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The Egyptian Mud Engineering and Chemicals Co.


Ministry of Petroleum & Mineral Resources
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Brown Fields Rejuvenation
"Maximizing Production & Recovery"
GPC 2022 Workshop

GPC Workshop 2022

Nanoparticle - Based Drilling Fluids Technology, Solved Depleted Reservoir Drilling Challenges, Optimized Production Zones and Minimized Pay Zones Damage.

By: EMEC TEAM

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Presentation Agenda

- GOS, Western Desert Basin Overview,
- Drilling Challenges & GOS Field Drilling Challenges,
- Solution, Why Nanoparticle Based Drilling Fluids Technology ?
- Wellbore Strengthening Software Models Drilling Solutions & (BPOT)
- Lab Testing Experimental Analysis
  - O Pilot Test Study,
  - O (PPA) Test Procedures,
  - O Testing of Fully Formulated Mud Systems

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- Return Permeability & Reservoir Damage
  - O Mineralogy by X-Ray Diffraction (XRD);
  - O Scanning Electron Microscopy (SEM);
  - O SEM Analysis Before & After NSLP/WSM/OBM Core Flooding
- Field Evaluation; Case 1
  - O Well # 1 & O Well # 2
- Closing Remarks / Conclusion

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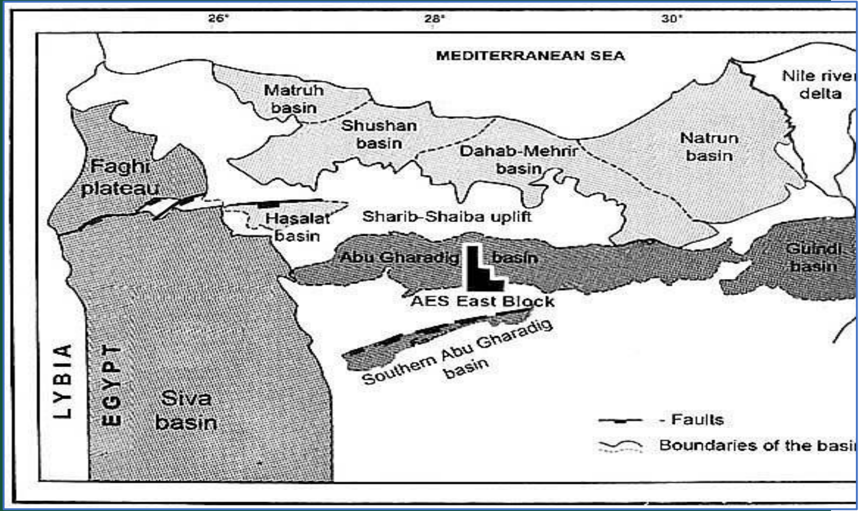
GOS / Western Desert Basin Overview



Gulf of Suez basin is located between the Eastern Desert and Sinai.

The Western Desert located in West of Nile Delta, Egypt,

The most prospective crud oil province in Egypt is in the GOS and W/D Basin.

Western Desert Basin consists of a few extensional coastal rift-basins.

The structurally complex area of the Gulf of Suez is dominated by normal faults and tilted fault blocks

Drilling Challenges

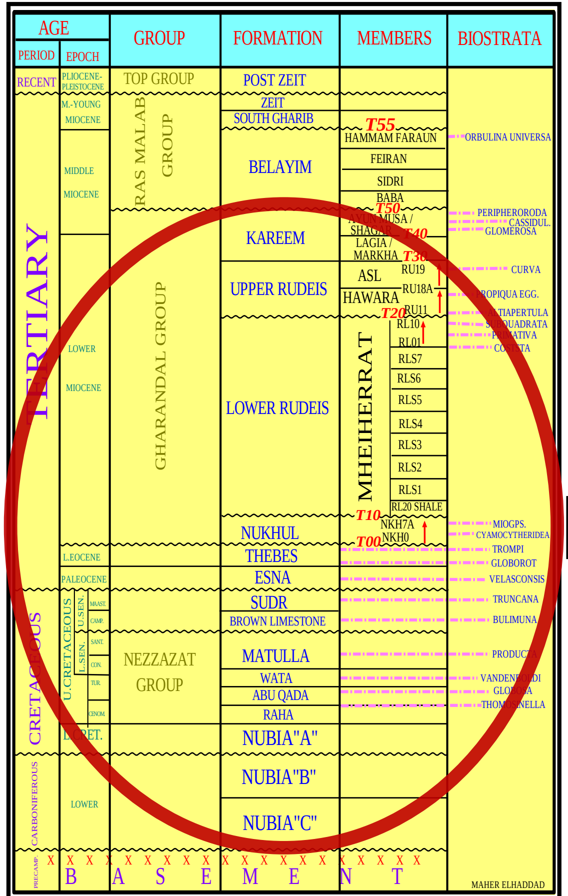
On the other hand, invasion of drilling fluids to permeable reservoir formations causes different challenges including:

- Increase in water saturation.
- Fine migration problems.
- Complicated fluid management.
- Severely impair production.
- Increase Rig time, Increase in Operation Cost.
- Significant Non-Productive Time (NPT)
- Increase in Treatments Costs to Restore the Initial Condition of the Reservoir Fm.

The challenge for designing a Nanoparticle Based Drilling Fluids Technology for drilling success through depleted reservoir Fm or through problematic formation consisting of high-pressured shales interval and low permeability Sandstone in the Gulf of Suez (Egypt) or in Western Desert Egypt is combating with the following:

- **Wellbore instability.**
- **Mechanical Shale Sloughing & Hole Back-off.**
- **High Pressured Zone and Sub-Pressured Sands.**
- **Gas Readings.**
- **Formation losses & Differential Sticking Problems against Depleted Sands Fm.**
- **Planned ECD while cementing 5” or 7” liner found to be > fracture gradient of depleted Reservoir Production zone.**

GOS Field Drilling Challenges



- The drilling team was assigned a challenging wells in different Fields in the GOS involving in the Kareem, Rudies, Mheherrat, Nezzazat Group (High pressure) and Nubia Formation (low pressure). This section is composed mainly of a highly Reactive Shale, Limestone, Marl, Chirt, Depleted Sand Fm.
- Offset wells in this area experienced differential sticking problems due to depleted sands with mechanical shale sloughing, leading to wellbore instability issues with high differential pressure.
- In Other offset wells the majority of the problems were tight hole, hole pack off, stuck pipe and lost circulation and mostly observed while Drilling, POOH or RIH penetrating this challenged Fm. However, these Formation are directly above Matullah or Nubia Reservoir Sand Fm.

Solution;

Why Nanoparticle Based Drilling Fluids Technology ?

- The newly designed Nanoparticle Based Drilling Fluids Technology incorporated in the fluid system formulation aided by Bridging Particles Optimization Tool (BPOT) customized to solve such drilling challenges and engineered to control fluid invasion of drilling fluid into reservoir.
- "BPOT" Optimizes the "PSD" of reservoir drilling fluids, improves leak-off control, and minimizes formation damage from solids invasion thereby increasing well productivity.
- NSLP/WSM incorporated in OBM Formulation Capable of forming a continues and integrate mud cake with low permeability and low porosity.
- This innovative Solution saves operator significant time and money when compared to problematic offset wells

BPOT

Bridging Particles Optimzation Tool

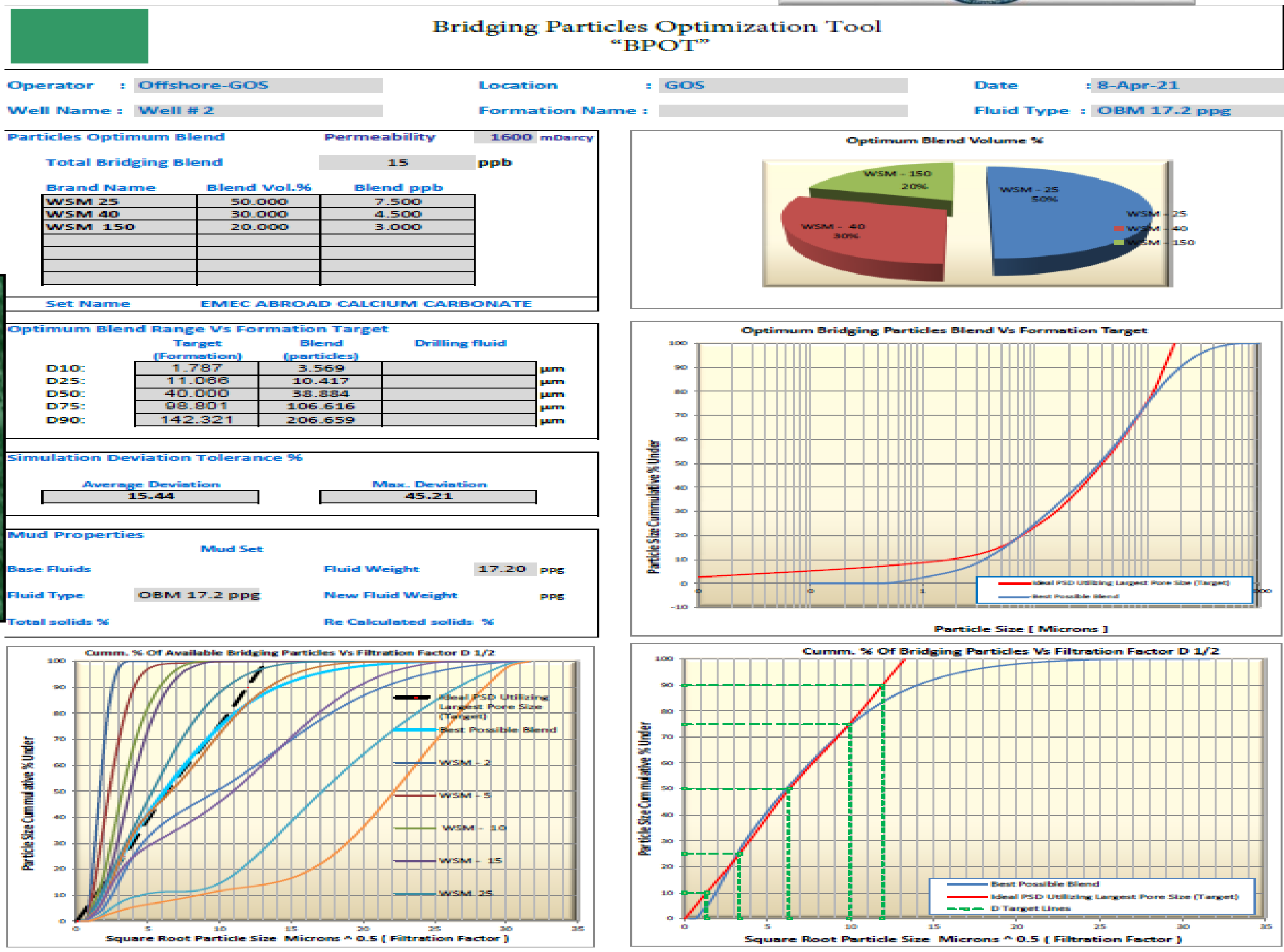
- Select the optimum blend of sized “WSM” as bridging agents.
- Design Criteria based on Fm permeability or pore throat size.
- Determines the ideal Particle Size Distribution PSD of "WSM" required to seal off Fm pore matrix.
- Permeability Plugging Apparatus Lab Test “PPA” to evaluate the performance of “NSLP/ WSM/ Based drilling fluid System.

EMEC Bridging Particles Optimzation Tool (BPOT) are computer models developed to simulate the wellbore strengthening process and design the appropriate WSM blend based on well design, basic rock properties and in-situ earth stresses.

The, designing proper particle-size distribution is the first step towards formulating a minimally invading, non-damaging fluid.

Based on the permeability of depleted sands, the Software Model “BPOT” used to determine the correct selection and “PSD” for creating a thin and integrated filter cake, minimizing against formation damage; eliminates the induced lost circulation and differential sticking problems when the mud overbalance is expected to be > ± 3000 psi.

Wellbore Strengthening Software Models Drilling Solutions (BPOT)



Pilot Test Study & (PPA) Test Procedures & Testing of NSLP / WSM / 12.0 ppg Oil Base Formulated Mud System Fully

- Based on data provided by the Operator; an extensive laboratory tests were conducted in Burgan Lab in Kuwait on Oil Based Drilling Fluids to meet the API criteria:
- To evaluate the rheological and filtration Properties and
- To come up with the optimum PSD required in the Formulation to obtain the lowest spurt loss and the lowest total filtrate
- To pilot test the formulation of 12.0 ppg (over balance > 2000-3000 psi) OBM 80/20 OWR,
- To study the compatibility of the "NSLP" with OBM system
- To produce the Optimum NSLP/WSM Composite required to obtain the lowest spurt and total Filtrate Loss.
- Tests were conducted at differential pressure values up to 3200 psi and temperatures up to 330 °F
- The following recipe to pilot test and prepare one bbl of 12.0 ppg OBM With and Without "Nano Seal Liquid Polymer "NSLP".

NSLP/WSM/12.0 ppg Oil Base Mud System Formulation;

12.0 PPG OBM Mud Parameter Test Results

No.	Product	Function	Unit	Conc.
1	Base Oil	Base Fluid	gpb	19.09
2	Emulsifying agent	Primary Emulsifier	gpb	1.5 - 2.0
3	Wetting Agent	Wetting Agent	gpb	1.5 - 2.0
4	Viscosifier	Viscosifier	ppb	4.0 - 7.0
5	Water	Water phase	gpb	5.66
6	Calcium Chloride	Salinity Control	ppb	12.0 - 14.0
7	Lime	Alkalinity Control	ppb	5.0-8.0
8	HP-HT Fluid Loss Reducer	Fluid loss reducer	ppb	4.0 - 6.0
9	Shale Stabilizer	Shale Stabilizer	ppb	4.0
10	Carbon Derivative	Bridging Materials	ppb	5.0
11	Lube-OM	Lubricant	gpb	0.63
12	Sized WSM	Bridging Materials	ppb	15.0
13	Barite	Weighting Material	ppb	495

MUD PARAMETER	UNIT	Results		
		OBM Blank Sample Without "NSLP"	OBM Sample With 1.5% NSLP	OBM Sample With 3 % NSLP
Mud Weight @ 70 °F	lb/gal	12.0	12.0	12.0
Rheology test @ 150 °F				
PV	cP	32	33	38
YP	lb/100 ft²	15	18	20
Gel	lb/100 ft²	9.0 /14.0	12.0 / 16.0	13.0 / 19.0
Electrical Stability	Beak Volt	920	965	985
OWR		80/20	80/20	80/20
HPHT fluid loss @ 300°F	ml/30min	5.2	2.4	1.2
PSD (D50) µ	Microns (µ)	17.43 µ	17.87 µ	23.01 µ
Total PPT Filtrate Vol. @ 30 Min	ml/30min	3.6	2.2	1.20

NSLP/WSM/12.0ppg OBM PPA Lab Test Results:-

- Permeability plugging test was performed at 300 °F and 2500 psi differential pressure With 40 μm ceramic filter disks. The result of PPA fluid loss test for each NSLP/WSM/OBM Composite Samples were obtained as follows:-

Parameter	WSM Distribution (20 ppb)		
	OBM Without "NSLP"	OBM With 1.5 % "NSLP"	OBM With 3 % "NSLP"
WSM 25 μm		7.5 ppb	
WSM 40 μm		4.5 ppb	
WSM 150 μm		3.0 ppb	
Carbon Derivative		5.0 ppb	
Parameters	PPA Test Result		
	Oil Based Fluid Without NSLP	Oil Based Fluid With 1.5 % NSLP	Oil Based Fluid With 3 % NSLP
Spurt loss; @ 30 sec ml	0.40	0.25	0.15
Filtrate @ 7.5 Min	1.4	0.85	0.40
Total PPT Filtrate Vol. @ 30 Min	3.6	2.2	1.20

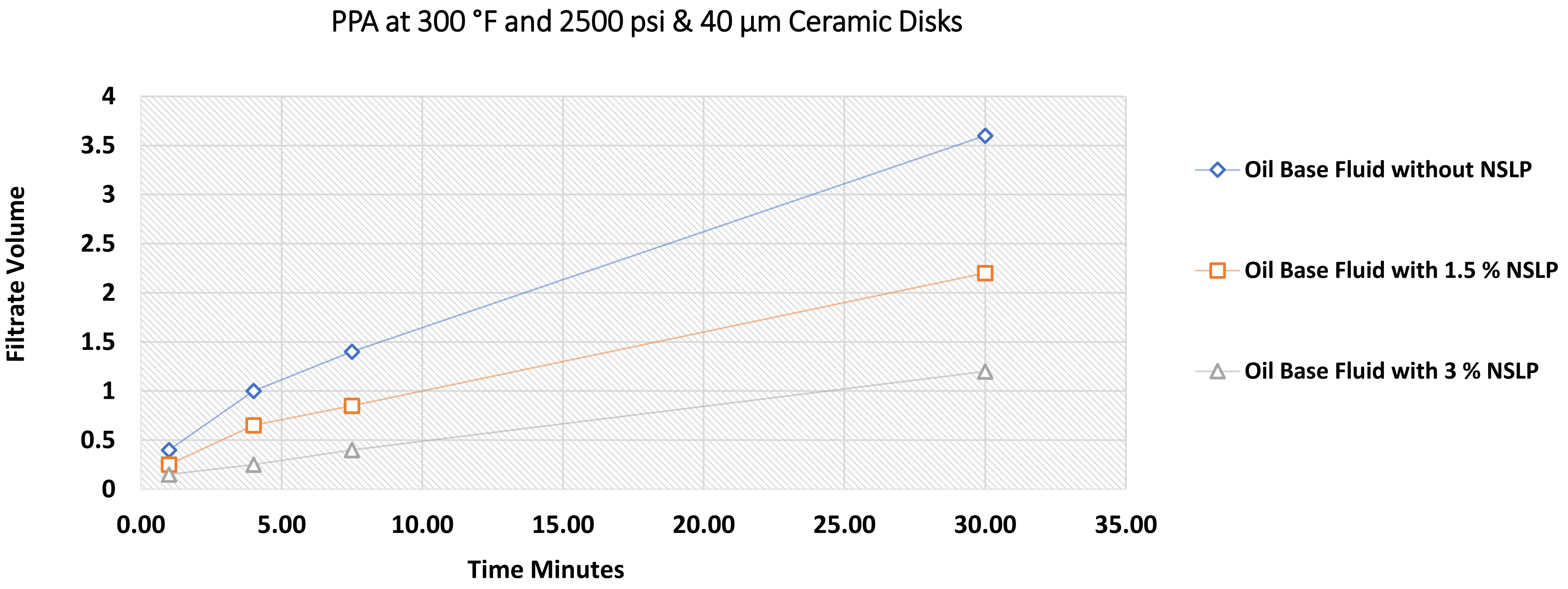
Mud Cake Pics after PPT Test @ 300°F and 2500 Psi Differential Pressure With 40 μm ceramic filter disks

3.8 mm

1.2 mm

0.8 mm

NSLP/WSM/OBM PPA Lab Test Results



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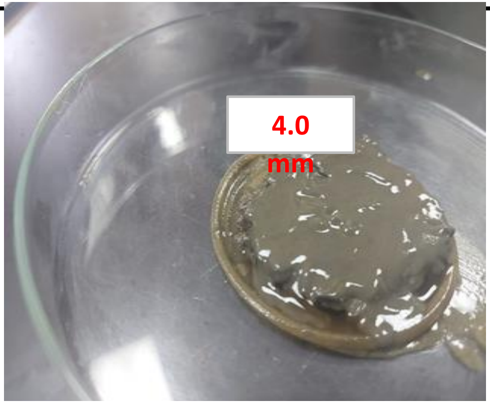
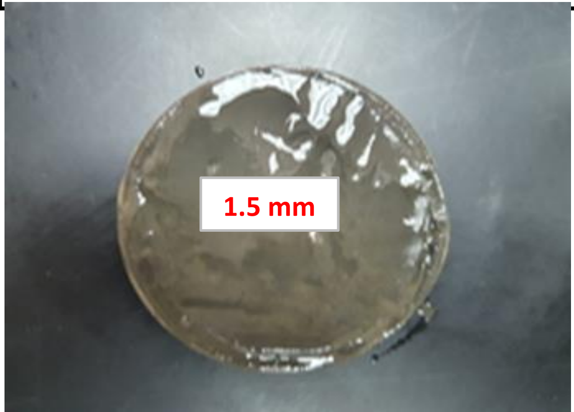
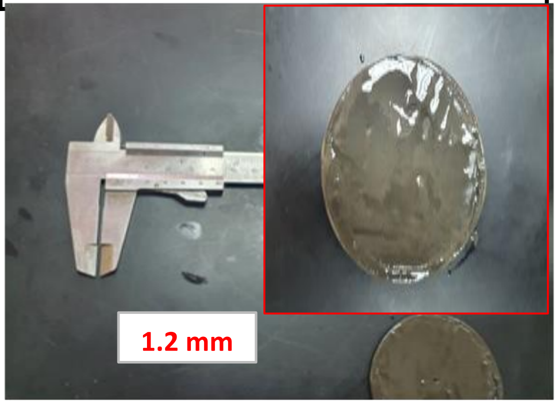
The result of HP-HT fluid loss test for each NSLP/WSM/12.0 ppg OBM Samples were obtained With and without " NSLP" as follows:- :-

Parameter	WSM Distribution (20 ppb)		
	OBM Without "NSLP"	OBM With 1.5 % "NSLP"	OBM With 3 % "NSLP"
WSM 25µm		7.5 ppb	
WSM 40µm		4.5 ppb	
WSM 150µm		3.0 ppb	
Carbon Derivative		5.0 PPB	
Parameter	HT-HP OBM Lab Test Result @ 300 0F 500 psi Differential Pressure after 16 Hrs hot rolling		
	Base Fluid Without NSLP	Base Fluid With 1.5 % NSLP	Base Fluid With 3.0 % NSLP
Filtrate@7.5 Min	2.2 ml	1.4 ml	1.2 ml
Filtrate @ 30 Min	6.80 ml	2.8 ml	1.4 ml

Mud Cake Pictures after HT - HP Lab Test @ 300 °F and 500 Psi Differential Pressure







PSD of NSLP

- The Particle Size Distribution (PSD) of "NSLP" was measured utilizing Laser Diffraction Analyzer model MALVERN MASTERSIZER HYDRO 2000 MU.
- The obtained PSD showed that Particles Median Size
- D50 is 179 Nanometer "nm"
- D10 is 135 nm , D90 is 255 nm.

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MALVERN INSTRUMENTS

MASTERSIZER 2000

Result Analysis Report

Sample Name: NSLP
SOP Name: NSLP
Measured: Sunday, April 25, 2021 1:04:21 PM

Sample Source & type: Supplier
Measured by: Wael
Analysed: Sunday, April 25, 2021 1:04:22 PM

Sample bulk lot ref:
Result Source: Measurement

Particle Name: Latex
Accessory Name: Hydro 2000MU (A)
Analysis model: General purpose
Sensitivity: Enhanced

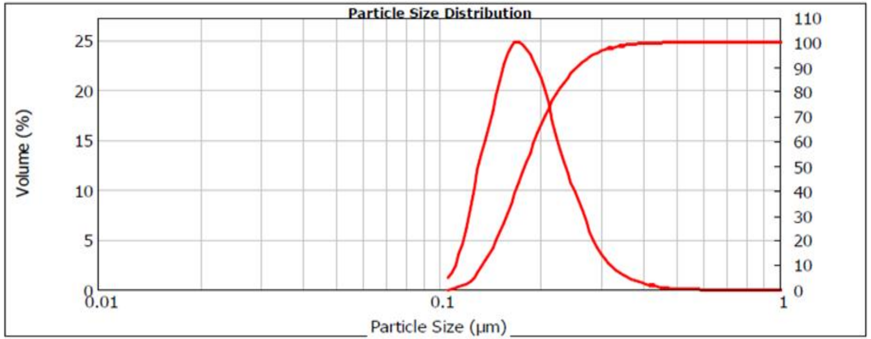
Particle RI: 1.590
Absorption: 0
Size range: 0.100 to 1000.000 um
Obscuration: 16.29 %

Dispersant Name: Water
Dispersant RI: 1.000
Weighted Residual: 12.499 %
Result Emulation: Off

Concentration: 0.0037 %Vol
Span : 0.670
Uniformity: 0.208
Result units: Volume

Specific Surface Area: 33.7 m²/g
Surface Weighted Mean D[3,2]: 0.178 um
Vol. Weighted Mean D[4,3]: 0.189 um

d(0.1): 0.135 um   d(0.5): 0.179 um   d(0.9): 0.255 um

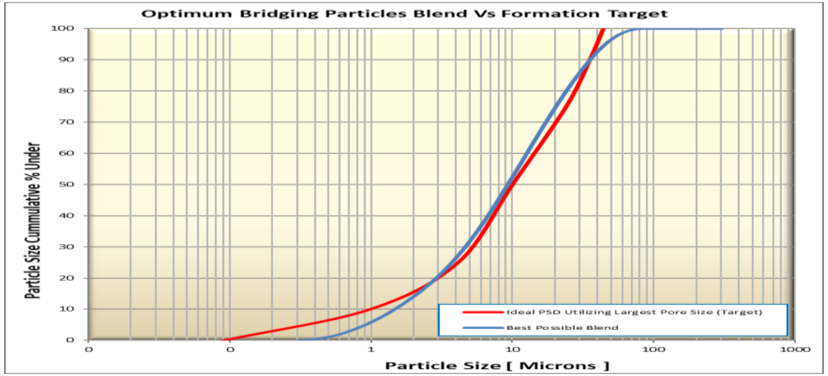


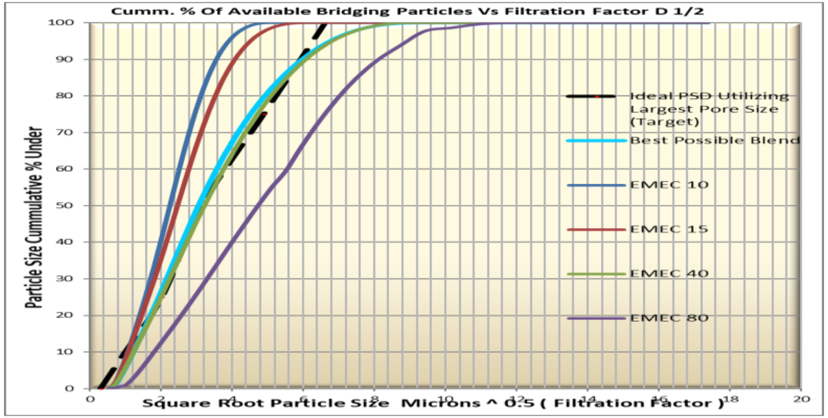
Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.036	0.00	0.071	0.00	0.142	14.98	0.283	94.85	0.564	100.00
0.020	0.00	0.040	0.00	0.080	0.00	0.159	30.23	0.317	97.50	0.632	100.00
0.022	0.00	0.045	0.00	0.089	0.00	0.178	49.03	0.356	98.89	0.710	100.00
0.025	0.00	0.050	0.00	0.100	0.00	0.200	66.52	0.399	99.58	0.796	100.00
0.028	0.00	0.056	0.00	0.112	0.88	0.224	80.31	0.448	99.88	0.893	100.00
0.032	0.00	0.063	0.00	0.126	4.55	0.252	89.22	0.502	99.98	1.000	100.00

Conclusion:

- The PPA Lab Test results show the excellent performance of the NSLP/WSM/Based Fluids System. The Ceramic disc recovered from the PPA run with the optimum mud formulation showed a very thin, slick and impenetrable filter cake.
- Significantly, NSLP enhances filter cake texture and improves its toughness for sealing off permeable depleted formation without the excessive build up of cake thickness.
- PSD of the selected WSM blend showed the best results in terms of spurt loss and total fluid loss.
- NSLP/WSM/OBM Fluids System was effective in mitigating differential stuck pipe tendency while managing a high Mud overbalance > 3000 psi

PSD analysis of the WSM blends





Return Permeability & Reservoir Damage

NSLP/WSM/OBM was designed and formulated as per the following recipe:

Mixing Ordered	OBM Product	UNIT	ppb
01	Base Oil	bbl	0.597
02	Emulsifying agent	Primary Emulsifier	0.5 – 0.85
03	Wetting Agent	Wetting Agent	0.55 – 0.95
04	Emulsifying agent	Secondary Emulsifier	0.4 - 0.75
05	Viscosifier	Viscosifier	5.0 - 8.0
06	HP-HT F.L. Reducer	Fluid loss reducer	6.0 - 8.00
07	Lime	Alkalinity Control	10.00
08	Water	bbl	0.161
09	Calcium Chloride	Salinity Control	22.46
10	Carbon Derivative	Bridging Materials	5.00
11	StrataHeal	Bridging Materials	5.00
12	Sized Marble " 25µ"	Bridging Materials	10.00
13	Sized Marble " 40µ"	Bridging Materials	10.00
14	Sized Marble " 150µ"	Bridging Materials	10.00
15	E. Carb " XF"	Weighting Agents	53.00
16	"NSLP"	gpb	0.630

NSLP/WSM/OBM Parameters as per lab test results for the above formula as follow:

Results		AHR
@ 150 °F	Unit	
M. Wt.	lb/gal	9.5
PV	cP	25
YP	lb/100ft²	20
LSYP	lb/100ft²	11
Gel 10"/10'	lb/100ft²	15/20
E.S	Peak Volt	880
HP-HT @ 300 F°	ml	0.6
O/W ratio	-	80 / 20
Excess Lime	ppb	2.33
CaCl2	%	24.8

Return Permeability & Reservoir Damage

The permeability to oil was established at Swi and the final oil permeability was measured as follow;

Effect of adding NSLP/WSM/OBM on Reservoir Damage; O The following study presents the results of return permeability, XRD and SEM before and after OBM flooding. O All analyses were undertaken at the request of Client's. **Aim Of The Study;** O The main objective of this study was to measure the change in the rock plug sample permeability before and after flooding with the NSLP/WSM/OBM, O Core analysis lab tests were performed on four (4) core plug samples received from the Client's. O **Return Permeability Test Results;** The permeability to oil was established at Swi and the final oil permeability was measured. O The return permeability as % change in base permeability was measured to be from 83 - 88% with NSLP/OBM and Up to 91% With NSLP/HPWMM.

Sample No.	Depth (ft)	Fm.	Porosity (%)	Grain Density (g/cc)	Ka (mD)	Swi (%)	Ko@Swi Before OBM Flooding (mD)	Ko@Swi After OBM Flooding (mD)	Return Permeability (% Change in Base Permeability)
1	F/14900 To/15000	Sand	24.3	2.63	900	17	372	312 (16%)	84%
2		Sand	26.9	2.64	930	19	278	245 (12%)	88%
3		Sand	30.6	2.65	491	28	151	129 (15%)	85%
4		Sand	35.6	2.64	5408	15	942	783 (17%)	83%

SEM Analysis:

Sample No.	Depth	Quartz	Calcite	Kaolinite	Barite	Total (wt.%)
2	14955	85.5	12.6	1.1	0.4	100

SEM Analysis:

Scanning Electron Microscopy (SEM) analysis was carried out on core samples. For SEM Before and After NSLP/WSM/OBM Core Flooding, SEM description includes a summary of pore geometry and the composition and morphology of the main pore-occluding minerals; in addition, each sample is illustrated by photomicrographs as follow :

Company: EMEC	Well: GOS
Depth (ft): 14955	Photo Type: SEM
Sample Type: Core	Sample No.: 2

Textural Characteristics :

Grain Size: Fine- to medium-grained sand

Sorting : Moderately to well sorted

Cementation: Poorly cemented

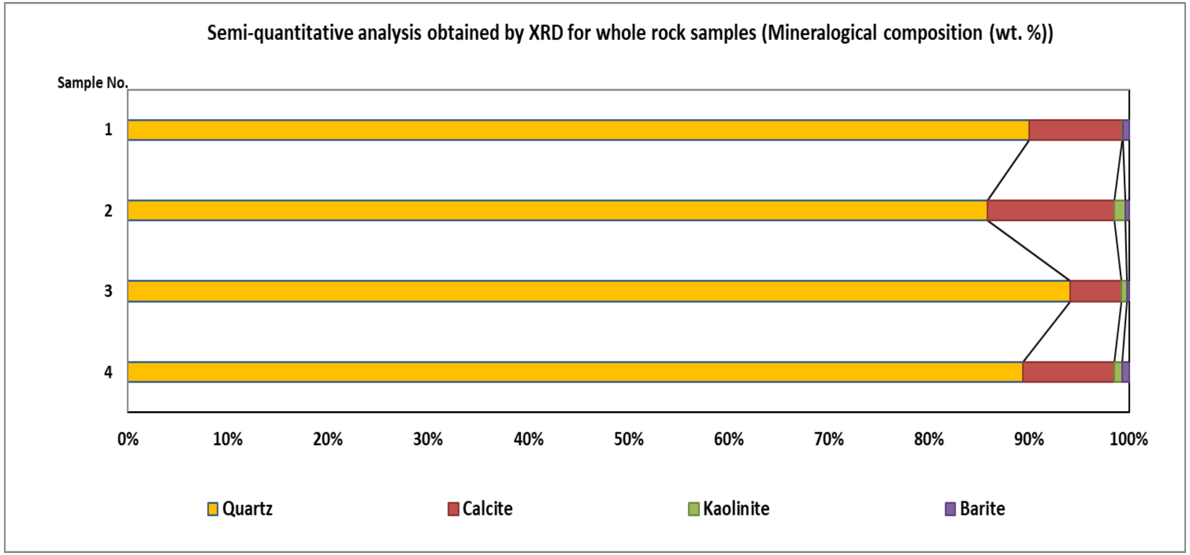
Detrital Grains: Dominant amounts of detrital quartz grains (Qz) with small amount of barite (Ba) (most probably came from drilling fluid).

Detrital Clays: Traces of detrital kaolinite between and/or coating the detrital quartz grains.

Authigenic Cement: Fine-grained calcite crystals (Ca) between the detrital quartz grains

Pore System: Interparticle porosity (yellow arrows) with pore size ranges in diameter between 5 to 50 microns.

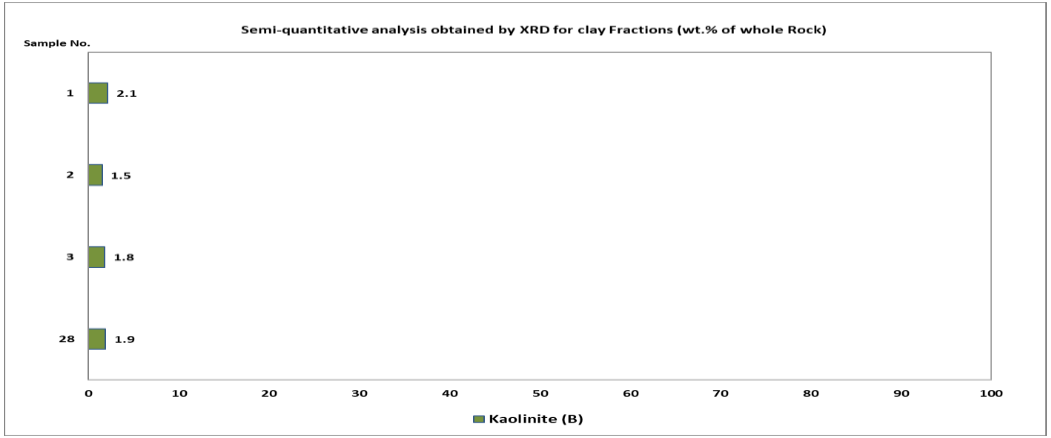
X-Ray Diffraction (XRD) Analysis: XRD analysis of whole rock (WR) and clay fraction (CF) will apply to a sample. The sample preparation and analytical procedures described in Appendix A. The results of whole rock and clay fraction XRD analyses are summarized in The Following Tables and Figures;

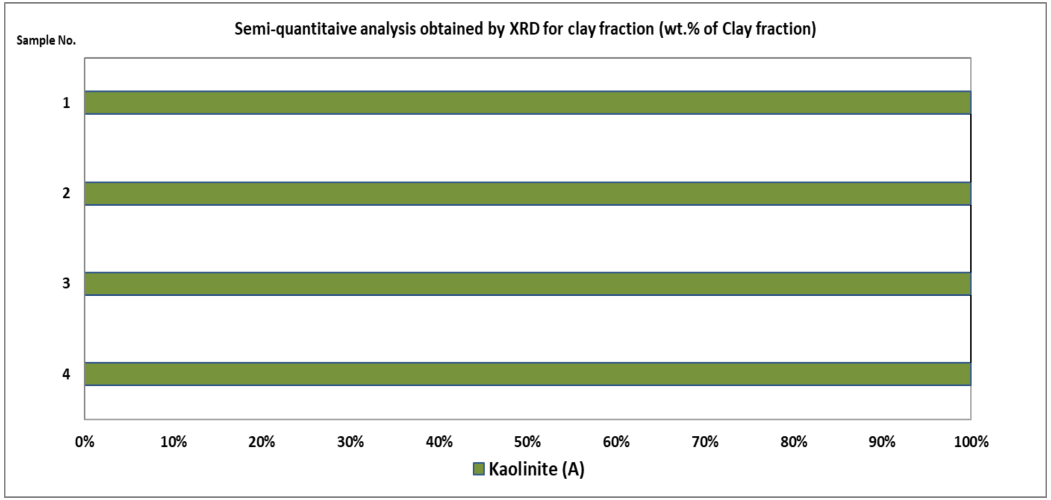


Well Name	Sample No.	Depth (ft)	Quartz	Calcite	Kaolinite	Barite	Total (wt.%)
GOS Field	1	14954	88.3	9.1	0.1	0.6	100
	2	14955	85.5	12.6	1.1	0.4	100
	3	14967	93.0	5.0	0.6	0.2	100
	4	14968	88.5	9.0	0.8	0.7	100

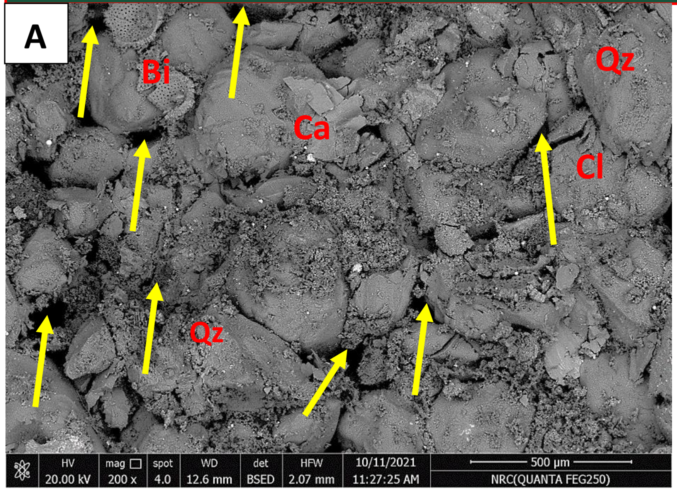
Semi-quantitative analysis obtained by XRD for clay fractions

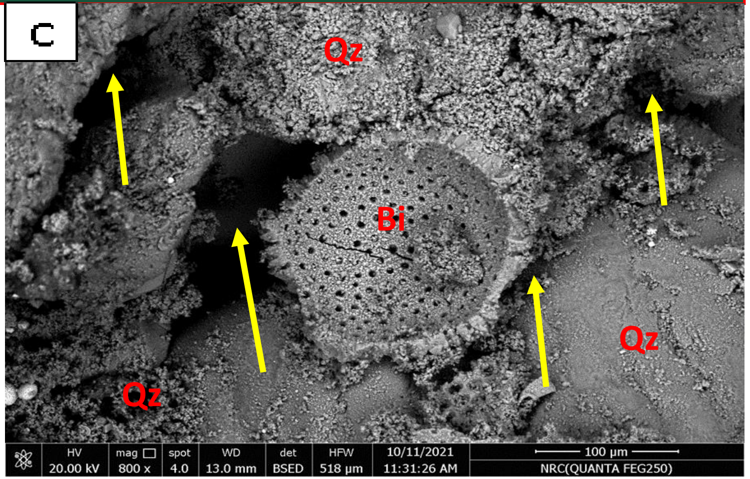
Well Name	Sample No.	Depth (ft)	Kaolinite (A)	Kaolinite (B)
GOS Field	1	F/14900 - To/15000	100	2.1
	2		100	1.5
	3		100	1.8
	4		100	1.9

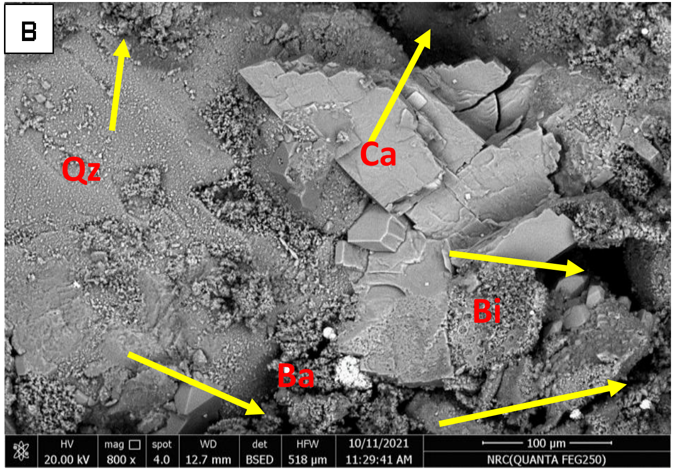


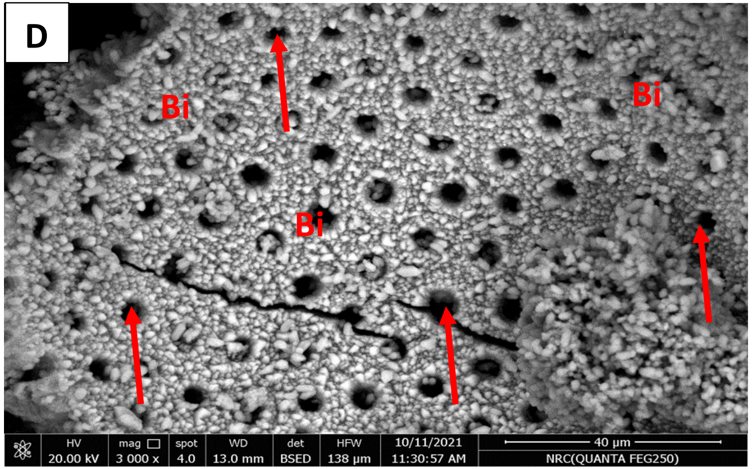


SEM Analysis Before NSLP/WSM/OBM Core Flooding:









SEM micrographs photo of the sample.

A) General overview of the sand shows the major components, detrital quartz (Qz), sparry calcite (Ca), Bioclastic (Bi) pores (yellow arrows) and traces of detrital clays (Cl),

B) B) close up for the sparry calcite (Ca),

C) C) close up for the Bioclastic (Bi) and

D) D) close up for the micropores within the Bioclastic (Yellow arrows).

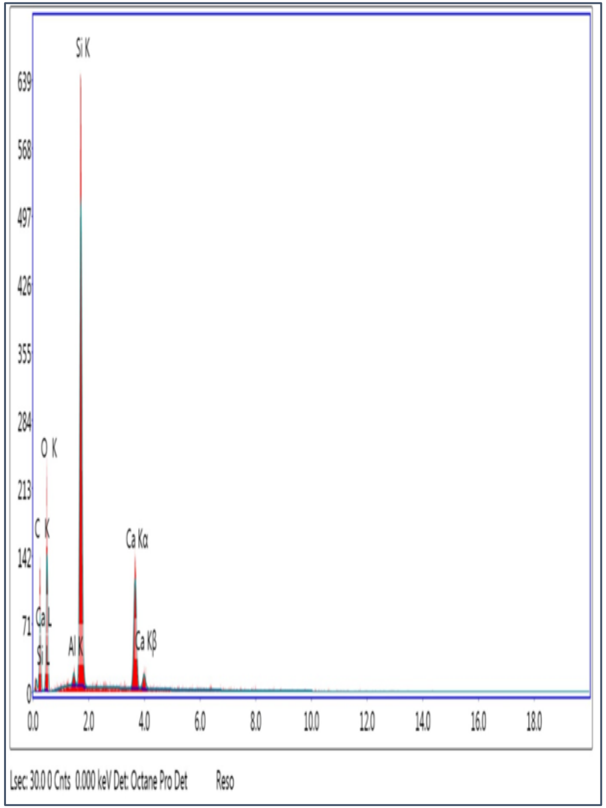


Figure (1): EDAX analysis of quartz shows the Si peak and its elemental analysis

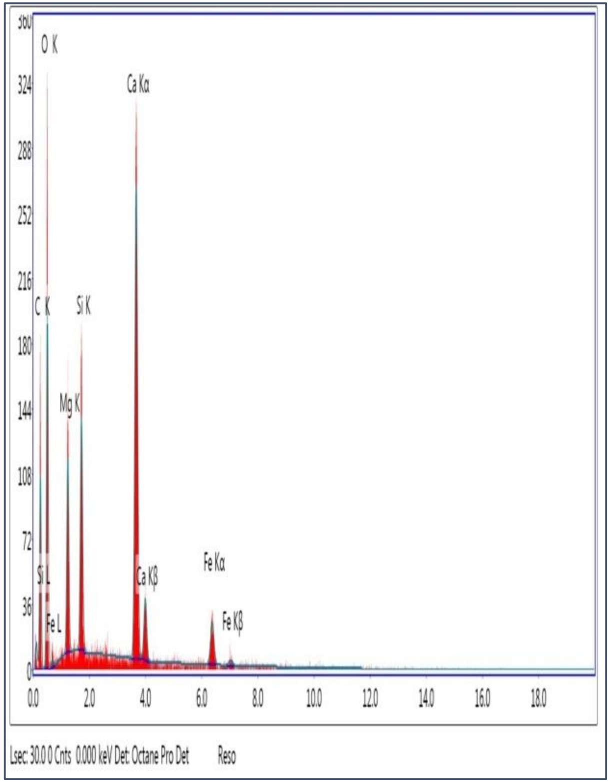


Figure (2): EDAX analysis of calcite bioclast shows the Ca peak and its elemental analysis

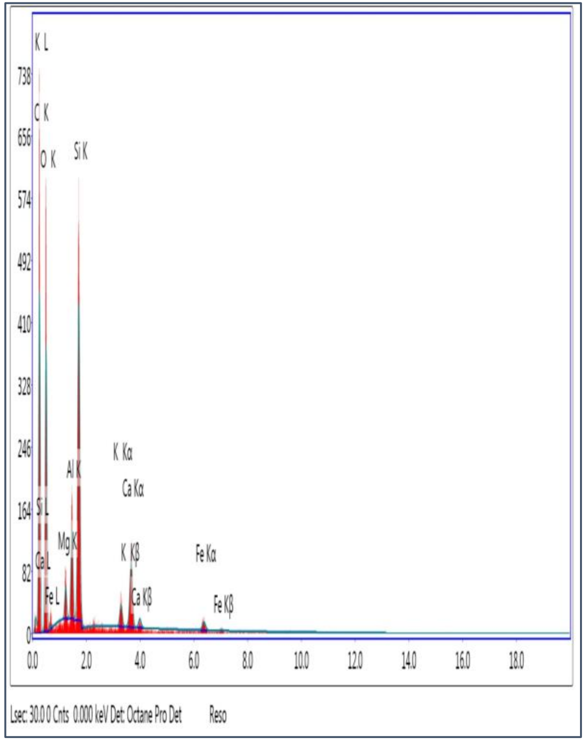
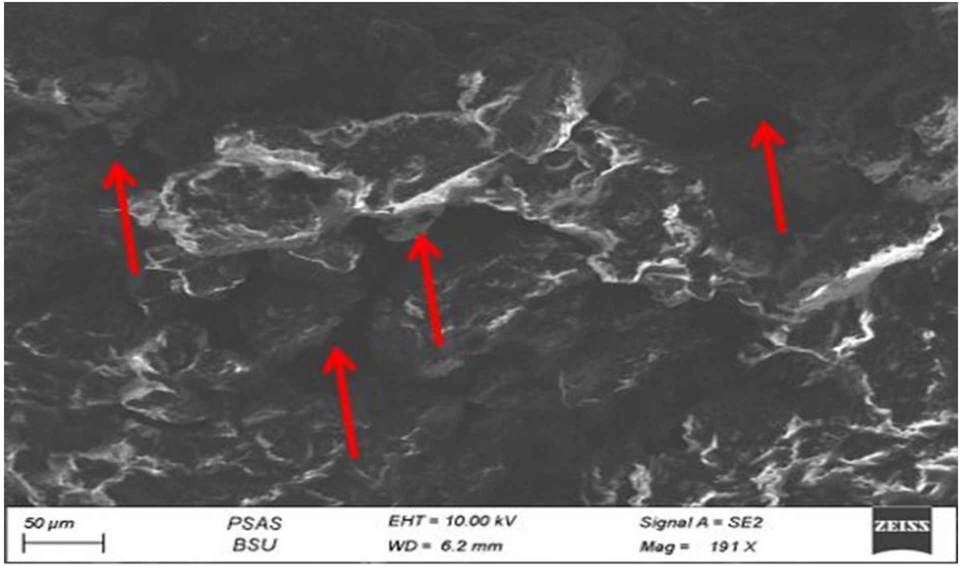
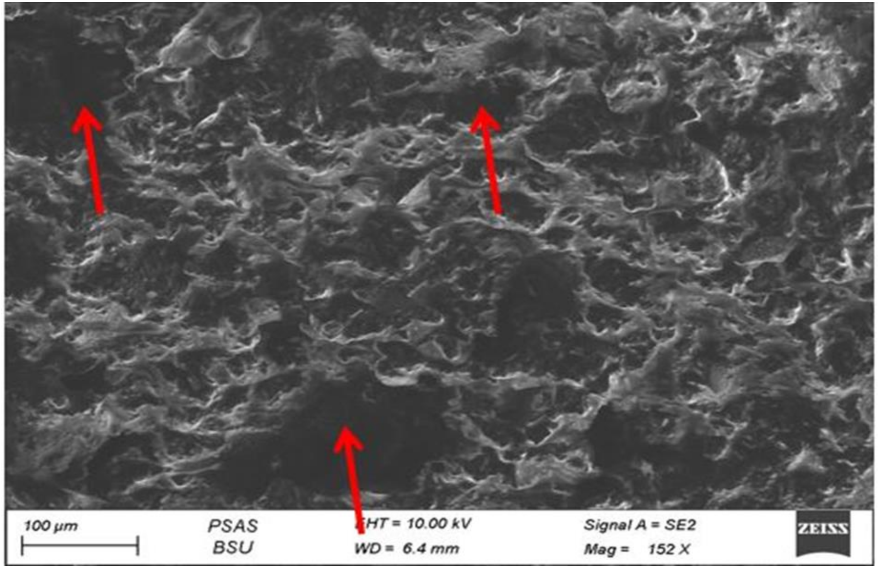


Figure (3): EDAX analysis shows the occurrence of (Al) peak indicating the occurrence of detrital clays

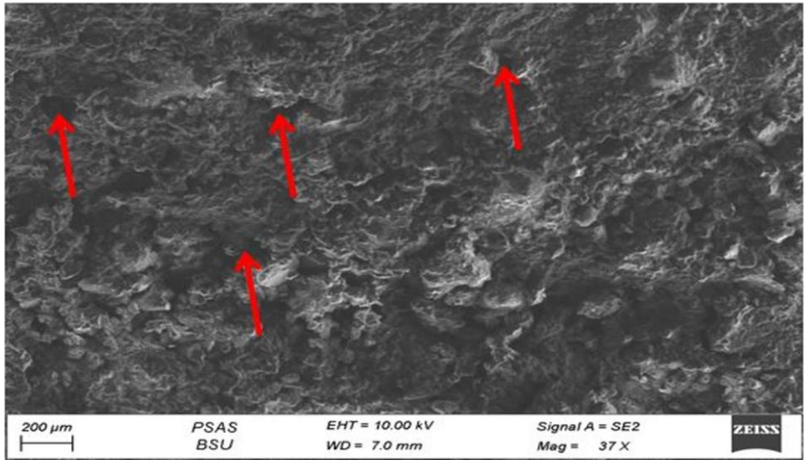
SEM Analysis After NSLP/WSM/OBM Core Flooding:

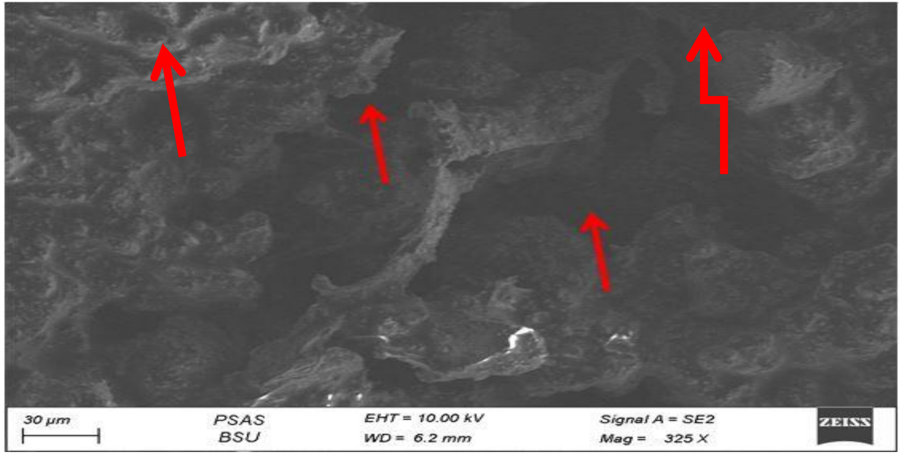
SEM observations of the four samples After flooding treatment indicate the occurrence of pores as shown in the following SEM photos. Therefore, there is no show of sever mechanical damage evidence on the formation including its pores system and permeability as a result of flooding and it is shown in the Return Permeability results . Red arrows on the photos below refer to the pores.

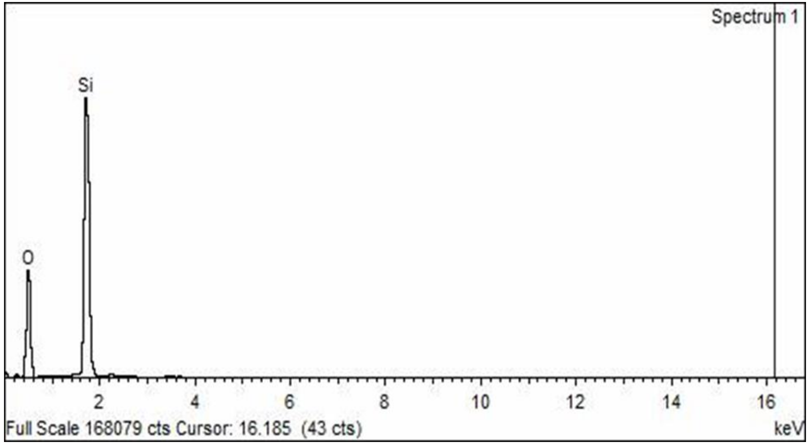


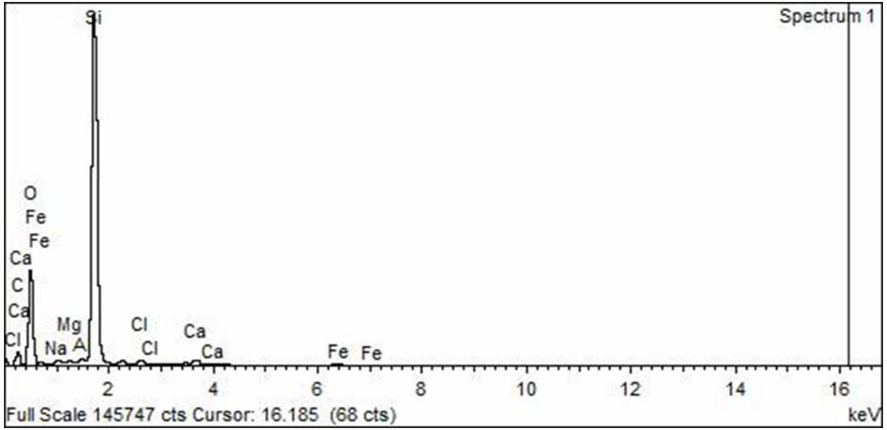


SEM Analysis & EDAX analysis of quartz grains for sample 2 After NSLP/WSM/OBM Core Flooding









Field Evaluation Case 1, Well # 1& Well # 2

Well Name	Well # 1
Interval Size inch	6” (ST1)
Interval Depth ft	12265.0 – 14,605.0
Footage ft	2340
Fluid Type	NSLP / WSM /OBM

Well Name	Well # 2
Interval Size inch	6” (ST2)
Interval Depth ft	10370 - 13850.0
Footage ft	3480.0
Fluid Type	NSLP/WSM/OBM

Well # 1& Well # 2 Drilling Challenges;

Historically, The operator experienced the following challenges with the offset drilled wells:

- **A high pressured / Low-pressured Sands, Wellbore instability issues, High Gas readings, and Finally Seepage or Severe Lost of circulation.**
- **Offset wells data indicated that a higher fluid density of +/- 10.8 ppg is required for safe drilling High Pressure Shale of Lower Rudies Fm mean while a fluid density of +/- 9.5 ppg to drill out the depleted reservoir Sand Fm.**
- **So, in these offset wells the planning team design to isolate high pressure zone with 7” casing and drill 6” section through the depleted sands. This solution costs the operator significant time and money .**

Field Evaluation Case 1,

Well # 1& Well # 2 Drilling Solutions

- **Effective NSLP/WSM Composite incorporated in the design of Oil-Based Fluid Formulation to form continues and integrate mud cake with low permeability and low porosity.**
- **Engineering wellbore strengthening treatment specifically selected for drilling this type of sand to enhance its formation strengthening and to give a chance for Drilling with mud overbalance > +/- 2800 psi, safely, and to Combine the two sections in only one section.**
- **As NSLP/WSM Composite minimizes the pore pressure transmission and improve wellbore stability at relatively lower fluid density (< 10 ppg) so, the plan was set to included the new NSLP/WSM composite to lower the risk of lost circulation while drilling depleted sands with that higher mud weight of ≥ 10.0 ppg.**
- **Based on Physical Rock Properties, The software model Bridging Particles Optimization Tool (BPOT) used to determine the correct selection and particle size distribution PSD of the WSM for creating a thin and integrated filter cake.**

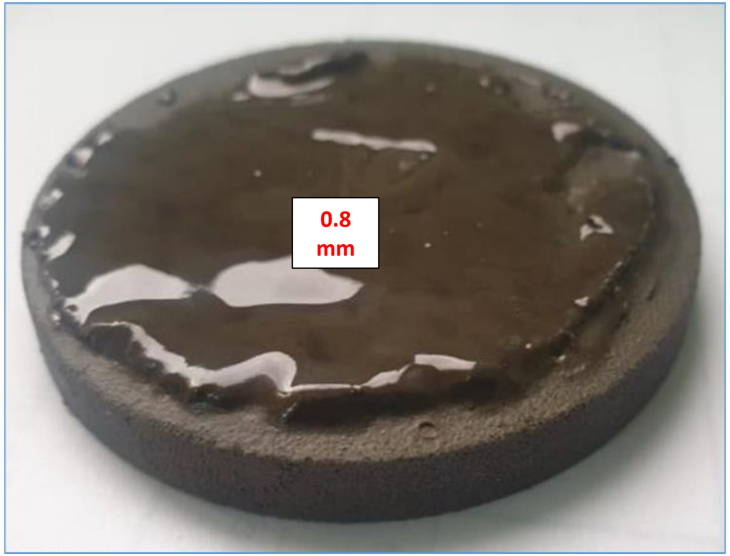
Field Evaluation Case 1, Well # 1 & Well # 2

Execution:

Well # 1 Sections Data					
	Interval Size (in)	Fluid Type	Top MD (ft)	Bottom MD (ft)	Casing Set (ft)
Well #1	6.0 (ST-2)	NSLP/WSM/OBM	12265.0	14,605.0	4.5 (in) Liner 11,935.0- 14,605
Well #1	6.0 (ST-2)	Brine	14,605.0	14,605.0	

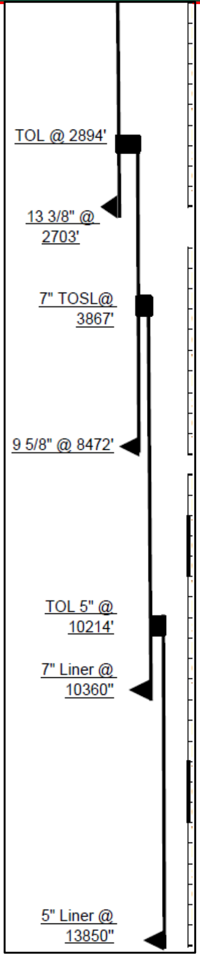
Well # 2 Sections Data					
Well Section	Interval Size (in)	Fluid Type	Top MD (ft)	Bottom MD (ft)	Casing Set (ft)
Well # 2	6.0 (ST-2)	NSLP/WSM/OBM	10,370.0	13,850.0	5” Liner 10,214.0 - 13,850.0
Well # 2	6.0 (ST-2)	NaCl/KCl Brine	13,850.0	13,850.0	

WSM Treatment	Concentration
NSLP (D50 0.179 µm)	0.84 gal/bbl
Graphite	5.0 lb/bbl
Dynared	5.0 lb/bbl
Sized Marble 10 µ	3.0 lb/bbl
Sized Marble 25 µ	15.0 lb/bbl
Sized Marble 100 µ	7.0 lb/bbl



Fluid Parameter	Result
HP-HT Fluid loss at 300°F	1.0 ml/30 min
PPA Spurt fluid loss	0.25
PPA fluid loss at 320°F, 20µ and 3500 psi	2.6 ml/30 min

Case 1, Well # 1 & Well # 2 : Execution

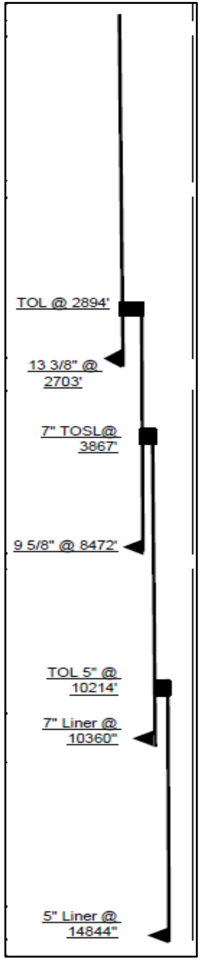


WELL # 2

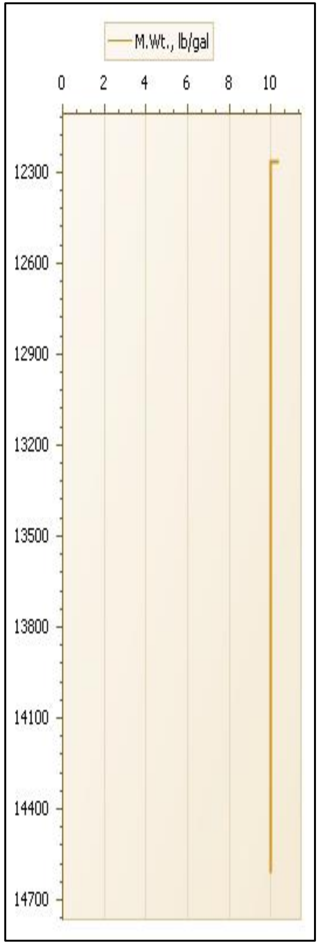
- In second well, the 6" hole side - track Production Zone section drilled from 10370 - 13850.0 TD MD with maximum angle of > 55°.
- The pore pressure of depleted reservoir was recorded to be about 3700 PSI.
- the depleted sand was drilled safely with using NSLP/WSM Composite 10.0 ppg Oil Based Fluids System and differential pressure +/- 2000 PSI,
- The hole showed a stable condition till run 5" liner and cemented successfully without down hole losses.

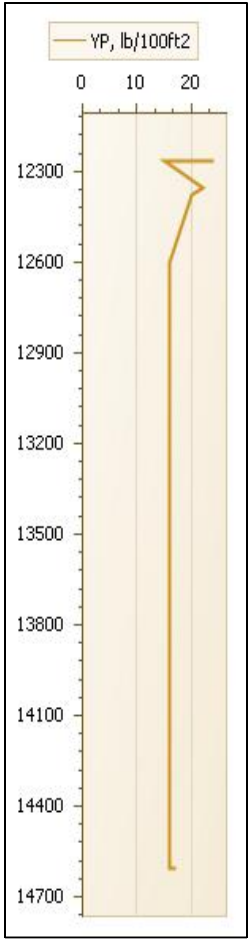
WELL # 1

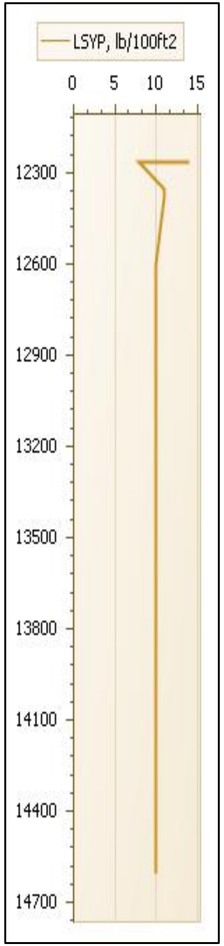
- In first well, the operator drilled 6" side-track Production Zone section from 12265.0 – 14,605.0 TD ft MD with maximum angle of 40.00°.
- Pressure measurements taken indicated the pore pressure of the depleted Matulla Sand was +/- 2600 PSI.
- Despite the sub-normal pressure, the depleted sand was drilled safely with 10.0 ppg using NSLP/WSM Composite Oil Based Fluids System and with differential pressure +/- 3000 PSI,
- Also, the hole showed stable condition during tripping, logging, and during running 4 ½" liner smoothly to bottom without down hole losses..

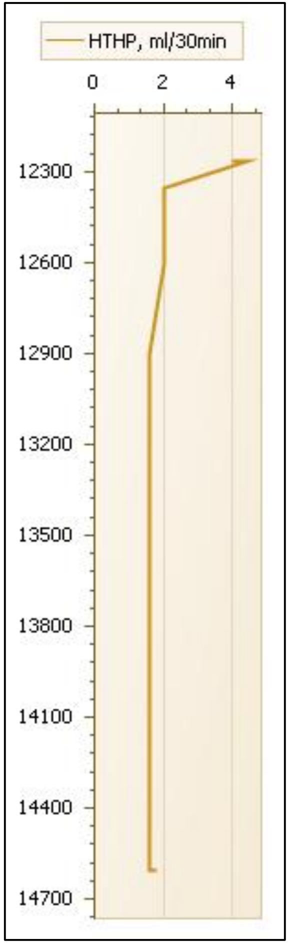


Well # 1 / GOS - Daily Drilling Fluid Properties - Execution

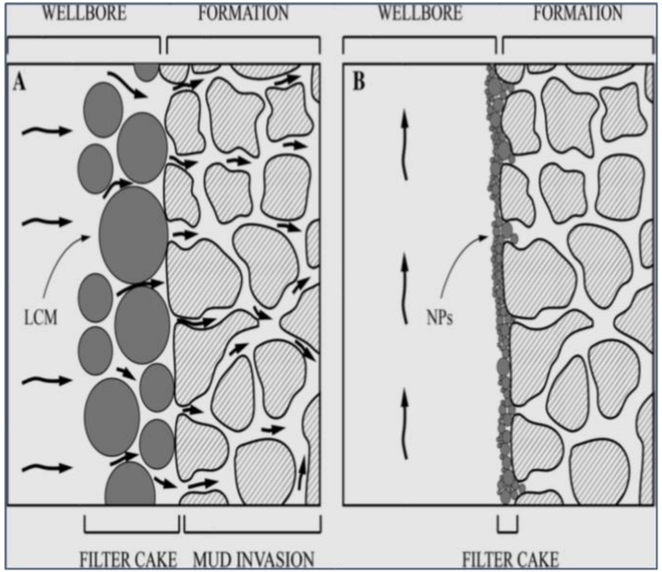




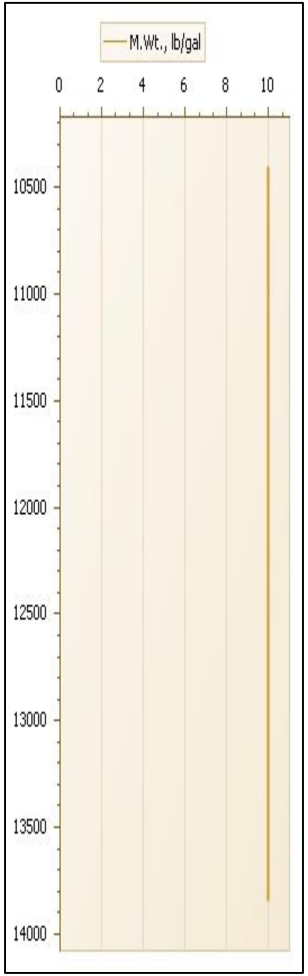


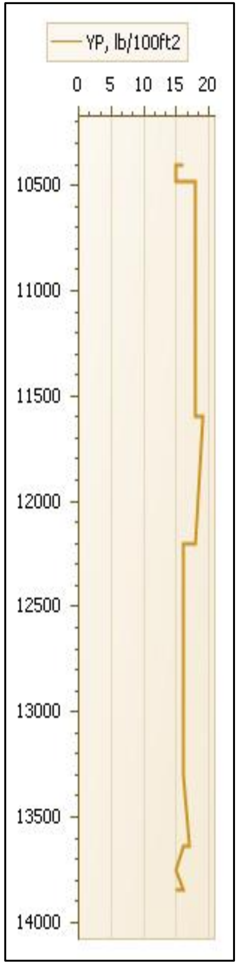


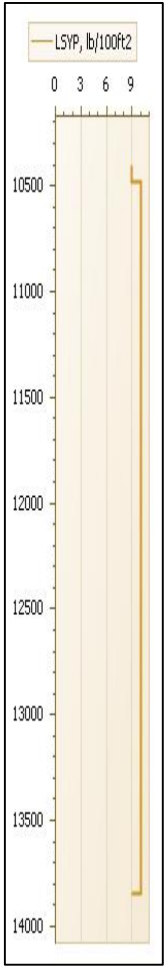
Formation	Member	Lithology	Rock Symbol
Rudies		Shale	
Nukul		Anhydrite	
Thebes		Limestone	
Esna		Shale	
Sudr		Limestone	
Brown Ls		Limestone	
Matulla		Sand	
Wata		Sand	



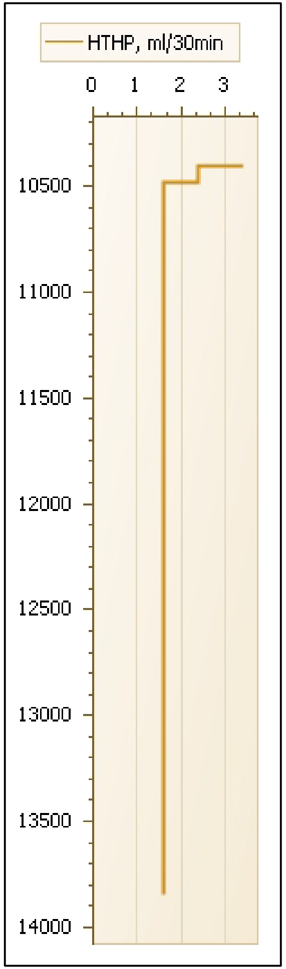
Well # 2 / GOS - Daily Drilling Fluid Properties - Execution







Formation	Member	Lithology	Rock Symbol
Kareem		Shale	
Kareem		Limestone	
U.Rudies		Shale	
L.Rudies		Limestone	
L.Rudies		Shale	
L.Rudies		Sand	
L.Rudies		Shale	
L.Rudies		Limestone	
L.Rudies		Shale	
Sudr		Limestone	
Brown Ls		Limestone	



Field Evaluation Case 1, Well # 1 & Well # 2 - Highlights / Success Points

Depleted sands safely drilled with > 2800 psi over-balance without losses, sticking tendency or wellbore stability issues using the new approach NSLP/WSM Oil Based Fluids System.

The operator drilled many wells through high-pressure zone and sub-pressure depleted sand formation with minimum to Zero (NPT). Well condition/homogenous fluids prior tripping out.

No differential sticking during Drilling Operation. Liner, was run smoothly in both wells to section TD without obstructions indicating stable wellbore.

This Solution saves operator significant time and money when compared to problematic offset wells.

Well # 1 & Well # 2 completed and showing an increase in the production rate compared to the gross rate before start the sidetrack operation indicating no formation damage occurred during drilling operation using the new NSLP/WSM Based OBM Fluid System.

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Closing Remarks / Conclusion

The newly designed Nanoparticle Based Drilling Fluids Technology incorporated in the fluid system formulation aided by (BPOT) customized to solve such drilling challenges and engineered to control fluid invasion of drilling fluid into reservoir.

"BPOT" Optimizes "PSD" of reservoir drilling fluids, improves leak-off control, and minimizes formation damage from solids invasion thereby increasing well productivity.

"NSLP" / "WSM" incorporated in OBM Formulation Capable of forming a continues and integrate mud cake with low permeability and low porosity.

This Innovative Solution saves operator significant time and money when compared to problematic offset wells

Closing Remarks / Conclusion

The plugging efficiency was evaluated, and lab tested experimentally using the "PPA" to measure the filtration volume.

The results showed that NSLP/WSM/Based Fluids System provide a combination of chemical inhibition and micro fracture sealing capability against a low permeable Sand and Shale Fm.

Also, it Optimizes wellbore stability in a variety of drilling conditions including, deep drilling well applications, depleted or poorly consolidated formations, interbedded formations, and mechanically weak formations.

The "NSLP" technology Equally effective in Water, Oil, or Synthetic-Based Drilling Fluid Systems maintaining a good well bore hole stability and preventing equipment problems, such as differential sticking, seepage losses and slow (ROP) due to bit balling,

Closing Remarks / Conclusion

Nanoparticle-Based Drilling Fluids system is suitable for use in all sections of the well including the reservoir and it demonstrated to be a Non-Damaging as seen from the return permeability Lab Test done in independent 3rd party showing that the Return Permeability percentage Changed between 83 up to 91 %.

Taking the new Nanoparticle Based Drilling Fluids to the field, the Planning & Drilling Team drilled many successful wells in the offshore GOS, WD Egypt where the offset wells in these area experienced differential sticking due to depleted sands with mechanical shale sloughing, leading to wellbore instability.

Successfully drilling many wells in GOS, WD, Egypt and in Kuwait penetrating through the production Zone, (high-pressure zone and sub-pressure depleted sand formation) with Minimum to Zero (NPT) using this innovative solution.

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Closing Remarks / Conclusion

The sealing membrane resulted in NSLP/WSM/Based Fluids System is easily removed, restoring almost instantly the original rock permeability which clearly proved in our Cases shown in this presentation completed producer as well showing an increase in the production rate without costly and challenging remedial treatments indicating no formation damage occurred during drilling operation using the new system.

When production is initiated, the inflow of the well lifts off the thin external filter cake with minimal differential pressure, eliminating the need for acid stimulation washes.

Drilling operations reported no differential sticking, or wellbore instability issues compared to very challenging situations for field offset wells targeting the same Formations in GOS or in W/D even at highly mud overbalance > 3000 psi.

Closing Remarks / Conclusion

NSLP/WSM/Based Fluids System proves its economic value, as it can be used to drill out Hi-Pressure – Low Pressure Zone, eliminating a possible additional casing string and managed to decrease the drilling section time (NPT) which reflected on overall section drilling cost.

Now this innovative solution became an integral for most of the operators' well planner in Egypt and was selected to drill out such challenged complex wells in the following upcoming drilling operation in both W/D and GOS - Egypt

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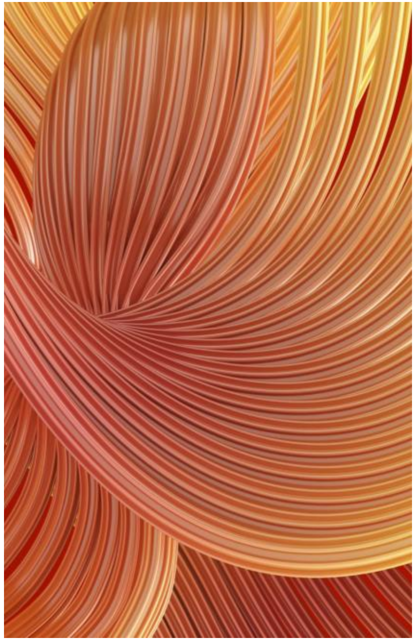

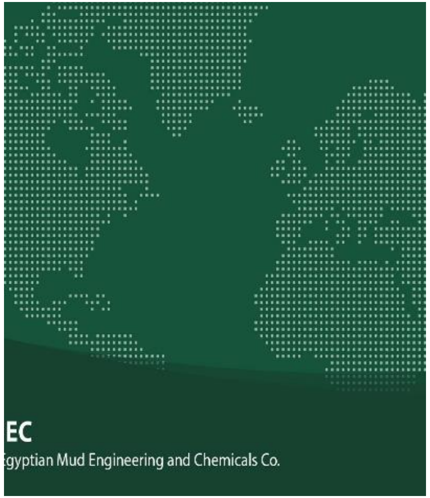

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Questions ?

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Biography

Youssry Abdelaziz Eladly is a Technical, Project Manager at EMEC with more than 30 years of experience. After obtaining his B.Sc. in Chemistry from Ain Shams University in 1981, he started working in GPC's Lab and Fields as a Lab and Mud Chemist. In 1988 he moved to EMEC where he worked as a Mud Engineer then Mud Supervisor. In 1995 he promoted to be a Base Manager in various region Inside and Outside Egypt including Syria and Saudi Arabia. In 2008, till now he currently worked as Technical, Project Manager with GUPCO/PB/DRAGON and with Petrosannan Supervising operations in Gulf of Suez, Red sea, and Western Desert regions. He is also known for training lots of junior mud engineers as well establishing successful collaborations with academic institutions in Egypt. Recently three SPE Papers have been published in cooperation with GUPCO&PETROSANNAN, Youssry was the main author of these papers.