Marvin Blan #1 Well Testing Report

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Presentation Content

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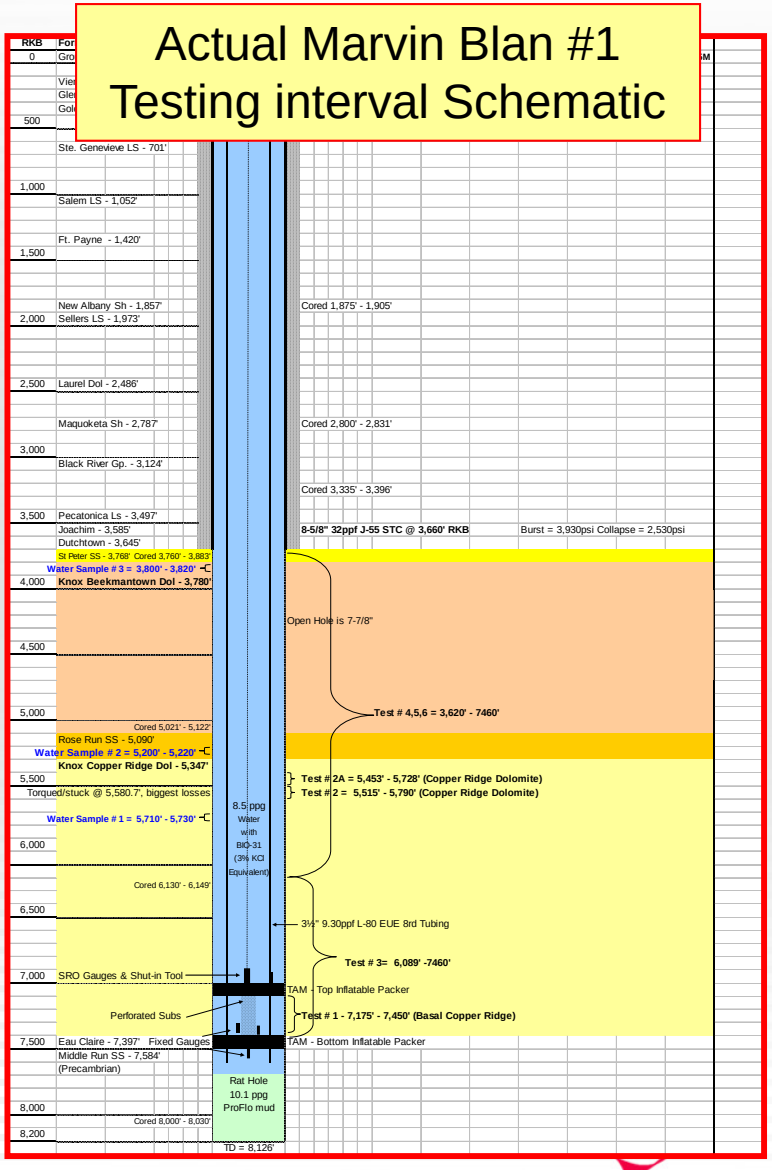

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Summary of Testing Activities

- Water Sample Test WS-1: Interval 5707 ft – 5730 ft. To obtain water sample from the Copper Ridge Dolomite. No water sample collected.
- WS-1A: Interval 5,867 ft to 5,890 ft. Isolation issues behind the packer prevented water sample collection
- WS-2: Rose Run SS interval from 5,120 ft – 5,143 ft. Successful water sampling. 155 bls of reservoir water were produced and sufficient samples were collected, stored and labeled by KGS geochemistry experts.
- WS-3: St. Peter interval from 3,800 ft to 3,823 ft was swabbed dry with no evidence of contributing flow from the reservoir during the test.
- Injection Fall Off Test (IFOT-1): Tested the basal Copper ridge zone from 7,175 ft to 7,460 ft. Result show a parting pressure gradient of 0.92 psi/ft. Indication of pressure communication behind the packer plus vacuum effects made the results inconclusive for reservoir characterization interpretation.
- IFOT-2: The target zone was the Copper Ridge Dolomite from 5,515 ft – 5,790 ft. Injected 12,890 bwpd with 1200 psi of build up. It was later determined that there was communication across the bottom element of the straddle system, interpretation results were questionable.

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Summary of Testing Activities

- IFOT-2A, Target zone was 5,453 ft – 5,728 ft, achieved water injection rate of 4,317 bwpd for 14 hours with 1150 psi of pressure build up. When POOH, it was found the bottom packer assembly had been mechanically compromised during the previous testing operations.
- IFOT #3: Successfully tested from 6,089 ft – 7,460 ft. Only one packer was run in the hole. Copper ridge dolomite and the basal Copper ridge intervals. Injected 7,200 bwpd with 1510 psi of build up.
- IFOT #4: Successfully tested the entire open hole from 3,800 ft - 7,460ft. One inflatable packer was installed in the casing shoe @ 3,650 ft. Injection rates of 14,450 bwpd were achieved with 250 psi of pressure build up. Additional temperature decay log was run
- IFOT #5: Injection of boron soap to study the thief zones across the open-hole section. Baseline spinner surveys were also run. The test confirmed the presence of a natural fracture region near 3,860 ft. and also clear water injection end point below 7,200 ft. The boron concentration was 8.5 ppg. Injection rate of 14,240 bwpd with 275 psi of pressure build up and a total injection volume of 3,175 bbls.
- IFOT #6: Supercritical CO_2 injection. Tested the entire OH interval and injected at 22 MMSCFD with 1200 psi of well head pressure. A total volume of 1,762 bbls of CO_2 were injected.

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Summary table of results

KGS Marvin Blan #1

Summary of Well Test Results

Injection Test Number		WS #1	WS#1 ALT	WS #2	WS #3	IFOT #1	IFOT #2	IFOT #2 ALT	IFOT #3	IFOT #4	IFOT #6
Zone (s)		Copper Ridge Dolomite	Copper Ridge Dolomite	Rose Run SS	St. Peter	Basal Copper Ridge	Copper Ridge Dolomite	Copper Ridge Dolomite	Copper Ridge Dolomite / Basal Copper Ridge	Entire OH section	Entire OH section
	Units										
Tested Interval	Ft	5707 - 5730 **23**	5867 - 5890 **23**	5120 - 5143 **23**	3800 - 3823 **23**	7175 - 7450 **275**	5515 - 5790 **275**	5453 - 5728 **275**	6089 - 7460 **1371**	3620 - 7460 **3840**	3620 - 7460 **3840**
Recover/Injected Fluid Type		Water	Water	Water	Water	Water	Water	Water	Water	Water	CO2
Avg. Water Injection Rate	bwpd	0	0	* 765	0		12960	4320	7184	14400	** 20.7
Final Fall Of Pressure	psi			* 1950			2530	3500	3880	1754	1760
Flow Duration	hrs			8							
Injection							8	16	8	6	8
Fall Off						Vaccum	4	Vaccum	14	30	36
Init. Reservoir Pressure	psi	2517	2590	2207	1638						
Guage Depth	ft		5875	5130	3815		2382	2340	2633	1550	1530
Reservoir Temperature	°F	109	110	105	99		110	108	110	94	93
Conductivity	md*Ft			106			3570	1580	4390	30800	1100
Injectivity	bwpd/psi			0.57			9.75	19.4	14.8	69.74	** 0.09
Skin				-4.3			-3.4	-2.5	-2.5	-2	-3.4
Radios of Investigation	ft			113			126	91	298	487	130
Injection Test Reference Date	mm/dd/yy	7/27/09	7/28/09	7/28/09			8/1/09	8/1/09	8/7/09	8/5/09	8/20/09

* Reprsent a flowand PBU test from the swabbing operations during the water collection sampling

** Present CO2 Injection in gas phase in MMSCFD

Blank spaces in table represent inconclusive results from the IFOT.

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Marvin Blan # Well Test Recommendations

- To isolate highly fractured dolomite section in the Knox formation, straddle packers, should only be set above and below areas where formation image logs show no presence of natural fractures.
- An alternative for open hole testing could be a cement and cased 7” testing liner and underbalanced perforation of selected intervals.
- If natural fractures in the Knox formation are considered a hazardous cementing job, an alternative could be utilizing 7” inflatable liners.
- Real time monitoring of pressures below and above the straddle packer system would have saved the operations days. It would be ideal to have a BHA configuration with telemetry pulsed pressure gauges for control in the back side.
- Further water injection tests to achieve behind packer isolation for the intervals in the Knox formation are necessary to characterize the storage capacity.
- Proper selection of wireline equipments for handling of supercritical CO2 is required. Special consideration should be given to e-line protection coat, o-rings and lubricator valves.

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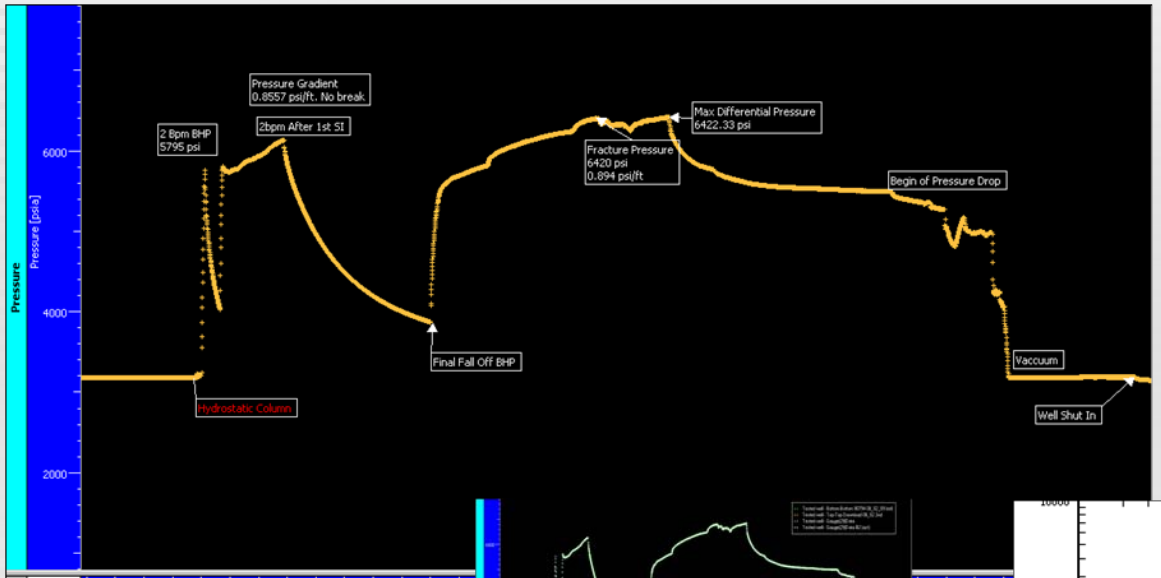
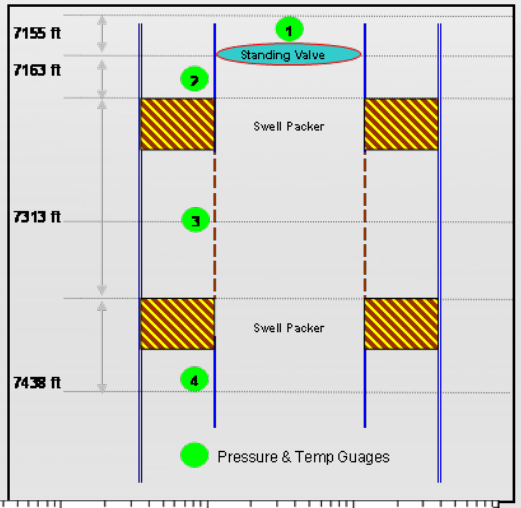
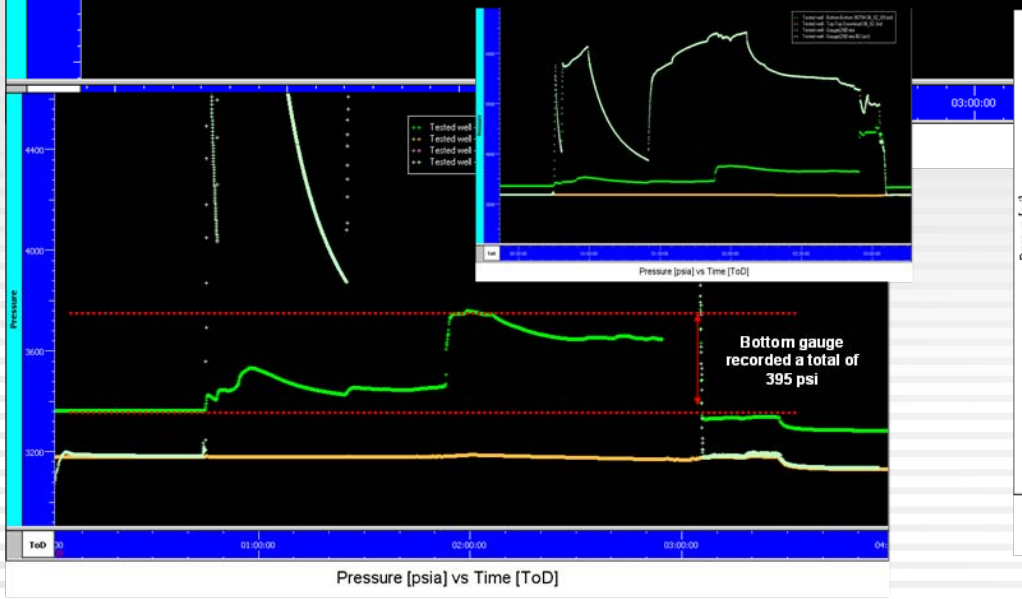
Water Injection test, IFOT#1

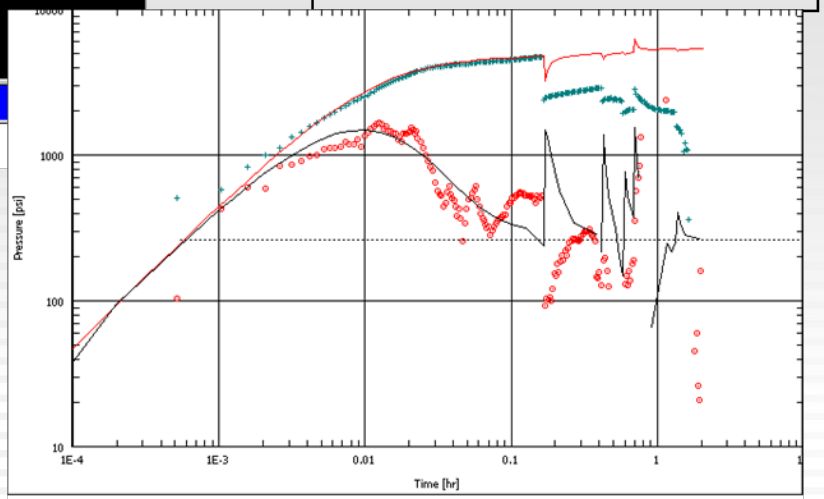
Test Basal Copper Ridge, 7175 ft to 7460 ft. However, the results were questionable due to failure of the swell packers to provide isolation of the zone behind packer. Achieved an average injection rate of 2780 bwpd with an estimated injectivity index of 1.15 bwpd/psi







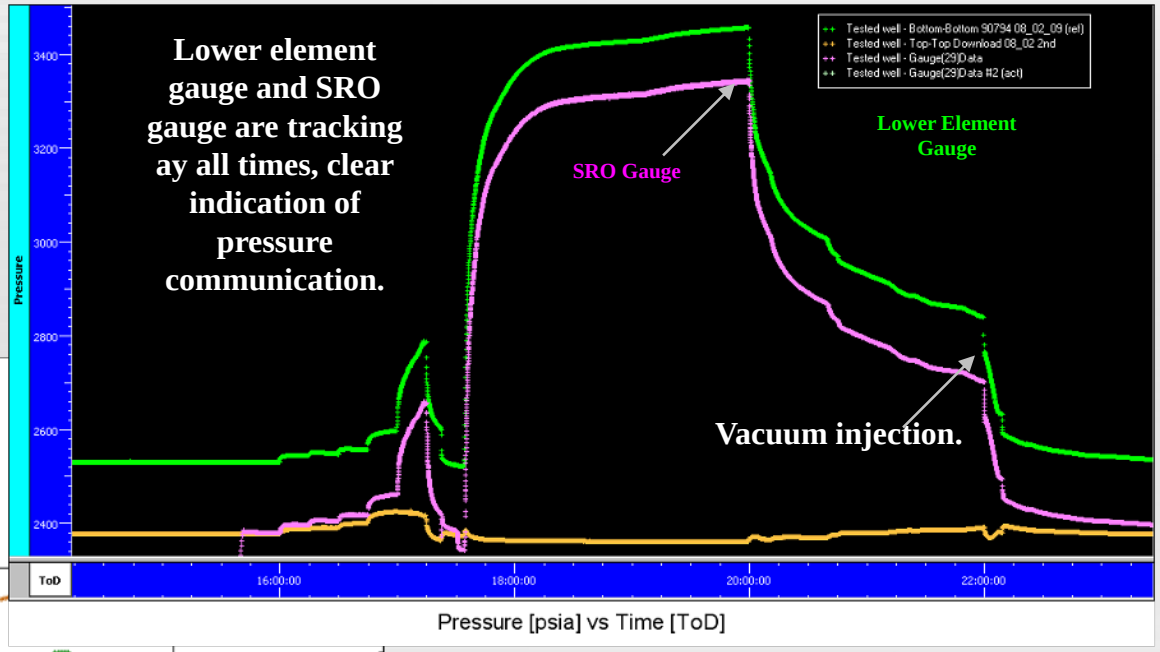
Pressure [psia] vs Time [ToD]



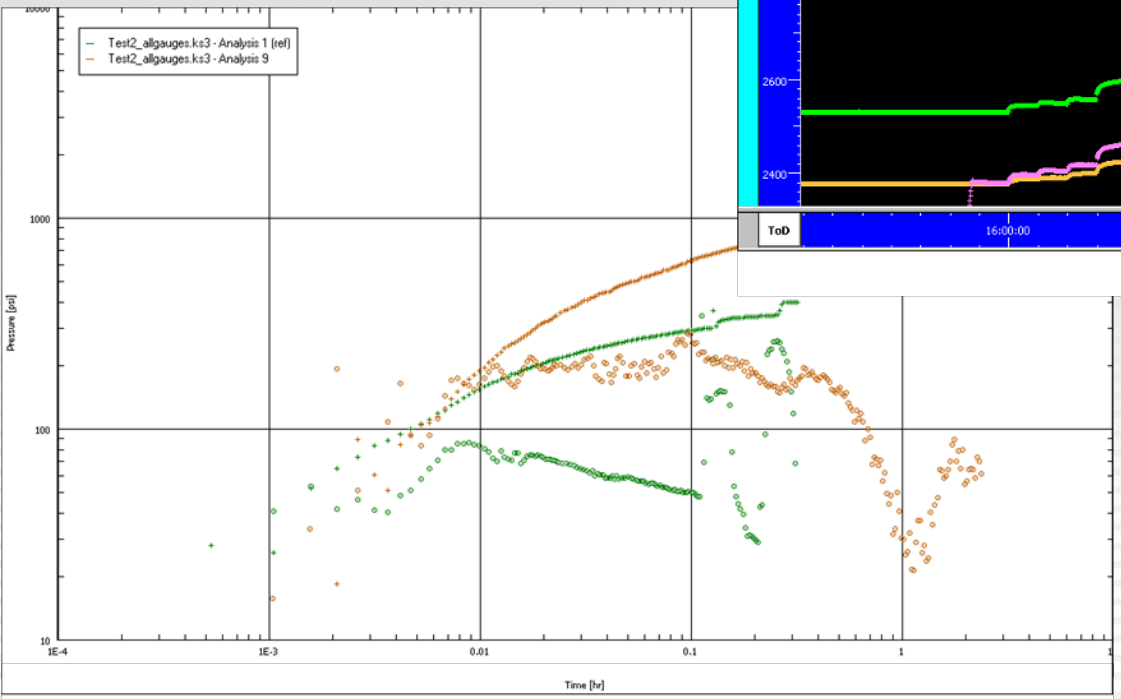
Log-Log plot: (p-p@dt=0).Q/[qn-qn-1] and derivative [psi] vs dt [hr]

Water Injection test
IFOT#2

Test Copper Ridge Dolomite from 5,515 ft – 5,790 ft. Injection rate of 12,890 bwpd with 1200 psi of build-up. Real-time monitoring of the injection pressure transient response suggested the presence of pressure communication behind packers.



Pressure [psia] vs Time [ToD]



Compare files: Log-Log plot (dp and dp' normalized [psi] vs dt)

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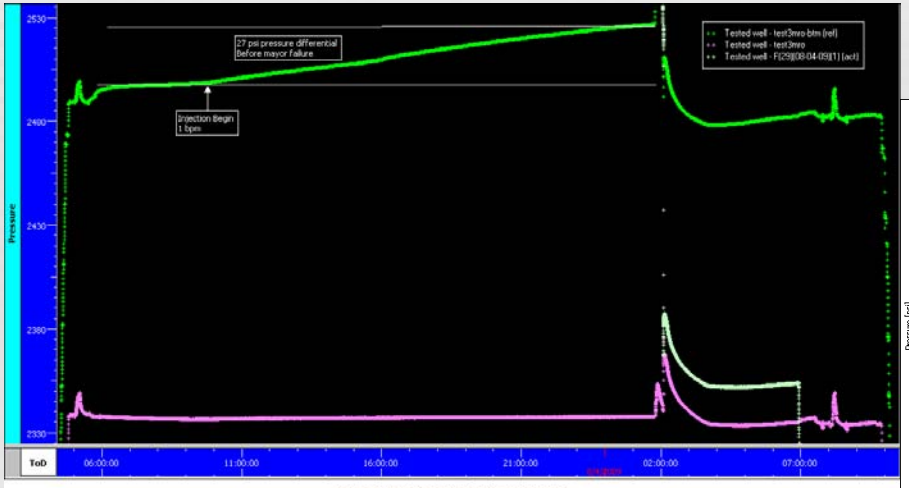
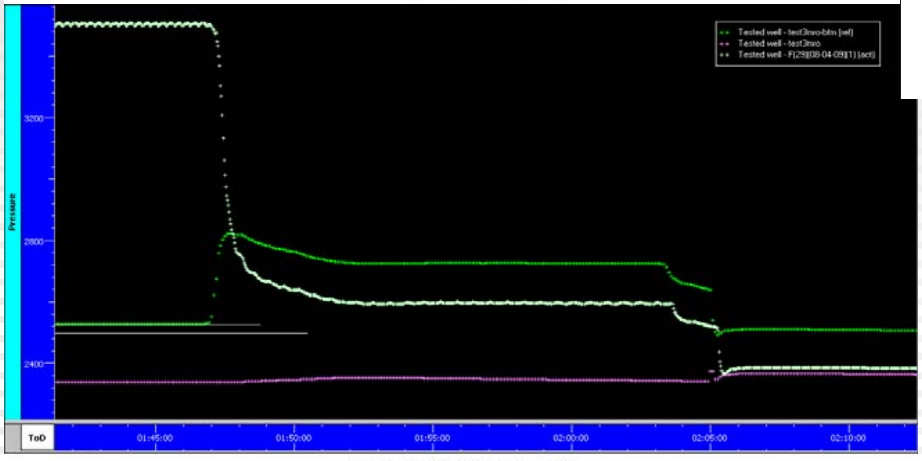
Water Injection test
IFOT#2A

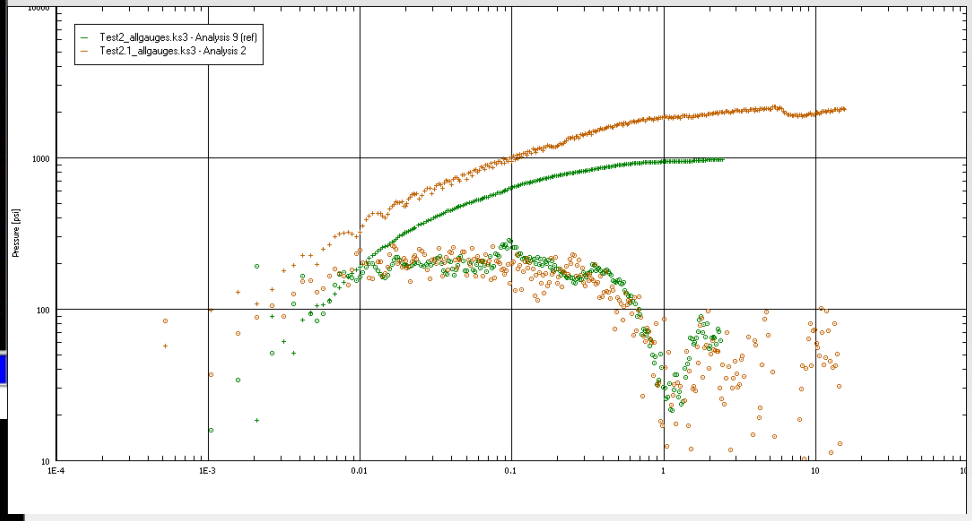
The IFOT-2A was designed to move away from natural fracture region in the wellbore. The packers at 5,435 ft – 5,728 ft. Injection rate of 4,280 bwpd with 1200 psi of build-up. Real-time monitoring of the injection pressure transient response suggested the presence of pressure communication behind packers.



Pressure [psia] vs Time [ToD]



Pressure [psia] vs Time [ToD]



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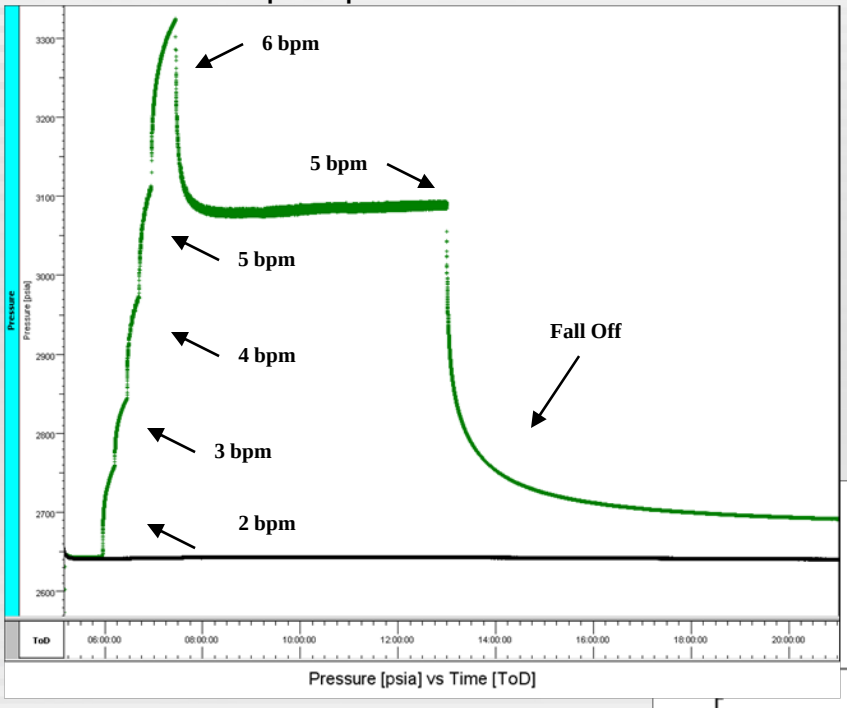
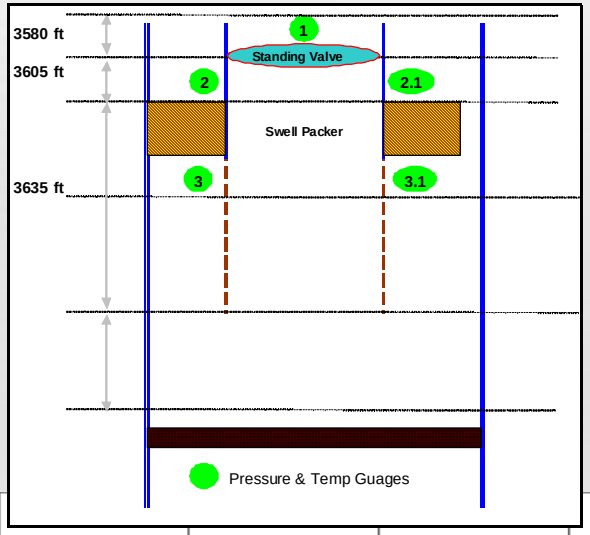
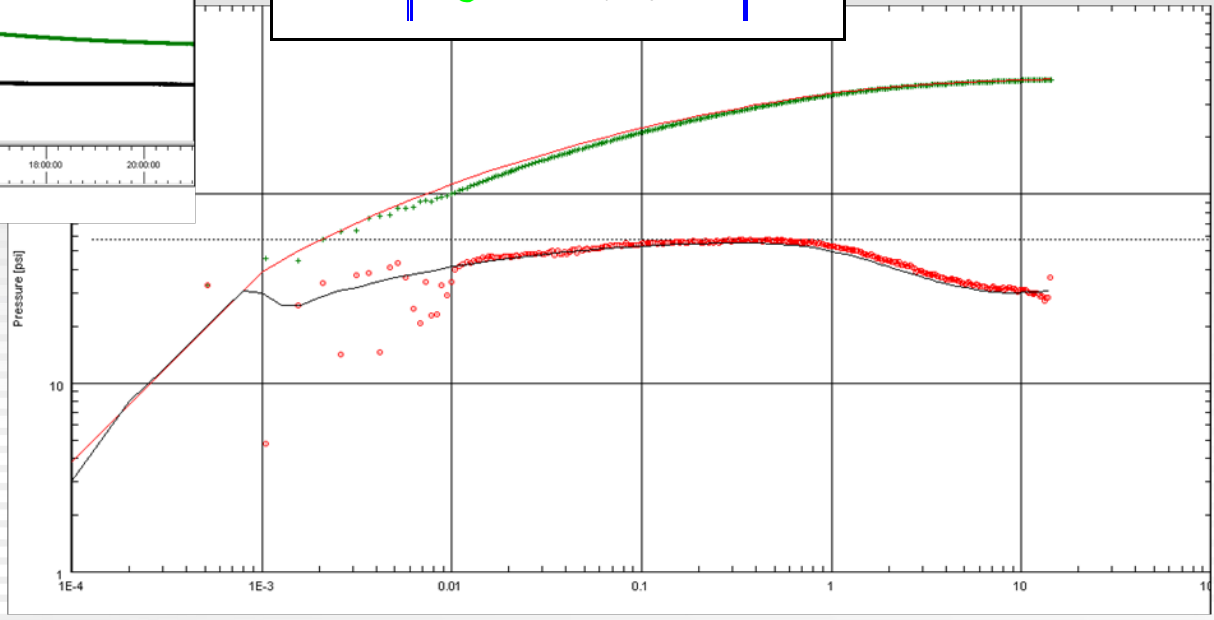
Water Injection test
IFOT#3

IFOT #3 successfully tested a comingled zone between the Basal Copper Ridge and the Copper Ridge Dolomite where a single packer was set @ 6,089 ft. IFOT #3 injected up to 7,280 bwpd with an injectivity index of 10.6 bpwd/psi .





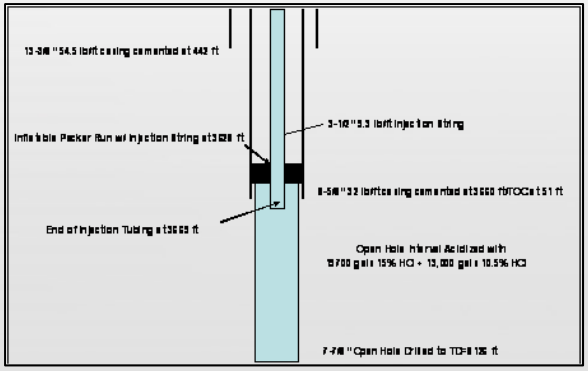


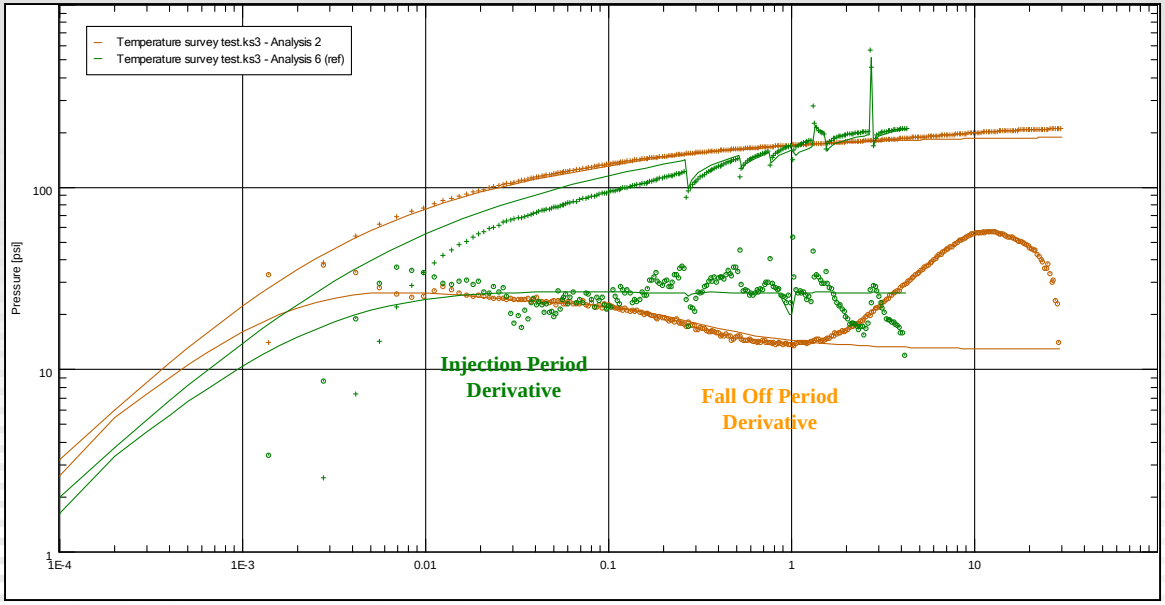
Water Injection test
IFOT#4

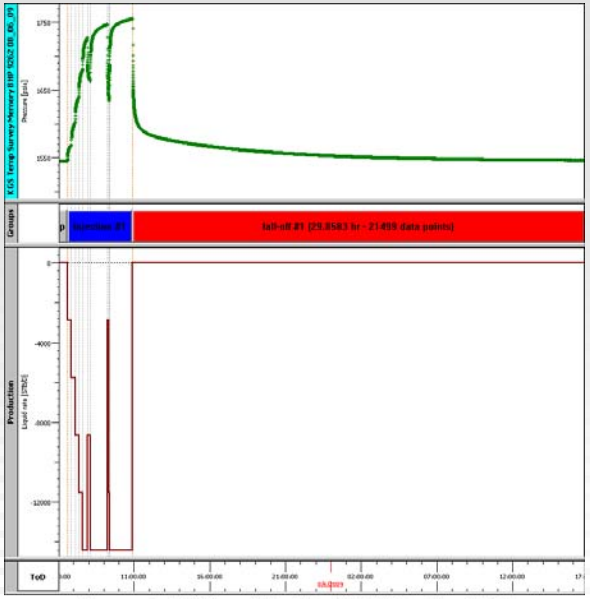
• IFOT #4 successfully tested entire open hole interval with single packer set @ 3620 ft. The estimated average Kh for the Commingled Zone is ~ 28,900 md-ft.

Temperature decay log Results

	Inflow zones 1	Inflow zones 2	Inflow zones 3	Inflow zones 4	Inflow zones 5	Inflow zones 6	Inflow zones 7
From , ft	3630	4820	5440	5620	5700	7010	7080
To , ft	3878	5220	5580	5660	5720	7040	7110







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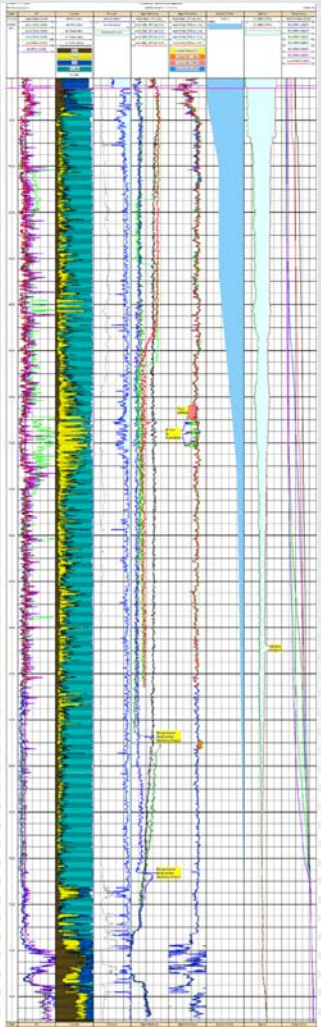
Borox Injection test
IFOT#5

•The overall objective of the test was to determine the presence of thief zones across the carbonates intervals and quantify the contribution of individual intervals to flow. Injection of Borox Decahydrate mixed with Bio 31 Water was used to identify through the usage of neutron RST logs the thief zones across the section. The utilization of a MPLT tool was successful in acquiring flow characteristics of the horizons.

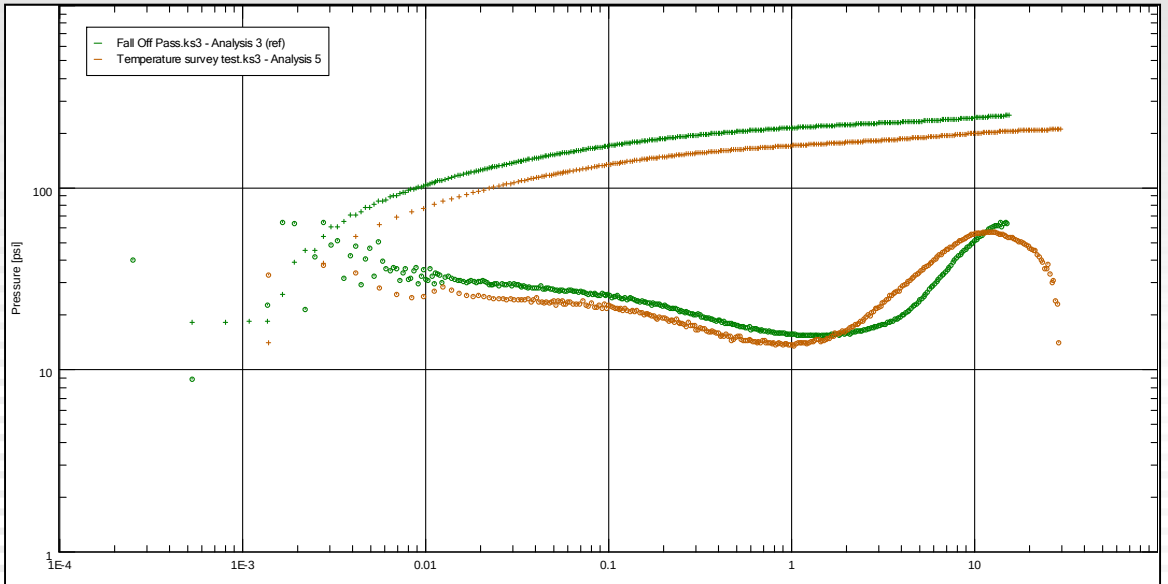


Fall-off Data

Initial Reservoir Pressure	1476 psia @ 3,580 ft TVD gauge depth
Reservoir Temperature	94 °F @ 3,580 ft TVD gauge depth
Permeability-thickness	28600 md-ft, Total Kh away from the wellbore ~ 11660 md-ft
Skin factor	-3.7
Injectivity Index (actual)	69.74 bwpd/psi

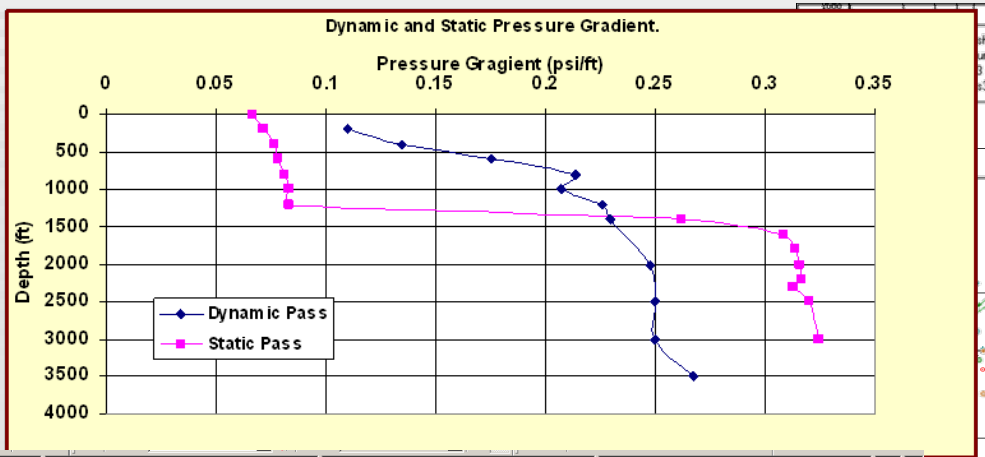
PLT Data (Contribution from each interval)

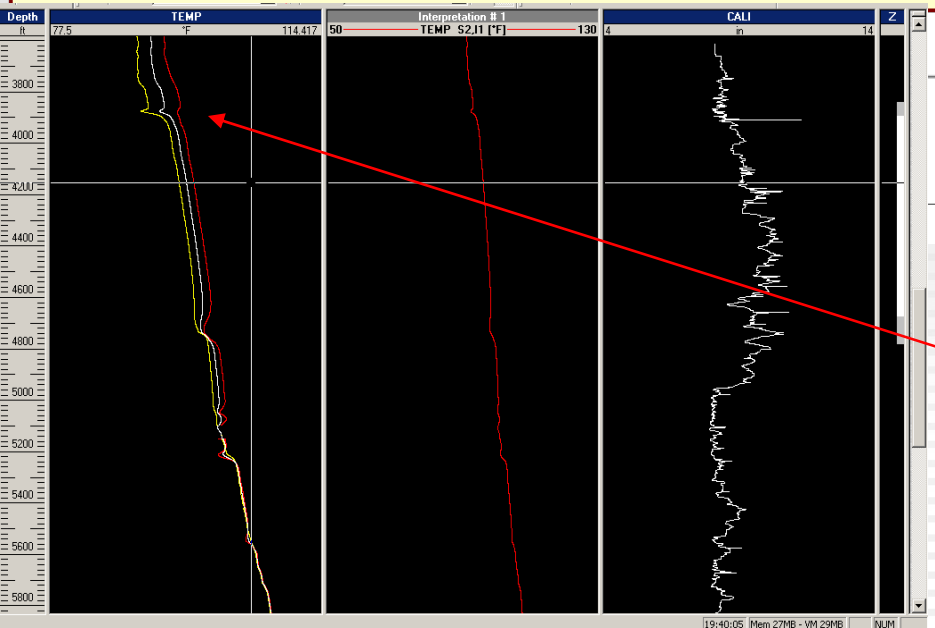
Zone 1	(9706 - 9700) ft MD (40 ft)	22.5% flow contribution
Zone 2	(9730 - 9706) ft MD (64 ft)	-4.07% flow contribution
Zone 3	(9744 - 9730) ft MD (117ft)	29.08% flow contribution
Zone 4	(9758 - 9744) ft MD (415 ft)	26.2% flow contribution
Zone 5	(9768 - 9758) ft MD (151 ft)	18.06% flow contribution

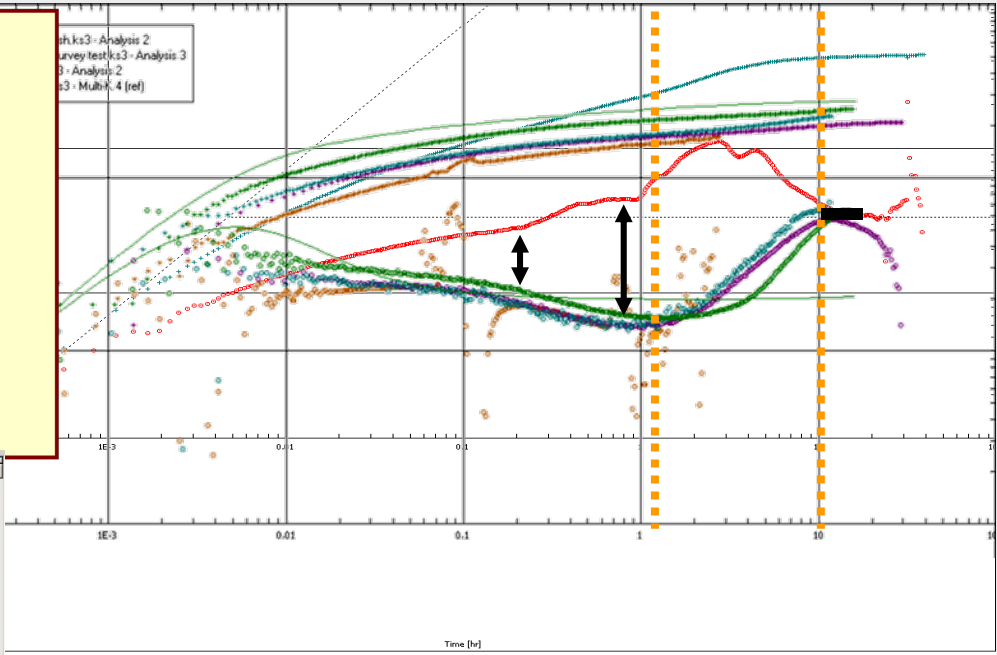


CO2 Injection test
IFOT#6

• A constant CO_2 injection rate of 4.0 bpm, total injection volume of 1,765 bbl of CO_2. The final injection BHP and BHT at 3,580 ft were 1,753.8 psia and 103.2 °F. At the end of IFOT#6, a temperature logging survey was performed across the open hole interval and determined final injection point of CO_2 to be @ 5230ft







Log-Log plot: m(p)-m(p@dt=0) and derivative [psi2/cp] vs dt [hr]

Interval predominantly injected with CO2

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Back-Up Slide

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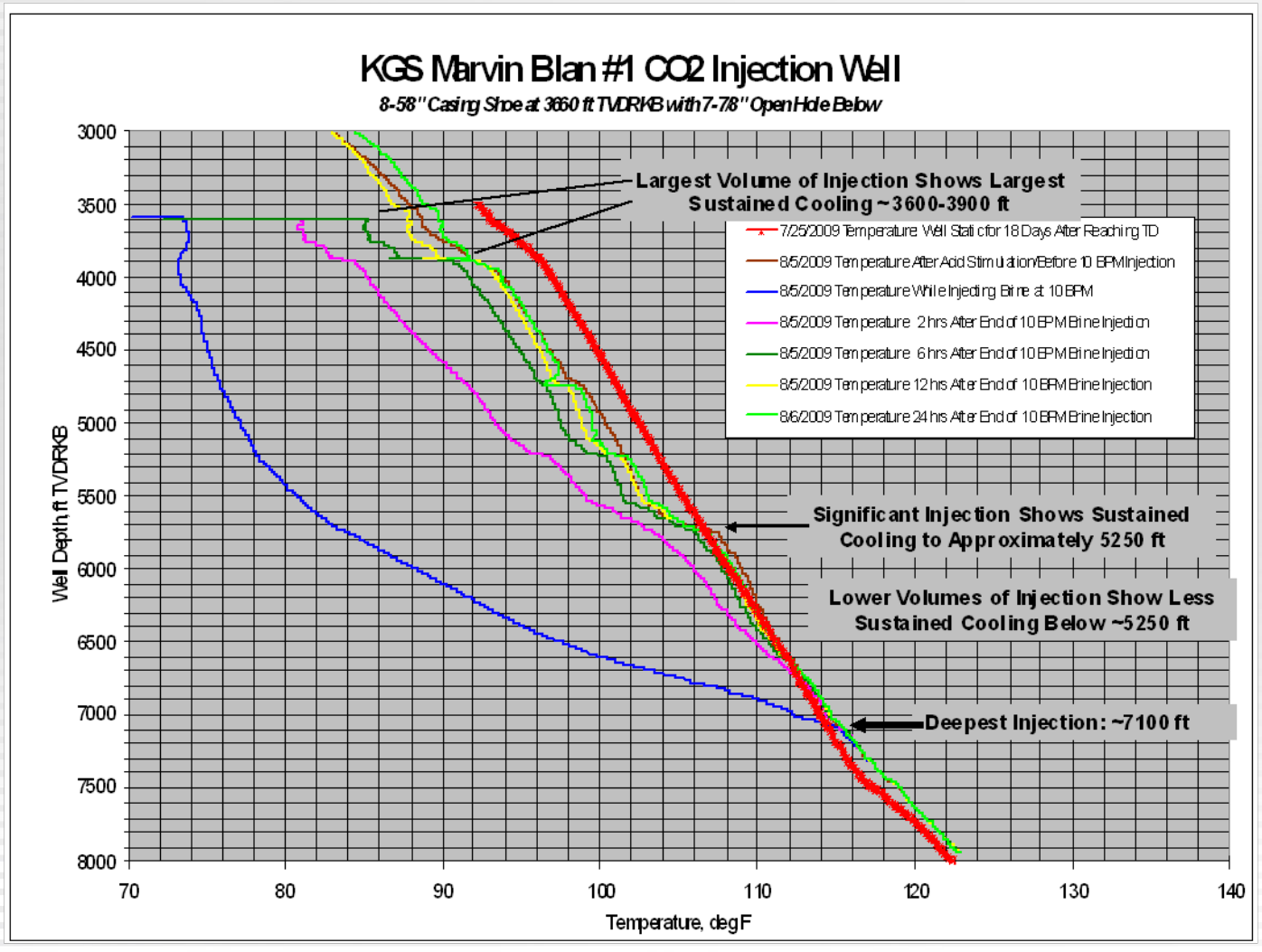
Temperature Logging



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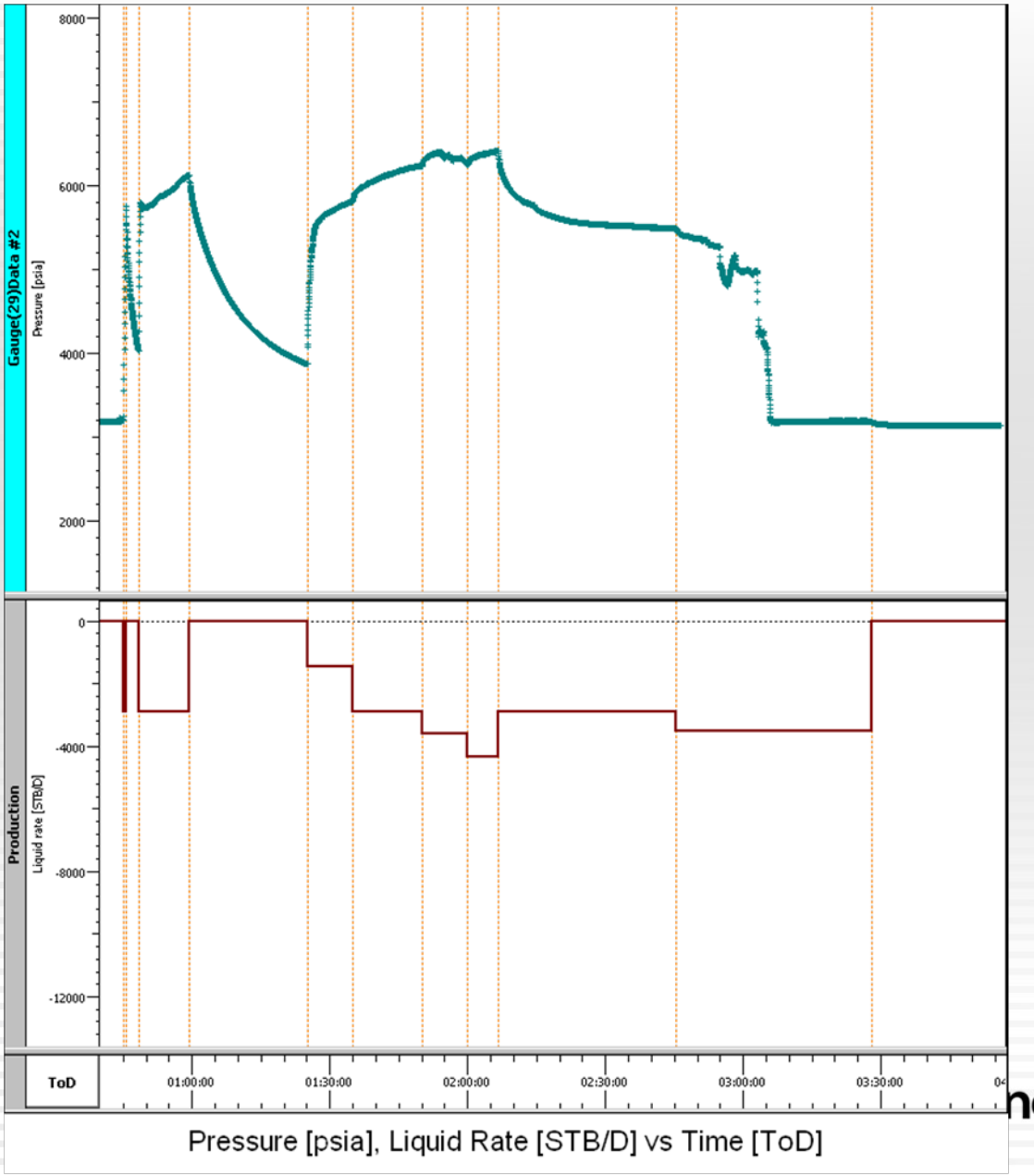
IFOT 1 – Pressure and Rates



Pressure [psia], Liquid Rate [STB/D] vs Time [ToD]

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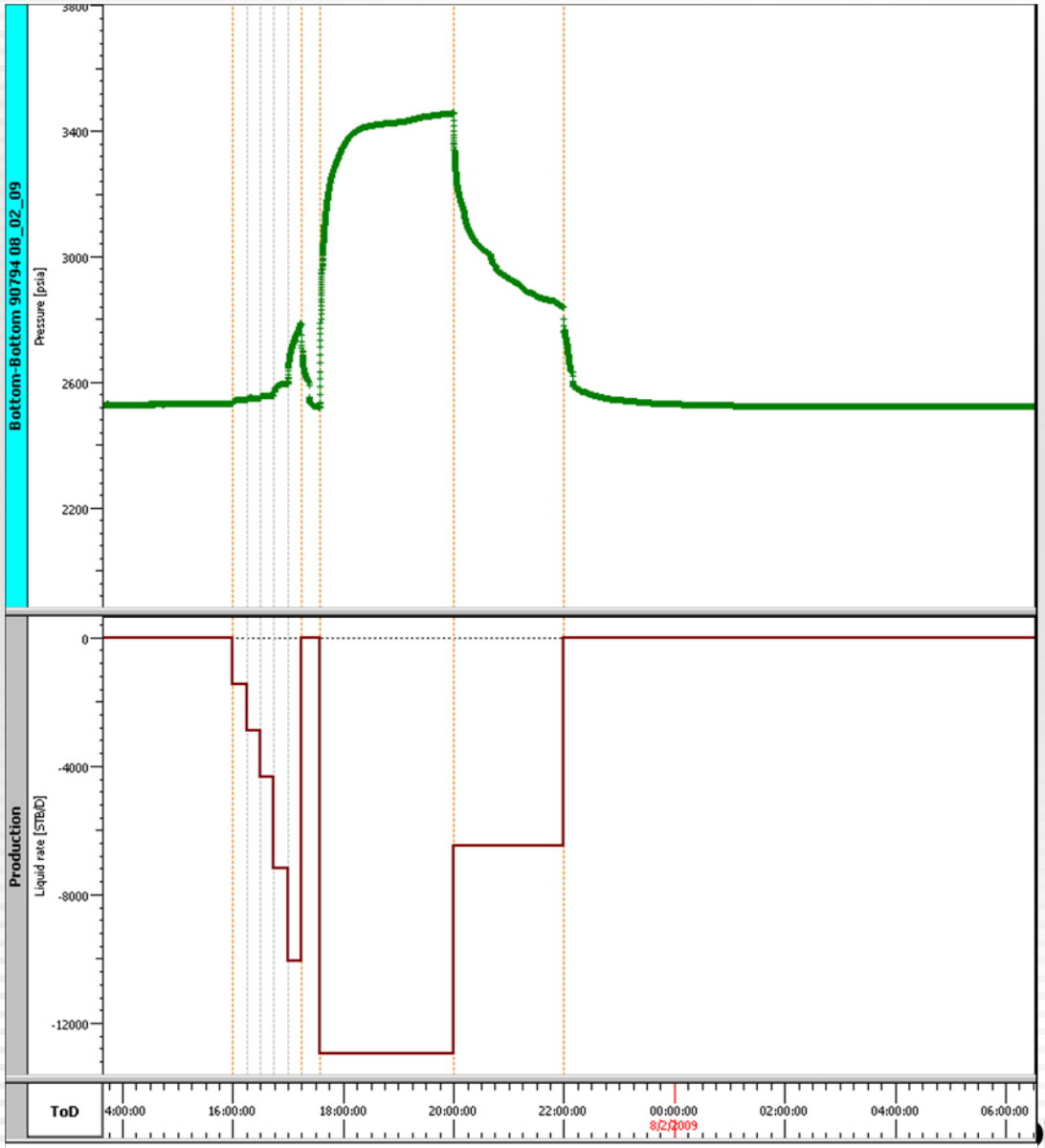
IFOT 2 – Pressure and Rates



Pressure [psia], Liquid Rate [STB/D] vs Time [ToD]

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