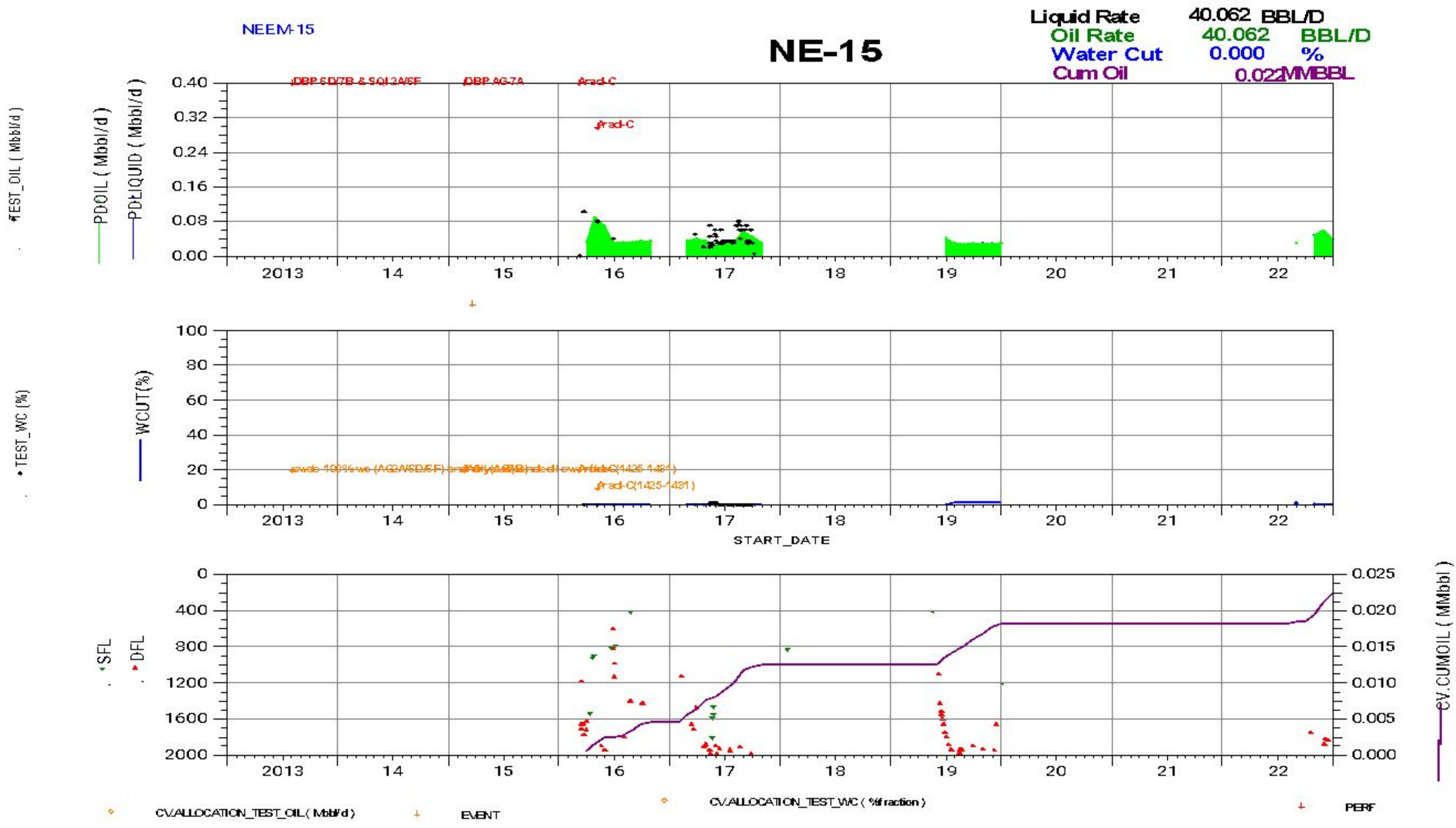
NE-15, NEE-09

Perforation & Events

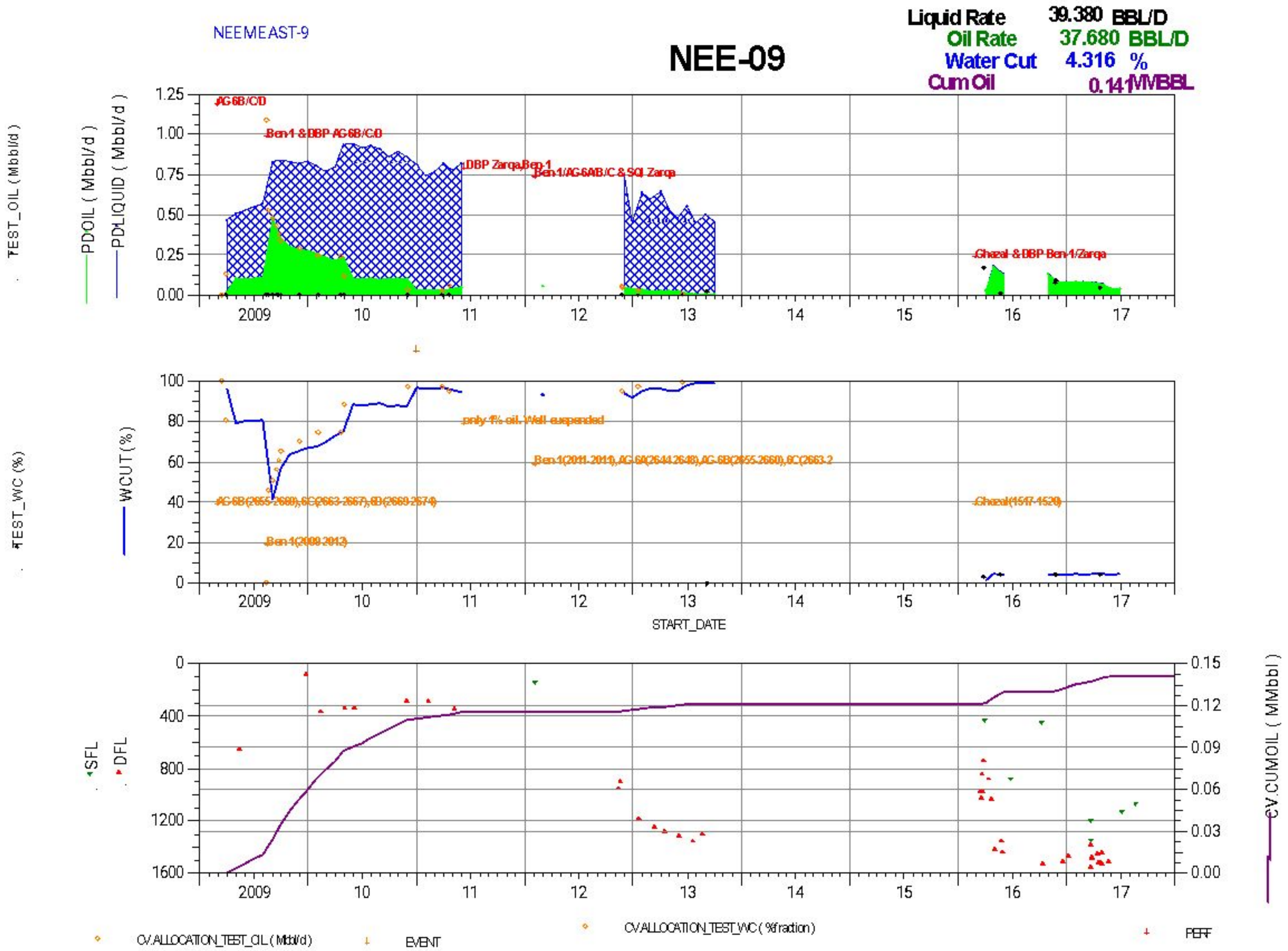
WELLNAME NE-15								
2508	2515	AG-2A	03.08.2013	Squeeze	1985.00	1992.00	Dev well. Swab 100% WC.	
2946.5	2955.5	AG-6D	03.08.2013	DBP	2423.50	2432.50	Dev well. Swab 100% WC.	
3000	3024	AG-6F	03.08.2013	Squeeze	2477.00	2501.00	Dev well. Swab 100% WC.	
3113	3119	AG-7B	03.08.2013	DBP	2590.00	2596.00	Dev well. Swab no fluid. Dry.	
3129	3134	AG-7B	03.08.2013	DBP	2606.00	2611.00	Dev well. Swab no fluid. Dry.	
3085.5	3099	AG-7A	25.02.2015	DBP	2562.50	2576.00	Dev well. Swab 0% WC.	
3085.5	3099	AG-7A	25.02.2015	DBP	2562.50	2576.00	Dev well. Swab commingled 0 WC. Low influx	
3078	3083.3	AG-7A	25.02.2015	DBP	2555.00	2560.30		Well Suspended with low influx
1948	1954	Aradieba-C	06.03.2016	open	1425.00	1431.00	Dev well. Swab 100% OIL.	
1948	1954	Aradieba-C	02.10.2022	open	1425.00	1431.00		Instaal PBU

WELLNAME NEE-09							
2655	2660	AG-6B	28.02.2009	open	2134.25	2139.25	Dev well. Swab Commingled 92% OIL.
2663	2667	AG-6C	28.02.2009	open	2142.25	2146.25	
2669	2674	AG-6D	28.02.2009	open	2148.25	2153.25	
2009	2012	Bentiu-1	13.08.2009	open	1488.25	1491.25	Dev well. Swab 100% OIL.
2655	2660	AG-6B	13.08.2009	DBP	2134.25	2139.25	Dev well. Swab Commingled 2% WC.
2663	2667	AG-6C	13.08.2009	DBP	2142.25	2146.25	
2669	2674	AG-6D	13.08.2009	DBP	2148.25	2153.25	
1908	1914	Zarqa	07.06.2011	DBP	1387.25	1393.25	Dev well. Swab 98% WC.
2009	2012	Bentiu-1	07.06.2011	DBP	1488.25	1491.25	**Well Suspended**
1908	1914	Zarqa	02.02.2012	Squeeze	1387.25	1393.25	
2009	2010	Bentiu-1	02.02.2012	open	1488.25	1489.25	
2644	2648	AG-6A	02.02.2012	open	2123.25	2127.25	Dev well. Swab Commingled 1% OIL.
2655	2660	AG-6B	02.02.2012	open	2134.25	2139.25	
2663	2667	AG-6C	02.02.2012	open	2142.25	2146.25	
2010	2011	Bentiu-1	14.11.2012	open	1489.25	1490.25	Dev well. Swab 10% OIL.
2009	2011	Bentiu-1	28.02.2016	DBP	1488.25	1490.25	Dev well. Swab 97% WC.
1604.7	1610	Zarqa	28.02.2016	DBP	1083.95	1089.25	Dev well. Swab 90% WC.
1517	1520	Ghazal	28.02.2016	open	996.25	999.25	Dev well. Swab 100% OIL.
1517	1520	Ghazal	12.11.2017	open	996.25	999.25	Dev well. Swab 100% OIL.

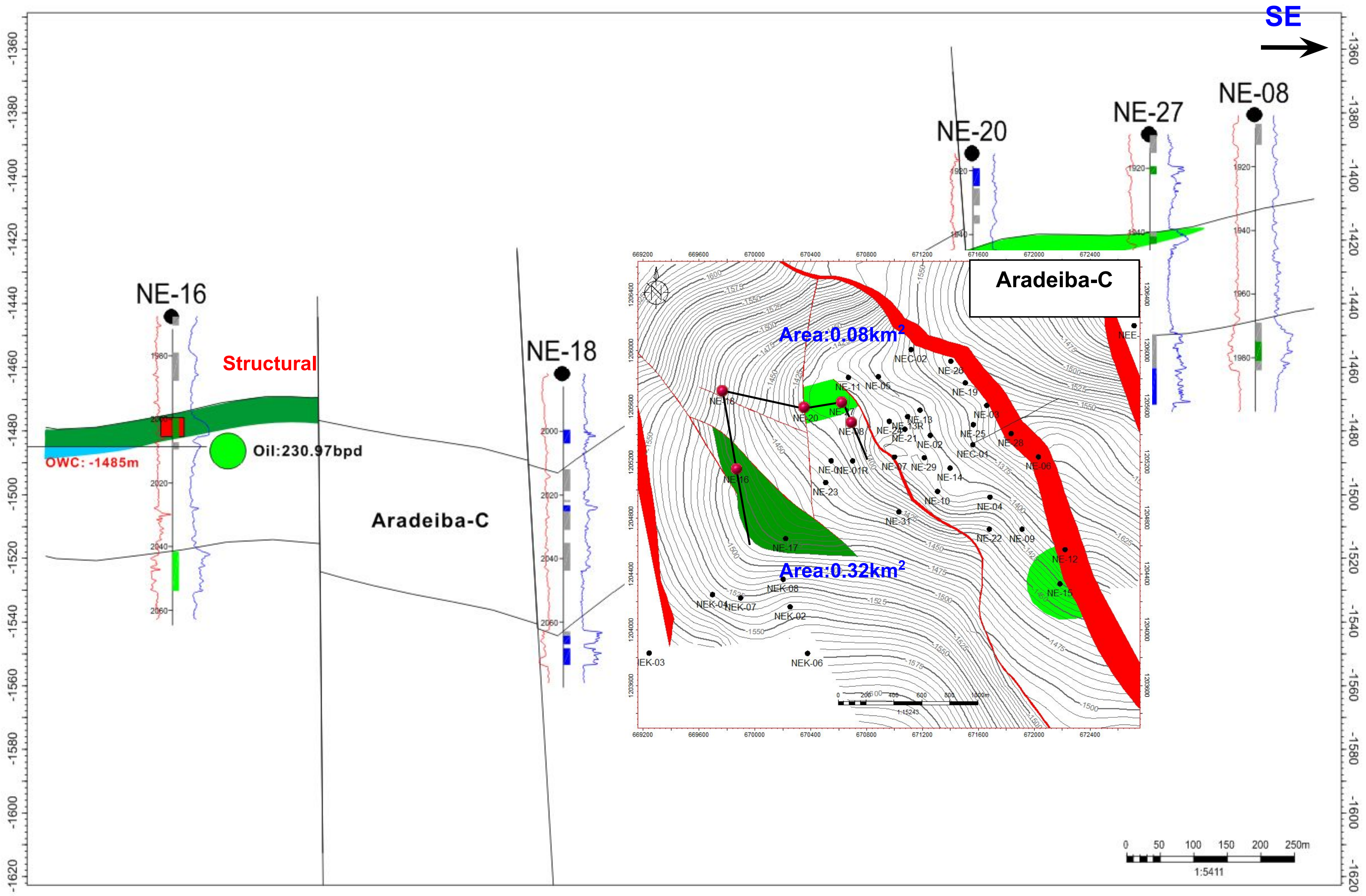
NE-15 Production Performance



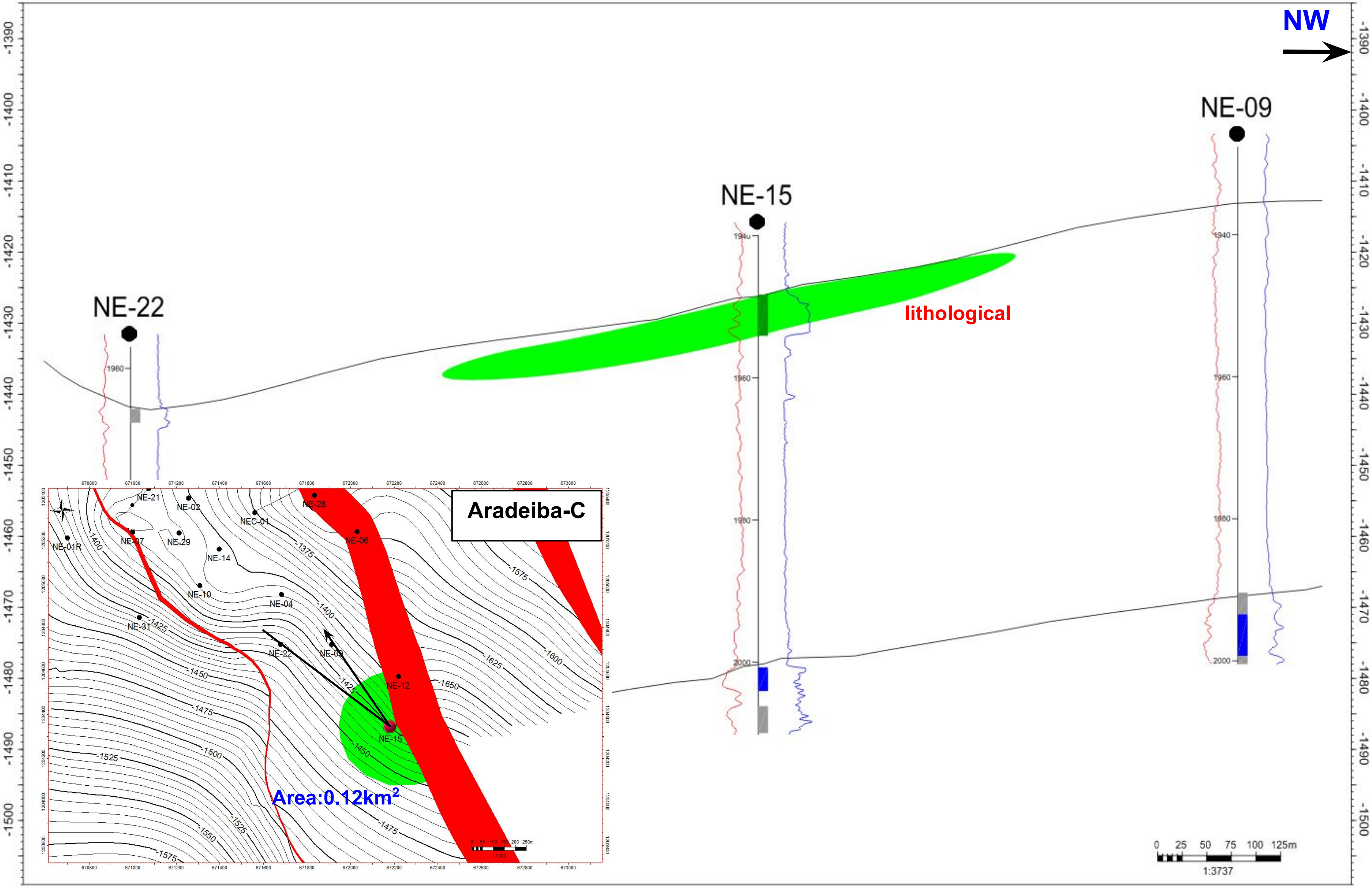
NEE-09 Production Performance



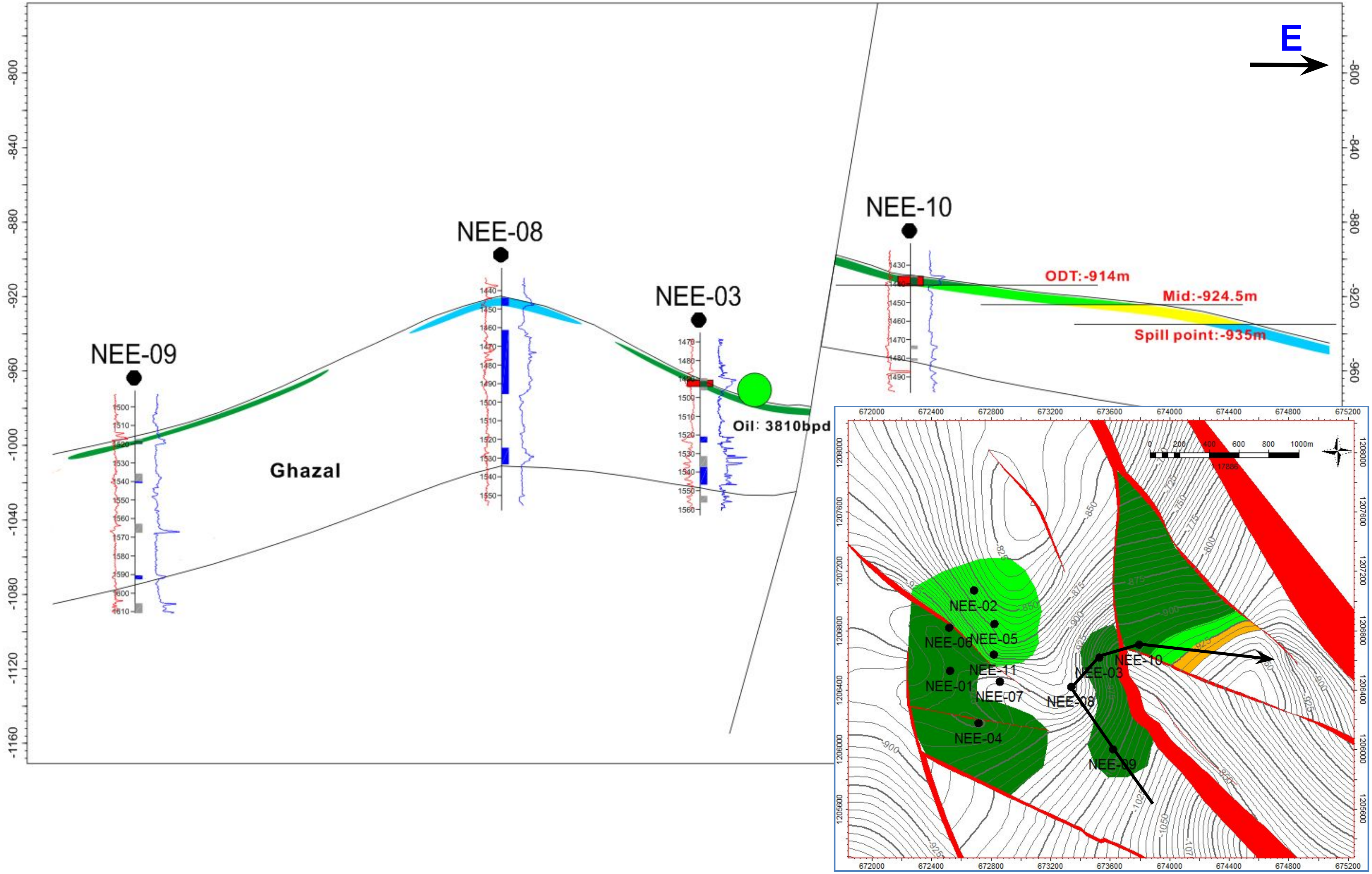
Neem main _Aradeiba-C



Neem main _Aradeiba-C



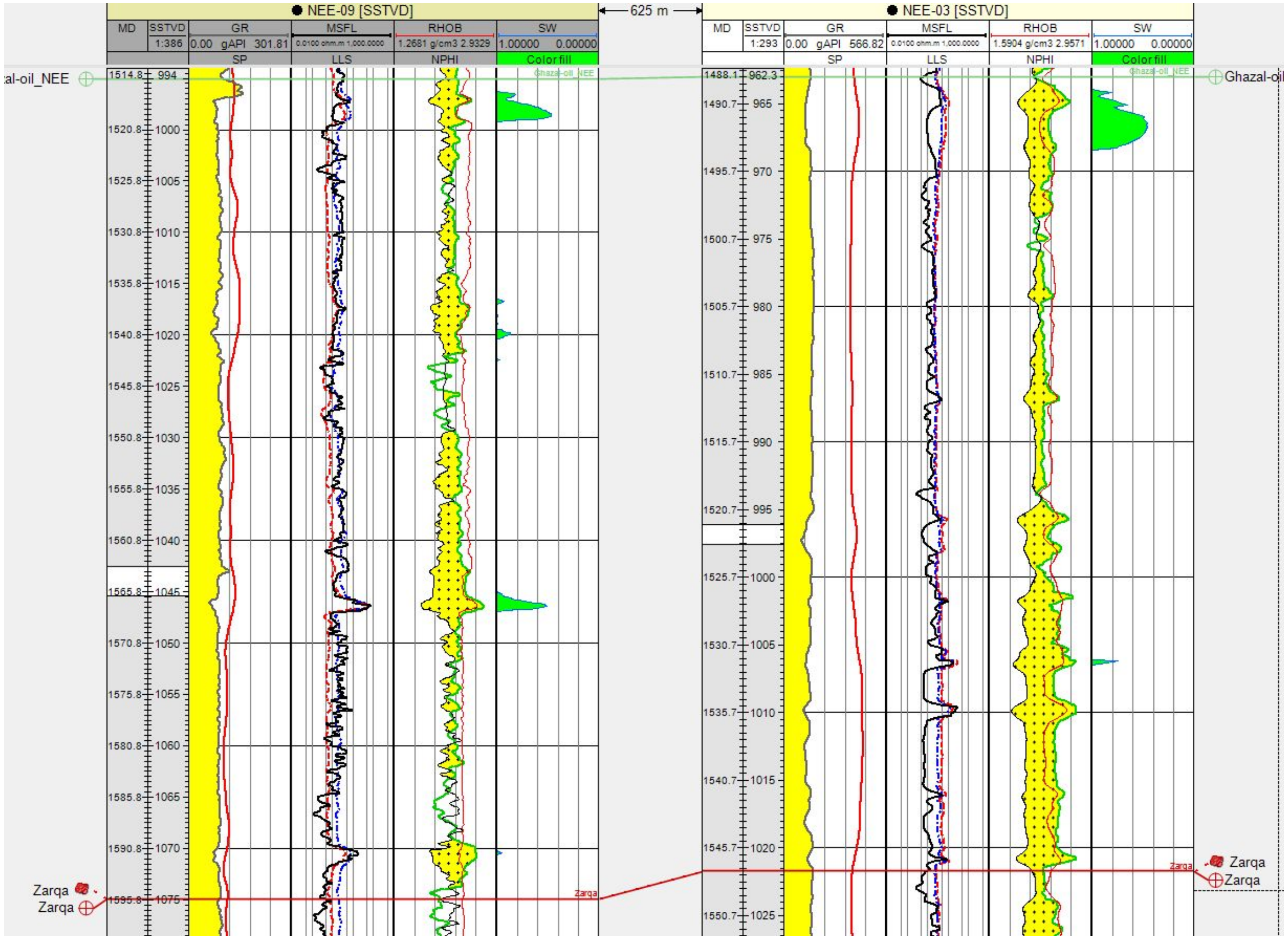
Ghazal



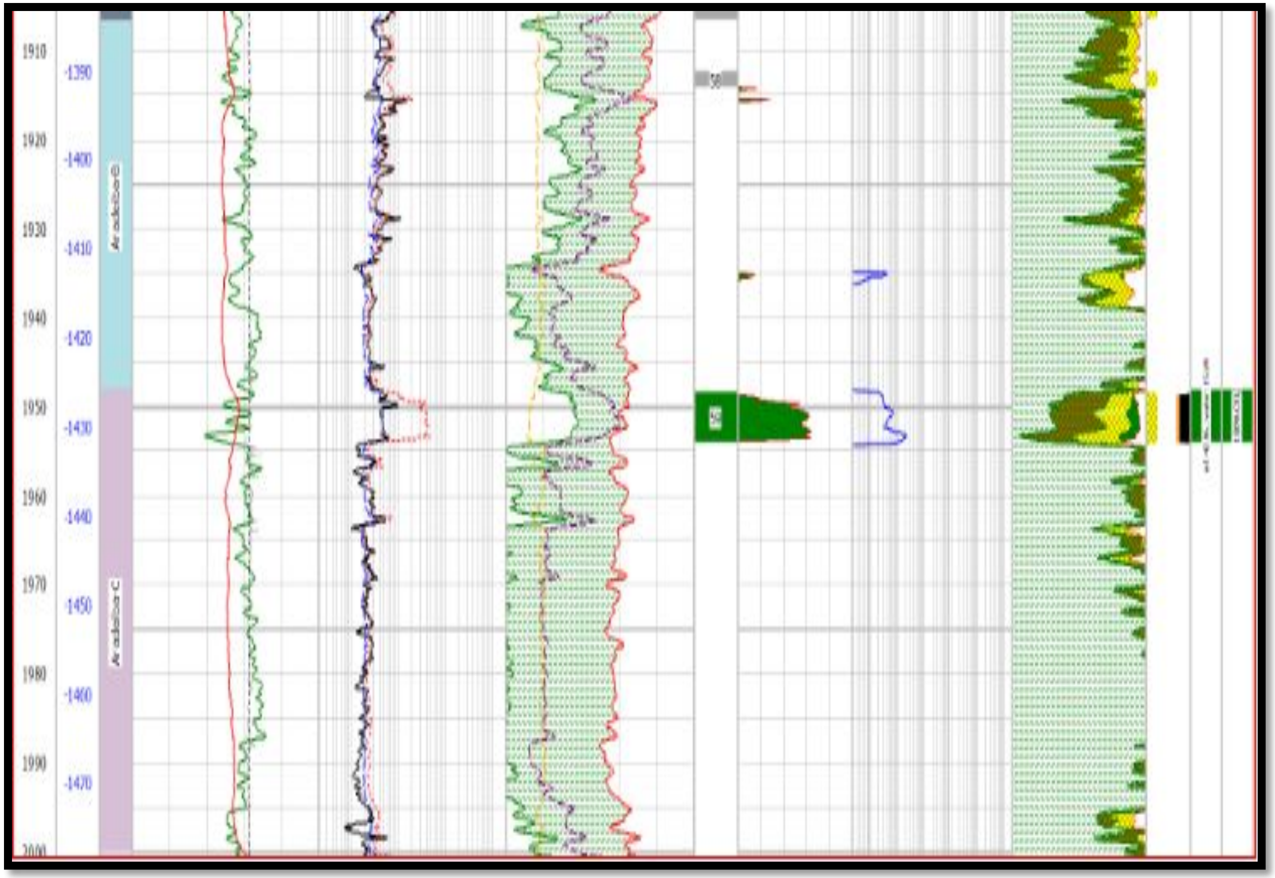
E
NEE-09
NEE-08
NEE-03
NEE-10
Ghazal
Oil：3810bpd
ODT:-914m
Mid:-924.5m
Spill point:-935m
NEE-02
NEE-06
NEE-05
NEE-11
NEE-01
NEE-07
NEE-04
NEE-03
NEE-08
NEE-10
NEE-09

NEE-09 : Geological Correlation

Ghazal_oil



NE-15: Well Logs



Lab Data

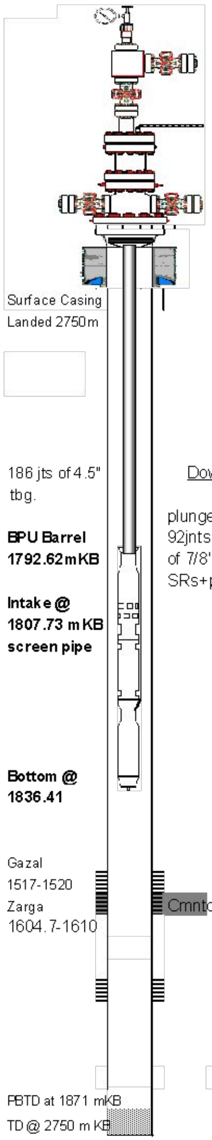
	ITEM_NAM	START_DATETIME	API	BS	our Point	VIS_30	VIS_35	VIS_40	VIS_45	VIS_50	VIS_55	VIS_60	VIS_65	VIS_70	VIS_75
2	NEE-10	2017-01-26 00:00:00	35.19	0	96.8	868	90	33	18	12	9	8	8	7	7

ITEM_NAME	ANALYSIS_DATE	API	BS	BSW	Pour Poi	VIS_25	VIS_30	VIS_35	VIS_40	VIS_45	VIS_50	VIS_55	VIS_60	VIS_65	VIS_70	VIS_75	VIS_80
NE-15	2022-08-16 00:00:00	31.94	0.3	0.2	96.8	352	109	51	37	27	21	16	14	12	11	9	8

NEE-09: Completion Schematic

2B OPERATING PETROLEUM COMPANY

SURFACE AND DOWNHOLE EQUIPMENT LIST



Date: 12-Nov-22

Well name and #: **NEE-09)**

Perf Zone: Ghazal, Zarga
Perforations: (1517-1520) & (1604.7-1610)
Bentiu 1A(1610-1614.3) isolated by DBP at 1873mkb.
AG-6 isolated by DBP at 2105mkb.

KB:	520.75	CF:	513.00
GL:	513.25	TD:	2750.00
KB-CF:	7.75 m	PBTD:	1871.00

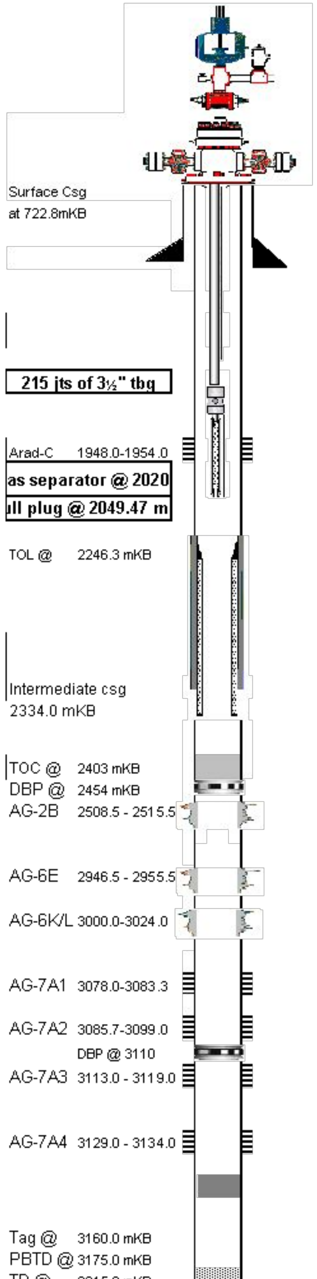
Tubulars:	Size	Weight	Grade	Set at
Conductor:	N/A	N/A	N/A	N/A
Surface Casing:				
Production Casing:	177.8	29 PPF	K-55	2750.00
Production tubing:	4.5	40 Kg/m	J-55	186 jnt

Down hole eqmt.:	Make	Series	Type	Serial Number
plunger+9sinker bar				
92jnts 3/4"SRs+67jnt				
of 7/8"SRS+63jnts1"				
SRs+polished rod				

Wellhead:	Make	Size	WP	Serial Number
Tubing head:				
Casing valve:				
Casing valve:				
ESP Spool:				
Tbg Hanger:				
Master Valve:				
Wing Valve:				
Choke:				

Other:				
Top Drive:				
Electric Motor:				

NE-15: Completion Schematic



2B OPERATING PETROLEUM COMPANY (2B OPCO)

DOWNHOLE+SURFACE EQUIPMENT

Date: 02-Oct-2022

Well name and #: Neem-15
Producing Zone: Aradeiba-C
Perforated Intervals: (1948.0m-1954.0m)
Other Zones: AG-2, AG-6 & AG-7.
Perforated Intervals: (2508.0m - 2515.0m).
Perforated Intervals: (2946.5m - 2955.5m), (3000.0m-3024.0m) & (3078.0m-3083.3m
Perforated Intervals: (3085.7m-3099.0m), (3113.0m - 3119.0m) & (3129.0m - 3134.0 m).

KB:	523m	CF:	N/A	
GL:	515m	TD:	3215 mKB	
KB-CF:	N/A	PBTD:	2403 mKB	

TUBULARS

	Size	Weight	Grade	Set at	Capacities
Surface Casing:	13 3/8	71.42kg/m	K-55	722.8	
Intermediate Casing:	9 5/8	69.9kg/m	N-80	2810	
Production Casing:	7	43.0kg/m	N-80	3420	
Production tubing:	3 1/2	13.67kg/m	J-55 210 jts	1996.15	

DOWNHOLE EQUIPMENT

	Make	Size	Type	Remarks
Pump Barrel		2 [illegible]"	30-200THM22-4-2-2	
plunger		3/4"	30-200THM22-4-2-2	
Sucker Rods	Norris	¾"		1 jt
Sinker bar		1 ½"		9 jts
Sucker Rods	Norris	¾"		74 jts
Sucker Rods	Norris	[illegible]"		90 jts
Sucker Rods	Norris	1"		86 jts
Pony Rods	Norris	1"		1 X 4 ft & 2 X 10 ft
Polished Rod	Norris	1 1/4"		

WELLHEAD

	Make	Size	WP	Serial Number
Casing Vent:	Stream Flo	2"	2000 PSI	
Casing Bowl:	Stream Flo	11"	3000 PSI	
Tubing Head:	Stream Flo	11" x 11"	3000 PSI	
Tubing Head:	Stream Flo	11" x 7 1/16"	3000 PSI	As Adapter
DSA	Stream Flo	7 1/16" x 3½"	3000 PSI	
Master Valve:	Stream Flo	3½"	3000 PSI	
Flow tee:	Stream Flo	3½"	3000 PSI	
Rod BOP	Stream Flo	3½"	3000 PSI	
Casing Valve:	Stream Flo	2 1/16"	3000 PSI	
Casing Valve:	Stream Flo	2 1/16'	3000 PSI	
Tubing Hanger:	Stream Flo	11" x 4½" NU		

Comments: **Tubing string wt: 27 tons & Rod string wt: 8 tons.**
Pump barrel assy.: 3 jts of 3 ½" tbg, sand/gas separator, 1 jts of 3 ½" tbg, pump barrel, pup jt, 211 jts.
No NTT installed in this well. RIH with same pump & equipment.
Hanger thread is 4 ½".

Prepared by: ***Eltayeb Mohamed Eltayeb***

NE-15 Swab Test

Company: GNPOC	*Previous Recovery:* Oil m^3:	Water m^3: 0.00	*Fluid Type:*	Oil	Water
Well Name: Neem-15	*Zone:* Aradeiba C		*Load to recover:*	13.20 m^3	m^3
LSD:	*Perforations:* 1948.0 - 1954.0 mkb		*Total Recovery:*	25.60 m^3	0.00 m^3
Start Test: April 27, 2016	*Perforations:*		*Left to recover:*	m^3	m^3
End Test:	*Reported By:* Greg Lauman		*New Fluid:*	12.40 m^3	0.00 m^3

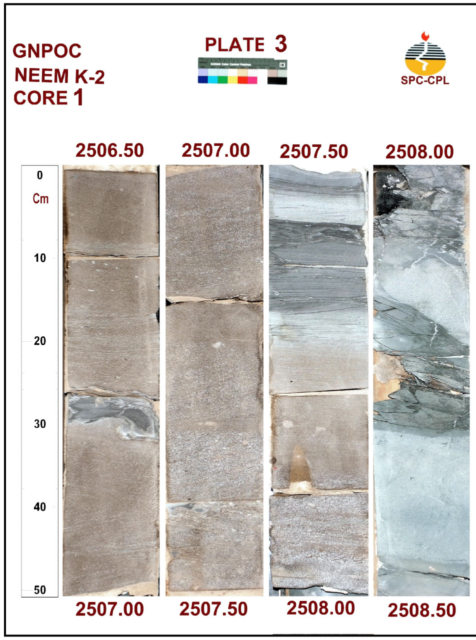
Time	Swab Number	Fluid Level Meters	Swab Depth Meters	Choke Size mm	Casing Pressure psi	Flowing Tubing Pressure	Total Fluid This Run m^3	Total Fluid Cumm m^3	Water Cut %	Water This Run m^3	Water Cumm m^3	Oil This Run m^3	Oil Cumm m^3	Salinity	PH	Flowing Temp °C	Gas Rate 10^3 m^3	Remarks
3:30	1	410	560		0		0.32	0.32	0.0%	0.00	0.00	0.32	0.32					
3:45	2	520	720		0		0.48	0.80	0.0%	0.00	0.00	0.48	0.80					
4:00	3	690	890		0		0.32	1.12	0.0%	0.00	0.00	0.32	1.12					
4:15	4	800	1000		0		0.32	1.44	0.0%	0.00	0.00	0.32	1.44					
4:30	5	8070	1070		0		0.48	1.92	0.0%	0.00	0.00	0.48	1.92					Change swab cups.
5:00	6	900	1100		0		0.32	2.24	0.0%	0.00	0.00	0.32	2.24					
5:30	7	970	1170		0		0.32	2.56	0.0%	0.00	0.00	0.32	2.56					
6:00	8	1000	1200		0		0.48	3.04	0.0%	0.00	0.00	0.48	3.04					
6:30	9	1000	1200		0		0.32	3.36	0.0%	0.00	0.00	0.32	3.36					
7:12	10	1000	1200		0		0.16	3.52	0.0%	0.00	0.00	0.16	3.52					Change swab cups.
7:30	11	1000	1200		0		0.16	3.68	0.0%	0.00	0.00	0.16	3.68					
8:05	12	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	0.0%	[illegible]	[illegible]	[illegible]	[illegible]					
23:00	39	1530	1730		0		0.96	19.84	0.0%	0.00	0.00	0.96	19.84					Empty swab tank
23:40	40	1600	1800		0		0.16	20.00	0.0%	0.00	0.00	0.16	20.00					
00:20	41	1600	1800		0		0.48	20.48	0.0%	0.00	0.00	0.48	20.48					
01:00	42	1600	1800		0		0.16	20.64	0.0%	0.00	0.00	0.16	20.64					change swab cups
01:40	43	1500	1700		0		0.96	21.60	0.0%	0.00	0.00	0.96	21.60					
02:15	44	1500	1800		0		0.48	22.08	0.0%	0.00	0.00	0.48	22.08					
02:50	45	1600	1800		0		0.48	22.56	0.0%	0.00	0.00	0.48	22.56					change swab cups
03:30	46	1630	1830		0		0.80	23.36	0.0%	0.00	0.00	0.80	23.36					
04:15	47	1670	1870		0		0.80	24.16	0.0%	0.00	0.00	0.80	24.16					
04:50	48	1700	1800		0		0.80	24.96	0.0%	0.00	0.00	0.80	24.96					
05:40	49	1700	1800		0		0.16	25.12	0.0%	0.00	0.00	0.16	25.12					change swab cups
06:20	50	1700	1800		0		0.48	25.60	0.0%	0.00	0.00	0.48	25.60					

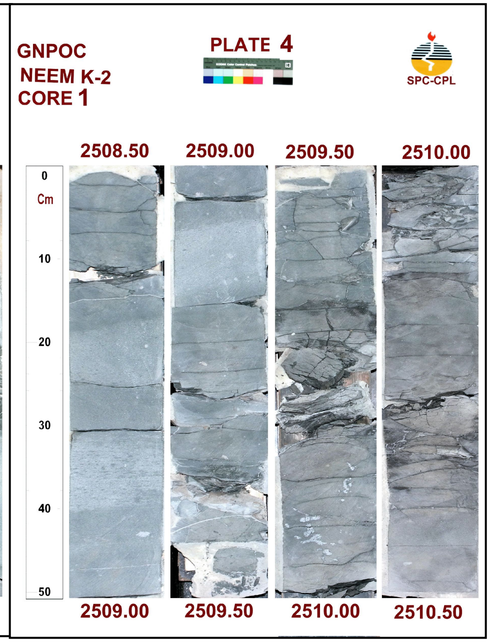
Formation Water Analysis

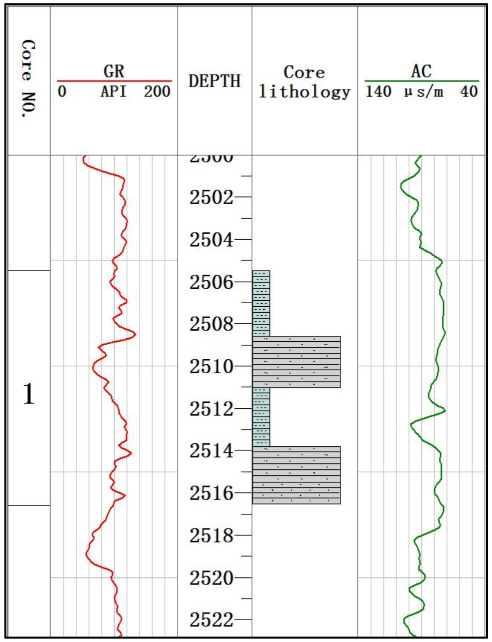
Formation	Well Count	Sample No	Chloride Range	Chloride Average	Salinity Range	Salinity Average
			mg/l	mg/l	mg/l	mg/l
Ghazal	2	5	653.2-2485	1657.2	1078.0-4100.0	2734.4
Aradeiba	2	2	710.0-1207.0	958.5	1171.0-1992.0	1581.5
Bentiu	2	4	1065.0-2663.0	1864.0	1757.0-4393.0	3075.3
AG-3	1	3	817.0-1846.0	1467.7	1348.0-3046.0	2421.7
AG-4	1	1	/	1065.0	/	1757.0
AG-5	3	7	850.0-1775.0	1181.4	1403.0-2929.0	1945.9
AG-6	1	4	1065.0-1100.0	1082.3	1757.0-1816.0	1786.5
AG-7	1	2	1278.0-1313.0	1295.5	2109.0-2167.0	2138.0

11 wells have formation water analysis data. The water of the field is fresh.

NEK-02 core photo/log Facies symbols – Bentiu







sandstone :fine-coarse grain

shale: greenish grey

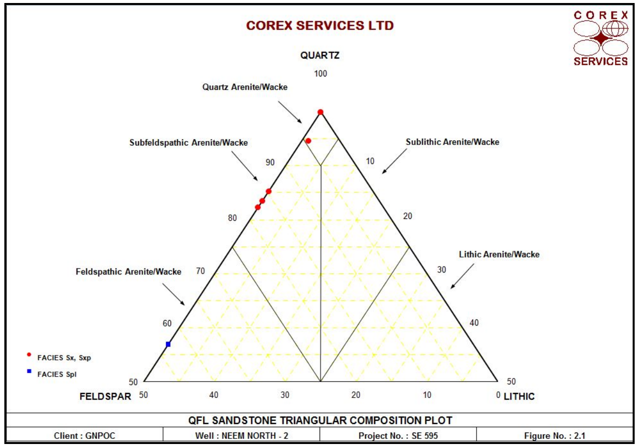
GR curve:
thin Sandstone ,box- bell shape with
medium GR
thick shale, high GR

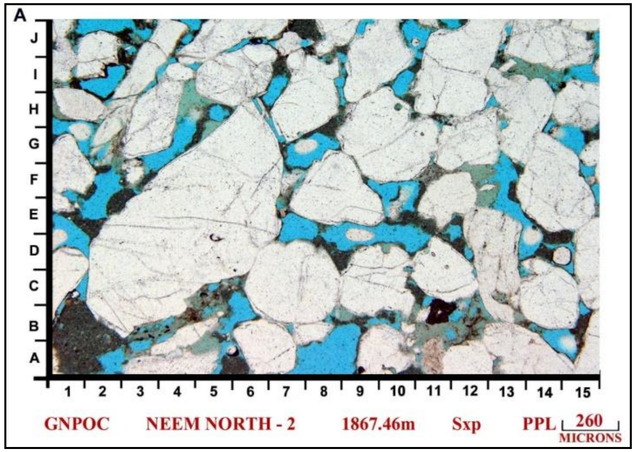
Sedimentary characteristics of braided bar,

shale ,Not deep water

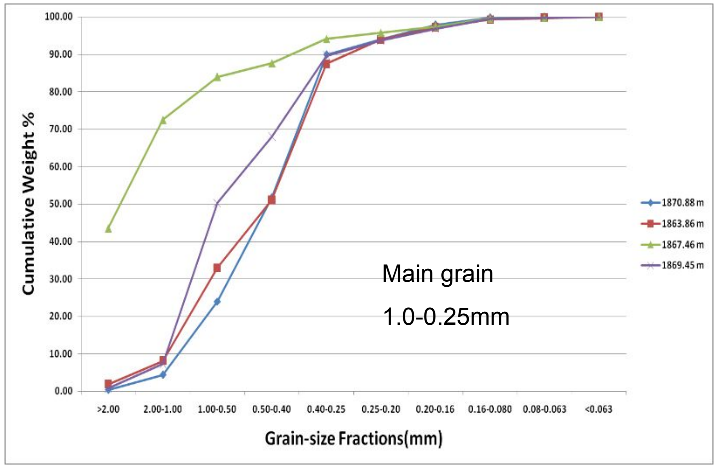
Facies symbols – Bentiu

NEN-02 Sedimentary petrology





NEN-02 Grain size distribution



Abundant quartz 85%

fine to granule grained,

common medium to coarse

Poorly -well sorted

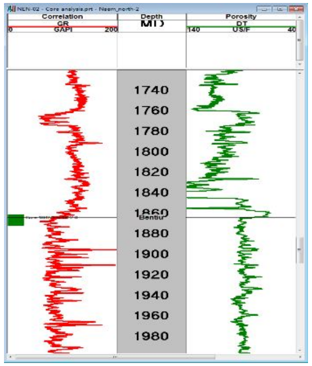
angular to subangular

Medium textural maturity and

high compositional maturity

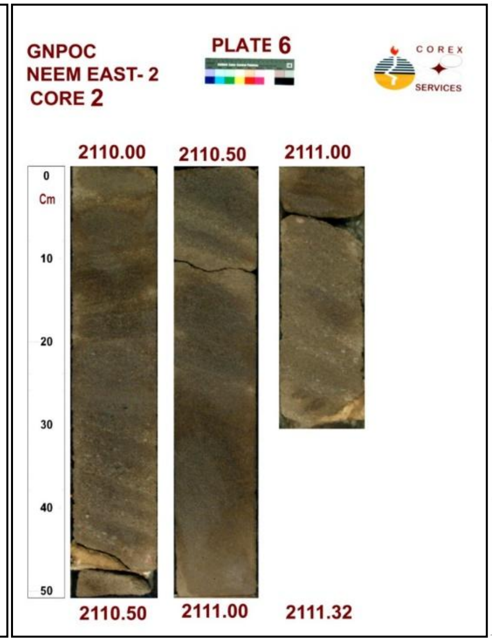
Didn't transport long distance

NEN-02 (Core#1)

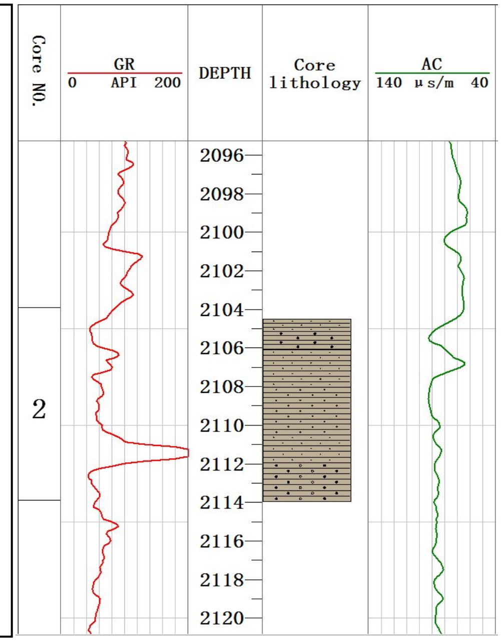


NEE-02 core photo/log Facies symbols – Bentiu

sandstone :crossing bedding
parallel bedding



sandstone :coarse - granule grained

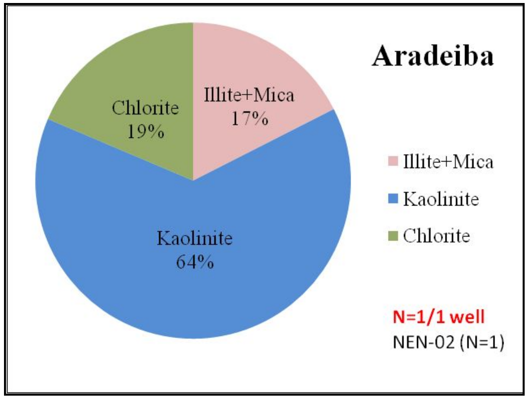


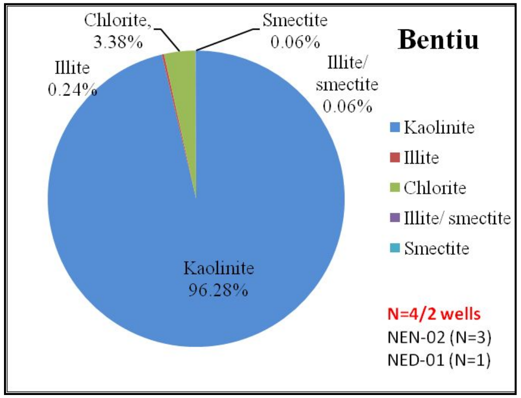
GR curve: jugged box- bell shape

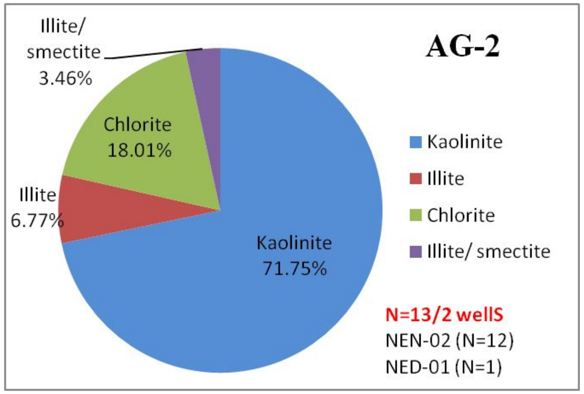
The strong hydrodynamic,

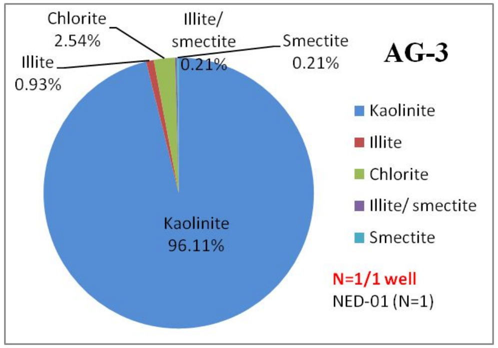
Sedimentary characteristics of braided channel

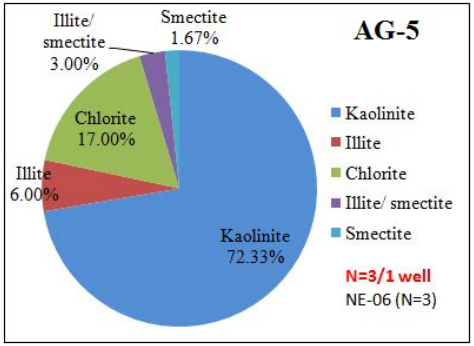
Grater Neem Results :

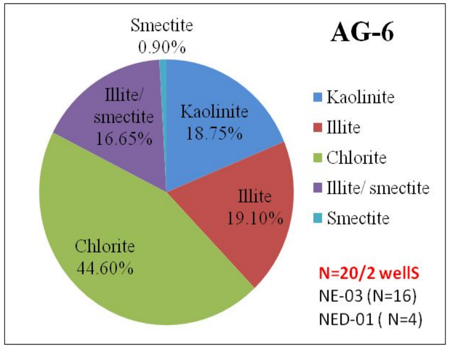


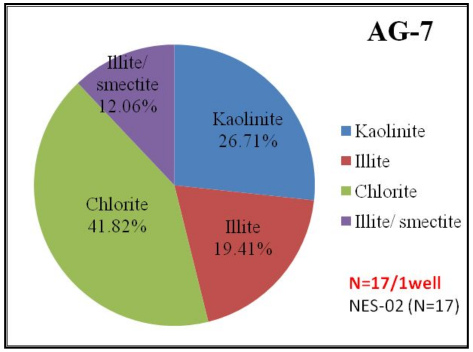










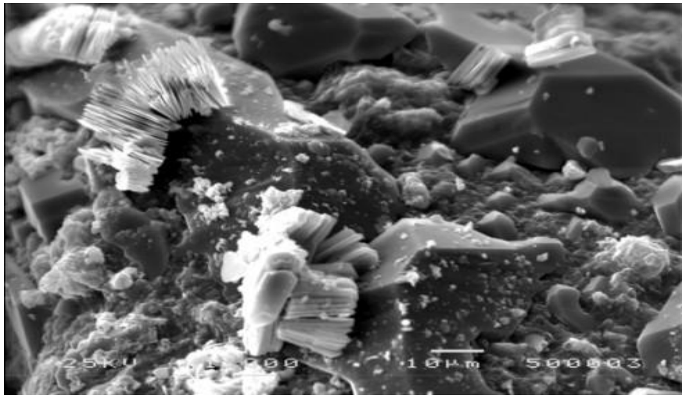


- Kaolinite is the dominant clay mineral with less Chlorite in Aradeiba, Bentiu, AG-2, AG-3, and AG-5.
- In AG-2 ,AG-5, the Illite and I/S mixture content increase slightly.
- The dominant clay mineral for AG-6 and AG-7 is Chlorite, with Illite, Kaolinite and I/S mixture is about 30%.
- In AG-5,AG-6 ,AG-7, the content of Illite and Illite/smectite increase, this is one cause for low resistivity oil zones development in Neem oil field.

Clay Mineral (Neem-2 & Neem-3)

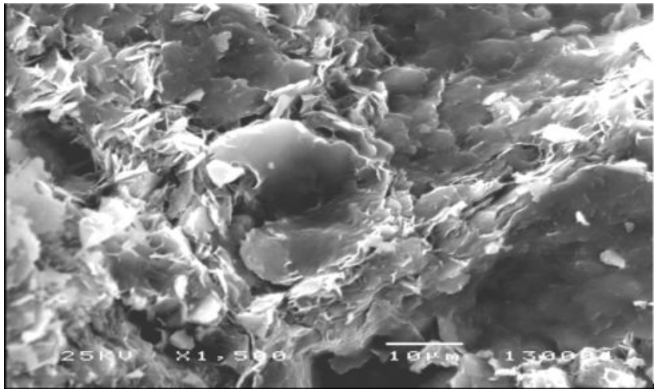
Neem-2					
Depth (m)	Illite/smectite	Illite	Kaolinite	Chlorite	Quartz
2406.5	7.1	9.6	60.4	16.6	6.4
2404.7	6.6	20.0	50.9	17.5	5.0
2406.1	8.7	9.8	51.9	24.7	4.8
2398.8	0.0	6.9	71.3	15.7	6.2
2399.5	3.3	4.3	81.7	7.6	3.1
2400.0	1.5	5.5	74.6	8.7	9.7
2401.0	5.7	6.5	70.1	9.4	8.3
2401.3	0.0	0.0	65.7	7.5	26.8
2401.8	0.0	TR	68.1	11.0	20.9
2403.0	5.2	6.3	66.0	7.7	14.9
2403.8	3.3	7.8	65.1	11.5	12.2
2405.3	0.0	4.8	15.0	75.6	4.6

Neem-3						
Depth (m)	Illite/smectite	Illite	Kaolinite	Chlorite	Quartz	Calcite
2913.9	11.5	17.8	0.0	63.5	7.2	0.0
2914.3	25.4	29.1	0.0	37.8	4.2	3.4
2914.8	23.0	26.5	0.0	41.3	3.6	5.6
2915.5	24.1	27.7	0.0	41.5	6.7	0.0
2916.3	20.5	20.2	0.0	54.3	4.9	0.0
2917.0	19.5	25.3	14.1	37.1	3.9	0.0
2919.3	16.3	9.7	0.0	68.5	5.5	0.0
2919.5	20.7	18.5	0.0	54.8	6.1	0.0
2919.8	13.3	21.0	0.0	59.6	6.1	0.0
2920.3	13.1	18.4	0.0	62.7	5.8	0.0
2921.0	11.4	12.2	0.0	59.8	6.9	9.6
2923.3	31.2	31.2	11.4	13.8	6.4	6.0
2924.0	0.0	TR	29.2	18.0	10.2	42.7
2925.6	27.4	26.6	24.1	16.4	5.5	0.0
2927.3	12.5	21.0	0.0	60.8	5.7	0.0
2929.0	18.3	16.4	0.0	51.6	4.6	9.1
2929.5	14.5	13.4	TR	54.0	3.7	14.4



Neem-2 2401.76m

Well crystallised patchy pore filling kaolinite booklets.



Neem-3 2927.06m

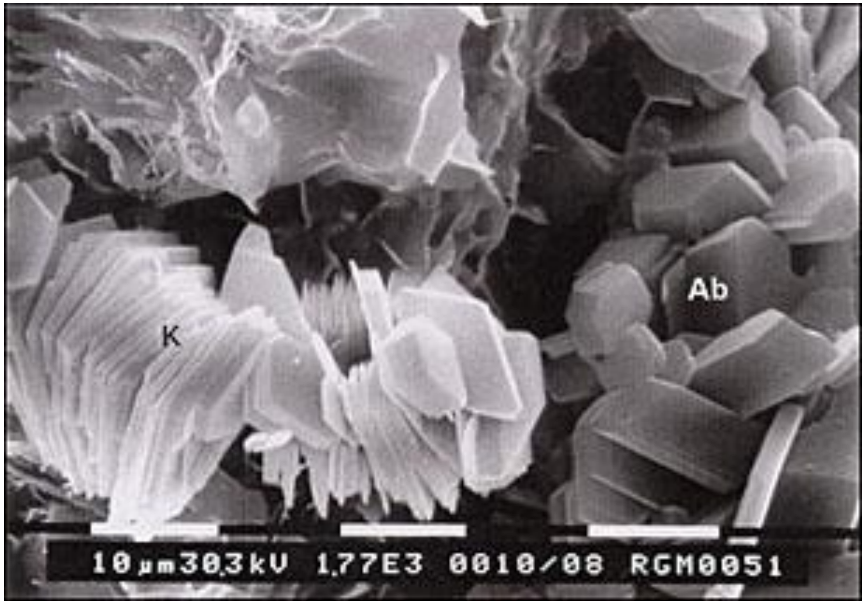
Moderately crystallised face to edge chlorite plates. Rare poorly crystallised ribbon-like illites locally replase clay matrix

Result and analysis

Reservoir	Illite	Kaolinite	Chlorite	Quartz
Aradeiba	3.5	65.9	15.8	14.6
Aradeiba	4.7	80.6	10.0	4.7
Bentiu	9.3	75.4	7.9	7.4

- The book form which creates micro-porosity meaning kaolinite is less detrimental to reservoir quality than other types of fibrous clay which can block pore throats.
- As a pore-filling blocky clay, kaolinites chief contribution to reservoir degradation is caused by fines migration during production when it can become trapped at pore throats reducing permeability.
- In a virgin reservoir kaolinite may reduce porosity but unless volumetrically significant (>10%) will not affect permeability.
- At depths greater than around 11000ft kaolin volume declines as it recrystallises as illite which is more stable at increased temperature (AG-6&7 in Neem area).

Clay morphology is the key property which controls their effect on reservoir quality.



SEM images of kaolinite

Results and analyses cont …:

- The X-ray diffraction (clay fraction method) and the Scanning Electron Microscope Analyses revealed that the studied samples are essentially composed of kaolinite ranges between 75.4% to 100%.
- Also the analysis have shown that the studied samples contain chlorite and illite.
- This occurrence of the illite at the lower horizons could be interpreted due to burial diagenesis, which affect mainly the lower layers of the studied area.

kaolinite:

- It has recorded in all of the investigated samples with variable percentages ranging between 75.4 % – 100%
- The sharp peaks pattern of the kaolinite in the XRD charts indicate that great part of the kaolinite is monocrystalline which means it has authigenically formed which confirm by books of Kaolinite in the SEM micrograph.

Chlorite:

- The concentration of the chlorite in the examined samples ranges between 7.0 and 25%
- Great amount of the clay mineral chlorite in the studied samples is authigenic in origin, which derived from the transformation of the biotite-rich sandstone rock during the intermittent hot dry periods.
- Not all of the amount of the chlorite that measured with the studied samples is authigenic but also, few amount of detrital chlorite has occur in these studied samples.

Illite:

- Illite occurs in most of the analysed samples. Its concentration varies between 3% and 10%.
- Illite is not present in sedimentary rocks derived from basic rock terrain

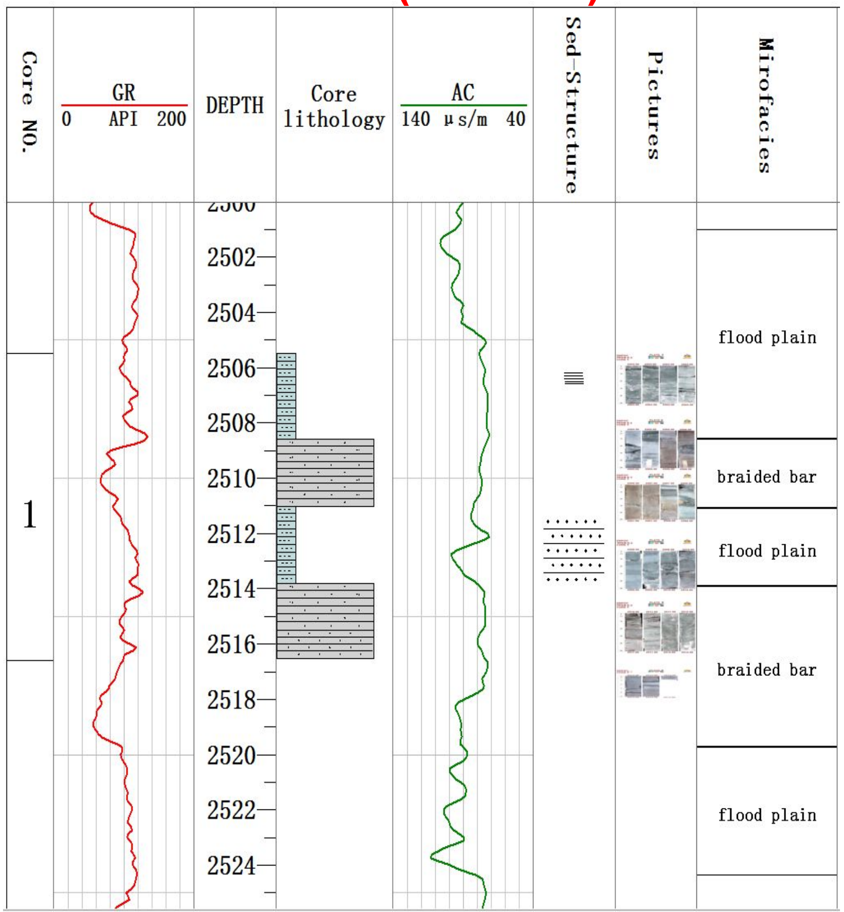
Results and analyses:

- Based on Bi-charts it is clear that the dominant clay mineral is kaolinite in Aradeiba, Bentiu, AG-2, AG-3 and AG-5 reservoirs.
- The reasons behind that could be due to the
  - ✔ Paleo-depositional environment (Hot Wet condition) i.e. Fluvial/ Braided or Meandering rivers, which had prevailed during the deposition of the above layers.
  - ✔ The mineralogical composition of these reservoir layers is mainly rich in K-feldspars. Therefore, the higher amount of the kaolinite arises from the authogenic formation of the K-feldspar due to the entrance of CO_2 that comes from the biodegradation of the oil shale layers that occur normally beneath these reservoir layers.

- In AG-2, AG-5 the illite & illite/smectite mixture content increase slightly due to the burial diagenesis (deep horizons: Sediments load).
- This is normally happen with increasing in depth. It has occurred by the transformation of the K-feldspar to illite as well as transformation of smectite to illite.
- when the process in 3 occurs, the water salinity will be changed due to the release of the cations; K, Fe and Mg in the water formation that lower the value of the resistivity log at these horizons

Core-log facies– Bentiu

NEK-02 (Core# 1)



braided bar:

Medium-coarse Sandstone

parallel bedding

Low GR of box-shaped

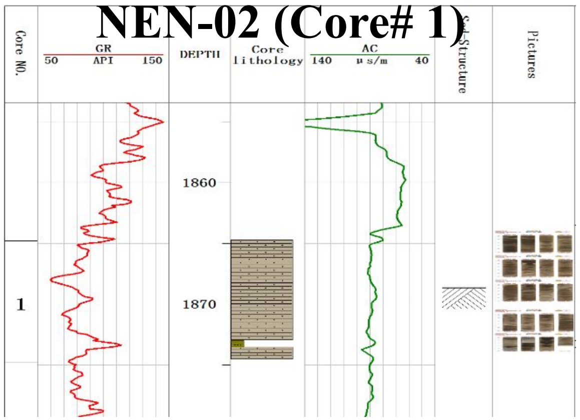
flood plain:

Thick shale ,greenish grey

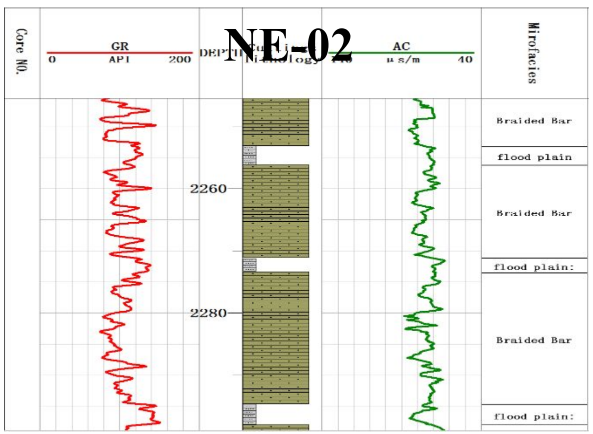
High GR value

Bentiu_2 facies

NEN-02 (Core# 1)



NE-02



Braided channel:

Medium-coarse Sands

crossing bedding

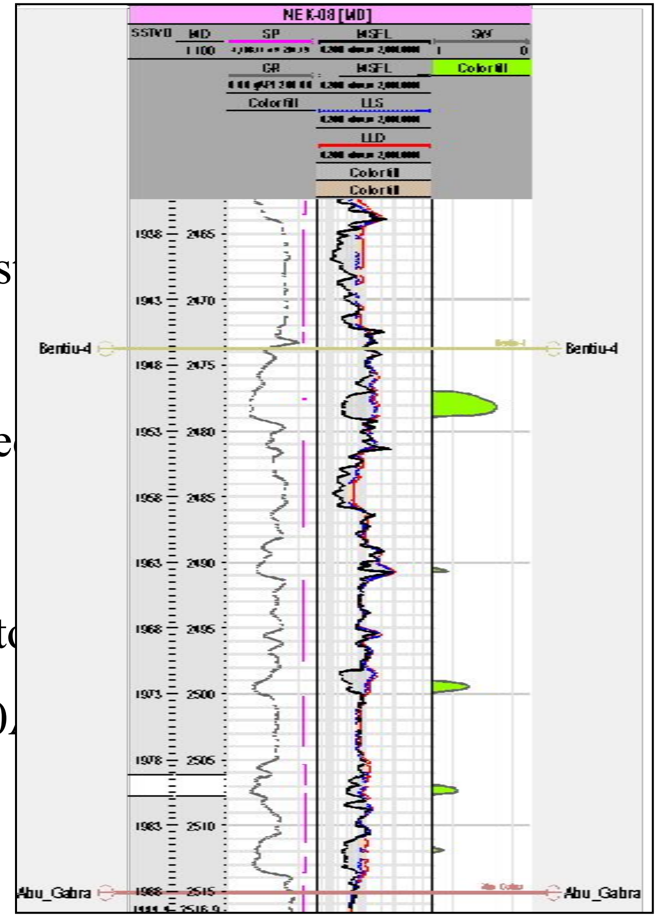
Low GR of box-shape

Braided bar :

Fine-Medium Sandsto

Medium GR (80-100

of box-bell shaped,

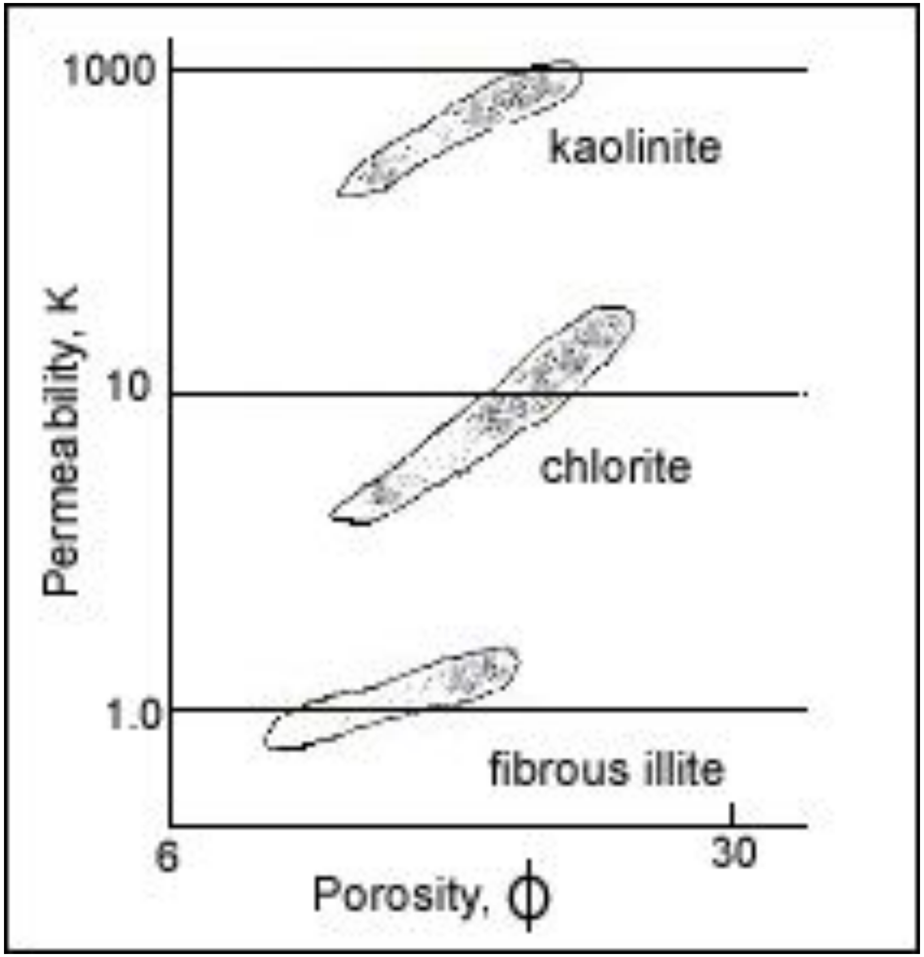


Clay Minerals & Reservoir Quality

- There are four types of authigenic clay found in clastic reservoirs: Kaolinite, Chlorite, Smectite and Illite.

Clay Type	Effect	Treatment
Kaolinite	• pore-filling blocky clay, reducing Porosity &permeability	• Chemically very stable it react to acid like QTZ. • Resolved through the use of any of the clay stabilization system as long treatment is carried out early.
Chlorite	• Contain high amount Fe & Mg extremely sensitive to acid and O2 water.	• Dissolved in dilute HCL
Illite	• Display a fibrous texture can destroy permeability by blocking pore throats even when present in minor quantity. • Create large volumes of micro porosity, increase pore tortuosity	• Dissolved using acid & mixure consisting of HCL & HF acid
Scmectite	• Extremely water sensitive and swell in fresh water • Pore lining	• Oil base, Potassium or Ammonium chloride drilling completion and stimulation fluids. • Corrected by acidizing with weak mixture of HCL & HF

- Clay porosity-permeability relationships show the importance of identifying correct clay type
- Although porosity is the same, the fibrous nature of some clays means they can block pore throats, drastically reducing permeability.
- Kaolinite clays form blocky pore-filling crystals and only reduce porosity and permeability when present in significant quantity (>10%).
- illite which can display a fibrous texture can destroy permeability by blocking pore throats even when present in minor quantity



Thank you