FORMATION TESTER MOBILITY

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Petrofac Engineering & Production Services

Engineering Services Consultancy

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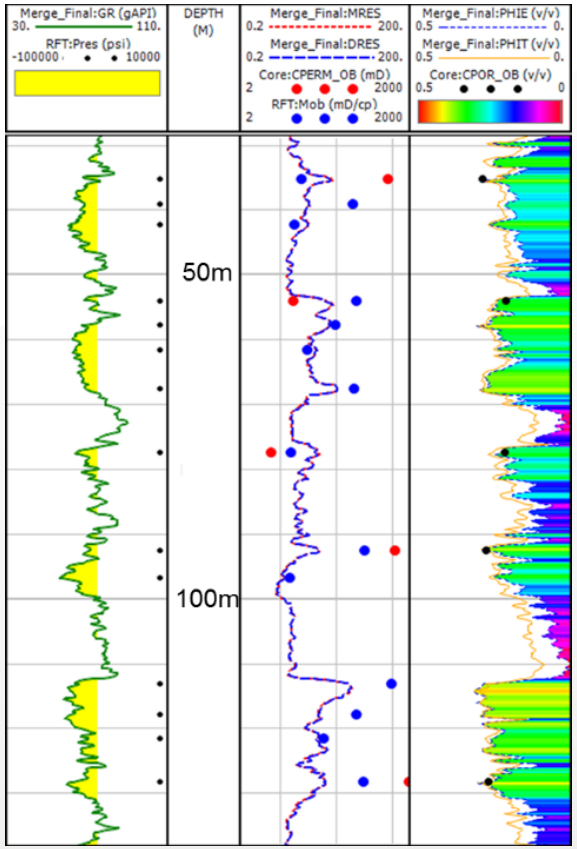
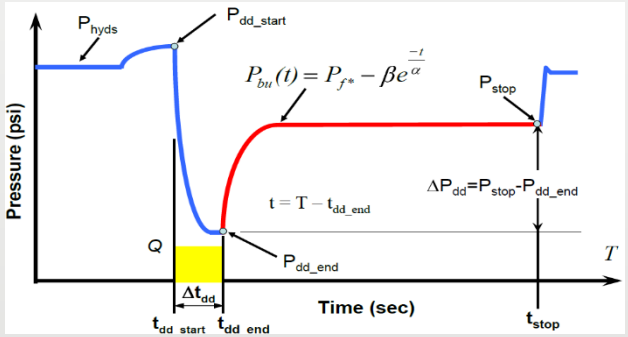
Introduction

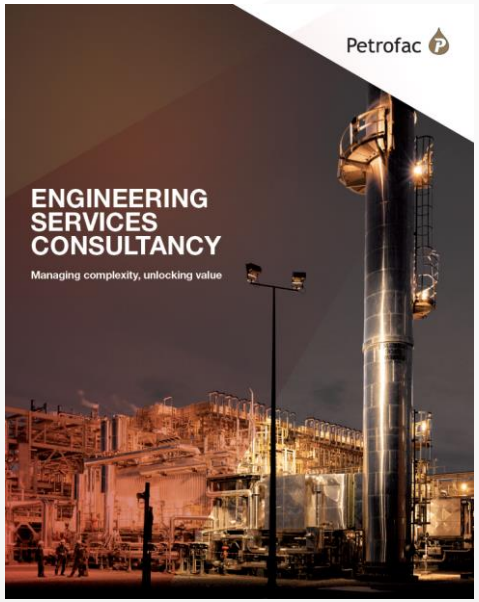
- Petrofac
- Formation Testers
  - Pretest Procedure
  - Pressure Interpretation
  - Older & Newer Tools
- Draw-Down Mobility
- Reservoir Quality
- Pressure Interpretation
- Pretest Acquisition & Quality Control
- Conclusions
- Questions & Discussion

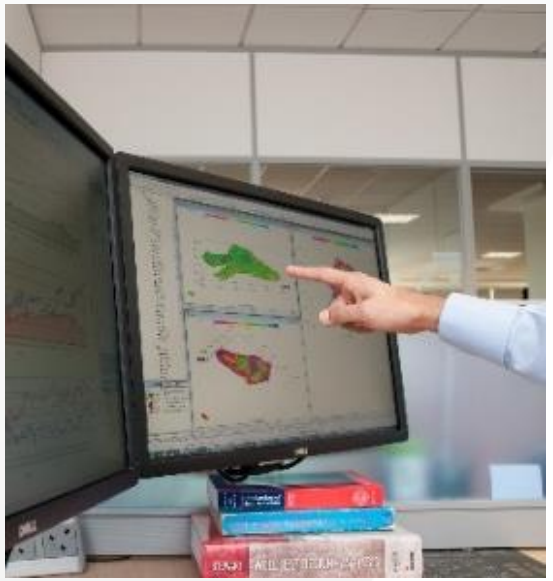


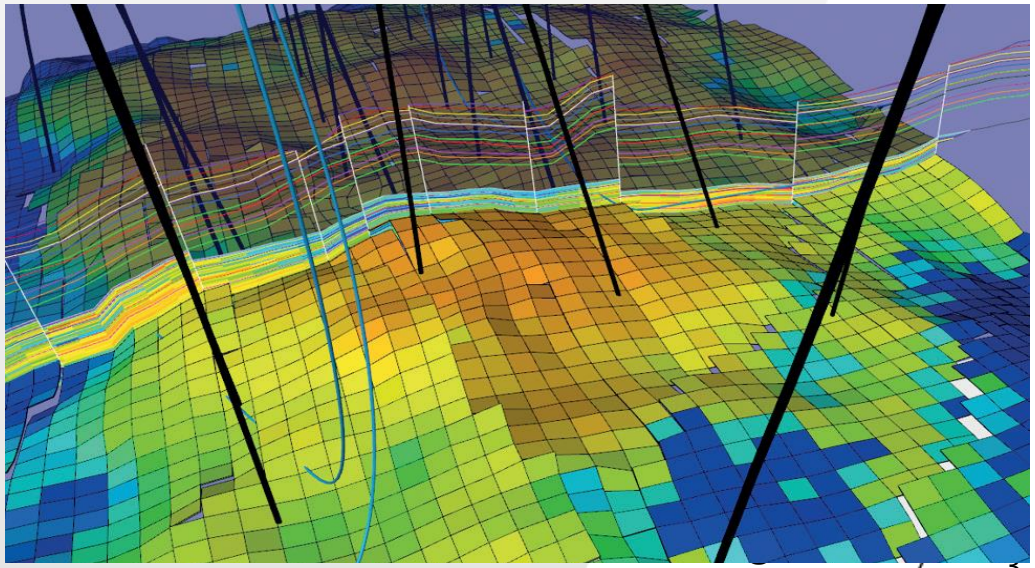


Introduction to Petrofac

- We are an international service provider to the oil and gas processing industry.
- More than 13,000 people support our operations in 29 countries worldwide.
- We design, build, operate and maintain oil and gas facilities and our capabilities span the asset life cycle from concept through to decommissioning.
- Petrofac Engineering & Production Services (EPS) span Engineering, Operations & Maintenance, Asset Management, Well Engineering, Training, Late Life and Decommissioning.
- Our Engineering Services consultancy includes a Subsurface Consultancy team delivering:
  - Geoscience
  - Reservoir and production engineering
- We integrate our subsurface skills with wider Petrofac capabilities.
- We execute fast-track oil and gas projects, including greenfield developments, mid-life production enhancements and late-life field optimization.







FORMATION TESTERS

- PRETEST PROCEDURE
- PRESSURE INTERPRETATION
- OLDER & NEWER TOOLS

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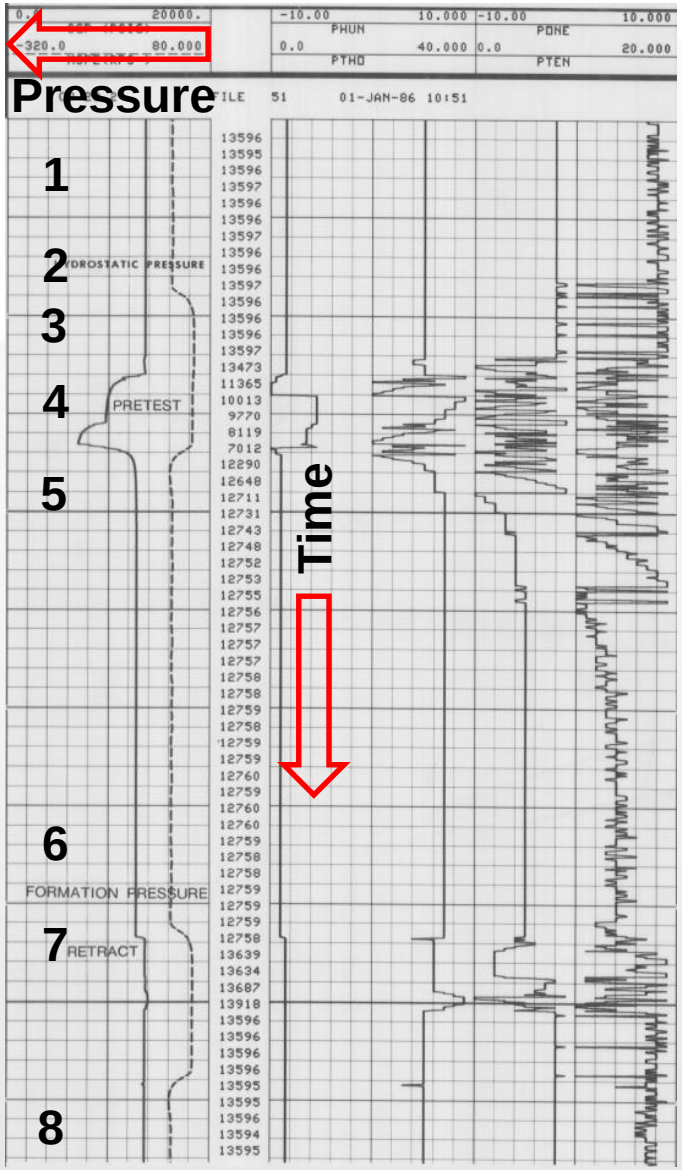
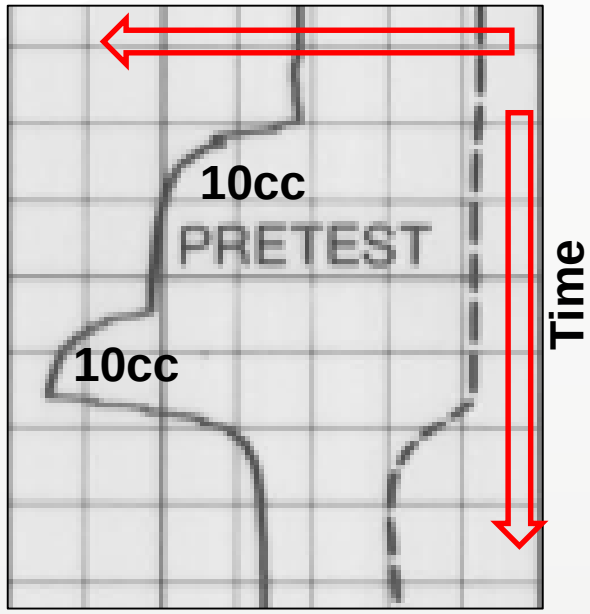
Formation Tester Pretest Procedure

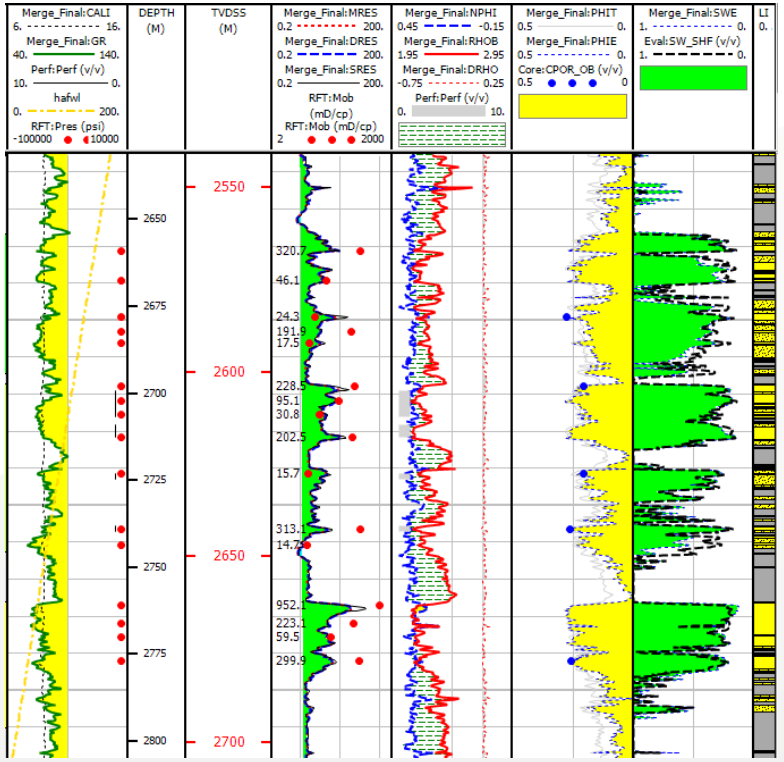
- Tool positioned at depth of interest
- Pressure gauge stabilized (**1**)
- Mud pressure recorded (**2**)
- Packer seals against formation & probe extended to formation (**3**)
- Small volume of fluid is extracted and pressure draw-down (**4**)
- Formation pressure build-up (**5**)
- Formation pressure stabilized (**6**)
- Tool retracted (**7**)
- Mud pressure stabilized & recorded (**8**)

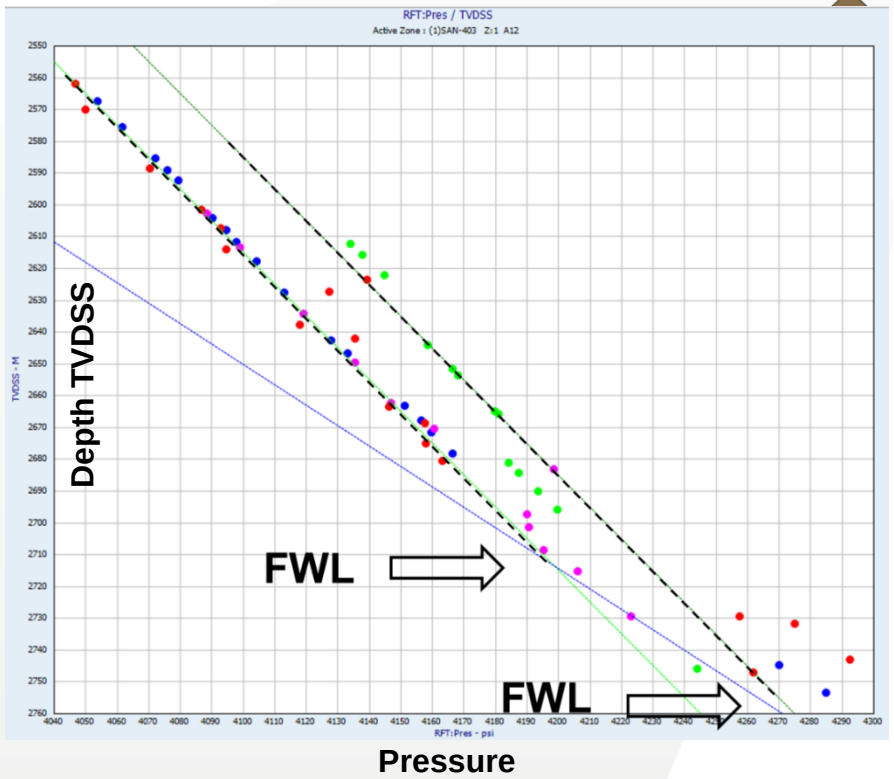


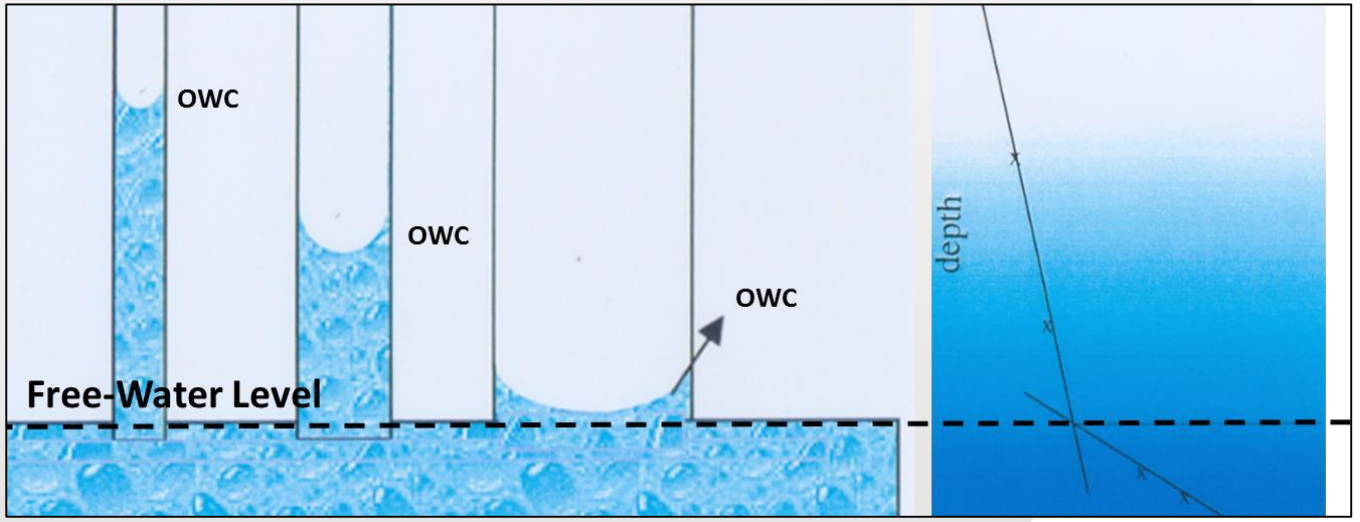


Pressure Interpretation

- Reservoir at original pressure
- Pressure points define a gradient consistent with formation fluid properties
  - Gas, Oil, Water
- Gradients consistent with PVT properties & water salinity
- Free-Water Level defined by intersection of water & hydrocarbon gradients
- Oil-Water Contact is <u>above</u> the Free-Water Level in a water-wet reservoir
- In a produced reservoir FTs may have different objectives







Older and Newer Tools

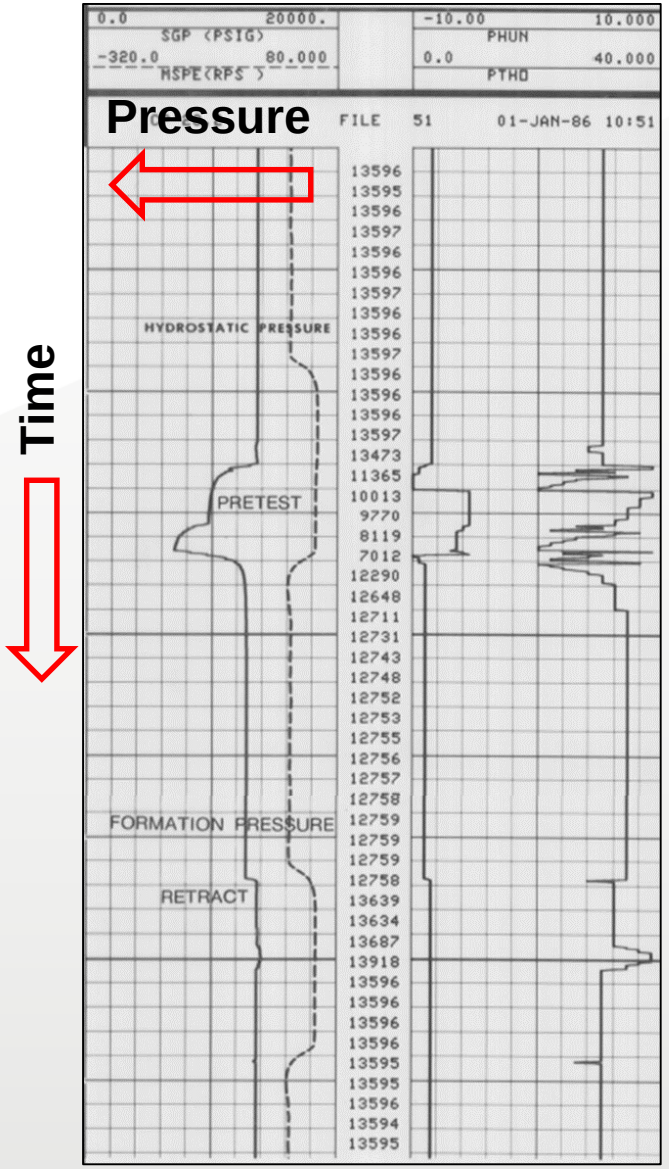
Older tools

- Strain Gauge
- Quartz Gauge if run
- Fixed draw-down volume
- 2 X 10cc
- 1 X 20cc
- Fixed draw-down rate
- Single Build-up

Newer tools

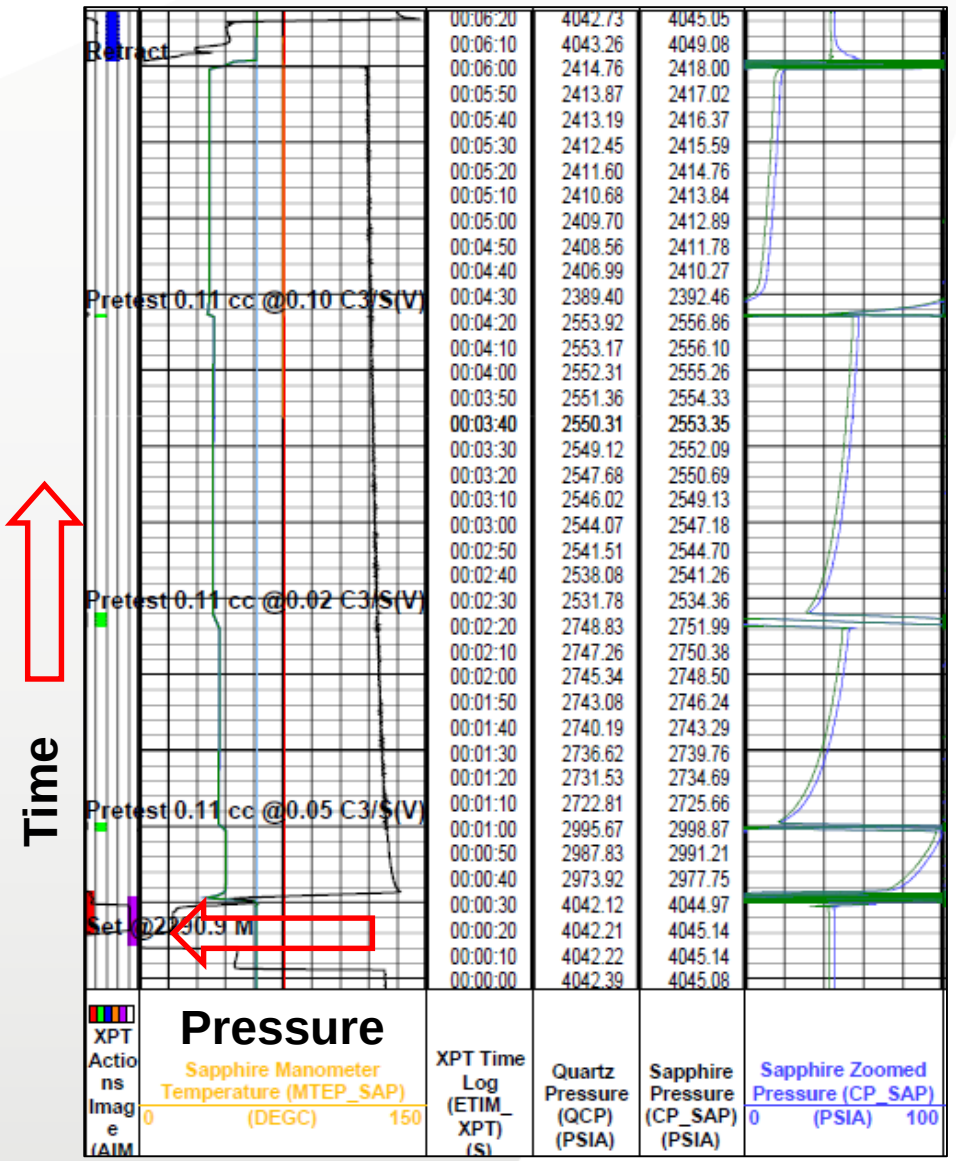
- Improved Strain Gauge
- Improved Quartz Gauge
- Variable draw-down volume
- Variable draw-down rate
- Multiple draw-downs
- Multiple build-ups

Older Tool



2 X 10cc DD

Newer Tool



3 X 0.1cc DD

DRAW-DOWN MOBILITY mD/cp

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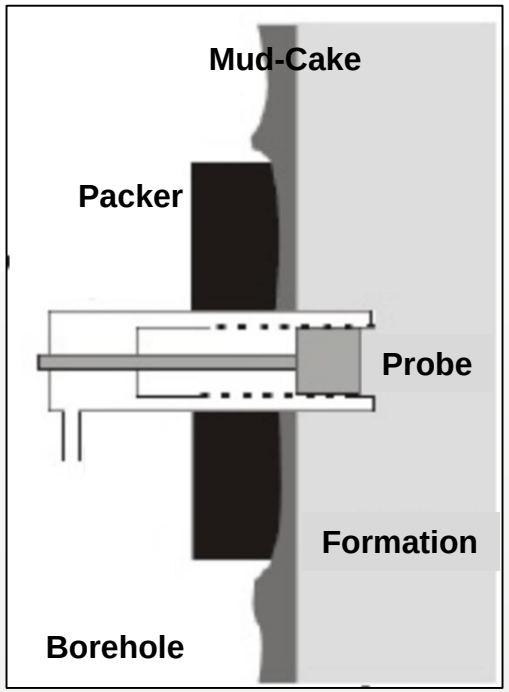
Draw-Down Mobility (mD/cp)

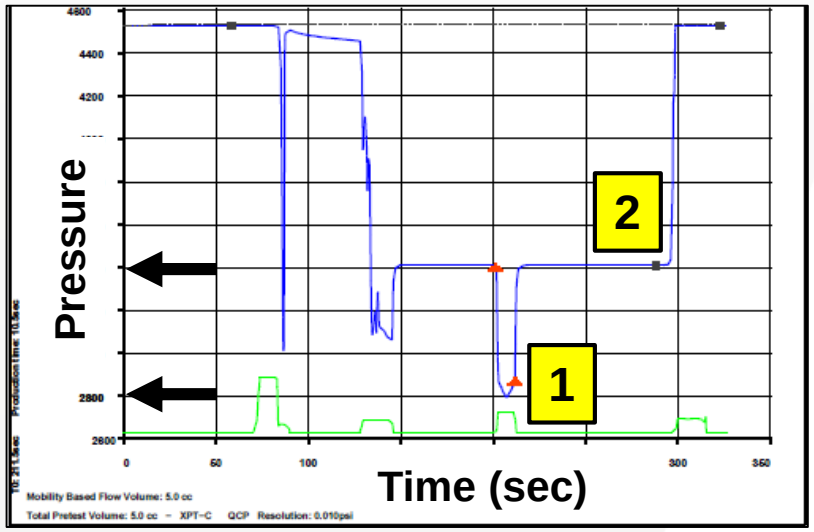
- Draw-down mobility calculated from:
  - Minimum DD pressure 1
  - Stabilized formation pressure 2
  - Pretest volume & rate
  - Filtrate viscosity
  - Probe diameter

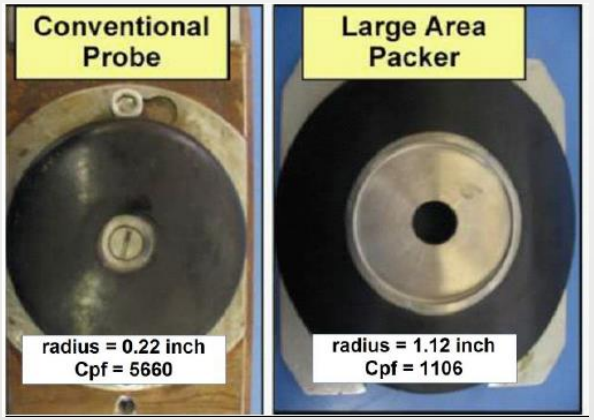
$$K_{dd} = C * \frac{q\mu}{\Delta P}$$

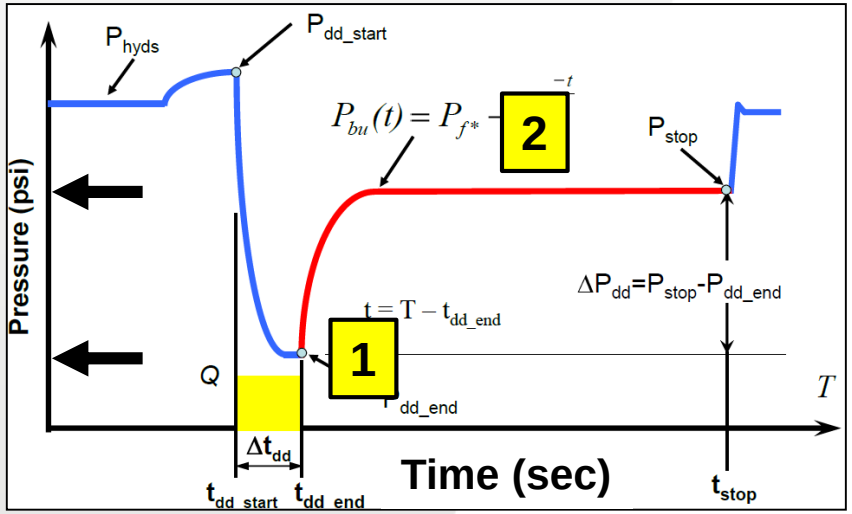
K_{dd}= $Drawdown\ Permeability\ in\ md/cp$

$C = probe\ Constant$
$q = fluid\ extraction\ rate$
$\mu = fluid\ viscosity$
$\Delta P = pressure\ drawdown$

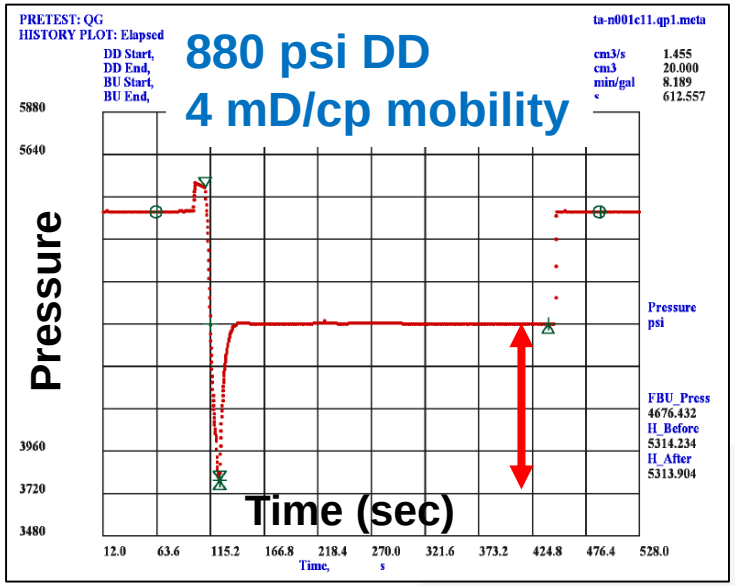


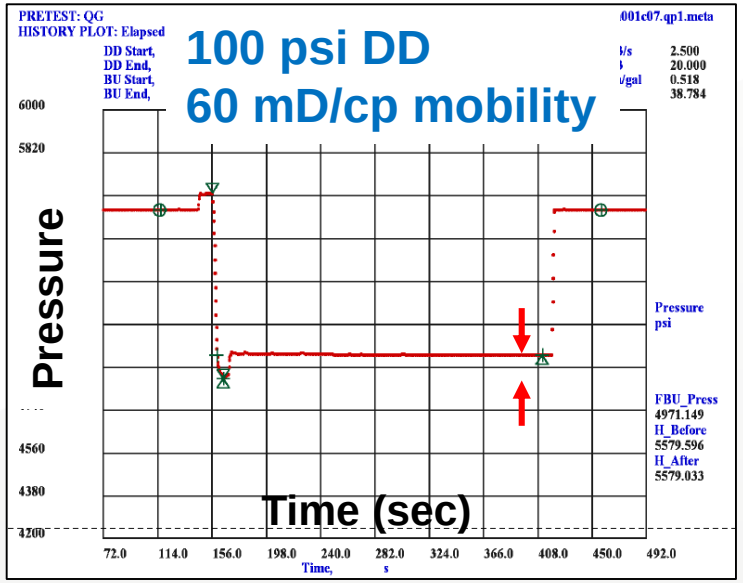


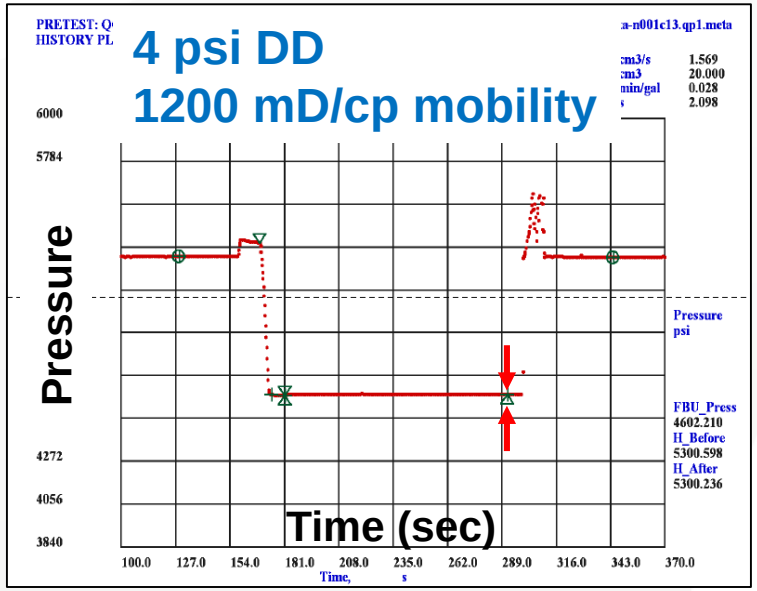


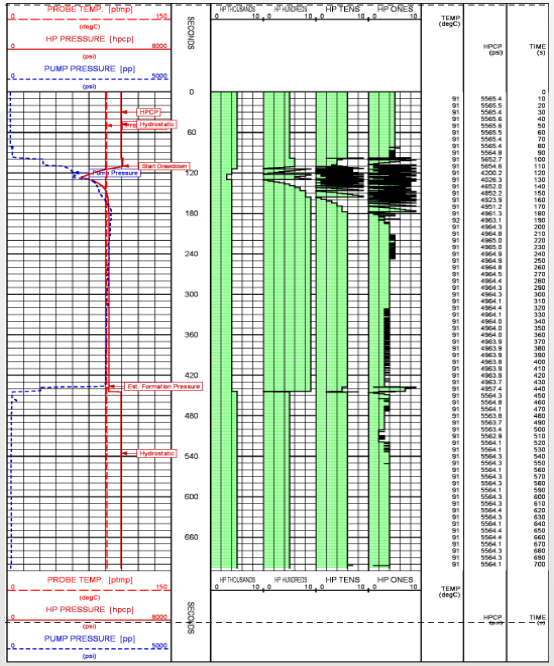


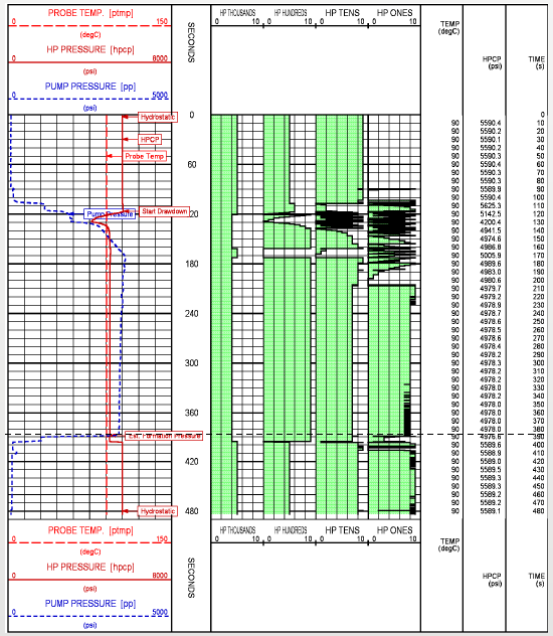
Draw-Down Mobility Reservoir Quality Low – Medium - High

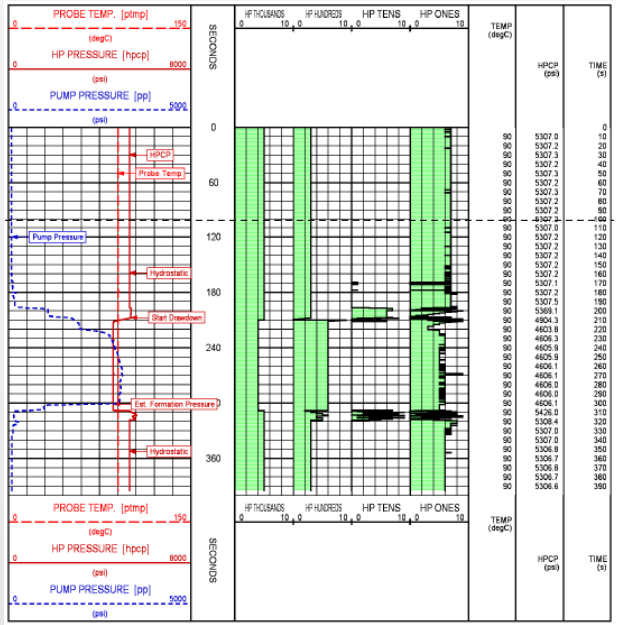












Draw-Down Mobility Summary Plots: Old and New Tools

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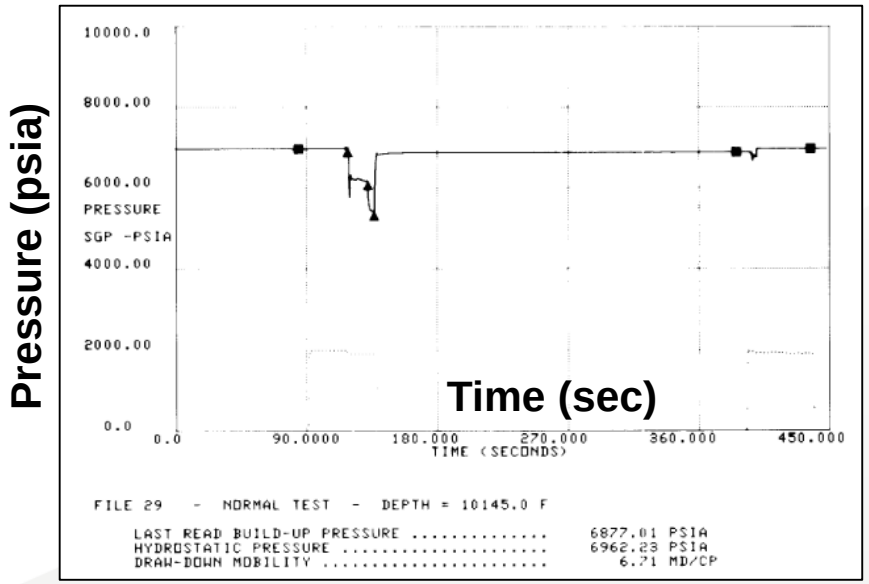
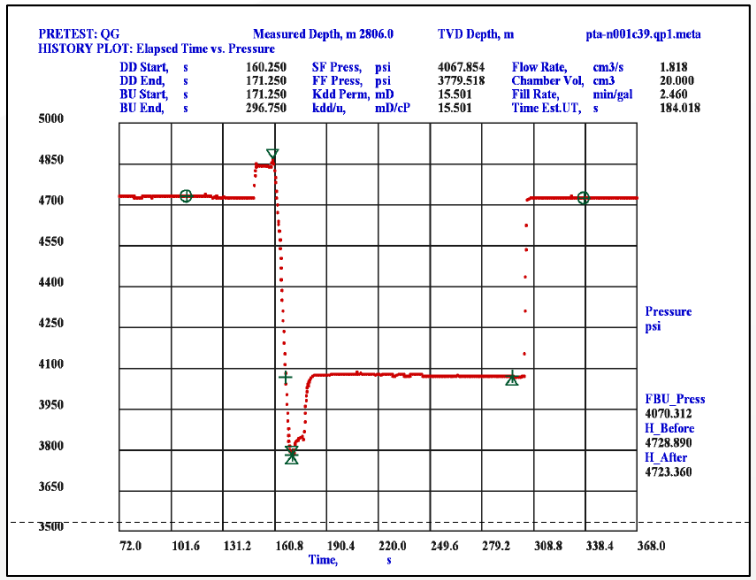
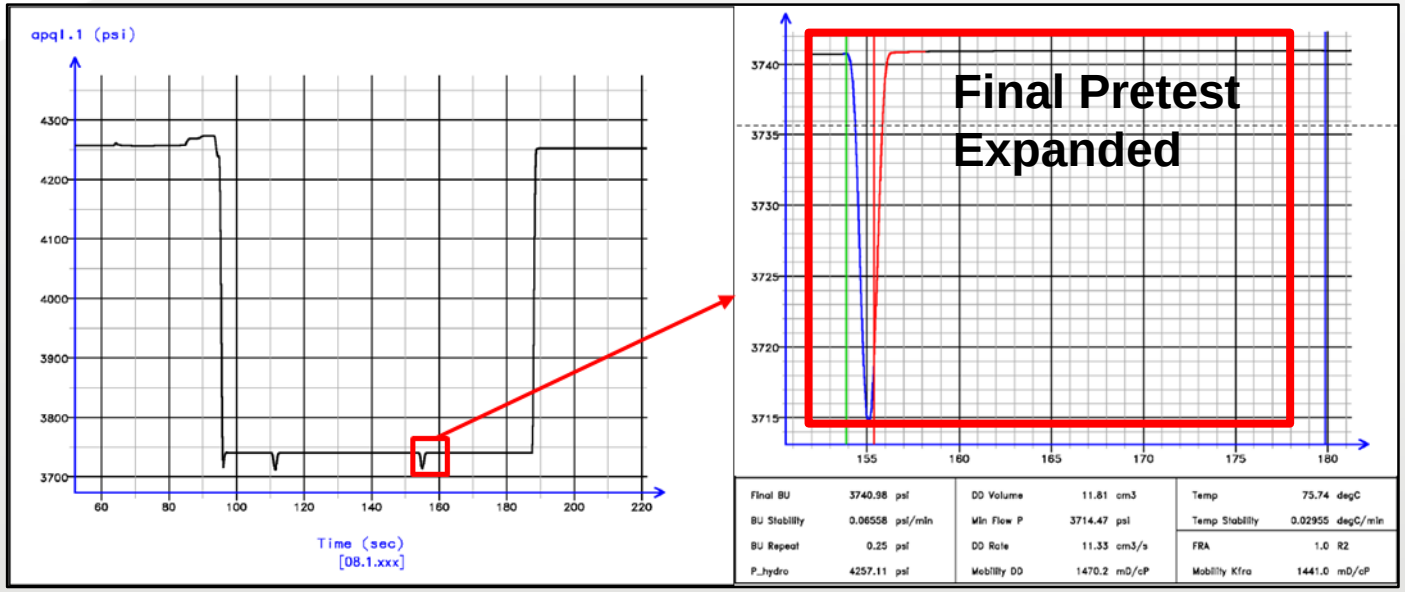
2 X 10cc DD



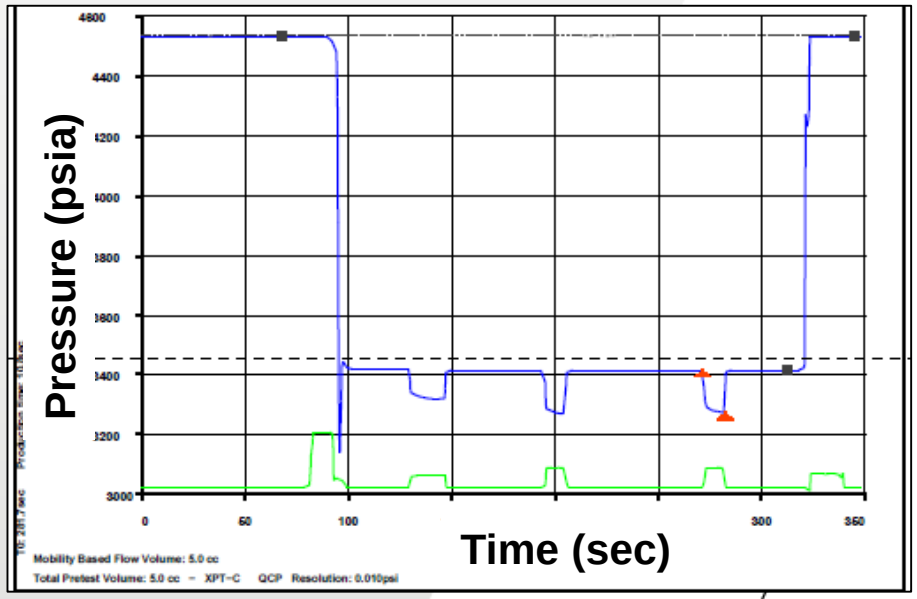
1 X 20cc DD



3 X 12cc DD



3 X 5cc DD



Draw-Down Mobility Summary Tables

Formation Pressure

Mobility

Mud Pressure Before & After

Depth MD (m)	Depth TVD (m)	Gauge Temp. (degC)	DD Vol. (cm3)	Flow Time (sec)	Minimum Pressure (psia)	Final BU Pressure (psia)	DD Mobility (mD/cP)	FRA Mobility (mD/cP)	Hydro. Before (psia)	Hydro. After (psia)	Comment
1900.1	1896.6	67.7	6.9	0.9	2781.92	2852.48	327.7	307.2	3369.79	3368.88	Good Test
1900.1	1896.6	67.7	6.7	1.0	2785.10	2852.67	330.4	326.3	3369.79	3368.88	Repeat Test
1906.7	1902.0	68.0	N/A	N/A	N/A	N/A	N/A	N/A	3381.70	3380.58	Tight Test
1906.2	1901.8	68.1	11.6	1.2	2839.01	2862.22	1692.0	1675.5	3379.25	3378.93	Good Test
1906.2	1901.8	68.1	12.3	1.5	2843.69	2862.50	2080.1	2084.7	3379.25	3378.93	Repeat Test
2173.4	2168.6	70.9	12.2	1.2	3259.08	3277.08	2268.0	2247.4	3872.22	3868.98	Good Test
2173.4	2168.6	71.0	12.1	1.2	3261.28	3277.16	2439.8	2477.3	3872.22	3868.98	Repeat Test
2361.7	2357.0	73.4	6.2	1.1	1499.42	3617.20	11.4	4.5	4206.71	4201.79	Good Test
2361.7	2357.0	73.6	4.1	0.8	2169.16	3617.37	12.0	Note E	4206.71	4201.79	Repeat Test
2364.3	2359.6	74.6	5.8	1.0	145.68	3620.08	5.6	Note E	4205.21	4186.51	Good Test

Test	File	Depth M	TVD M	Drawdown Mobility MD/CP	Mud Pressure Before PSI	Mud Pressure After PSI	Last read build-up Pres PSI	Formation Pressure PSI	Test Type
57	103	2637.48	2637.48	2.72	4659.11	4658.99	4384.80	4384.80	Volumetric Limited draw-down
59	104	2631.83	2631.83	0.14	4648.94	4648.91	4406.10	4406.10	Volumetric Limited draw-down
61	105	2621.97	2621.97	2.26	4631.30	4631.20	4373.26	4373.26	Volumetric Limited draw-down
62	106	2539.93	2539.93	0.13	4484.75	4485.02	4103.12	4103.12	Tight Test
63	107	2540.56	2540.56	0.14	4485.96	4486.13	4191.00	4191.00	Tight Test
67	108	2533.94	2533.94	3.54	4474.22	4474.17	4179.95	4179.95	Volumetric Limited draw-down
70	109	2527.94	2527.94	2.00	4463.49	4463.40	4169.40	4169.40	Tight Test
72	110	2527.47	2527.47	3.82	4462.46	4462.58	4167.69	4167.69	Volumetric Limited draw-down

Mud Pressure Before & After

Mobility

Formation Pressure

RESERVOIR QUALITY FROM MOBILITY

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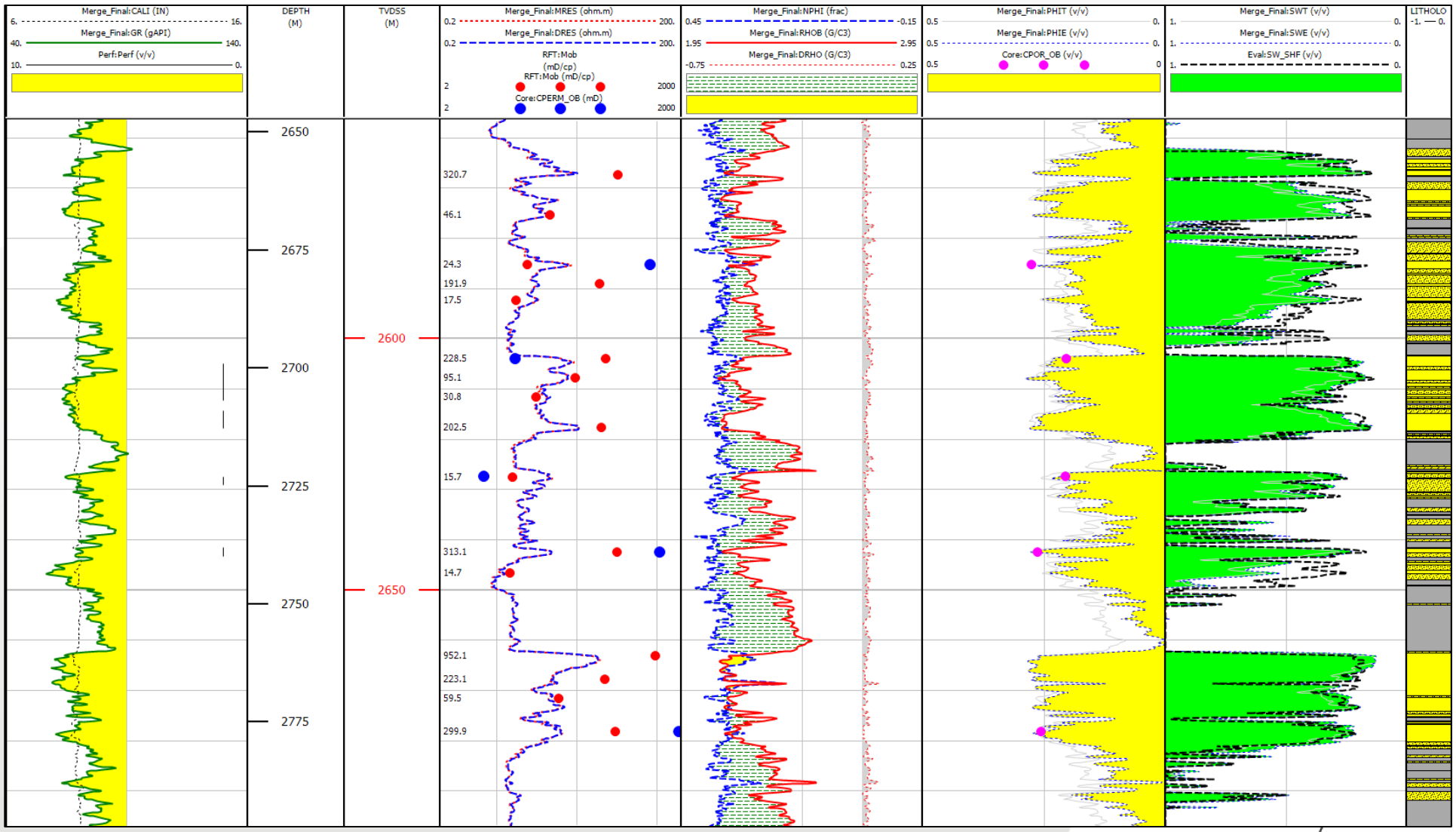
Reservoir Quality from Draw-Down Mobility

- ~150m TVDSS
- Multiple Sand & Shale Oil Reservoirs
- Oil-Based Mud
- Rotary Side-Wall Cores
  - Permeability (mD)
  - Porosity (v/v)
- Formation Tester data
  - Mobility (mD/cp)

FT Mobility

Rotary SWC Perm.

Rotary SWC Porosity



Core Permeability and Draw-Down Mobility

Single Well

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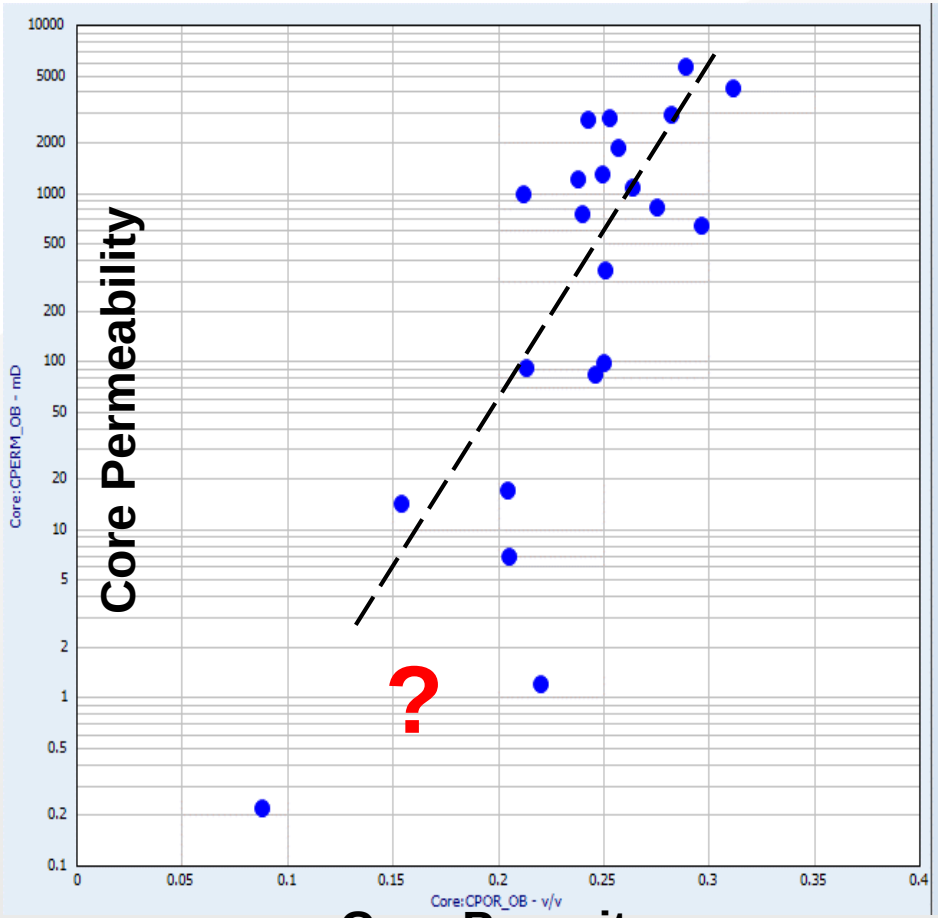
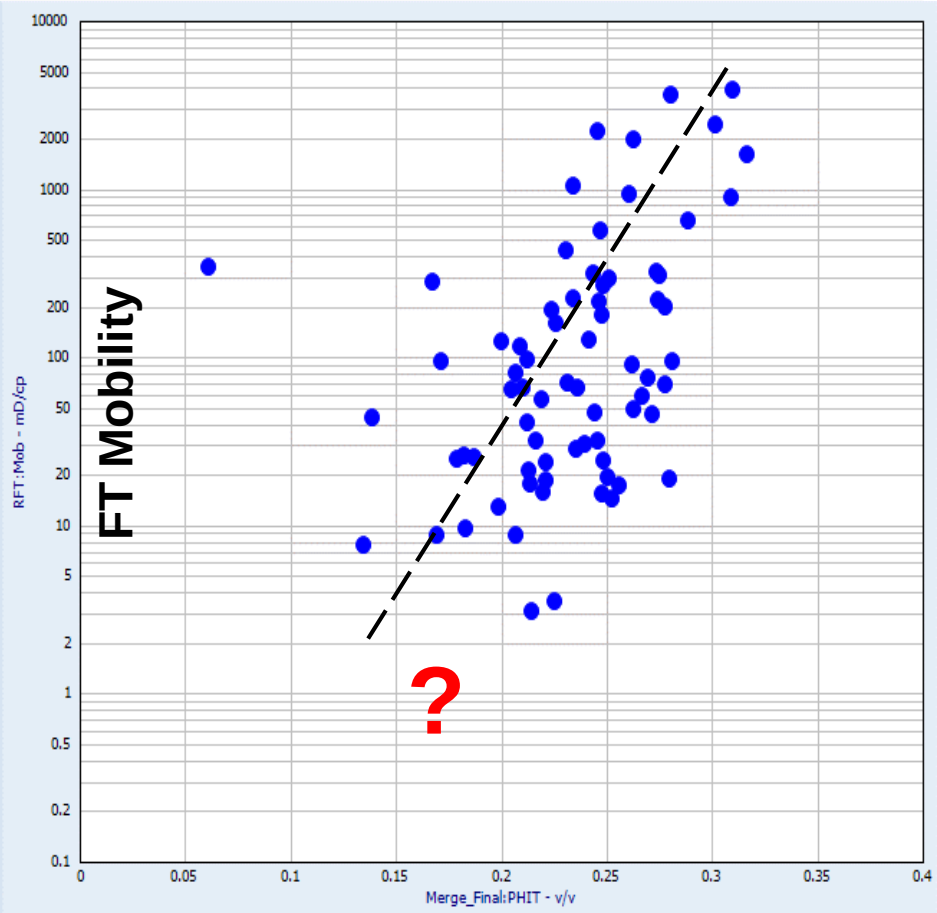
- Core analysis from Rotary SWCs in a single well
- Limited core data
- Multiple reservoirs
- Core indicates a possible Poro-Perm trend
- Draw-Down Mobility from Formation Tester
- FT mobility shows a similar trend to core analysis

Core Data



Core Porosity

FT Data



Log Porosity

Core Permeability and Draw-Down Mobility

Three Wells

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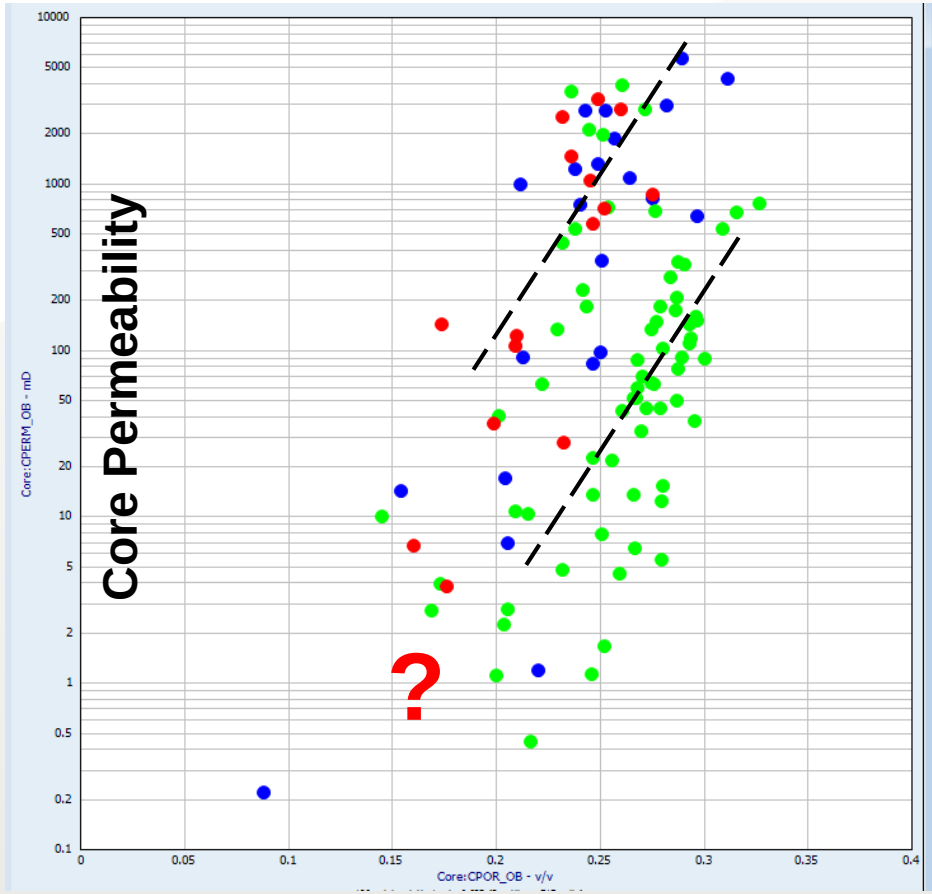
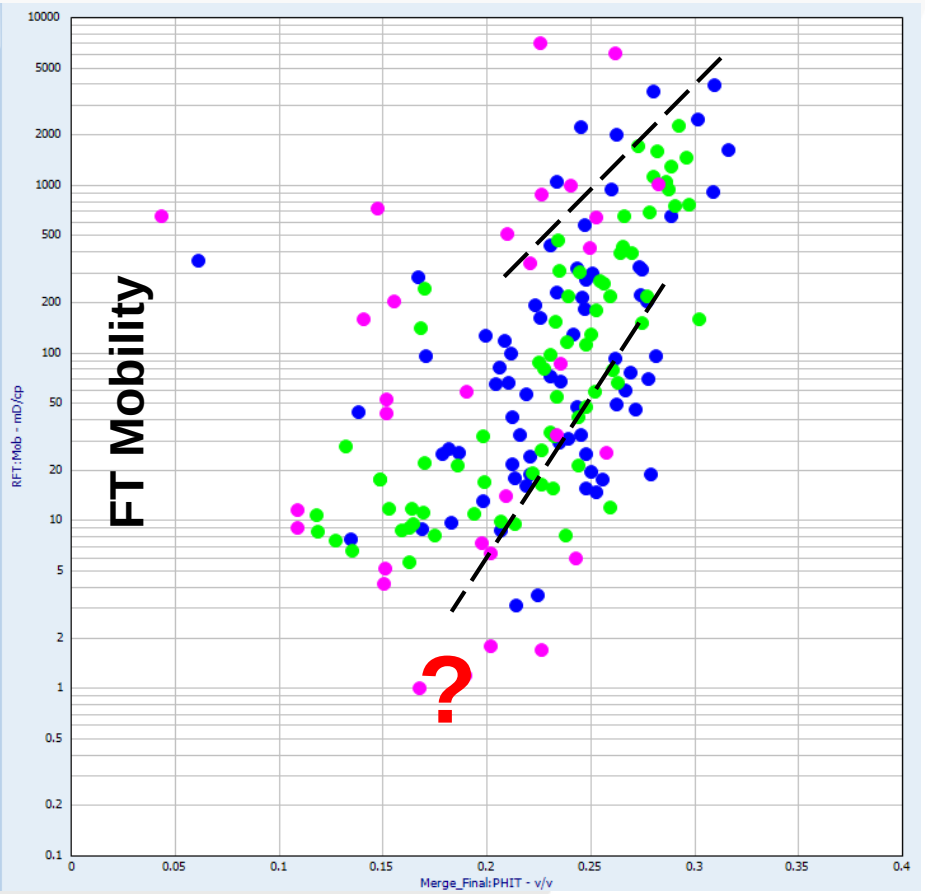
- Core and FT mobility data from three wells
- Z colour axis for well
- Rotary SWCs & conventional core
- Abundant Draw-Down Mobility data from FTs
- Better defined Poro-Perm trends using multiple well data
- Draw-Down Mobility and core shows similar trends

Core Data



Core Porosity

FT Data



Log Porosity

Core Permeability and Draw-Down Mobility

Three Wells and VSH

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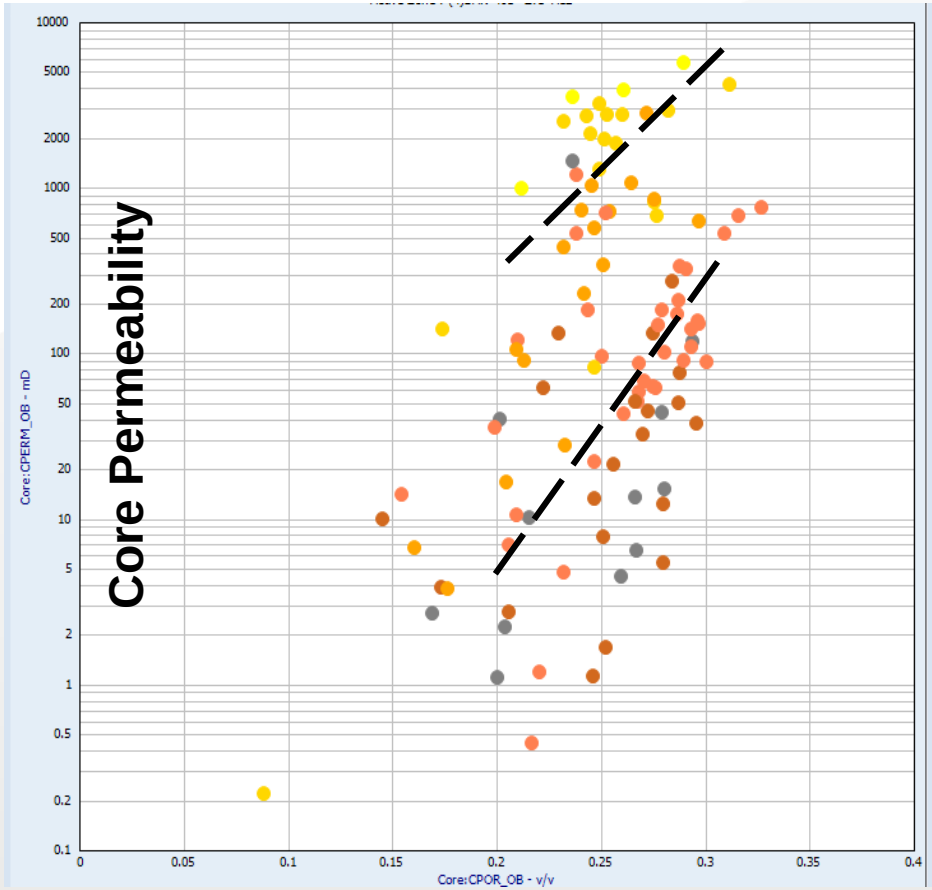
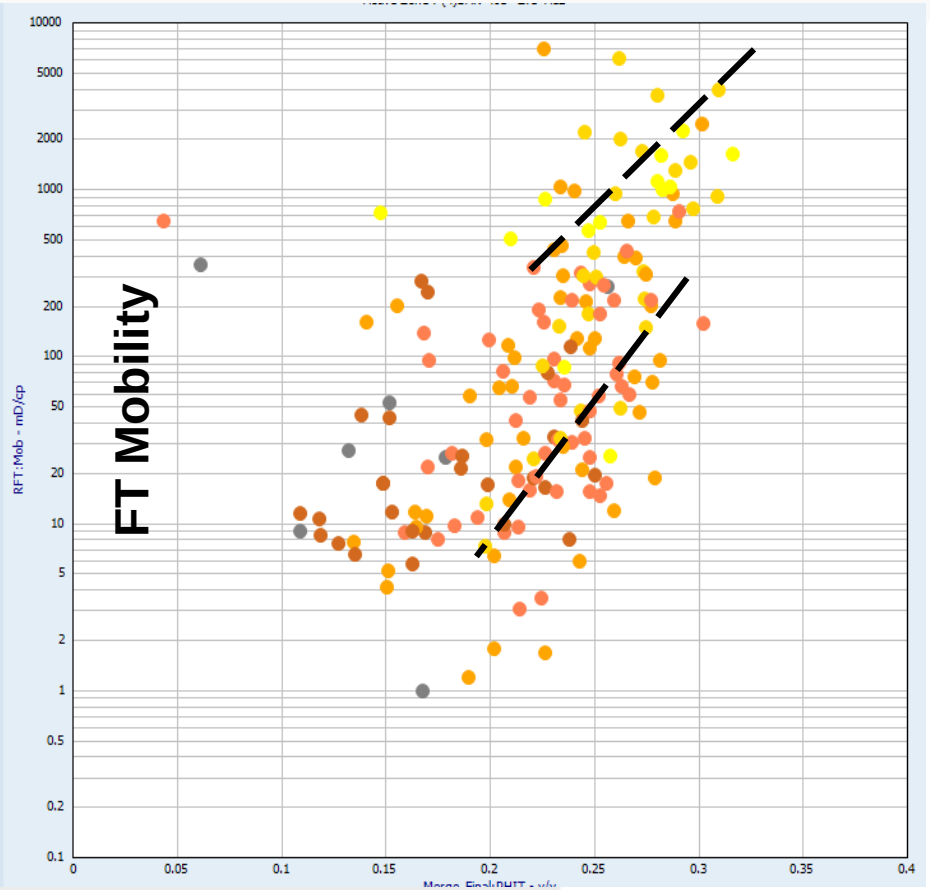
- Z axis colour is VSH
- Lighter points are cleaner & darker points are shalier
- Draw-Down Mobility and core shows similar trends
- Draw-Down mobility seems to be a reasonable proxy for permeability
- Check and calibrate against other methods such as Core, Well Test, NMR

Core Data

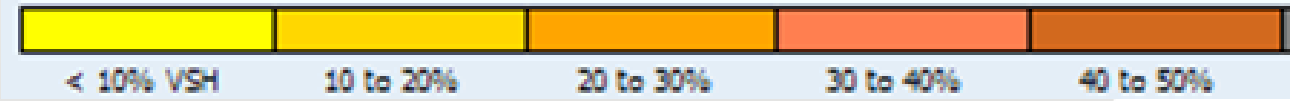


Core Porosity

FT Data



Log Porosity



PRESSURE INTERPRETATION USING DRAW-DOWN MOBILITY

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Formation Tester Pressure Interpretation – High Perm. Reservoir

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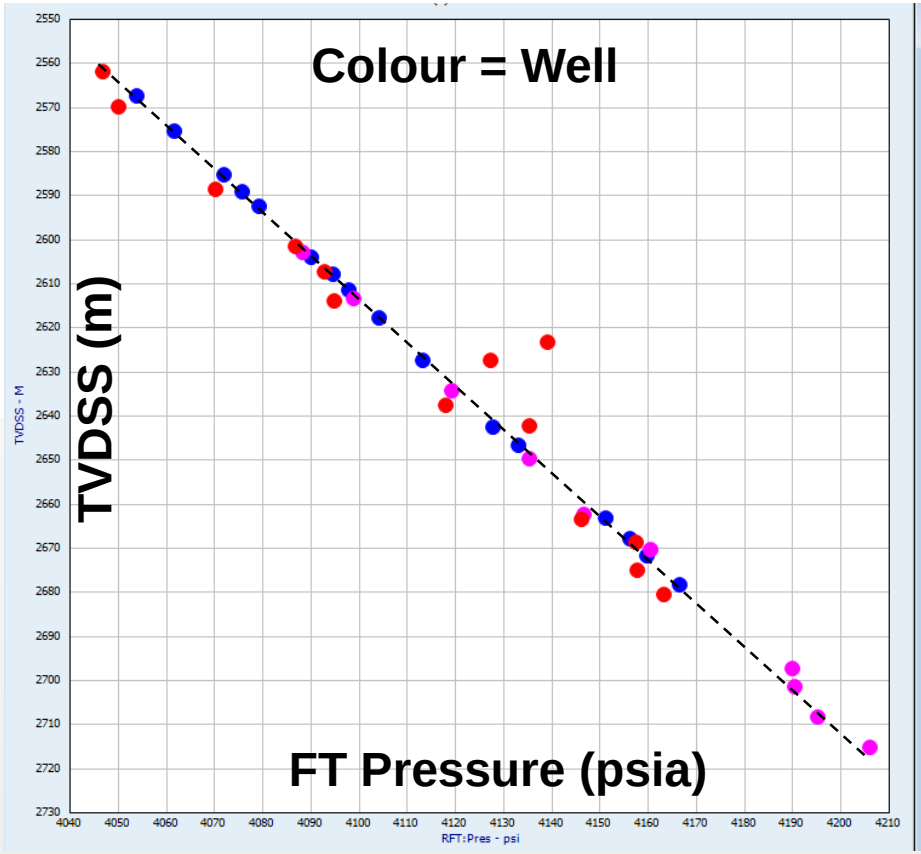
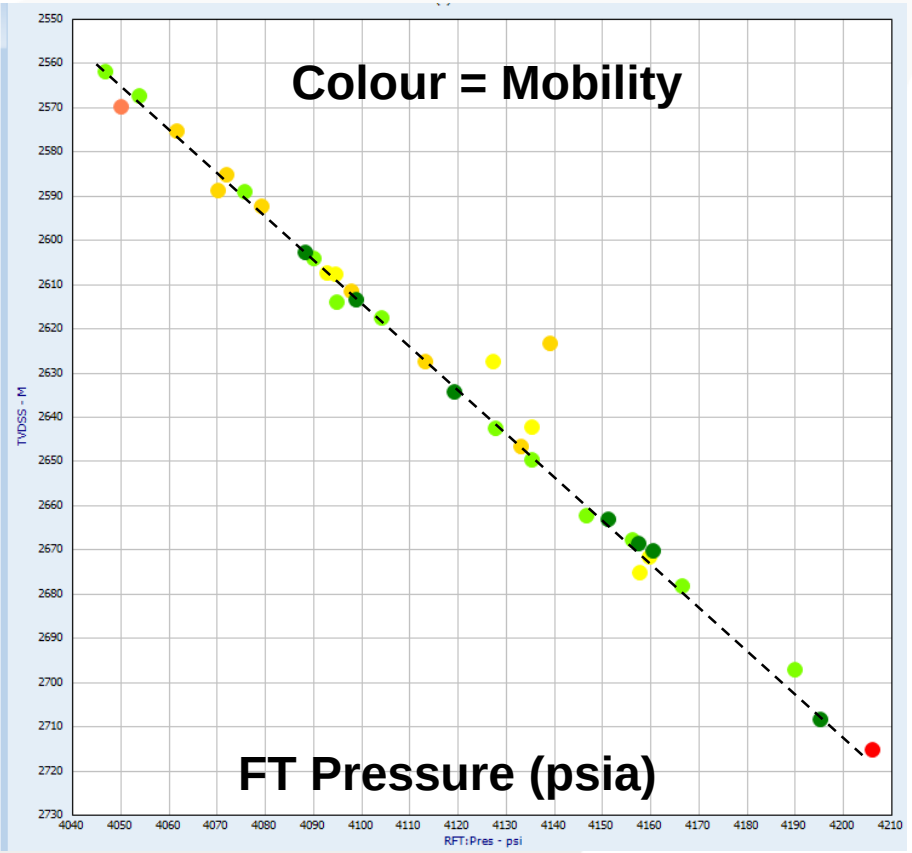
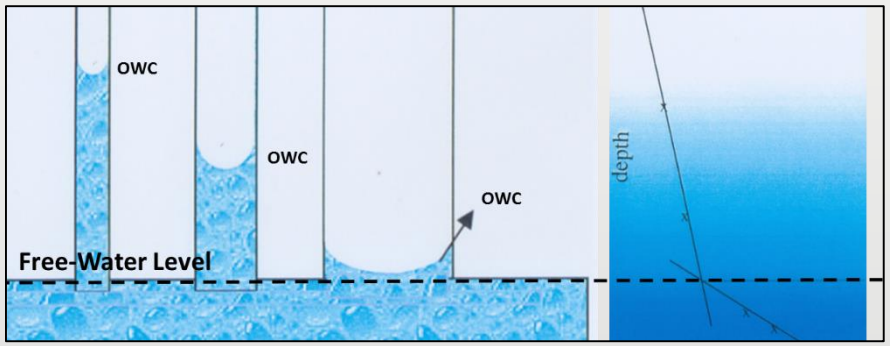
- FT Pressures plotted against TVDSS depth
- Pressure gradients related to fluid type
- Intersection of hydrocarbon and water gradients identify the Free-Water Level
- Pressure gradient and positioning on FT points should be:
  - Guided by pretests with higher mobility and more reliable pressure data
  - Consistent with fluid PVT properties and water salinity







Min Value	Max Value	Color
0	5	
5	10	
10	50	
50	100	
100	500	
500	1000	

Formation Tester Pressure Interpretation – Lower Perm Reservoir

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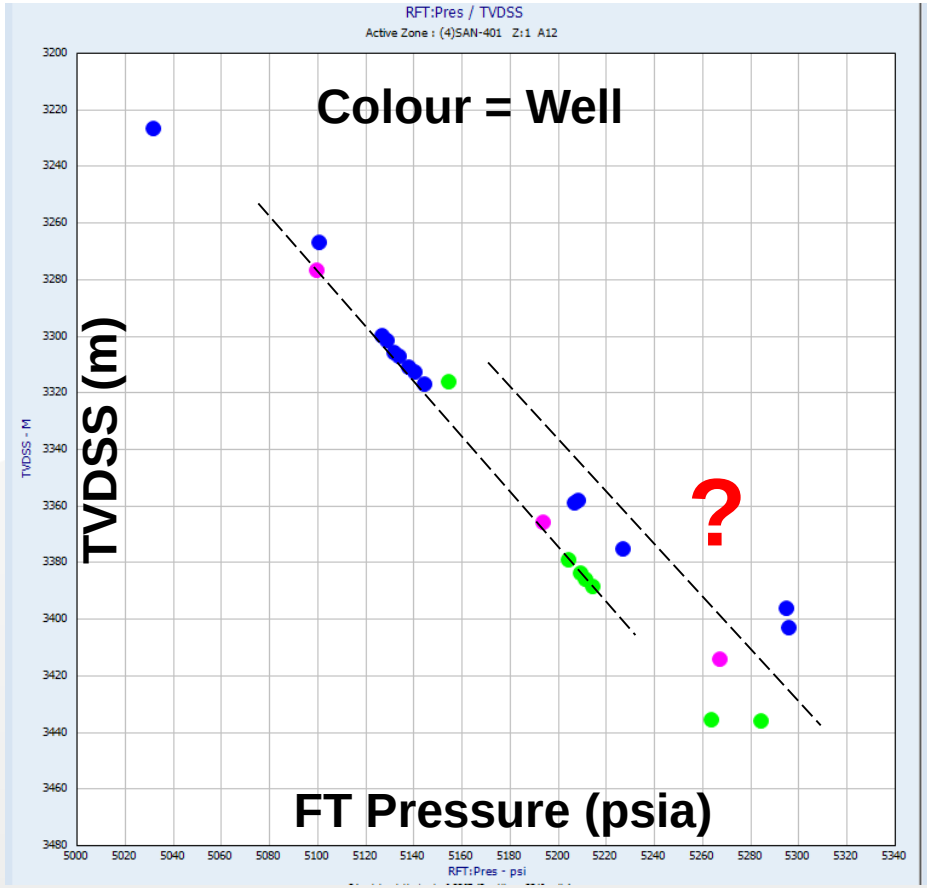
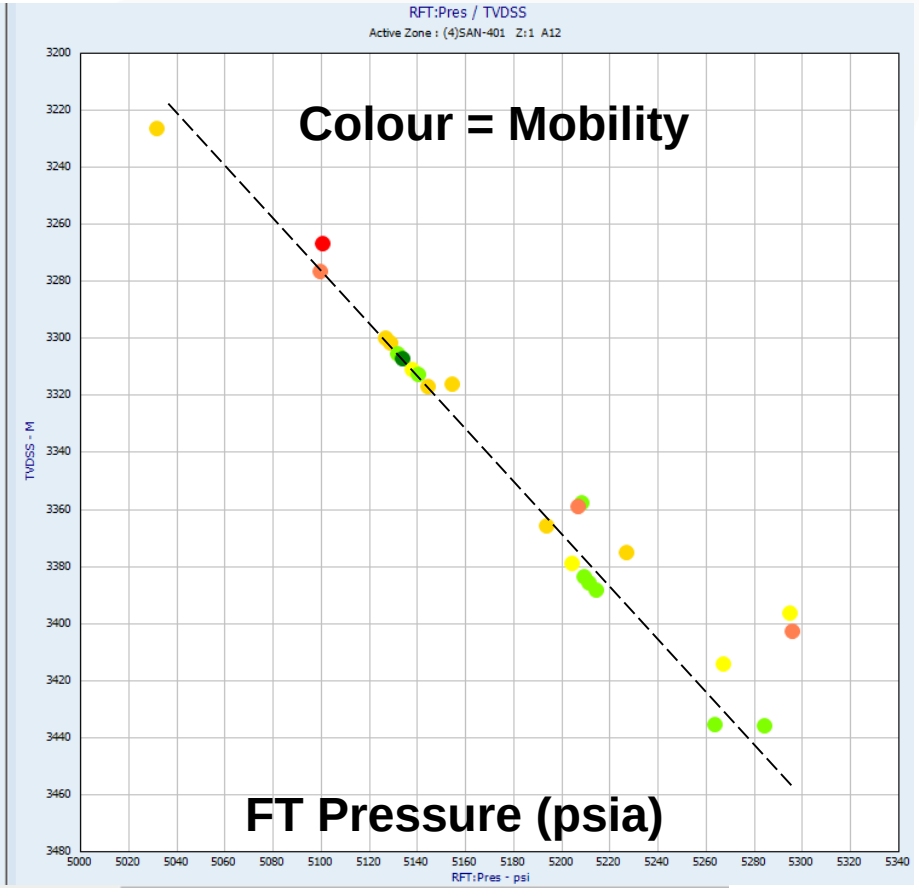
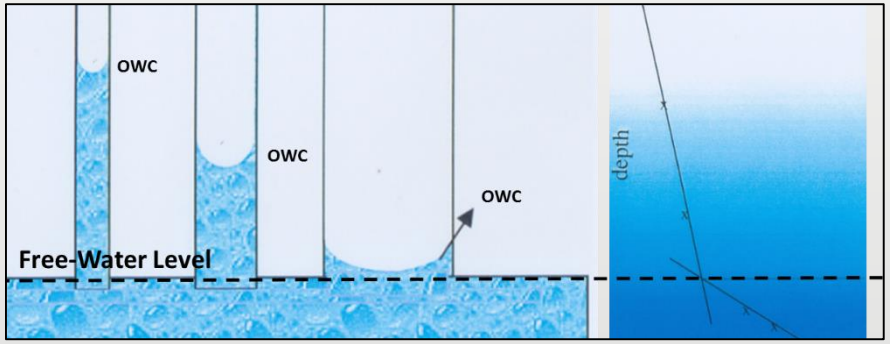
- In lower quality reservoirs the pressure data may be more difficult to interpret:
  - Insufficient build-up stabilisation time
  - Super-charging of the formation
  - Fewer valid FT points
- Pressure gradient and positioning on FT points should be:
  - Guided by pretests with higher mobility and more reliable pressure data
  - Consistent with fluid PVT properties and water salinity







Min Value	Max Value	Color
0	5	
5	10	
10	50	
50	100	
100	500	
500	1000	

PRETEST ACQUISITION & QUALITY CONTROL

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Pretest Quality Control

Older generation FT tools:

- Fixed DD volume and rate

Newer generation FT tools:

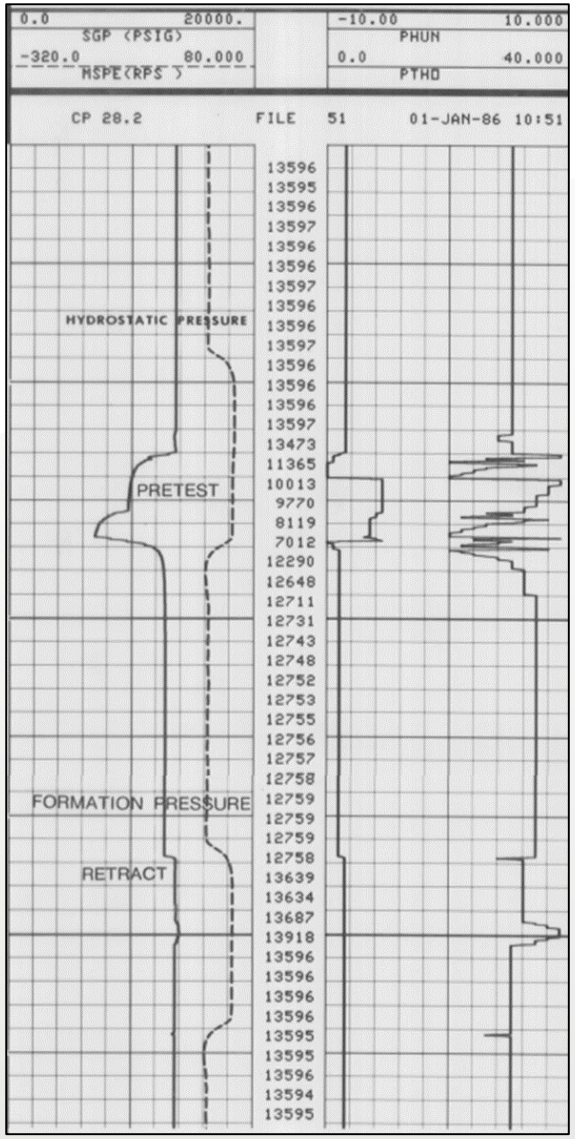
- Allow multiple Draw-Downs with each Pretest
- Control of volume and rate

- Small pretest volumes:
  - Less drawdown
  - Faster buildup & stabilization

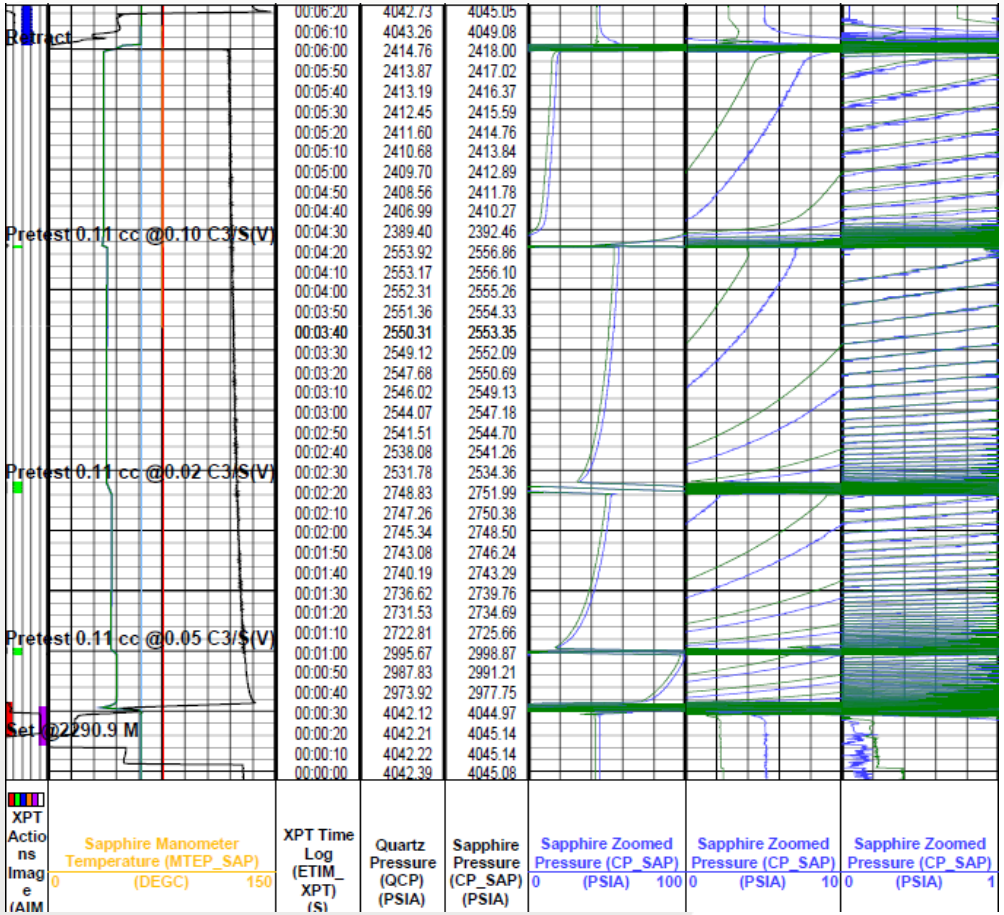
- Improved acquisition of valid pressure data in low perm formations

- Quicker surveys with better results due to more control on volume and rate

Pretest Size



2 X 10cc pretest



3 X 0.11 cc pretest

Pretest Quality Control

- Poor buildup may be due to:
  - Poor reservoir quality
  - Failure to communicate with formation through mudcake

- Select a sufficient <u>initial</u> drawdown volume to ensure pressure communication is established with the formation:
  - 1cc to 2cc in low perm
  - 3cc to 7cc in high perm

- Drawdown rate is less sensitive:
  - 0.1 to 0.2 cc/sec in low perm
  - 0.5 to 1.0 cc/sec in high perm

- Volumes and rates are a guide and will depend on the formation, field engineer and local experience

Pretest Size

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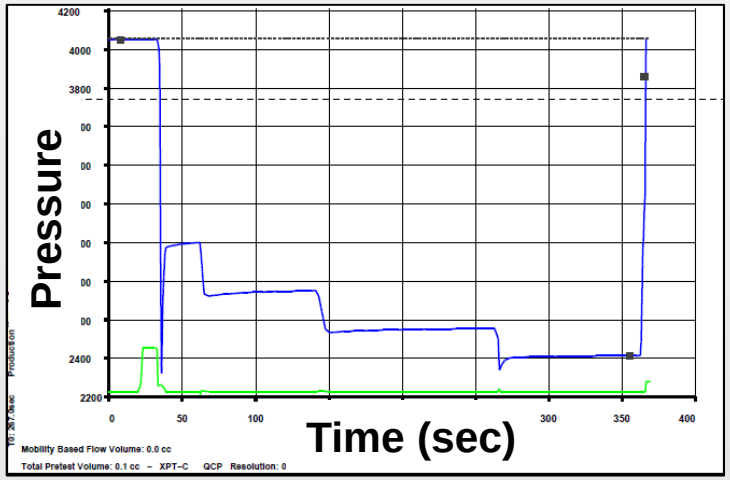
Depth (m)	TVDSS (m)	Pressure Before (psia)	Formation Pressure (psia)	Pressure After (psia)	Mobility (mD)	Temperature (degC)	Pretest Type	Remark
2503	2491.65	4418.64	4154.02	4418.73	0.3	81.14	Normal	0.3 cc @ 0.02 cc/s + 0.2 cc @ 0.02 cc/s
2441	2429.65	4308.77		4308.82		75.18	Dry	0.5 cc @ 0.02 cc/s + 0.3 cc @ 0.02 cc/s
2421.5	2410.15	4274.47		4274.88	0.2	76.61	Dry	0.3 cc @0.02 cc/s + 0.1 cc @ 0.02 cc/s
2398.75	2387.4	4234.34		4234.25		76.81	Dry	0.1 cc @ 0.02 cc/s + 0.1 cc @ 0.02 cc/s
2382.5	2371.15	4205.21		4205.55	0.06	77.39	Dry	0.2 cc @ 0.02 cc/s + 0.2 cc @ 0.02 cc/s
2357.5	2346.15	4161.03		4160.97	0.2	77.362	Dry	0.1 cc @ 0.01 cc/s + 0.5 cc @ 0.05 cc/s
2334	2322.65	4119.26		4119.15	0.07	77.2	Dry	0.1 cc @ 0.01 cc/s + 0.5 cc @ 0.02 cc/s
2326	2314.65	4105.01		4104.94	0.4	76.94	Dry	0.1 cc @ 0.01 cc/s +0.2 cc @ 0.1 cc/s
2317.5	2306.15	4089.83		4089.71		76.47	Dry	0.1 cc @ 0.1 cc/s + 0.1 cc @ 0.1 cc/s
2301.5	2290.15	4061.21		4062.05	0.1	75.77	Dry	0.3 cc @ 0.05 cc/s +0.3 cc @ 0.05 cc/s
2295.5	2284.15	4050.45		4051.26	0.3	75.57	Dry	0.22 cc@ 0.05cc/s + 0.11 cc @ 0.1 cc/s + 0.2 cc
2290.9	2279.55	4042.22		3853.55	0.5	75.209	dry	0.11 cc @ 0.05 cc/s + 0.11 cc @ 0.02 cc/s + 0.11
2272.5	2261.15	4009.24		4009.77	0.8	74.89	Dry	0.11 cc @ 0.05 cc/s + 0.11 cc @ 0.05 cc/s
2265.5	2254.15	3996.84						
2261	2249.65	3988.8						
2255.75	2244.4	3979.4						
2250	2238.65	3968.98						
2243.5	2232.15	3957.55						
2194.5	2183.15	3870.23						

0.1 cc @ 0.01 cc/s +0.2 cc @ 0.1 cc/s

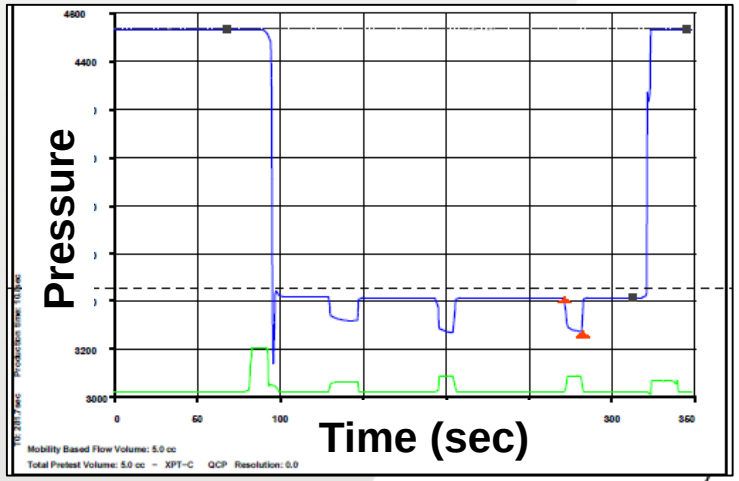
0.1 cc @ 0.1 cc/s + 0.1 cc @ 0.1 cc/s

0.3 cc @ 0.05 cc/s +0.3 cc @ 0.05 cc/s

0.22 cc@ 0.05cc/s + 0.11 cc @ 0.1 cc/s + 0.2 cc



3 X 0.1 cc

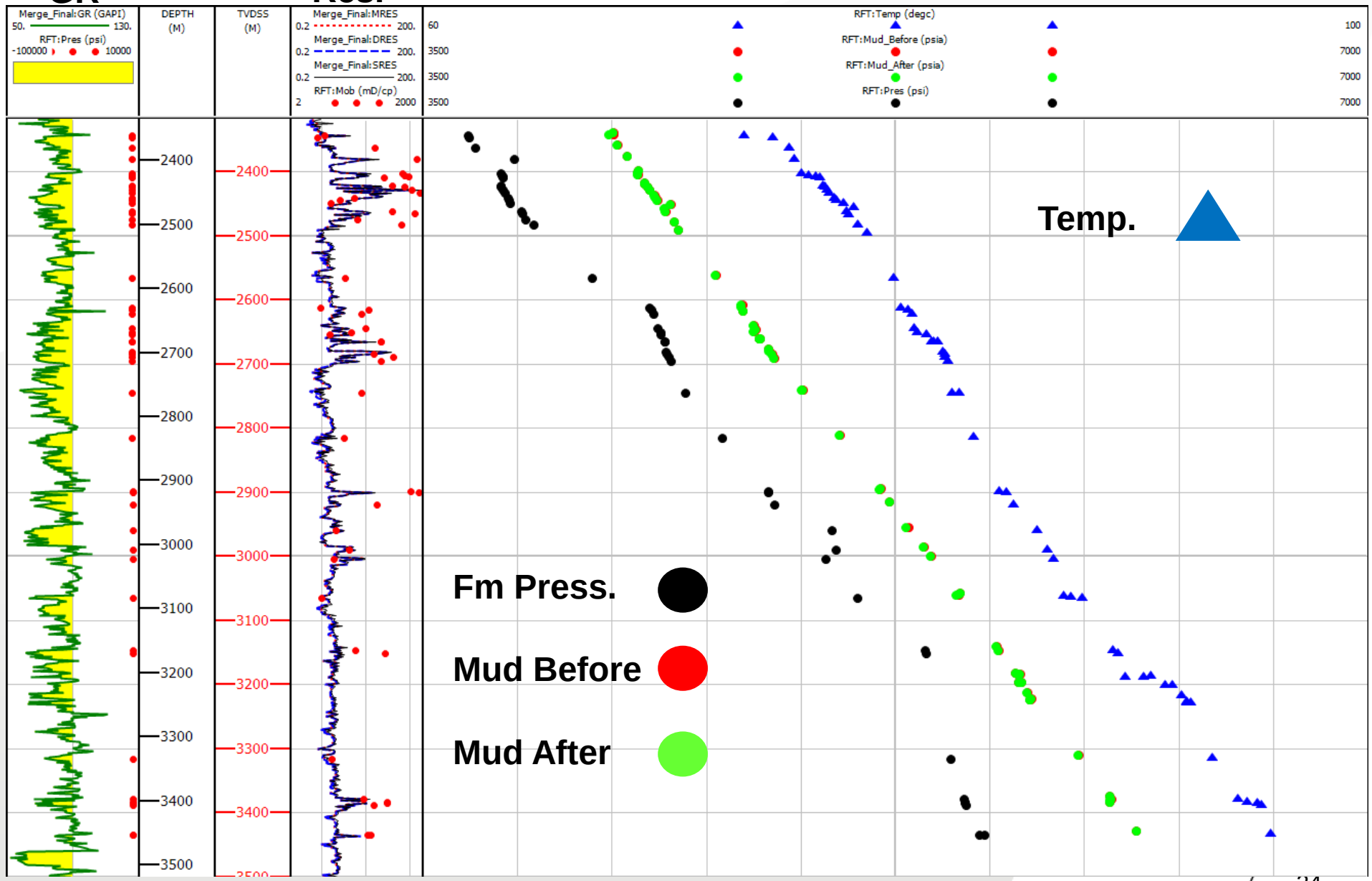


3 X 5.0 cc (Offset Well)

Pretest Quality Control

Mud Hydrostatic Before and After

- Mud hydrostatic pressure
  - Before and After the Pretest
  - Pressure difference may indicate insufficient stabilisation time
- Temperature Profile
  - Geothermal gradient
  - Fluid influx or losses
- Mud Weight Profile
  - Downhole direct measurement of MW
  - Mud quality



Pretest Quality Control

Mud Hydrostatic Before and After

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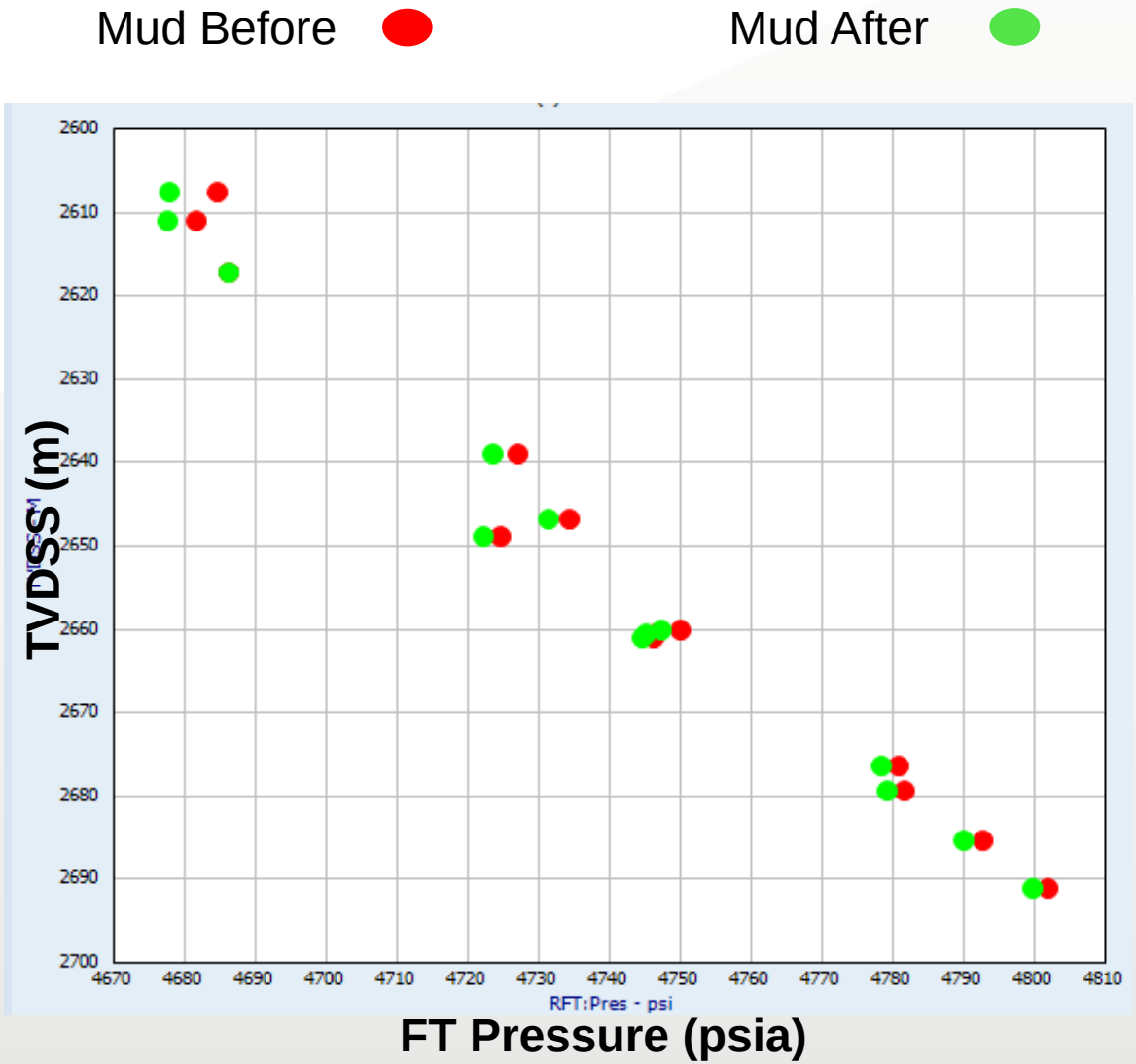
- Mud hydrostatic pressure
  - Before and After the Pretest
  - Pressure difference may indicate insufficient stabilisation time
- Less than 1 or 2 psia is usually good
- More than a few psia may not be good
- Operational Issues
  - Hole conditions
  - Time available
  - FT conveyance
  - Wireline or Drillpipe
  - FT objectives



MUD HYDRO BEFORE (psia)	MUD HYDRO AFTER (psia)	MUD Delta PSI -5 to +5 (Psia)
4684.6	4677.9	6.7
4684.6	4677.9	6.7
4681.5	4677.7	3.8
4681.5	4677.7	3.8
4686.2	4683.2	3.1
4686.2	4686.2	0.1
4727.0	4723.6	3.4
4727.0	4723.6	3.4
4734.4	4731.3	3.1
4734.4	4731.3	3.1
4724.5	4722.2	2.3
4724.5	4722.2	2.3
4750.0	4747.3	2.7
4750.0	4747.3	2.7
4746.5	4745.1	1.3
4746.2	4744.5	1.7

CONCLUSIONS
QUESTIONS & DISCUSSION

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Conclusions

- Formation Testers
  - Pretest Procedure — Wireline & LWD
  - Pressure Interpretation — Fluid gradients and FWLs
  - Older & Newer Tools — Pretest volume and Drawdown rate
- Draw-down Mobility — Theory and calculations
- Reservoir Quality — Mobility may be a useful proxy for permeability
- Pressure Interpretation — QC using FT mobility and Mud Before & After
- Pretest Acquisition & QC — Pretest Size and Drawdown Rate in Low and High perm formations

- Many more FT issues: objectives, planning, acquisition, data delivery, interpretation
- Local knowledge and Wireline or LWD field engineer experience
- Operational issues: Packers, probes, gauges, well conditions, depletion, time, cost, priority, log in/out
- Shared responsibility and collaborative effort between many parties
- Field Team (Engineer, Wellsite Geologist, Drillers) Client Office Team, Service Company Team

Questions and Discussion

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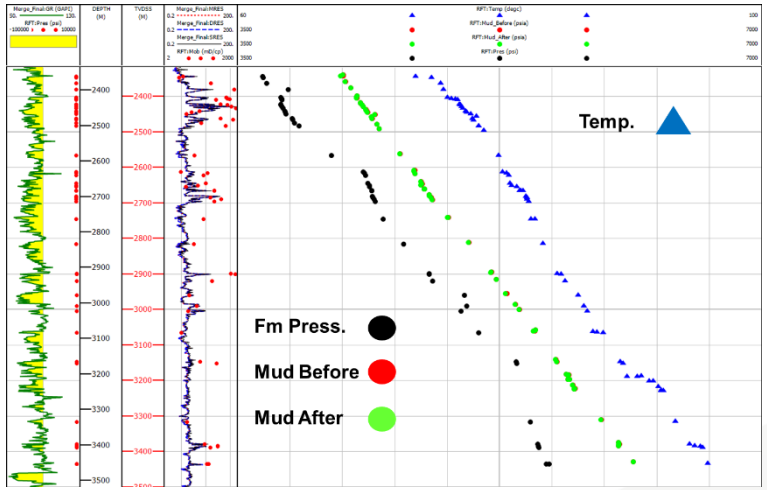
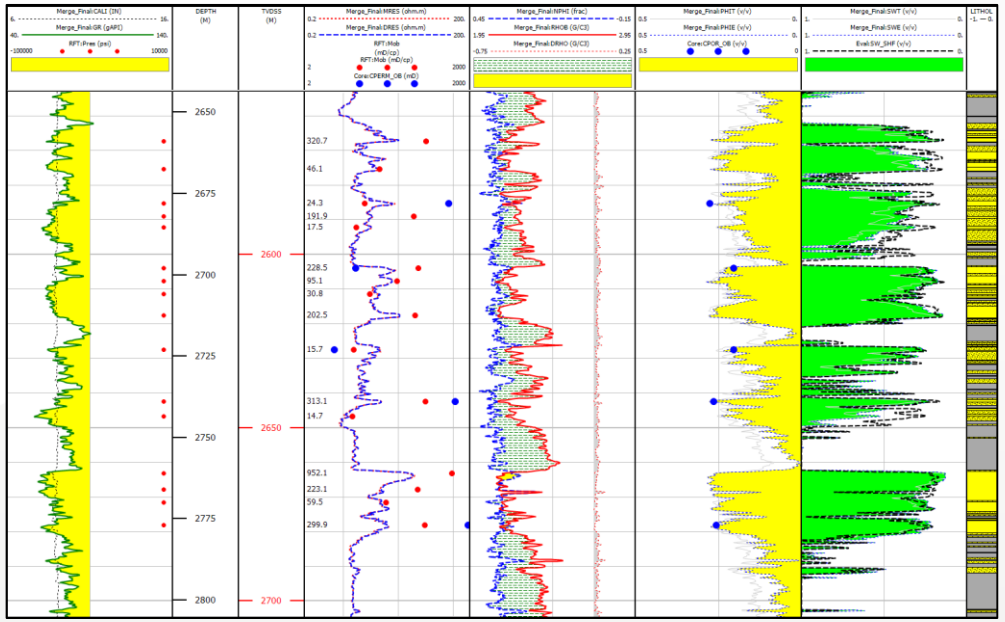
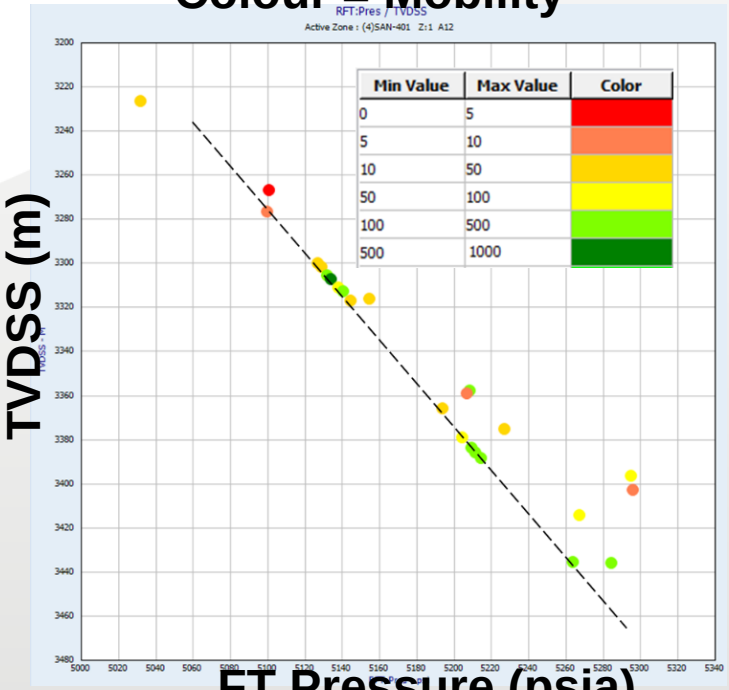
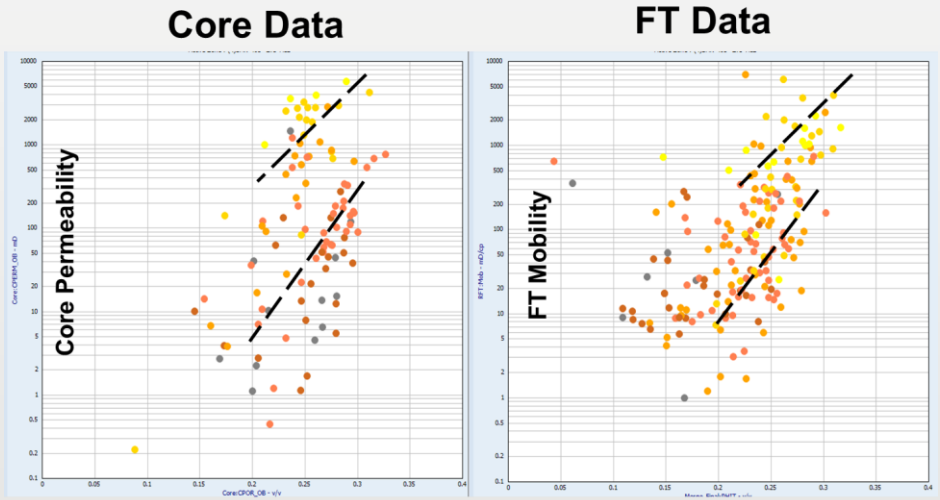


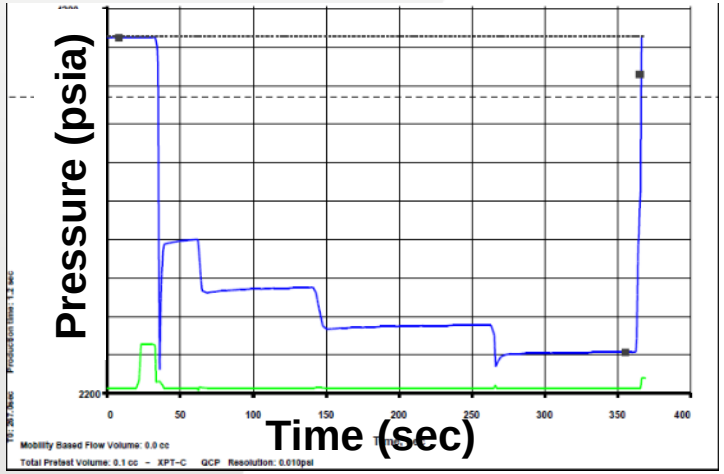


TVD DEPTH (m)	MUD HYDRO BEFORE (psia)	MUD HYDRO AFTER (psia)	MUD Delta PSI -5 to +5 (Psia)
2685.0	4883.9	4883.0	0.9
2690.3	4893.3	4892.9	0.4
2739.0	4981.4	4981.3	0.1
2741.5	4986.5	4985.8	0.7
2752.5	5006.5	5006.3	0.2
2756.6	5014.7	5013.8	0.9
2811.6	5114.1	5113.8	0.3
2817.6	5124.2	5124.2	0.0
2825.4	5139.1	5138.6	0.5
2862.7	5202.8	5203.5	-0.7
2891.1	5258.6	5258.1	0.5
2906.2	5285.7	5285.5	0.2

Colour = Mobility







BACK-UP SLIDES

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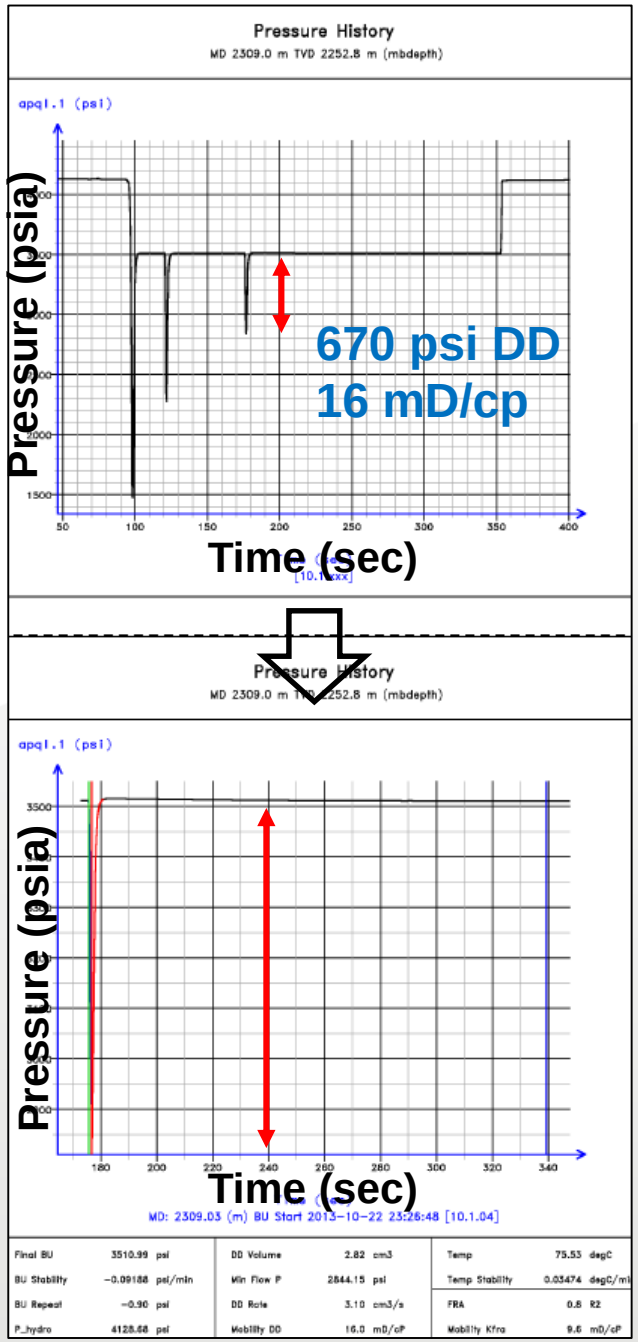
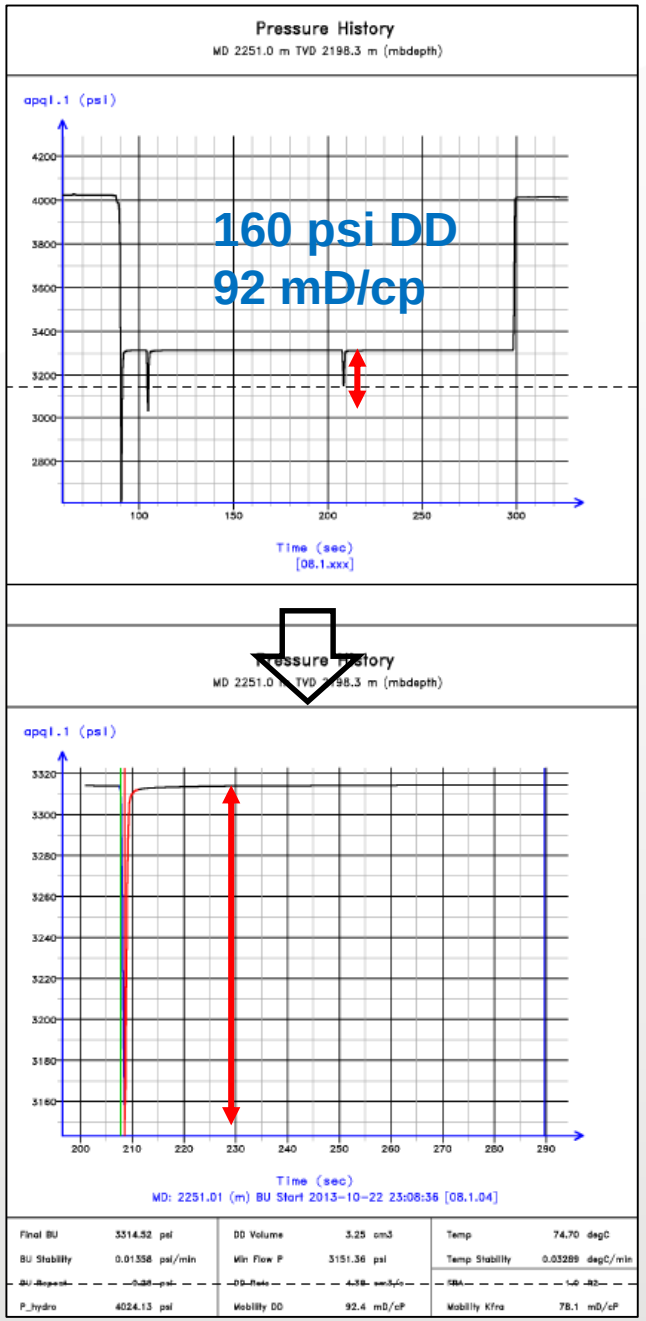
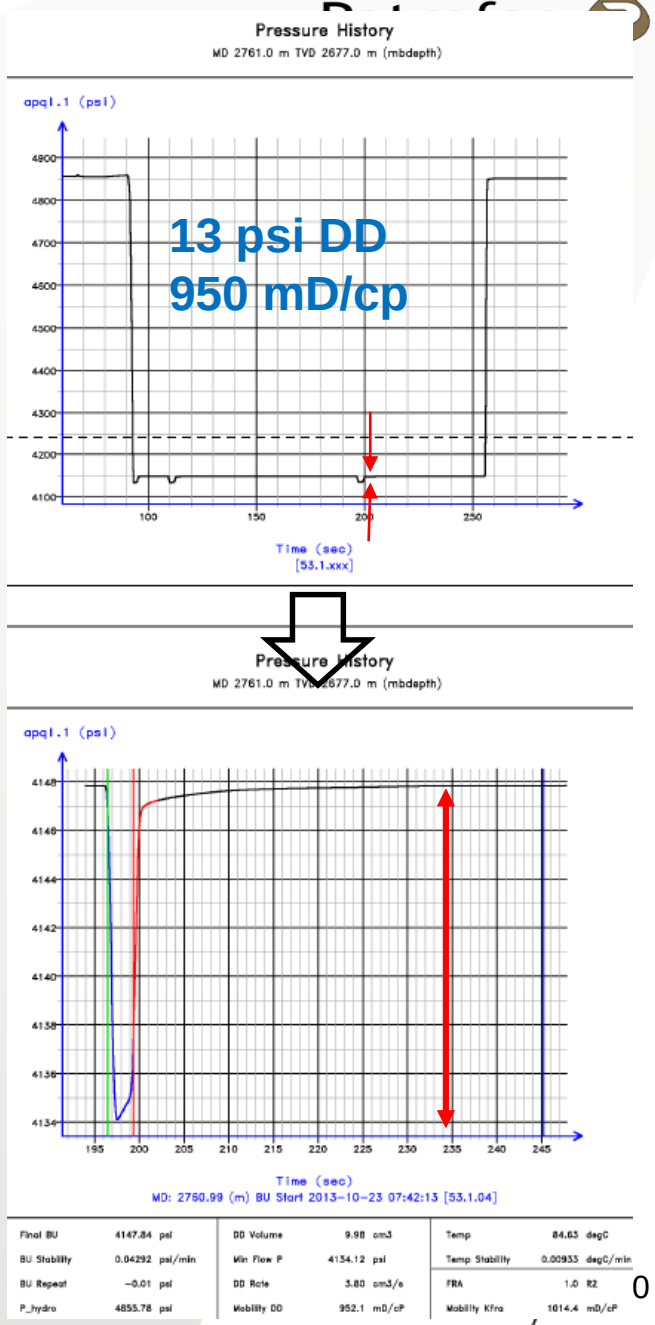
Draw-Down Mobility Reservoir Quality Low – Medium - High

Full Pretest

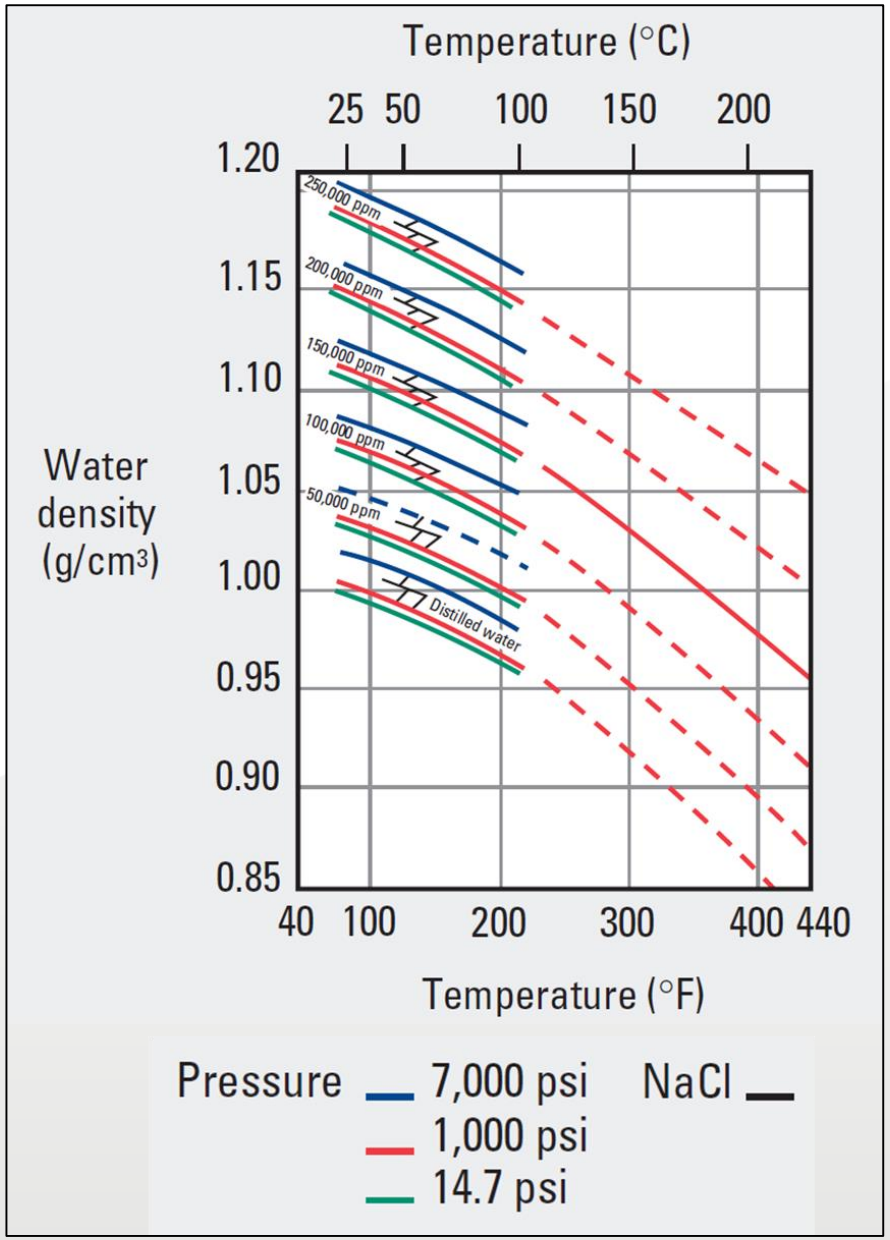
Final Pretest Expanded

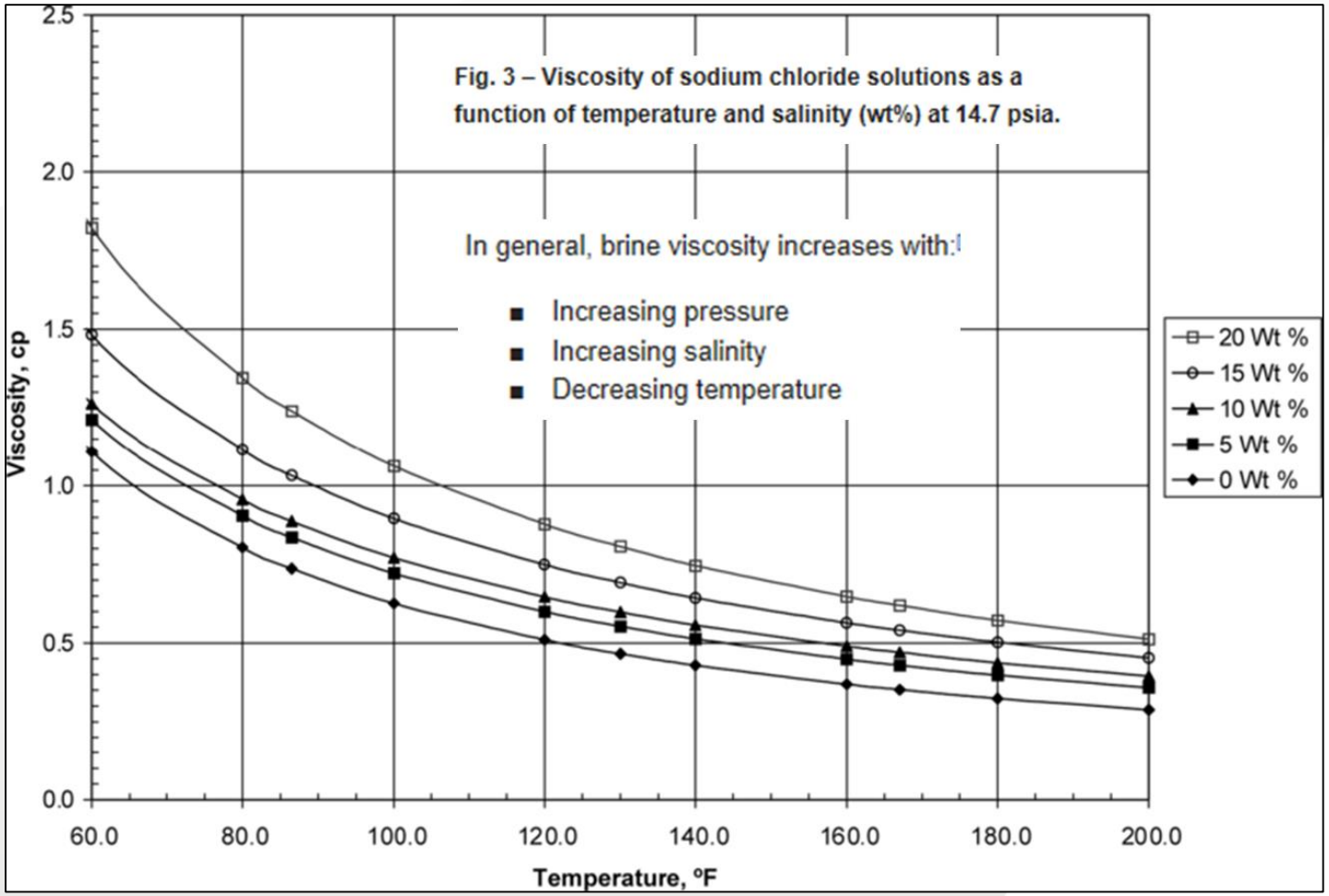






Water Density and Viscosity vs Temperature, Pressure and Salinity





Pressure Conversions

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Pressure or Force per Unit Area

Multiply Number of / to Obtain by	Atmospheres[†]	Bayres or Dynes per Square Centimeter[‡]	Centimeters of Mercury at 0°C[§]	Inches of Mercury at 0°C[§]	Inches of Water at 4°C	Kilograms per Square Meter[††]	Pounds per Square Foot	Pounds per Square Inch[‡‡]	Tons (short) per Square Foot	Pascals
Atmospheres[†]	1	9.869×10^{-7}	1.316×10^{-2}	3.342×10^{-2}	2.458×10^{-3}	9.678×10^{-5}	4.725×10^{-4}	6.804×10^{-2}	0.9450	9.869×10^{-6}
Bayres or dynes per square centimeter[‡]	1.013×10^{6}	1	1.333×10^{4}	3.386×10^{4}	2.491×10^{-3}	98.07	478.8	6.895×10^{4}	9.576×10^{5}	10
Centimeters of mercury at 0°C[§]	76.00	7.501×10^{-5}	1	2.540	0.1868	7.356×10^{-3}	3.591×10^{-2}	5.171	71.83	7.501×10^{-4}
Inches of mercury at 0°C[§]	29.92	2.953×10^{-5}	0.3937	1	7.355×10^{-2}	2.896×10^{-3}	1.414×10^{-2}	2.036	28.28	2.953×10^{-4}
Inches of water at 4°C	406.8	4.015×10^{-4}	5.354	13.60	1	3.937×10^{-2}	0.1922	27.68	384.5	4.015×10^{-3}
Kilograms per square meter[††]	1.033×10^{4}	1.020×10^{-2}	136.0	345.3	25.40	1	4.882	703.1	9765	0.1020
Pounds per square foot	2117	2.089×10^{-3}	27.85	70.73	5.204	0.2048	1	144	2000	2.089×10^{-2}
Pounds per square inch[‡‡]	14.70	1.450×10^{-5}	0.1934	0.4912	3.613×10^{-2}	1.422×10^{-3}	6.944×10^{-3}	1	13.89	1.450×10^{-4}
Tons (short) per square foot	1.058	1.044×10^{-5}	1.392×10^{-2}	3.536×10^{-2}	2.601×10^{-3}	1.024×10^{-4}	0.0005	0.072	1	1.044×10^{-5}
Pascals	1.013×10^{5}	10^{-1}	1.333×10^{3}	3.386×10^{3}	2.491×10^{-4}	9.807	47.88	6.895×10^{3}	9.576×10^{4}	1

[†] One atmosphere (standard) = 76 cm of mercury at 0°C

[‡] Bar

[§] To convert height h of a column of mercury at t°C to the equivalent height h_0 at 0°C, use $h_0 = h\{1 - [(m - l)\, t / 1 + mt]\}$, where $m = 0.0001818$ and $l = 18.4 \times 10^{-6}$ if the scale is engraved on brass; $l = 8.5 \times 10^{-6}$ if on glass. This assumes the scale is correct at 0°C; for other cases (any liquid) see *International Critical Tables*, Vol. 1, 68.

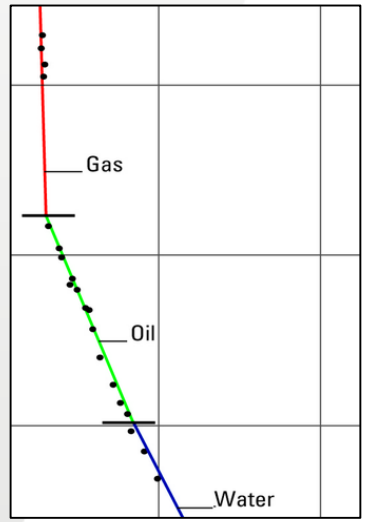
[††] 1 gram per square centimeter = 10 kilograms per square meter

[‡‡] psi = MPa × 145.038
psi/ft = 0.433 × g/cm³ = lbf/ft³/144 = lbf/gal/19.27

Density or Mass per Unit Volume

Multiply Number of / to Obtain by	Grams per Cubic Centimeter	Kilograms per Cubic Meter	Pounds per Cubic Foot	Pounds per Cubic Inch	Pounds per Gallon
Grams per cubic centimeter	1	0.001	1.602×10^{-2}	27.68	0.1198
Kilograms per cubic meter	1000	1	16.02	2.768×10^{4}	119.8
Pounds per cubic foot	62.43	6.243×10^{-2}	1	1728	7.479
Pounds per cubic inch	3.613×10^{-2}	3.613×10^{-5}	5.787×10^{-4}	1	4.329×10^{-3}
Pounds per gallon	8.347	8.3×10^{-3}	13.37×10^{-2}	231.0	1

Temperature	
°F	1.8°C + 32
°C	⅝ (°F – 32)
°R	°F + 459.69
K	°C + 273.16



FT Packers and Probes

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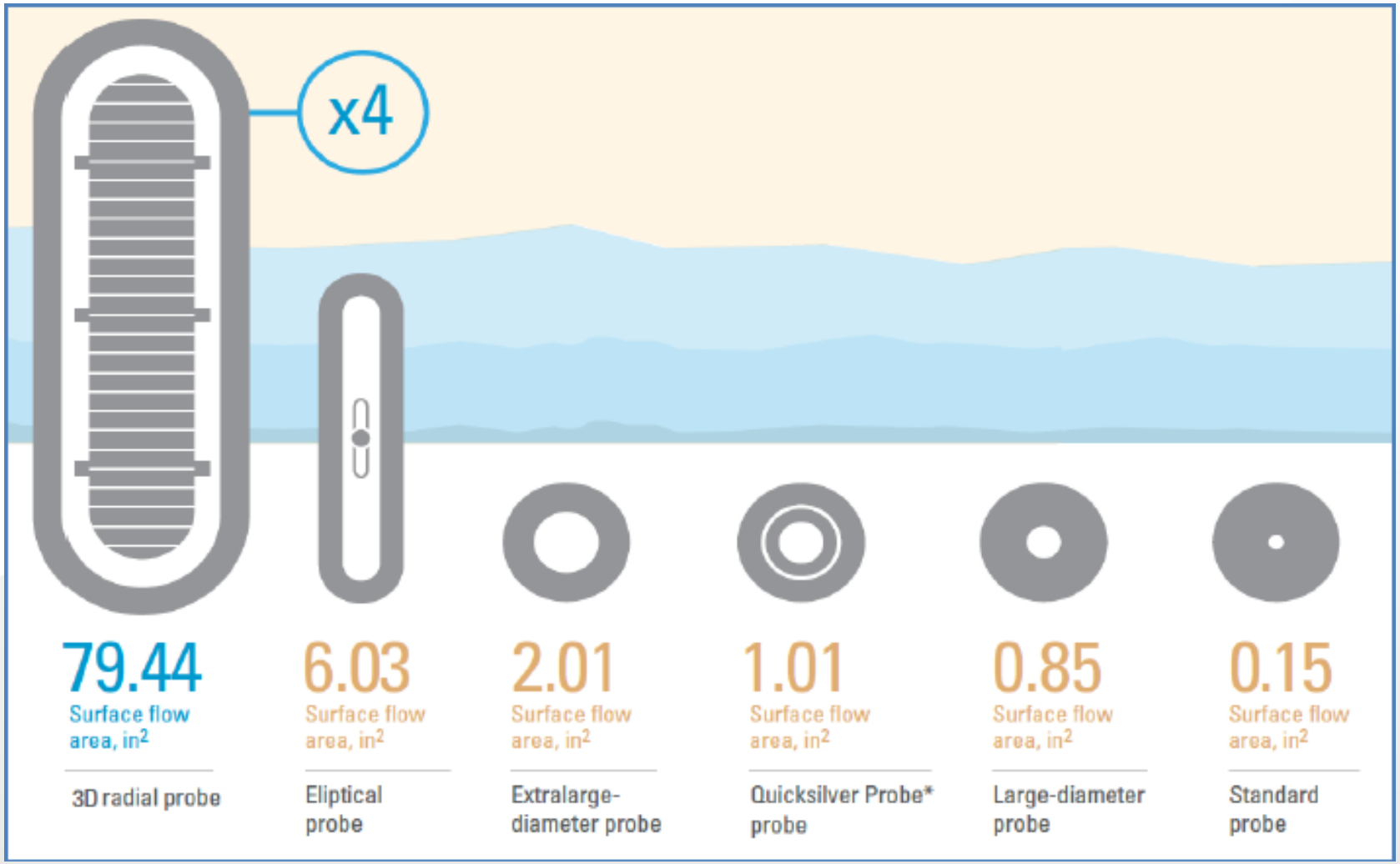

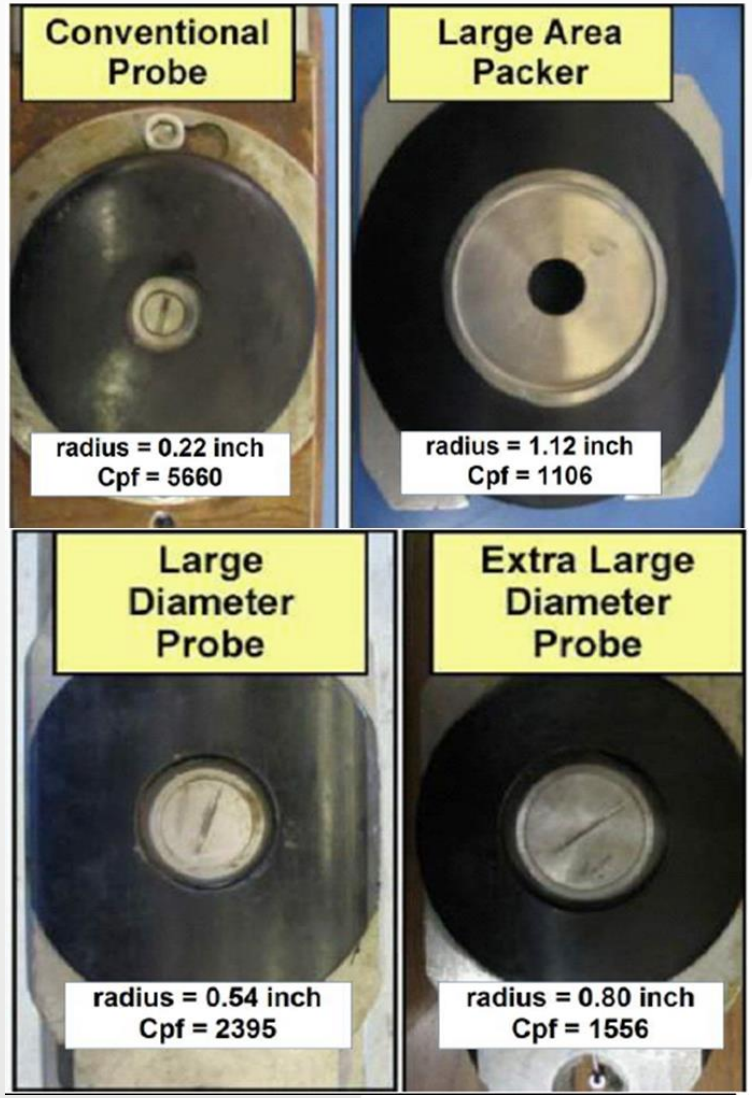

Petrofac Engineering Consultancy

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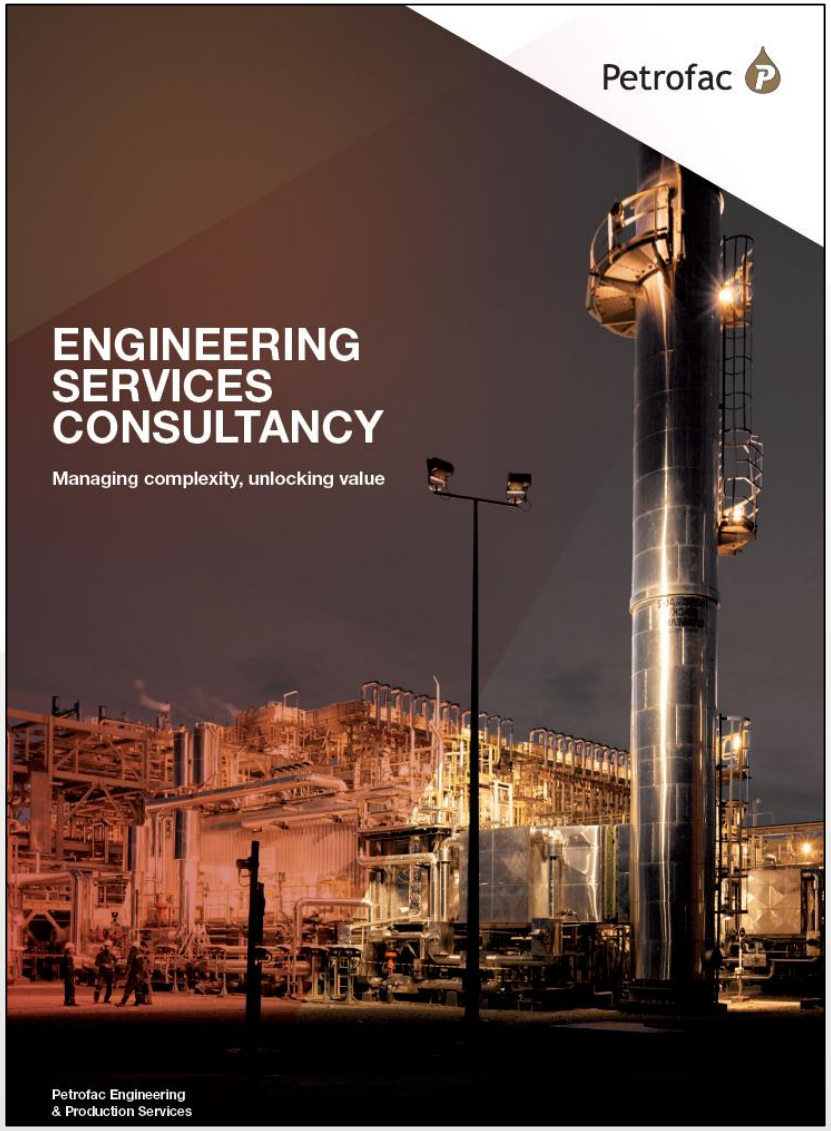
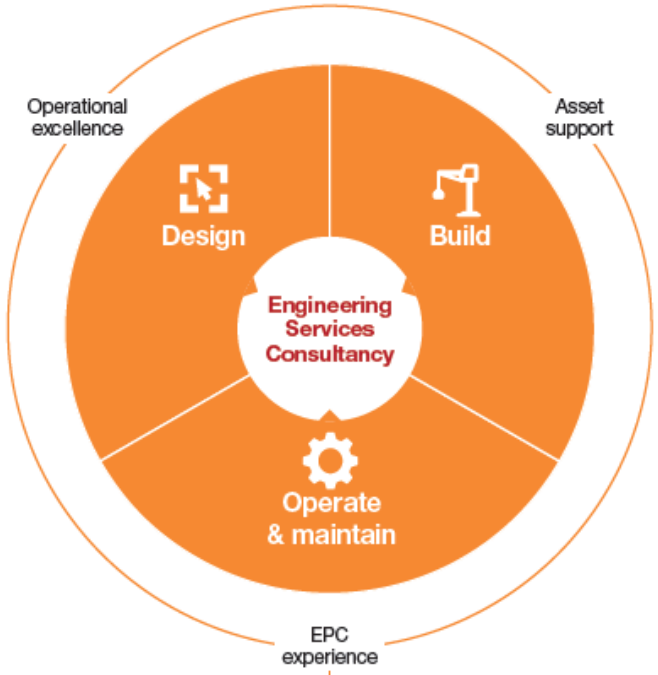


Petrofac is an international service provider to the oil and gas industry. We have been supporting the industry for over three decades. More than 13,500 people assist our operations in 29 countries worldwide.

Our consultancy offering within Engineering Services supports clients in unlocking value from their assets through the provision of life cycle engineering support.

We tailor our solutions to deliver a truly differentiated outcome:

- **Life of asset services, from pre-investment analysis to late life**
- **Broad technical capability, including subsurface and surface expertise**
- **Intelligent solutions that leverage the strength of Petrofac Group capabilities**
- **Responsive and flexible team that combines an innovative approach with practical knowledge of execution**
- **Cost and planning deliverables enhanced by real time operations and construction data sharing**



We combine the nimbleness and flexibility associated with a consultancy business with the strength and depth of a FTSE 250 company with a track record spanning more than 200 EPC projects and an operating capability and know-how.

Our engineering services consultancy complements our wider engineering capability, enabling us to deliver expert analysis and assurance for developments onshore, offshore and subsea.

We deliver these services on a standalone basis or as part of our wider service delivery, seamlessly integrating with capabilities from the wider Petrofac Group.

Our clients include independent oil companies (IOCs), national oil companies (NOCs), technology developers, construction companies, Government bodies and public sector institutions.

Our services encompass:

- **Advisory services** – surface and subsurface expertise supporting new and existing assets, mergers and acquisitions
- **Field development planning** – feasibility, concept and pre-front end engineering design (FEED)
- **Asset/facilities support**
- **Late life asset management** – asset-led support services
- **Process technology**
- **Renewable energy** – offshore wind (fixed and floating)

Petrofac Engineering Consultancy

Petrofac

Technical assurance

Our ability to deliver across the value chain and to draw on a wide breadth of technical resources means we can deliver intelligent solutions that benefit from synergies within the Petrofac Group. We have a reputation for providing pragmatic and measured advice and have developed 'trusted advisor' status with our clients.

Our capability includes:

- Reservoir characterisation/geological modelling and reservoir simulation
- Operations support and production technology and chemistry
- Well engineering (including plugging and abandonment)
- Dynamic simulation and transient analysis
- Computational flow dynamics
- Vibration analysis
- Acoustic engineering
- Flow assurance
- Safety and environmental assessment, compliance and engineering
- Process and facilities design
- Subsea and pipeline engineering
- Advanced structural analysis
- Asset integrity assurance
- Asset management
- Cost estimating and planning

Advisory services

By integrating our technical capability, which spans both subsurface and surface domains, with the resources and know-how of the wider Petrofac Group, we provide a vital link between strategic level decisions and front line implementation. Our subsurface and surface expertise is also central to our modelling expertise, allowing us to deliver high-quality planning and forecasting.

Our subsurface skills span geoscience, petroleum engineering, production and well engineering. We use this expertise to identify uncertainties associated with oil and gas reservoirs and perform valuable analysis much earlier than traditional approaches. This front-end loading enables us to unlock significant benefits such as managing risk and reducing costs further down the line.

Field development planning

We have been delivering field development services for over 15 years and our project history spans onshore, offshore and subsea developments. This includes assets where a combination of onshore and offshore facilities and pipelines are required and those in challenging or remote environments.

The breadth of our experience means we are fully equipped to manage the challenges that can emerge during this early planning. Our study managers are experienced in identifying the key issues and developing the right solution. Their expertise covers reservoir, well engineering, facilities, pipelines and refining.

We manage the whole field development process, developing options suitable for further screening and detailing. Our solutions are enhanced by an ability to cost benchmark against data held by our construction and operations services. We use this data to inform our decisions.

FT Pretest Drawdown

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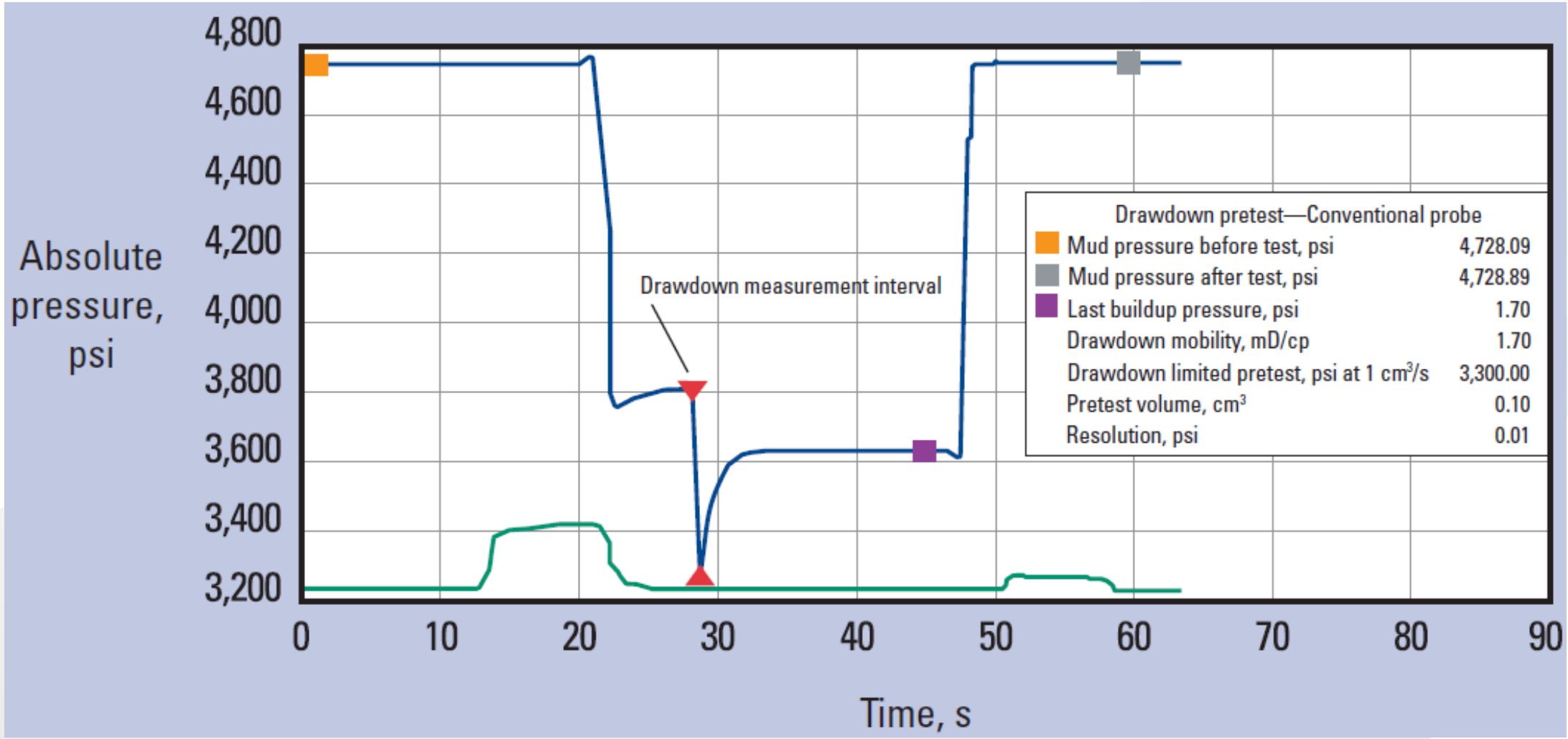
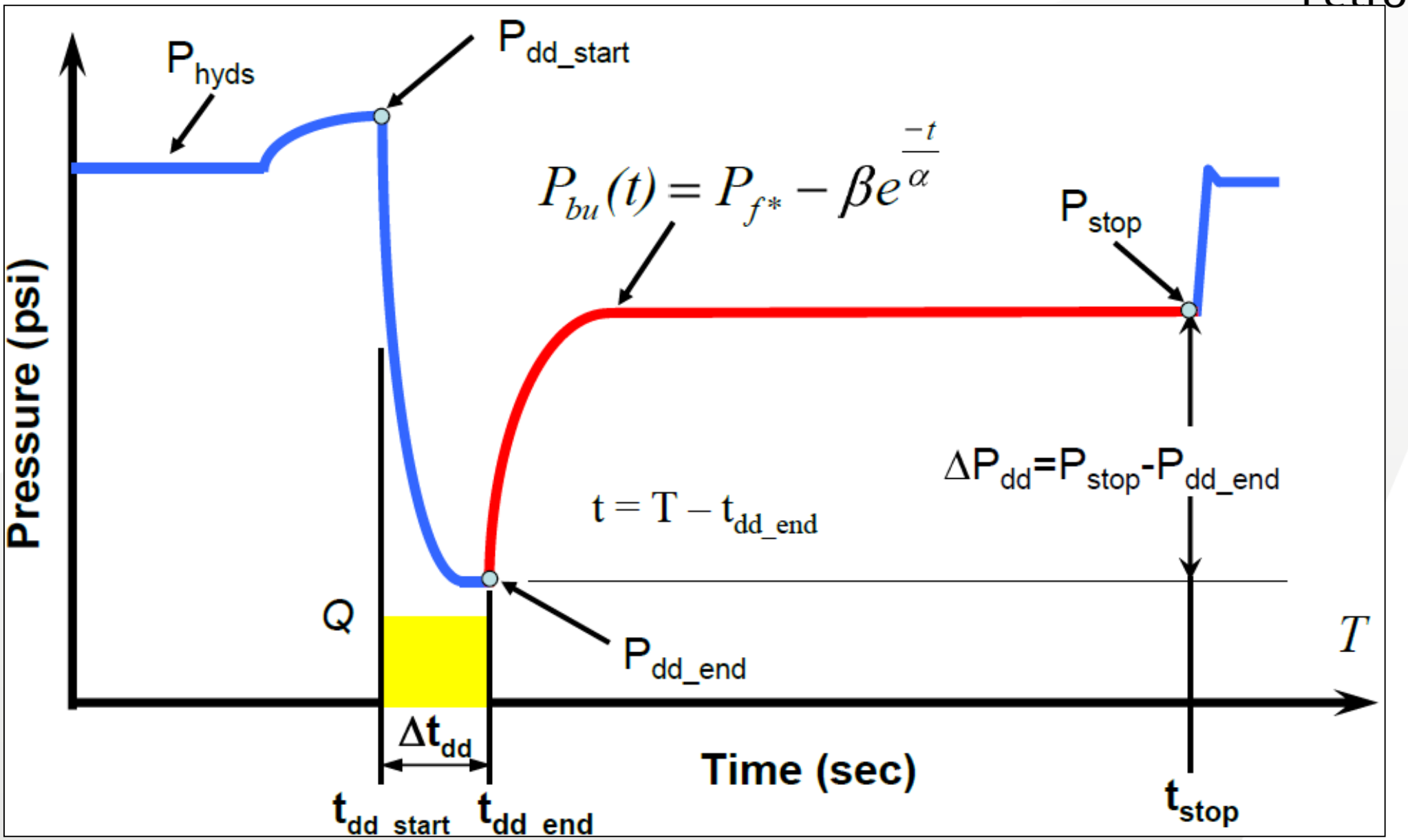


- **As probe is set, tool performs very small ~0.3 cc pretest**
- **Engineer then does one or more pretests with defined volume and rate**

FT Pretest Drawdown



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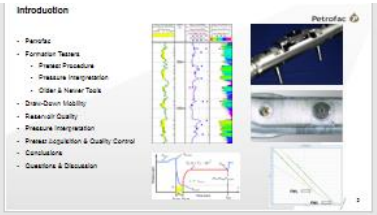

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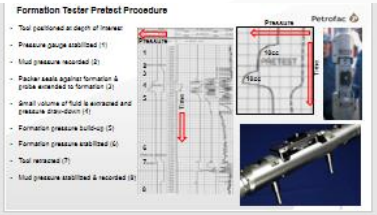

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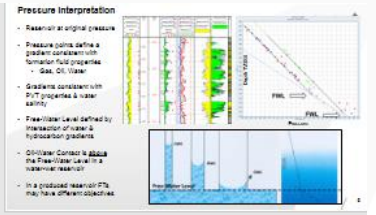

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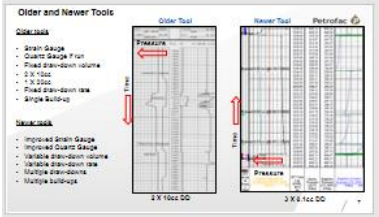

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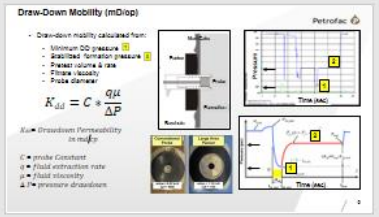

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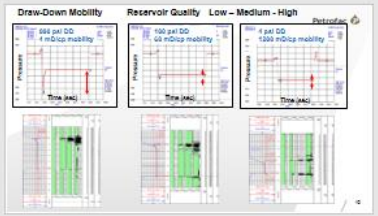

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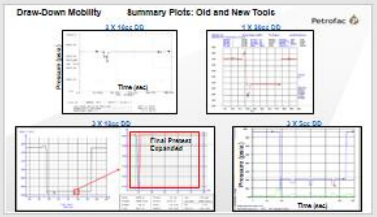

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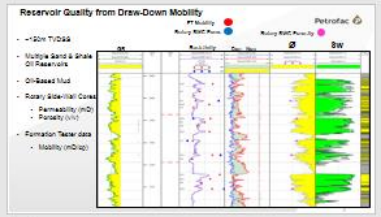

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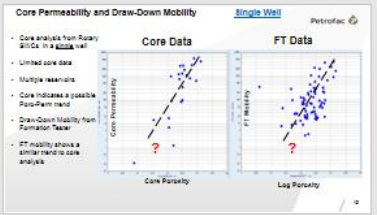

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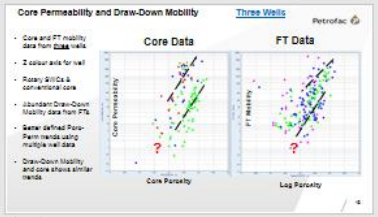

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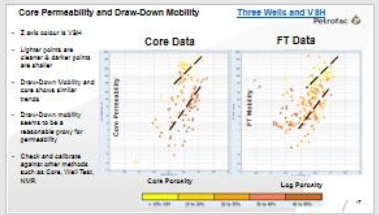

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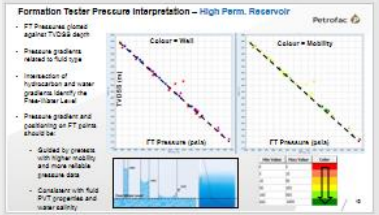

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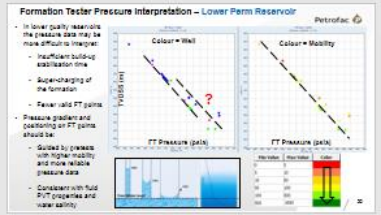

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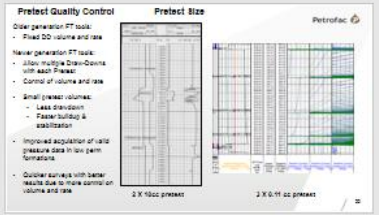

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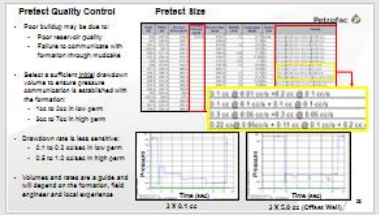

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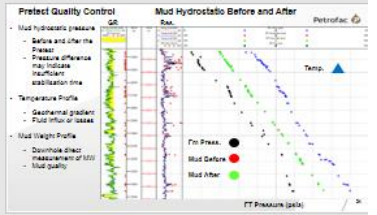

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