logging Source NSR-F 5203

#### Calibration Parameter :

Water Temperature (Calibration Tank Water Temperature) 64.0

Housing Size (Thermal Housing Size) 3.37

JIG-BKG

### HGNS Accelerometer EEPROM - Accelerometer EEPROM Read

Master (EEPROM): 18:00:00 14-Jul-2005

Measurement	Unit	Phase	Nominal	Low Limit	Actual	High Limit		
Accelerometer Manufacturer		Master			QAT_160			
Accelerometer Reference Temperature	degF	Master		30.2	77.0	122.0		
Accelerometer Coefficients - 0		Master	-----	-----	1582.500	-----		
Accelerometer Coefficients - 1		Master	-----	-----	35.100	-----		
Accelerometer Coefficients - 2		Master	-----	-----	-0.047	-----		
Accelerometer Coefficients - 3		Master	-----	-----	-0.001	-----		
Accelerometer Coefficients - 4		Master	-----	-----	2.739	-----		
Accelerometer Coefficients - 5		Master	-----	-----	0.000	-----		
Accelerometer Coefficients - 6		Master	-----	-----	0.000	-----		
Accelerometer Coefficients - 7		Master	-----	-----	0.000	-----		
Accelerometer Coefficients - 8		Master	-----	-----	298.400	-----		
Accelerometer Coefficients - 9		Master	-----	-----	0.991	-----		

### HGNS Neutron Calibration - HGNS Neutron Accumulations

Master (EEPROM): 12:16:40 17-May-2018

Measurement	Unit	Phase	Nominal	Low Limit	Actual	High Limit		
Near Zero Measurement	1/s	Master	0	5.0	27.0	40.0		
Far Zero Measurement	1/s	Master	0	5.0	27.7	40.0		
Near Plus Measurement	1/s	Master	6031.0	4700.0	4992.0	6900.0		
Far Plus Measurement	1/s	Master	2793.0	1900.0	2078.0	2900.0		
Near Corrected Plus Measurement	1/s	Master		4700.0	4965.0	6900.0		
Far Corrected Plus Measurement	1/s	Master		1900.0	2047.0	2900.0		

Company:	Noble Energy Inc	<b>Schlumberger</b>
Well:	Larson A23-645	
Field:	Wattenberg	
County:	Weld	
State:	Colorado	

Neutron Log