

Cuadrilla Resources

Preese Hall #1

Stage 2 Fracture Height Growth

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Barree & Associates

Well Overview

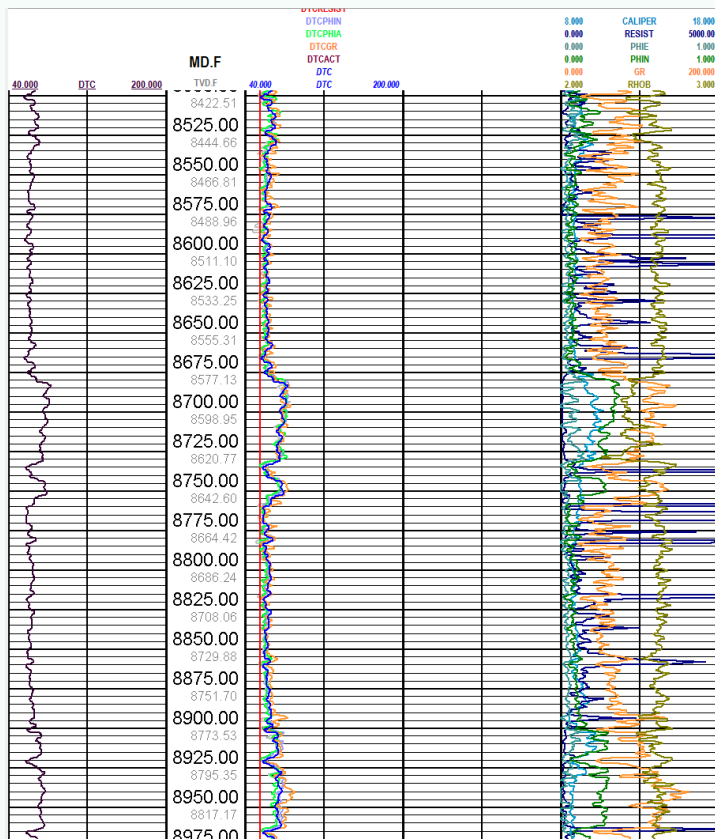
- Objective: Pressure match stage 2 fracture treatment to determine fracture geometry. Model change in fracture geometry from smaller fracture treatment at a lower pump rate.
- Stage 2 Perforations
 - 8700-8709 ft
 - 8730-8739 ft
 - 8750-8759 ft
- Mechanical properties and stress profile calibrated to stage 2 DFIT

Stage 2 – DFIT

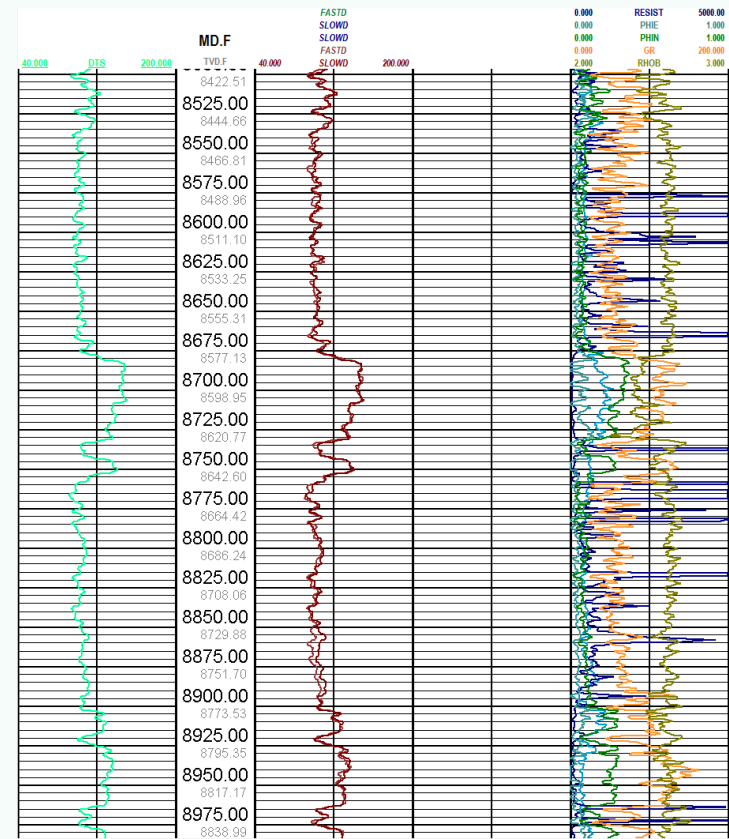
- Fracture extension pressure of 8171 psi or a fracture gradient of 0.95 psi/ft
- Fracture closure at 7119 psi or 0.83 psi/ft
- Pressure dependent leakoff with a fissure opening pressure of 7194 psi and a PDL coefficient of 0.0013
- Pseudoradial flow post closure (-1 slope) with a pore pressure of 5858 psi or 0.64 psi/ft and a flow capacity of 80.3 md.ft

Sonic Velocities

Synthetic Compressional Velocity

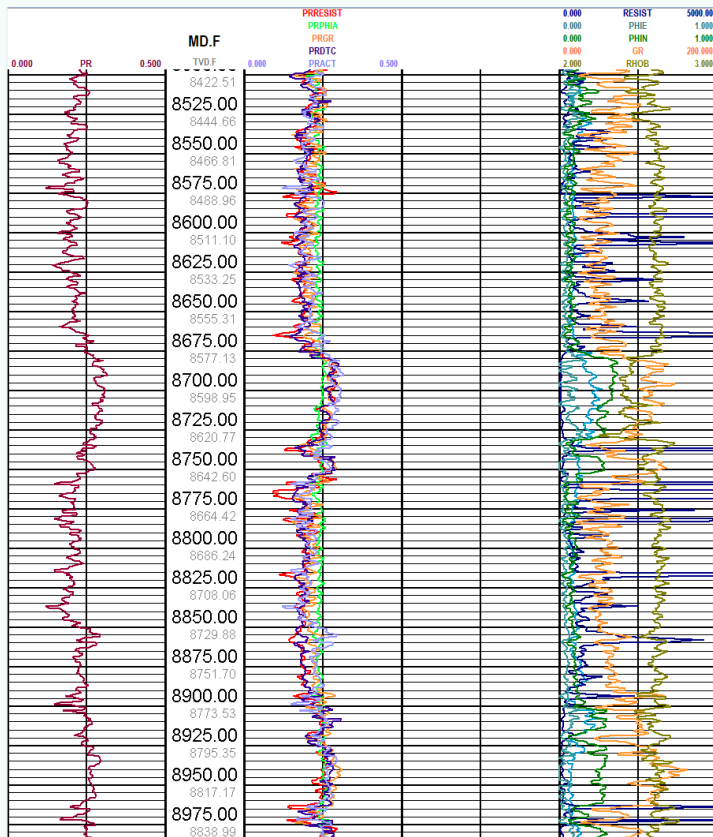


Shear Velocity

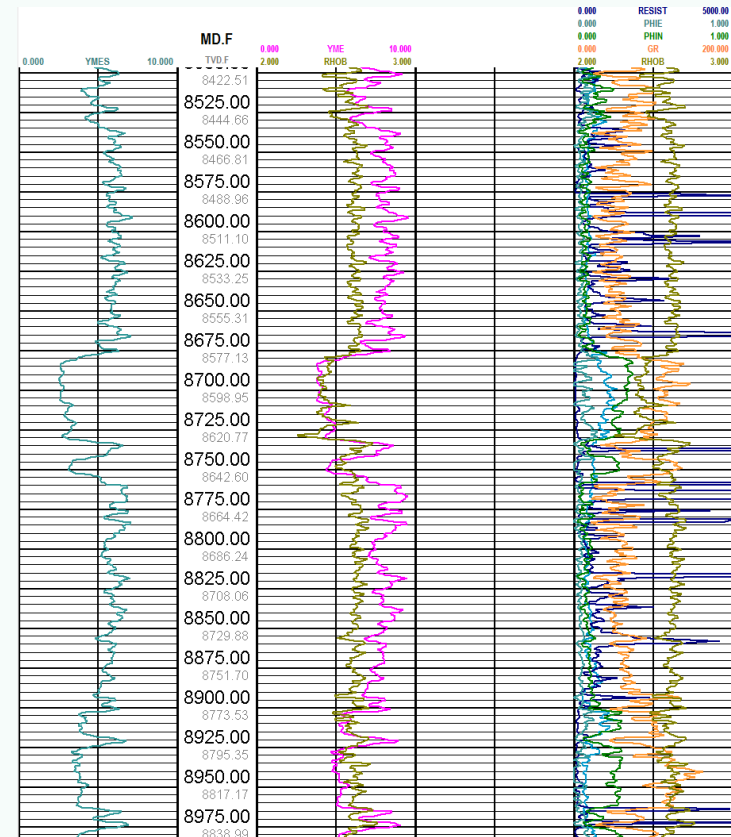


Mechanical Properties

Poisson's Ratio

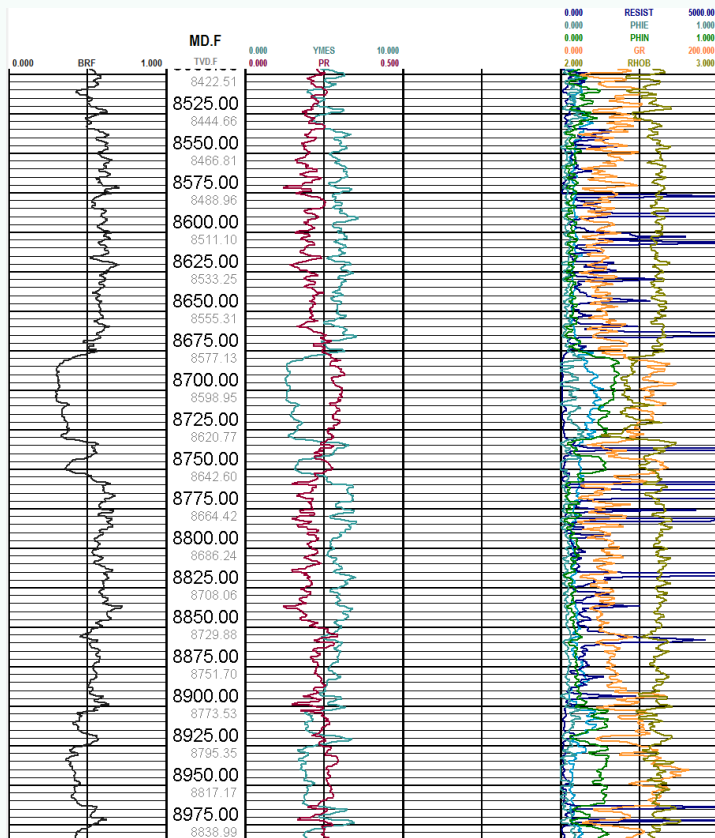


Young's Modulus

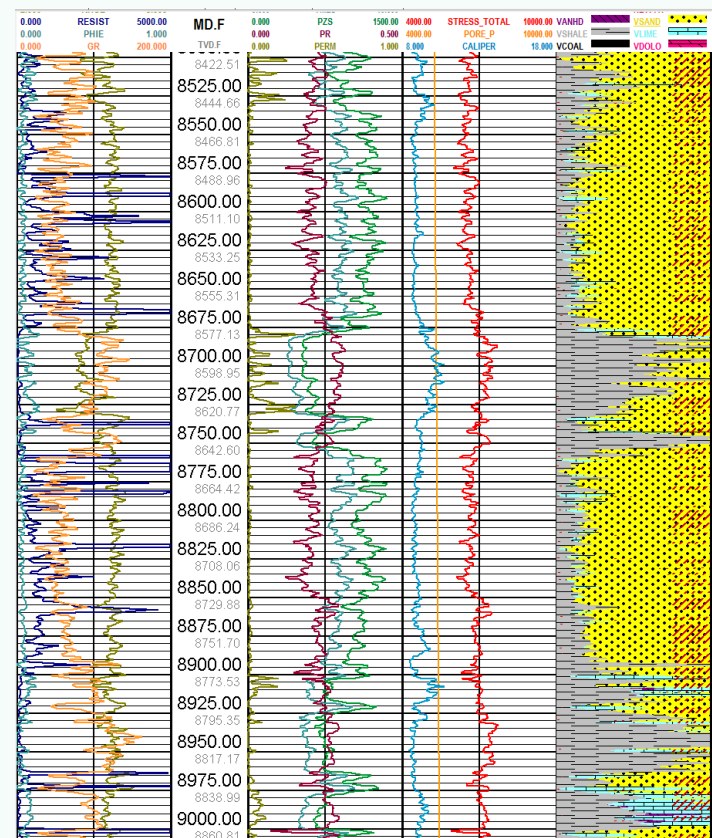


Brittleness & Total Stress

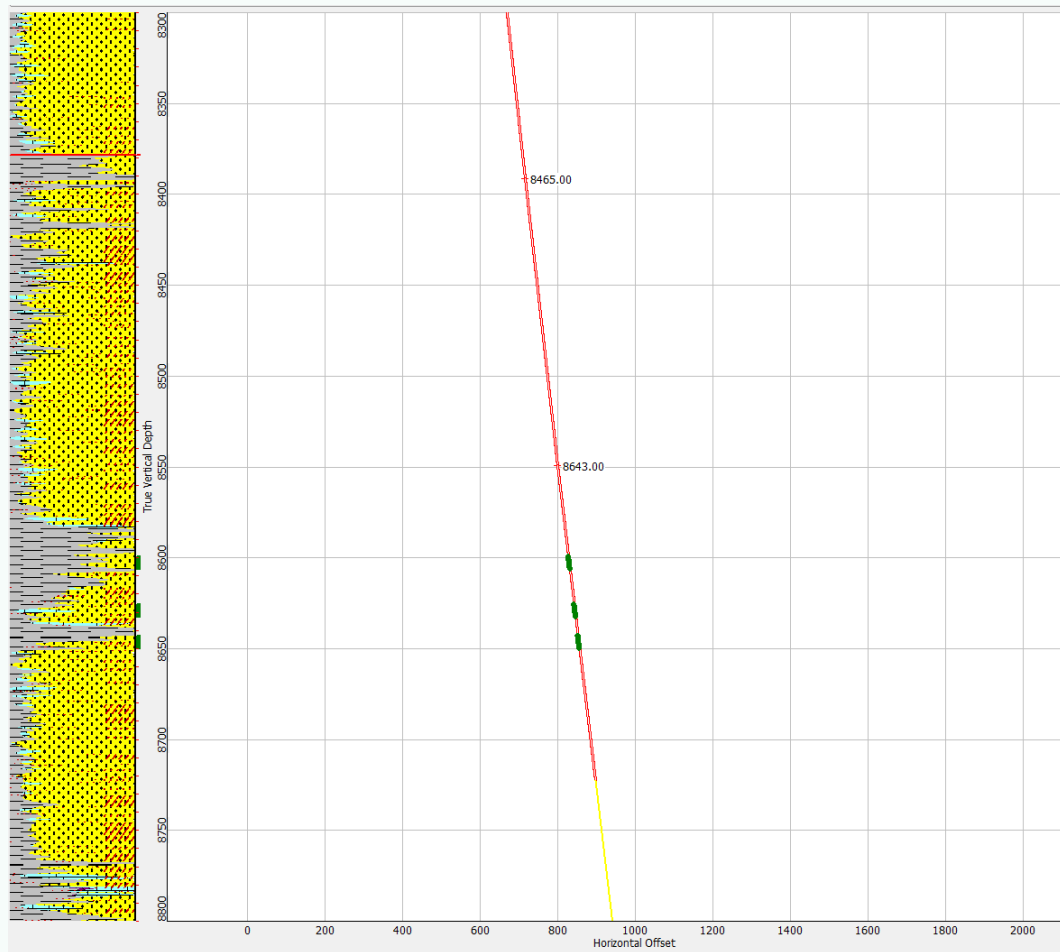
Brittleness Factor



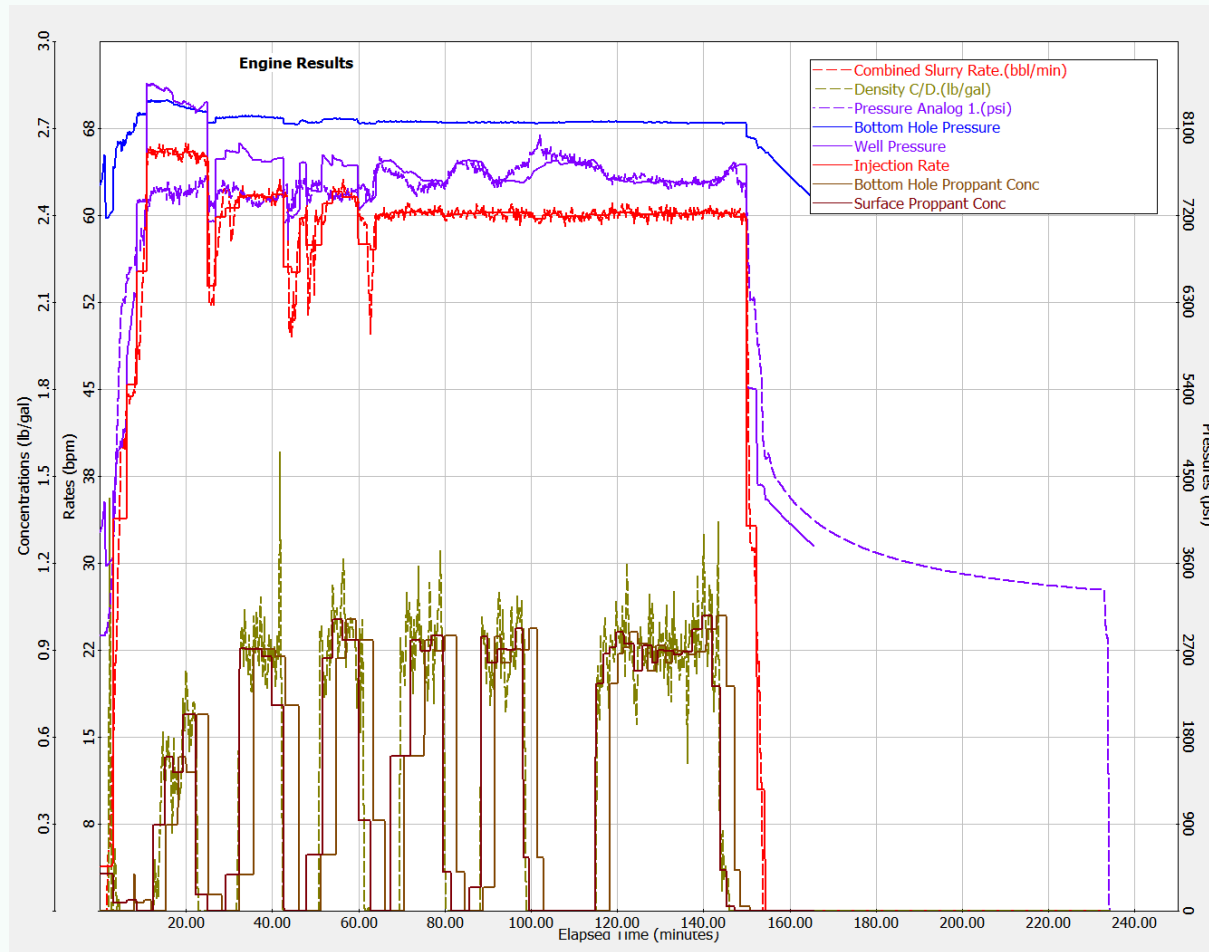
Total Stress Profile



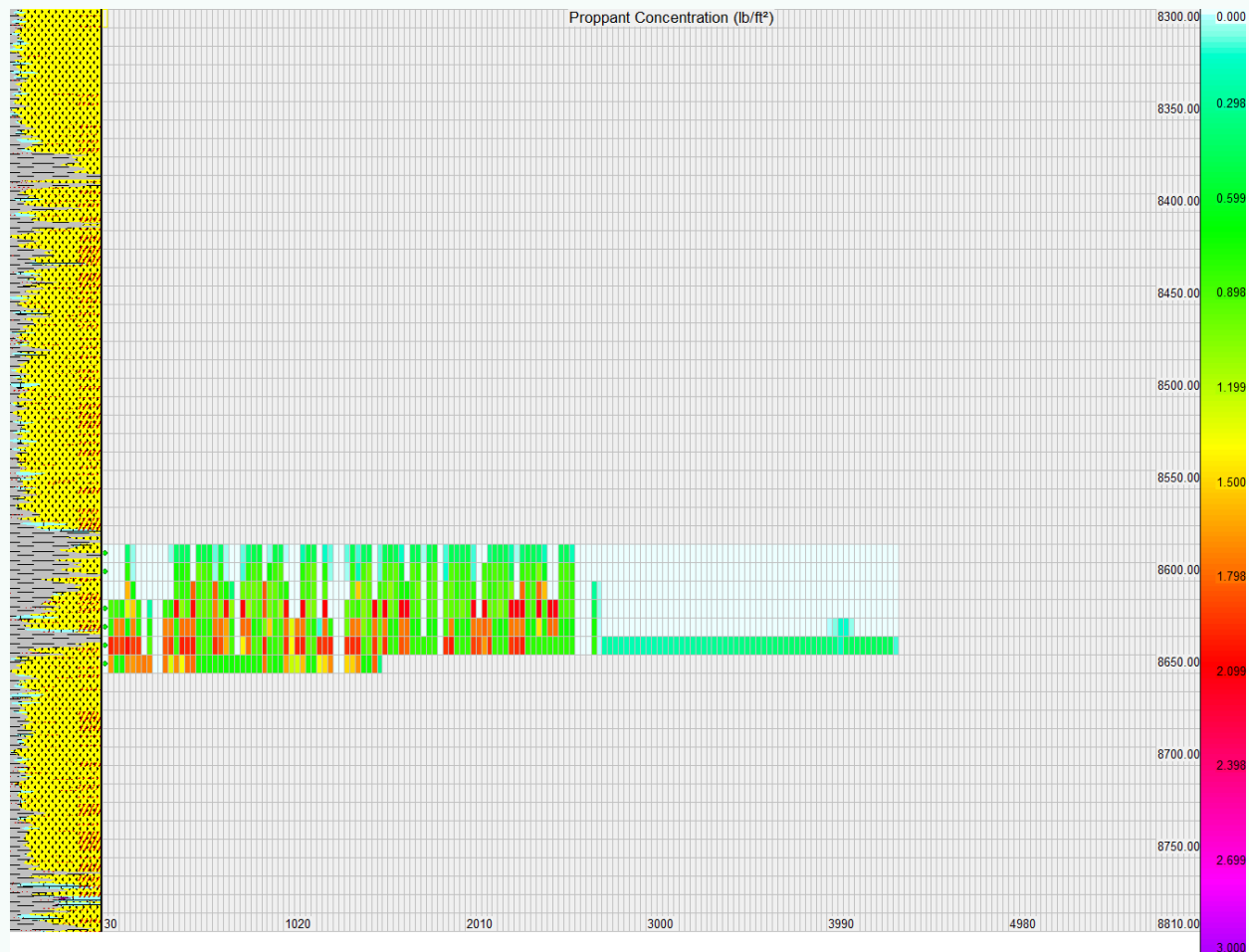
Stage 2 - Perforations



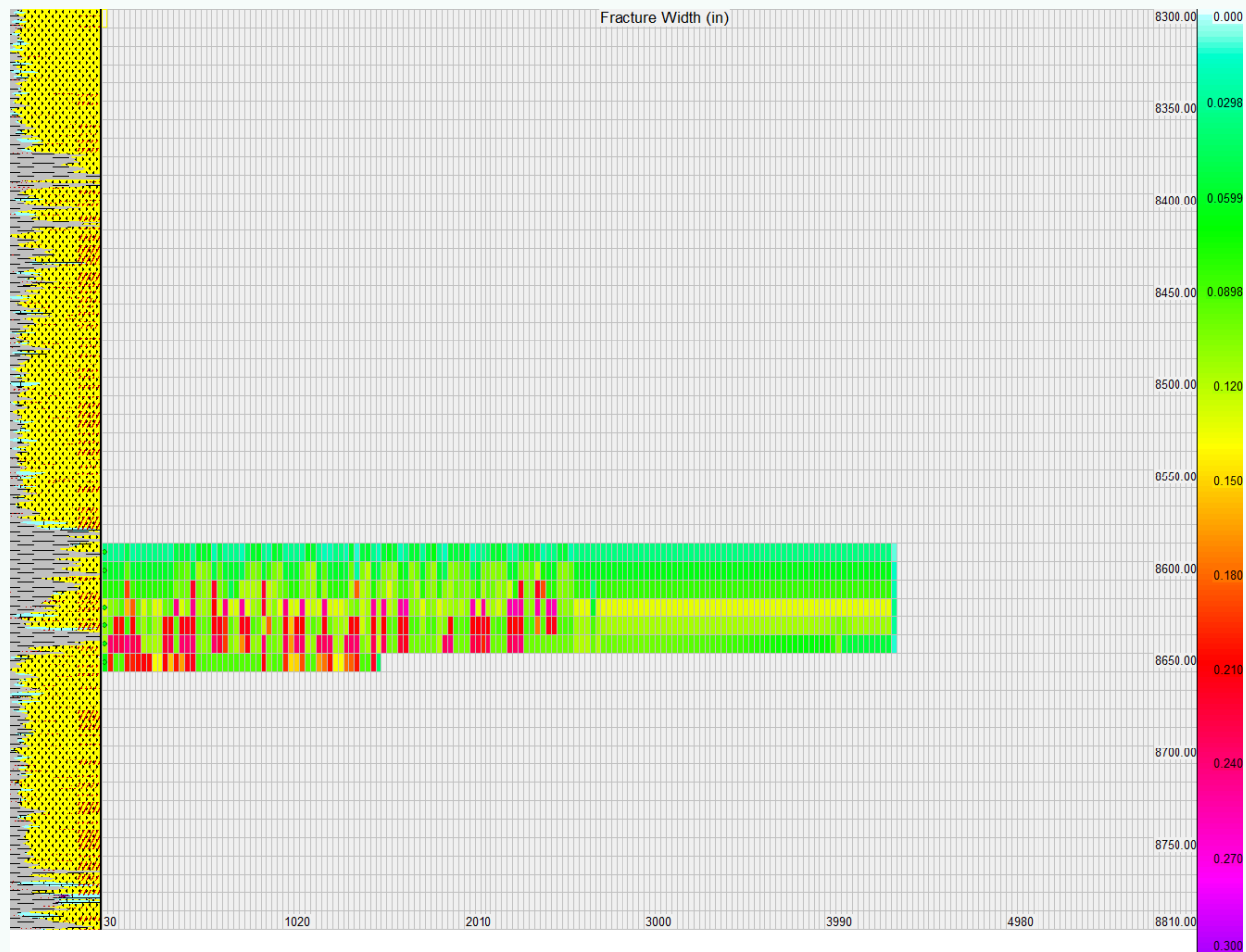
Stage 2 - Pressure Profile



Proppant Concentration



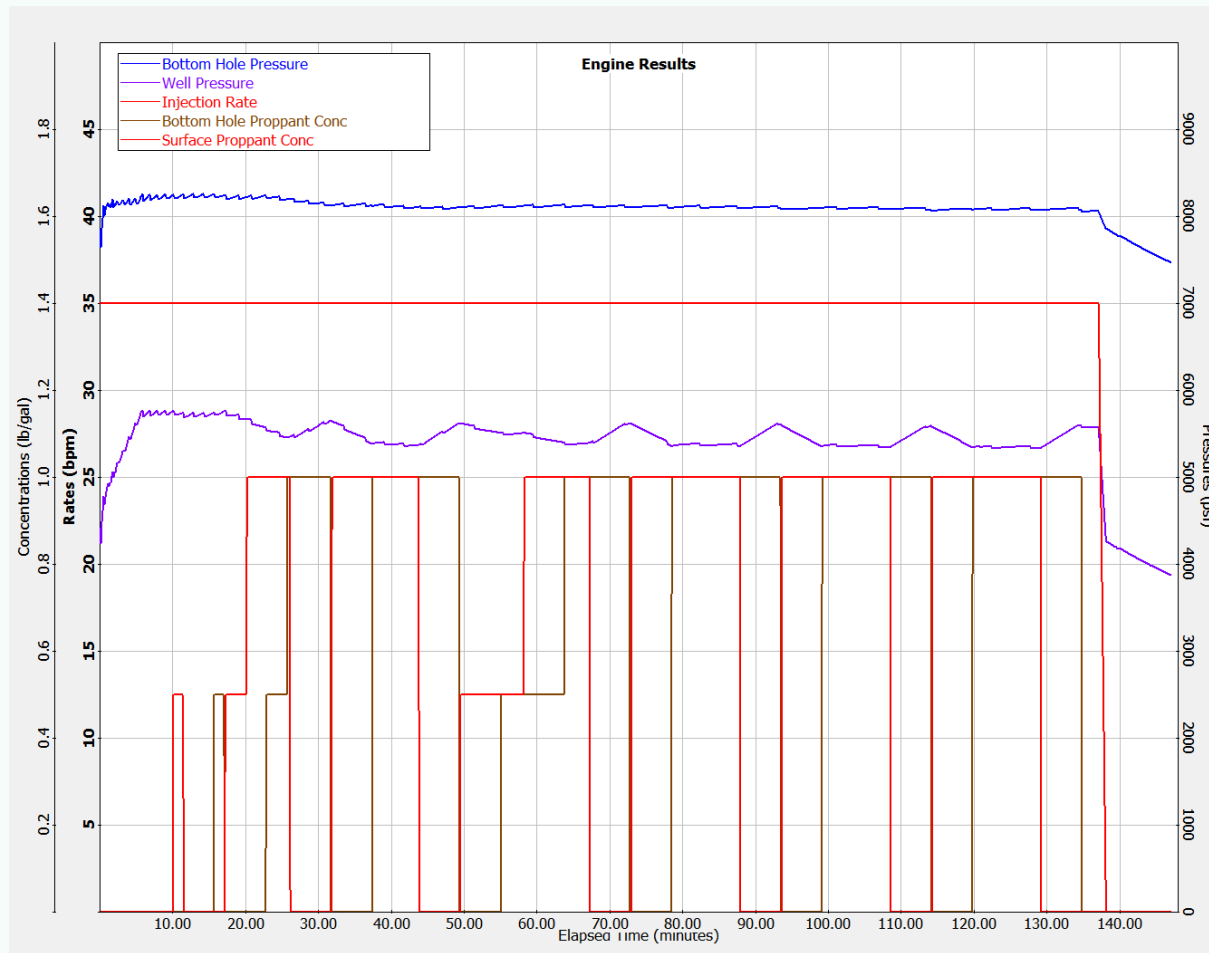
Fracture Width



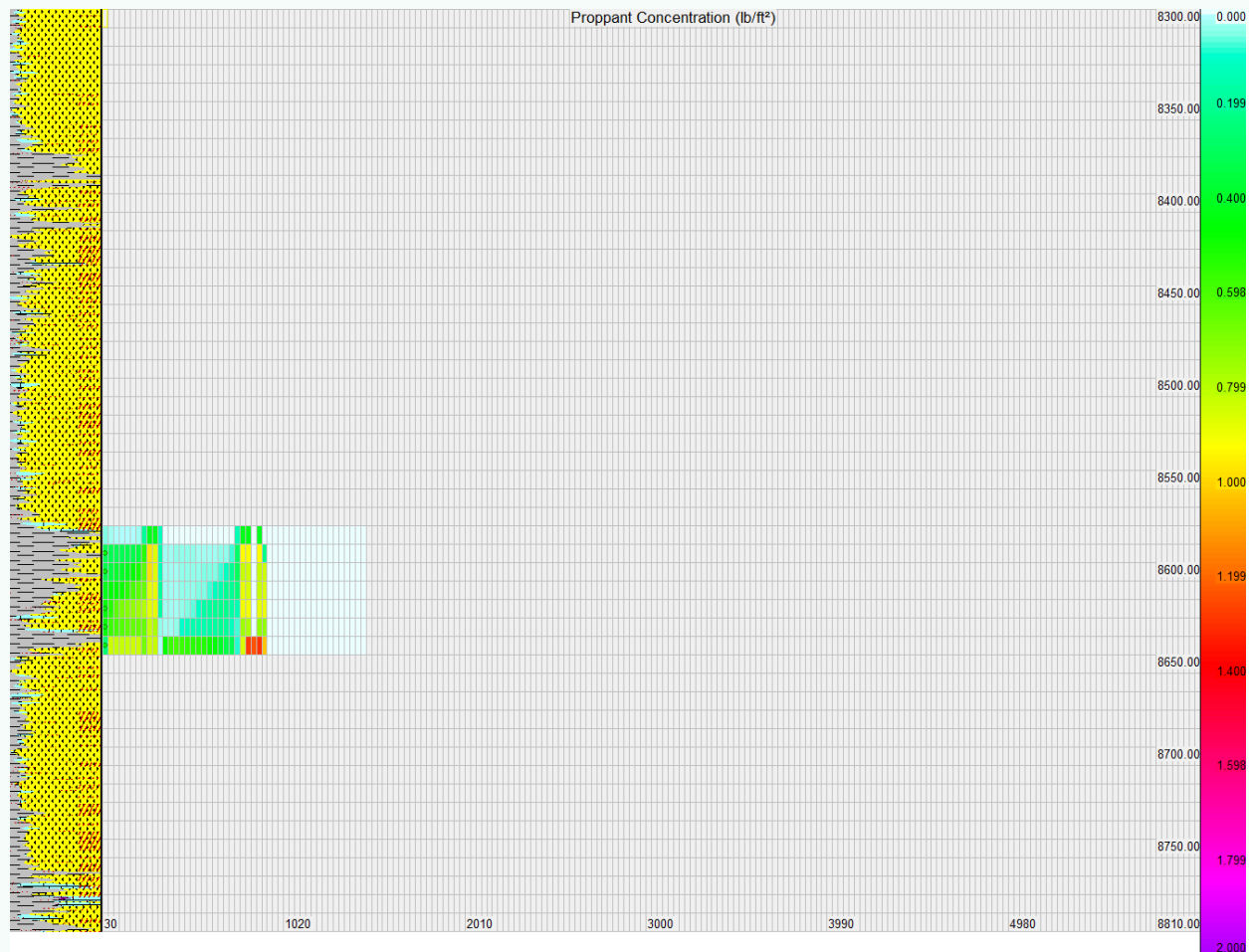
Reduced Fracture Design

Stage #	Elapsed Time:mm:ss	Stage Time:mm:ss	Fluid	Clean Stage Vol.GAL	Cum Clean Vol.GAL	Proppant	Slurry Conc.PPA	Cum Proppant.LB	Slurry Rate.BBL/M	Cum Slurry.BBL	Clean Fluid Rate.BBL/M
1	10:00	10:00	SlickWater_180F	14700.00	14700.00	<None>	0.00	0.00	35.00	350.00	35.00
2	20:00	1:28	SlickWater_180F	2100.00	16800.00	100 Mesh Sand	0.50	1050.00	35.00	401.14	34.22
3	21:28	5:43	SlickWater_180F	8400.00	25200.00	<None>	0.00	1050.00	35.00	601.14	35.00
4	27:11	2:55	SlickWater_180F	4200.00	29400.00	100 Mesh Sand	0.50	3150.00	35.00	703.41	34.22
5	30:06	5:58	SlickWater_180F	8400.00	37800.00	100 Mesh Sand	1.00	11550.00	35.00	912.51	33.48
6	36:04	5:43	SlickWater_180F	8400.00	46200.00	<None>	0.00	11550.00	35.00	1112.51	35.00
7	41:47	11:57	SlickWater_180F	16800.00	63000.00	100 Mesh Sand	1.00	28350.00	35.00	1530.72	33.48
8	53:44	5:43	SlickWater_180F	8400.00	71400.00	<None>	0.00	28350.00	35.00	1730.72	35.00
9	59:27	8:46	SlickWater_180F	12599.99	83999.99	Badger Sand 40/70	0.50	34650.00	35.00	2037.54	34.22
10	1:08:13	8:58	SlickWater_180F	12600.00	96599.99	Badger Sand 40/70	1.00	47250.00	35.00	2351.20	33.48
11	1:17:11	5:43	SlickWater_180F	8400.00	104999.99	<None>	0.00	47250.00	35.00	2551.20	35.00
12	1:22:53	14:56	SlickWater_180F	20999.99	125999.98	Badger Sand 40/70	1.00	68249.99	35.00	3073.97	33.48
13	1:37:50	5:43	SlickWater_180F	8400.00	134399.98	<None>	0.00	68249.99	35.00	3273.97	35.00
14	1:43:33	14:56	SlickWater_180F	20999.99	155399.98	Badger Sand 40/70	1.00	89249.98	35.00	3796.73	33.48
15	1:58:29	5:43	SlickWater_180F	8400.00	163799.98	<None>	0.00	89249.98	35.00	3996.73	35.00
16	2:04:12	14:56	SlickWater_180F	21000.01	184799.98	Badger Sand 40/70	1.00	110249.99	35.00	4519.50	33.48
17	2:19:08	8:00	SlickWater_180F	11760.00	196559.98	<None>	0.00	110249.99	35.00	4799.50	35.00
18	2:27:08	10:00	SlickWater_180F	0.00	196559.98	<None>	0.00	110249.99	0.00	4799.50	0.00
19	2:37:08	0:00	SlickWater_180F	0.00	196559.98	<None>	0.00	110249.99	0.00	4799.50	0.00
Total	2:37:08				196559.98			110249.99		4799.50	

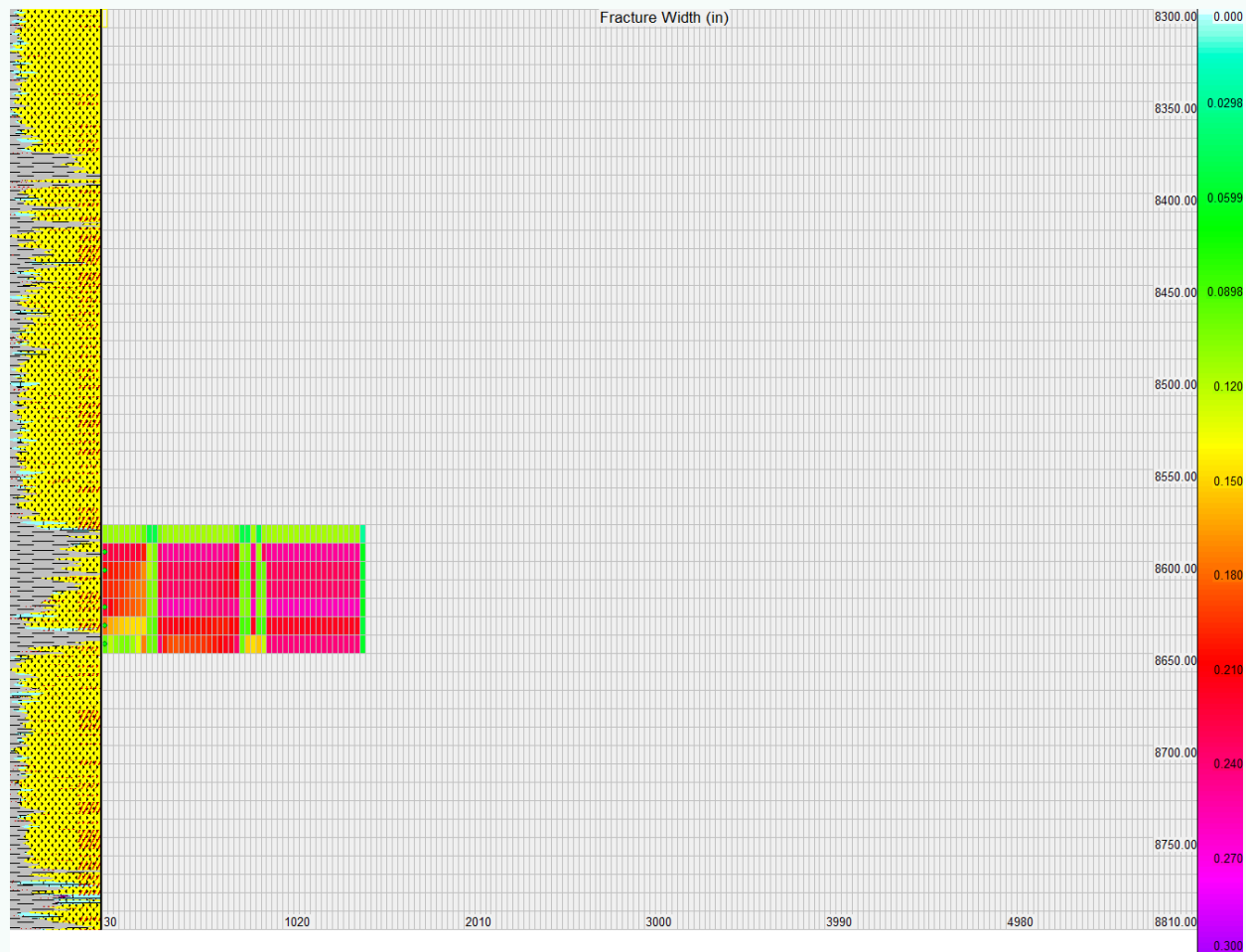
Pressure Profile



Proppant Concentration



Fracture Width



Summary

- Stage 2 pressure match showed no fracture height growth out of the perforated interval
- Reducing proppant volume and pump rate reduced the created fracture half length with no change in fracture height
- Restricted fracture height growth with slickwater in shale reservoirs is commonly observed from diagnostic techniques including radioactive tracer, temperature surveys and production logs
- Microseismic events displaced large distances vertically are commonly observed during hydraulic fracturing – these events are caused by induced deformation but are not indicators of physical fracture height growth