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TNO report

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NCP_2e Rotliegend

Petrophysical analysis

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1 Introduction

Petrophysical analysis of seventeen wells in the NCP_2E area has been carried out as part of the offshore mapping project NCP-2. In these wells the reservoir intervals of the Upper Slochteren Sandstone (ROSLU) and the Lower Slochteren Sandstone (ROSLL) have been analysed.
In Chapter 2 the well selection will be presented and in Chapter 3 the available data will be illustrated. The petrophysical analysis of the selected wells will be clarified in Chapter 4. In Chapter 5 the poroperm function is shown. This function is deducted from core analysis data and is used to calculate the reservoir permeability from log porosity. The results of the petrophysical analysis (clay volume, reservoir porosity and permeability) are presented in Chapter 6.

2 Well selection

In this chapter the well selection will be clarified. The main criteria amongst others are the availability of digital well logs, core analysis as well as the geographical location of the wells in the NCP_2E area.

For a number of these wells a so-called digital composite log, containing GR, RHOB, DRHO, DT and NPHI, were already compiled for correlation purposes. This selection was increased with an additional 5 wells (Table 1, marked with an asterisk).

For the petrophysical analysis an additional set of well logs (just for the reservoir interval) was used including the resistivity logs. The digital data were loaded into Geoframe to compile an extended composite log.

The petrophysical analysis itself was executed in the program Interactive Petrophysics (IP). The composite logs and the petrophysical results (clay volume, porosity, saturation and permeability) will be exported as curves and loaded into Petrel for property modeling.

The selected wells are listed table 1.

Table 1 Well selection NCP_2E Rotliegend

Well	UWI	TD	TD	COMP	IP-Evaluation	
		[m. MD]	[m. TVDss]			
L04-07	8232	4126.0	4053.37	COMP		ROSLL
L07-01	7264	3934.0	3906.40	COMP	ROSLU	ROSLL
L07-04	7265	4182.0	4149.03	COMP	ROSLU	ROSLL
L07-06	7267	4145.5	4119.59	COMP	ROSLU	ROSLL
L08-01-S1	7278	4229.0	4201.32	COMP	ROSLU	ROSLL
L08-P-01	8086	4450.0	4327.30	COMP		ROSLL
L08-P-03	8210	5075.0	4736.03	COMP		ROSLL
L10-01	7282	4122.0	4089.10	Comp*	ROSLU	ROSLL
L10-10	7289	4036.0	3995.75	Comp*	ROSLU	ROSLL
L10-A-01	7304	4084.0	3911.38	Comp*	ROSLU	ROSLL
L10-D-01-S1	7337	3886.0	3452.84	Comp*	ROSLU	ROSLL
L11B-A-01	7355	3820.3	3790.41	Comp*	ROSLU	ROSLL
L12-03	7361	3150.0	3122.05	COMP	ROSLU	ROSLL
L12-05	7783	3708.0	3667.62	COMP	ROSLU	ROSLL
L14-A-01	7370	3438.1	3406.77	COMP	ROSLU	ROSLL
L15-01	7374	3202.0	3168.96	COMP	ROSLU	ROSLL
M10-02	7394	3070.0	2951.68	COMP	ROSLU	

3 Available data

To perform a reliable petrophysical analysis it is important to have a proper set of (porosity) logs available, as well as core analyses.

3.1 Well logs

In most of the wells a sufficient set of digital well logs are available in the reservoir interval (table 2).

The GR has been run in all the wells and as porosity logs the DT is always present and the RHOB and NPHI in most wells. All wells have resistivity logs.

Table 2 Available well log data

Well	Digital					Interval	
	GR	DT	RHOB	NPHI	RES		
L04-07	GR	DT	RHOB	SLB-CNL	ILD,ILM,SFLU,LLD,LLS,MSFL		ROSLL
L07-01	GR	DT	RHOB	SLB-SNP	ILD, SN, LLD, LLS, MLL	ROSLU	ROSLL
L07-04	GR	DT	RHOB	SLB-CNL	LLD, LLS, MLL	ROSLU	ROSLL
L07-06	GR	DT	RHOB	DA-CNL	ILD, LL7	ROSLU	ROSLL
L08-01-S1	GR	DT	RHOB	SLB-CNL	LLD, LLS	ROSLU	ROSLL
L08-P-01	GR	DT		SLB-CNL	LLD, LLS, MSFL		ROSLL
L08-P-03	GR	DT	RHOB	SLB-CNL	LLG, LLD, LLS, MSFL		ROSLL
L10-01	GR	DT	RHOB	SLB-SNP	ILD, SN, LL7, MLL	ROSLU	ROSLL
L10-10	GR	DT	RHOB		ILD	ROSLU	ROSLL
L10-A-01	GR	DT	RHOB	DA-SNP	ILD	ROSLU	ROSLL
L10-D-01-	GR	DT	RHOB	SLB-SNP	RILD, SNS	ROSLU	ROSLL
L11B-A-	GR	DT	RHOB	SLB-CNL	ILD	ROSLU	ROSLL
L12-03	GR	DT	RHOB	SLB-CNL	ILD, SFLU, LLD, LLS, MSFL	ROSLU	ROSLL
L12-05	GR	DT	RHOB	SLB-CNL	ILD, ILM	ROSLU	ROSLL
L14-A-01	GR	DT		SLB-CNL	ILD	ROSLU	ROSLL
L15-01	GR	DT	RHOB	SLB-CNL	ILD, SFL, LLD, LLS, MSFL	ROSLU	ROSLL
M10-02	GR	DT	RHOB	SLB-CNL	ILD, SFL, LLD, LLS, MSFL	ROSLU	

3.2 Cores

In most wells core analyses are present for the Rotliegend interval (Table 3).

Table 3a: Intervals with core analyses in the Upper Slochteren Sandstone

Well	Core data	Shifted core [m,MD]	Core data shift [m]
L07-01	3659.00-3704.75	3657.00-3702.75	-2.00
L07-04	3967.90-3969.50	3973.80-3975.40	5.90
L07-06	3876.50-3957.75	3876.50-3957.75	0.00
L10-10	3786.50-3871.90	3788.40-3873.80	1.90
L10-D-01-S1	3627.60-3733.20	3629.55-3735.00	1.80
L11B-A-01	3524.50-3548.75	3523.80-3548.05	-0.70
	3579.00-3595.00	3577.30-3593.30	-1.70
L12-03	2912.20-2928.90	2909.80-2926.50	-2.40
	2977.00-2986.00	2975.60-2984.60	-1.40
L15-01	2926.00-2944.00	2931.80-2949.80	5.80
M10-02	2805.00-2822.70	2807.30-2825.00	2.30

Table 3b: Intervals with core analyses in the Lower Slochteren Sandstone

Well	Core data	Shifted core [m,MD]	Core data shift [m]
L04-07	3830.65-3856.80	3831.25-3857.40	0.60
	3858.80-3883.60	3859.60-3884.65	0.80
	3884.10-3893.15	3885.70-3894.75	1.60
L07-01	3810.00-3845.10	3807.50-3842.60	-2.50
L07-04	4128.00-4136.95	4133.90-4142.90	5.90
L07-06			
L08-01-S1	4164.40-4208.00	4167.40-4211.00	3.00
L08-P-01	4283.50-4340.00	4285.70-4342.20	2.20
L08-P-03			
L10-01			
L10-10	3968.50-4013.91	3969.30-4014.70	0.80
L10-A-01	4011.15-4028.85	4011.15-4028.85	0.00
L10-D-01-S1	3776.80-3844.40	3771.80-3839.40	-5.00

4 Petrophysical analysis

A listing of the reservoir intervals of the Upper Slochteren and Lower Slochteren Sandstone is shown in table 4. The petrophysical analysis has been done in Interactive Petrophysics (IP).

Table 4 Reservoir intervals in the analysed wells

Well	ROSLU				ROSLL			
	m, MD		m, TVDss		m, MD		m, TVDss	
L04-07					3832.92	3894.11	3761.67	3822.20
L07-01	3644.00	3705.00	3617.53	3678.37	3796.00	3871.34	3769.06	3844.03
L07-04	3912.00	3982.00	3879.29	3949.22	4097.52	4177.00	4064.61	4144.04
L07-06	3876.00	3954.75	3841.72	3920.27	4062.26	4130.00	4027.62	4095.15
L08-01-S1	3952.53	4018.52	3925.02	3990.96	4139.99	4213.00	4112.38	4185.33
L08-P-01	4084.93	4145.93	4019.27	4070.97	4278.00	4346.00	4181.77	4239.84
L08-P-03					4858.50	4934.00	4530.67	4602.33
L10-01	3851.50	3958.50	3818.69	3925.66	4003.00	4089.00	3970.14	4056.11
L10-10	3778.50	3885.00	3739.23	3845.32	3927.00	4017.50	3887.16	3977.32
L10-A-01	3804.00	3948.00	3643.07	3781.05	3994.00	4073.00	3825.17	3900.97
L10-D-01-S1	3594.00	3735.00	3561.18	3702.01	3774.50	3857.00	3741.47	3823.87
L11B-A-01	3524.00	3604.00	3494.26	3574.25	3696.00	3758.00	3666.23	3728.22
L12-03	2912.00	2996.00	2884.49	2968.26	3068.30	3120.30	3040.433	3092.38
L12-05	3260.00	3279.00	3220.06	3239.04	3430.00	3438.00	3389.92	3397.91
L14-A-01	3212.00	3336.44	3180.68	3305.07	3364.00	3422.00	3332.67	3390.67
L15-01	2865.00	2989.00	2832.02	2956.00	3090.00	3099.00	3056.99	3065.99
M10-02	2787.00	2904.00	2677.52	2792.16				

4.1 Well log corrections

The boreholes and the well logs gave a good quality in the reservoir interval. Environmental corrections, depth shifts and in some cases merging different runs of the curves result in corrected and depth shifted well logs. These model traces are displayed in measured depth in the final evaluation-playback.

4.2 Interactive Petrophysics-evaluation

The petrophysical analysis has been done in IP.

4.2.1 Choice of model

The choice of model in IP is determined by the available porosity logs. In table 5a it shows that where density and neutron are present the choice is made for the neutron-density model. In one well the neutron-sonic model is used and in another well the density model.

Table 5a Choice of model in IP

Well	Neutron-Density [Variable Grain Density]	Density	Neutron-Sonic
L04-07	ND_var_gd		
L07-01	ND_var_gd		
L07-04	ND_var_gd		
L07-06	ND_var_gd		
L08-01-S1	ND_var_gd		
L08-P-01			NS
L08-P-03	ND_var_gd		
L10-01	ND_var_gd		
L10-10		D	
L10-A-01	ND_var_gd		
L10-D-01-S1	ND_var_gd		
L11B-A-01	ND_var_gd		
L12-03	ND_var_gd		
L12-05	ND_var_gd		
L14-A-01	ND_var_gd		
L15-01	ND_var_gd		
M10-02	ND_var_gd		

4.2.2 General parameters

Some general parameters concerning mud and temperature etc. are listed in table 5b.

Table 5b General parameters in IP

Well	Deviation	Mud type	Mud density	Rmf	Tref	Rmf	Salinity
			g/cm^3	(ohmm@	(ºC)	(ohmm@20ºC)	(ppk)
L04-07	Y	OBM					
L07-01	Y	SW	1.25	0.060	23.0	0.0643	133.1
L07-04	Y	Polymer	1.38	0.0495	19.4	0.0488	207.7
L07-06	Y			0.083	21.0	0.0850	93.3
L08-01-	Y	SW	1.425	0.075	14.0	0.0642	132.7
L08-P-	Y	Salt sat.	1.32	0.047	15.0	0.0413	270.0
L08-P-	Y	KCl-	1.33	0.050	18.0	0.0476	220.0
L10-01	Y		1.26	0.092	10.1	0.0701	118.9
L10-10	Y	OBM	1.25				
L10-A-	Y	OBM	1.34				
L10-D-	Y	SW		0.659	10.0	0.5004	13.3
L11B-	Y	OBM					
L12-03	Y		1.26	0.085	18.5	0.0819	97.6
L12-05	Y	OBM	1.48				
L14-A-	Y	OBM	1.26				
L15-01	Y	SS	1.31	0.051	20.0	0.0510	190.0
M10-02	Y	MgPol	1.20	0.090	10.0	0.0683	123.8

4.2.3 Clay volume

To calculate the clay volume the gamma-ray is used as clay indicator:
[lineair]: $V_{cl} = (GR-GR_{clean})/(GR_{shale}-GR_{clean})$.
The used parameters are listed in table 5c.

Table 5c Model parameters in IP for clay volume

Well	**ROSLU**		**ROSLL**	
	GRclean API	**Grshale API**	**GRclean API**	**GRshale API**
L04-07			25	130
L07-01	15.8	90	15.8	90
L07-04	16	100	16	100
L07-06	18	128	18	128
L08-01-S1	26	105.8	26	105.8
L08-P-01			25	150
L08-P-03			20	132
L10-01	17	83	17	83
L10-10	10	105	10	105
L10-A-01	8	45	8	45
L10-D-01-S1	15	80	15	80
L11B-A-01	14	110	14	110
L12-03	16	135	16	135
L12-05	16	108	16	108
L14-A-01	19	95	19	95
L15-01	32	100	32	100
M10-02	35	125		

4.2.4 Porosity

The porosity was calculated from densitylog and neutronlog, using corrections for gas and clay effect . The used parameters are listed in table 5d.

Table 5d Model parameters in IP for porosity

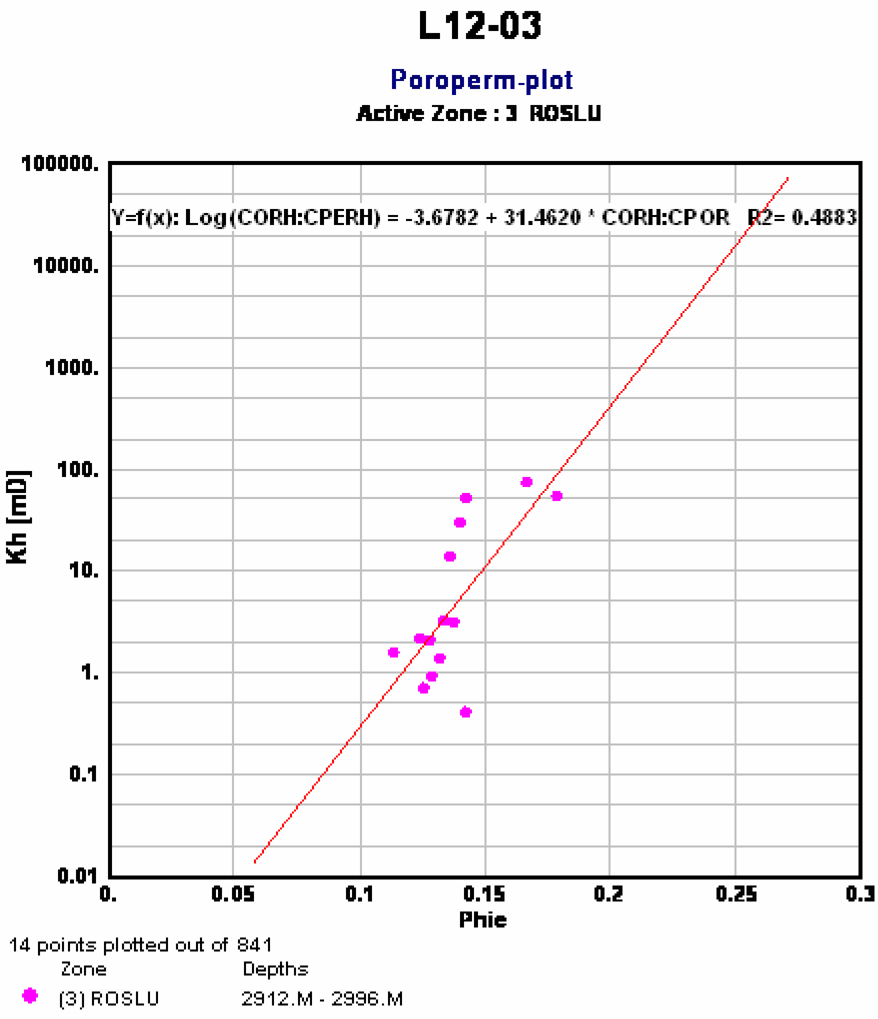
Well	RHOB [g/cm^3]								NPHI	DT			
	GD	var GD	min	max	fluid	wet clay	dry clay	hydro-carbon	wet clay	sand-stone	wet clay	fluid	hydro-carbon
L04-07	2.683	Y	2.60	2.75	1.05161	2.85	2.95	0.20	0.25				
L07-01	2.687	Y	2.60	2.75	1.05780	2.85	2.95	0.20	0.25				
L07-01	2.670	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L07-04	2.679	Y	2.60	2.75	1.09860	2.85	2.95	0.20	0.25				
L07-04	2.667	Y	2.60	2.75	1.09005	2.85	2.95	0.20	0.25				
L07-06	2.684	Y	2.60	2.75	1.02451	2.85	2.95	0.20	0.25				
L07-06	2.684	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L08-01-	2.672	Y	2.60	2.75	1.05270	2.85	2.95	0.20	0.25				
L08-01-	2.672	Y	2.60	2.75	1.04385	2.85	2.95	0.20	0.25				
L08-P-01									0.25	51.5	70	169	220
L08-P-01									0.25	51.5	70	169	220
L08-P-03	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L10-01	2.683	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L10-01	2.683	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L10-10	2.683	Y	2.60	2.75	1.11228	2.85	2.95	0.20					
L10-10	2.675	Y	2.60	2.75		2.85	2.95	0.20					
L10-A-	2.675	Y	2.60	2.75	1.07598	2.85	2.95	0.20	0.25				
L10-A-	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L10-D-	2.683	Y	2.60	2.75	0.9783	2.85	2.95	0.20	0.25				
L10-D-	2.675	Y	2.60	2.75	0.96775	2.85	2.95	0.20	0.25				
L11B-A-	2.666	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L11B-A-	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L12-03	2.672	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L12-03	2.672	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L12-05	2.683	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L12-05	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L14-A-	2.683	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L14-A-	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L15-01	2.683	Y	2.60	2.75		2.85	2.95	0.20	0.25				
L15-01	2.675	Y	2.60	2.75		2.85	2.95	0.20	0.25				
M10-02	2.707	Y	2.60	2.75		2.85	2.95	0.20	0.25				

5 Available data

For the calculation of the permeability the poroperm-relation of the available core data is used to translate log porosity to an estimate for reservoir permeability.

5.1 Upper Slochteren Sandstone [ROSLU]

In graph 1a the available poroperm data are plotted for the Upper Slochteren Sandstone in well
L12-03. Also the linear least squares fit (y on x) is shown.

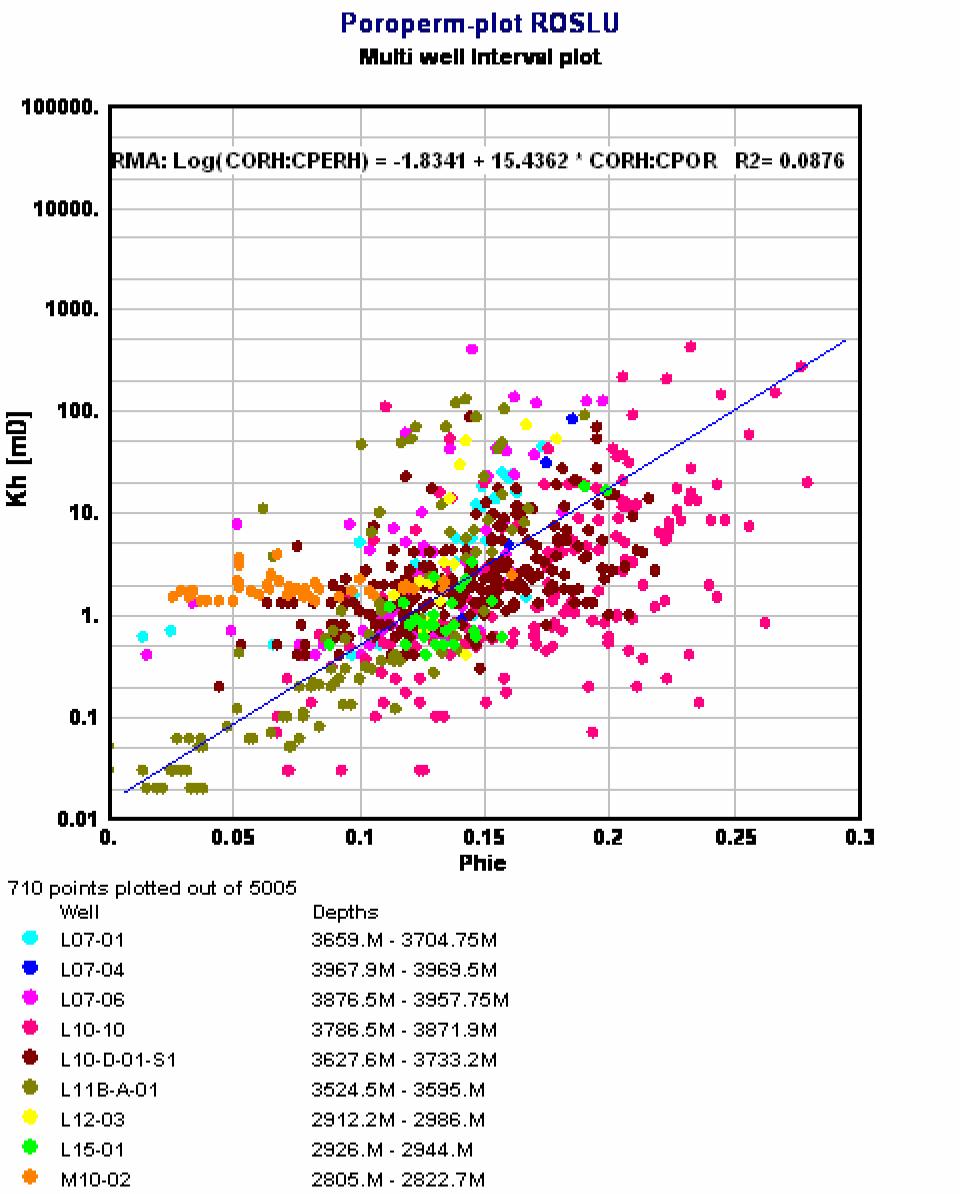


Graph 1a. Poroperm-plot of core analysis data in de Upper Slochteren Sandstone in well L12-03.
The solid line represents the linear least squares fit (y on x).

In the Upper Slochteren Sandstone interval in well L12-03 the permeability (Kh in mD) is now calculated from logporosity (phie, decimal) using the function deducted from the poroperm-plot:

$$Kh = 10 \wedge ^{[(31.4695 * phie) - 3.6782]}$$

Graph 1b shows all poroperm data for the Upper Slochteren Sandstone. In this plot the linear least squares fit (RMA) is also shown.



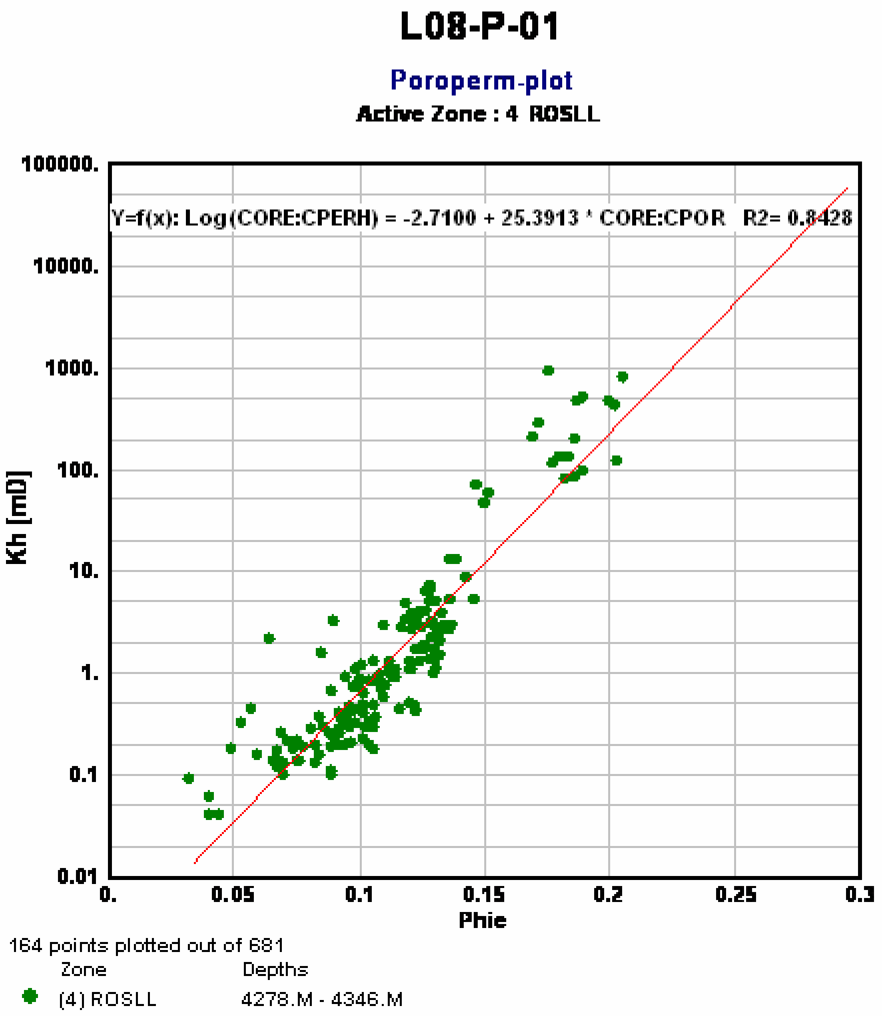
Graph 1b. Poroperm-plot of all available core analysis data in the Upper Slochteren Sandstone. The solid line represents the linear least squares fit (rma).

In all wells without core analyses in the Upper Slochteren Sandstone interval the permeability (Kh in mD) is now calculated from the log porosity (phie, decimal) using the function deducted from the poroperm-plot:

$$Kh = 10 \wedge {}^{[(15.4362 * phie) - 1.8341]}$$

5.2 De Lower Slochteren Sandstone

In graph 2a the available poroperm data are plotted for the Lower Slochteren Sandstone in the well
L08-P-01. Also the linear least squares fit (y on x) is shown.

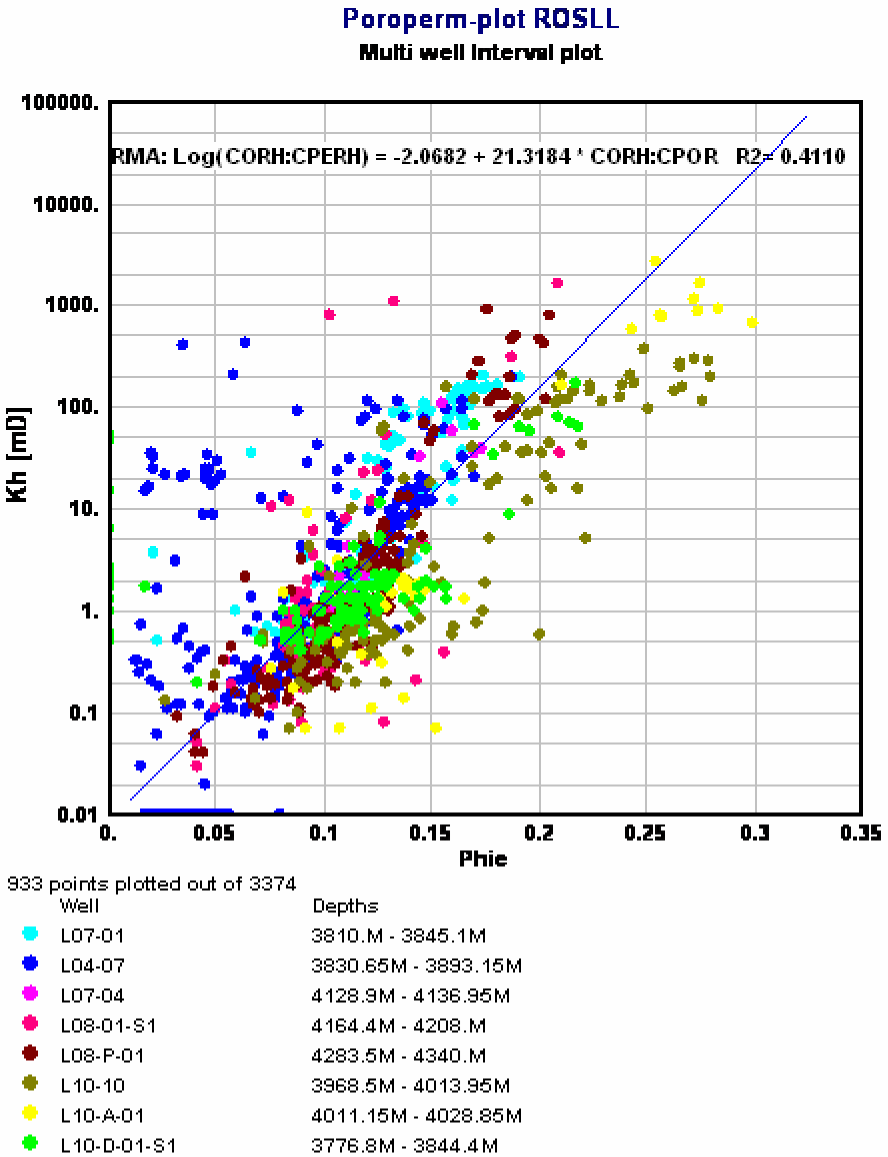


Graph 2a. Poroperm-plot of core analysis data in de Lower Slochteren Sandstone in well L08-P-01. The solid line represents the linear least squares fit (y on x).

In the Lower Slochteren Sandstone interval in the well L08-P-01 the permeability (Kh in mD) is now calculated from the logporosity (phie, decimal) using the function deducted from the poroperm-plot:

$$Kh = 10 \wedge {}^{[(25.3913 * phie) - 2.7100]}$$

Graph 1b shows all poroperm data for the Lower Slochteren Sandstone. In this plot the linear least squares fit (RMA) is also shown.



Graph 2b. Poroperm-plot of all available core analysis data in the Lower Slochteren Sandstone. The solid line represents the linear least squares fit (rma).

In all wells without core analyses in the Lower Slochteren Sandstone interval the permeability (Kh in mD) is now calculated from the log porosity (phie, decimal) using the function deducted from the poroperm-plot:

$$Kh = 10 \wedge {}^{[(21.3184 * phie) – 2.0682]}$$

In Tables 6a en 6b the poroperm relations for the calculation of the permeability derived from the log porosity is listed for all Upper and Lower Slochteren Sandstone intervals..

Table 6a. Poroperm relations in the Upper Slochteren Sandstone

Well	Poroperm relation
L07-01	$Kh = 10 \wedge {}^{[(11.3998 * phie) – 0.9126]}$
L07-04	$Kh = 10 \wedge {}^{[(36.6883 * phie) – 5.0926]}$
L07-06	$Kh = 10 \wedge {}^{[(13.4914 * phie) – 1.1409]}$
L08-01-S1	$Kh = 10 \wedge {}^{[(15.4362 * phie) – 1.8341]}$
L10-01	$Kh = 10 \wedge {}^{[(15.4362 * phie) – 1.8341]}$
L10-10	$Kh = 10 \wedge {}^{[(10.5696 * phie) – 1.5315]}$
L10-A-01	$Kh = 10 \wedge {}^{[(15.4362 * phie) – 1.8341]}$
L10-D-01-S1	$Kh = 10 \wedge {}^{[(6.9760 * phie) – 0.6558]}$
L11B-A-01	$Kh = 10 \wedge {}^{[(19.9892 * phie) – 2.0829]}$
L12-03	$Kh = 10 \wedge {}^{[(31.4695 * phie) – 3.6782]}$
L12-05	$Kh = 10 \wedge {}^{[(15.4362 * phie) – 1.8341]}$
L14-A-01	$Kh = 10 \wedge {}^{[(15.4362 * phie) – 1.8341]}$
L15-01	$Kh = 10 \wedge {}^{[(13.7874 * phie) – 1.8389]}$
M10-02	$Kh = 10 \wedge {}^{[(0.5846 * phie) + 0.2238]}$

Table 6b. Poroperm relations in the Lower Slochteren Sandstone

Well	Poroperm relation
L04-07	$Kh = 10 \wedge^{[(19.3354 * phie) – 1.6992]}$
L07-01	$Kh = 10 \wedge^{[(21.9827 * phie) – 1.8106]}$
L07-04	$Kh = 10 \wedge^{[(25.2913 * phie) – 2.5562]}$
L07-06	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L08-01-S1	$Kh = 10 \wedge^{[(19.4070 * phie) – 1.8752]}$
L08-P-01	$Kh = 10 \wedge^{[(25.3913 * phie) – 2.7100]}$
L08-P-03	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L10-01	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L10-10	$Kh = 10 \wedge^{[(16.5863 * phie) – 1.9272]}$
L10-A-01	$Kh = 10 \wedge^{[(19.7166 * phie) – 2.4664]}$
L10-D-01-S1	$Kh = 10 \wedge^{[(13.5142 * phie) – 1.3717]}$
L11B-A-01	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L12-03	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L12-05	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L14-A-01	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$
L15-01	$Kh = 10 \wedge^{[(21.3184 * phie) – 2.0682]}$

6 Results

6.1 Evaluation playback

In the evaluation playback the results for the seventeen wells that have been evaluated in Interactive Petrophysics are presented (all depths are measured depths along hole).
In the left columns (1 to 4) the corrected and depthshifted well logs are shown. Most of these well logs were used in the evaluation, such as gamma ray, density, neutron and deep resistivity. In righthand columns (5 to 8) the result curves, such as clay volume, effective porosity, water saturation, gas saturation, oil saturation and permeability are depicted.

6.2 Reservoir summations

Reservoir summations have been made for the reservoir intervals of the Upper Slochteren Sandstone and the Lower Slochteren Sandstone.

In the reservoir summations a cutoff of 50% of the clay volume and a porosity cut-off 5% were applied (table 7a and 7b).

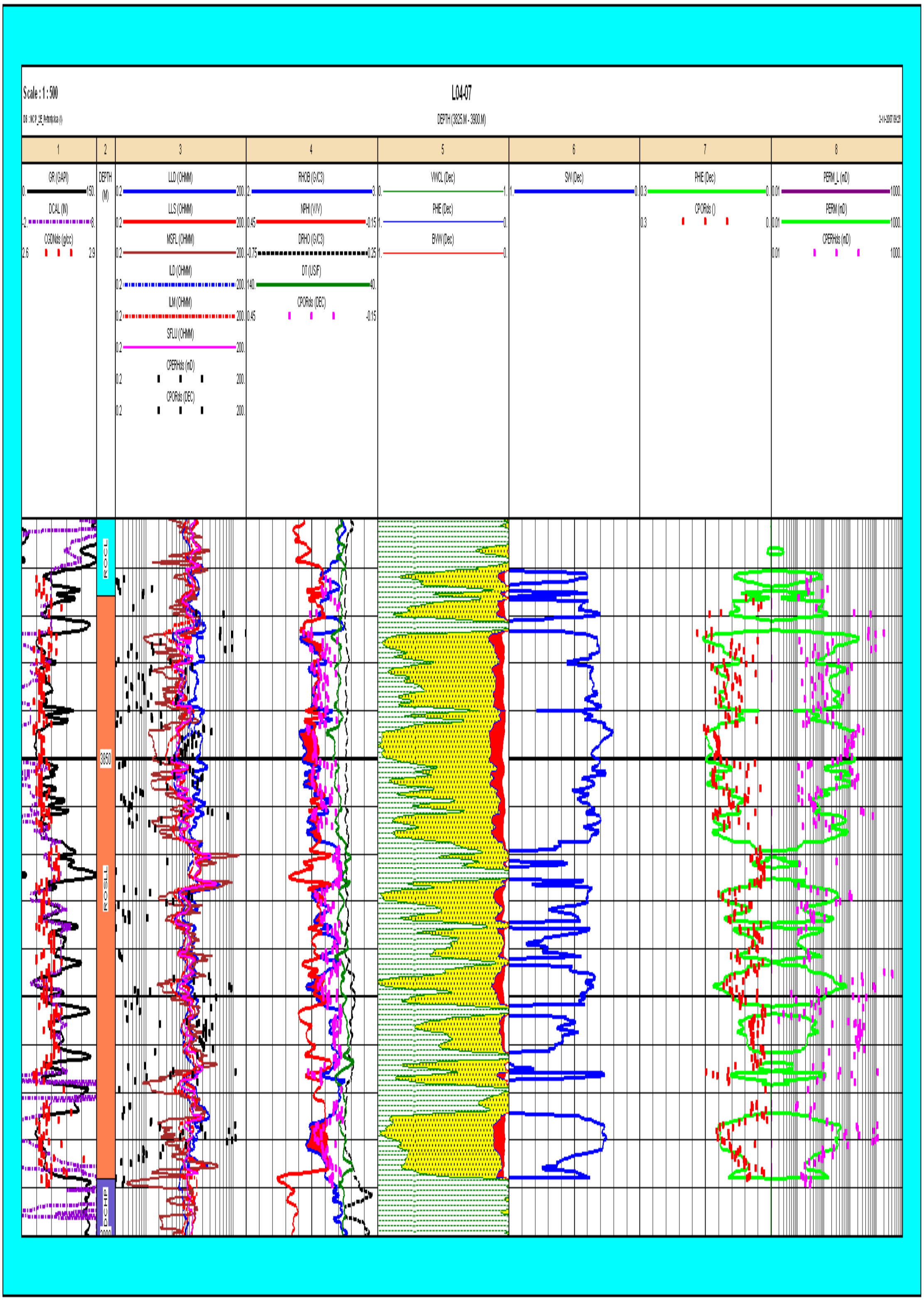
Table 7a Reservoir summation Upper Slochteren Sandstone [Cut-offs: clay volume 50%, porosity 5%]

Reservoir summation	Top	Bottom	Top	Bottom	Gross	Net	n/g	phie	V_{cl}	Kb	Kb x h	S_w
Well	**[m,MD]**	**[m,MD]**	**m,tvdss**	**m,tvdss**	**[m]**	**[m]**				**[mD]**	**[Dm]**	
L04-07												
L07-01	3644.00	3705.00	3617.53	3678.37	60.84	10.87	0.179	0.120	0.289	2.831	30.8	0.537
L07-04	3912.00	3982.00	3879.29	3949.22	69.93	7.64	0.109	0.116	0.347	0.153	1.2	0.640
L07-06	3876.00	3954.75	3841.72	3920.27	78.60	25.45	0.324	0.098	0.208	1.527	38.9	0.759
L08-01-S1	3952.53	4018.52	3925.02	3990.96	65.94	1.12	0.017	0.059	0.291	0.120	0.1	0.639
L08-P-01												
L08-P-03												
L10-01	3851.50	3958.50	3818.69	3925.66	106.96	92.57	0.865	0.173	0.222	6.807	630.1	0.391
L10-10	3778.50	3885.00	3739.23	3845.32	106.09	61.27	0.577	0.163	0.320	1.562	95.7	0.699
L10-A-01	3804.00	3948.00	3643.07	3781.05	137.98	105.79	0.767	0.092	0.263	0.388	41.0	0.533
L10-D-01-S1	3594.00	3735.00	3561.18	3702.01	140.84	120.41	0.855	0.143	0.203	2.183	262.5	0.362
L11B-A-01	3524.00	3604.00	3494.26	3574.25	79.99	22.25	0.278	0.113	0.278	1.499	33.4	0.562
L12-03	2912.00	2996.00	2884.49	2968.26	83.77	35.46	0.423	0.101	0.277	0.322	11.4	0.630
L12-05	3260.00	3279.00	3220.06	3239.04	18.98	5.69	0.300	0.121	0.334	1.072	6.1	0.683
L14-A-01	3212.00	3336.44	3180.68	3305.07	124.44	113.79	0.914	0.139	0.191	2.067	235.2	0.954
L15-01	2865.00	2989.00	2832.02	2956.00	123.98	59.49	0.480	0.110	0.191	0.475	28.3	0.425
M10-02	2787.00	2904.00	2677.52	2792.16	114.63	56.01	0.489	0.108	0.251	1.741	97.5	0.711

Table 7b Reservoir summation Lower Slochteren Sandstone [Cut-offs: clay volume 50%, porosity 5%]

Reservoir summatie	**Top**	**Bottom**	**Top**	**Bottom**	**Gross**	**Net**	**n/g**	**phie**	**V_{cl}**	**Kb**	**Kb x h**	**S_w**
Well	**[m,MD]**	**[m,MD]**	**m,tvdss**	**m,tvdss**	**[m]**	**[m]**				**[mD]**	**[Dm]**	
L04-07	3832.92	3894.11	3761.67	3822.20	60.52	37.39	0.618	0.103	0.219	1.941	72.6	0.372
L07-01	3796.00	3871.34	3769.06	3844.03	75.01	52.36	0.698	0.121	0.164	6.923	362.5	0.803
L07-04	4097.52	4177.00	4064.61	4144.04	79.40	68.88	0.868	0.104	0.159	1.168	80.5	0.925
L07-06	4062.26	4130.00	4027.62	4095.15	67.58	37.51	0.555	0.106	0.122	1.567	58.8	0.838
L08-01-S1	4139.99	4213.00	4112.38	4185.33	72.96	33.68	0.462	0.080	0.161	0.479	16.1	0.354
L08-P-01	4278.00	4346.00	4181.77	4239.84	58.07	53.49	0.921	0.108	0.097	1.091	58.4	0.255
L08-P-03	4858.50	4934.00	4530.67	4602.33	71.66	47.84	0.668	0.096	0.097	0.941	45.0	0.286
L10-01	4003.00	4089.00	3970.14	4056.11	85.97	54.53	0.634	0.131	0.165	5.205	283.9	0.515
L10-10	3927.00	4017.50	3887.16	3977.32	90.16	52.70	0.585	0.123	0.258	1.322	69.7	0.934
L10-A-01	3994.00	4073.00	3825.17	3900.97	75.81	45.10	0.595	0.084	0.213	0.155	7.0	0.879
L10-D-01-S1	3774.50	3857.00	3741.47	3823.87	82.40	41.25	0.501	0.108	0.229	1.208	49.8	0.646
L11B-A-01	3696.00	3758.00	3666.23	3728.22	61.99	46.79	0.755	0.112	0.234	2.043	95.6	0.752
L12-03	3068.30	3120.30	3040.433	3092.38	51.95	3.70	0.071	0.066	0.356	0.215	0.8	0.702
L12-05	3430.00	3438.00	3389.92	3397.91	7.99	5.70	0.713	0.107	0.286	1.618	9.2	0.671
L14-A-01	3364.00	3422.00	3332.67	3390.67	58.00	36.60	0.631	0.107	0.231	1.668	61.0	0.913
L15-01	3090.00	3099.00	3056.99	3065.99	9.00	7.05	0.783	0.092	0.223	0.784	5.5	0.935
M10-02												

Playbacks



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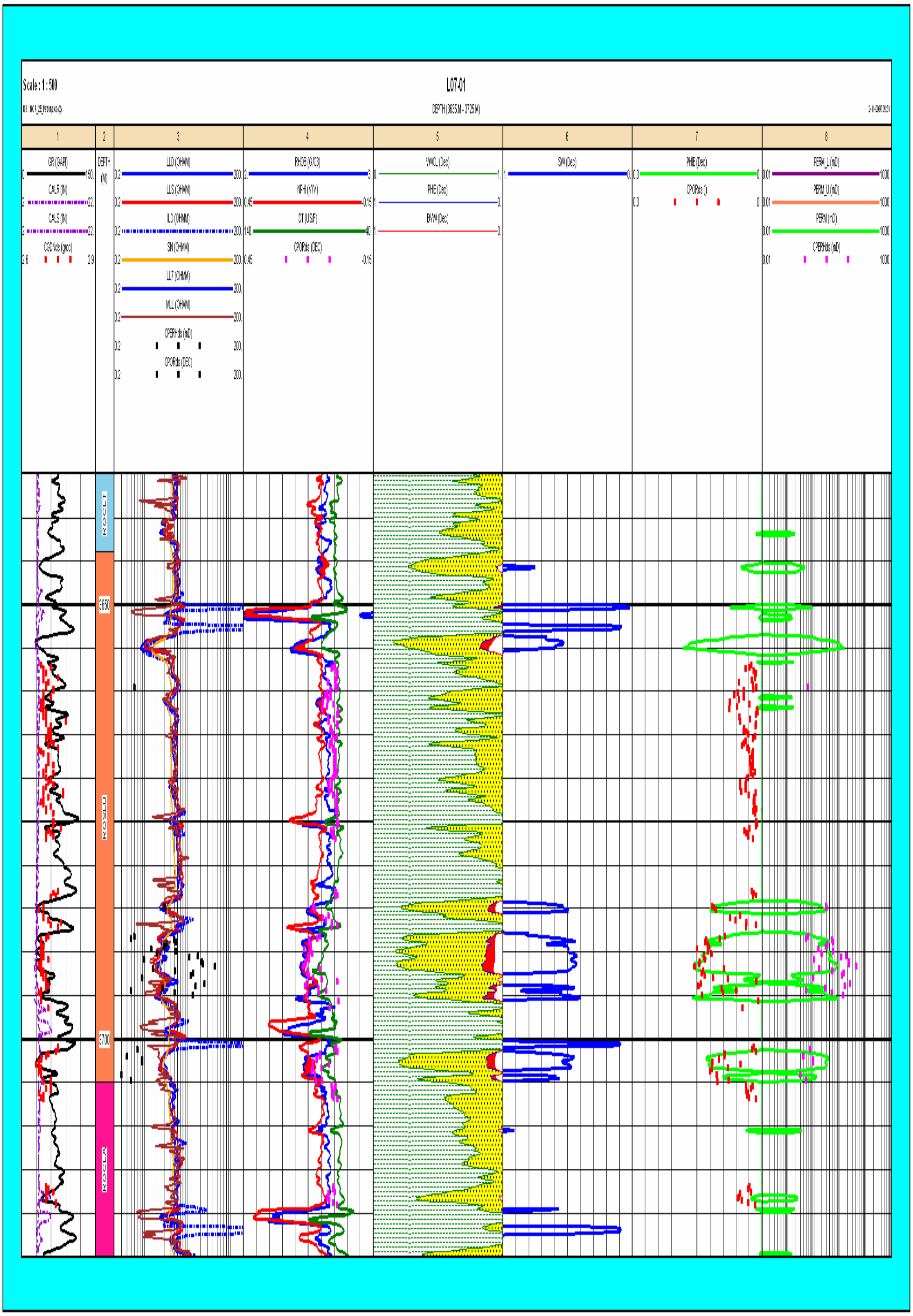

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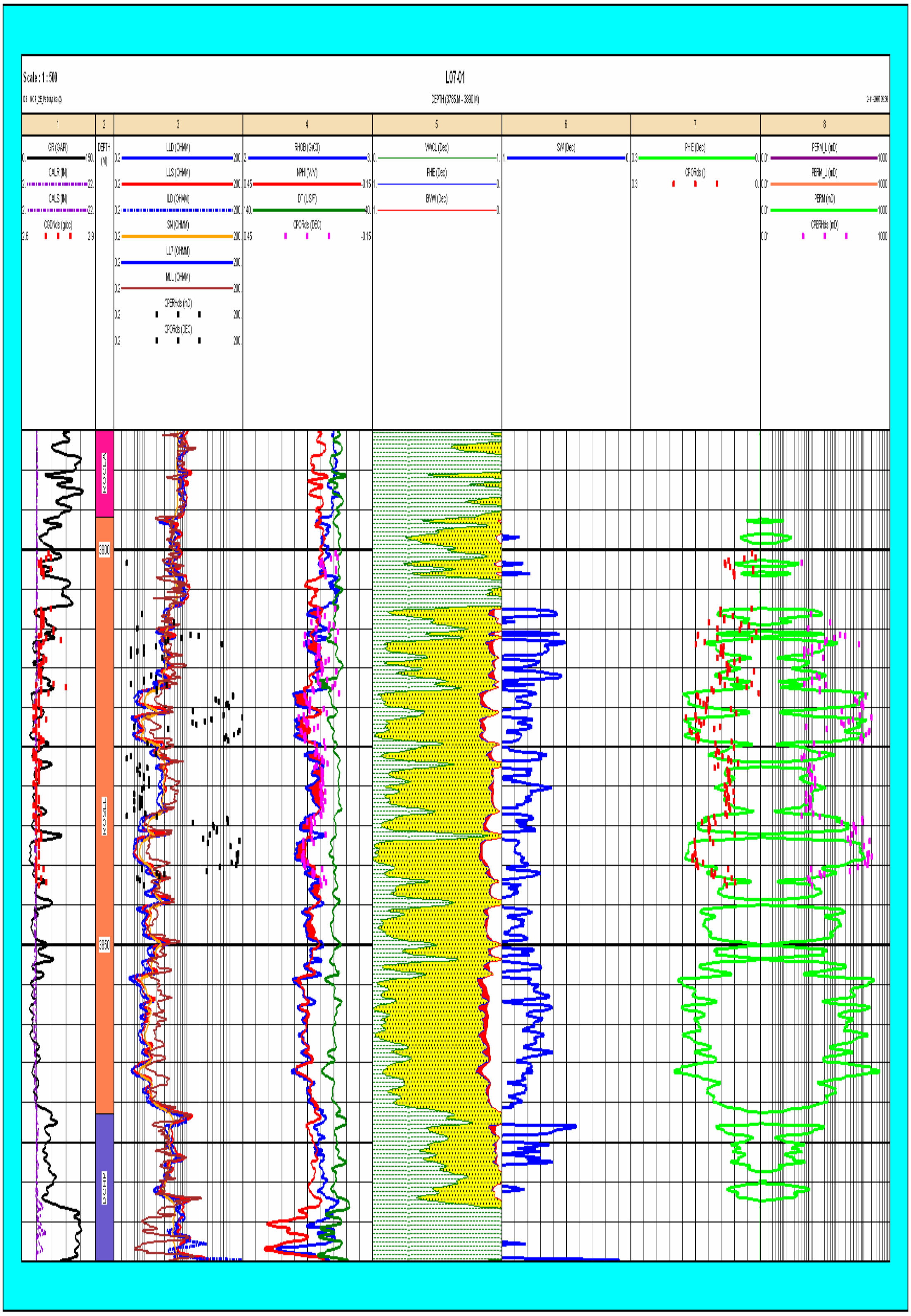

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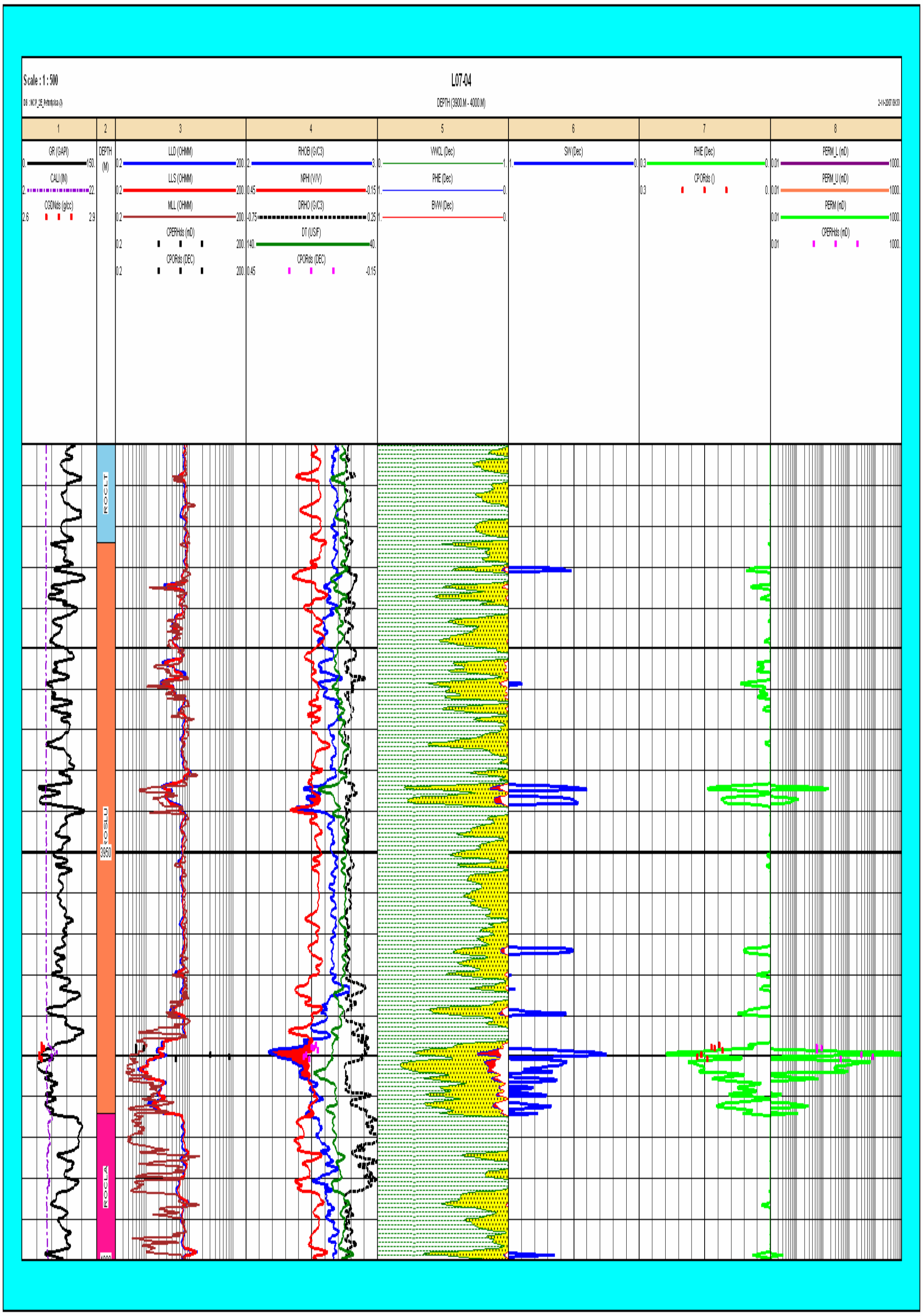

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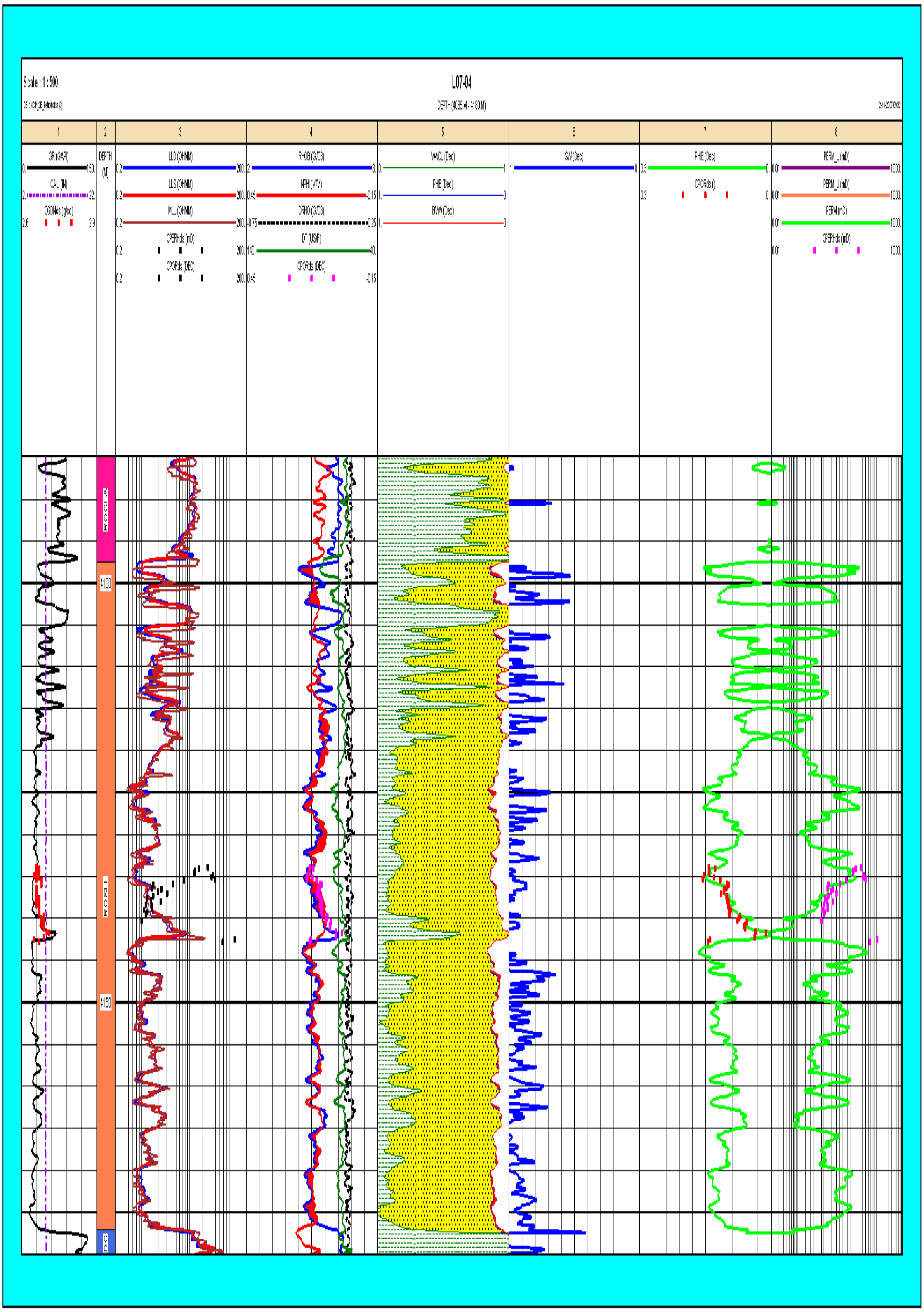

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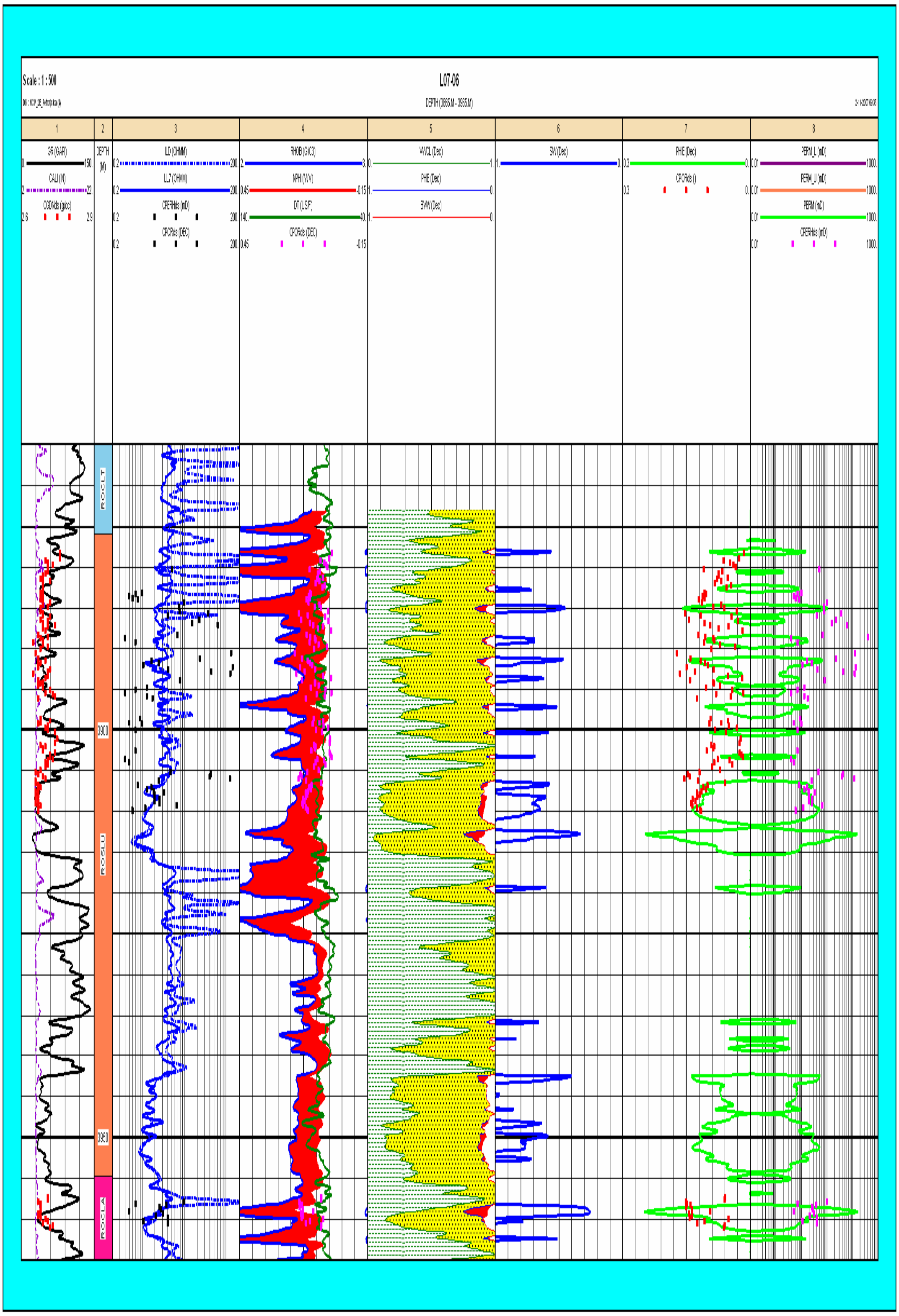

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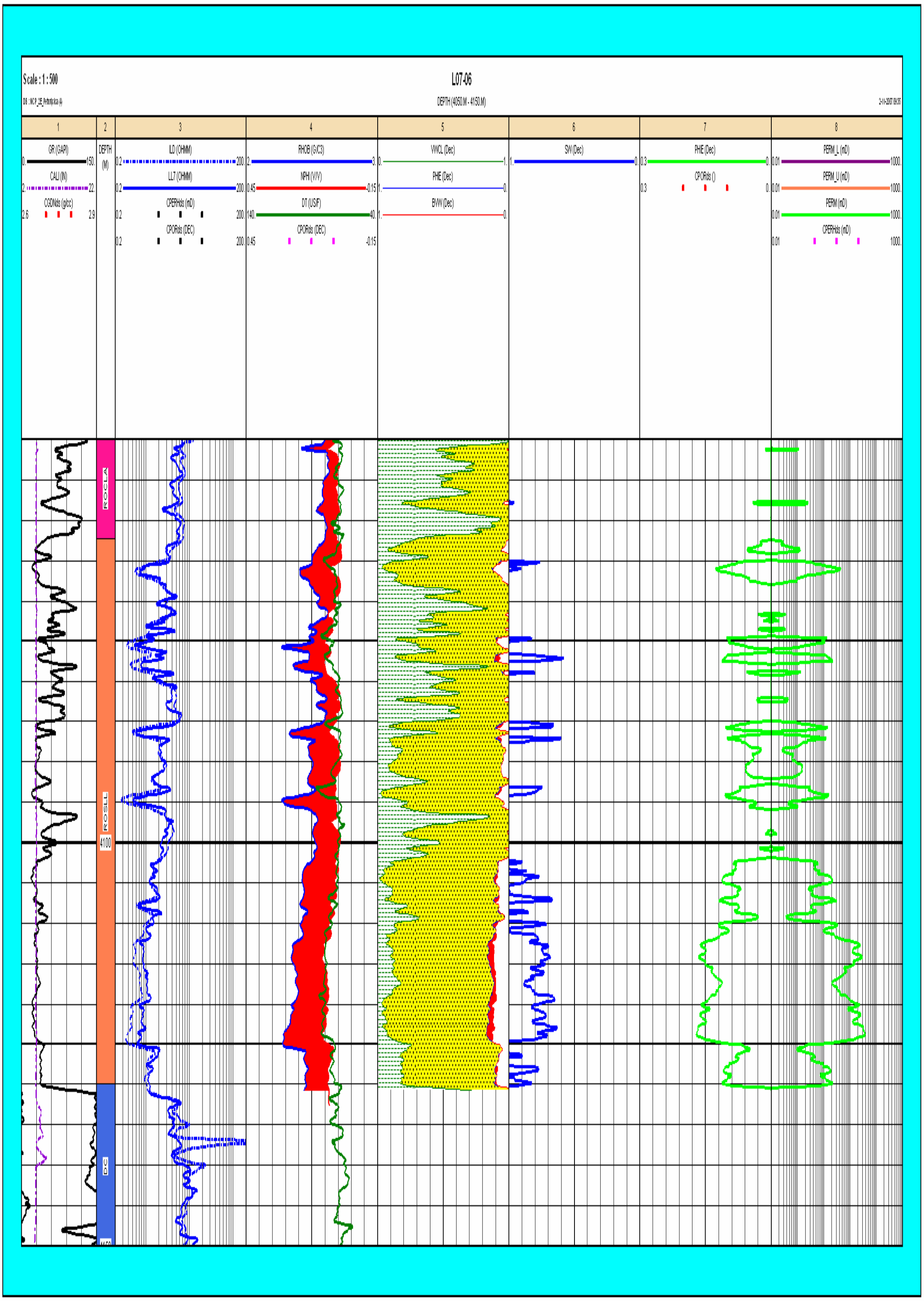

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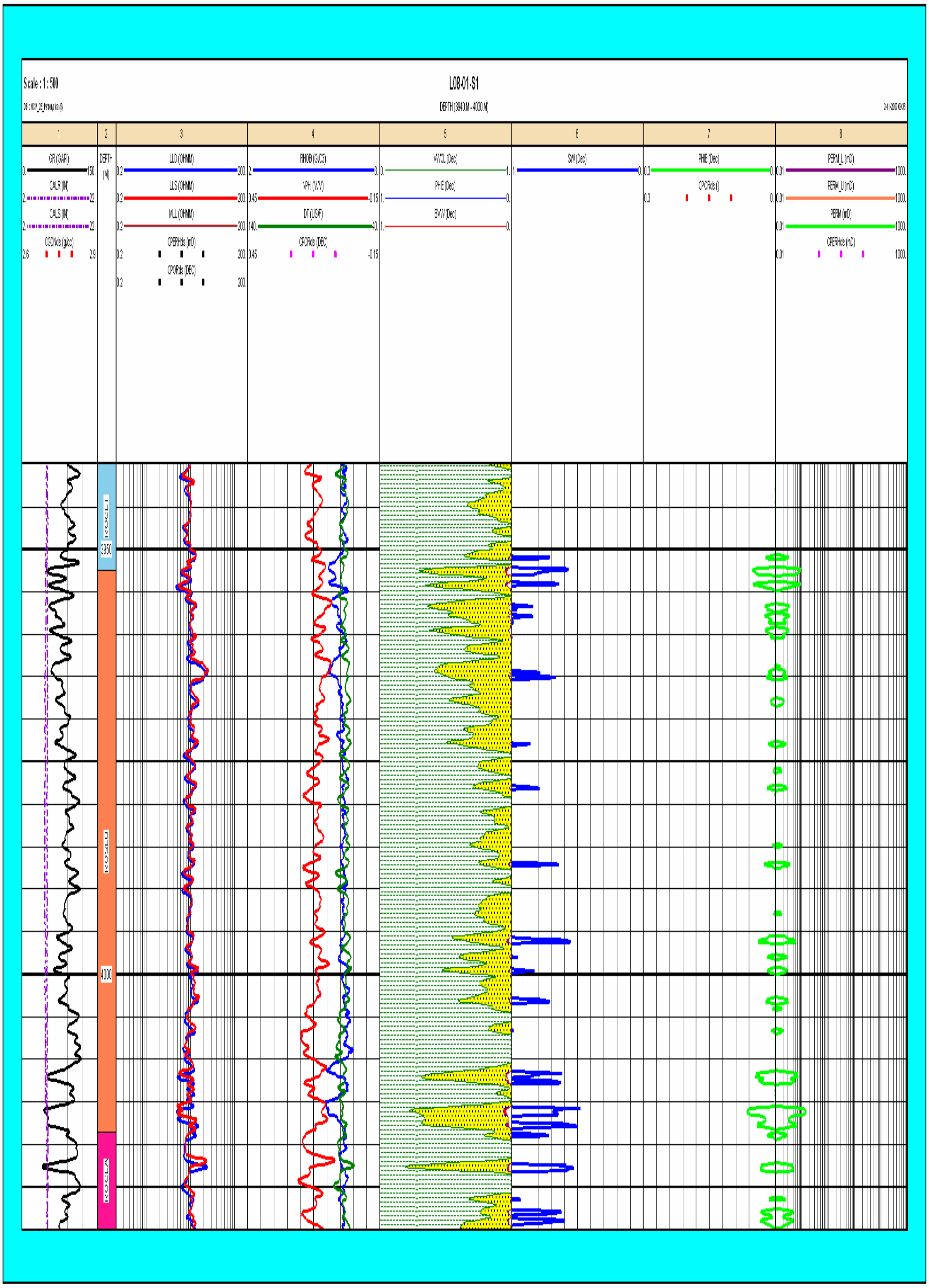

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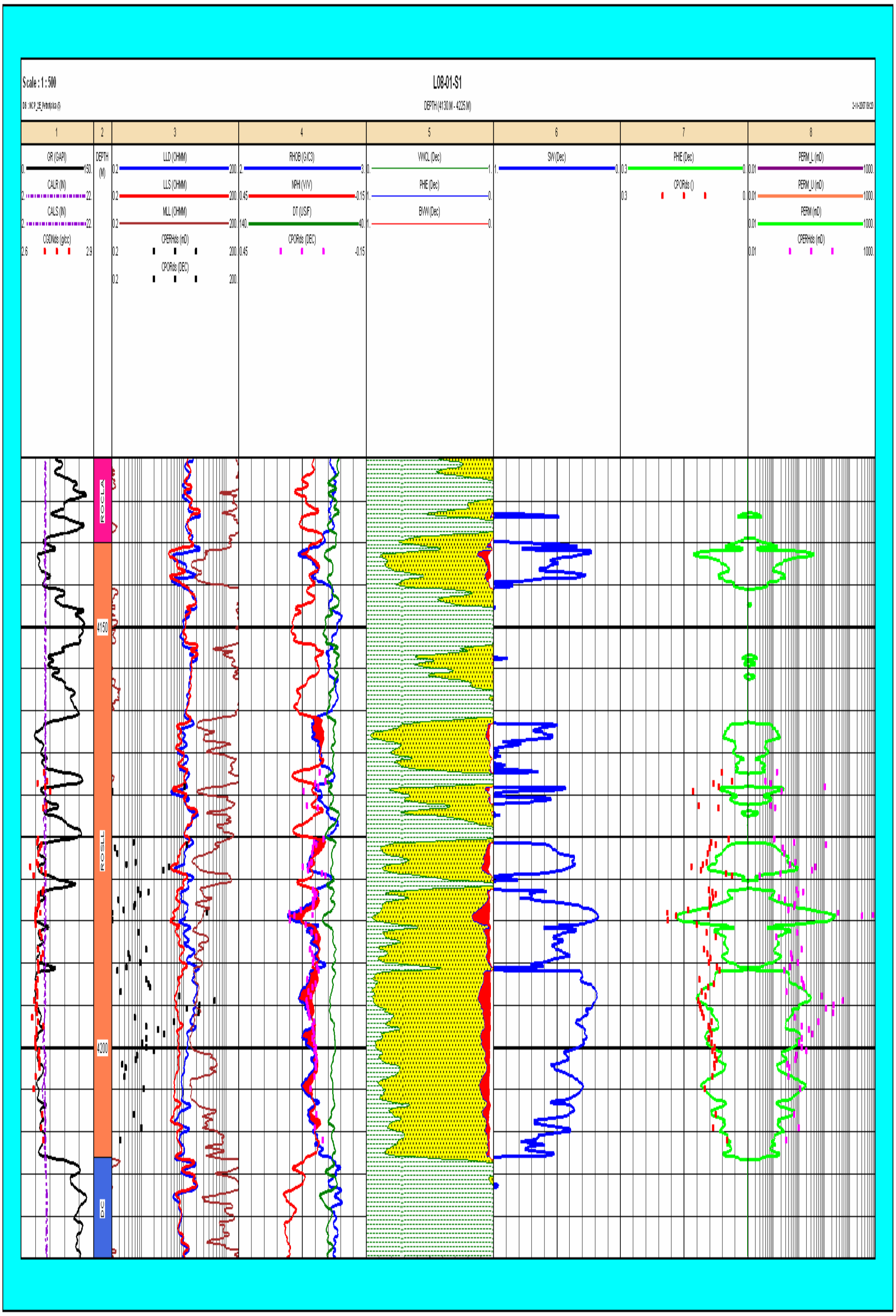

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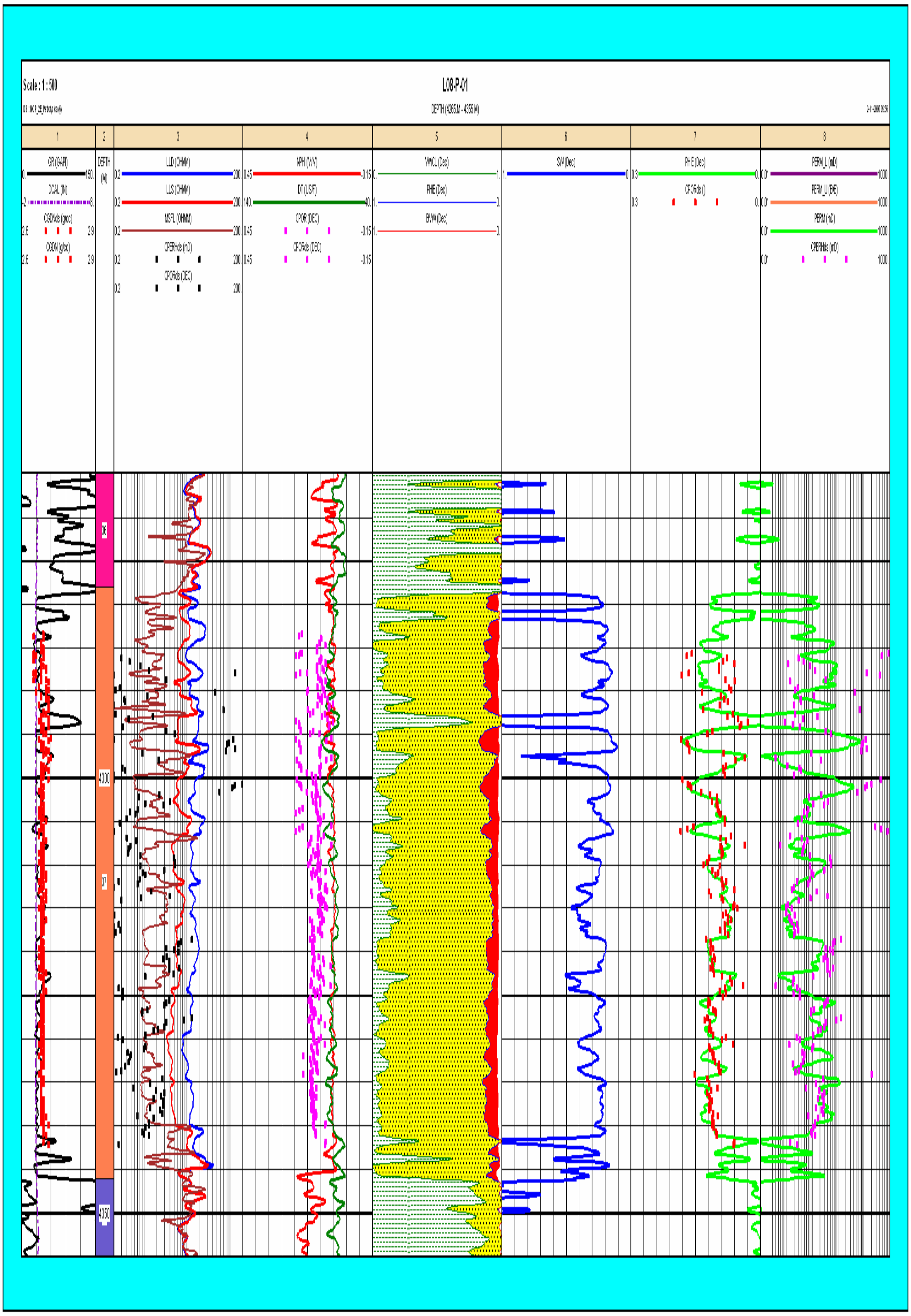

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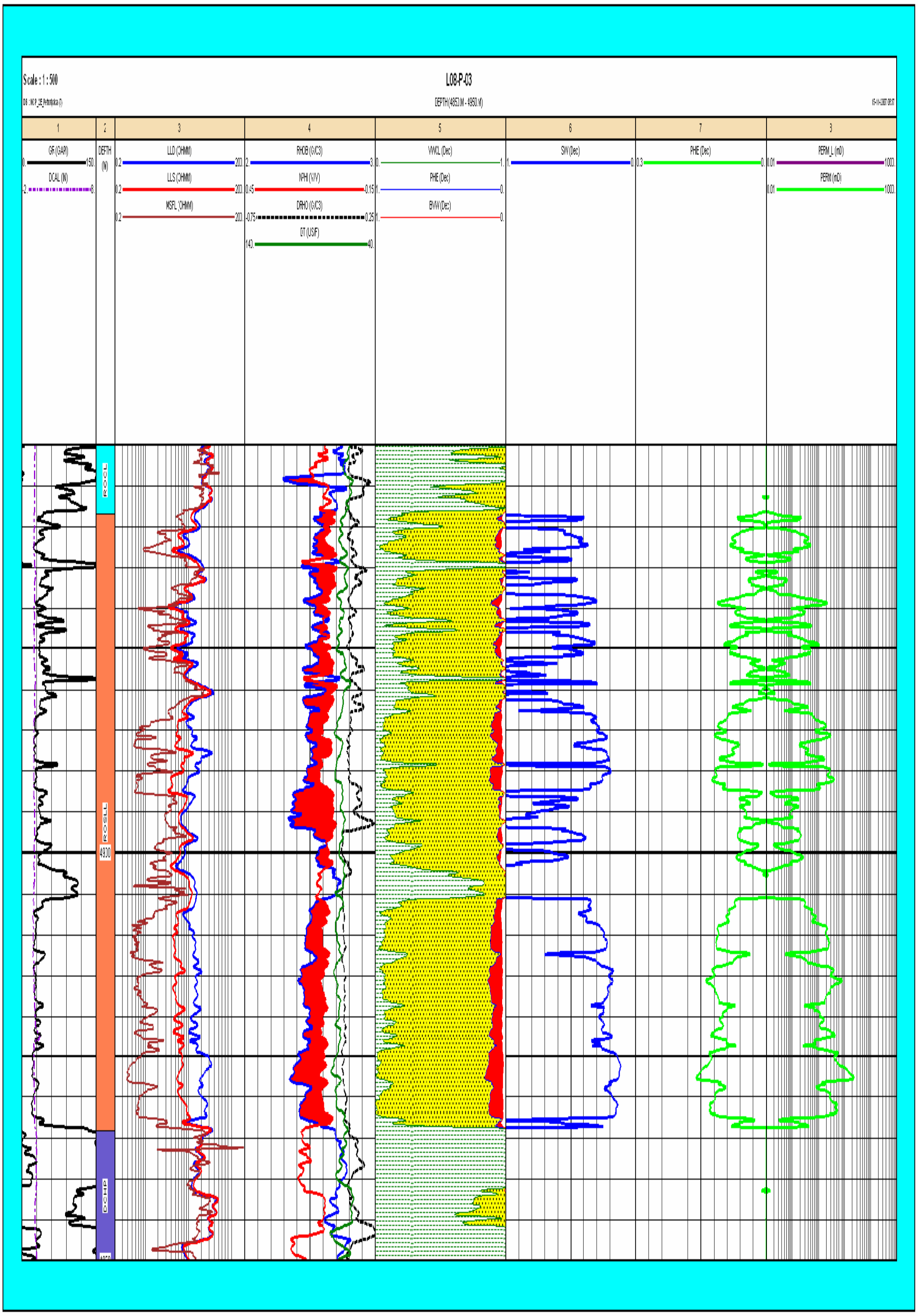

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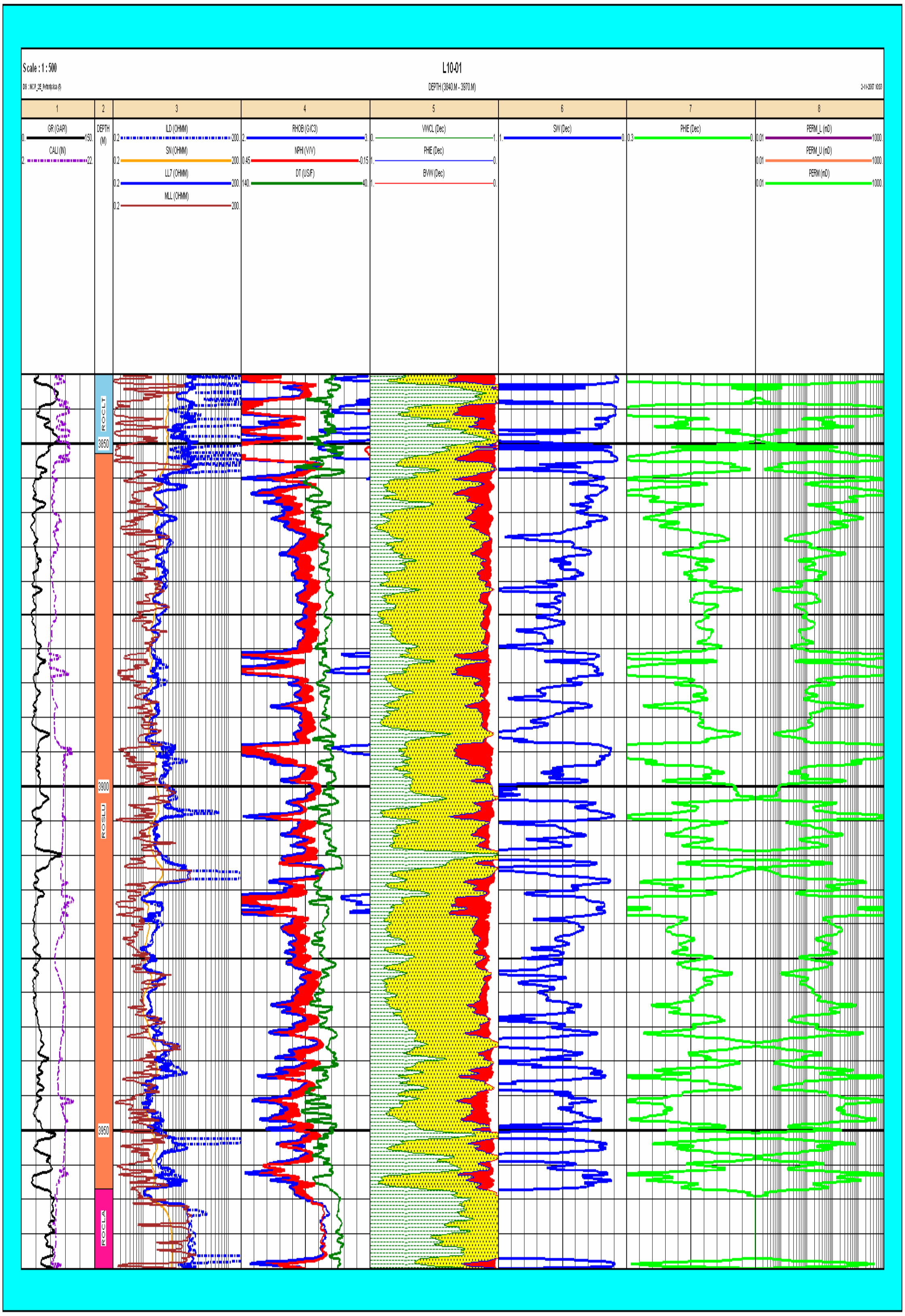

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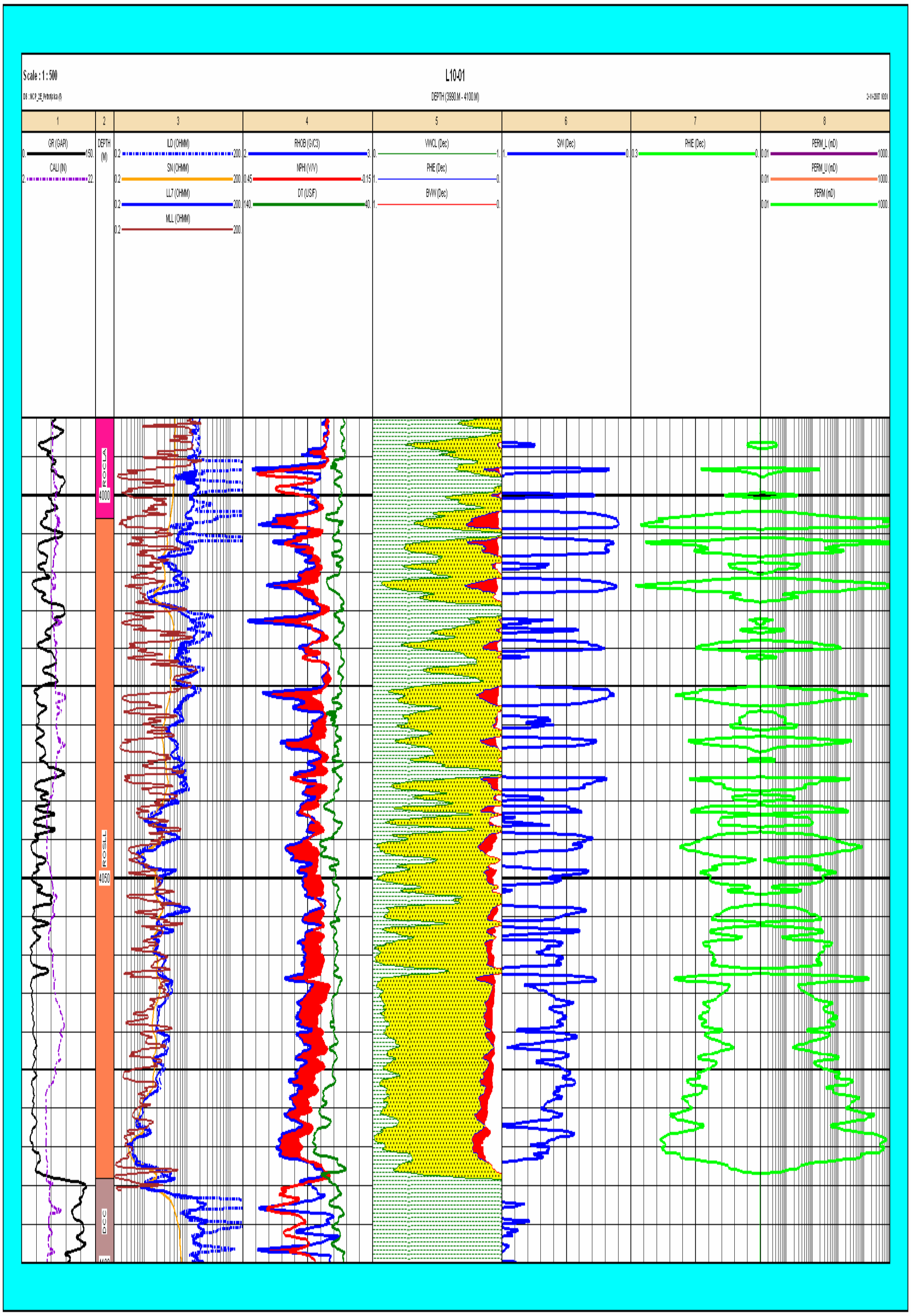

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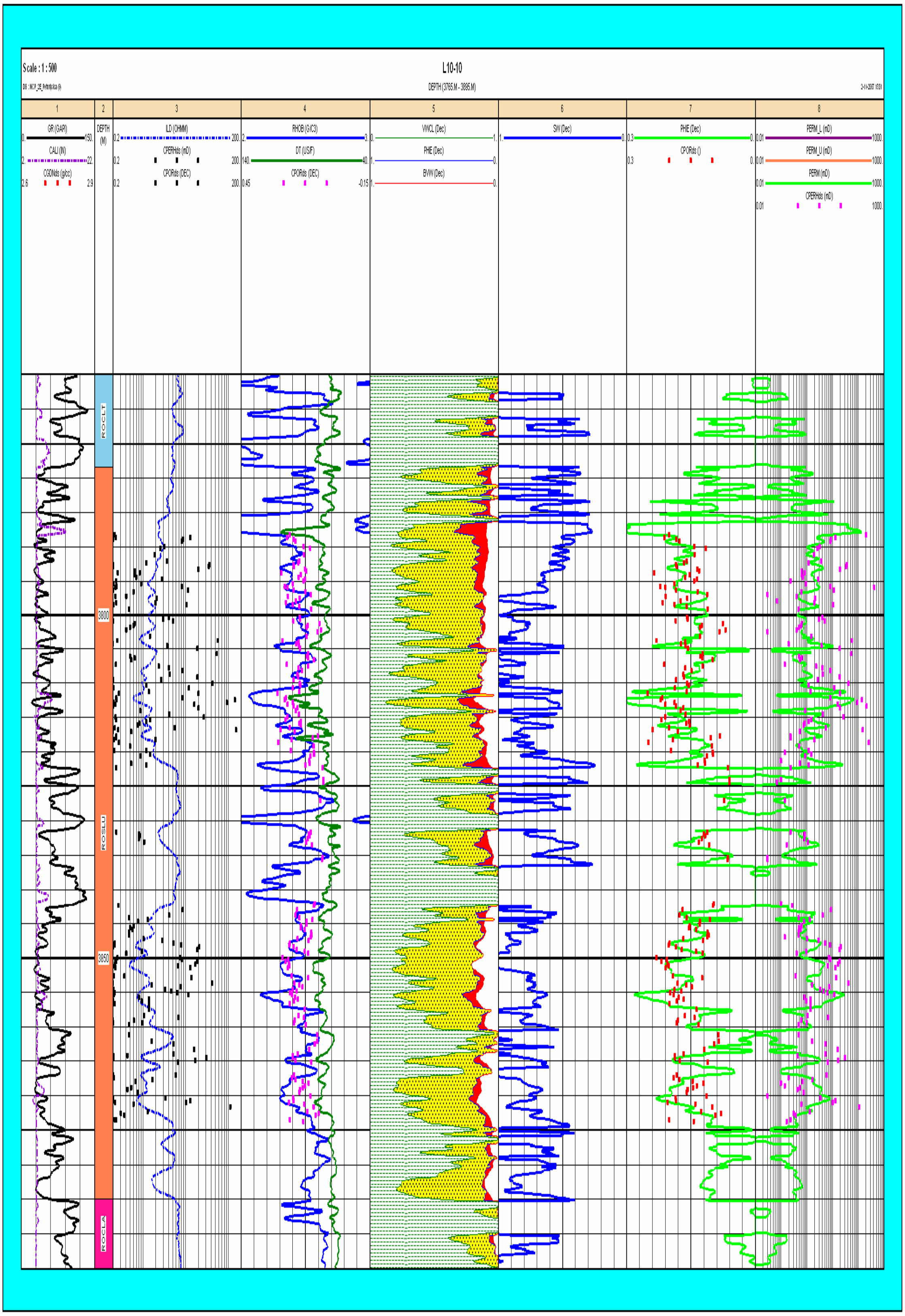

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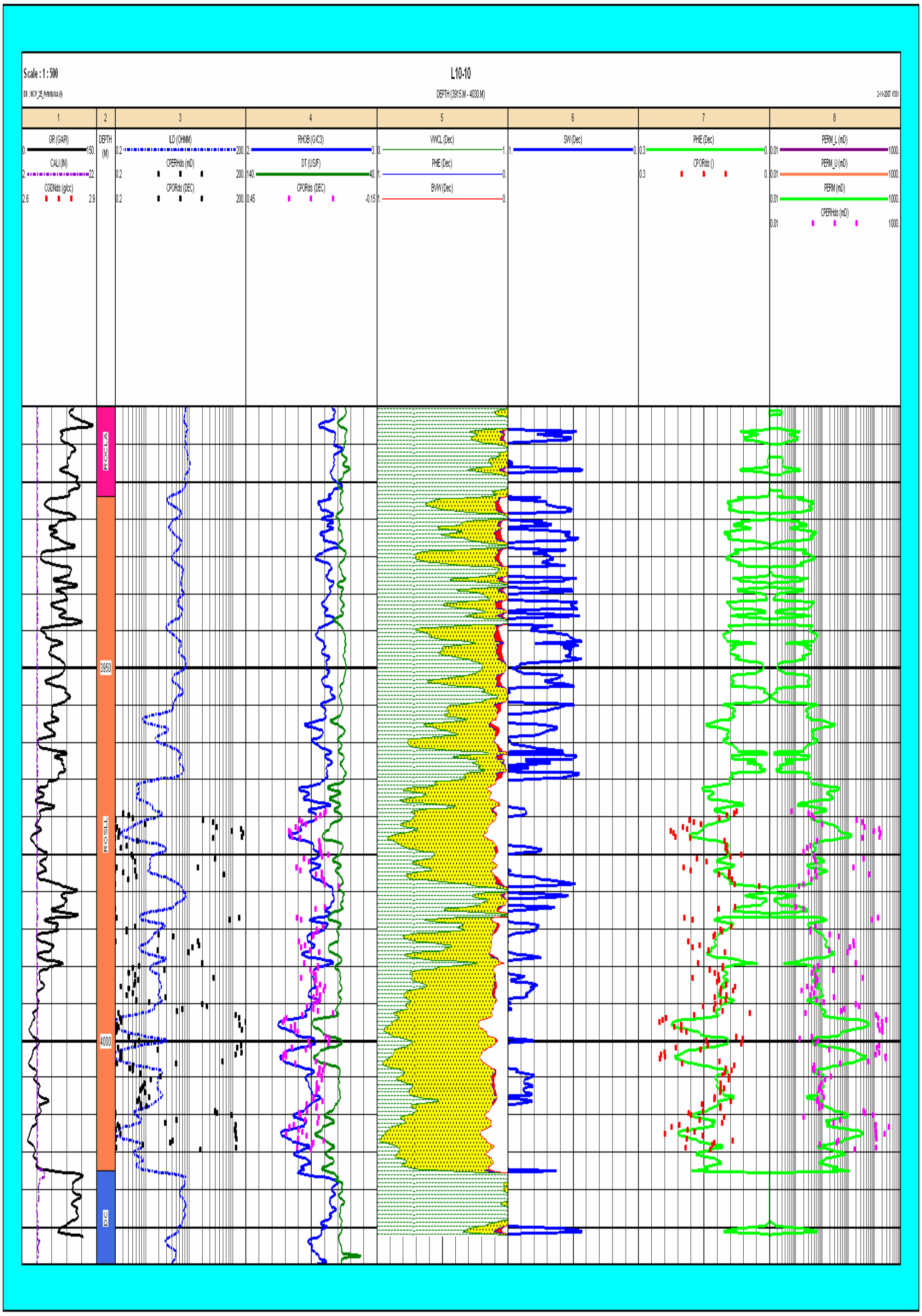

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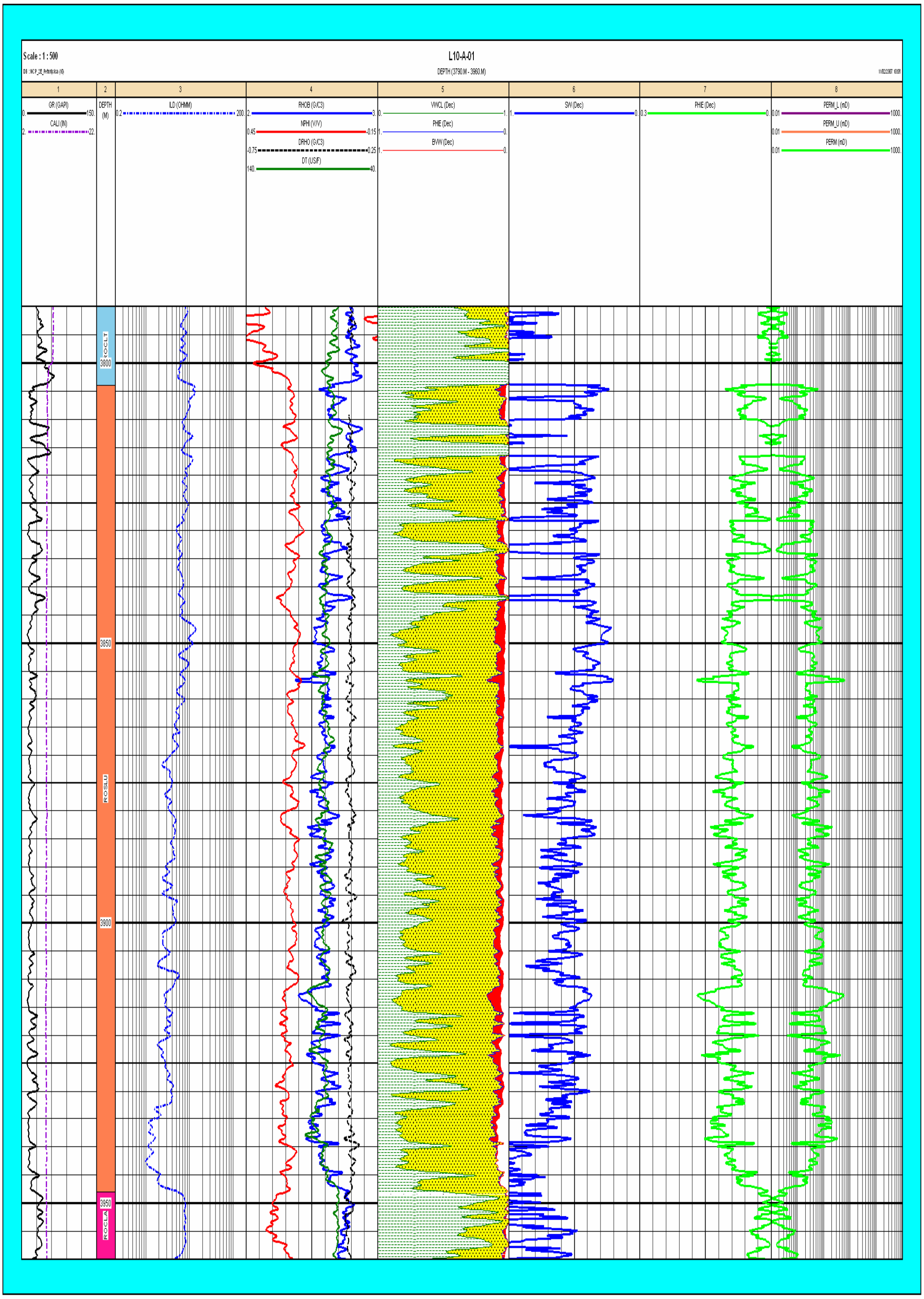

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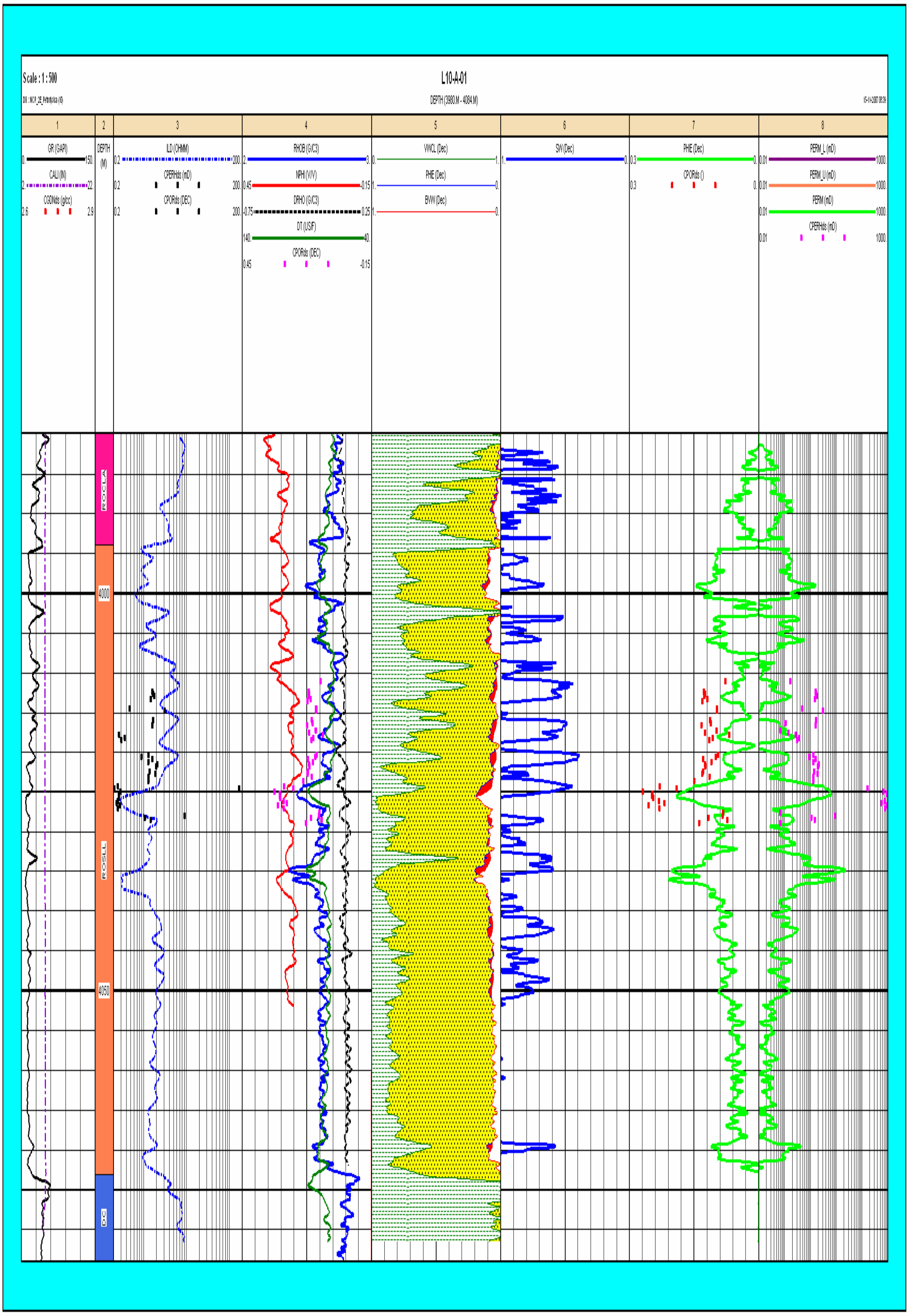

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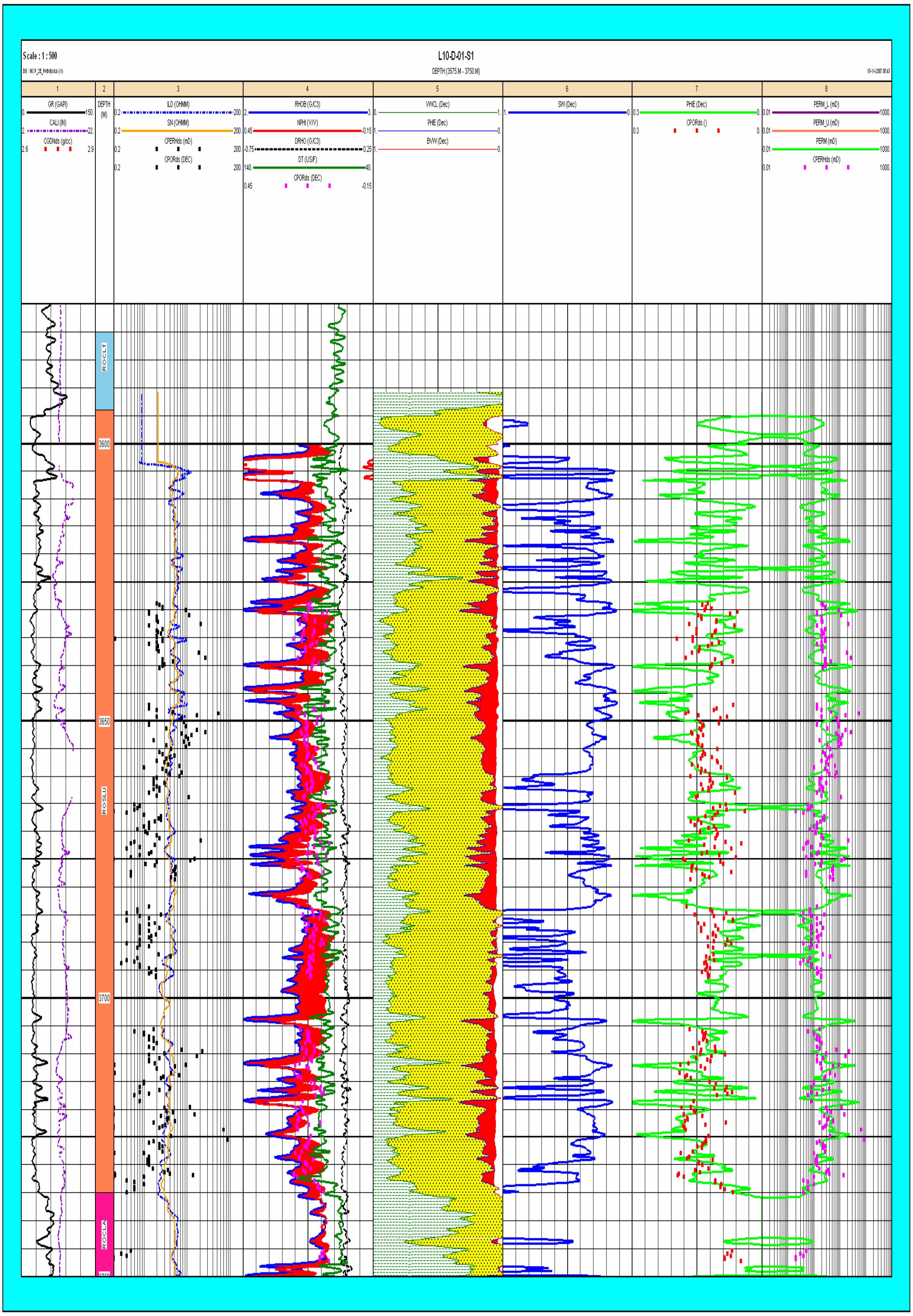

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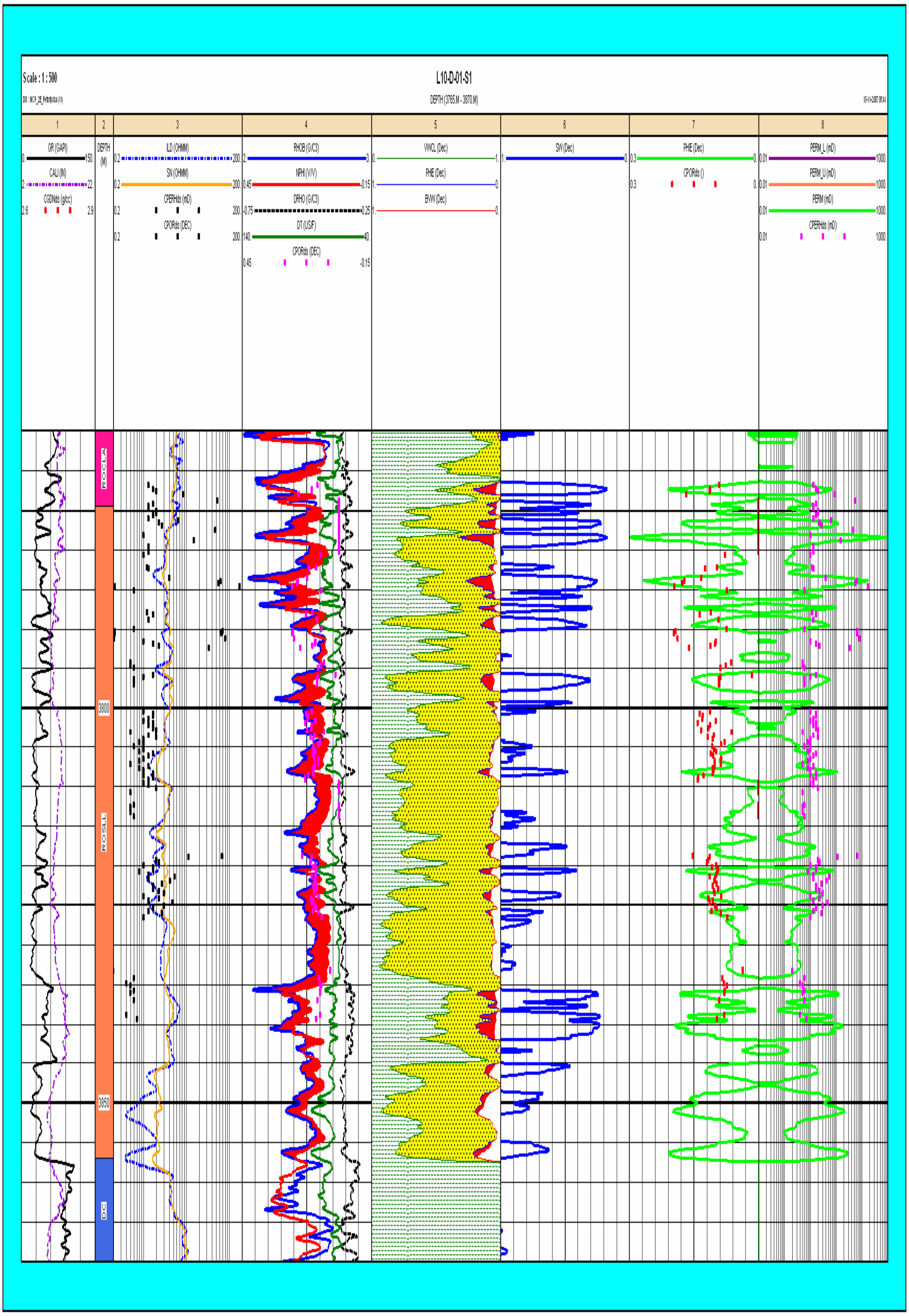

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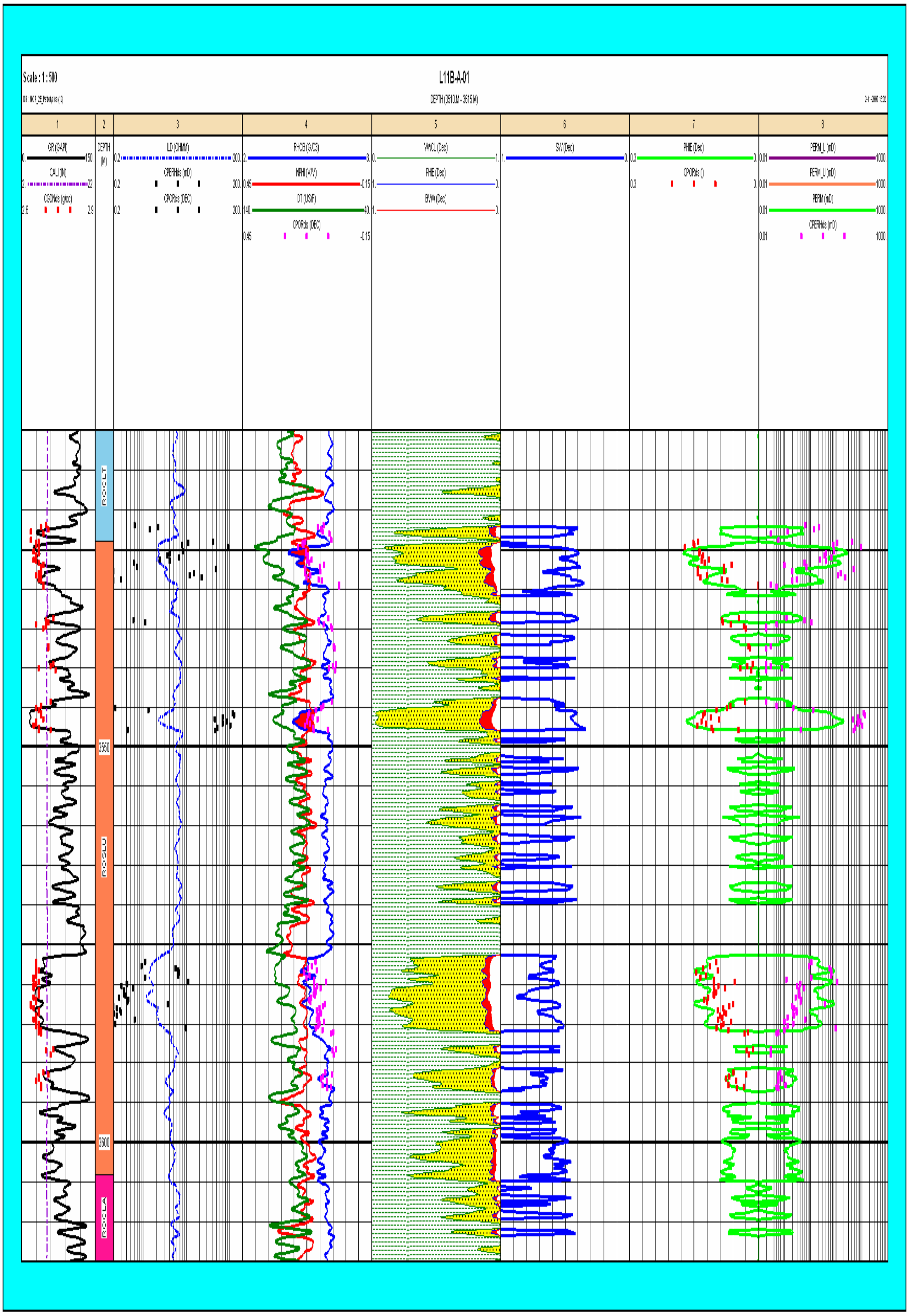

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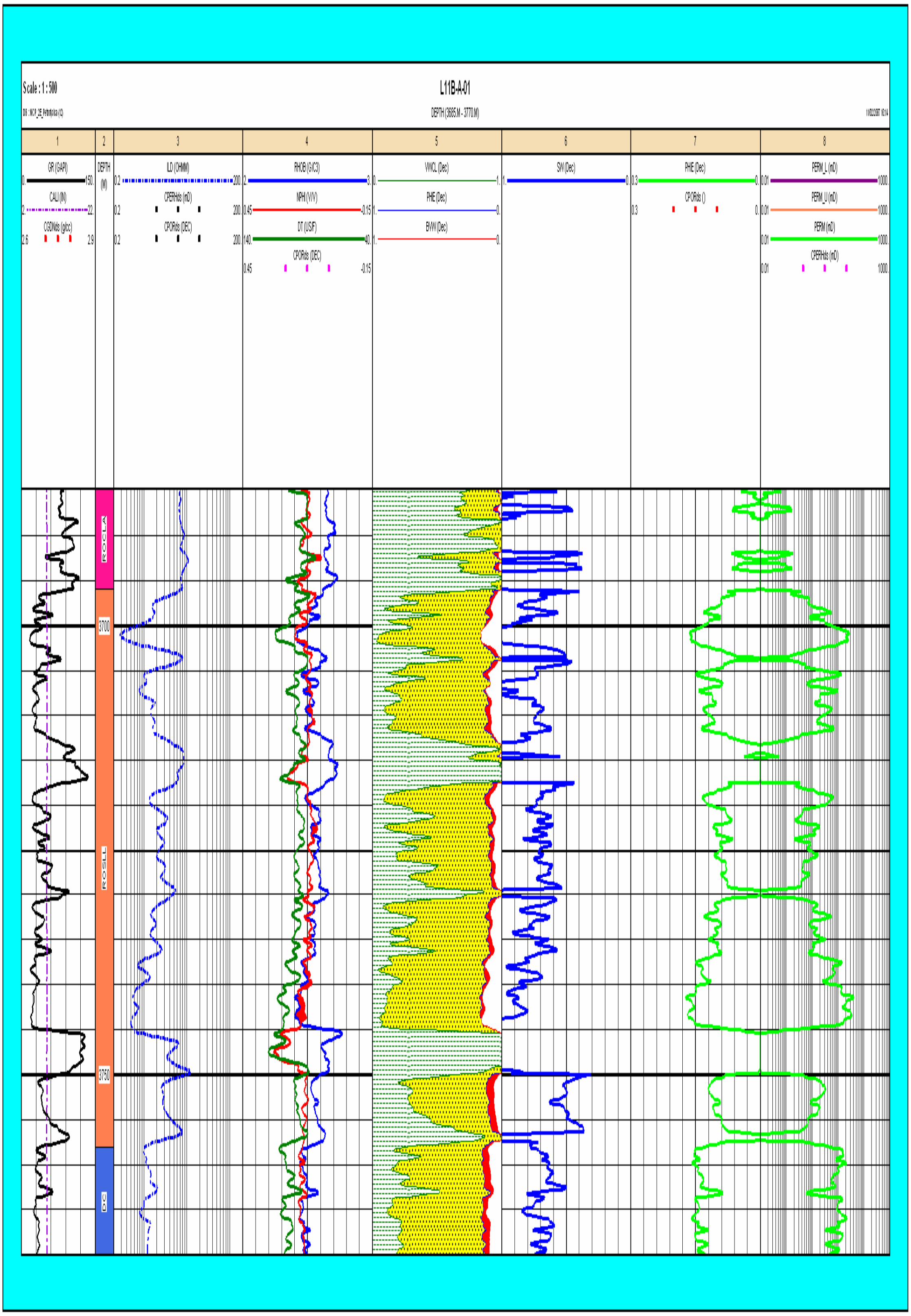

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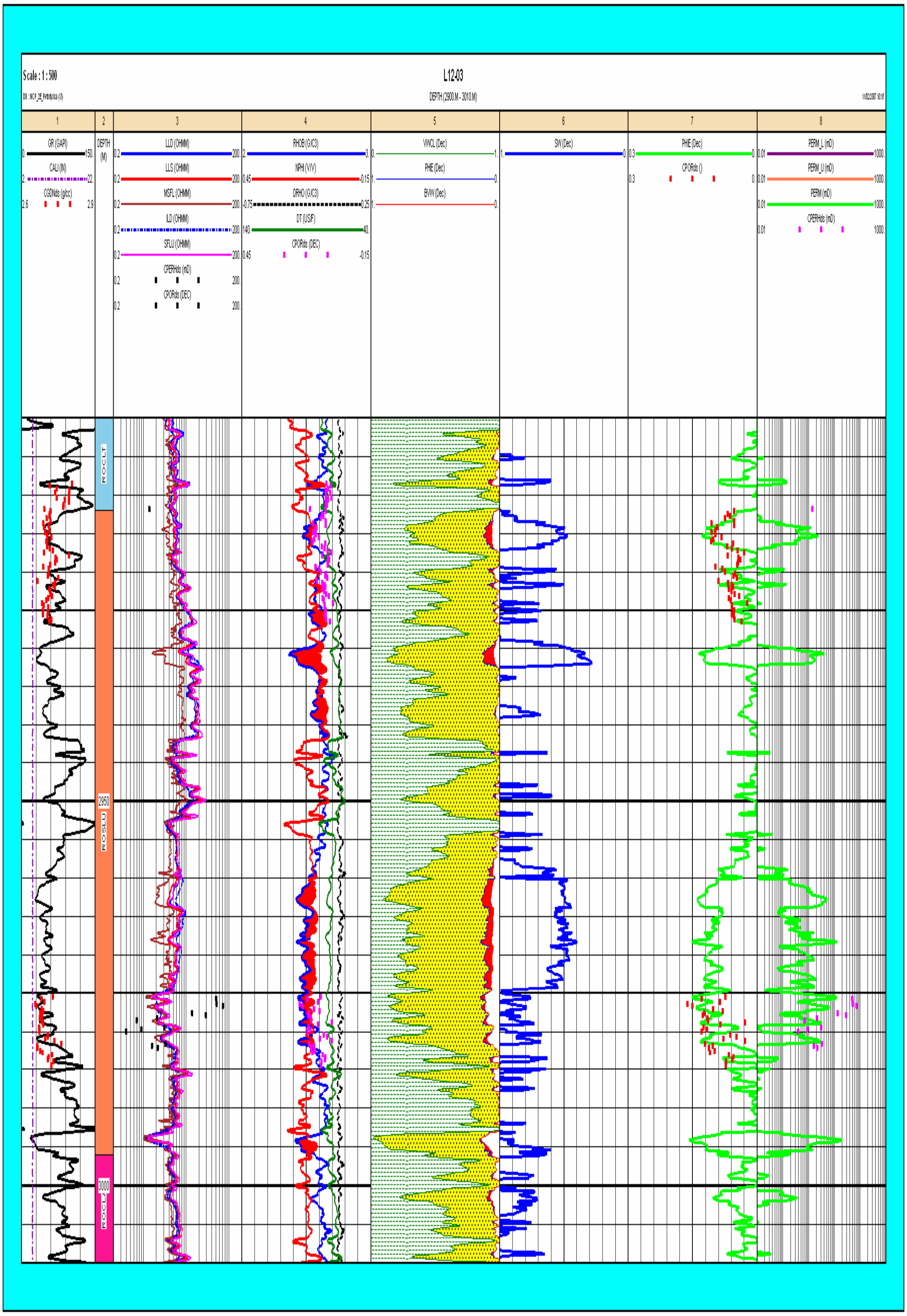

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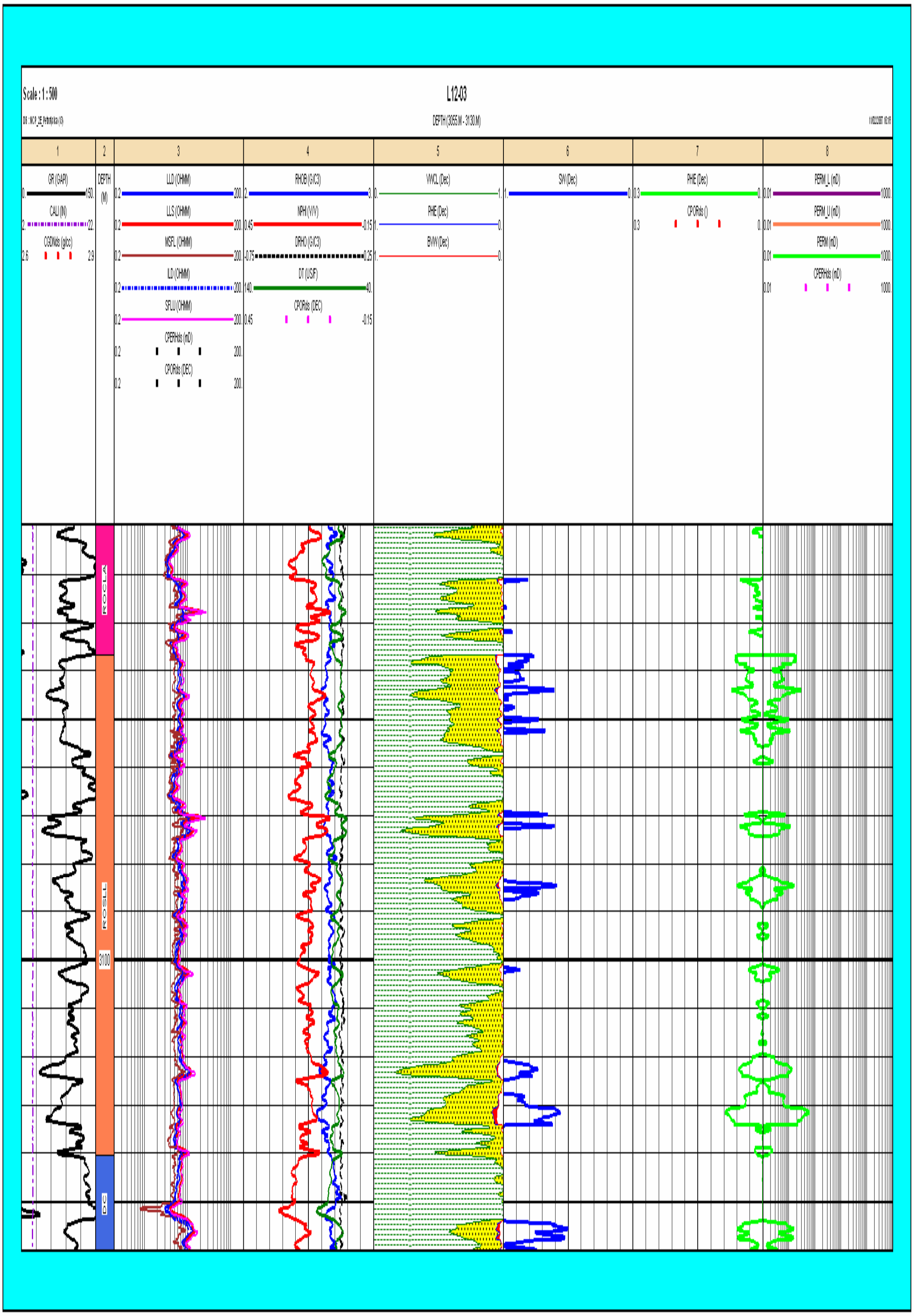

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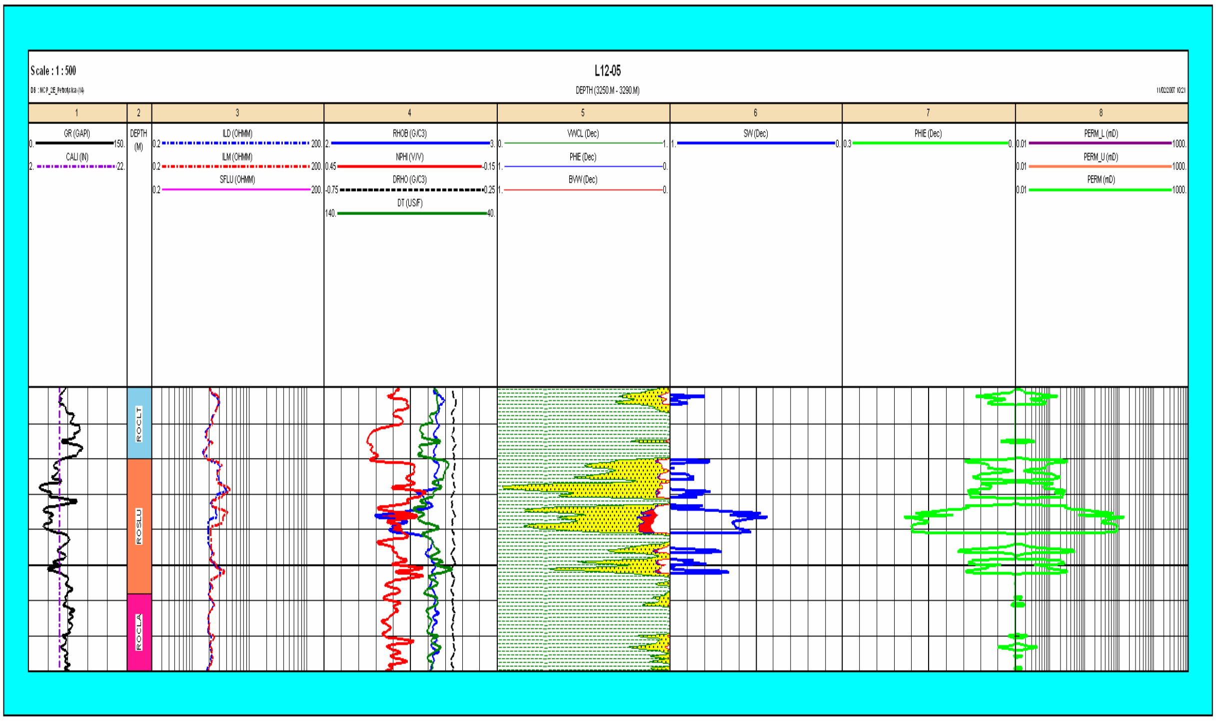

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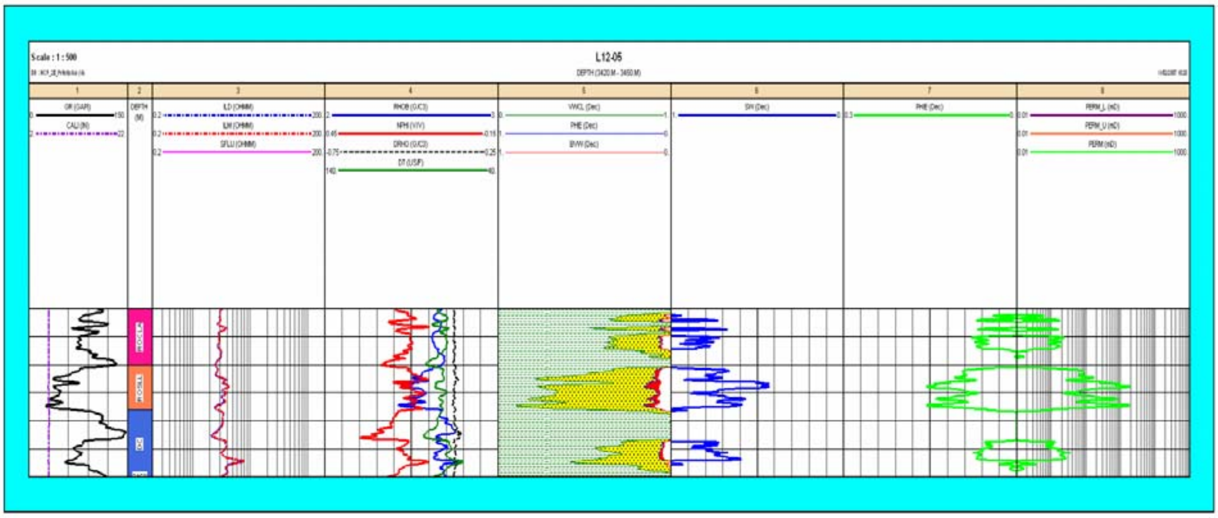

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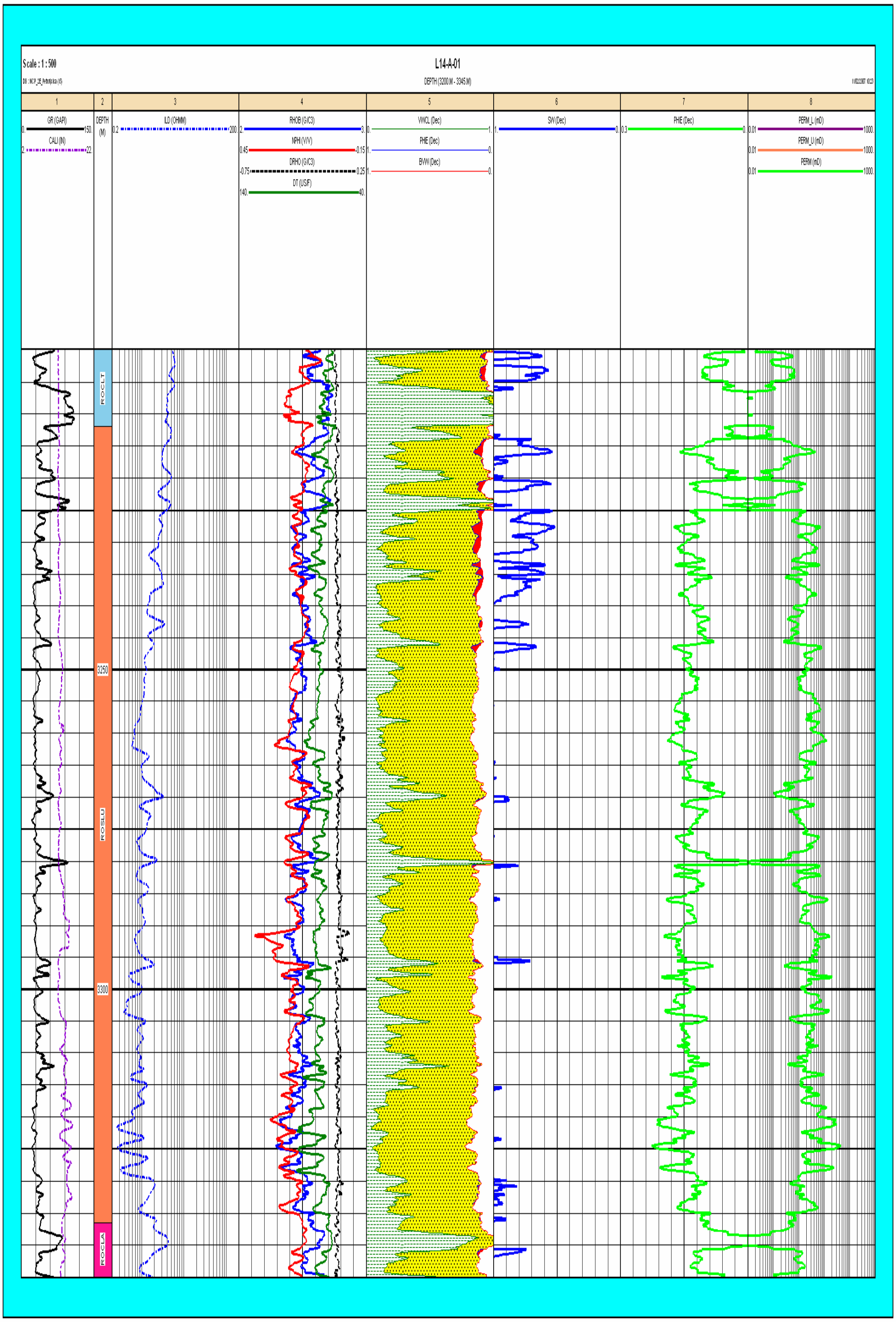

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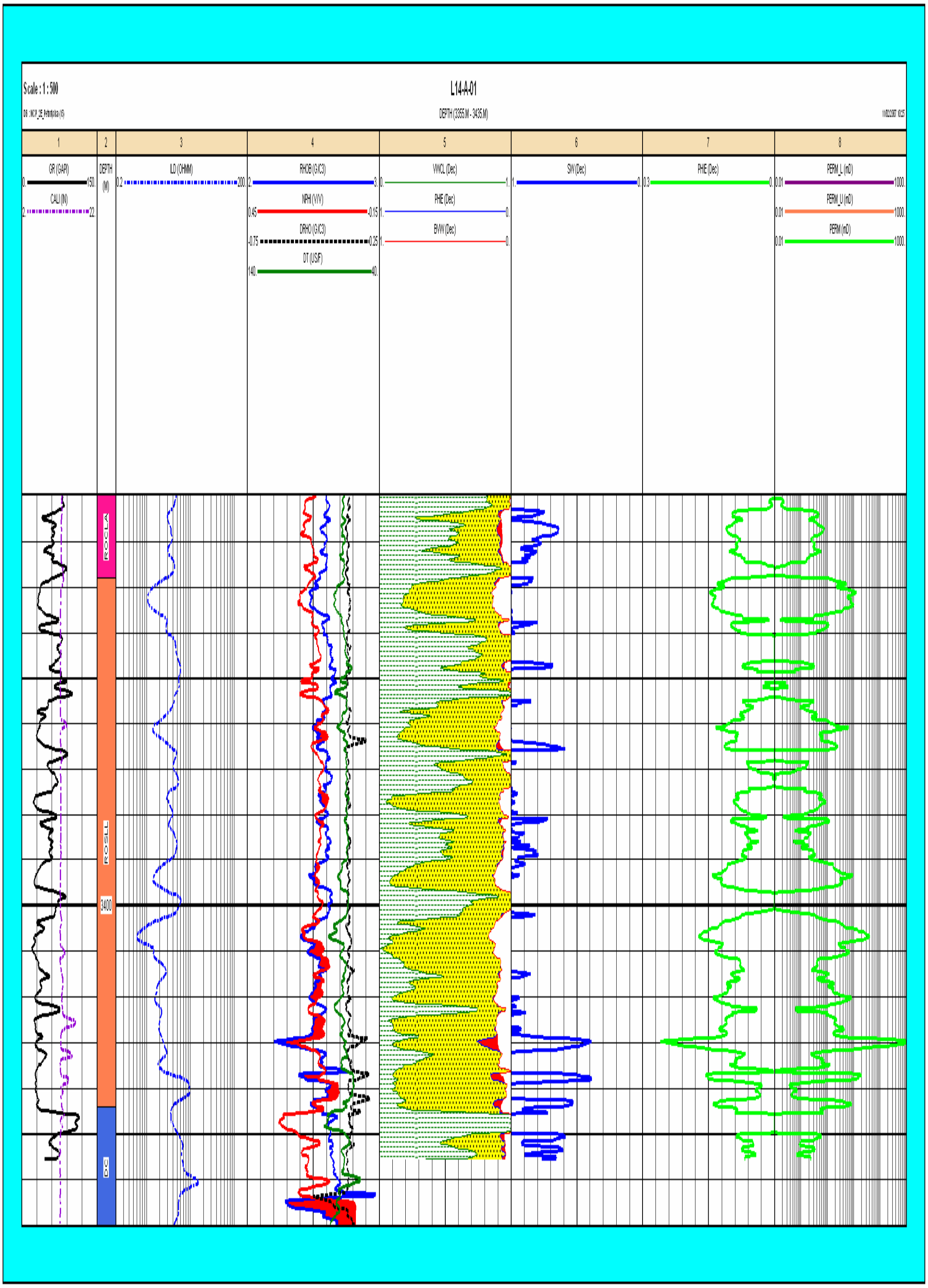

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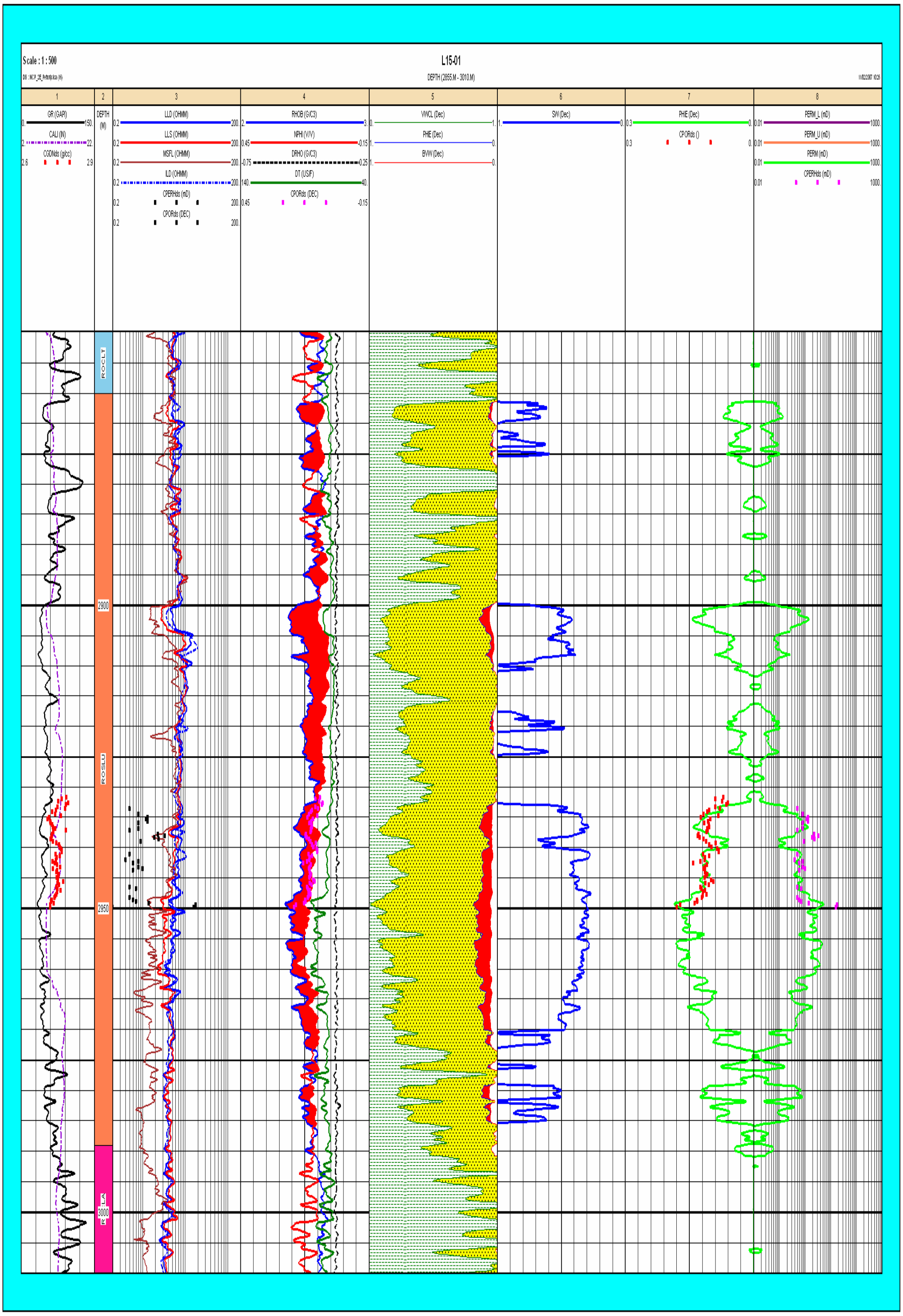

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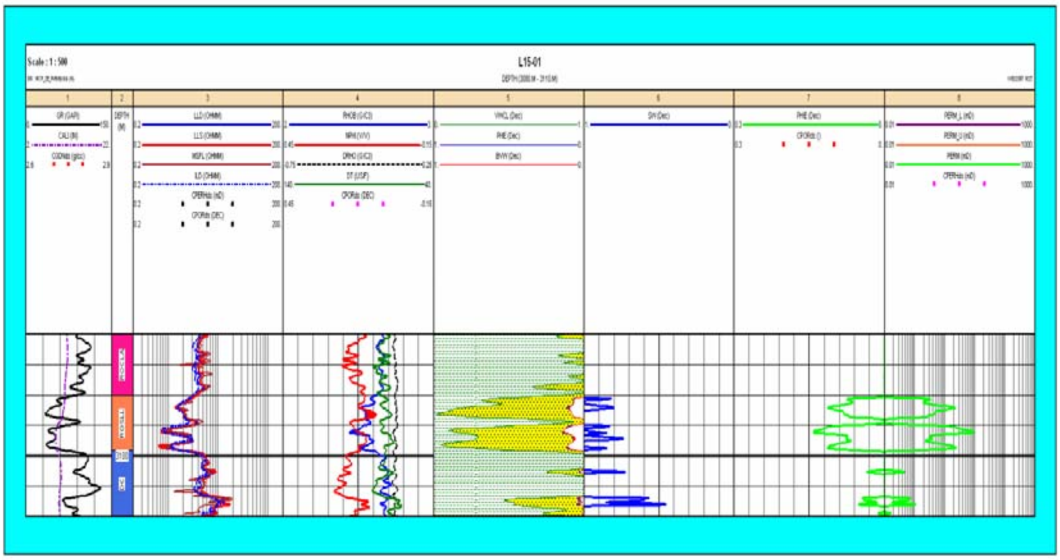

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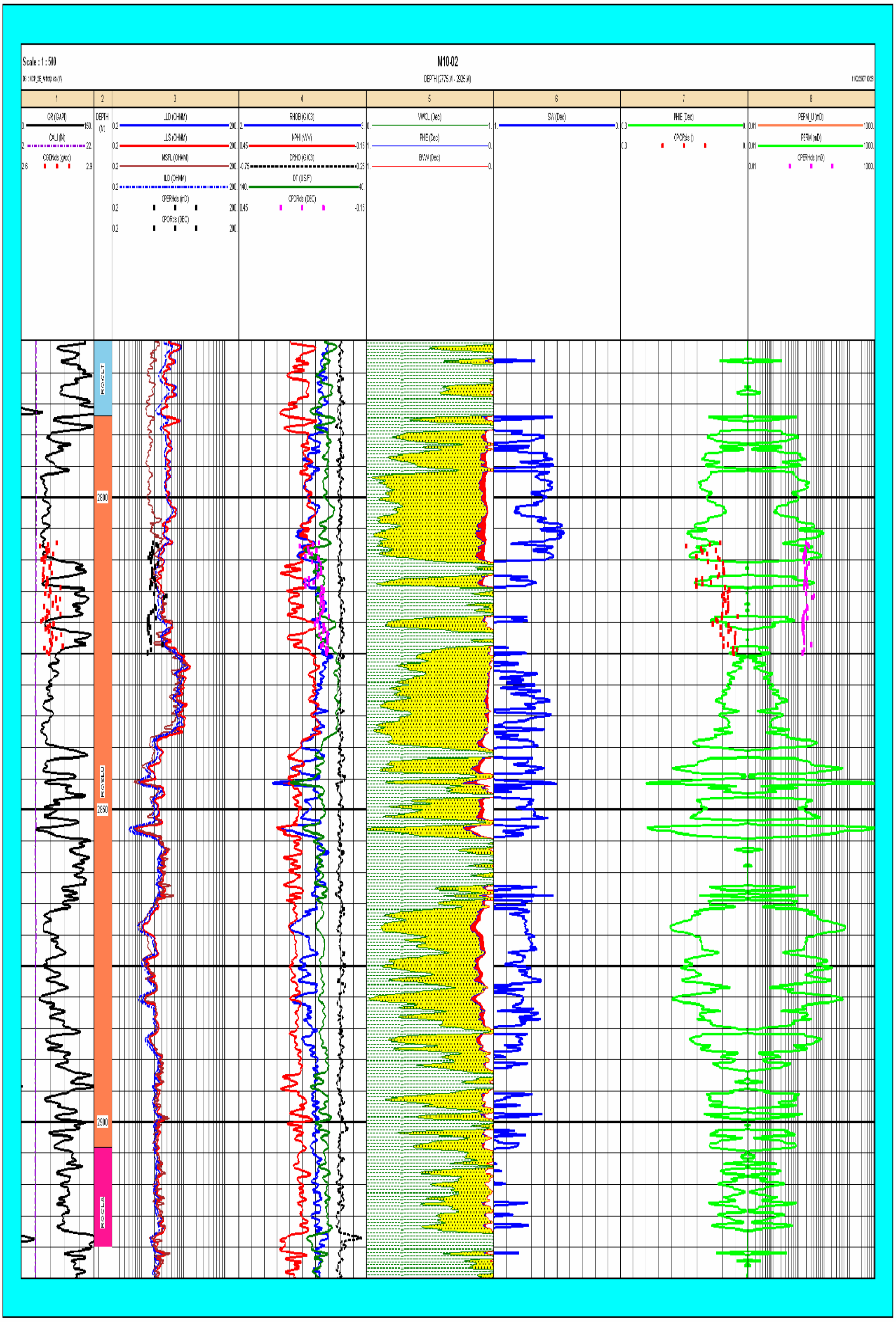

Playback 17a Petrophysical analysis Upper Slochteren Sandstone M10-02

7 Signature

Utrecht, June 2008

TNO Buiilt Environment
and Geosciences

J.C. Doornenbal
Project manager

J.J.F. Ramaekers
Author