Utah Forge

Monitored Well: 16B(78)-32

Evolution 5 - FORGE TTU/CSULB Circulation Tests 2025

Field Operations: Aug 2025

Neubrex Energy Services (US), LLC

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Last update: March 2026

August 2025 Circulation and Huff and Puff Testing

Utah FORGE: Monitor Well 16B(78)-32

Fiber Optic Monitoring of August 2025 Circulation and Huff and Puff Tests Executed by Texas Tech University and California Statue University Long Beach

Acquisition Date: August 2024

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Expert signal processing and analysis of fiber optic data acquired during this project was provided by Dr. Artur Guzik, Mr. Sajan Khatara, and Mr. Dana Jurick, of Neubrex Energy Services (US), LLC.

FORGE August 2025 Circulation Test Key Findings

Distributed fiber optic sensing was used in the 16B as a monitor well during Cross well circulation flow testing from16A to 16B after hydraulic fracturing had been completed on both wells. Huff and Puff Tests were also completed in the 16B well after cross well circulation testing.

RFS DSS, DTS and DAS were the primary fiber measurement methods used on the Single Mode Fiber and MMF residing in metal tubes within a 1.75” OD Coiled Tubing ran from surface to 10,100 MD on 16B well. These tests were executed in the field at UTAH FORGE site in August 2025.

Circulation tests provided useful information about the distributed temperature changes associated with fluid inflow flow at 16B producer well during the test. The data were tied to a Botton Hole Gauge that measured Pressure and Temperature.

Monitored well and reference elevation

Monitored well and wells on the pad are listed in Table 1.

Table 1. Wells info

Well Name	API/UWI	MD, ft
16B(78)-32	NA	10,208.40

- Kelly Bushing (KB) is the reference elevation in this project and report
- KB is 31 feet above the casing bowl

Observer (OB) Logs and Start of TTU Experiment with Highlighted Times

	LOCAL			UTC		
18-Aug-25	[illegible]	[illegible]	18-Aug-25	[illegible]	Mob	Vehicle inspection completed ,Getting on the road
	20:30	6:00		2:30	Mob	Mobilization completed Arrived at Travelodge Milford UT
17-Aug-25	9:32	6:00	17-Aug-25	15:32	Travel	Heading to location
	9:59	6:00		15:59	Travel	Arrived at location
	10:11	6:00		16:11	Rig up	Met with Leroy S. Discussed spot of trailer. Met with Precise and located where fiber is terminated in command center
	10:46	6:00		16:46	Rig up	DAQ spotted and powered up Met with Smith L. and discussed operations briefly
	14:09	6:00		20:09	Rig up	Take OTDR traces on SM and Mm fibers. DSS fiber was broken while installing coiled tubing
	14:20	6:00		20:20	Troubelshooting	Using the WDM SR snd SB signak was good, but DAS was not. Upon further inspection it was noticed that the DAS IU was jumpered internally. Moved internal jumpers to external ports. DAS operational now
	14:40	6:00		20:40	Acquisition	Will record in UTC ... Smith L:. Requested
	14:55	6:00		20:55	Acquisition	Rig up completed .Setting up acquisition
	15:01	6:00		21:01	Acquisition	Loss good on SR
	15:07	6:00		21:07	Acquisition	Start SB baseline traces
	15:34	6:00		21:34	Acquisition	DTSX loss is good
	15:49	6:00		21:49	Acquisition	DAS signal has good signal level
	16:00	6:00		22:00	Note	Artur G. checks Das noise floor. Level is -36db. Good for acquisition
	16:01	6:00		22:01	Acquisition	Fine tune IU's for data acquisition
	16:49	6:00		22:49	Acquisition	SR environment stable
	17:03	6:00		23:03	Acquisition	Adjusting DAS settings
	17:38	6:00		23:38	Acquisition	Apply ice for depth registration. Start tap test for DAS
	17:40	6:00		23:40	Acquisition	Tap test completed
	17:48	6:00		23:48	Acquisition	DTSX offset 995.7ft
	17:49	6:00		23:49	Acquisition	SR offset 1064.3ft
	17:52	6:00		23:52	Acquisition	Offsets applied
	18:16	6:00	18-Aug-25	0:16	Travel	Departing location for Milford
	18:35	6:00		0:35	Travel	Arrived in Milford
	19:59	6:00		1:59	Note	Alec J. on remote monitoring
	20:39	6:00		2:39	Note	This is 11 feet above ground level. KB is 30 feet. Can we add 19 feet to our depths in order to report depths in KB?
	20:44	6:00		2:44	Note	New offset appied of 30'
18-Aug-25	6:20	6:00		12:20	Note	All DAS settings look ok, although I recommend to go SR 2 m and GL 2 m (they should match, it's current conclusion from JP), use the output interval 40 cm or 20 cm (but the size of files will be bigger). [8/18, 7:20 AM] Dana Jurick: Make note on recommend by artur to change das setting of SR 2m and GL 2m.
	6:27	6:00		12:27	Acquisition	DAS settings changed
	6:28	6:00		12:28	Travel	Depart Milford for location
	6:48	6:00		12:48	Travel	Arrived at location
	7:07	6:00		13:07	Note	Alec J relieved
	8:35	6:00		14:35	Note	Noted some change on 1-10 hz das fbe
	9:08	6:00		15:08	Note	In order to get the approximate well MD on the DAS FBE panels,subtract 917 feet. When I do this it puts end of useable das signal at 10120 ft, which is reasonable.
	10:00	6:00		16:00	Operations	Safety / Pre-Job meeting
	10:48	6:00		16:48	Operations	Safety meeting completed....pressure testing line soon

OB Logs and Start of TTU Experiment with Highlighted Times

	LOCAL			UTC		
	12:17	6:00		18:17	Operations	12:17 started South Seperators turbine meter test. N and S calibration doesn't work because of the fluid level in the geothermal separator
	12:27	6:00		18:27	Operations	12:27 started 3" turbine meter calibration at 2.5 5 7.5 10 BPM
	12:38	6:00		18:38	Operations	12:38, Liberty pumps had issues with suction pressure. Finished at 12:52
	12:50	6:00		18:50	Operations	12:50 opened 16B S wing valve to expose 16B South pressure transmitter
	13:15	6:00		19:15	Operations	Opened valve to 16A for a water hammer pulse attempt at 1:15
	13:16	6:00		19:16	Operations	Started injection 13:16. Liberty Forgot to zero the total volume. Total volume read 251 bbl when we started. Trucks at running at 1680-1700 RPM. Might be interesting to note this for DAS pump noise.
	13:17	6:00		19:17	Operations	We are injecting now at 10 BPM
	14:07	6:00		20:07	Note	Checking SR to insure signal is correct
	14:09	6:00		20:09	Note	Verified SR signal is good
	17:05	6:00		23:05	Travel	Departing location for Milford
	17:27	6:00		23:27	Travel	Arrived in Milford
	19:01	6:00	19-Aug-25	1:01	Note	[19:01, 8/18/2025] Smith Leggett: Liberty just switched pump trucks and accidentally brought the rate up quickly to 12 BPM
	19:01	6:00		1:01	Note	[19:01, 8/18/2025] Smith Leggett: Now they are down to 5 BPM
	19:02	6:00		1:02	Note	[19:02, 8/18/2025] Smith Leggett: This might have made a water hammer to see on DAS
	19:29	6:00		1:29	Note	They just did an accidental water hammer test again.
	21:37	6:00		3:37	Operations	21:37 valve opened to monitor the coil tubing pressure
	20:57	6:00		2:57	Note	Alec J on remote monitoring
	22:15	6:00		4:15	Operations	Shut the pumps down fully for a water hammer test at 10:15
	22:23	6:00		4:23	Operations	Started ramping back up at 22:23
	22:31	6:00		4:31	Operations	Opened valve to pressure 16B flowlines at 22:31 local time.
	22:33	6:00		4:33	Operations	Opened well on 10/64 choke at 22:33
	22:35	6:00		4:35	Operations	Opened choke to 18/64, down to 16/64, then up to 24/64
	22:42	6:00		4:42	Operations	22:42 - Leroy beat on sep turbine North
	22:55	6:00		4:55	Operations	Opened choke to 32/64 at 22:55
	23:18	6:00		5:18	Operations	Opened choke to 42/64 23:18
19-Aug-25	0:00	6:00		6:00	Operations	0:00 removed 16B 3" flow to ensure it was working properly. It rattled when it was reinstalled. This flow meter was not reliable from 0:00-14:25
	7:00	6:00		13:00	Note	Liberty was instructed to drop rate 0.5 BPM if max pressure reaches 3400 psi.
	10:00	6:00		16:00	Note	Set up MS Teams meeting for job personnel to view realtime plota
	12:50	6:00		18:50	Note	12:50 injection temperature note- had briefly switched pumps.
	13:08	6:00		19:08	Note	Water hammer test at 13:08
	13:18	6:00		19:18	Note	To be more clear, we did a hard shut-in on the 16A at 13:08. We brought the pumps back online at 13:18
	14:30	6:00		20:30	Travel	Heading to location
	14:24	6:00		20:24	Operations	14:24 16B turbine meter opened back up.
	15:00	6:00		21:00	Travel	Arrived at location
	16:34	6:00		22:34	Travel	Departed location and have arrived in Milford
	20:00	6:00		2:00	Note	20:00 16B North meter started to drift. The separator turbine measurements do not seem reliable.
	20:01	6:00		2:01	Note	Note from Precise - fiber end is 2 meters from the bull nose and the RFT is 1 meter.
	20:59	6:00	20-Aug-25	2:59	Note	Alec J on remote monitoring
20-Aug-25	7:02	6:00		13:02	Note	Alec J relieved
	7:05	6:00		13:05	Operations	Started tracer injection at 7:05 8/20
	8:00	6:00		14:00	Operations	Opened up the other side of the wellhead on the 16B at 7:57 local time to check a pressure sensor. A temporary decrease in wellhead pressure was registered but was likely not real and due to the temperature sensitivity of sensors
	9:28	6:00		15:28	Note	CT gauge operational 3411.24 psi / 408.58 F
	12:05	6:00		18:05	Operations	12:05 stopped RESMAN tracer injection, switched to freshwater to flush out the hose. Flushed line with 50 gallons FW from 12:05-12:23. Possible that some diluted RESMAN tracer entered the flow during this time. Discussed with Han's about flushing to the pit next time.
	12:06	6:00		18:06	Operations	12:06 Switched from freshwater to produced water at 3000 bbl.
	14:04	6:00		20:04	Note	At 13:51 we wrapped the surface temperature probe with insulation. We should have a reliable surface temperature measurement tonight or tomorrow morning to calibrate to
	14:37	6:00		20:37	Travel	Heading to location
	15:00	6:00		21:00	Travel	Arrived at location
	15:52	6:00		21:52	Travel	Heading to Milford
	16:18	6:00		22:18	Travel	Arrived back in Milford
	17:55	6:00		23:55	Note	17:55 Injection temperature not reliable because the Liberty Pump shut down that has the temperature probe. While it was down I wrapped insulation around the temperature probe to get a better measurement not influenced by ambient temperature.
	21:00	6:00		3:00	Note	Alec J on duty to remote monitor
21-Aug-25	0:29	6:00	21-Aug-25	6:29	Operations	Temp rising in DAQ was notified by Alec J.
	0:35	6:00		6:35	Travel	Departing for location

OB Logs and Start of TTU Experiment with Highlighted Times

	LOCAL			UTC		
	21:00	6:00		3:00	Note	Alec J on duty to remote monitor
21-Aug-25	0:29	6:00	21-Aug-25	6:29	Operations	Temp rising in DAQ was notified by Alec J.
	0:35	6:00		6:35	Travel	Departing for location
	1:02	6:00		7:02	Travel	Arrived at location
	1:07	6:00		7:07	Operations	Rooftop AC coil is frozen...set to fan to thaw
	1:23	6:00		7:23	Operations	Rooftop AC back online....will monitor here for a little while
	2:28	6:00		8:28	Operations	DAQ temp stablizing. Departing location for Milford
	2:51	6:00		8:51	Travel	Arrived in Moilford
	5:44	6:00		11:44	Note	A subtle change is noted in the amplitude of the upper das amplitude anomaly compared to previous time. The shape of that das fbe doublet is changing overnight.
	8:00	6:00		14:00	Note	Wayne on duty
	9:07	6:00		15:07	Acquisition	Start SB 8/21 15:07
	9:16	6:00		15:16	Note	DECREASED choke size to 48/64 at 9:16 local time for an RFS-DSS experiment
	9:28	6:00		15:28	Note	Our experiment to suddenly INCREASE wellhead pressure resulted in a vertical red streak. Now we are seeing "cooling" thermal slugs. The inverse of what happened when we opened the choke
	9:50	6:00		15:50	Note	Fast open of choke back to 56/64 (look on DAS for water hammer) then gradual open to 62/64
	10:14	6:00		16:14	Operations	Tapped on the 3" turbine meter as it was making a rattling noise. Rattling lessened but temporarily. Flow rate remained the same. Going to change out the flowmeter
	12:30	6:00		18:30	Acquisition	Stop SB 8/21 16:28
	14:31	6:00		20:31	Operations	Temp is spiking...SR offline
	14:32	6:00		20:32	Operations	Lyve drives arrived
	14:47	6:00		20:47	Travel	Lyve drives in hand heading to location
	15:08	6:00		21:08	Travel	Arrived at location
	15:15	6:00		21:15	Operations	Both AC unit are frozen ...thawing now
	15:19	6:00		21:19	Operations	Rooftop AC operational
	15:40	6:00		21:40	Operations	Turbine meter back online 3:40
	16:13	6:00		22:13	Note	Portable AC down and will not recover. Heading to hardware store in Milford
	16:39	6:00		22:39	Travel	AC in hand heading to location
	17:16	6:00		23:16	Operations	Arrived at location....new AC setup and operational
	17:28	6:00		23:28	Operations	Shut in the 16B at 17:28 to change a leaking valve in the flowline
	17:36	6:00		23:36	Acquisition	RFS IU warming up...had to reset brillioun as well
	17:54	6:00		23:54	Operations	Opened well at 17:50. Increasing choke size incrementally
	17:57	6:00		23:57	Acquisition	Restart SR and DTSX recording now
	18:15	6:00	22-Aug-25	0:15	Note	Note from Smith L. 17:28 Shut in the 16B to repair a leaking flowline valve The 16B pressured up quickly. The wellhead flow cross valve was closed to try and zero a Pason pressure transducer. Pason tech did not answer the phone on how to do this. Decision was made to open the well. Shortly before opening the well, we had Liberty kill the pump trucks. The was a loud bang that rattled the 16B wellhead. Unknown origin. 17:50 opened the 16B incrementally opening the choke back to 62/64.
	19:04	6:00		1:04	Operations	New AC DAQ temperature is cooling now
	19:13	6:00		1:13	Travel	Depart location for Milford
	19:28	6:00		1:28	Operations	7:28-7:29 gradually increased choke size from 62 to 84
	19:40	6:00		1:40	Travel	Arrived in Milford
	20:58	6:00		2:58	Note	Alec J on duty to remote monitor
22-Aug-25	7:58	6:00		13:58	Note	New activity showing up, zoomed into it for reference
	11:01	6:00		17:01	Travel	Departing for location
	11:24	6:00		17:24	Travel	Arrived at location
	11:32	6:00		17:32	Operations	SLB rigging up
	11:55	6:00		17:55	Note	Backup lyve drives are unlocked and ready for use
	12:17	6:00		18:17	Operations	SLB stabbed onto well 16A....preparing to RIH
	12:50	6:00		18:50	Operations	SLB RIH
	13:05	6:00		19:05	Operations	01:05 pm – At 500 ft, tool weight observed → injection started at 3 bpm, then 7 bpm, reached 10 bpm within 10 minutes
	14:47	6:00		20:47	Operations	2:20 pm – RIH, depth 4,550 ft, inj 10 bpm, WHP 3,000 psi
	15:10	6:00		21:10	Operations	3:10 pm – At 7,100 ft, entered 60° deviation interval
	17:01	6:00		23:01	Operations	5:01 pm fluid level shot
	17:48	6:00		23:48	Operations	At 9000ft doing station log, since 4pm Another 50 mins to go at this depth
	21:00	6:00		3:00	Note	Alec J on remote monitoring
	21:29	6:00	23-Aug-25	3:29	Operations	SLB Wireline Operation Updates at 7:20 pm Issue occurred with the grease unit, seal could not be held.Only 5 stations completed on the downlog. Pulled out of hole and rigged down to maintain well control.
23-Aug-25	6:57	6:00		12:57	Note	Latest update for wireline operation they can have another unit to wellsite earliest this evening
	8:30	6:00		14:30	Note	Wayne on Duty
	17:57	6:00		23:57	Note	Matt B. called SLB they will run in hole at 5:30 am tomorrow, they should rig down around 1:00 or 2:00
						Circulation conditions have been very stable all day. Injection rate into 16A is 10 bpm @ 3,963 psi WHP. Outflow

OB Logs and Start of TTU Experiment with Highlighted Times

	LOCAL			UTC		
						minutes
	14:47	6:00		20:47	Operations	2:20 pm – RIH, depth 4,550 ft, inj 10 bpm, WHP 3,000 psi
	15:10	6:00		21:10	Operations	3:10 pm – At 7,100 ft, entered 60° deviation interval
	17:01	6:00		23:01	Operations	5:01 pm fluid level shot
	17:48	6:00		23:48	Operations	At 9000ft doing station log, since 4pm Another 50 mins to go at this depth
	21:00	6:00		3:00	Note	Alec J on remote monitoring
	21:29	6:00	23-Aug-25	3:29	Operations	SLB Wireline Operation Updates at 7:20 pm Issue occurred with the grease unit, seal could not be held.Only 5 stations completed on the downlog. Pulled out of hole and rigged down to maintain well control.
23-Aug-25	6:57	6:00		12:57	Note	Latest update for wireline operation they can have another unit to wellsite earliest this evening
	8:30	6:00		14:30	Note	Wayne on Duty
	17:57	6:00		23:57	Note	Matt B. called SLB they will run in hole at 5:30 am tomorrow, they should rig down around 1:00 or 2:00
	18:28	6:00	24-Aug-25	0:28	Note	Circulation conditions have been very stable all day. Injection rate into 16A is 10 bpm @ 2,962 psi WHP. Outflow rate from 16B is 6.4 bpm @ 235 psi WHP. Outflow temperature is 358 degF.
	21:00	6:00		3:00	Note	Alec J on remote monitoring
24-Aug-25	5:37	6:00		11:37	Operations	Hard shutdown 16A at 05:37 Mountain time. Getting the PLT tool into the wellbore.
	7:31	6:00		13:31	Operations	PLT running in hole currently at 1200ft
	8:01	6:00		14:01	Note	Wayne on Duty
	9:06	6:00		15:06	Operations	Plt at 6000 MD
	9:22	6:00		15:22	Operations	Plt at 7000 MD
	10:09	6:00		16:09	Operations	Plt at 9000 MD
	10:55	6:00		16:55	Operations	8997 static depth measurent station
	21:00	6:00	25-Aug-25	3:00	Note	Alec J on duty to remote monitor
	21:31	6:00		3:31	Operations	Hard shutdown of Liberty pumps at 21:31 Mountain Time.
25-Aug-25	5:51	6:00		11:51	Travel	Wayne heading to location
	6:18	6:00		12:18	Travel	Arrived at locatioon. Alec J. relieved
	6:44	6:00		12:44	Operations	Shut down at 12:08 UTC 8/25/25
	9:28	6:00		15:28	Operations	DAS data is being stored on a new 72TB drive and RFS and DTS are still writing to the original drive we started with
	9:52	6:00		15:52	Travel	Departing location for Milford
	10:12	6:00		16:12	Travel	Arrived in Milford
	13:30	6:00		19:30	Travel	Heading to location temp rising in DAQ
	14:29	6:00		20:29	Operations	DAQ is cooling.... Rooftop AC was frozen. Will stay on location and monitor for a while
	15:14	6:00		21:14	Travel	Temp in DAQ is still dropping in temperature should level out soon Departing location for Milford
	15:39	6:00		21:39	Travel	Arrived in Milford
	18:58	6:00	26-Aug-25	0:58	Travel	DAS lost remote desktop connection....heading to location
	19:26	6:00		1:26	Travel	Arrived at location....10gbe converter needed reset
	19:51	6:00		1:51	Operations	When the Ethernet converter lost connection data was not being transferred to the lyve drive... Will take time for RFS display to catch up
	20:36	6:00		2:36	Operations	Everything getting back to normal on DAQ cooling and RFS display has almost caught up to current time. No data lost.
	20:27	6:00		2:27	Travel	Heading to Milford
	21:04	6:00		3:04	Operations	Alec J. on remote monitoring
	22:25	6:00		4:25	Operations	SB finished 01:48~4:22UTC 8//26/2025

Field Testing Schedule for CSULB Experiment

CSULB Huff Puff Tracer and Injection Volumes

	Start	End	CSULB Activity	Rate (bpm)	Inj/Ret Duration (min)	Inj Vol (bbl)	Ret Vol (bbl)	Chase Vol (bbl)	Pump Hrs
1	8/26/25 13:38	8/26/25 17:01	Injection 1: Tracer 1	2.5	203	507		187	3.4
1	8/26/25 17:01	8/26/25 21:20	Flowback 1	2.5	259		648		
2	8/27/25 9:20	8/27/25 13:58	Injection 2: Tracer 2	2.5	278	695		375	4.6
2	8/27/25 13:58	8/27/25 20:06	Flowback 2	2.5	368		920		
3	8/28/25 7:17	8/28/25 13:10	Injection 3: Tracer 3	2.5	353	882		562	5.9
3	8/28/25 13:10	8/28/25 21:12	Flowback 3	2.5	482		1205		
4	8/29/25 6:32	8/29/25 8:06	Injection 4: Tracer 4	5	94	470		150	1.6
4	8/29/25 8:08	8/29/25 10:44	Flowback 4	5	156		780		
4	8/29/25 13:57	8/29/25 14:59	Injection 5: Tracer 5	7.5	63	470		150	1.0
4	8/29/25 14:59	8/29/25 16:30	Flowback 5	7.5	90		677		
			Totals			**3025**	**4230**		**17**

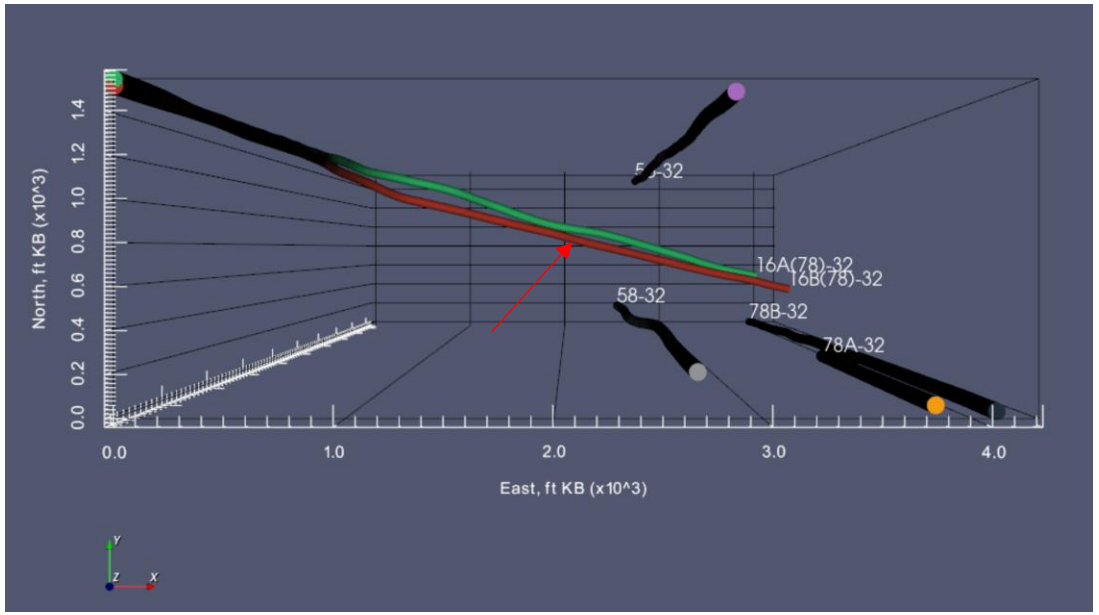
All times are in local Time Zone.
See Neubrex OB logs For local time Reporting.

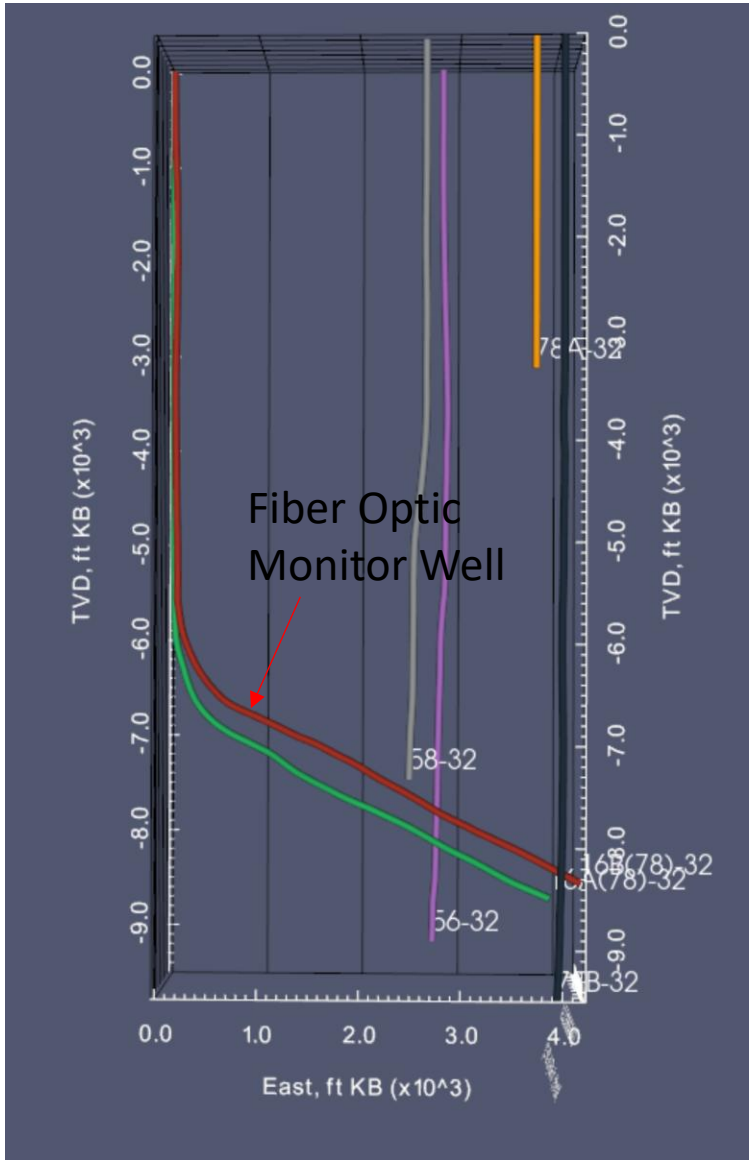
Borehole Volume	320	Targets:	Injection Duration to Displace Borehole Vol
Pumping Time	16.5		Backflow vol = BH Vol + 2x Chase except Test 5
Total Fluid Injected	3025		Tracer volume is 25% of chase volume
Total Fluid Ret	4230		Total Fluid Injection <3400 bbl

Well Survey Renderings

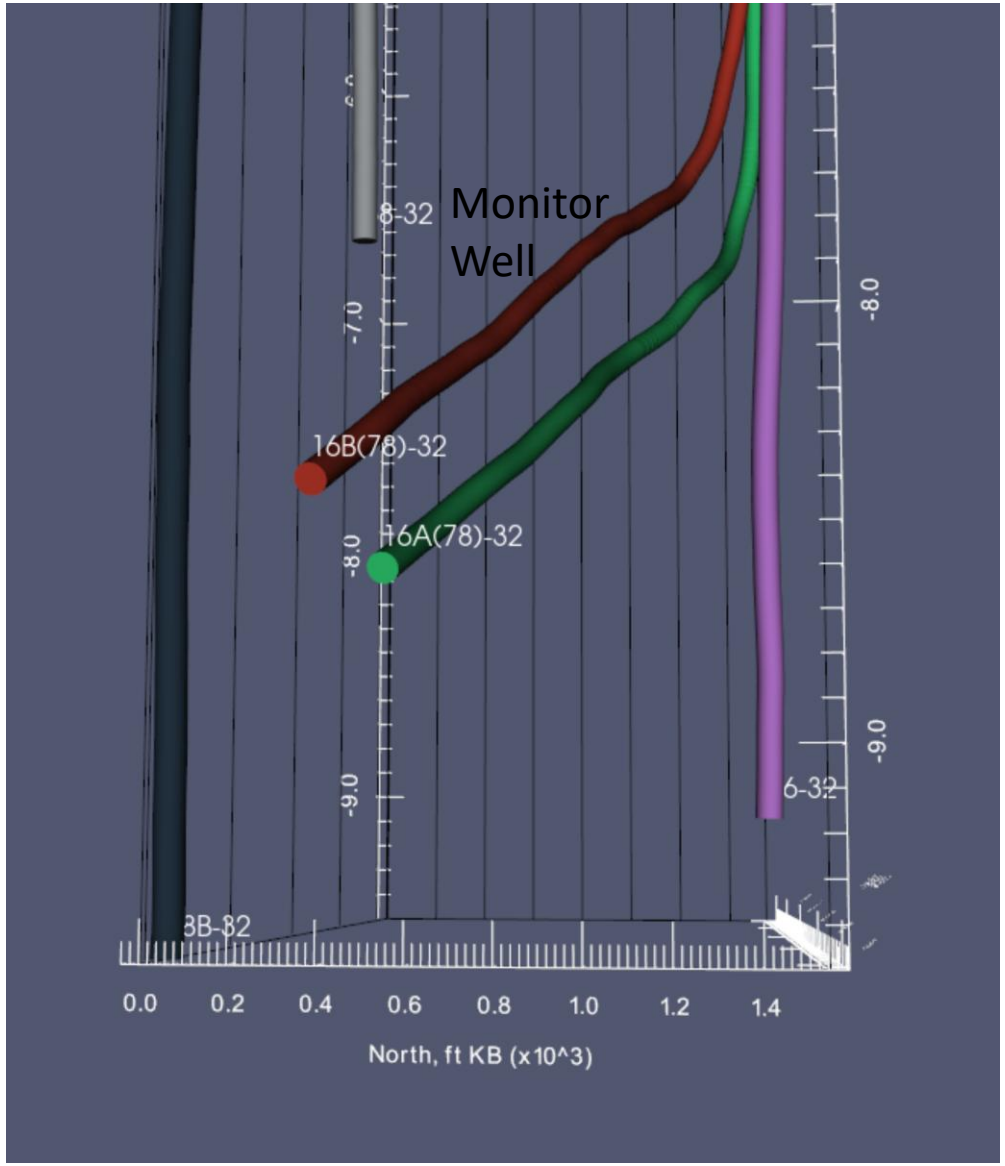
Based on schematics and deviation survey data provided by Operator

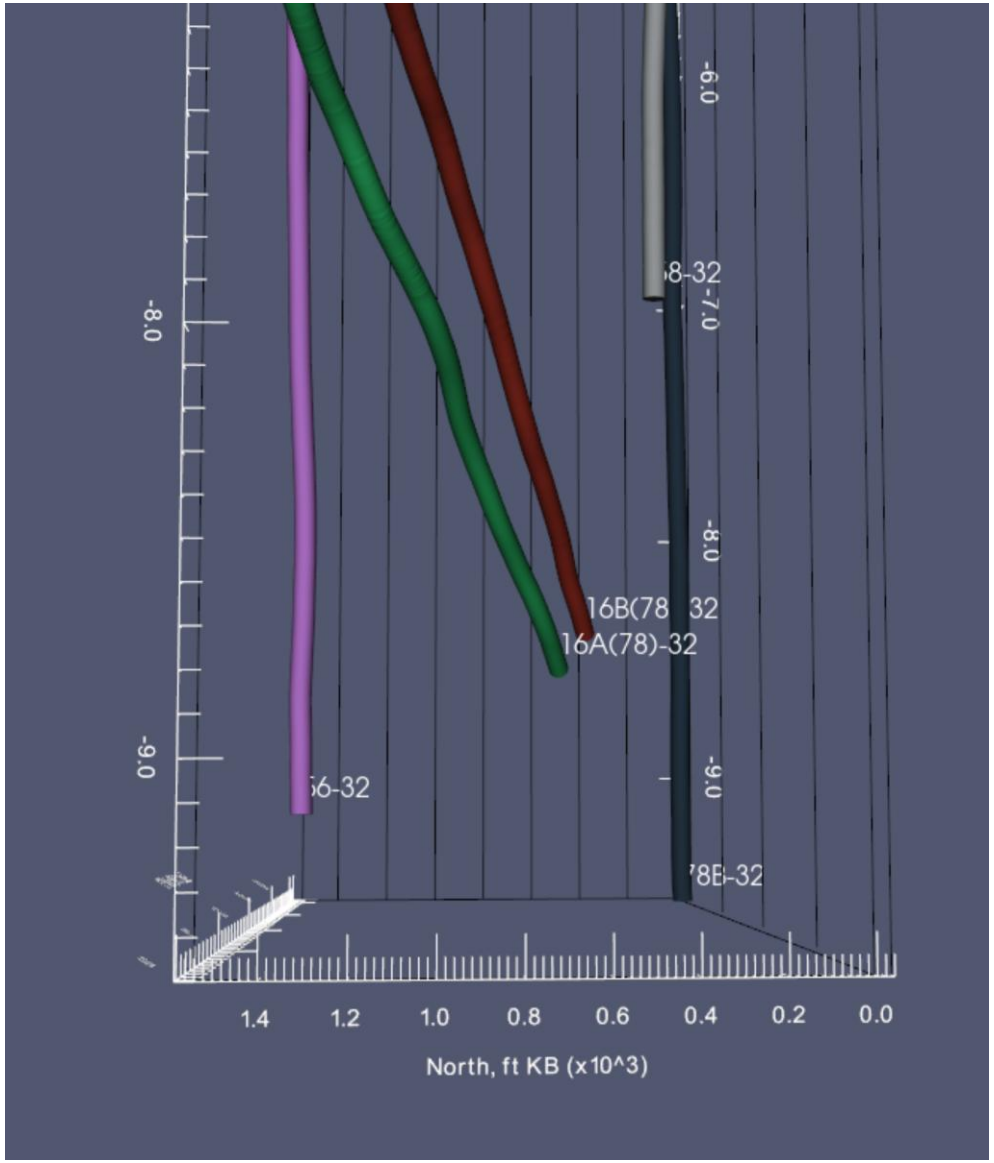
Monitored well 16B (78)-32 and other wells in project



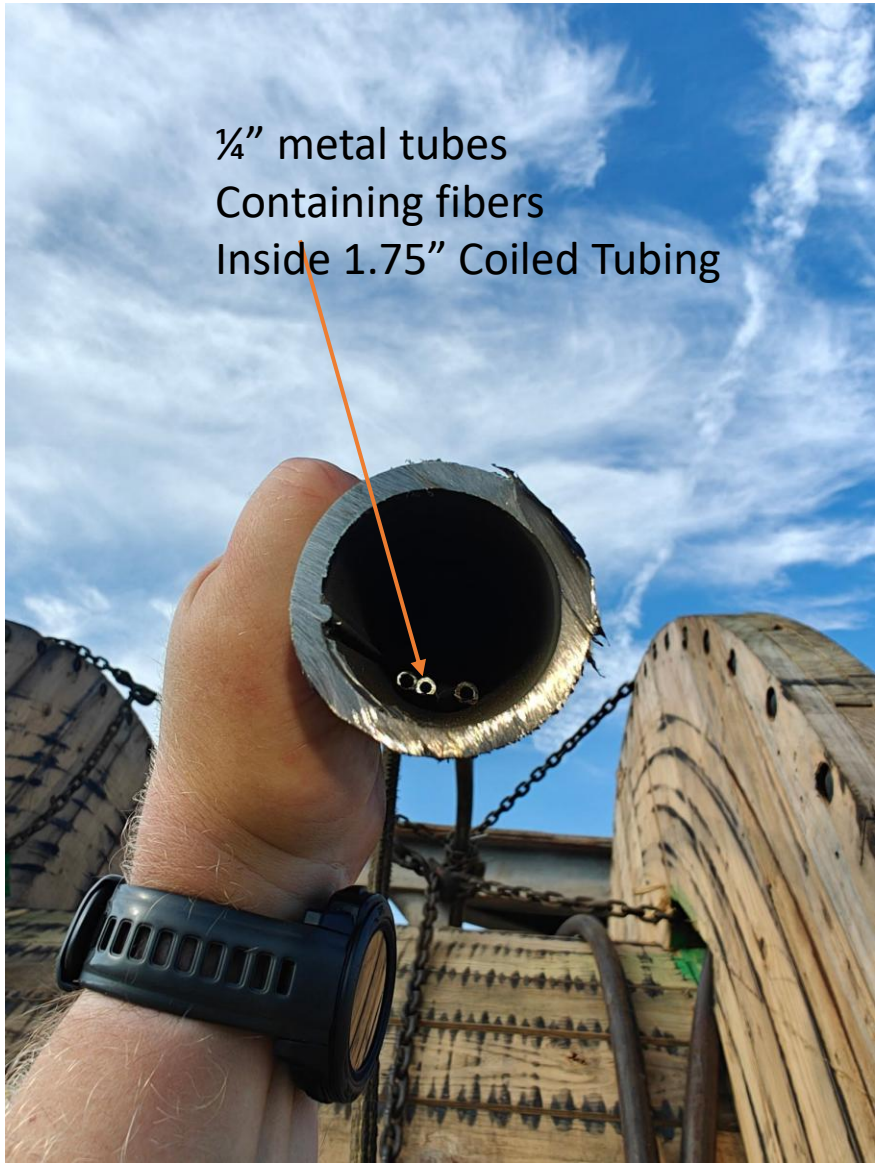


Monitored well and other wells in project

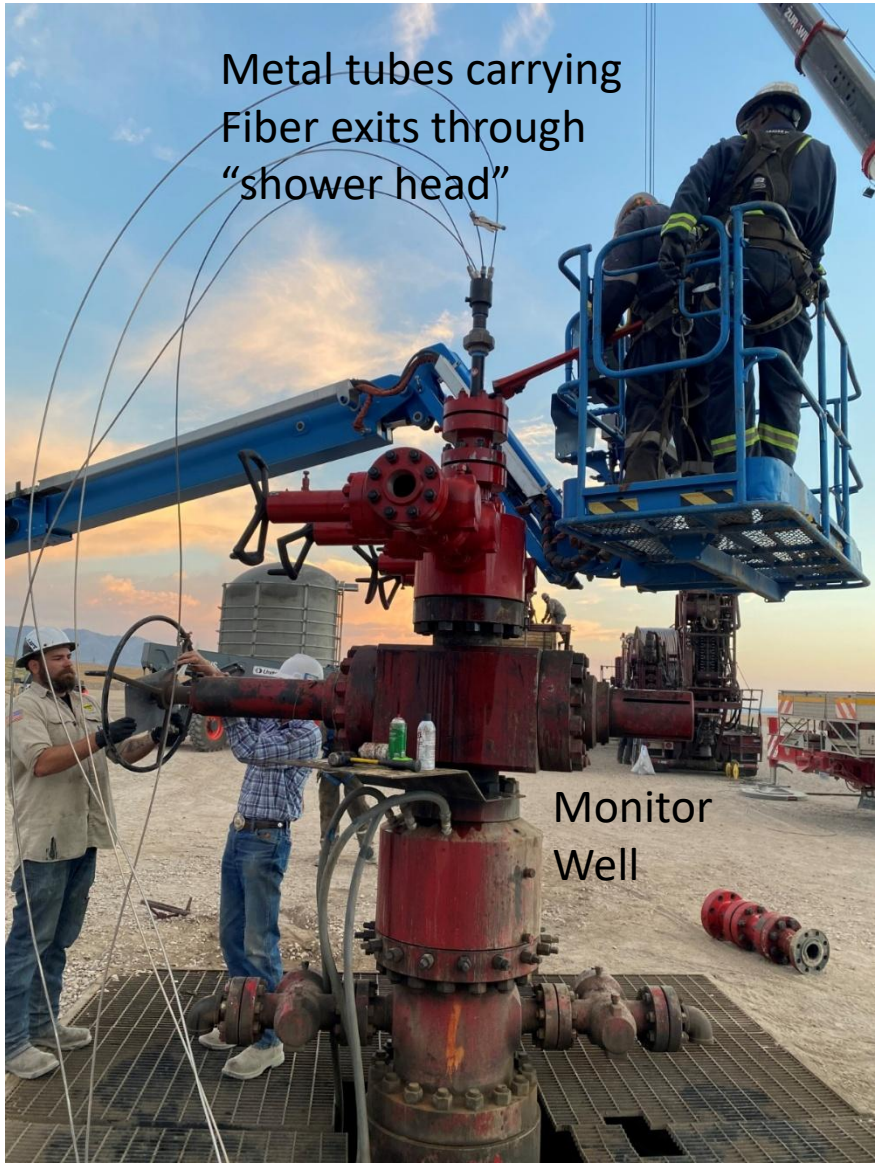


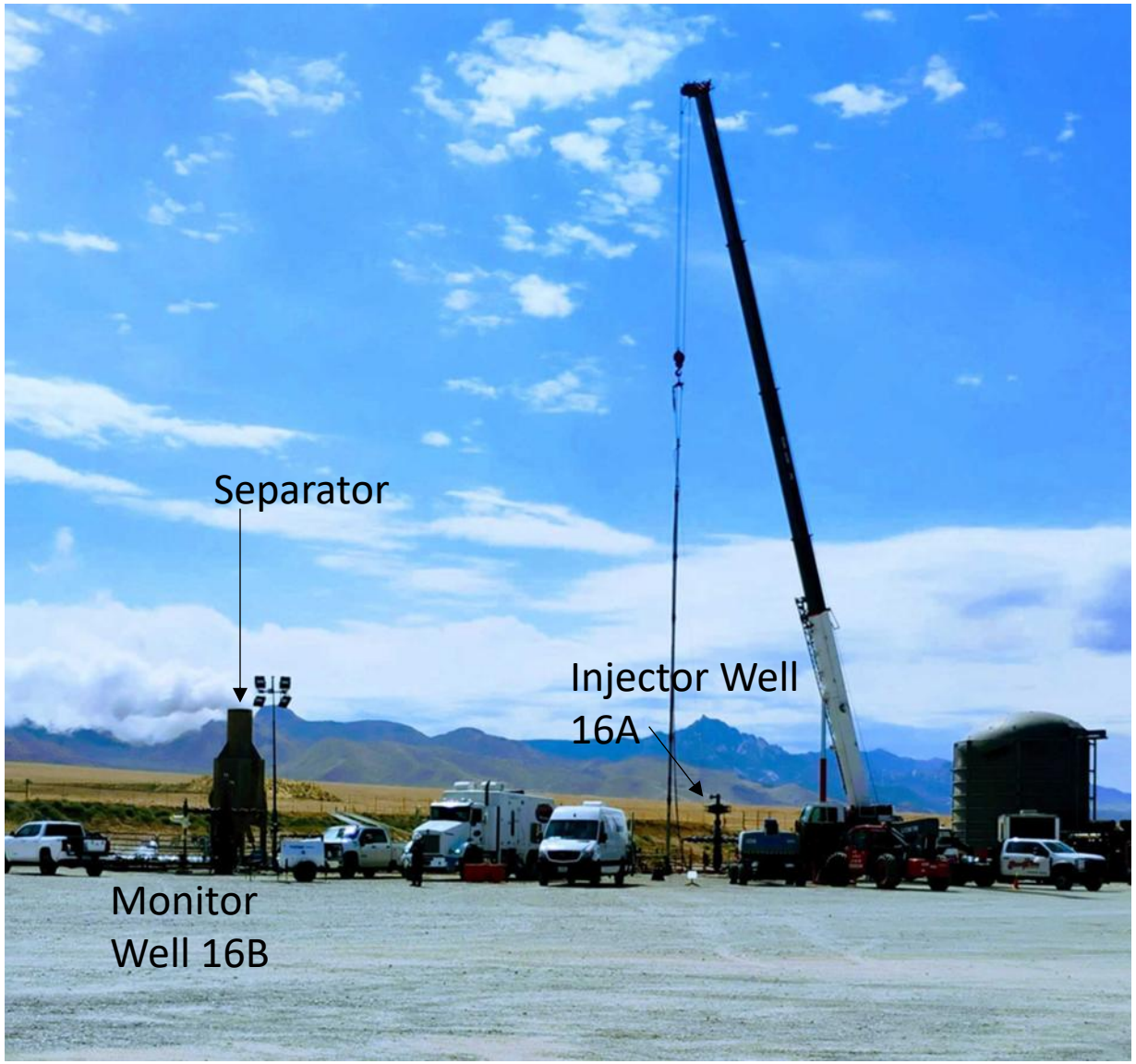


Coiled Tubing (CT) with Fiber in Metal Tubes (FIMT)



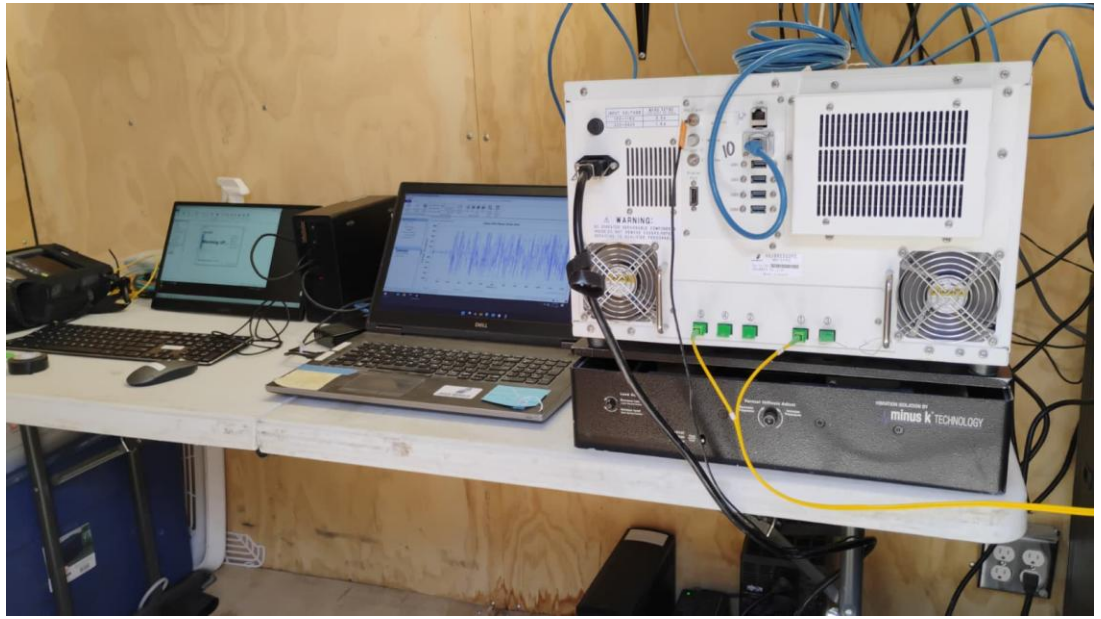
CT deployment and Fiber Optics Exiting Well Head





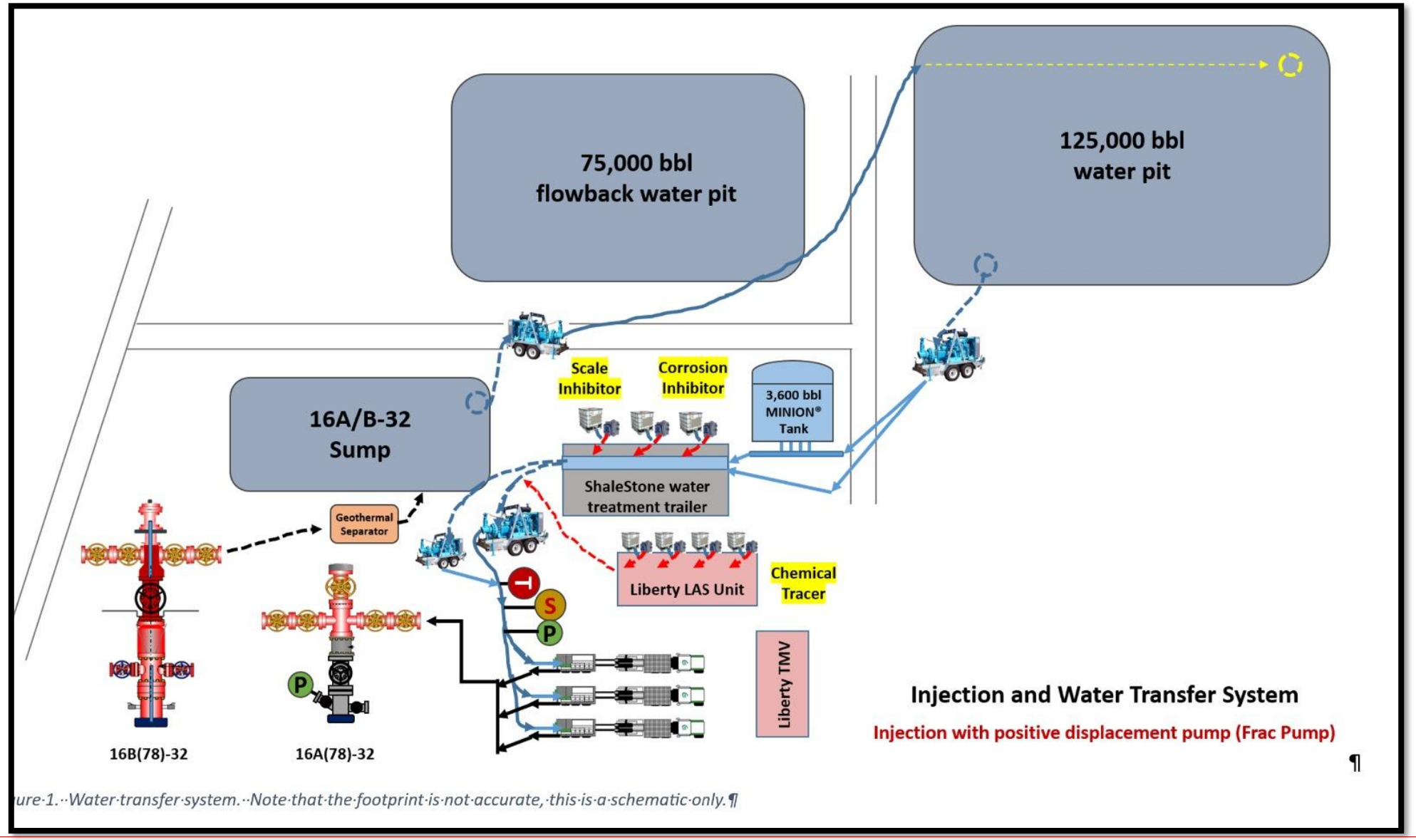
Neubrex Data Acquisition Unit and Interrogator Unit Device

Neubrex DAQ Trailer Unit and Work Van



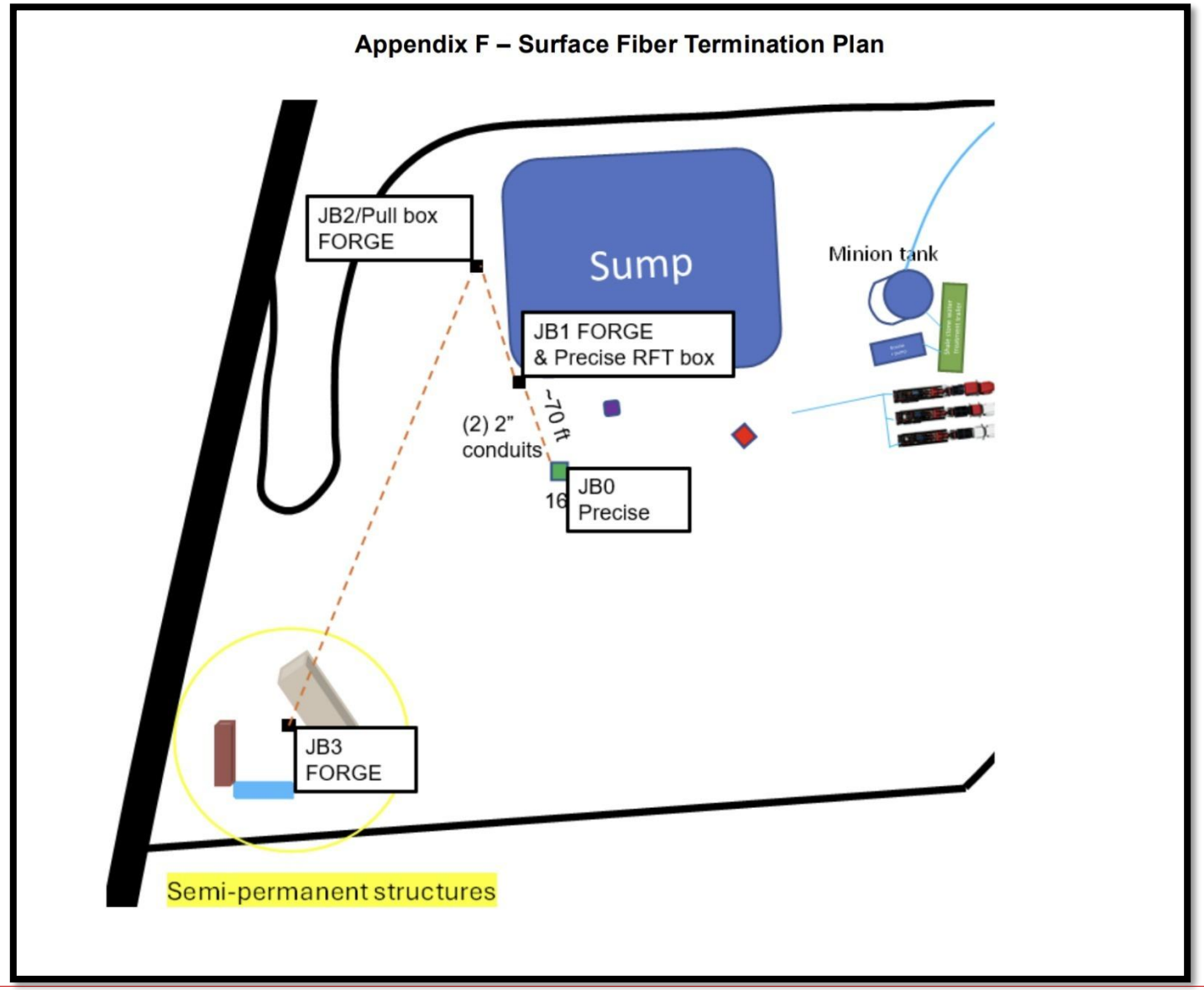
Neubrex DAS IU on Anti Vibration Table and computer workstations

Water transfer system scheme from experiment



ure·1.··Water·transfer·system.··Note·that·the·footprint·is·not·accurate,·this·is·a·schematic·only.¶

Junction Box (JB) arrangement scheme



Measurements type and target

Information on measurements type and acquired signals

Measurements type

- Monitoring target:
  - Strain and temperature changes on the monitored well

- Measurements:
  - Rayleigh Frequency Shift
    - (from reference time and at each depth) strain change; relative strain change
    - Rayleigh frequency shift, profile time to profile time, strain change rate (dRFS/dt)
  - Brillouin absolute strain
    - Brillouin wavelength center frequency converted to absolute total strain
  - DTS
    - Raman based temperature sensing measurements
  - DAS
    - Time Gated Digital Distributed Acoustic Sensing (TGD DAS) measurements

Measurement Units

The time zone and unit system

Measurement units

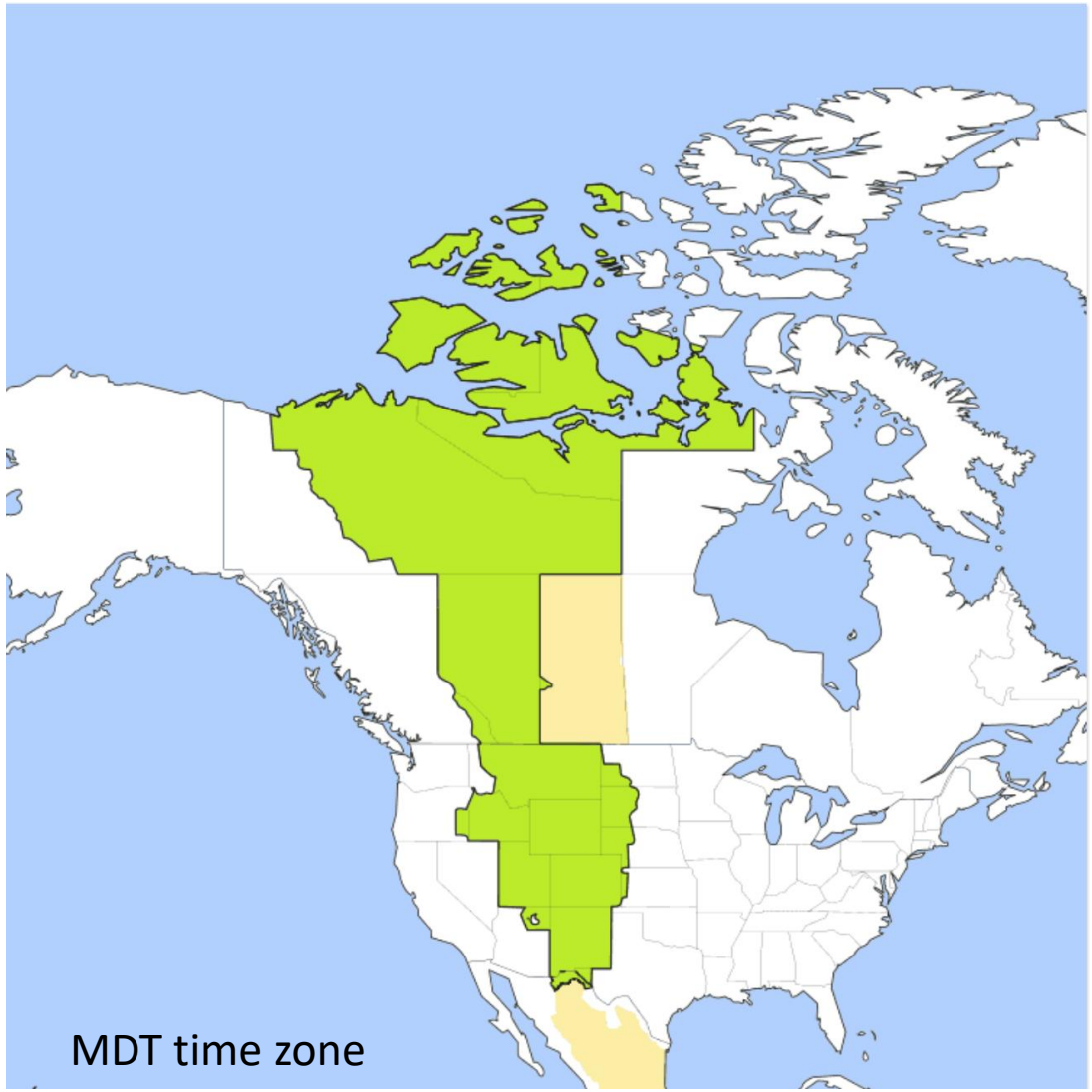
- Imperial (US) units are used in the report
  - Distance – foot, ft
  - Temperature – Fahrenheit degree, °F
  - Pressure – pound per square inch, psi

- Values of strain reported as micro-strain, με
  - Unless stated otherwise

Time zone

- Results reported in this document are in ***Coordinated Universal Time (UTC)***

- Local time zone was ***Mountain Daylight Time (MDT)***
  - UTC Offset: UTC −6

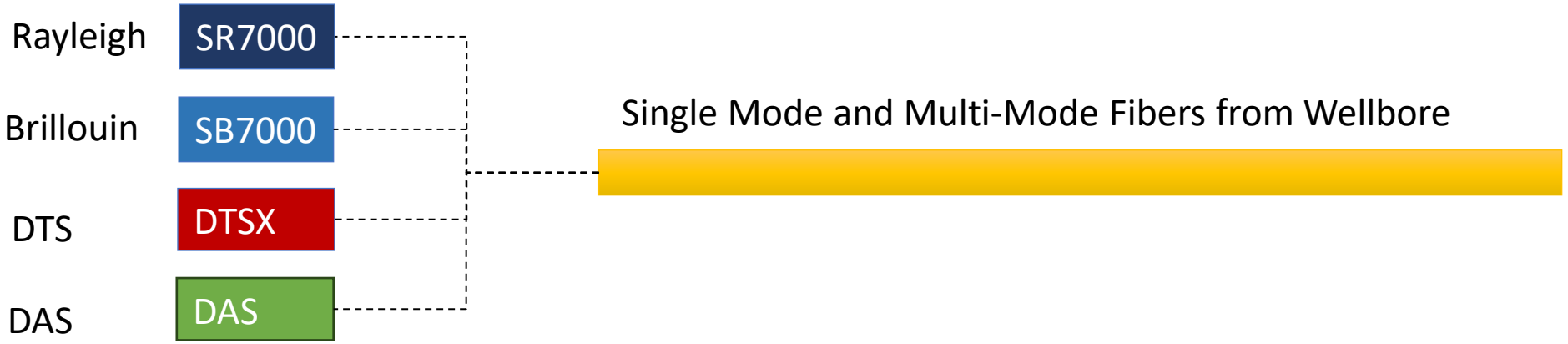


Fiber connection scheme

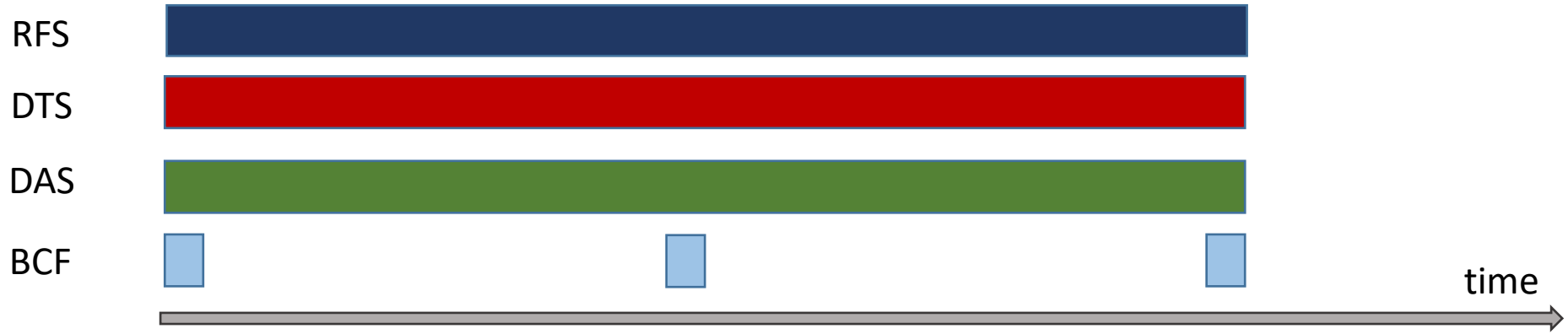
Connection of NBX instruments to CT fibers

Connection scheme

- Instruments are connected to the different SM and/or MM fibers
  - Continuous acquisition of DTS, RFS, and DAS was achieved during the survey time



Measurements types and sensing pattern over time



NES interrogator units: type, SN, and Connection details

Table 3. List of NES interrogators used during acquisition

Interrogator Information		
IU Type	**IU Serial Number**	**Extension Cable Color / Number**
SB	SB36103001002	SM1 from DAQ to Command Center to JB2 to JB 1 to wellhead
SR	SR19611001003	SM1 from DAQ to Command Center to JB2 to JB 1 to wellhead
DTS	NB3-10100226-02	MM1 from DAQ to Command Center to JB2 to JB 1 to wellhead
DAS	S236105001002	SM1 from DAQ to Command Center to JB2 to JB 1 to wellhead

Fibers

- The following fibers were used during data acquisition:

Table 3. Fibers used during acquisition

Name	Type	IOR	Length
SMF 1	SM	1.4782	10,100
MM 1	MM	1.4790	10,100

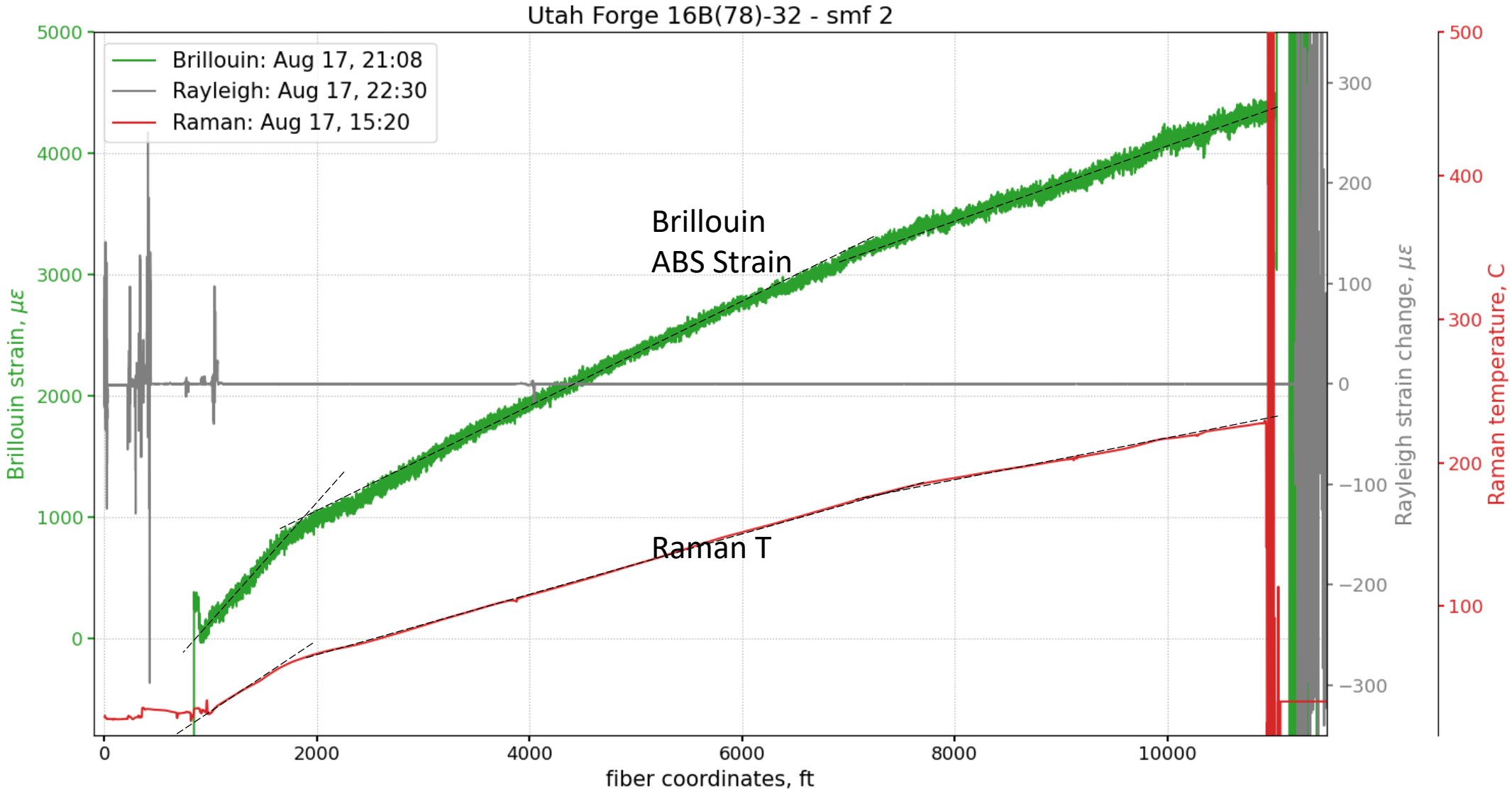
Depth calibration

This Section contains the depth mapping of the fiber optics on monitored well.

Depth calibration marking – ice and tap tests

- Ice test was used to detect the location on RFS and DTS IUs
- Tap test for DAS (see arrow)
- The location of the ice is 9 ft above the GL
- **Kelly Bushing of original rig is the elevation reference for this project and report in order to align depths with previous works, logs and other data sets.**

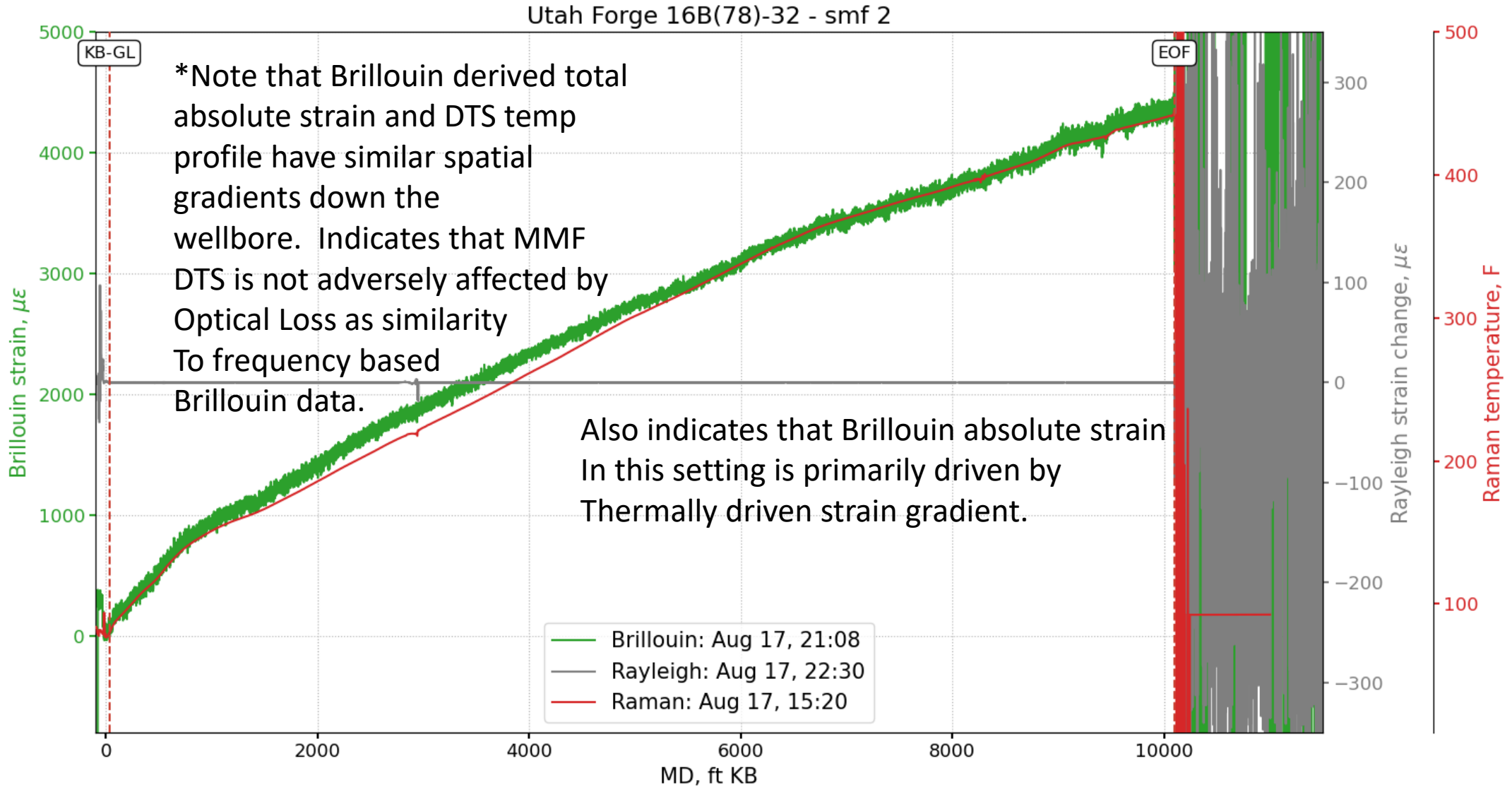
Well 16B – fiber coordinates (Original Lengths, no calibration)



Depth calibration findings from Neubrex workflow and data

- Final measured depth of the fiber termination = **10,091.0 MD, ft KB**
- KB = **31.0 ft MD**
  - CT deployment crew report
  - Reference location: GL
- **Depth Contraction coefficient (SMF 1/MMF 1)**:
  - RFS = 0.9975
  - BCF = 0.9975
  - DTS = 1.0160
  - DAS = 0.9975
- **Offset Correction Distances (SMF 1/MMF 1)**:
  - RFS: 1,082.0 ft
  - BCF: 911.0 ft
  - DTS: 1,001.7 ft
  - DAS: 902.2 ft

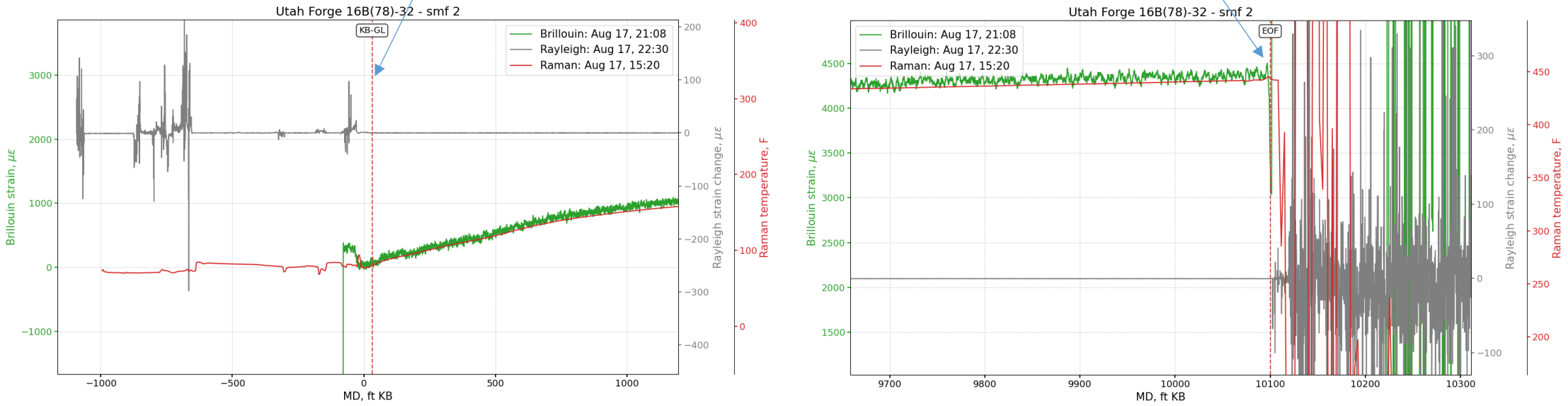
Well 16B – depth calibrations applied to BCF, RFS, and DTS



Well 16B – Depth calibration at Wellhead and Termination

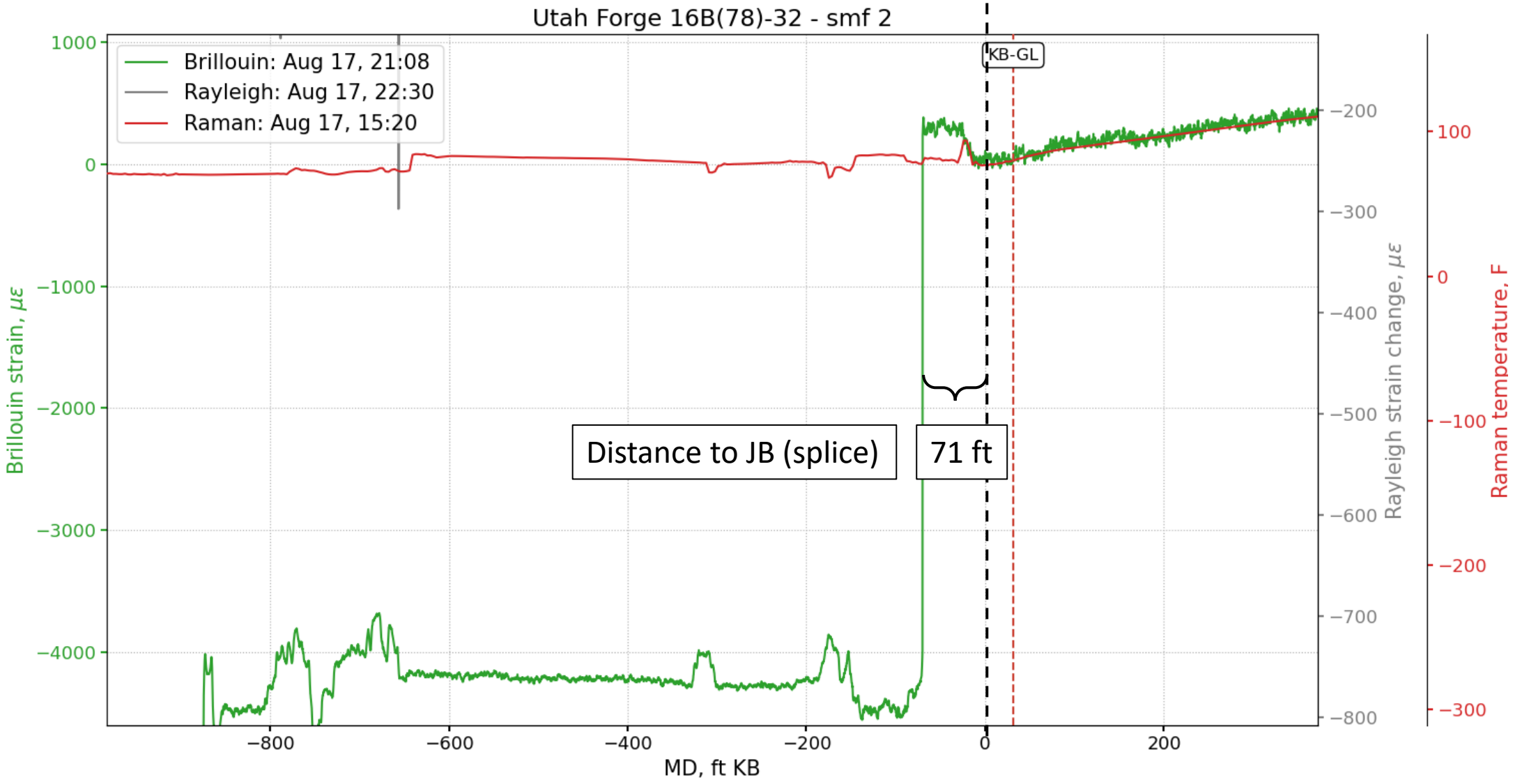
wellhead and GL

termination



Brillouin, Rayleigh, and Raman signals distributions

Well 16B – distance to JB



Summary of Depth Calibration – Fiber to Well MD Results

- The following offsets and scaling factors were derived from data analysis and are used in all subsequent plots to convert fiber coordinates to Well MD RKB coordinates
- Conversion method:
  - scaling factor is applied first, then offset value applied

Well 16B – SMF 1/MMF 1

Data type	Offset, ft	Scaling factor
Brillouin	911.0	0.9975
Rayleigh	1,082.0	0.9975
DTS	998.7	1.0160
DAS	902.2	0.9975

Observer (OB) Logs

Notes made on location by Operations Director Wayne Fishback (NES).

OB Logs (1/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
15-Aug-25	6:10	6:00	15-Aug-25	12:10	Mob	Getting on the road. Shooting for Morairty NM today.
	20:11	6:00		2:11	Mob	Arrived in Morairty NM safely.
16-Aug-25	8:47	6:00	16-Aug-25	14:47	Mob	Vehicle inspection completed ,Getting on the road
	20:30	6:00		2:30	Mob	Mobilization completed Arrived at Travelodge Milford UT
17-Aug-25	9:32	6:00	17-Aug-25	15:32	Travel	Heading to location
	9:59	6:00		15:59	Travel	Arrived at location
	10:11	6:00		16:11	Rig up	Met with Leroy S. Discussed spot of trailer. Met with Precise and located where fiber is terminated in command center
	10:46	6:00		16:46	Rig up	DAQ spotted and powered up Met with Smith L. and discussed operations briefly
	14:09	6:00		20:09	Rig up	Take OTDR traces on SM and Mm fibers. DSS fiber was broken while installing coiled tubing
	14:20	6:00		20:20	Troubelshooting	Using the WDM SR snd SB signak was good, but DAS was not. Upon further inspection it was noticed that the DAS IU was jumpered internally. Moved internal jumpers to external ports. DAS operational now
	14:40	6:00		20:40	Acquisition	Will record in UTC ... Smith L:. Requested
	14:55	6:00		20:55	Acquisition	Rig up completed .Setting up acquisition
	15:01	6:00		21:01	Acquisition	Loss good on SR
	15:07	6:00		21:07	Acquisition	Start SB baseline traces
	15:34	6:00		21:34	Acquisition	DTSX loss is good
	15:49	6:00		21:49	Acquisition	DAS signal has good signal level
	16:00	6:00		22:00	Note	Artur G. checks Das noise floor. Level is -36db. Good for acquisition
	16:01	6:00		22:01	Acquisition	Fine tune IU's for data acquisition
	16:49	6:00		22:49	Acquisition	SR environment stable
	17:03	6:00		23:03	Acquisition	Adjusting DAS settings
	17:38	6:00		23:38	Acquisition	Apply ice for depth registration. Start tap test for DAS
	17:40	6:00		23:40	Acquisition	Tap test completed
	17:48	6:00		23:48	Acquisition	DTSX offset 995.7ft
	17:49	6:00		23:49	Acquisition	SR offset 1064.3ft
	17:52	6:00		23:52	Acquisition	Offsets applied
	18:16	6:00	18-Aug-25	0:16	Travel	Departing location for Milford
	18:35	6:00		0:35	Travel	Arrived in Milford
	19:59	6:00		1:59	Note	Alec J. on remote monitoring
	20:39	6:00		2:39	Note	This is 11 feet above ground level. KB is 30 feet. Can we add 19 feet to our depths in order to report depths in KB?
	20:44	6:00		2:44	Note	New offset appied of 30'
18-Aug-25	6:20	6:00		12:20	Note	All DAS settings look ok, although I recommend to go SR 2 m and GL 2 m (they should match, it's current conclusion from JP), use the output interval 40 cm or 20 cm (but the size of files will be bigger). [8/18, 7:20 AM] Dana Jurick: Make note on recommend by artur to change das setting of SR 2m and GL 2m.
	6:27	6:00		12:27	Acquisition	DAS settings changed
	6:28	6:00		12:28	Travel	Depart Milford for location
	6:48	6:00		12:48	Travel	Arrived at location
	7:07	6:00		13:07	Note	Alec J relieved
	8:35	6:00		14:35	Note	Noted some change on 1-10 hz das fbe
	9:08	6:00		15:08	Note	In order to get the approximate well MD on the DAS FBE panels,subtract 917 feet. When I do this it puts end of useable das signal at 10120 ft, which is reasonable.
	10:00	6:00		16:00	Operations	Safety / Pre-Job meeting
	10:48	6:00		16:48	Operations	Safety meeting completed....pressure testing line soon

OB Logs (2/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	11:49	6:00		17:49	Note	Lost comms to TeamViewer
	11:55	6:00		17:55	Note	Starlink outage. All acquisiton good
	12:11	6:00		18:11	Operations	12:11 started calibration North Seperators Turbine meter test 2.5 and 5 BPM
	12:17	6:00		18:17	Operations	12:17 started South Seperators turbine meter test. N and S calibration doesn't work because of the fluid level in the geothermal separator
	12:27	6:00		18:27	Operations	12:27 started 3" turbine meter calibration at 2.5 5 7.5 10 BPM
	12:38	6:00		18:38	Operations	12:38, Liberty pumps had issues with suction pressure. Finished at 12:52
	12:50	6:00		18:50	Operations	12:50 opened 16B S wing valve to expose 16B South pressure transmitter
	13:15	6:00		19:15	Operations	Opened valve to 16A for a water hammer pulse attempt at 1:15
	13:16	6:00		19:16	Operations	Started injection 13:16. Liberty Forgot to zero the total volume. Total volume read 251 bbl when we started. Trucks at running at 1680-1700 RPM. Might be interesting to note this for DAS pump noise.
	13:17	6:00		19:17	Operations	We are injecting now at 10 BPM
	14:07	6:00		20:07	Note	Checking SR to insure signal is correct
	14:09	6:00		20:09	Note	Verified SR signal is good
	17:05	6:00		23:05	Travel	Departing location for Milford
	17:27	6:00		23:27	Travel	Arrived in Milford
	19:01	6:00	19-Aug-25	1:01	Note	[19:01, 8/18/2025] Smith Leggett: Liberty just switched pump trucks and accidentally brought the rate up quickly to 12 BPM
	19:01	6:00		1:01	Note	[19:01, 8/18/2025] Smith Leggett: Now they are down to 5 BPM
	19:02	6:00		1:02	Note	[19:02, 8/18/2025] Smith Leggett: This might have made a water hammer to see on DAS
	19:29	6:00		1:29	Note	They just did an accidental water hammer test again.
	21:37	6:00		3:37	Operations	21:37 valve opened to monitor the coil tubing pressure
	20:57	6:00		2:57	Note	Alec J on remote monitoring
	22:15	6:00		4:15	Operations	Shut the pumps down fully for a water hammer test at 10:15
	22:23	6:00		4:23	Operations	Started ramping back up at 22:23
	22:31	6:00		4:31	Operations	Opened valve to pressure 16B flowlines at 22:31 local time.
	22:33	6:00		4:33	Operations	Opened well on 10/64 choke at 22:33
	22:35	6:00		4:35	Operations	Opened choke to 18/64, down to 16/64, then up to 24/64
	22:42	6:00		4:42	Operations	22:42 - Leroy beat on sep turbine North
	22:55	6:00		4:55	Operations	Opened choke to 32/64 at 22:55
	23:18	6:00		5:18	Operations	Opened choke to 42/64 23:18
19-Aug-25	0:00	6:00		6:00	Operations	0:00 removed 16B 3" flow to ensure it was working properly. It rattled when it was reinstalled. This flow meter was not reliable from 0:00-14:25
	7:00	6:00		13:00	Note	Liberty was instructed to drop rate 0.5 BPM if max pressure reaches 3400 psi.
	10:00	6:00		16:00	Note	Set up MS Teams meeting for job personnel to view realtime plota
	12:50	6:00		18:50	Note	12:50 injection temperature note- had briefly switched pumps.
	13:08	6:00		19:08	Note	Water hammer test at 13:08
	13:18	6:00		19:18	Note	To be more clear, we did a hard shut-in on the 16A at 13:08. We brought the pumps back online at 13:18
	14:30	6:00		20:30	Travel	Heading to location
	14:24	6:00		20:24	Operations	14:24 16B turbine meter opened back up.
	15:00	6:00		21:00	Travel	Arrived at location
	16:34	6:00		22:34	Travel	Departed location and have arrived in Milford
	20:00	6:00		2:00	Note	20:00 16B North meter started to drift. The separator turbine measurements do not seem reliable.

OB Logs (3/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	20:01	6:00		2:01	Note	Note from Precise - fiber end is 2 meters from the bull nose and the RFT is 1 meter.
	20:59	6:00	20-Aug-25	2:59	Note	Alec J on remote monitoring
20-Aug-25	7:02	6:00		13:02	Note	Alec J relieved
	7:05	6:00		13:05	Operations	Started tracer injection at 7:05 8/20
	8:00	6:00		14:00	Operations	Opened up the other side of the wellhead on the 16B at 7:57 local time to check a pressure sensor. A temporary decrease in wellhead pressure was registered but was likely not real and due to the temperature sensitivity of sensors
	9:28	6:00		15:28	Note	CT gauge operational 3411.24 psi / 408.58 F
	12:05	6:00		18:05	Operations	12:05 stopped RESMAN tracer injection, switched to freshwater to flush out the hose. Flushed line with 50 gallons FW from 12:05-12:23. Possible that some diluted RESMAN tracer entered the flow during this time. Discussed with Han's about flushing to the pit next time.
	12:06	6:00		18:06	Operations	12:06 Switched from freshwater to produced water at 3000 bbl.
	14:04	6:00		20:04	Note	At 13:51 we wrapped the surface temperature probe with insulation. We should have a reliable surface temperature measurement tonight or tomorrow morning to calibrate to
	14:37	6:00		20:37	Travel	Heading to location
	15:00	6:00		21:00	Travel	Arrived at location
	15:52	6:00		21:52	Travel	Heading to Milford
	16:18	6:00		22:18	Travel	Arrived back in Milford
	17:55	6:00		23:55	Note	17:55 Injection temperature not reliable because the Liberty Pump shut down that has the temperature probe. While it was down I wrapped insulation around the temperature probe to get a better measurement not influenced by ambient temperature.
	21:00	6:00		3:00	Note	Alec J on duty to remote monitor
21-Aug-25	0:29	6:00	21-Aug-25	6:29	Operations	Temp rising in DAQ was notified by Alec J.
	0:35	6:00		6:35	Travel	Departing for location
	1:02	6:00		7:02	Travel	Arrived at location
	1:07	6:00		7:07	Operations	Rooftop AC coil is frozen...set to fan to thaw
	1:23	6:00		7:23	Operations	Rooftop AC back online....will monitor here for a little while
	2:28	6:00		8:28	Operations	DAQ temp stablizing. Departing location for Milford
	2:51	6:00		8:51	Travel	Arrived in Moilford
	5:44	6:00		11:44	Note	A subtle change is noted in the amplitude of the upper das amplitude anomaly compared to previous time. The shape of that das fbe doublet is changing overnight.
	8:00	6:00		14:00	Note	Wayne on duty
	9:07	6:00		15:07	Acquisition	Start SB 8/21 15:07
	9:16	6:00		15:16	Note	DECREASED choke size to 48/64 at 9:16 local time for an RFS-DSS experiment
	9:28	6:00		15:28	Note	Our experiment to suddenly INCREASE wellhead pressure resulted in a vertical red streak. Now we are seeing "cooling" thermal slugs. The inverse of what happened when we opened the choke
	9:50	6:00		15:50	Note	Fast open of choke back to 56/64 (look on DAS for water hammer) then gradual open to 62/64
	10:14	6:00		16:14	Operations	Tapped on the 3" turbine meter as it was making a rattling noise. Rattling lessened but temporarily. Flow rate remained the same. Going to change out the flowmeter
	12:30	6:00		18:30	Acquisition	Stop SB 8/21 16:28
	14:31	6:00		20:31	Operations	Temp is spiking...SR offline
	14:32	6:00		20:32	Operations	Lyve drives arrived
	14:47	6:00		20:47	Travel	Lyve drives in hand heading to location

OB Logs (4/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	15:08	6:00		21:08	Travel	Arrived at location
	15:15	6:00		21:15	Operations	Both AC unit are frozen ...thawing now
	15:19	6:00		21:19	Operations	Rooftop AC operational
	15:40	6:00		21:40	Operations	Turbine meter back online 3:40
	16:13	6:00		22:13	Note	Portable AC down and will not recover. Heading to hardware store in Milford
	16:39	6:00		22:39	Travel	AC in hand heading to location
	17:16	6:00		23:16	Operations	Arrived at location....new AC setup and operational
	17:28	6:00		23:28	Operations	Shut in the 16B at 17:28 to change a leaking valve in the flowline
	17:36	6:00		23:36	Acquisition	RFS IU warming up...had to reset brillioun as well
	17:54	6:00		23:54	Operations	Opened well at 17:50. Increasing choke size incrementally
	17:57	6:00		23:57	Acquisition	Restart SR and DTSX recording now
	18:15	6:00	22-Aug-25	0:15	Note	Note from Smith L. 17:28 Shut in the 16B to repair a leaking flowline valve The 16B pressured up quickly. The wellhead flow cross valve was closed to try and zero a Pason pressure transducer. Pason tech did not answer the phone on how to do this. Decision was made to open the well. Shortly before opening the well, we had Liberty kill the pump trucks. The was a loud bang that rattled the 16B wellhead. Unknown origin. 17:50 opened the 16B incrementally opening the choke back to 62/64.
	19:04	6:00		1:04	Operations	New AC DAQ temperature is cooling now
	19:13	6:00		1:13	Travel	Depart location for Milford
	19:28	6:00		1:28	Operations	7:28-7:29 gradually increased choke size from 62 to 84
	19:40	6:00		1:40	Travel	Arrived in Milford
	20:58	6:00		2:58	Note	Alec J on duty to remote monitor
22-Aug-25	7:58	6:00		13:58	Note	New activity showing up, zoomed into it for reference
	11:01	6:00		17:01	Travel	Departing for location
	11:24	6:00		17:24	Travel	Arrived at location
	11:32	6:00		17:32	Operations	SLB rigging up
	11:55	6:00		17:55	Note	Backup lyve drives are unlocked and ready for use
	12:17	6:00		18:17	Operations	SLB stabbed onto well 16A....preparing to RIH
	12:50	6:00		18:50	Operations	SLB RIH
	13:05	6:00		19:05	Operations	01:05 pm – At 500 ft, tool weight observed → injection started at 3 bpm, then 7 bpm, reached 10 bpm within 10 minutes
	14:47	6:00		20:47	Operations	2:20 pm – RIH, depth 4,550 ft, inj 10 bpm, WHP 3,000 psi
	15:10	6:00		21:10	Operations	3:10 pm – At 7,100 ft, entered 60° deviation interval
	17:01	6:00		23:01	Operations	5:01 pm fluid level shot
	17:48	6:00		23:48	Operations	At 9000ft doing station log, since 4pm Another 50 mins to go at this depth
	21:00	6:00		3:00	Note	Alec J on remote monitoring
	21:29	6:00	23-Aug-25	3:29	Operations	SLB Wireline Operation Updates at 7:20 pm Issue occurred with the grease unit, seal could not be held.Only 5 stations completed on the downlog. Pulled out of hole and rigged down to maintain well control.
23-Aug-25	6:57	6:00		12:57	Note	Latest update for wireline operation they can have another unit to wellsite earliest this evening
	8:30	6:00		14:30	Note	Wayne on Duty
	17:57	6:00		23:57	Note	Matt B. called SLB they will run in hole at 5:30 am tomorrow, they should rig down around 1:00 or 2:00
	18:28	6:00	24-Aug-25	0:28	Note	Circulation conditions have been very stable all day. Injection rate into 16A is 10 bpm @ 2,962 psi WHP. Outflow rate from 16B is 6.4 bpm @ 235 psi WHP. Outflow temperature is 358 degF.
	21:00	6:00		3:00	Note	Alec J on remote monitoring
24-Aug-25	5:37	6:00		11:37	Operations	Hard shutdown 16A at 05:37 Mountain time. Getting the PLT tool into the wellbore.

OB Logs (5/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	7:31	6:00		13:31	Operations	PLT running in hole currently at 1200ft
	8:01	6:00		14:01	Note	Wayne on Duty
	9:06	6:00		15:06	Operations	Plt at 6000 MD
	9:22	6:00		15:22	Operations	Plt at 7000 MD
	10:09	6:00		16:09	Operations	Plt at 9000 MD
	10:55	6:00		16:55	Operations	8997 static depth measurent station
	21:00	6:00	25-Aug-25	3:00	Note	Alec J on duty to remote monitor
	21:31	6:00		3:31	Operations	Hard shutdown of Liberty pumps at 21:31 Mountain Time.
25-Aug-25	5:51	6:00		11:51	Travel	Wayne heading to location
	6:18	6:00		12:18	Travel	Arrived at locatioon. Alec J. relieved
	6:44	6:00		12:44	Operations	Shut down at 12:08 UTC 8/25/25
	9:28	6:00		15:28	Operations	DAS data is being stored on a new 72TB drive and RFS and DTS are still writing to the original drive we started with
	9:52	6:00		15:52	Travel	Departing location for Milford
	10:12	6:00		16:12	Travel	Arrived in Milford
	13:30	6:00		19:30	Travel	Heading to location temp rising in DAQ
	14:29	6:00		20:29	Operations	DAQ is cooling.... Rooftop AC was frozen. Will stay on location and monitor for a while
	15:14	6:00		21:14	Travel	Temp in DAQ is still dropping in temperature should level out soon Departing location for Milford
	15:39	6:00		21:39	Travel	Arrived in Milford
	18:58	6:00	26-Aug-25	0:58	Travel	DAS lost remote desktop connection....heading to location
	19:26	6:00		1:26	Travel	Arrived at location....10gbe converter needed reset
	19:51	6:00		1:51	Operations	When the Ethernet converter lost connection data was not being transferred to the lyve drive... Will take time for RFS display to catch up
	20:36	6:00		2:36	Operations	Everything getting back to normal on DAQ cooling and RFS display has almost caught up to current time. No data lost.
	20:27	6:00		2:27	Travel	Heading to Milford
	21:04	6:00		3:04	Operations	Alec J. on remote monitoring
	22:25	6:00		4:25	Operations	SB finished 01:48~4:22UTC 8//26/2025
26-Aug-25	5:00	6:00		11:00	Operations	Servers offline
	5:17	6:00		11:17	Travel	Wayne heading to location
	5:38	6:00		11:38	Travel	Arrived at location
	5:47	6:00		11:47	Operations	Stopped and restarted Teams on Server 10 and power PC . Good speed on Starlink
	6:04	6:00		12:04	Travel	Departing location for Milford
	6:26	6:00		12:26	Travel	Arrived in Milford
	6:27	6:00		12:27	Operations	Wayne on Duty
	8:54	6:00		14:54	Travel	Heading to location
	9:15	6:00		15:15	Travel	Arrived at loction
	11:11	6:00		17:11	Operations	No pumping as of yet....calibration of flow meters is supposed to be occurring.
	11:15	6:00		17:15	Note	Flow system will be modified to inject and flow back from 16A ....Flow will discharge to pump through 2" line, bypassing geothermal separator because the return temperature will be lower than for recirculation. The objectives of the fiber sensing are to (a) identify stages that are taking and returning fluid, (b) measure formation strain in stages that are transmitting fluid, (c) collect microseismic.
	13:29	6:00		19:29	Operations	Ops update....leaking manifold that will not test....decision made to use valve on wellhead instead of manifold

OB Logs (6/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	13:40	6:00		19:40	Operations	Started injection 13:40 local. Rate 2.5 BPM
	15:13	6:00		21:13	Note	(Matt B.)I see that the thermal slug has moved 4200 ft in 80 min which is 53 ft/min. From rate and borehole avail area I was expecting 80 ft/min so there is a significant thermal delay.
	17:04	6:00		23:04	Operations	Pumping just stopped
	17:06	6:00		23:06	Operations	23:06 UTC start production
	18:44	6:00	27-Aug-25	0:44	Travel	Heading to Milford....will remote monitor
	19:06	6:00		1:06	Travel	Arrived in Milford . Getting fuel
	20:59	6:00		2:59	Operations	Alec J, on duty
27-Aug-25	5:56	6:00		11:56	Travel	Heading to location
	6:20	6:00		12:20	Travel	Arrived at location. Alec J. relieved
	9:20	6:00		15:20	Operations	Pumps ramping up…start injection
	14:00	6:00		20:00	Operations	Stopped pumping 20:00 UTC
	14:20	6:00		20:20	Operations	Started backflow at 20:00 but had a leak. Shut in at 20:07, fixed leak, restarted 20:20.
	15:20	6:00		21:20	Travel	Departing location for Milford
	15:38	6:00		21:38	Travel	Arrived in Milford
	20:59	6:00	28-Aug-25	2:59	Operations	Alec J. on remote monitoring
28-Aug-25	5:55	6:00		11:55	Travel	Heading to location
	6:15	6:00		12:15	Travel	Arrived at location Alec J. relieved
	6:30	6:00		12:30	Operations	Injection detected on rfs and dts plots. 0630 local time
	6:45	6:00		12:45	Operations	15 min inject starting 2.5 BPM
	7:02	6:00		13:02	Operations	15 min backflow started 2.5 B PM
	7:16	6:00		13:16	Operations	Start injection
	13:10	6:00		19:10	Operations	Stop injection / Start flowback
	13:30	6:00		19:30	Travel	Heading to Milford
	13:52	6:00		19:52	Travel	Arrived in Milford
	20:49	6:00	29-Aug-25	2:49	Operations	Starting 920 we will shut in backflow and do a step injection test. 3,4,5… bpm 5 min each until rates pressure
	21:02	6:00		3:02	Operations	Alec J on duty to remote monitor
29-Aug-25	5:48	6:00		11:48	Travel	Heading to location
	6:10	6:00		12:10	Travel	Arrived at location. Alec J. is relieved.
	6:32	6:00		12:32	Operations	Start pumping
	6:58	6:00		12:58	Note	Pump operations occurred at 21:00 MDT last night, but no flowback was done making waterfall plots look different than before
	8:06	6:00		14:06	Operations	Shut down pumping. Rate was 5 BPM
	9:10	6:00		15:10	Operations	Flow back at 5 B PM
	11:04	6:00		17:04	Operations	Current operation.....waiting on water for injection
	13:49	6:00		19:49	Operations	Started pumping 10 BPM
	13:52	6:00		19:52	Operations	Stopped pumping
	13:53	6:00		19:53	Operations	Pumping resumed
	14:59	6:00		20:59	Operations	Stopped pumping
	15:23	6:00		21:23	Operations	Flow back on 128 /64 choke
	15:24	6:00		21:24	Travel	Departing location for Milford....will remote monitor from hotel
	15:37	6:00		21:37	Operations	Choke open all the way but still can't backflow 7.5 bpm
	16:08	6:00		22:08	Travel	Arrived in milford

OB Logs (7/7)

Date	Time		Date UTC	Time UTC	Event	Event Details
	16:54	6:00		22:54	Travel	Heading back to location server 10 is off line
	17:18	6:00		23:18	Travel	Arrived at location
	17:20	6:00		23:20	Operations	Server 10 has crashed
	18:30	6:00	30-Aug-25	0:30	Acquisition	The server back online, DSS(SR) does not have gap, processing will be catching up in a couple of hours, DTS has gap 22:30 - 0:06
	18:42	6:00		0:42	Travel	Departing location for Milford
	19:06	6:00		1:06	Travel	Arrived in Milford
	20:59	6:00		2:59	Operations	Alec J. on remote monitoring
30-Aug-25	4:48	6:00		10:48	Acquisition	Start SB baseline 10:48 UTC on 08/30/25
	5:32	6:00		11:32	Acquisition	Stop all of acquisition 11:30 UTC on 08/30/25
	5:36	6:00		11:36	Operations	Alec J relieved
	7:25	6:00		13:25	Operations	Wells have been shut in since yesterday around 16:30 local time. Rigging down flow lines and Pason this morning
	9:07	6:00		15:07	Travel	Heading to location
	9:31	6:00		15:31	Travel	Arrived at location
	9:40	6:00		15:40	Operations	Starting rig down
	12:28	6:00		18:28	Travel	Rig down completed Heading to Milford Will pick up DAQ in the morning
	13:00	6:00		19:00	Travel	Arrived in Milford
30-Aug-25	8:14	6:00	30-Aug-25	14:14	Travel	Checked out of hotel... departing for location to pick up DAQ
	8:37	6:00		14:37	Travel	Arrived at location
	8:58	6:00		14:58	Operations	Vehicle and trailer inspection completed
	9:00	6:00		15:00	Travel	Departing location….getting on the road
	20:16	6:00	30-Aug-25	2:16	Travel	Arrived in Grants NM for the night
31-Aug-25	8:28	6:00		14:28	Travel	Departing Grants NM\
	17:41	6:00		23:41	Travel	Arrived in Stanton TX Demob completed

Field Testing Schedule for CSULB Experiment from CSULB

CSULB Huff Puff Tracer and Injection Volumes

	Start	End	CSULB Activity	Rate (bpm)	Inj/Ret Duration (min)	Inj Vol (bbl)	Ret Vol (bbl)	Chase Vol (bbl)	Pump Hrs
1	8/26/25 13:38	8/26/25 17:01	Injection 1: Tracer 1	2.5	203	507		187	3.4
1	8/26/25 17:01	8/26/25 21:20	Flowback 1	2.5	259		648		
2	8/27/25 9:20	8/27/25 13:58	Injection 2: Tracer 2	2.5	278	695		375	4.6
2	8/27/25 13:58	8/27/25 20:06	Flowback 2	2.5	368		920		
3	8/28/25 7:17	8/28/25 13:10	Injection 3: Tracer 3	2.5	353	882		562	5.9
3	8/28/25 13:10	8/28/25 21:12	Flowback 3	2.5	482		1205		
4	8/29/25 6:32	8/29/25 8:06	Injection 4: Tracer 4	5	94	470		150	1.6
4	8/29/25 8:08	8/29/25 10:44	Flowback 4	5	156		780		
4	8/29/25 13:57	8/29/25 14:59	Injection 5: Tracer 5	7.5	63	470		150	1.0
4	8/29/25 14:59	8/29/25 16:30	Flowback 5	7.5	90		677		
			Totals			**3025**	**4230**		**17**

All times are in local Time Zone.
See Neubrex OB logs For local time Reporting.

Borehole Volume	320	Targets:	Injection Duration to Displace Borehole Vol
Pumping Time	16.5		Backflow vol = BH Vol + 2x Chase except Test 5
Total Fluid Injected	3025		Tracer volume is 25% of chase volume
Total Fluid Ret	4230		Total Fluid Injection <3400 bbl

P/T gauges data – 3rd party gauge measurement data

Located at bottom of the coiled tubing in nose of coiled tubing.

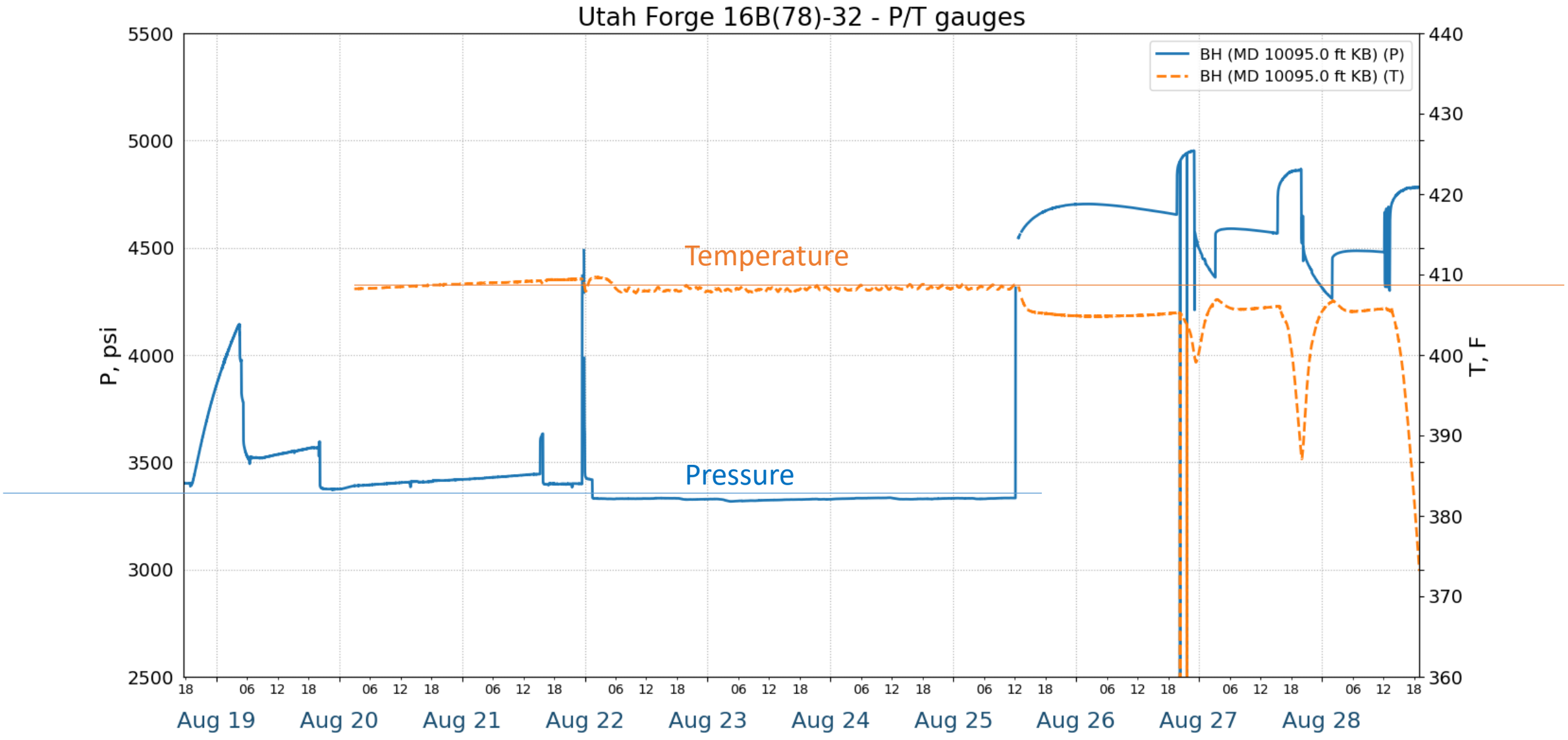
The P/T gauge is 1m (3.28 ft) above the fiber termination at the end of the CT. The fiber termination is at 10,091 ft MD RKB so the P/T gauge depth is ~10,088 ft MD RKB.

Well 16B – P/T gauge

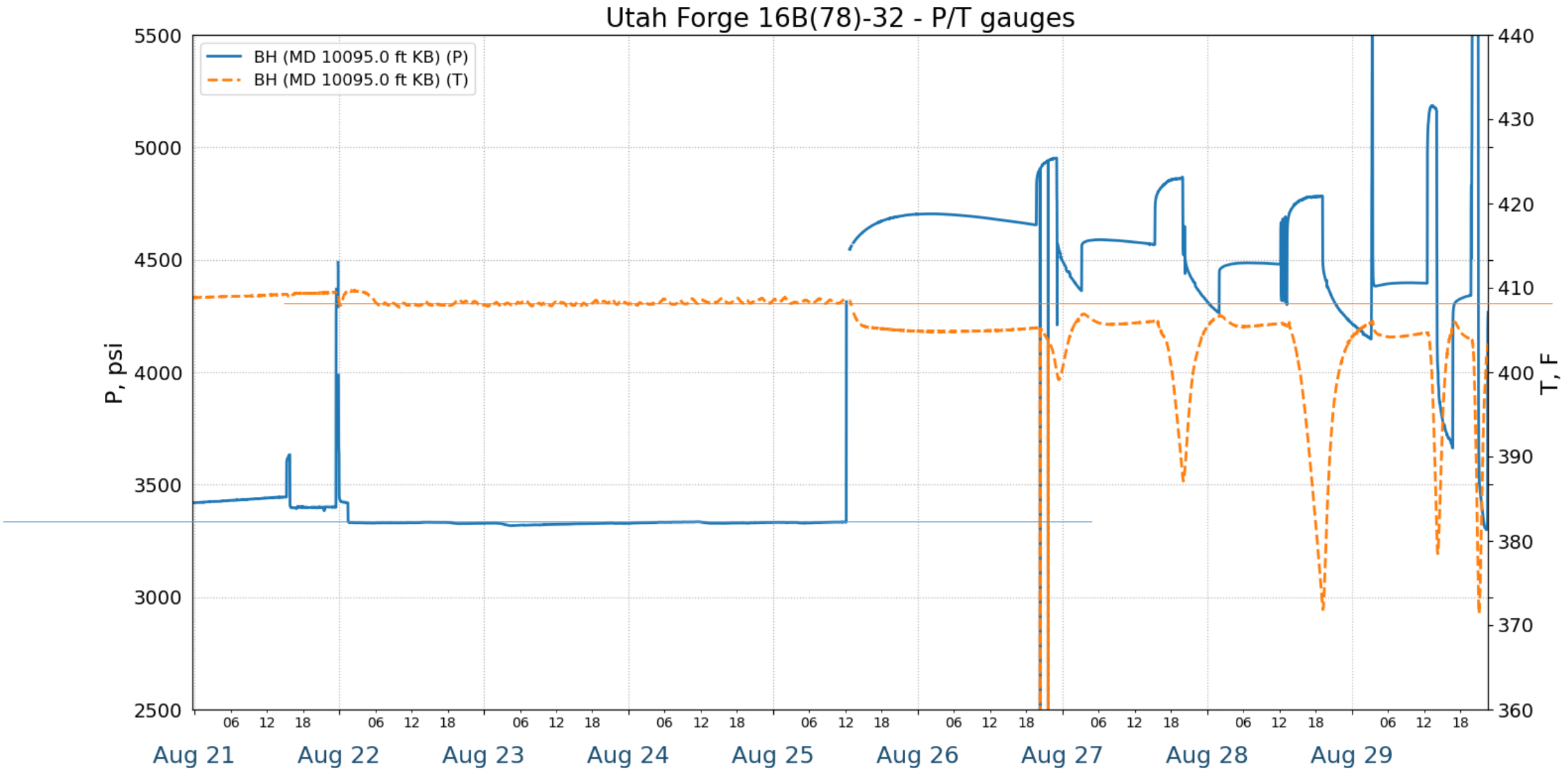
- The P/T gauge is installed 1 m (3.28 feet) from the FO termination
- P/T gauge type N/A

The P/T gauge is 1m (3.28 ft) above the fiber termination at the end of the CT. The fiber termination is at 10,091 ft MD RKB so the P/T gauge depth is ~10,088 ft MD RKB.

Well 16B – Downhole P/T gauge data in Well 16B



Well 16B – Downhole P/T gauge data (less precise time data set)



Pumping data

Data received from Liberty

Pumping data

List of available parameters:

- 16A Wellhead PSI (PSI)
- 16B WH Press. North (PSI)
- 16B 3" Flow - 2 (BPM)
- Separator Flow North (BPM)
- Separator Flow South (BPM)
- 16B 2" Flow (BPM)
- Injection Temp (deg F)
- 16B 3" Flow (BPM)
- 16B WH Temp (deg F)
- 16B Coil Tubing PSI (1K Sensor)
- Choke Pressure (PSI)
- Liberty Discharge Press. (PSI)
- Liberty Pumpstroke Flow R (BPM)
- Liberty Turbine Flow Rate (BPM)
- Liberty Total Volume (BBL)

Field Testing Schedule for CSULB Experiment

CSULB Huff Puff Tracer and Injection Volumes

	Start	End	CSULB Activity	Rate (bpm)	Inj/Ret Duration (min)	Inj Vol (bbl)	Ret Vol (bbl)	Chase Vol (bbl)	Pump Hrs
1	8/26/25 13:38	8/26/25 17:01	Injection 1: Tracer 1	2.5	203	507		187	3.4
1	8/26/25 17:01	8/26/25 21:20	Flowback 1	2.5	259		648		
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2	8/27/25 13:58	8/27/25 20:06	Flowback 2	2.5	368		920		
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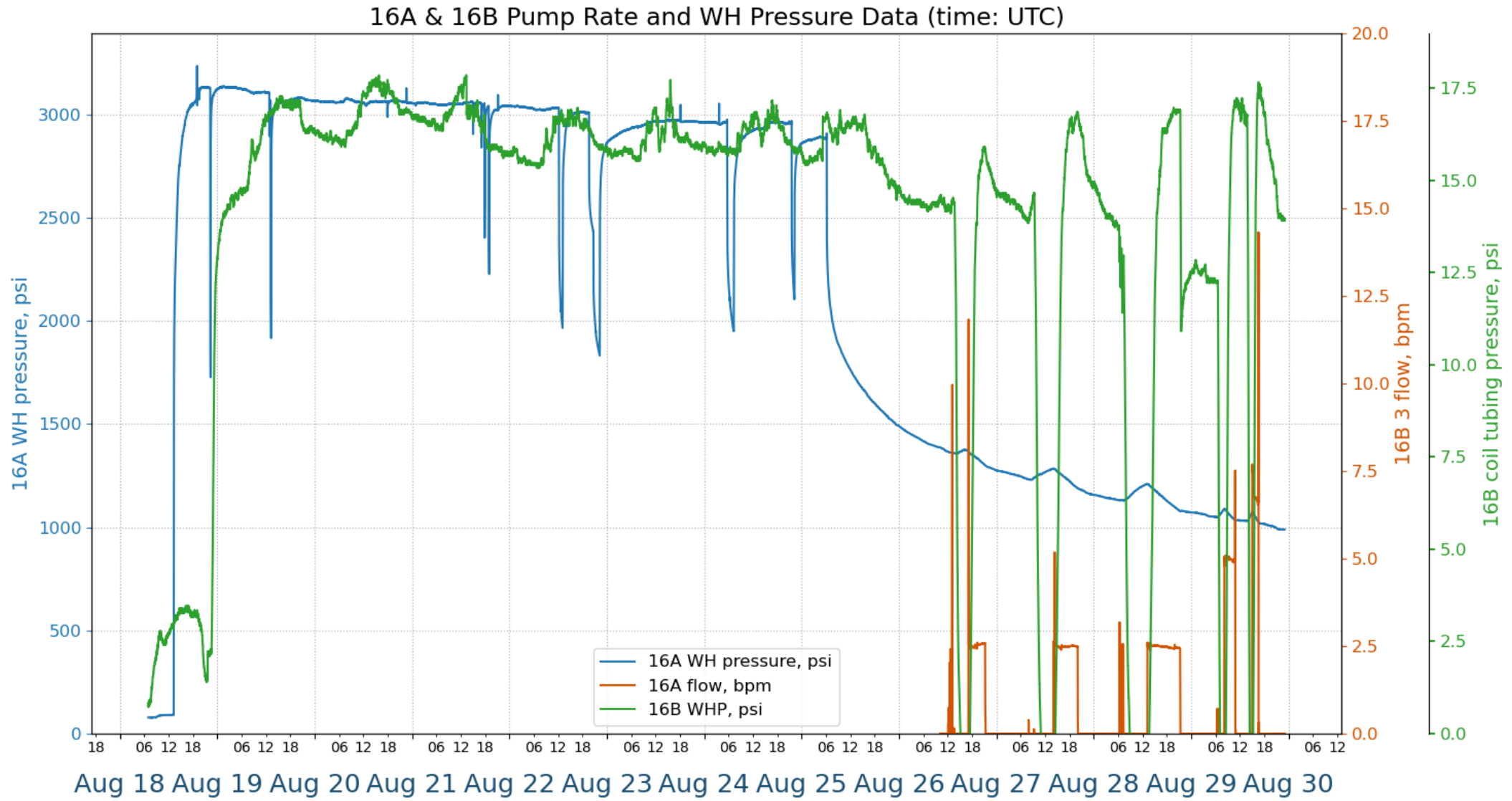
3	8/28/25 13:10	8/28/25 21:12	Flowback 3	2.5	482		1205		
4	8/29/25 6:32	8/29/25 8:06	Injection 4: Tracer 4	5	94	470		150	1.6
4	8/29/25 8:08	8/29/25 10:44	Flowback 4	5	156		780		
4	8/29/25 13:57	8/29/25 14:59	Injection 5: Tracer 5	7.5	63	470		150	1.0
4	8/29/25 14:59	8/29/25 16:30	Flowback 5	7.5	90		677		
			Totals			**3025**	**4230**		**17**

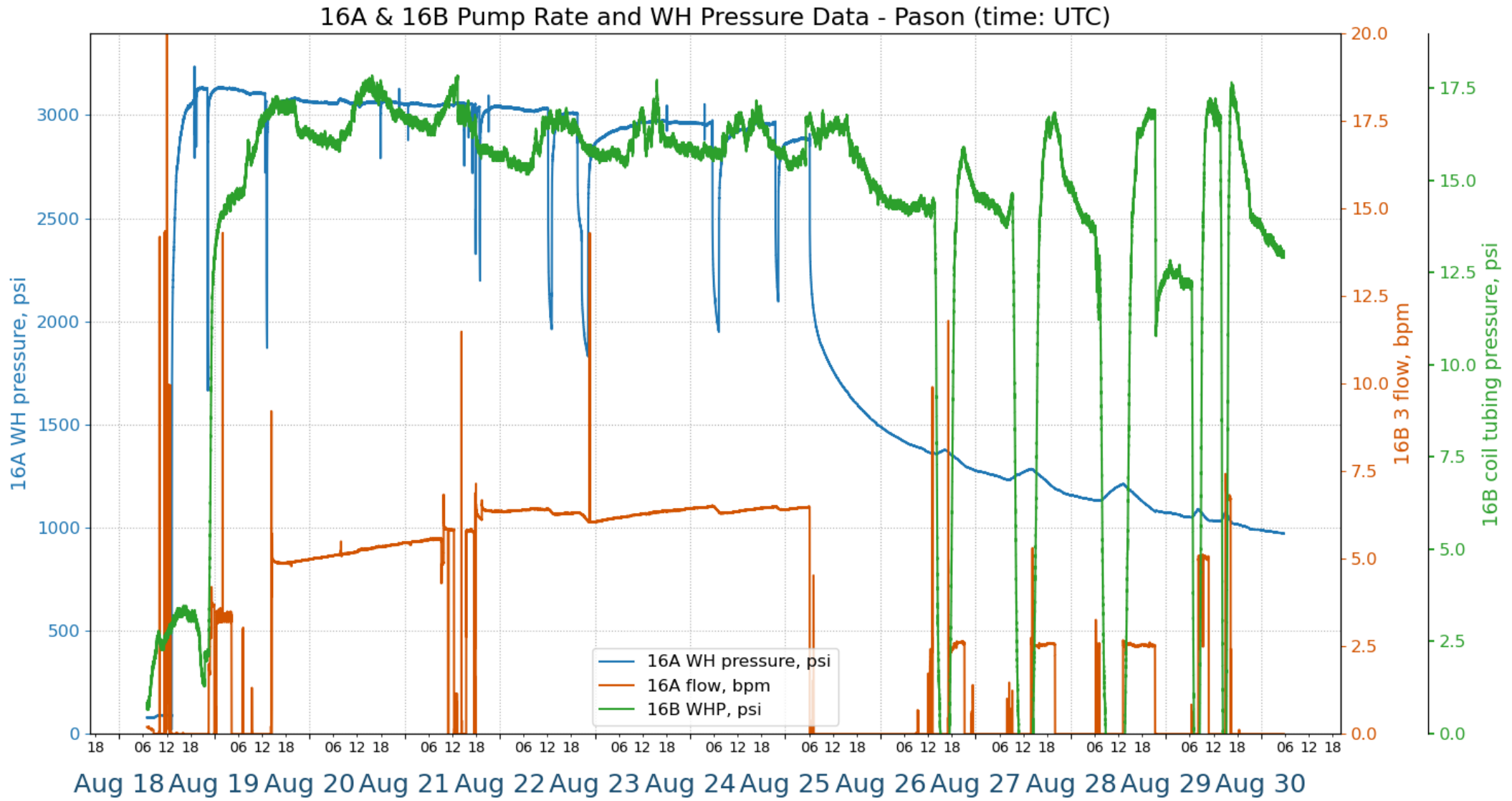
All times are in local Time Zone.
See Neubrex OB logs For local time Reporting.

Borehole Volume	320	Targets:	Injection Duration to Displace Borehole Vol
Pumping Time	16.5		Backflow vol = BH Vol + 2x Chase except Test 5
Total Fluid Injected	3025		Tracer volume is 25% of chase volume
Total Fluid Ret	4230		Total Fluid Injection <3400 bbl

Pumping data – selected properties – Liberty Provided Data



Pumping data – selected properties – Pason Data Set



Fiber Optic Measurements

Summary of measurements using RFS, DTS, and BCF

RFS = Rayleigh Frequency Shift fiber optic measurement

DTS = Distributed Temperature Sensing fiber optic measurement

BCF = Brillouin Center Frequency fiber optic measurement

DAS = TGD Acoustic sensing measurements

DTS

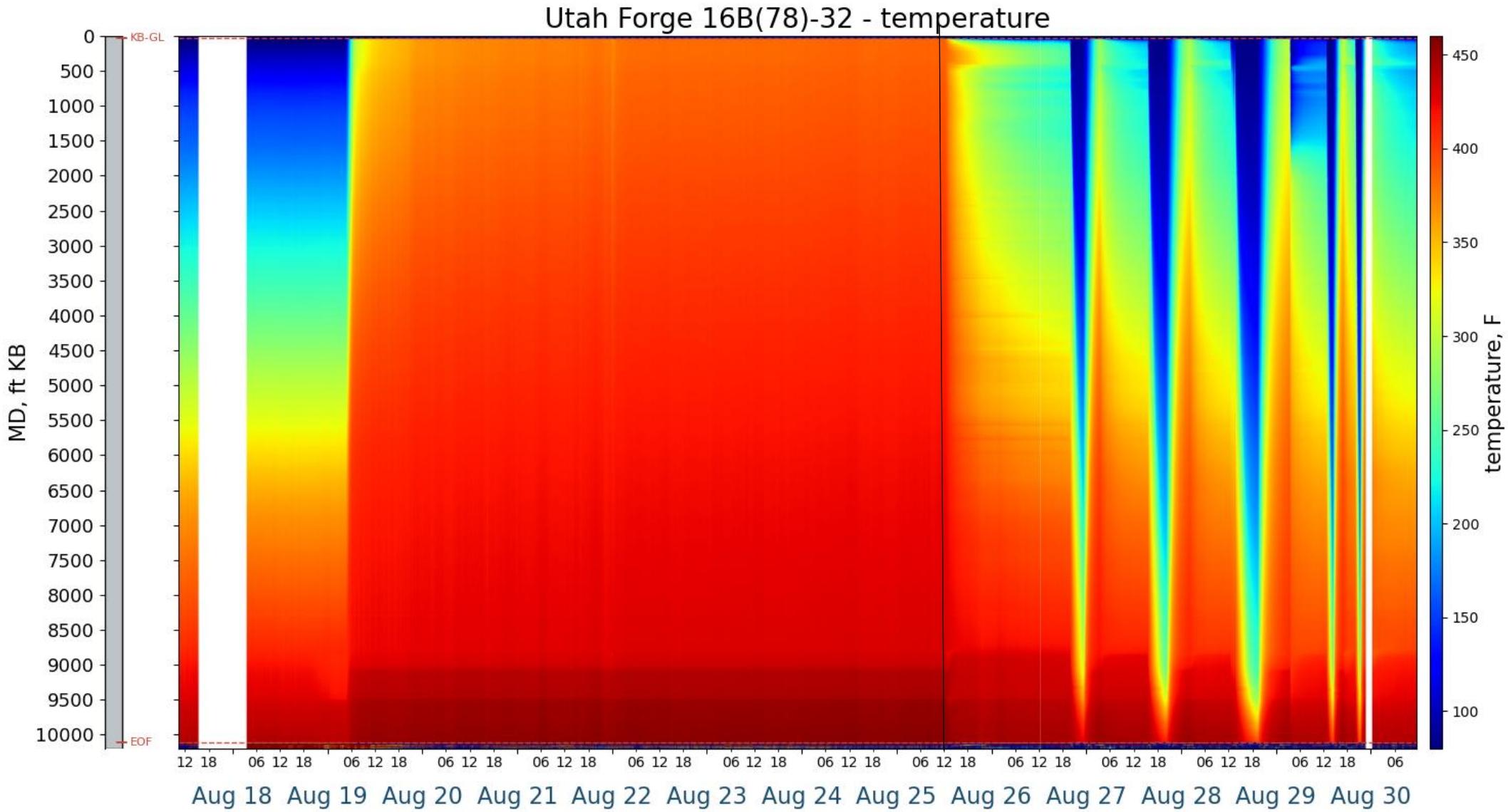
-- first trace: Aug 17, 2025, 10:15:43
-- last trace: Aug 30, 2025, 11:32:38
-- number of traces: 32,531
-- number of samples per trace: 3,581
-- average temporal interval (sec): 35 sec

Well 16B – DTS data gaps

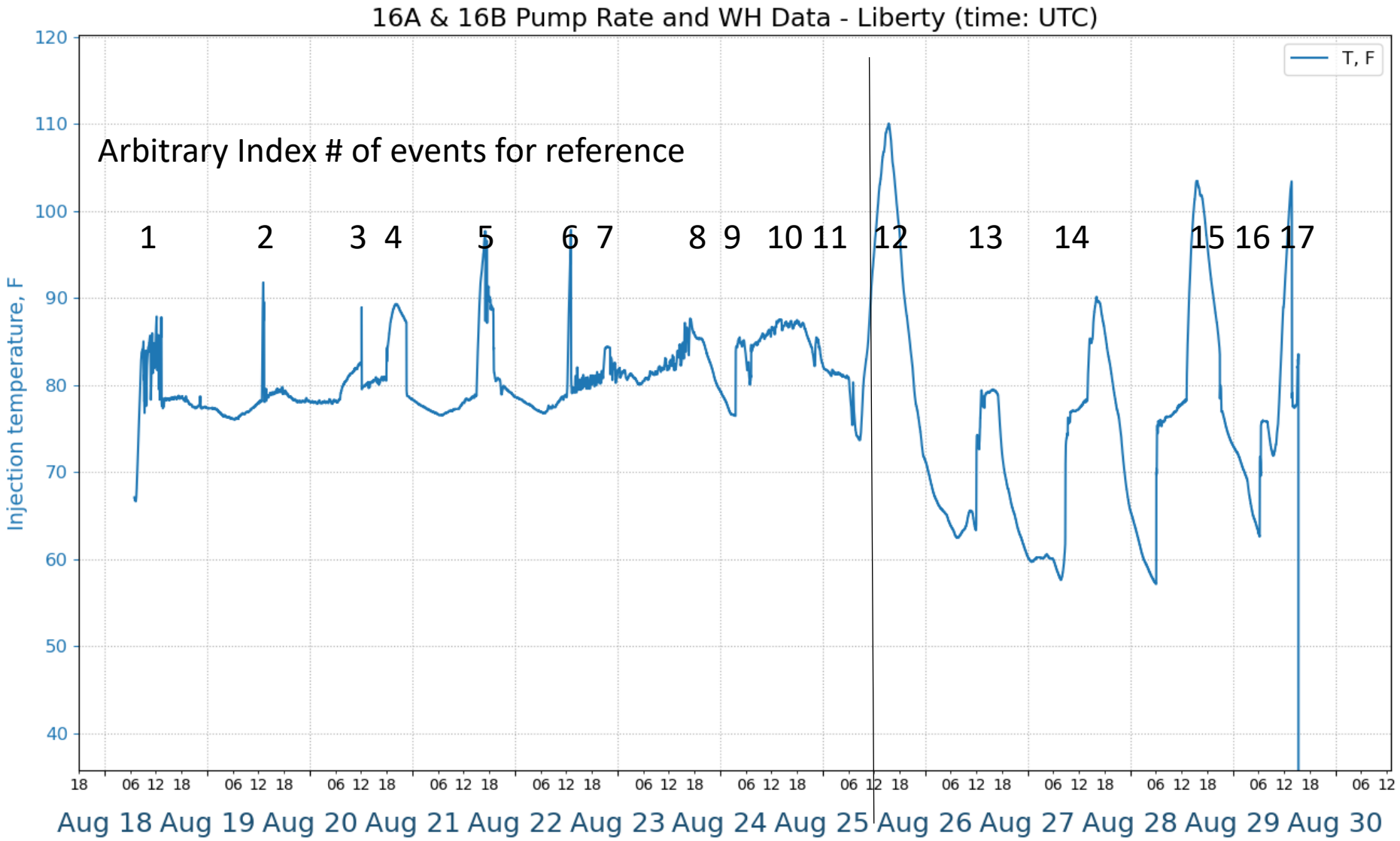
- The following gaps in DTS data set exist:

No.	Start	End	Duration
1	Aug 17, 2025, 15:20:42	Aug 18, 2025, 03:27:35	12:06:53
2	Aug 26, 2025, 12:10:22	Aug 26, 2025, 12:13:40	0:03:18
3	Aug 29, 2025, 22:30:01	Aug 30, 2025, 00:06:27	1:36:26

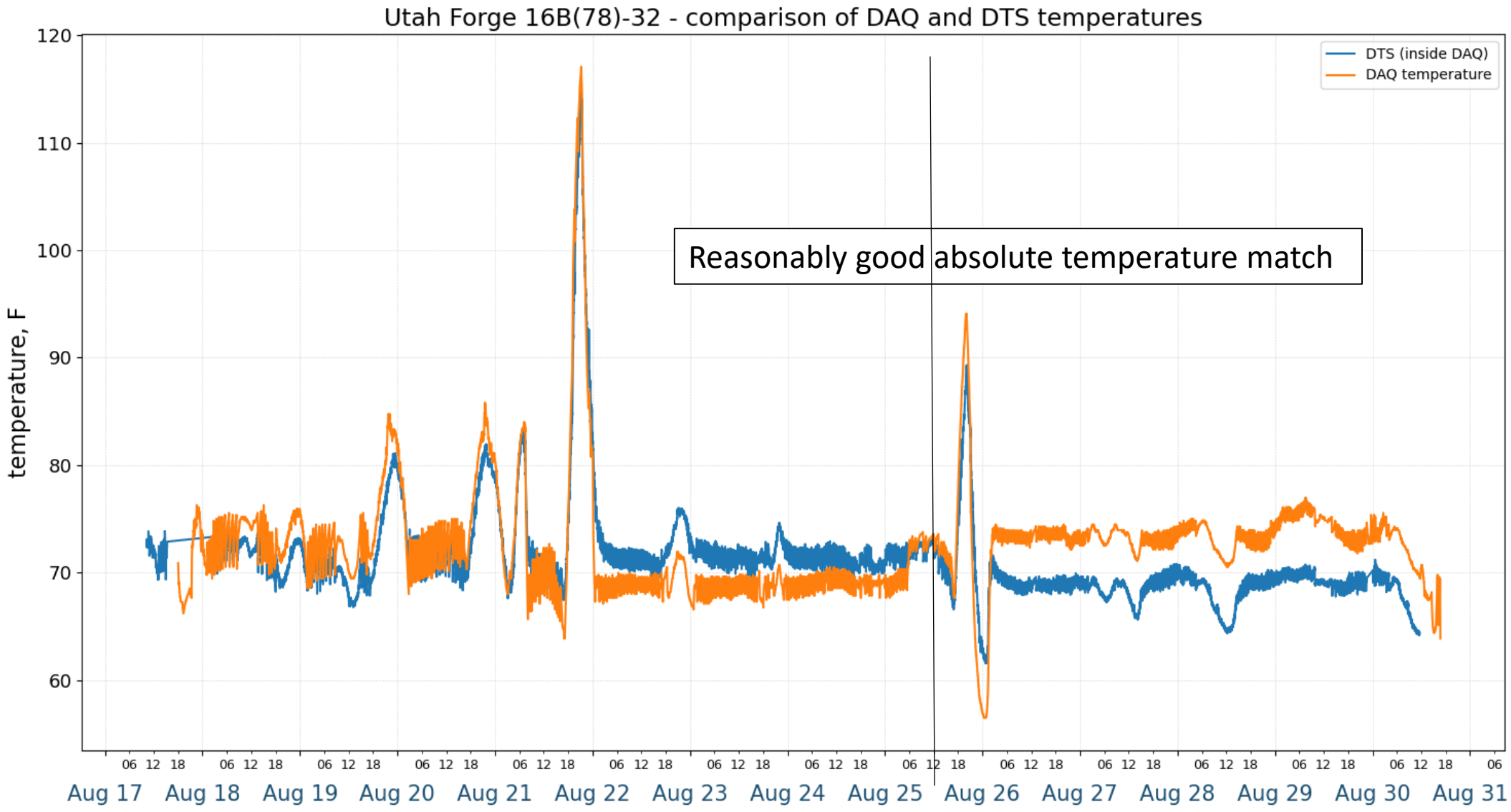
Well 16B – ORIGINAL Uncalibrated DTS temperature – overview



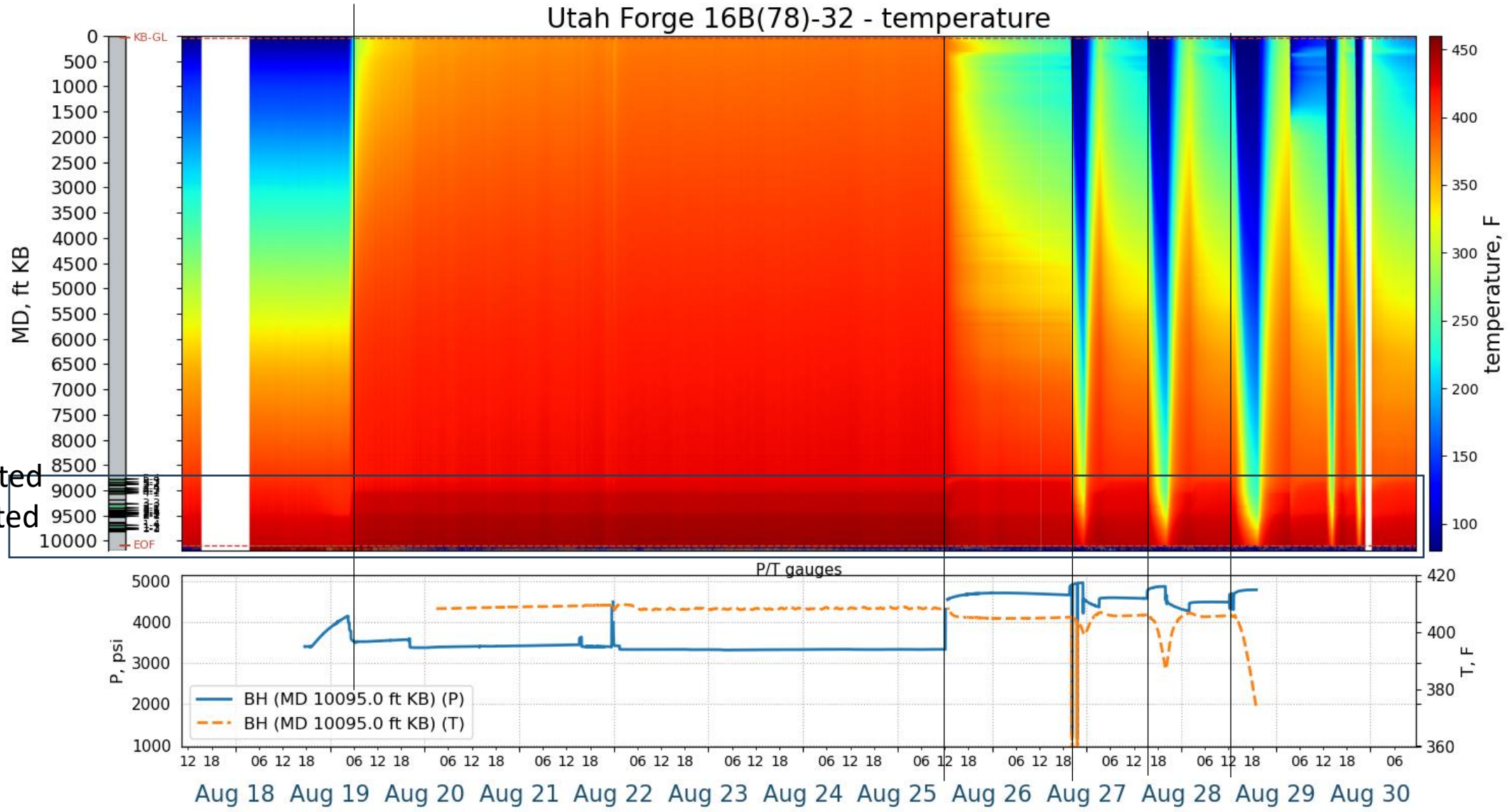
Well 16B – wellhead temperature as reported



Well 16B – Neubrex DTS and Neubrex internal DAQ calibration temperature comparison

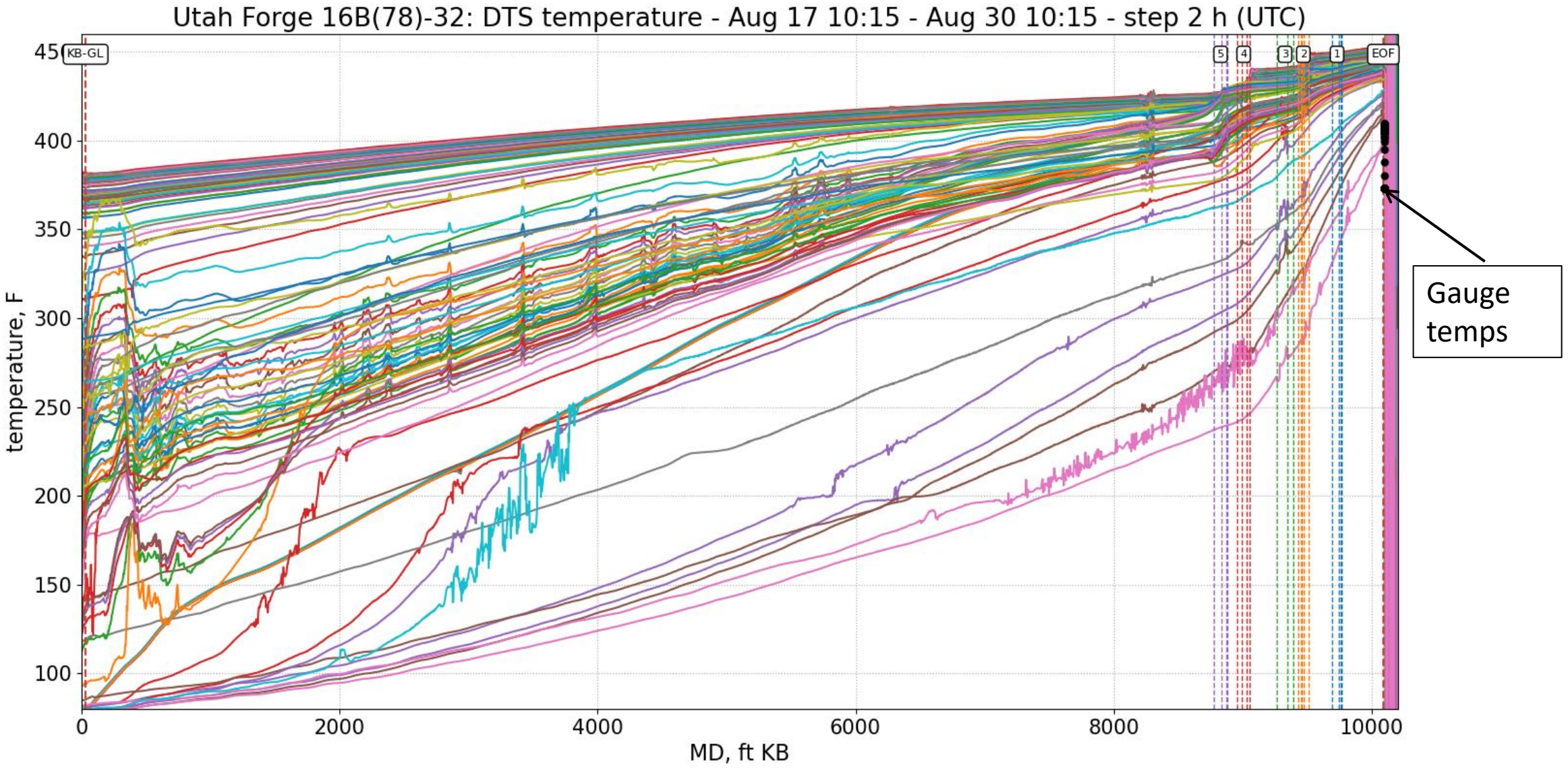


Well 16B – Original Uncalibrated DTS temperature with CT Gauge at Bottom of Plot – overview

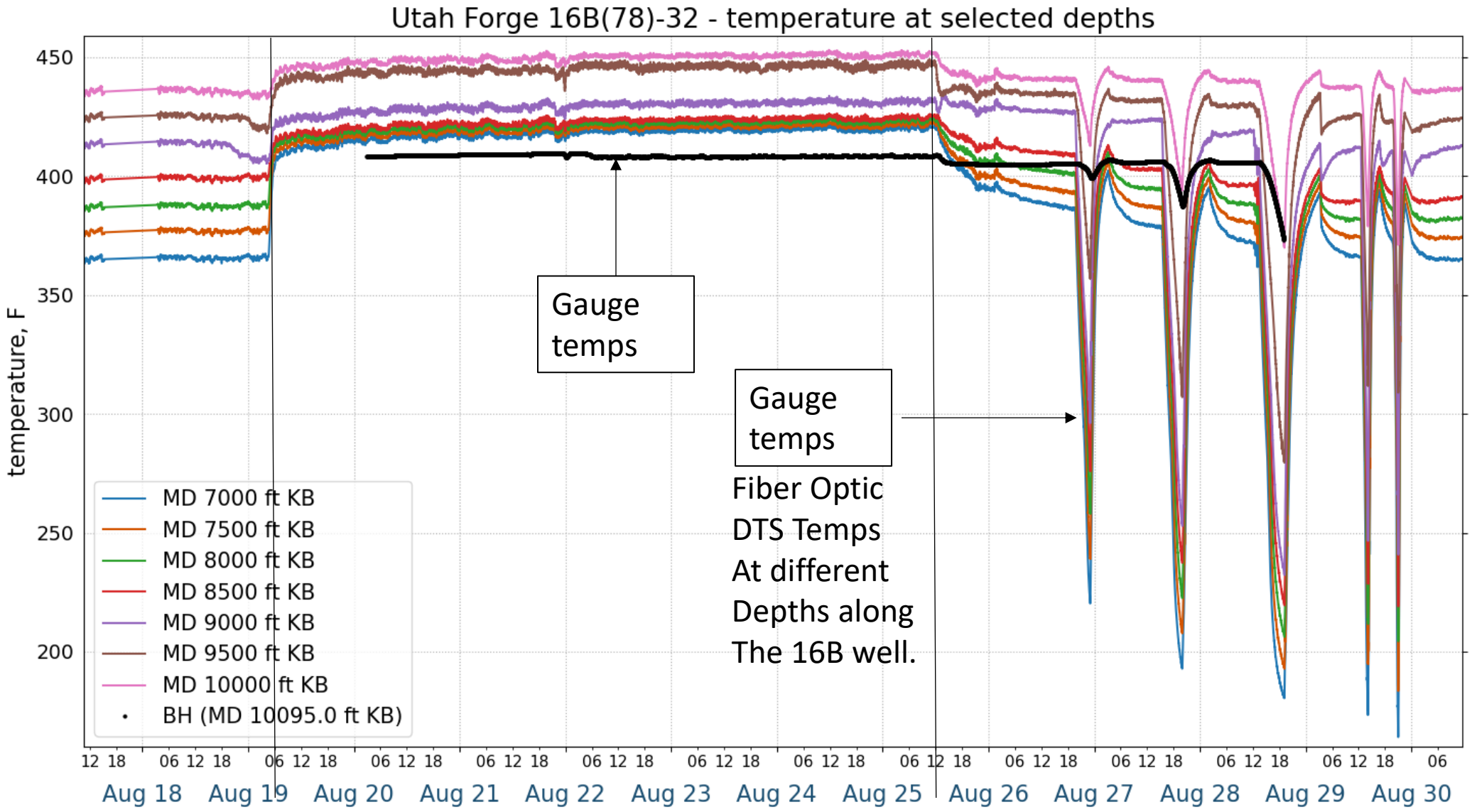


Stimulated Perforated Region

Well 16B – Original Uncalibrated DTS temperature – selected times vs depth

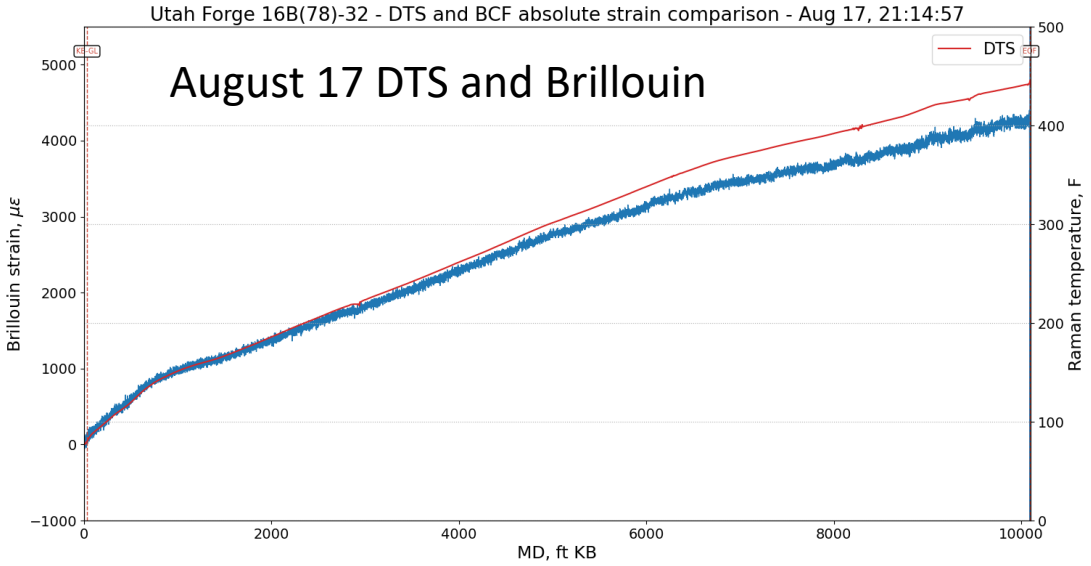


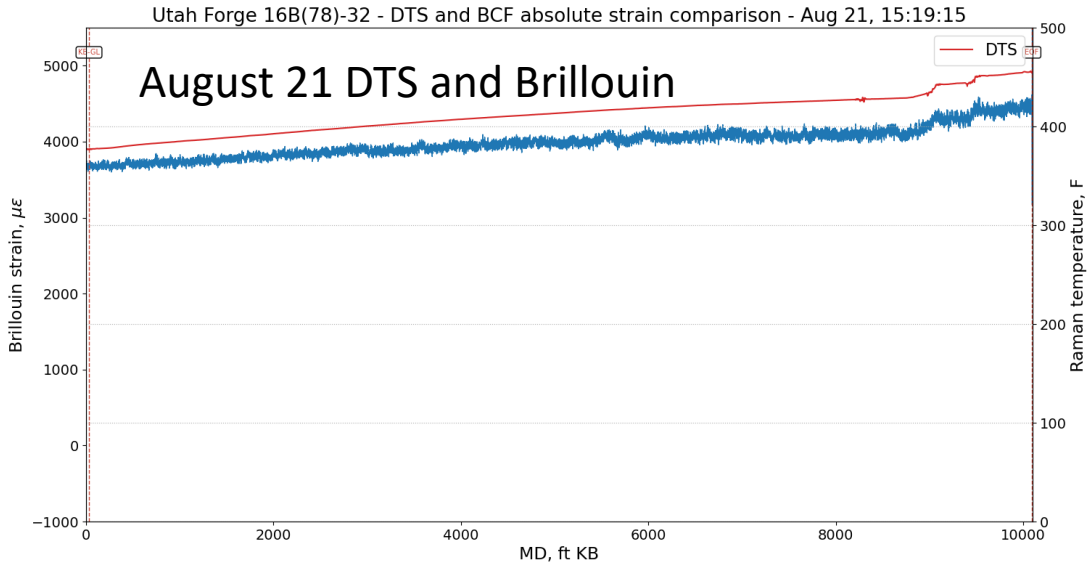
Well 16B – Original DTS temperature with Gauge T timeseries – selected depths



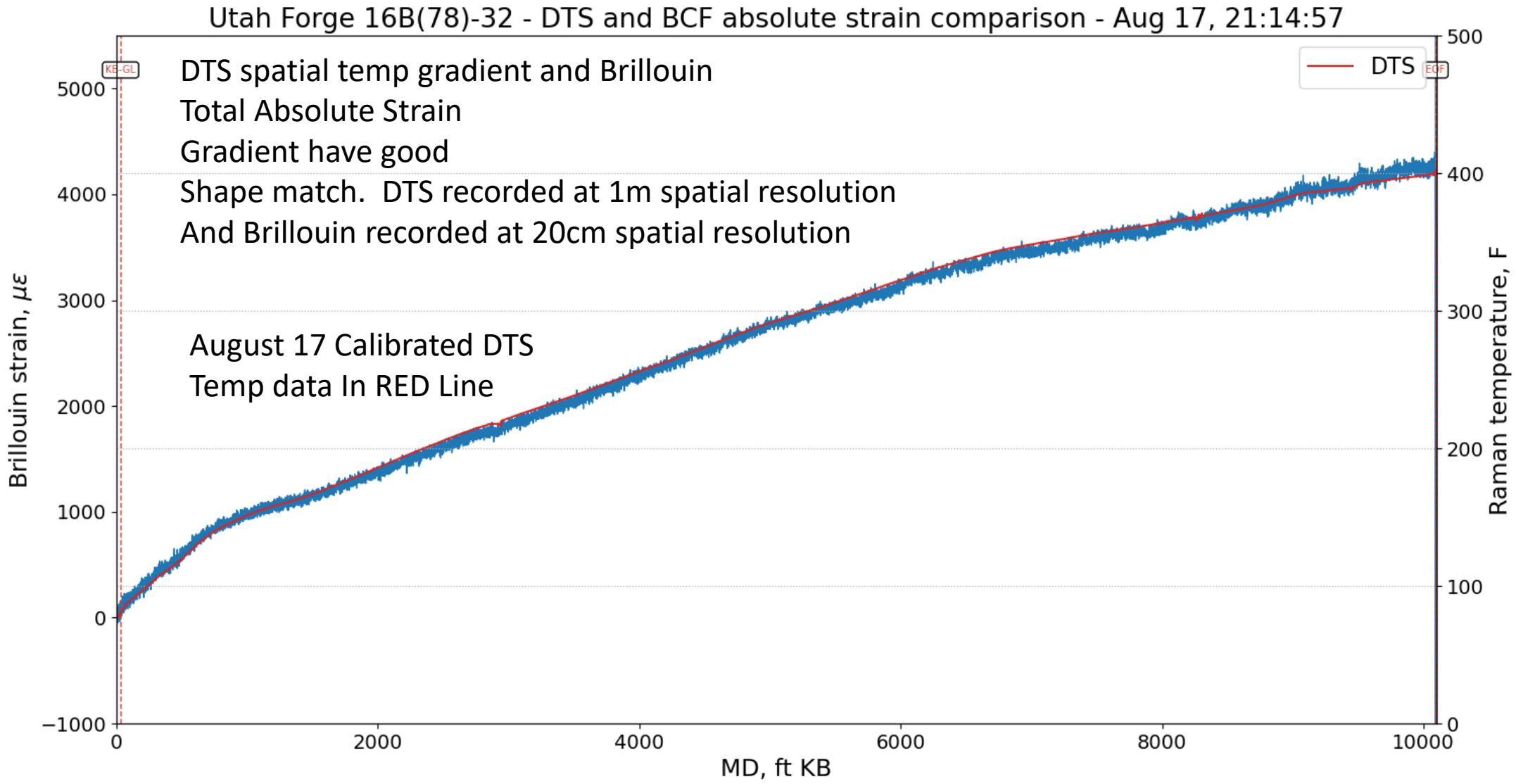
Well 16B – DTS Temp and Brillouin BCF Strain comparison

Loss related deviation in Raman DTS distribution for some of the traces. High temperature gradient results in substantial temperature changes

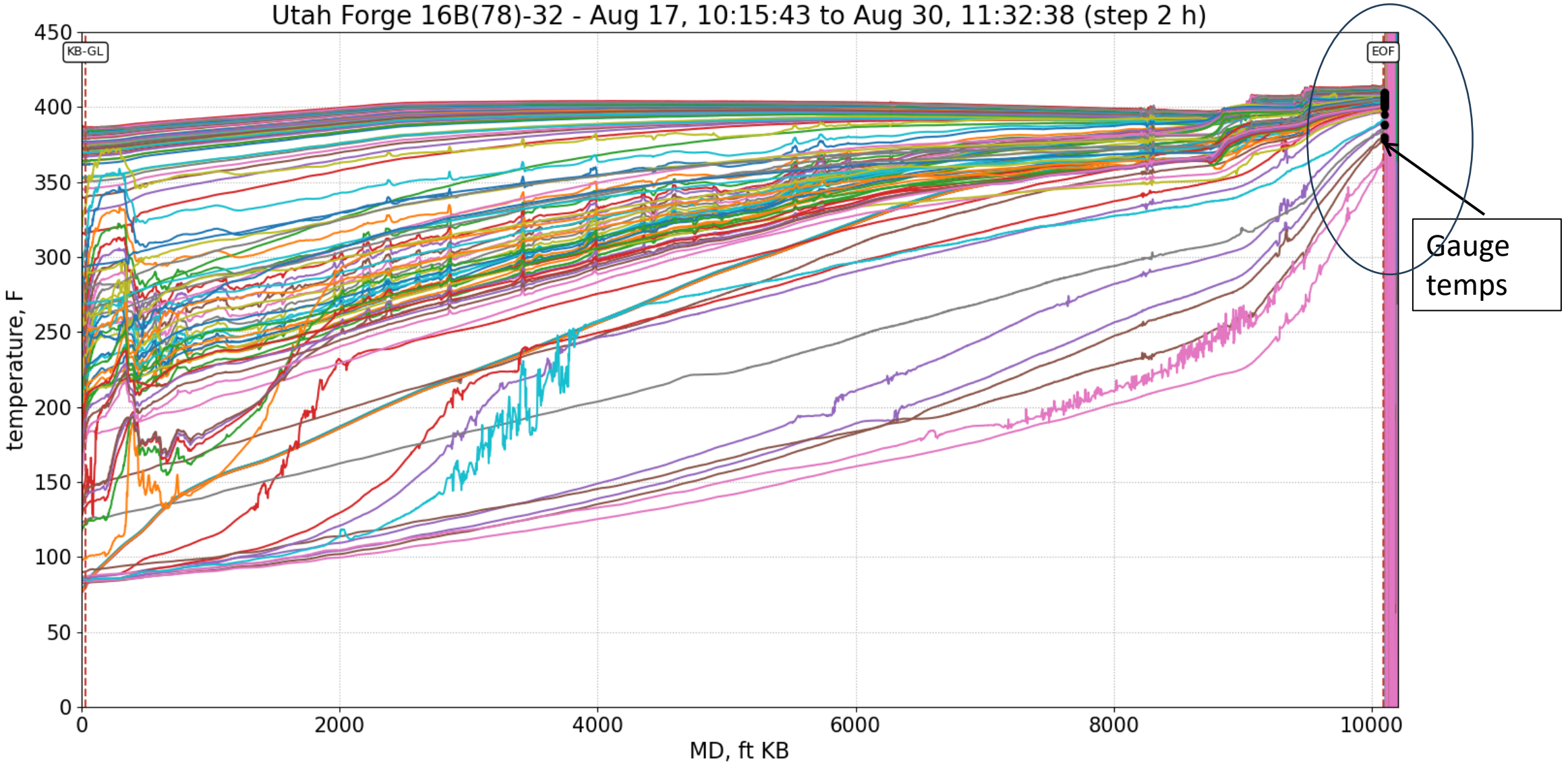




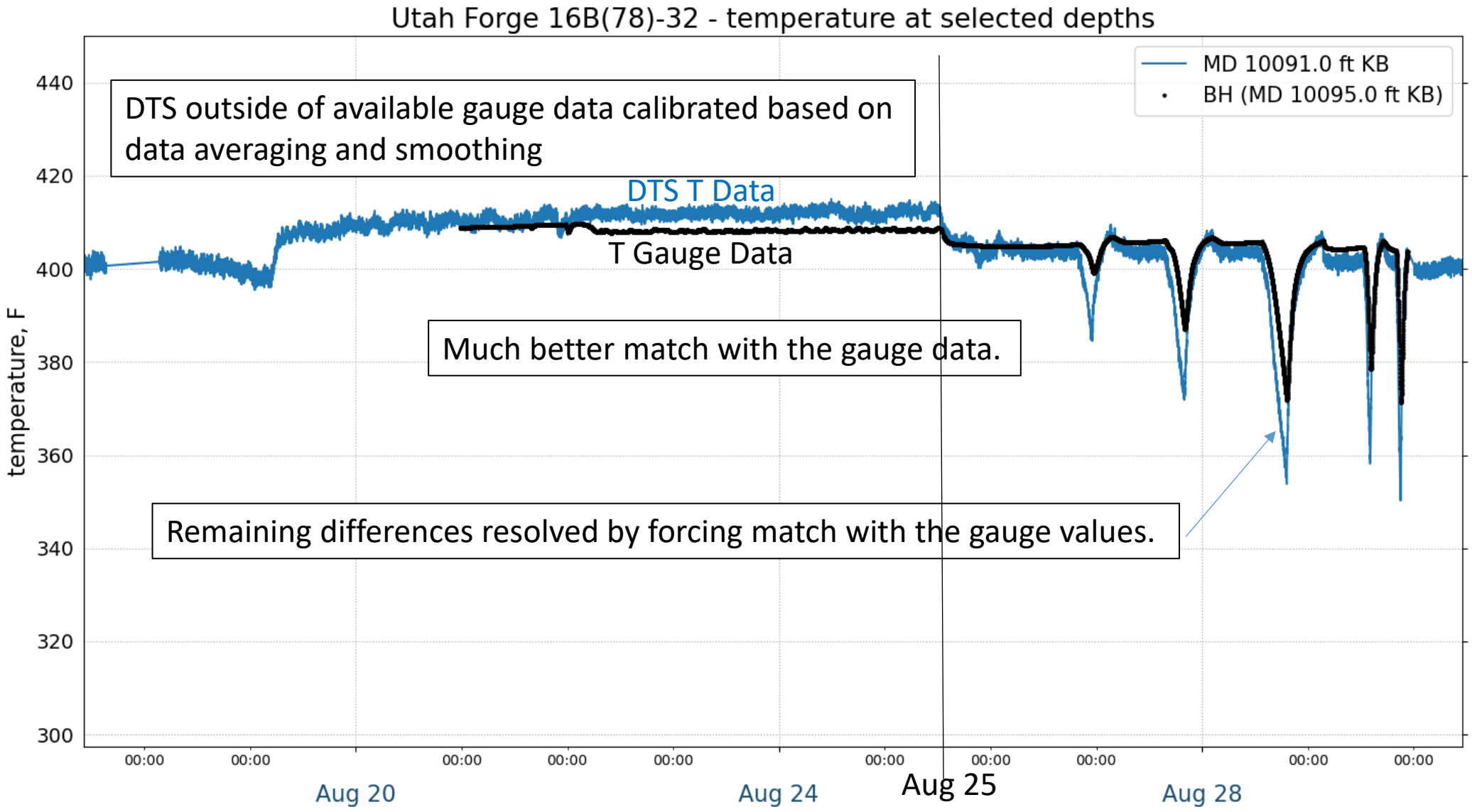
DTS calibrated using BCF center frequency at 20cm resolution



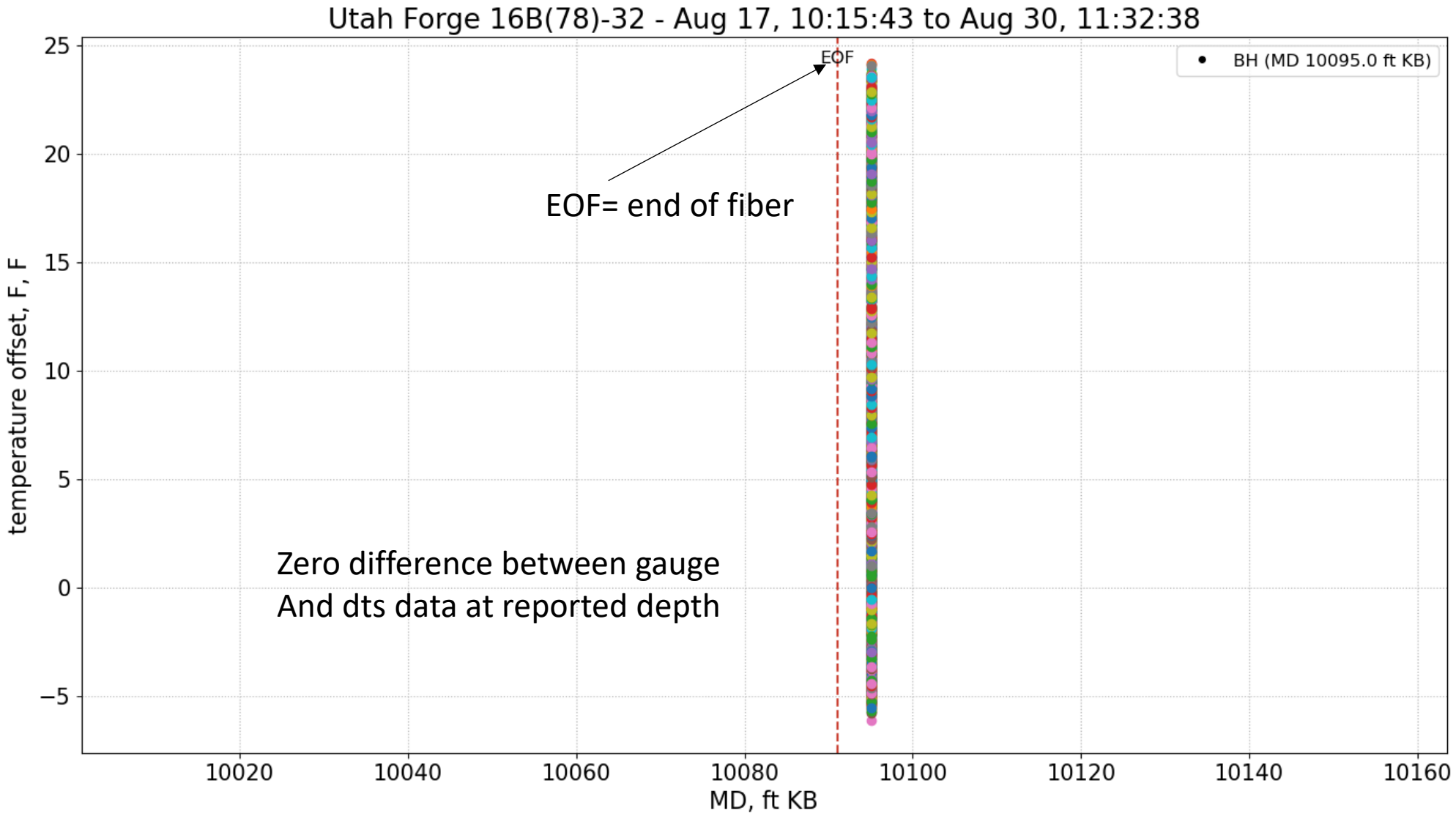
DTS calibrated using BCF center frequency – selected traces



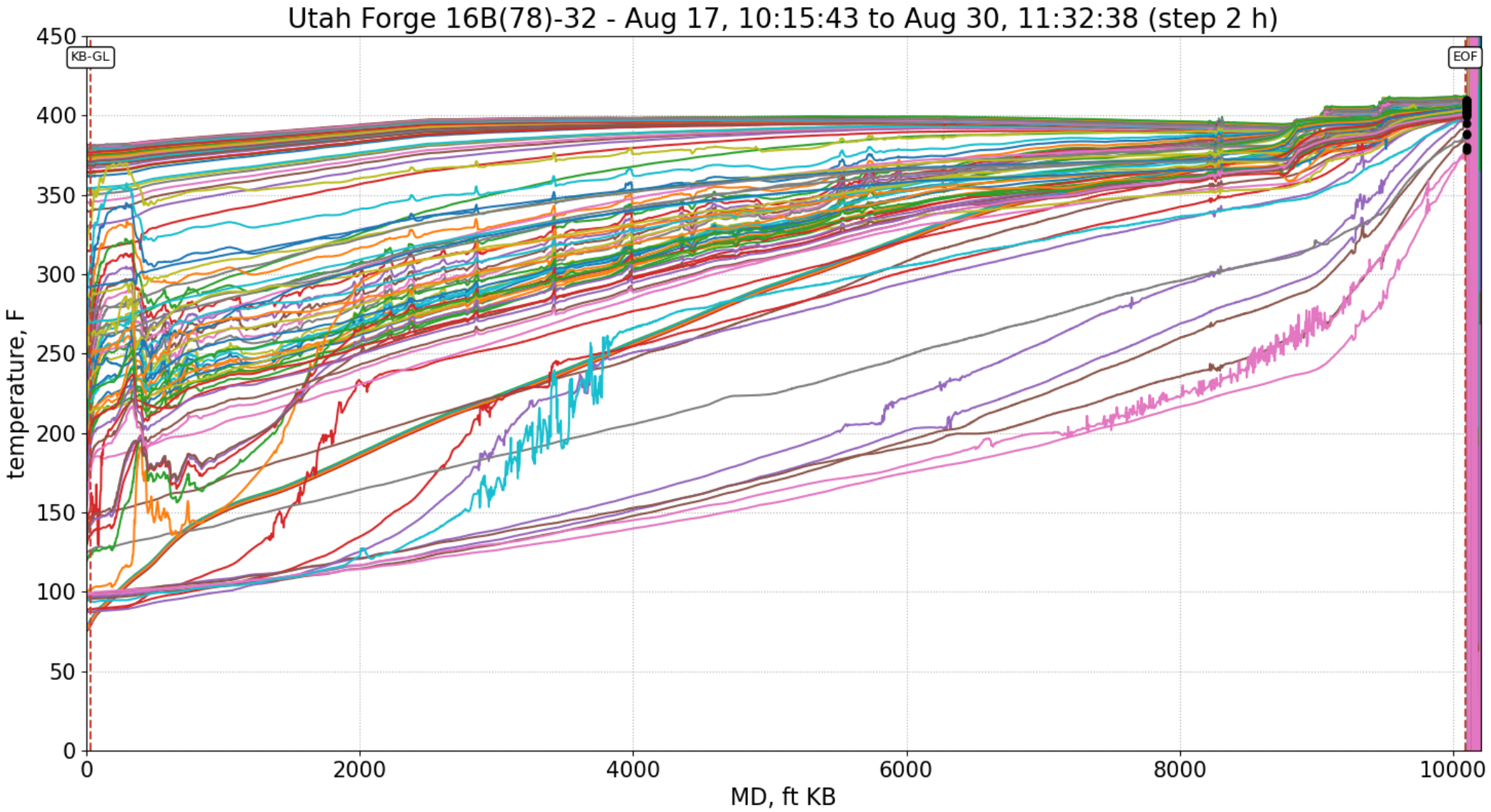
DTS at 10091 calibrated using BCF center frequency – comparison



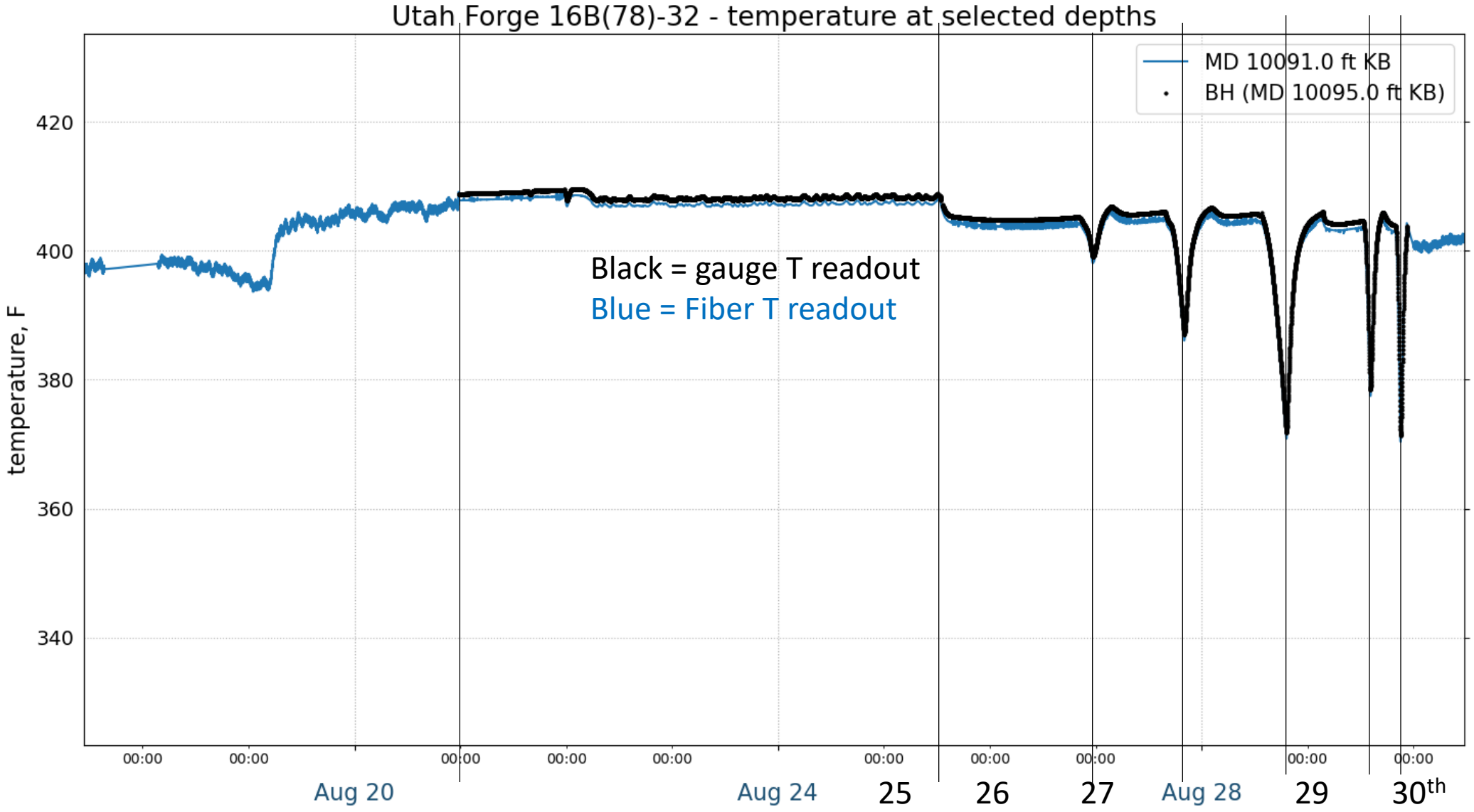
Temperature difference (offset) to gauge over time



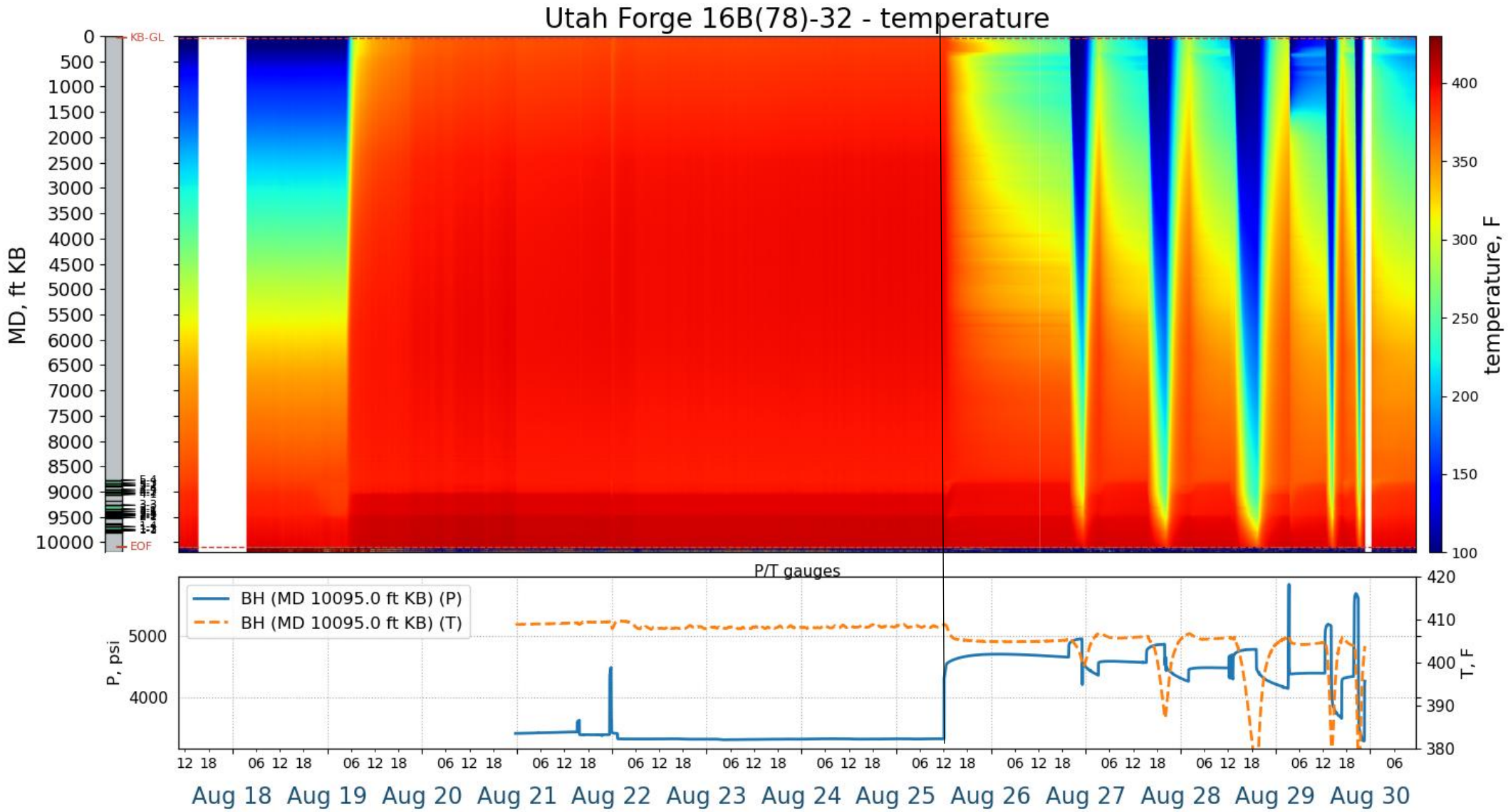
DTS calibrated using Brillouin BCF fiber data and gauge data



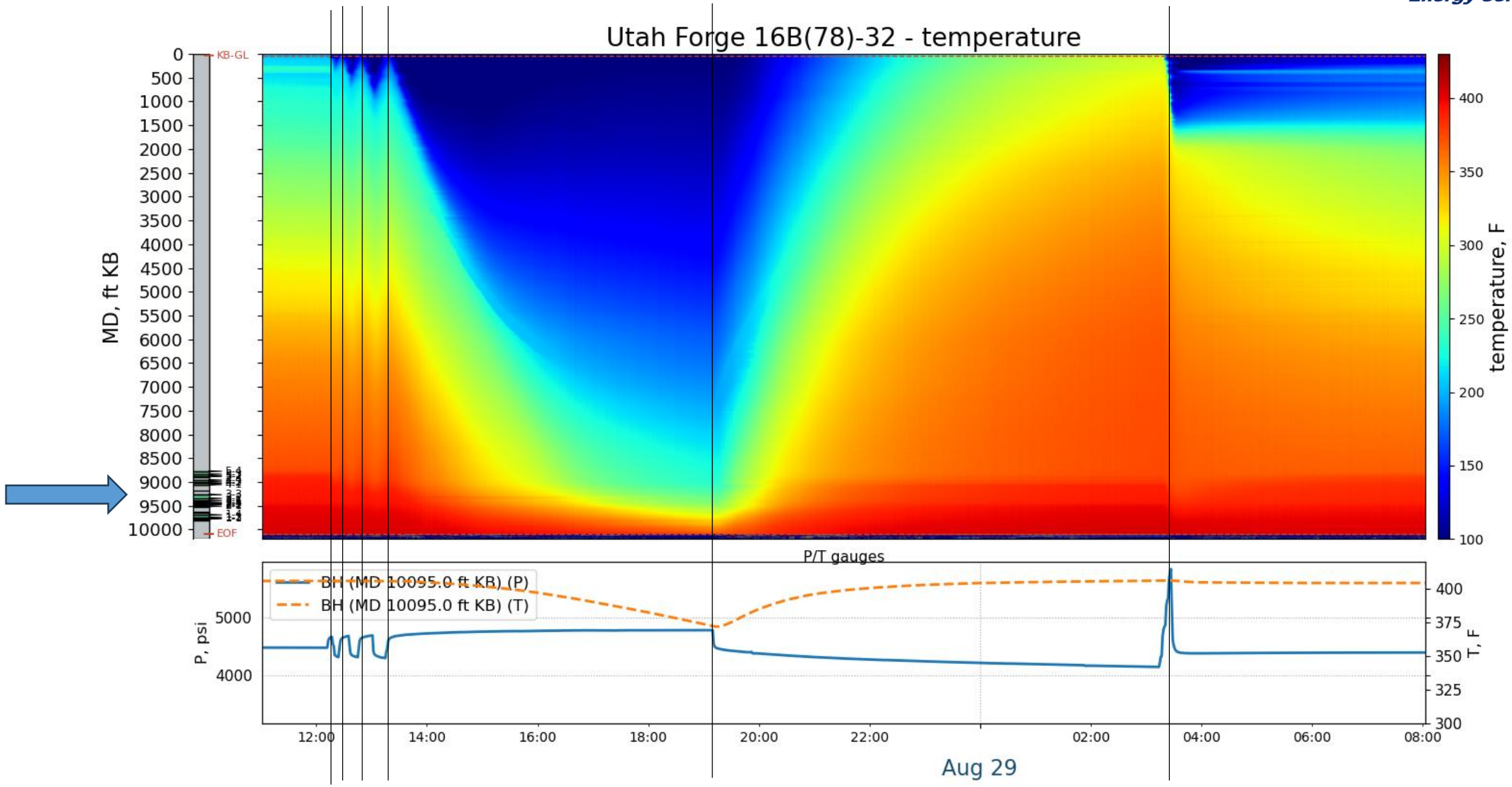
DTS calibrated using Brillouin BCF data and BHT gauge data



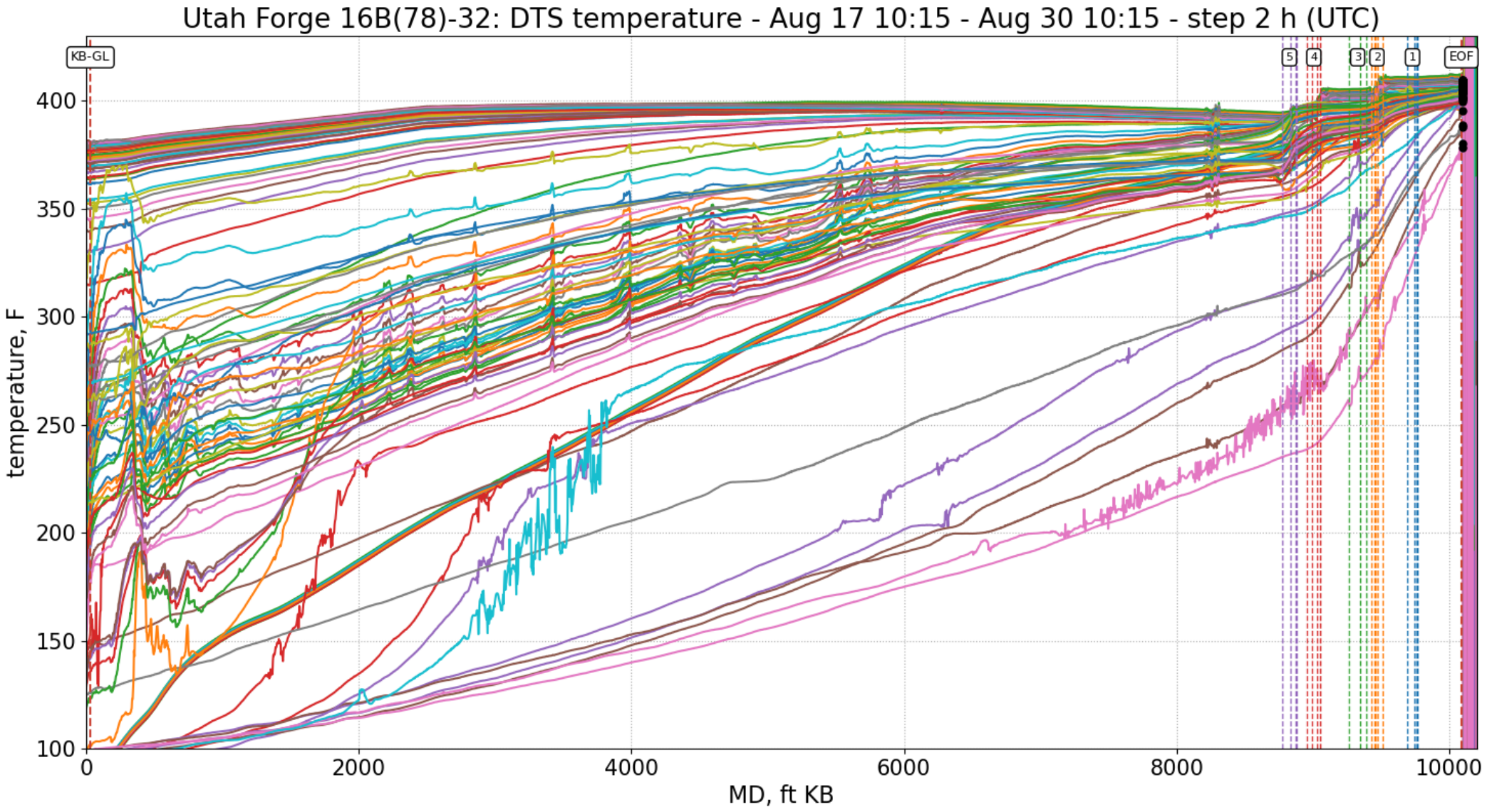
Well 16B – Calibrated and Corrected DTS temperature overview



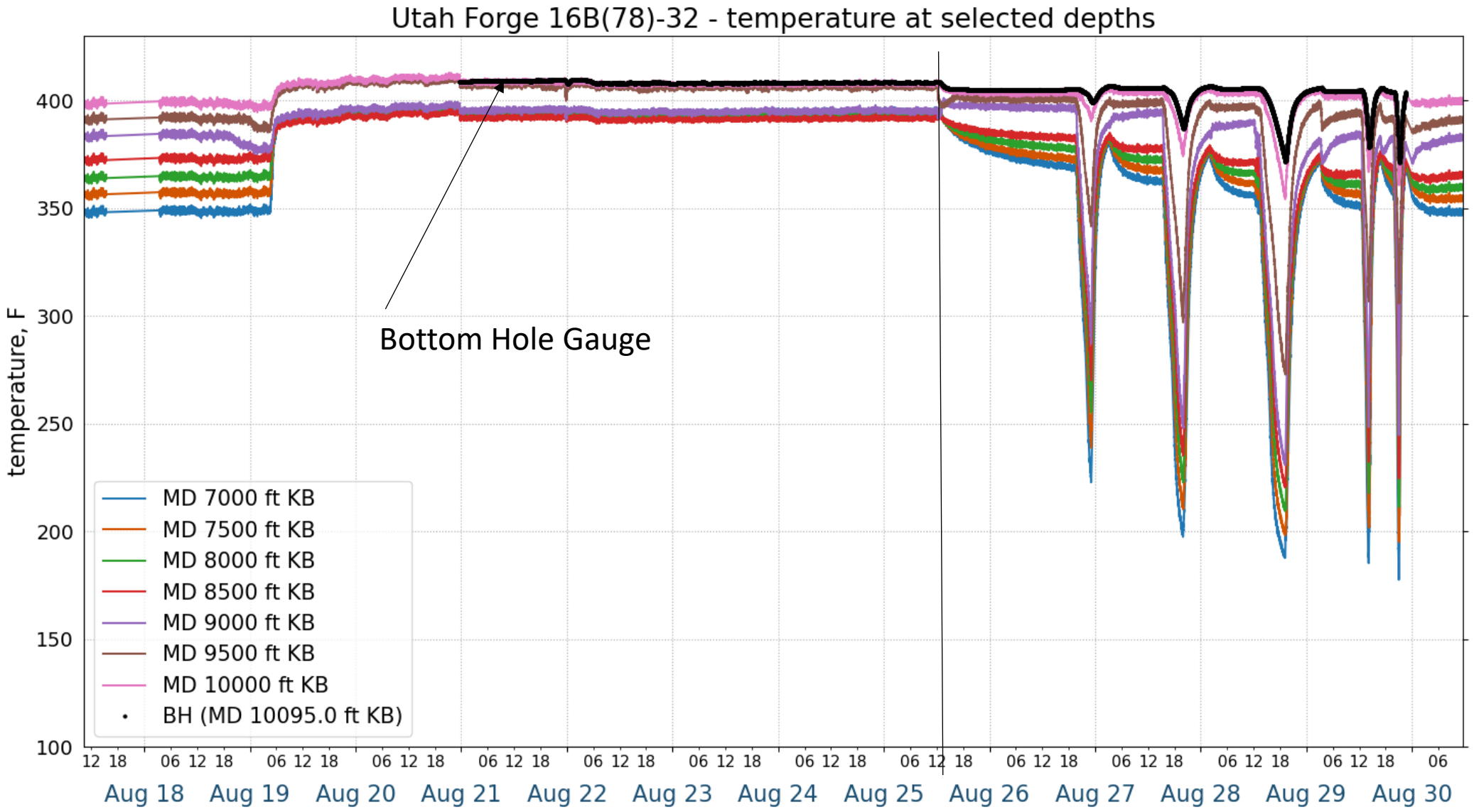
Well 16B –Calibrated and Correct DTS temperature – zoomed in



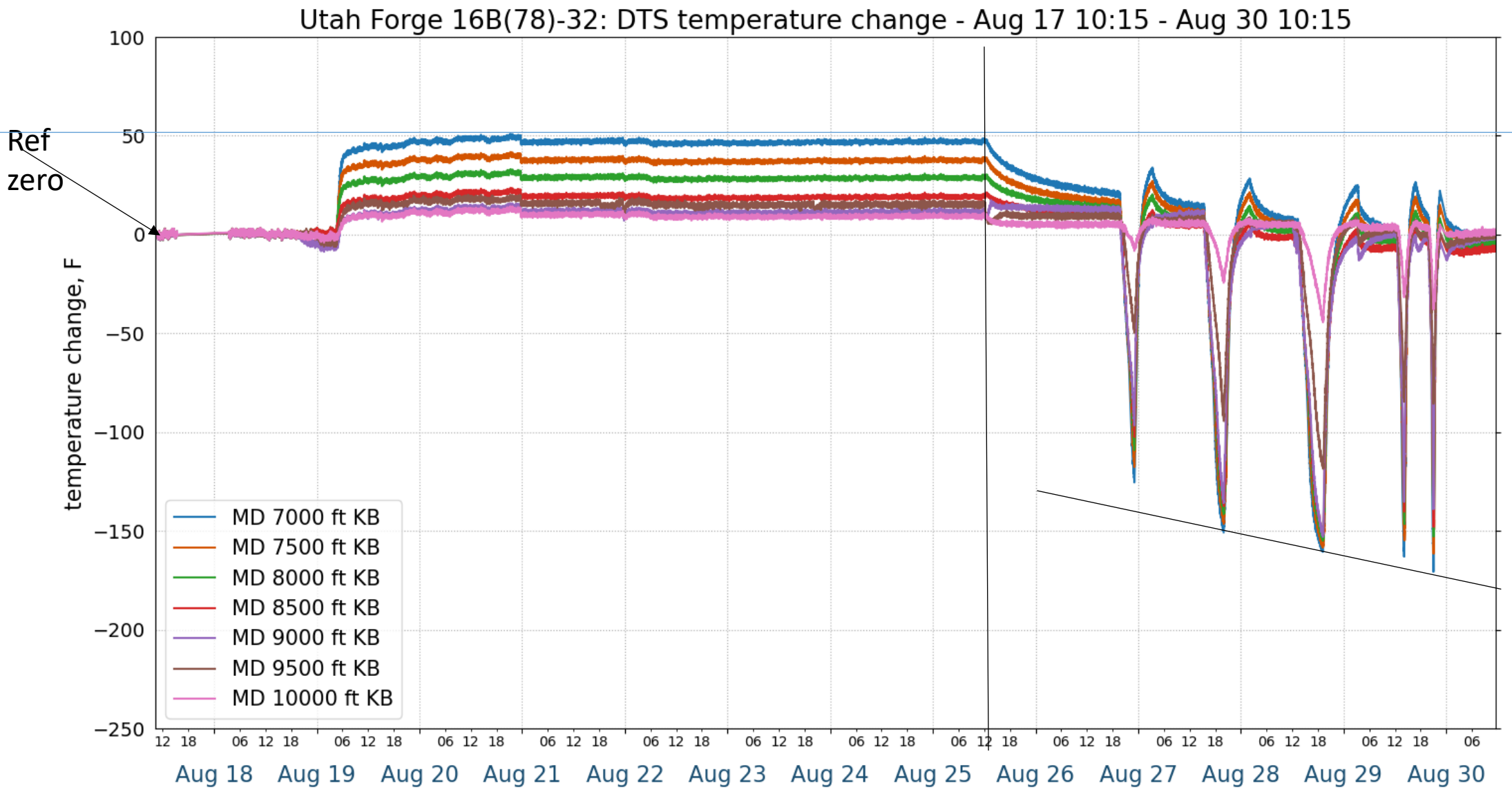
Well 16B – Calibrated and Corrected DTS temperature – selected traces across time



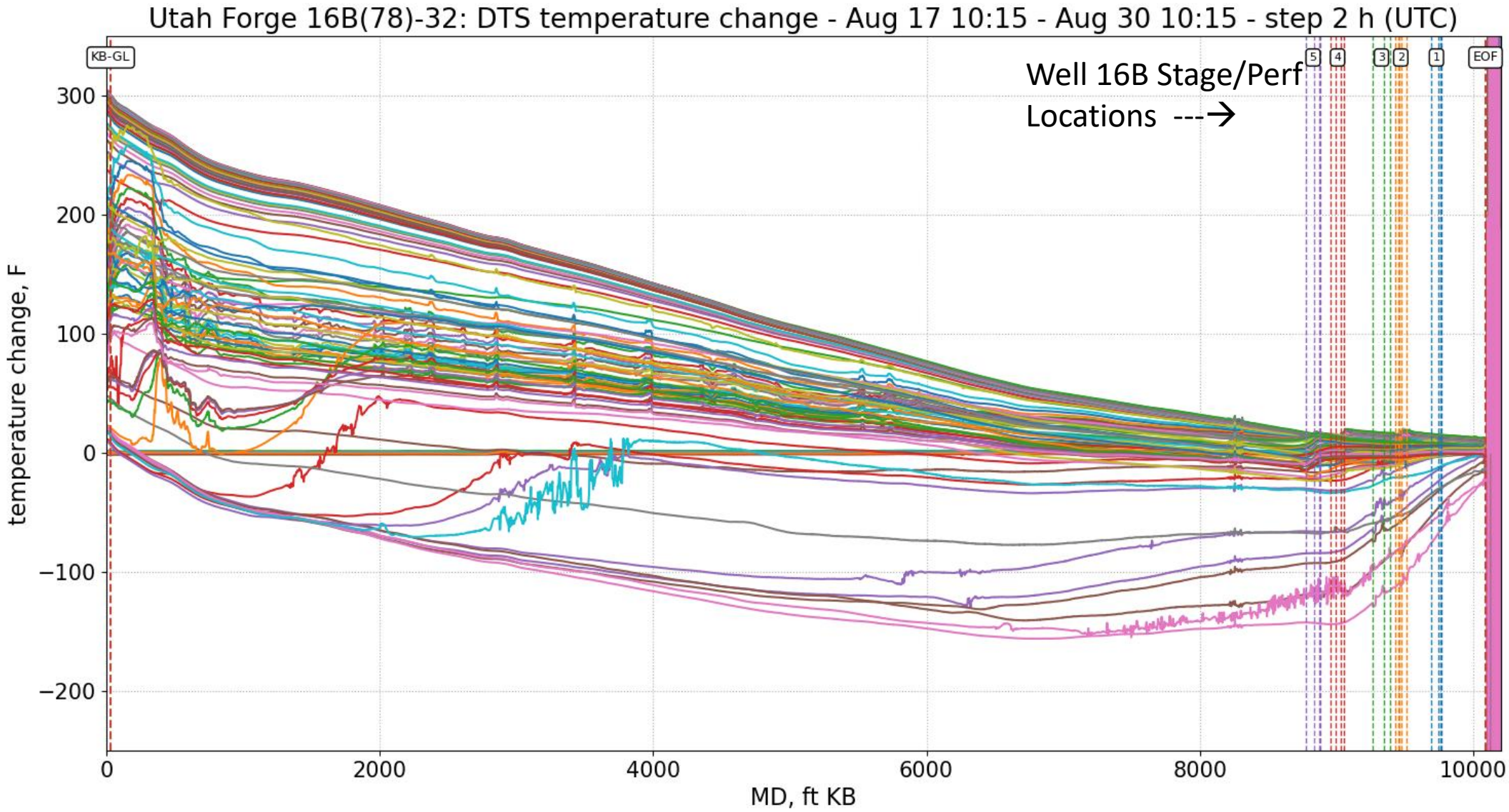
Well 16B – Calibrated and Corrected temperature –select depths



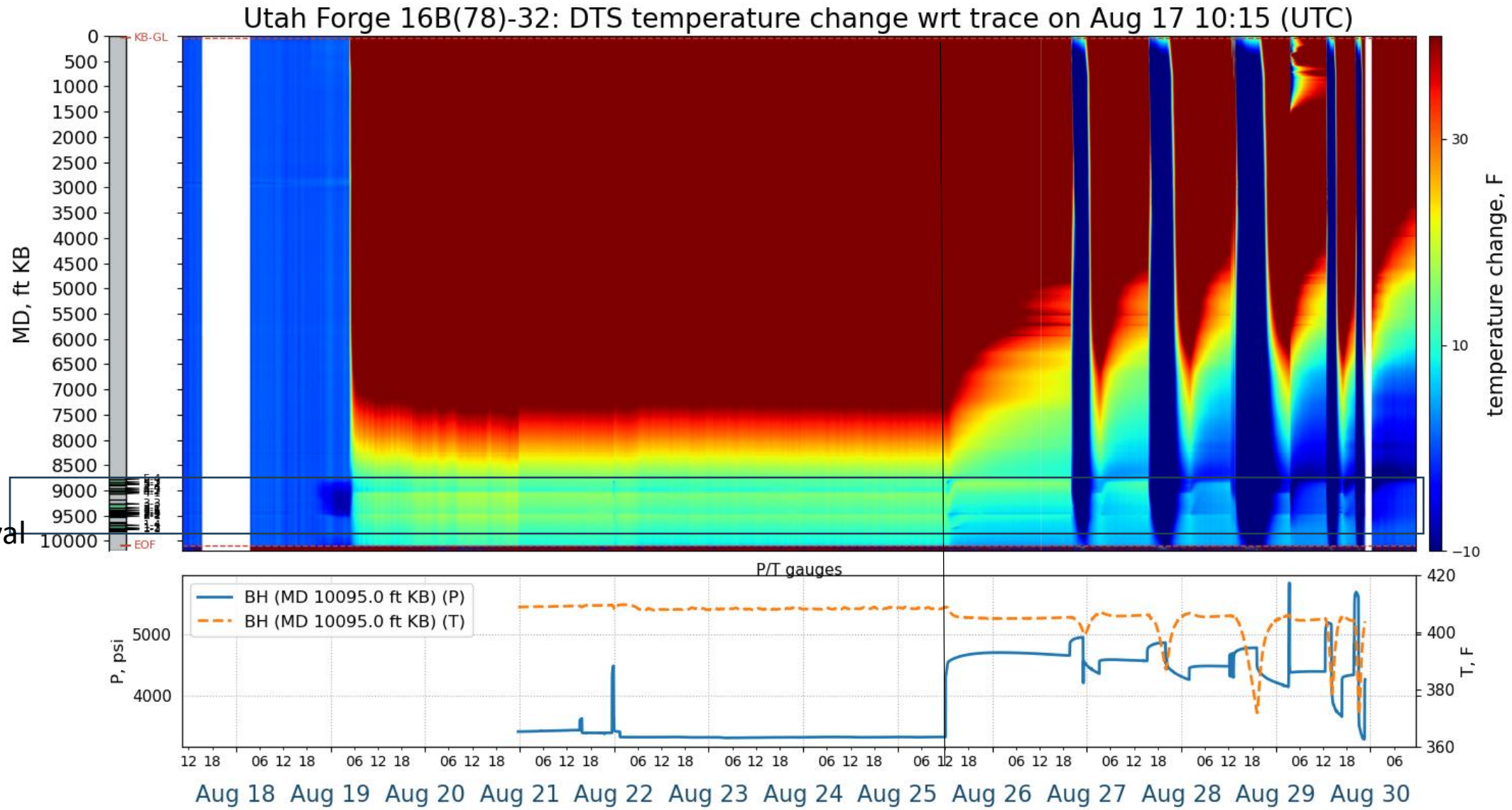
Well 16B – DTS temperature change – at selected depths



Well 16B – DTS temperature change – selected traces over time

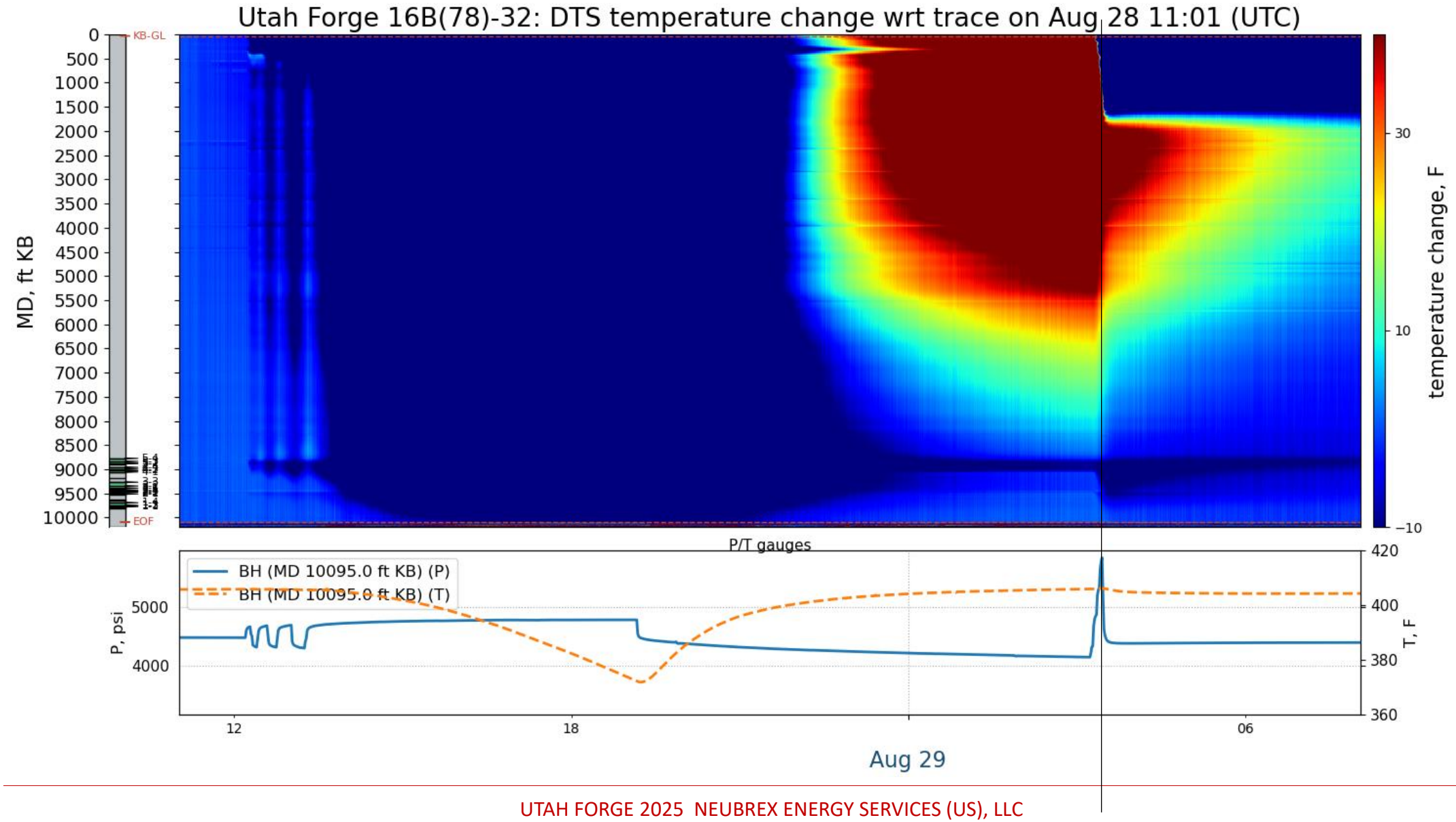


Well 16B – DTS temperature change – overview plot



Perf Interval

Well 16B – DTS temperature change – zoomed Aug 28-29



Brillouin absolute total strain

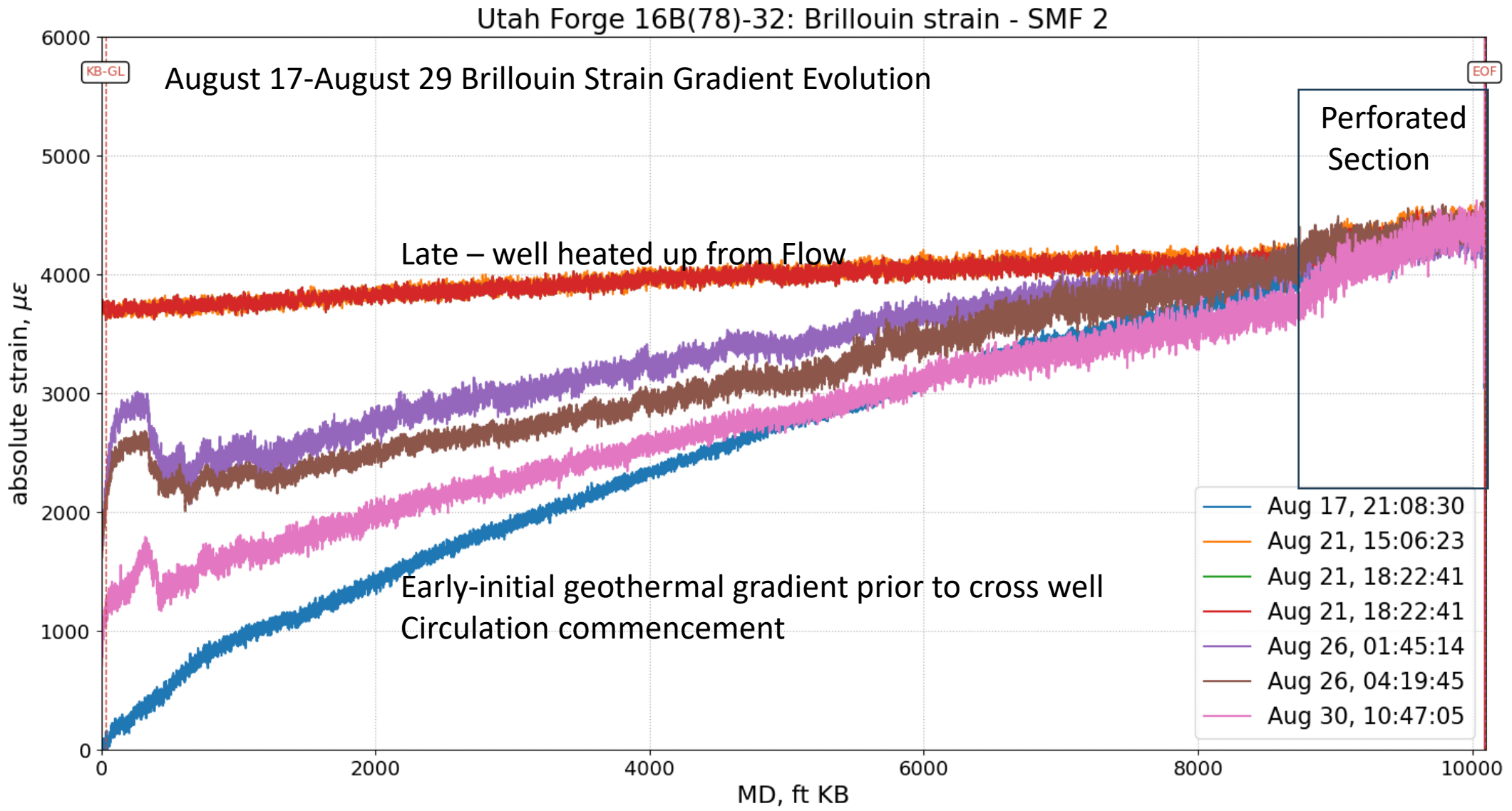
-- first trace: Aug 17, 2025, 21:08:30

-- last trace: Aug 30, 2025, 11:25:44

-- number of traces: 127

-- number of samples per trace: 78,349

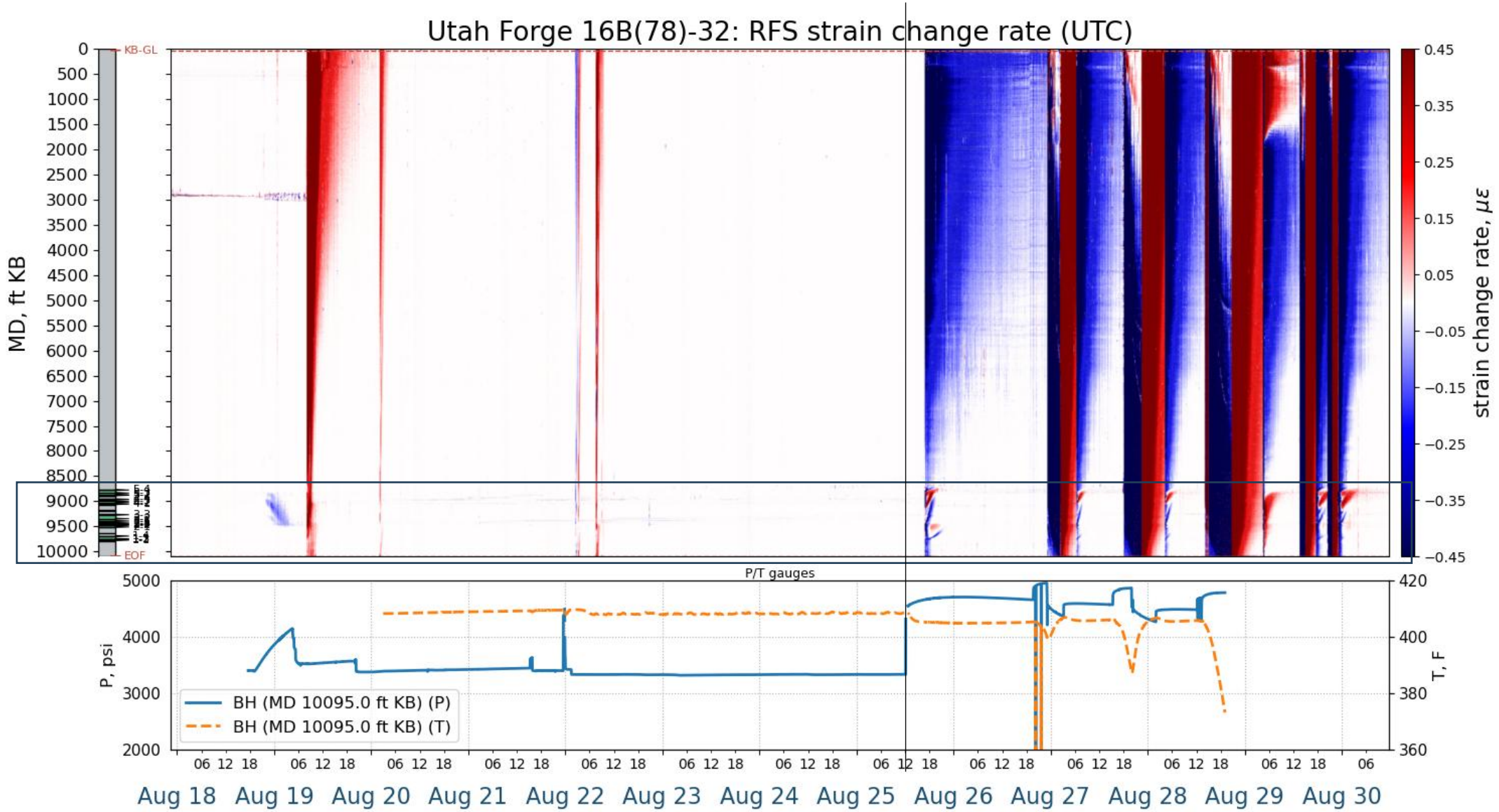
Well 16B – BCF absolute strain – selected traces in time



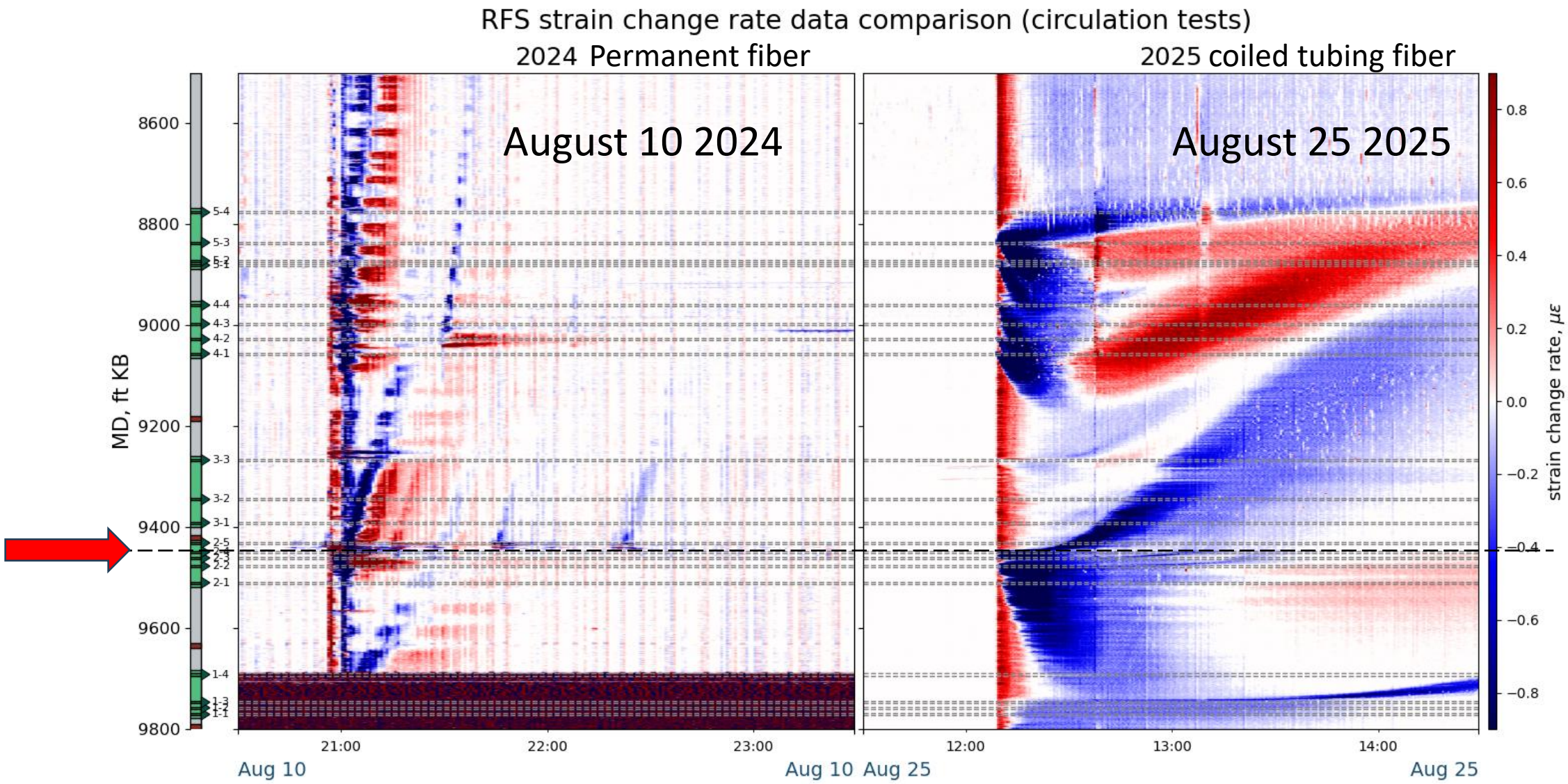
RFS DSS strain change rate
rate of change every 32 seconds

-- first trace: Aug 17, 2025, 22:30:35
-- last trace: Aug 30, 2025, 11:31:58
-- number of traces: 34,372
-- number of samples per trace: 78,349
-- average temporal interval (sec): 32

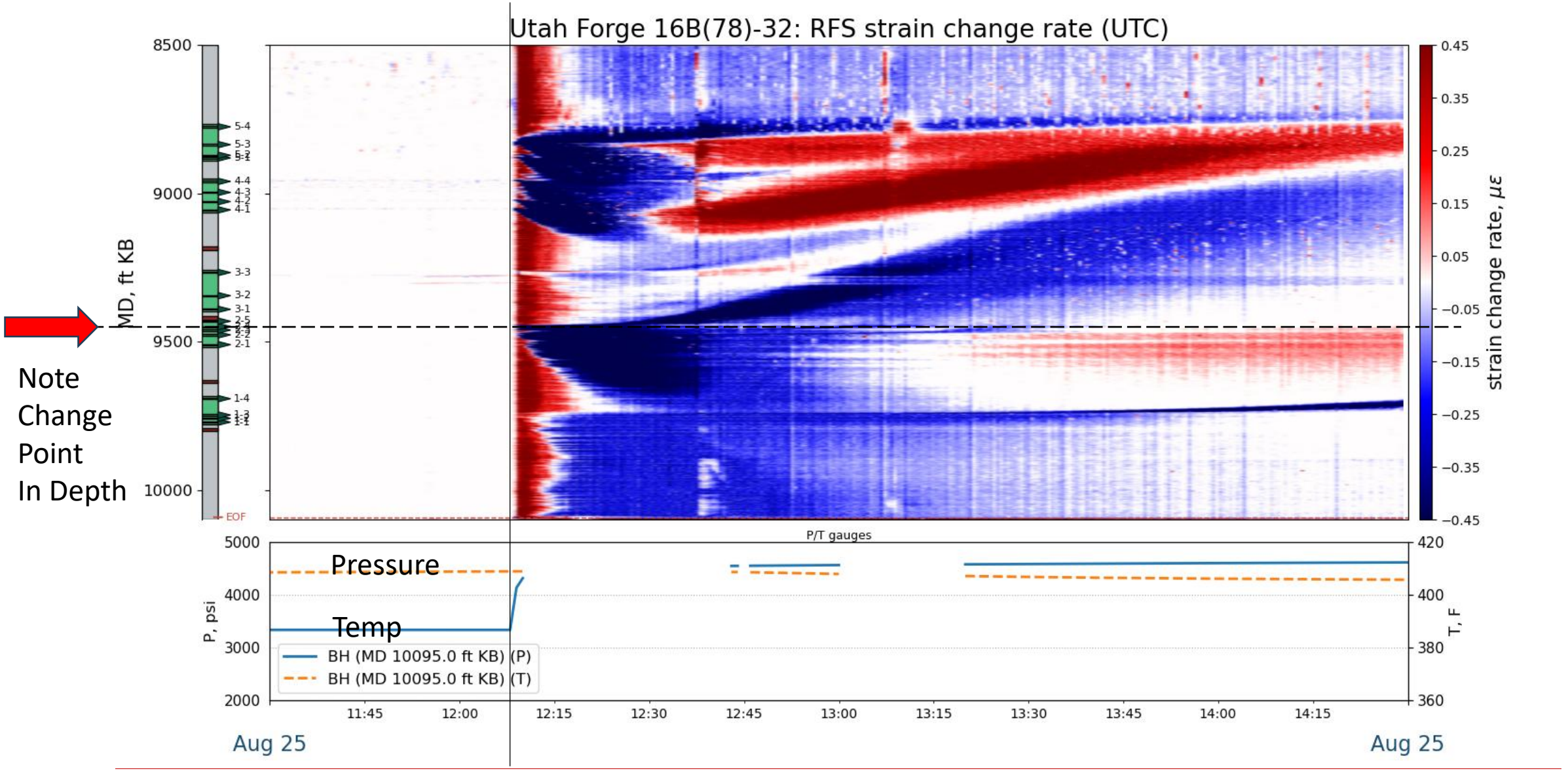
Well 16B – RFS strain change rate – overview Aug 17-30



Well 16B – RFS strain rate – circulation test Instrumented Well 2024 circulation test with permanent fiber vs 2025 Coiled Tubing

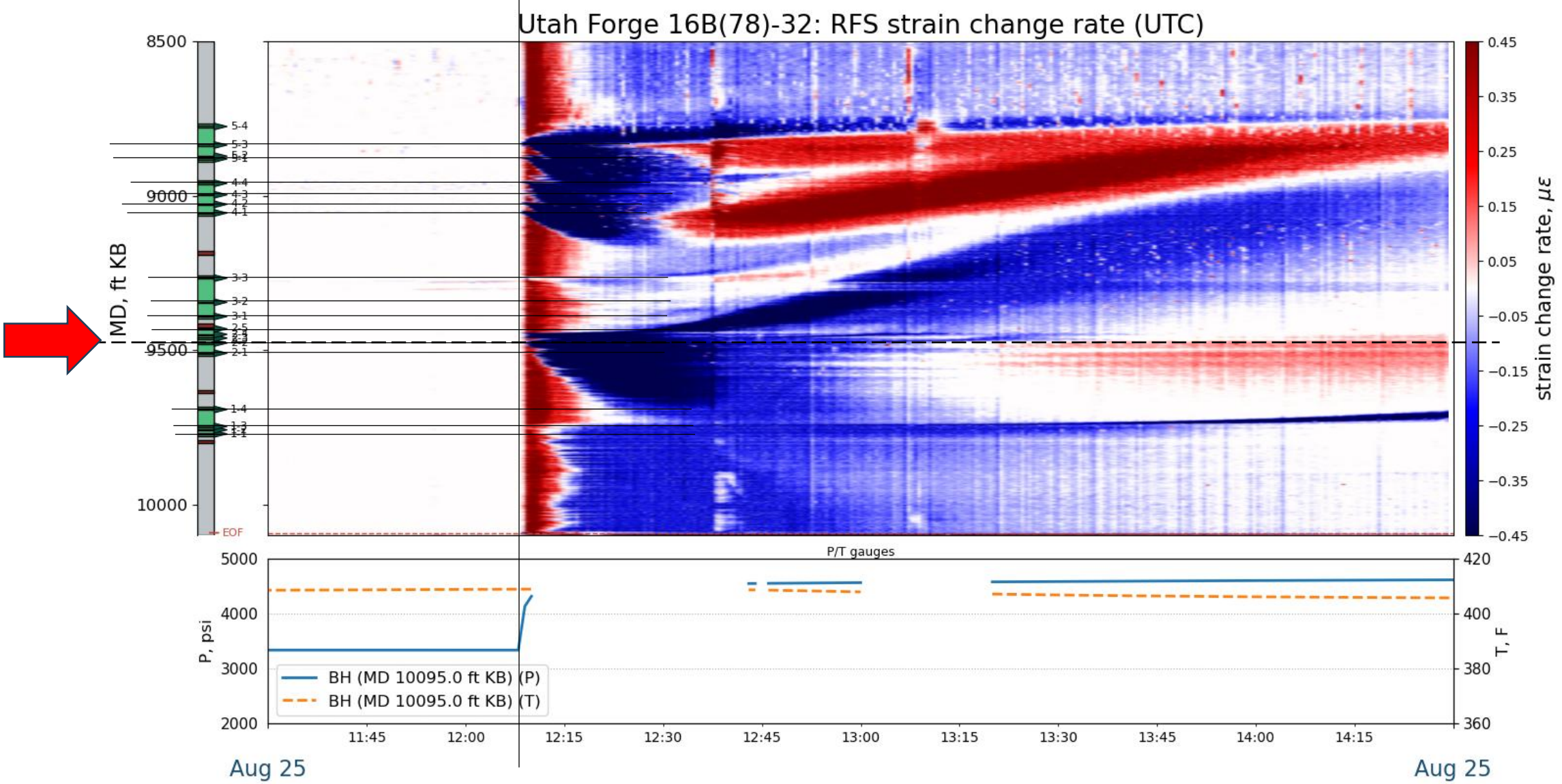


Well 16B – RFS strain change rate on coiled tubing fiber

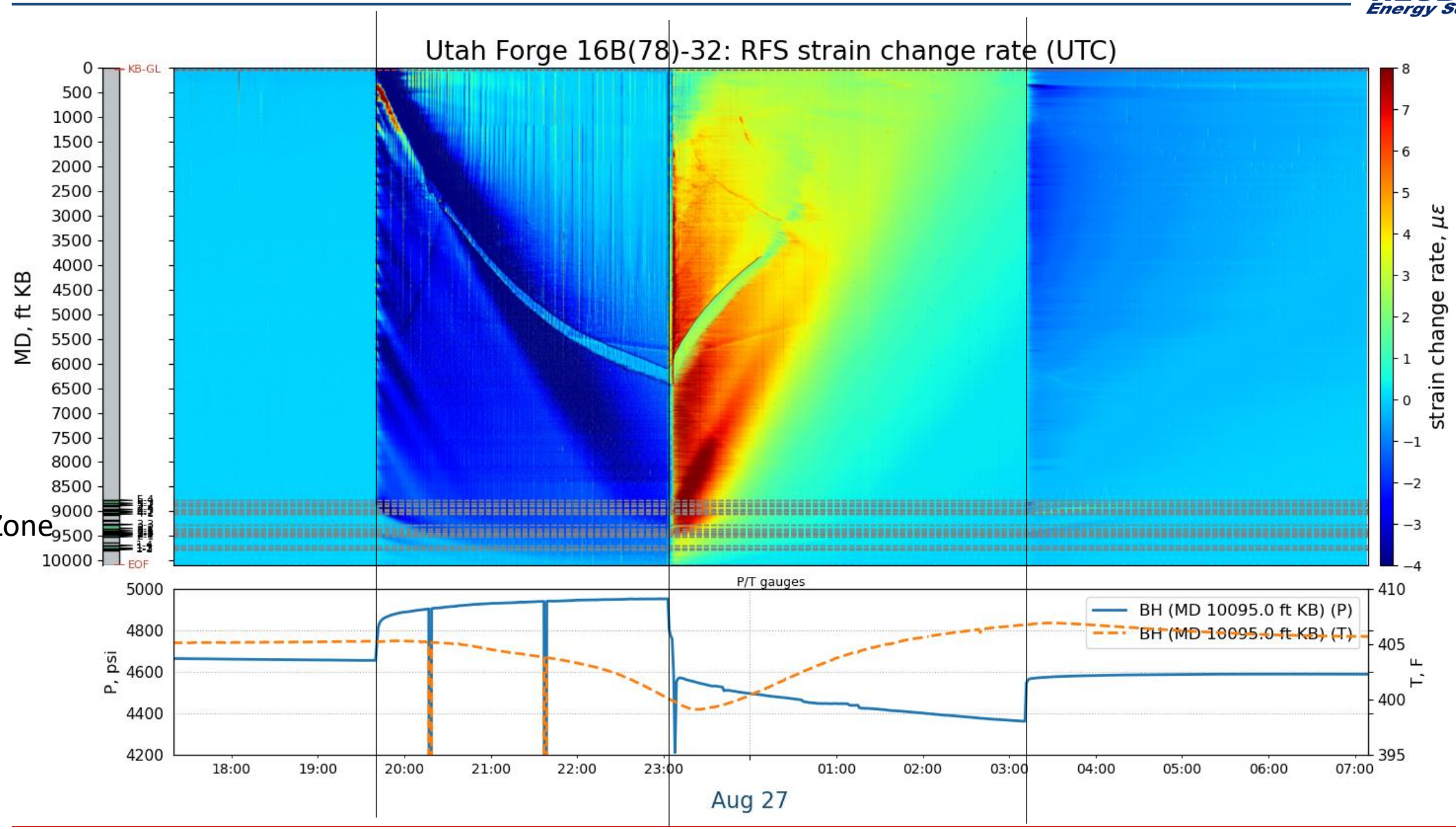


Note Change Point In Depth

Well 16B – RFS strain change rate on coiled tubing fiber with relationship to open perforations depths in 16B well. Huff n Puff

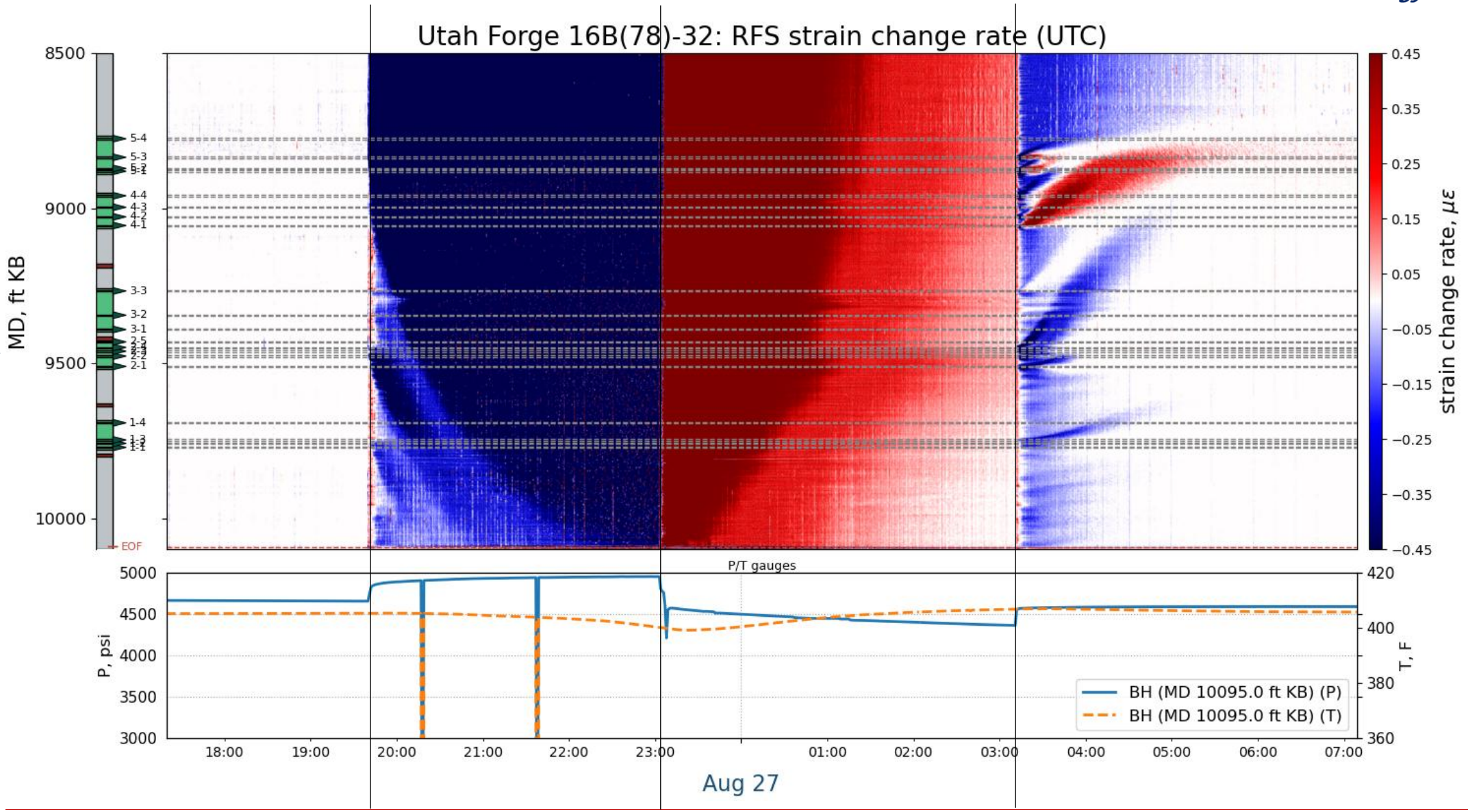


Well 16B – RFS strain change rate Aug 26 – 27 dates

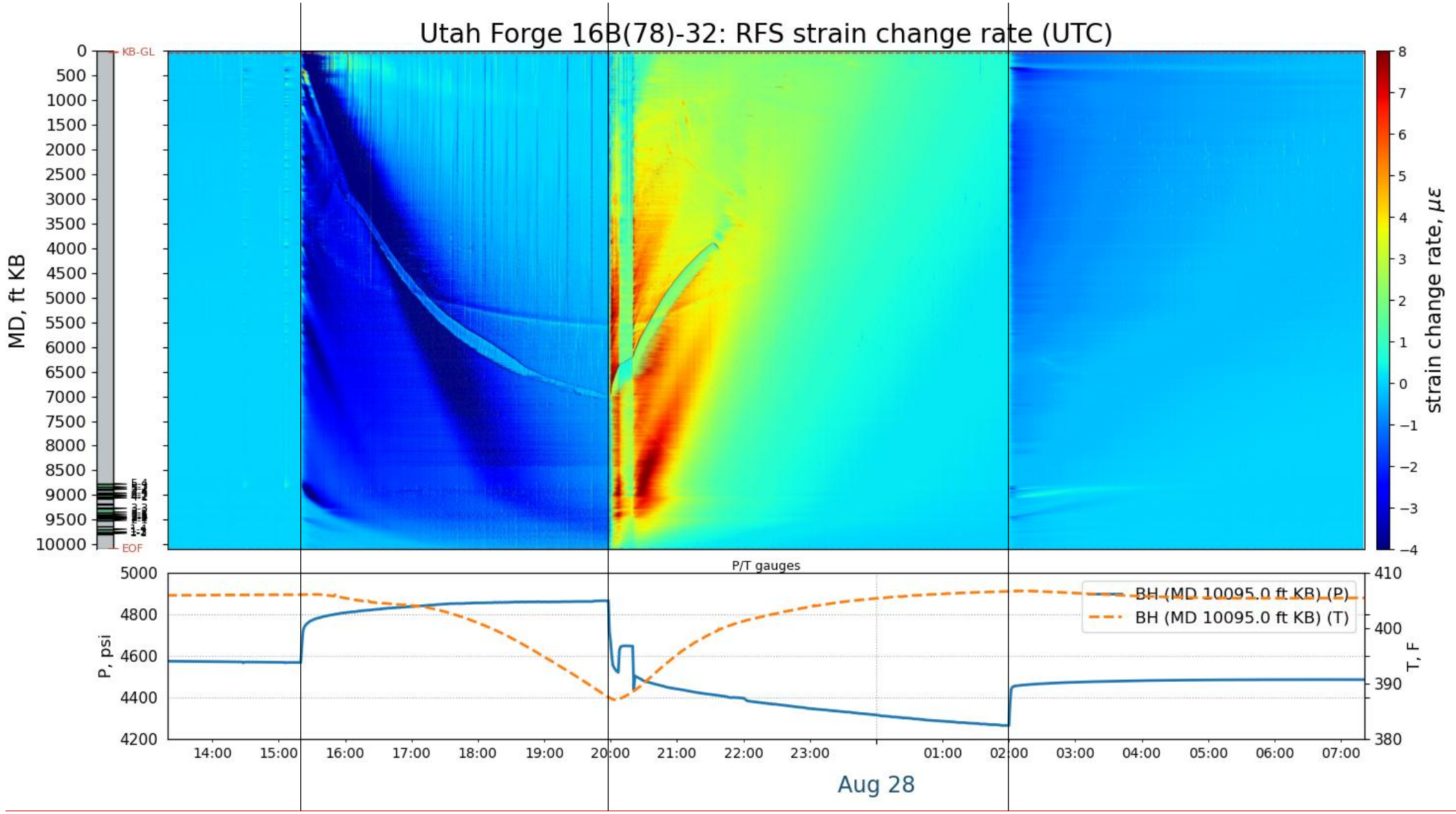


Perf Zone

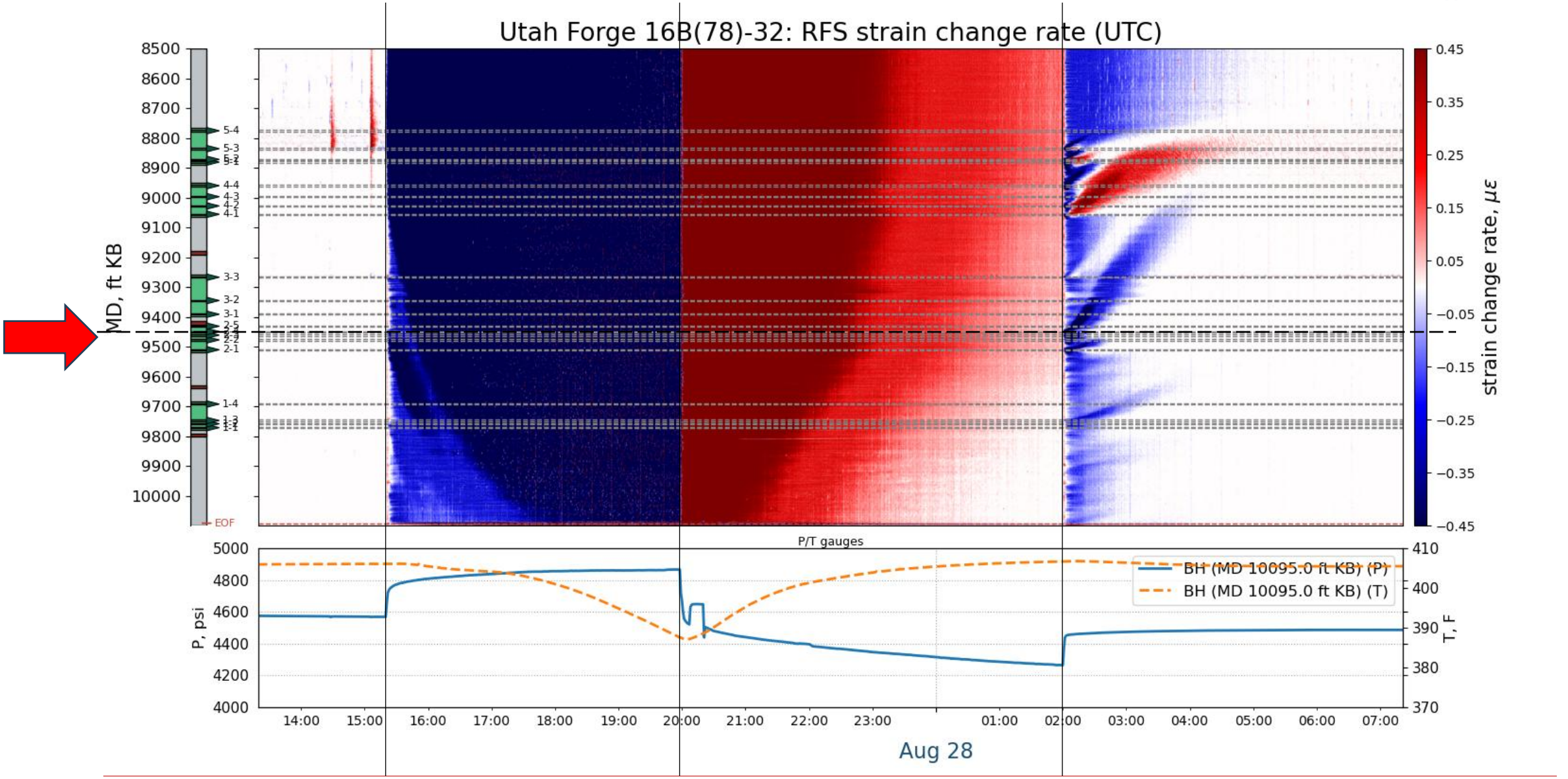
Well 16B – RFS strain change rate Aug 26-27



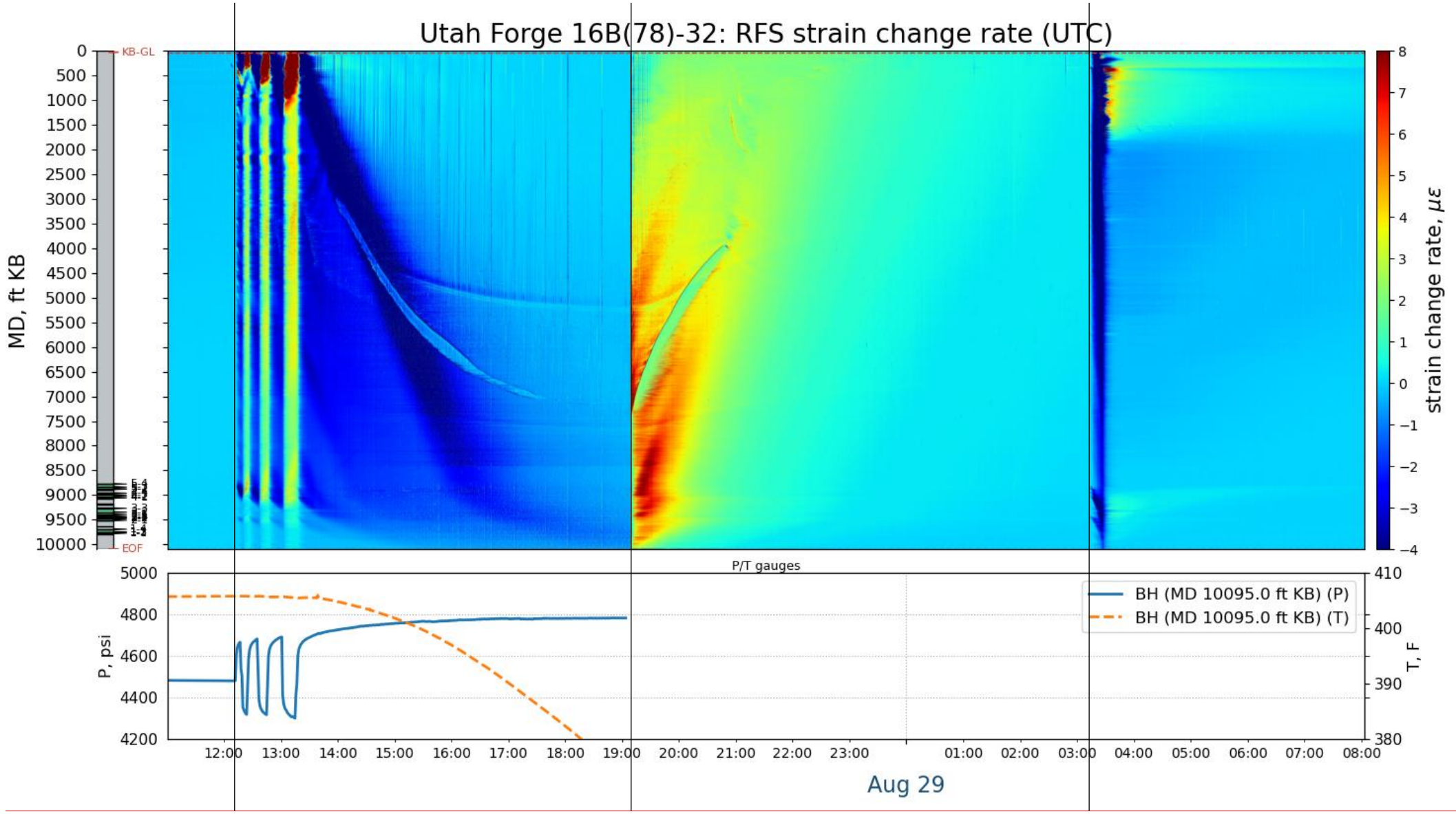
Well 16B – RFS strain change rate Aug 27 – 28



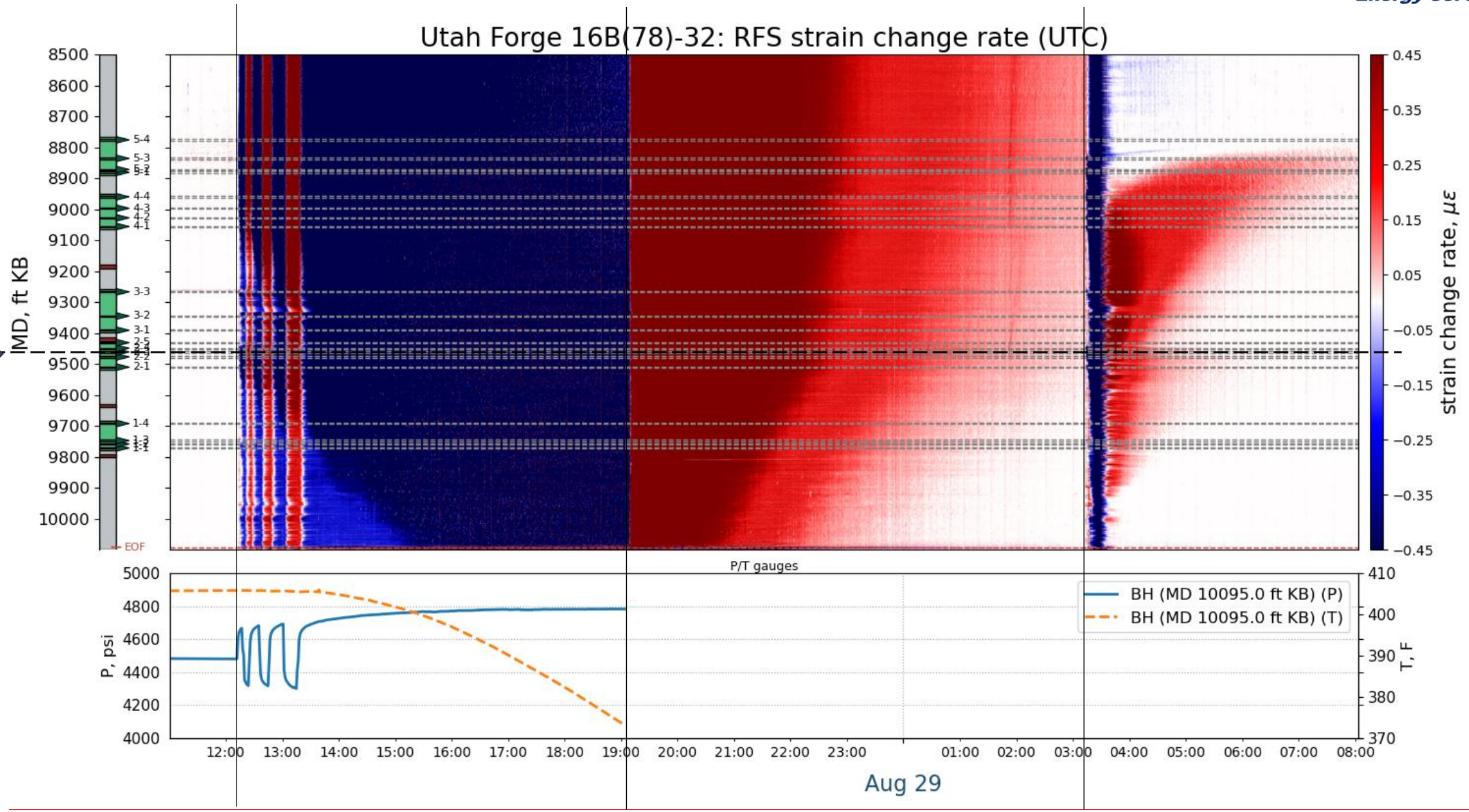
Well 16B – RFS strain change rate Aug 27 - 28



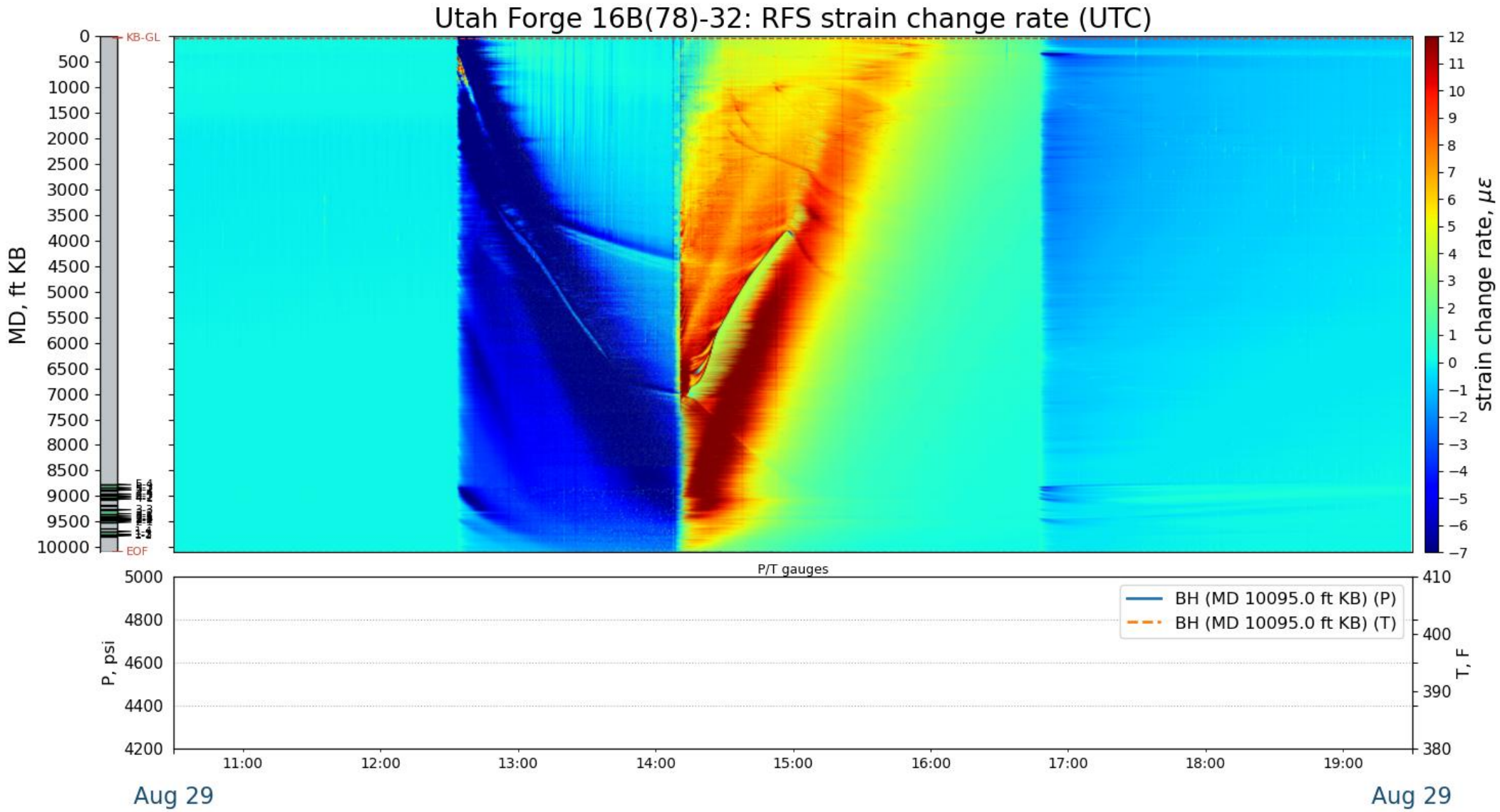
Well 16B – RFS strain change rate Aug 28 – 29



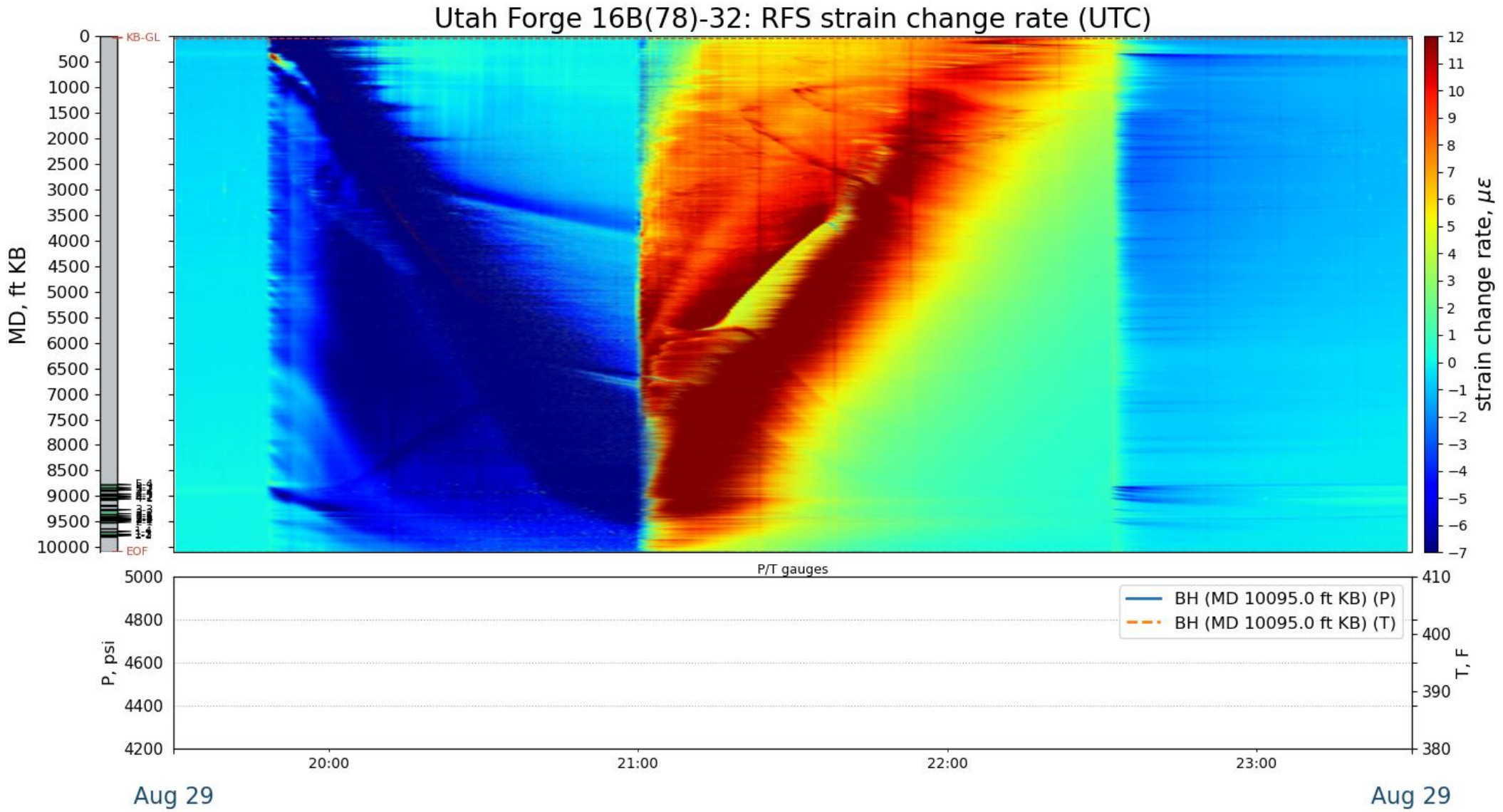
Well 16B – RFS strain change rate Aug 28 - 29



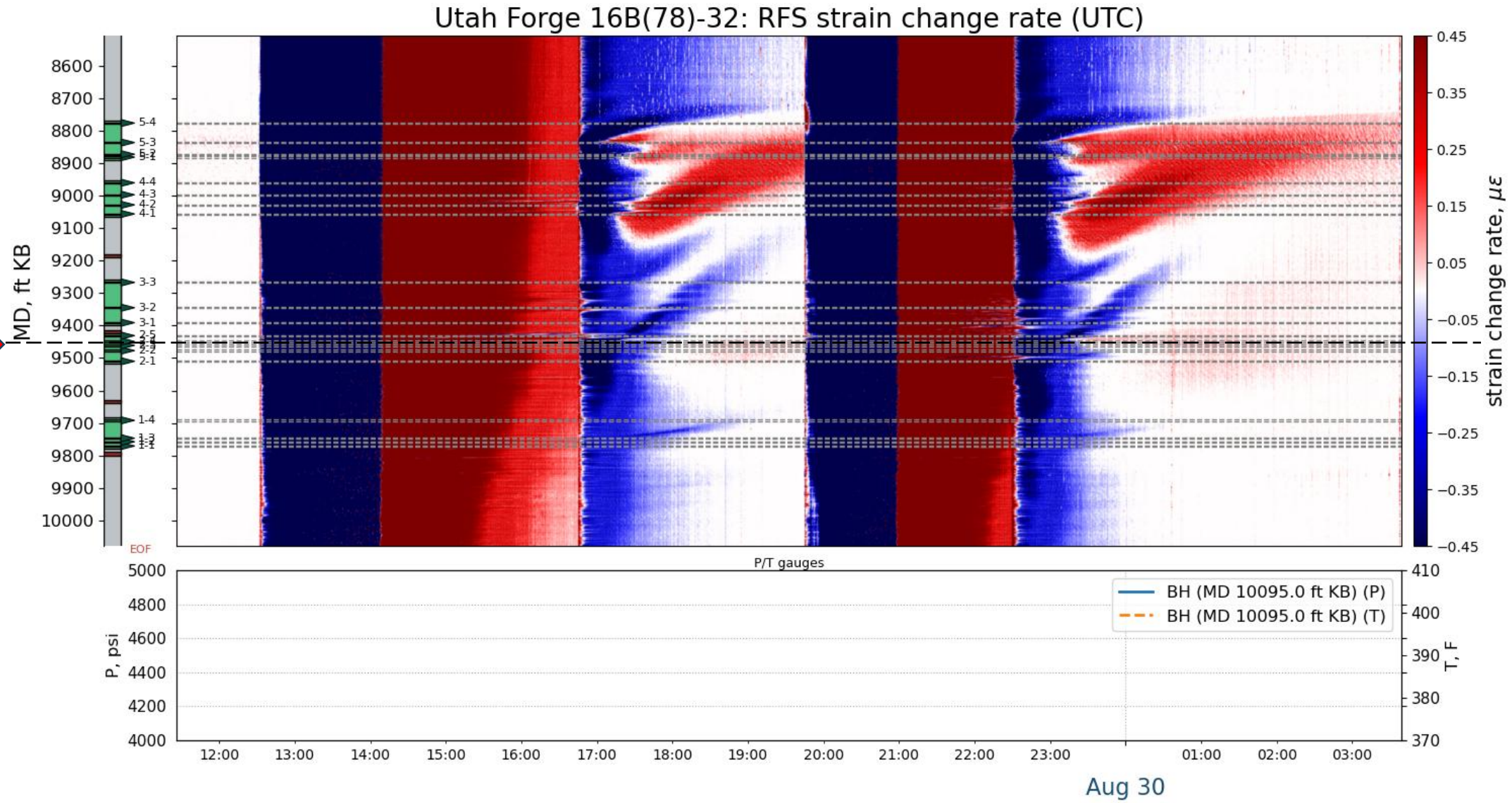
Well 16B – RFS strain change rate Aug 29



Well 16B – RFS strain change rate Aug 29



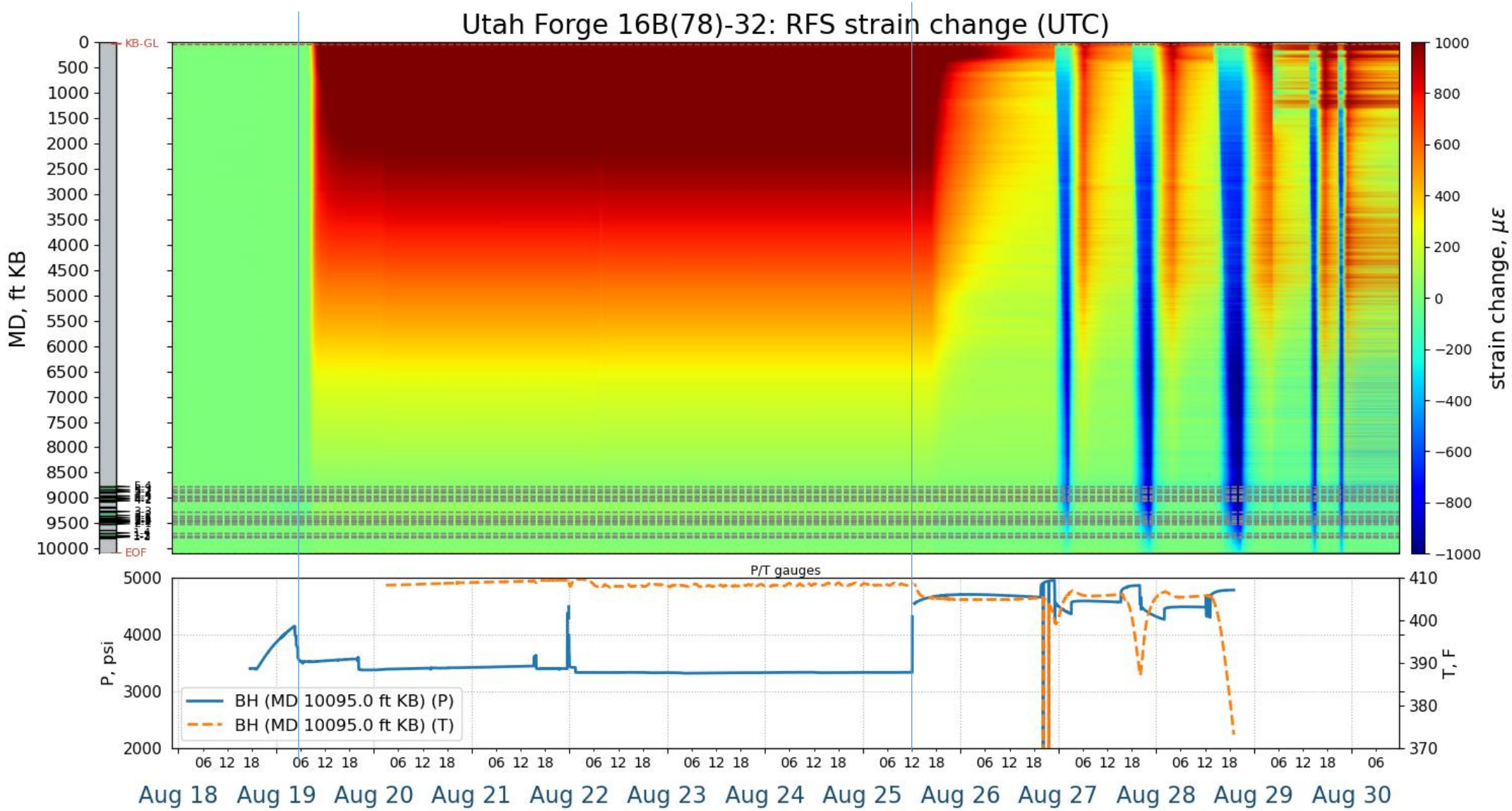
Well 16B – RFS strain change rate Aug 29 – 30



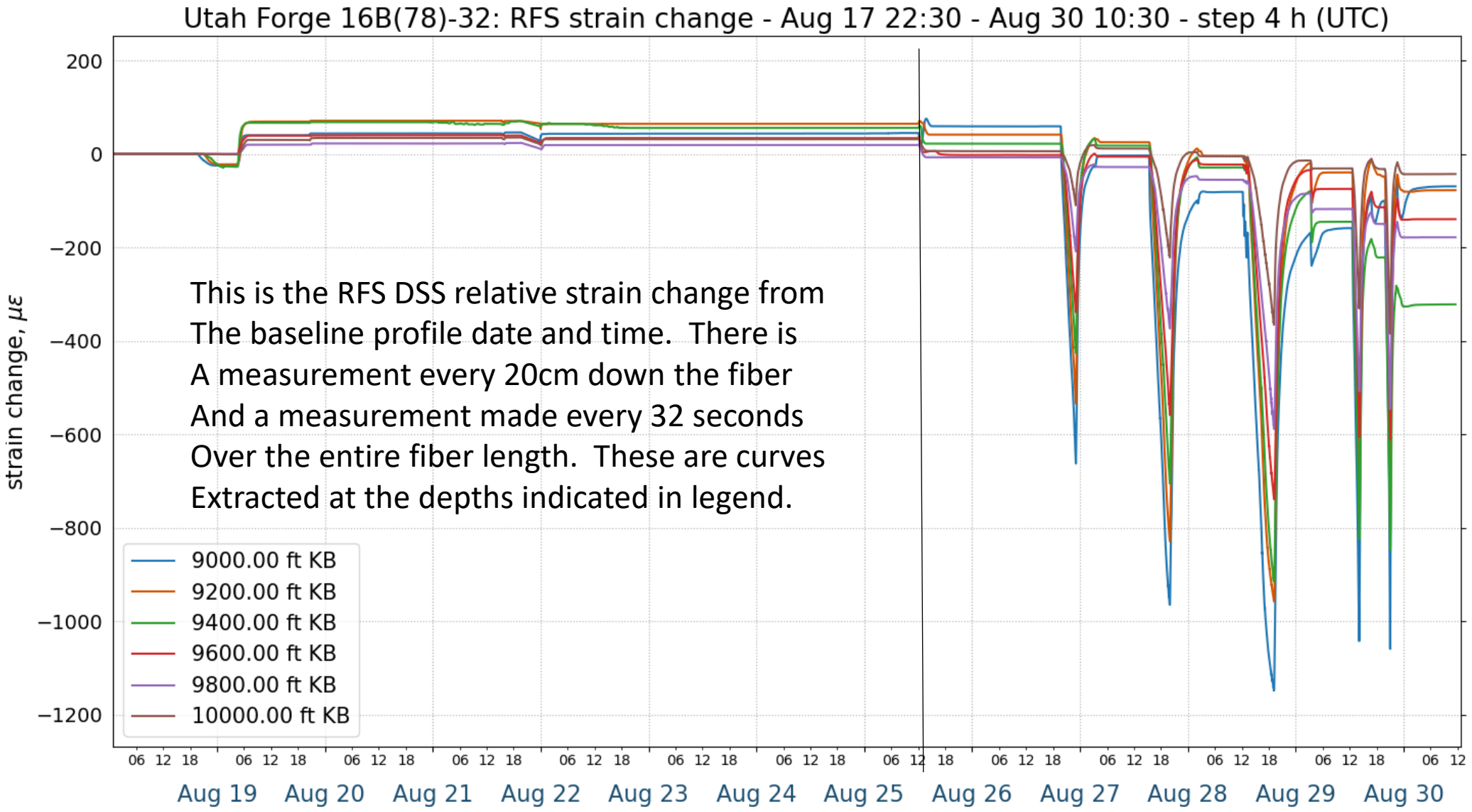
RFS strain change

-- first trace: Aug 17, 2025, 22:30:35
-- last trace: Aug 30, 2025, 11:31:58
-- number of traces: 34,372
-- number of samples per trace: 78,349
-- average temporal interval (sec): 32

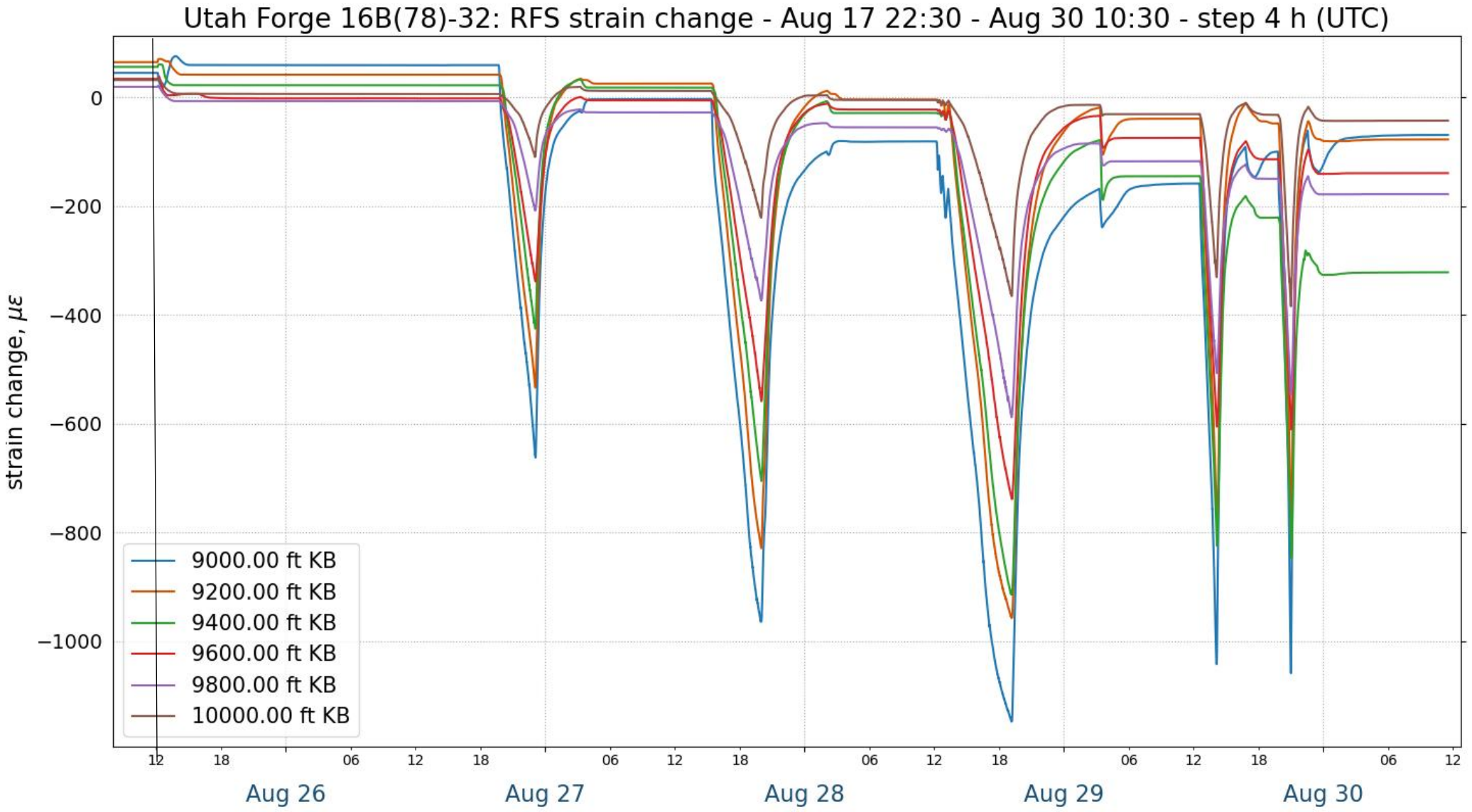
Well 16B – RFS strain change



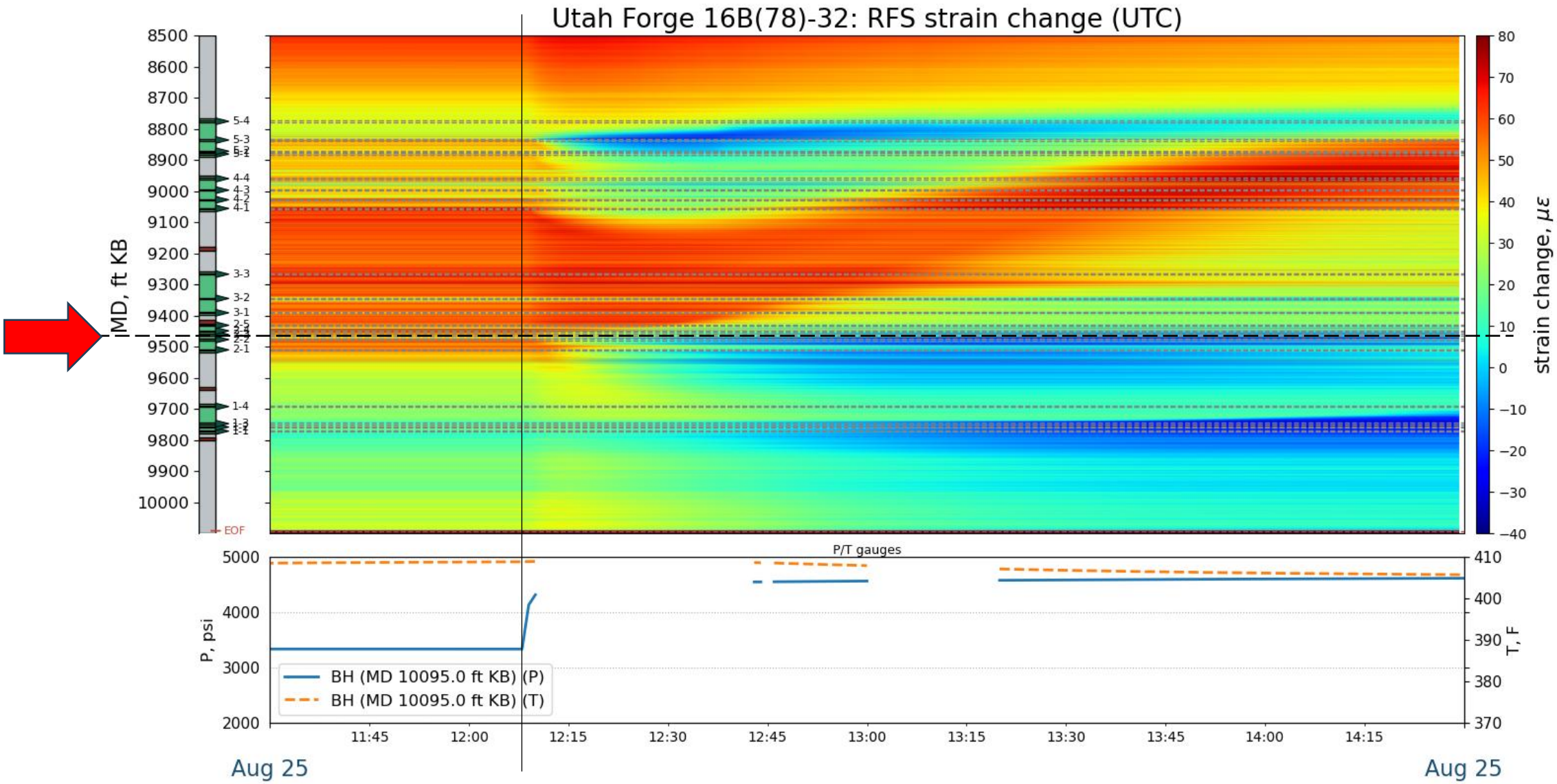
Well 16B – RFS strain change (relative strain change) over time



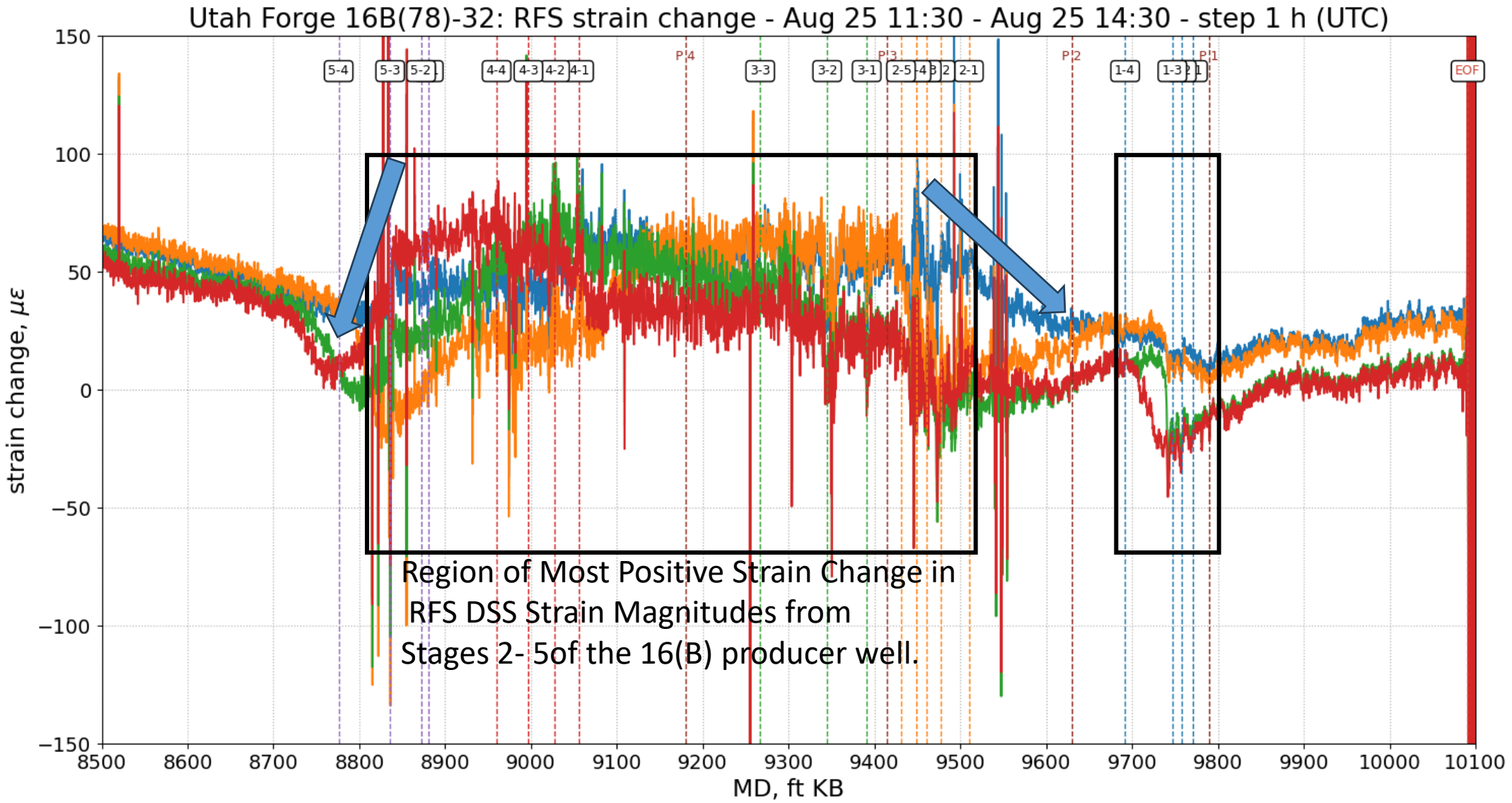
Well 16B – RFS strain change zoomed into time region



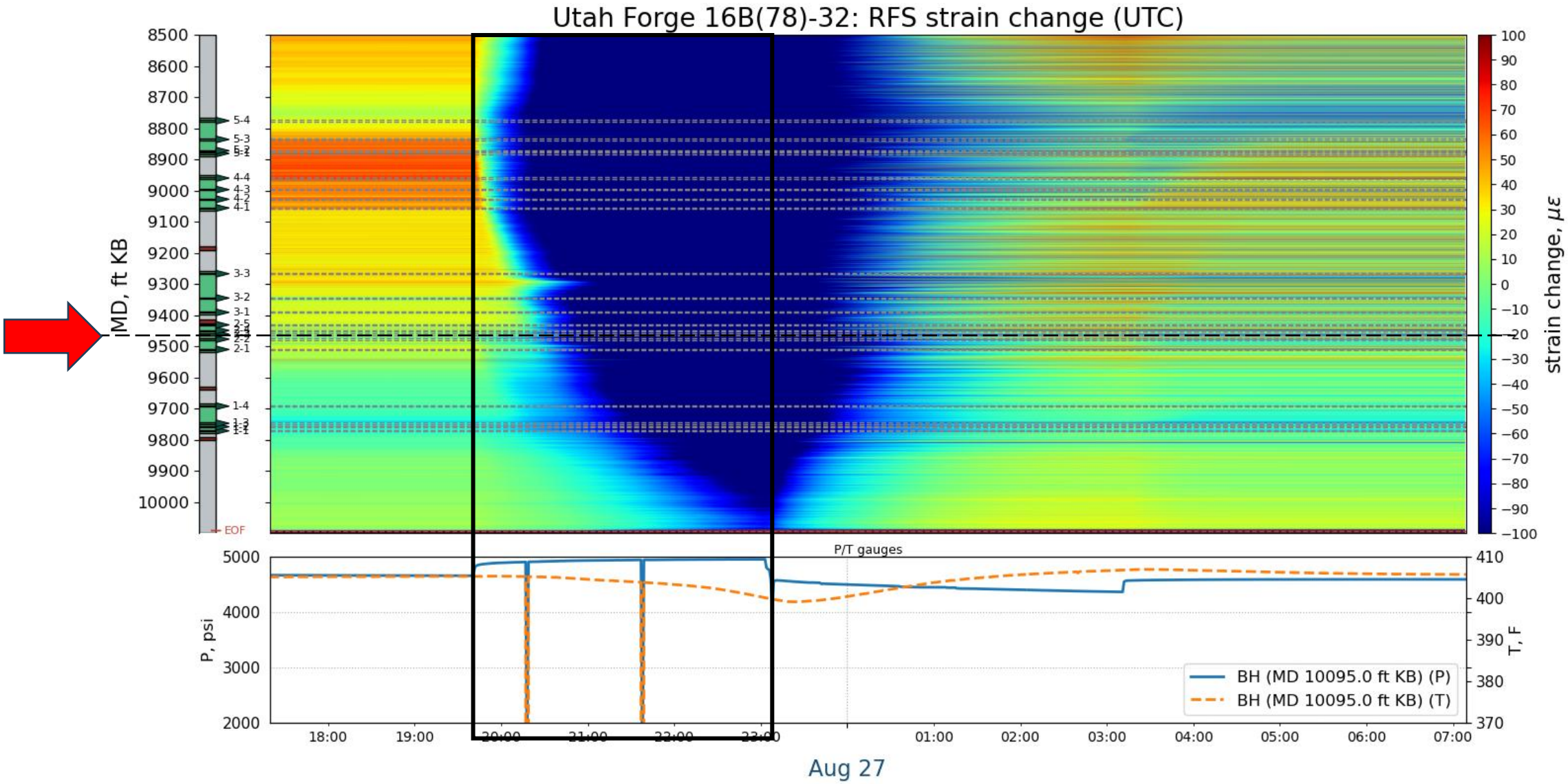
Well 16B – RFS strain change waterfall plot on Aug 25



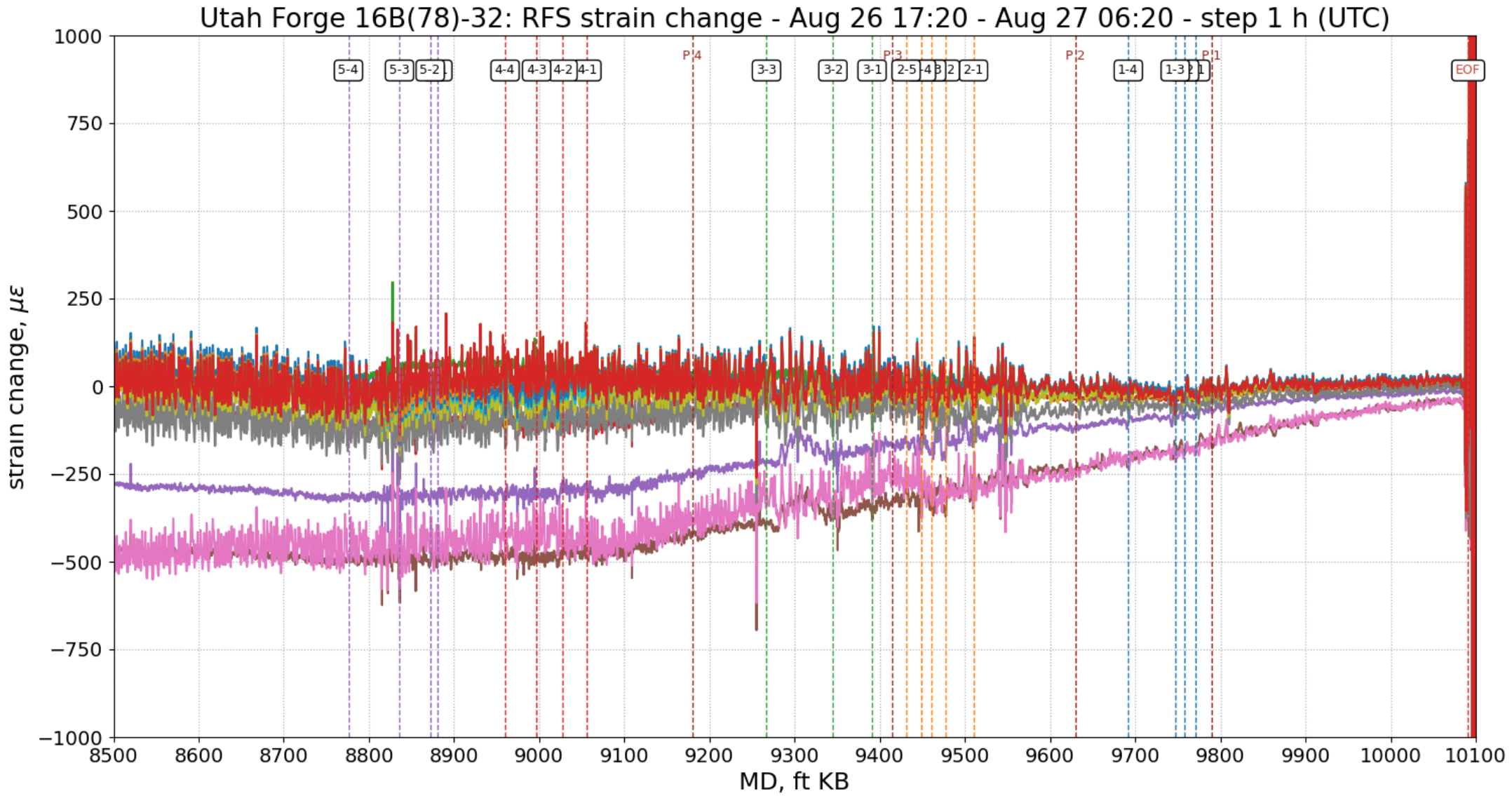
Well 16B – RFS strain change extracted depth profiles on *August 25* extracted in 1 hour time step.



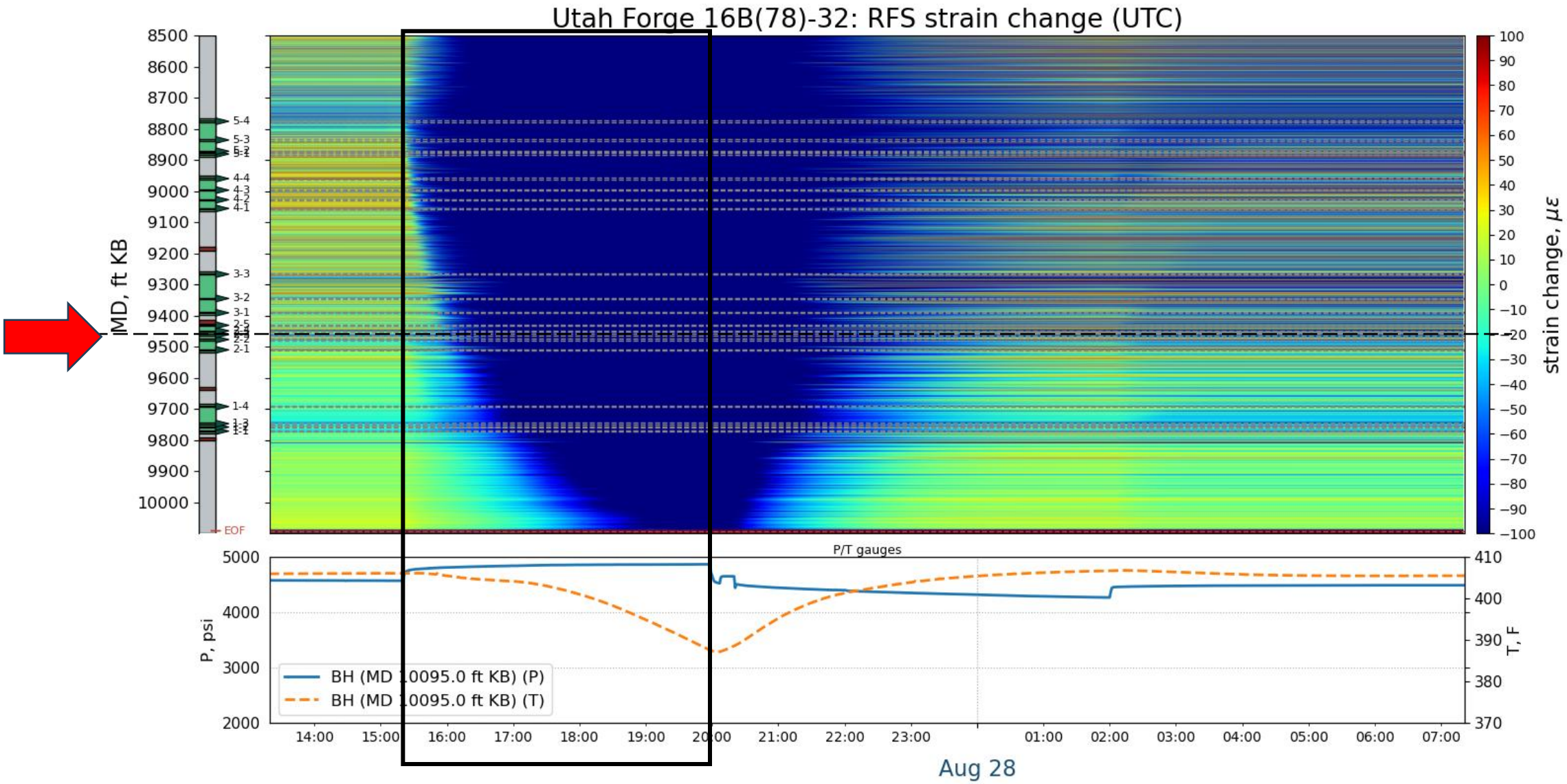
Well 16B – RFS strain change



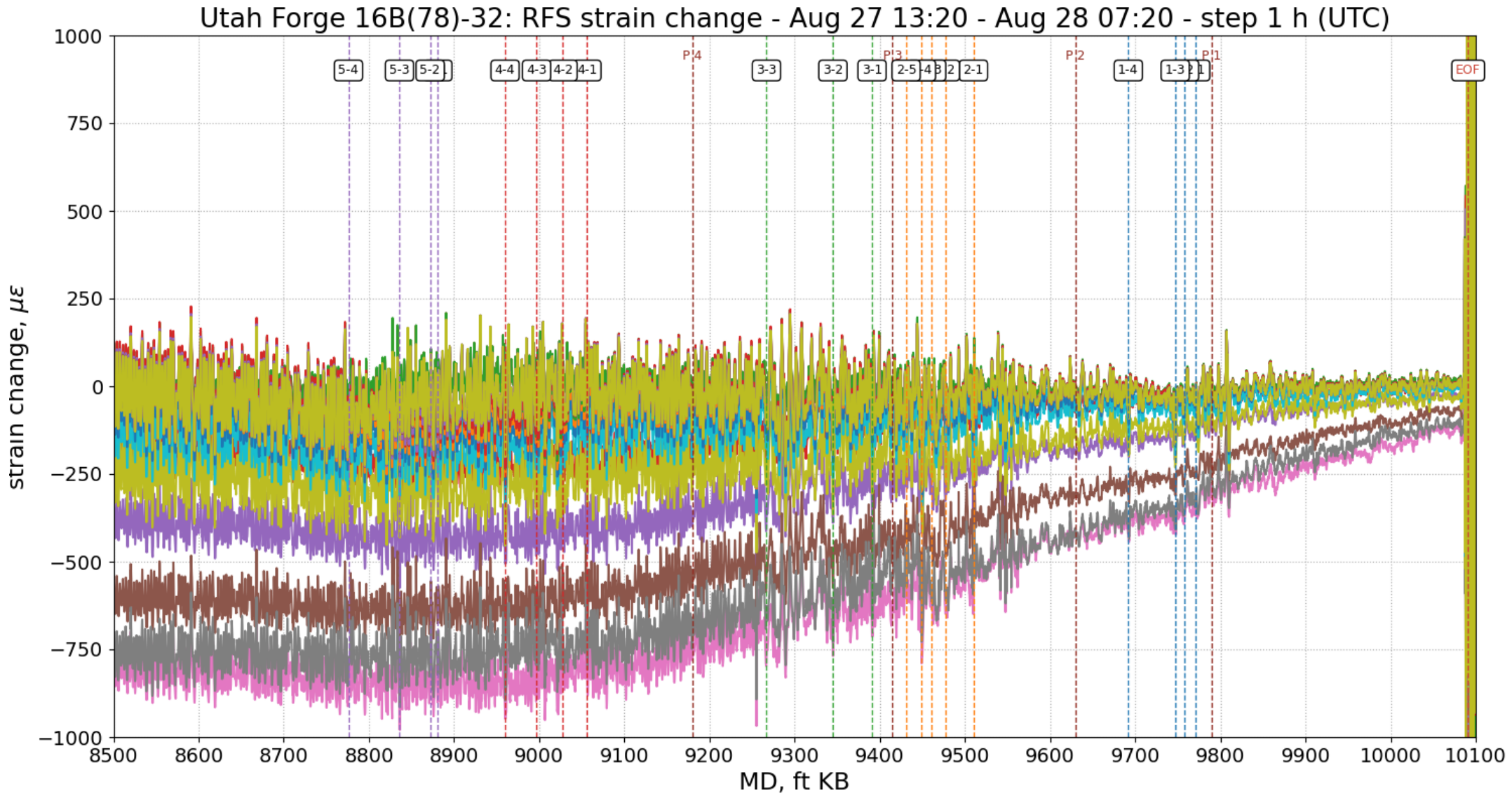
Well 16B – RFS strain change on August 26 – 27



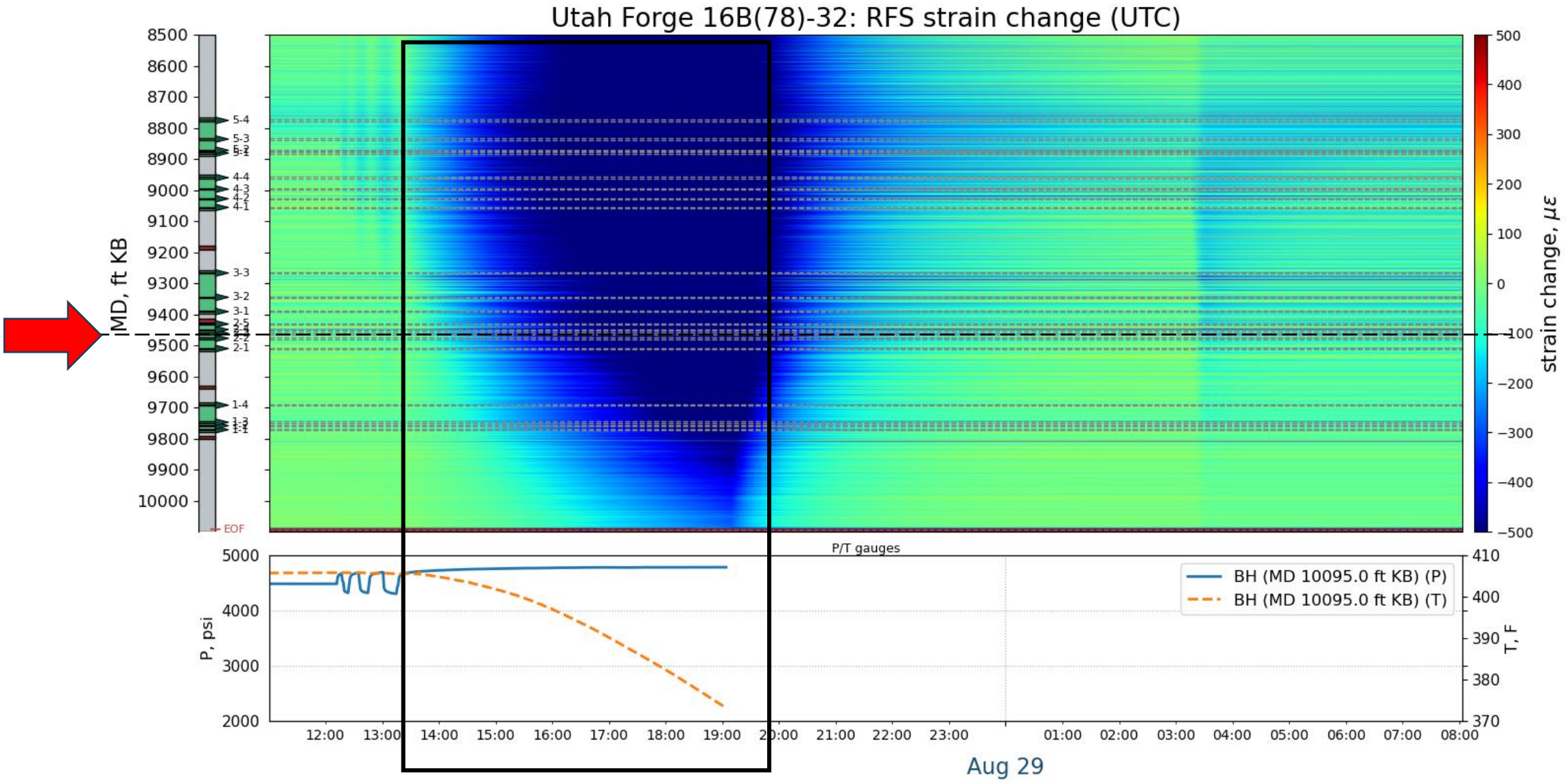
Well 16B – RFS strain change on August 27 – 28



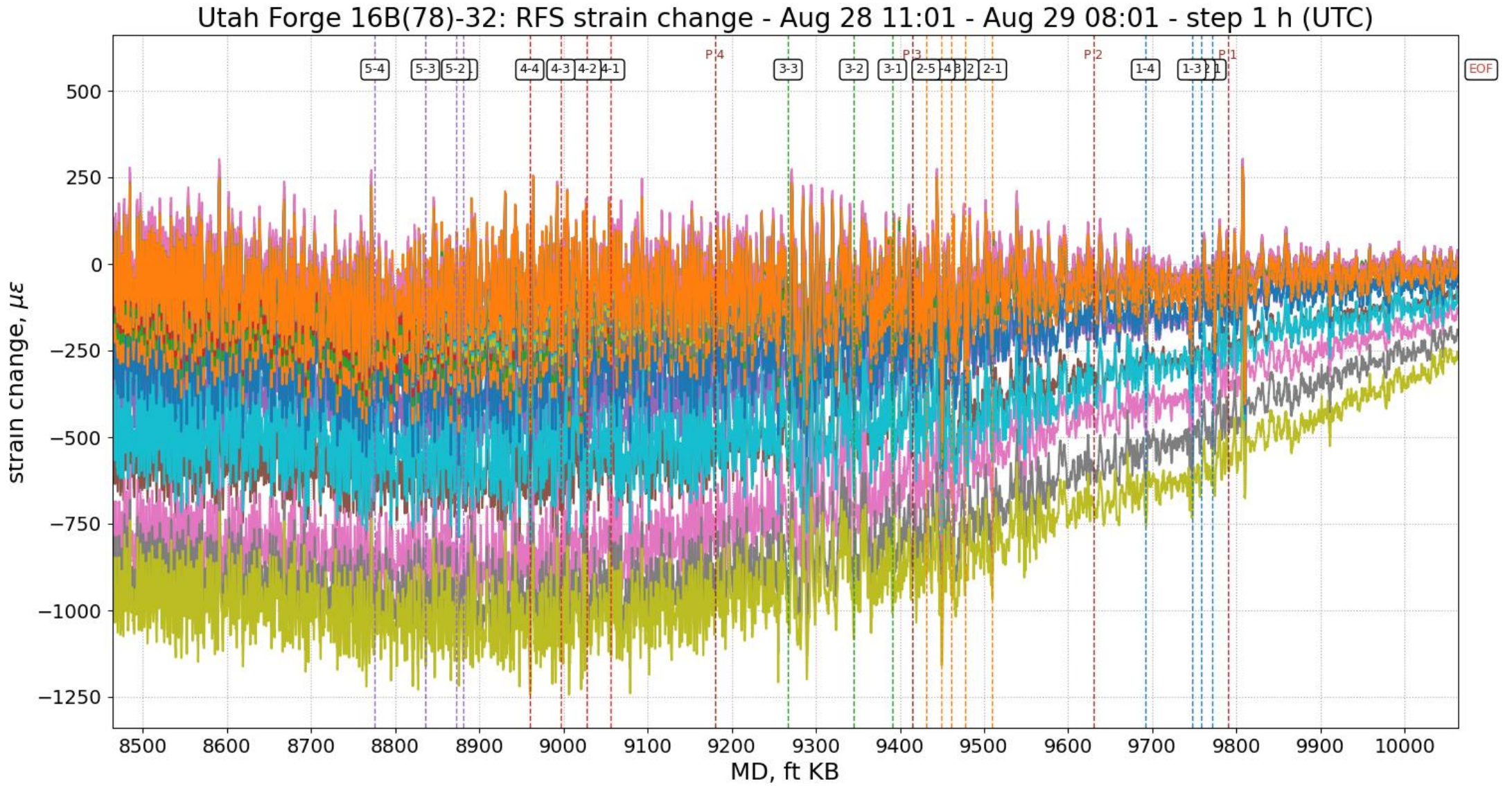
Well 16B – RFS strain change



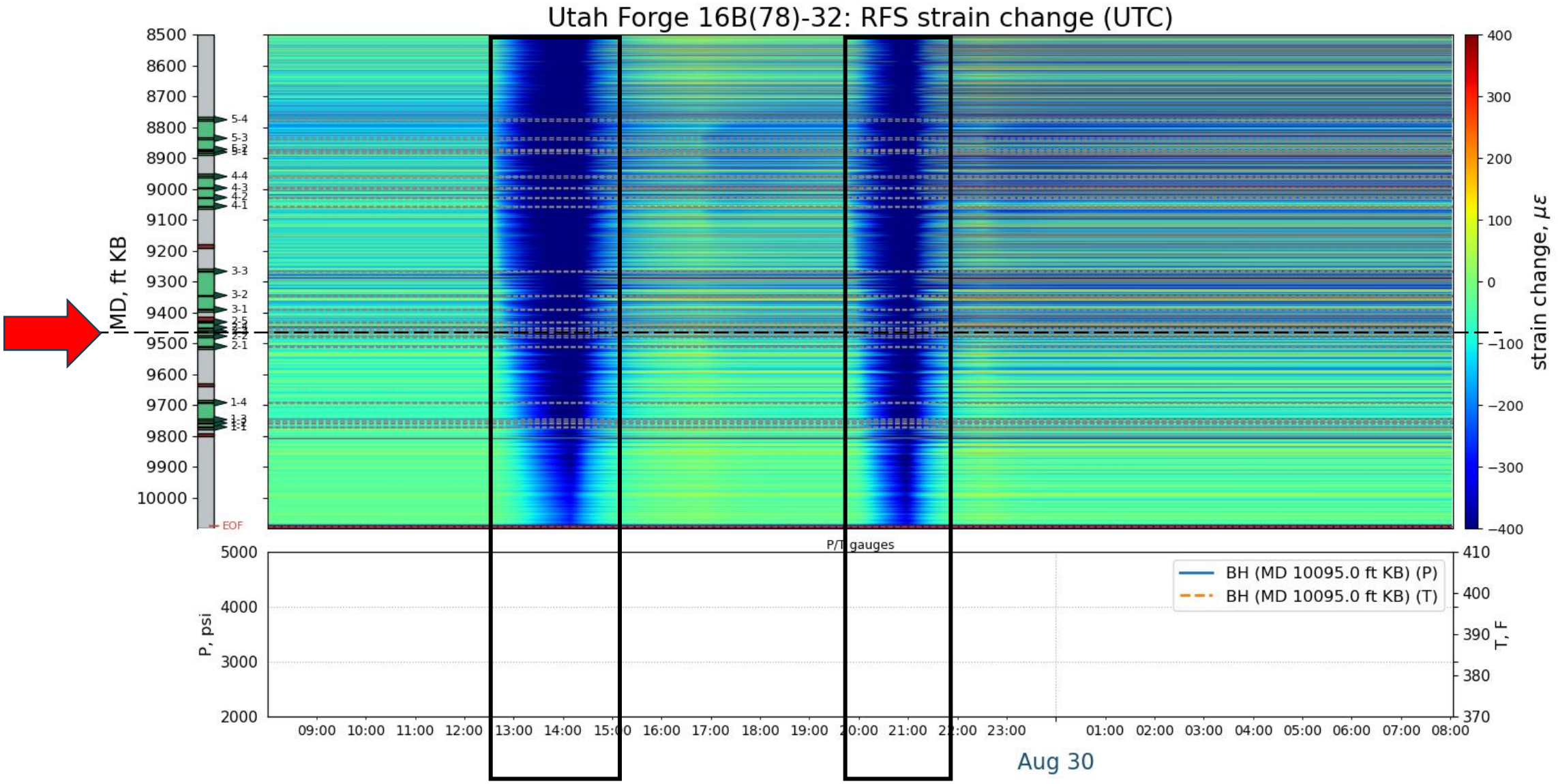
Well 16B – RFS strain change



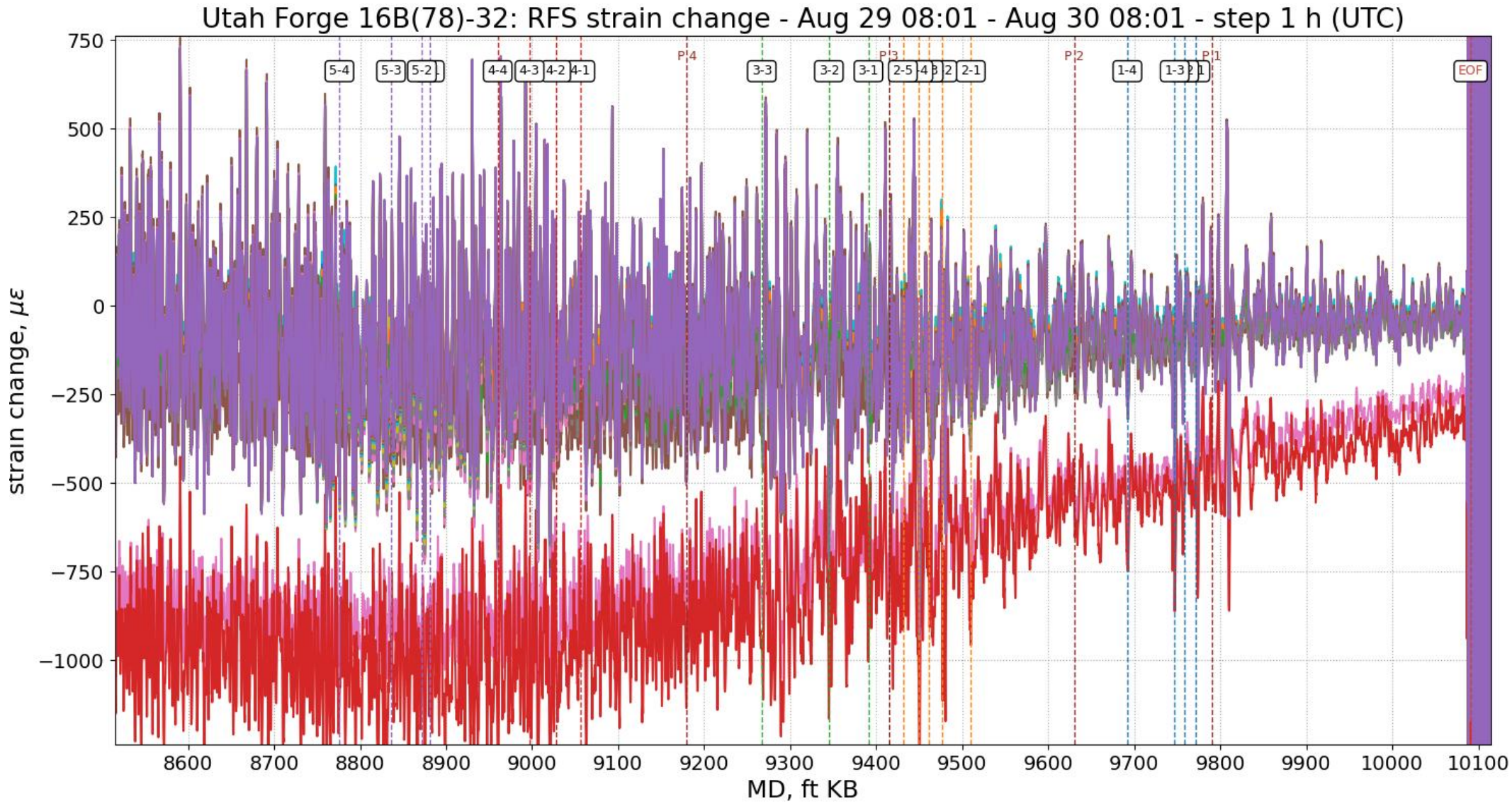
Well 16B – RFS strain change



Well 16B – RFS strain change – gauge data not available



Well 16B – RFS strain change



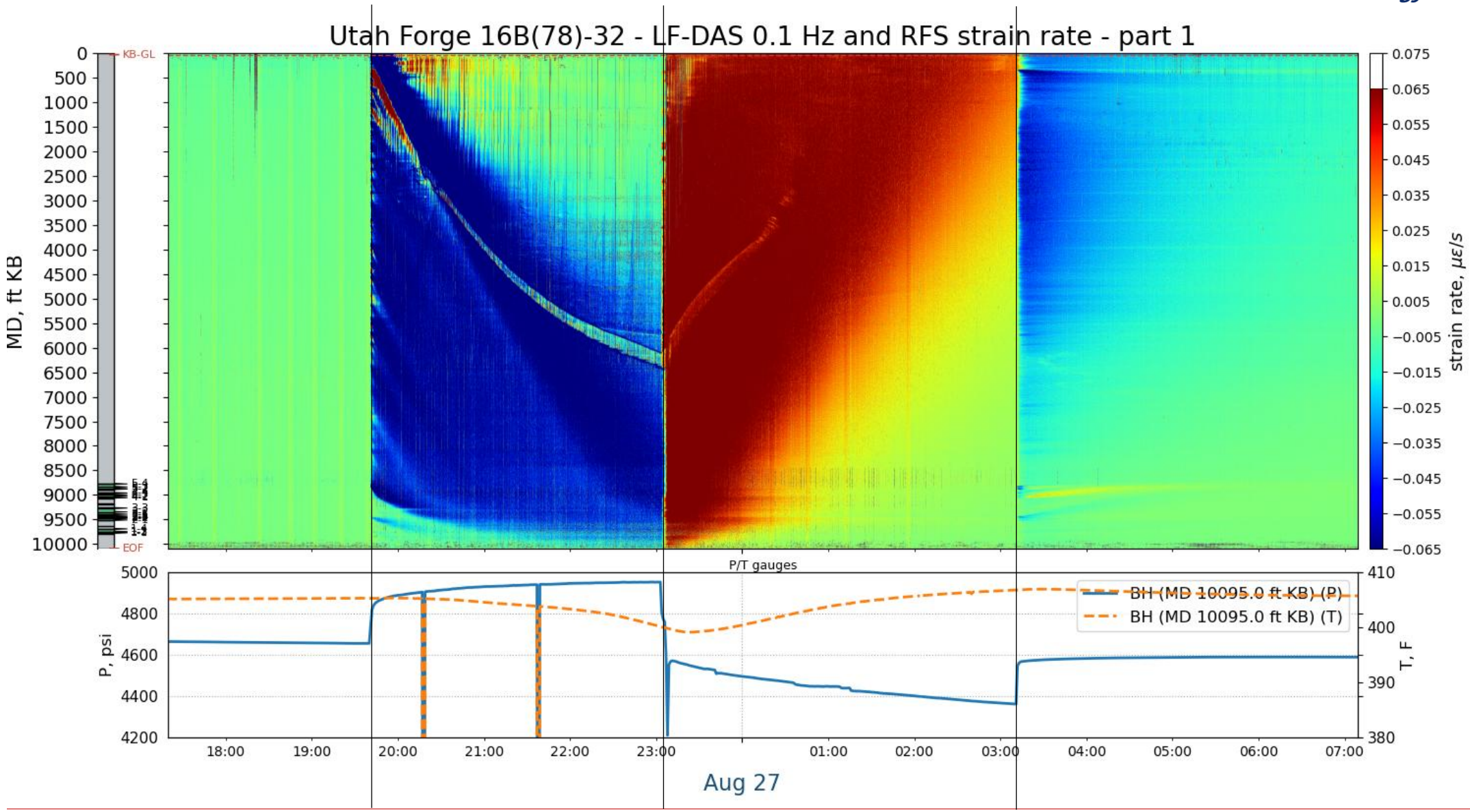
DAS – Distributed Acoustic Sensing with Neubrex Time Gated Digital DAS System on Single Mode Fiber inside coiled tubing inside of Casing

Sensing with Neubrex S-4000C Time Gated Digital (TGD) Distributed Acoustic Sensing (TGD DAS) Interrogator Unit.

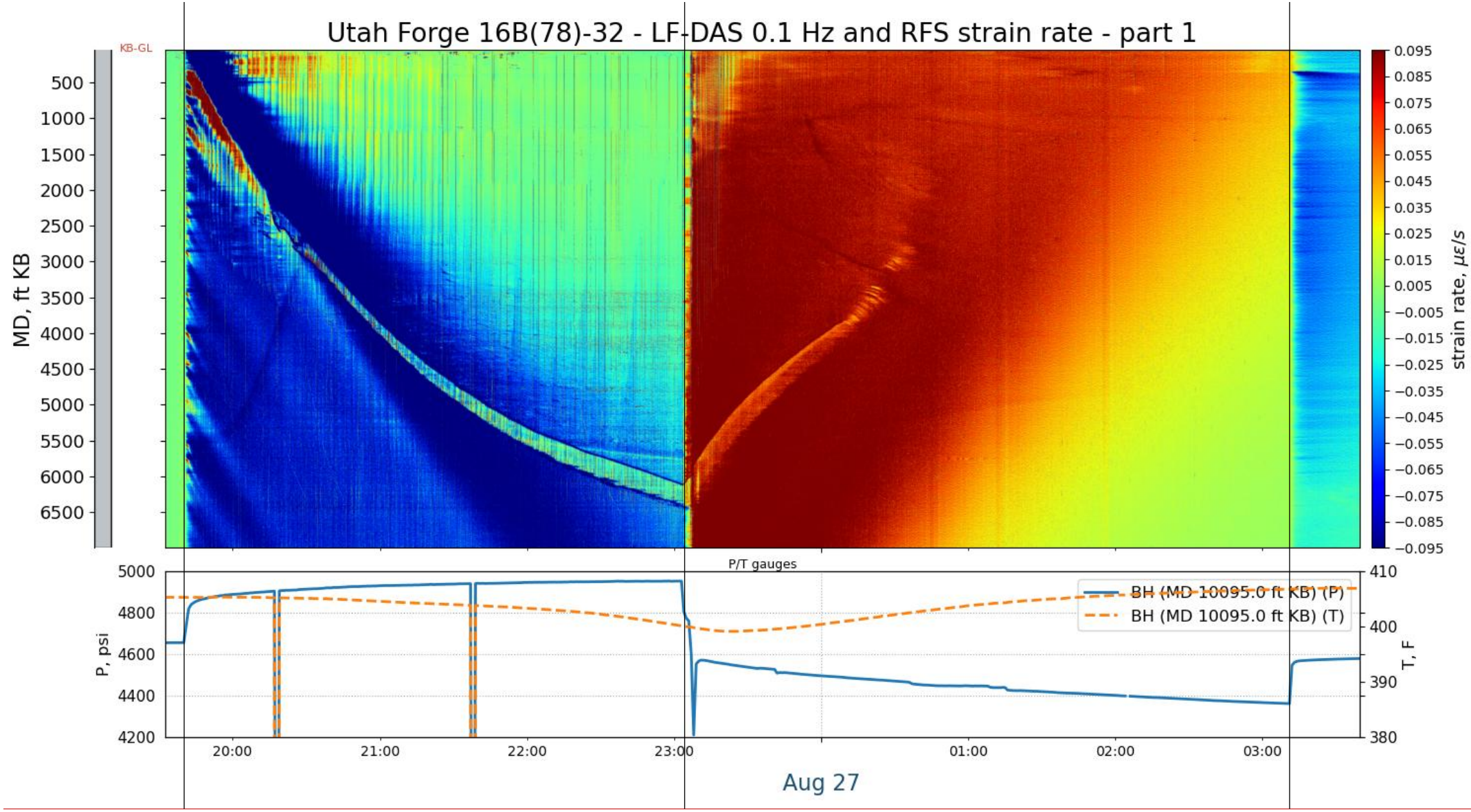
Well 16B – DAS data

- LF-DAS data post – processed after data acquisition
  - Energy extracted from full bandwidth DAS Below 0.1 Hz
- FBE (frequency Band Energy extraction data calculated in real-time available)
  - Any Band Limited Frequency Band Energy extractions can be defined and extracted from the full bandwidth DAS data.

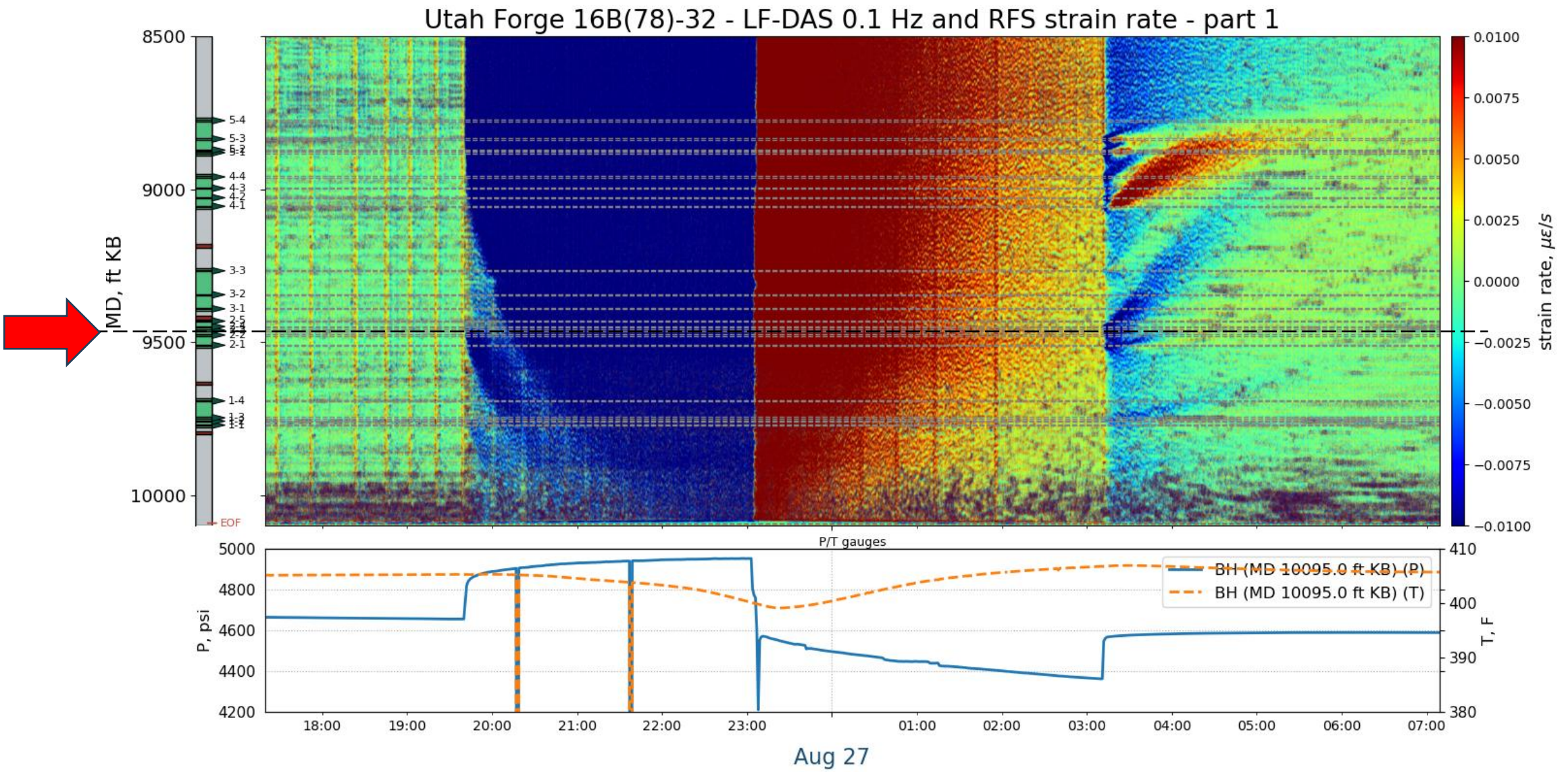
Well 16B – LF-DAS with 0.1 Hz cutoff (DAS Strain Rate Data)



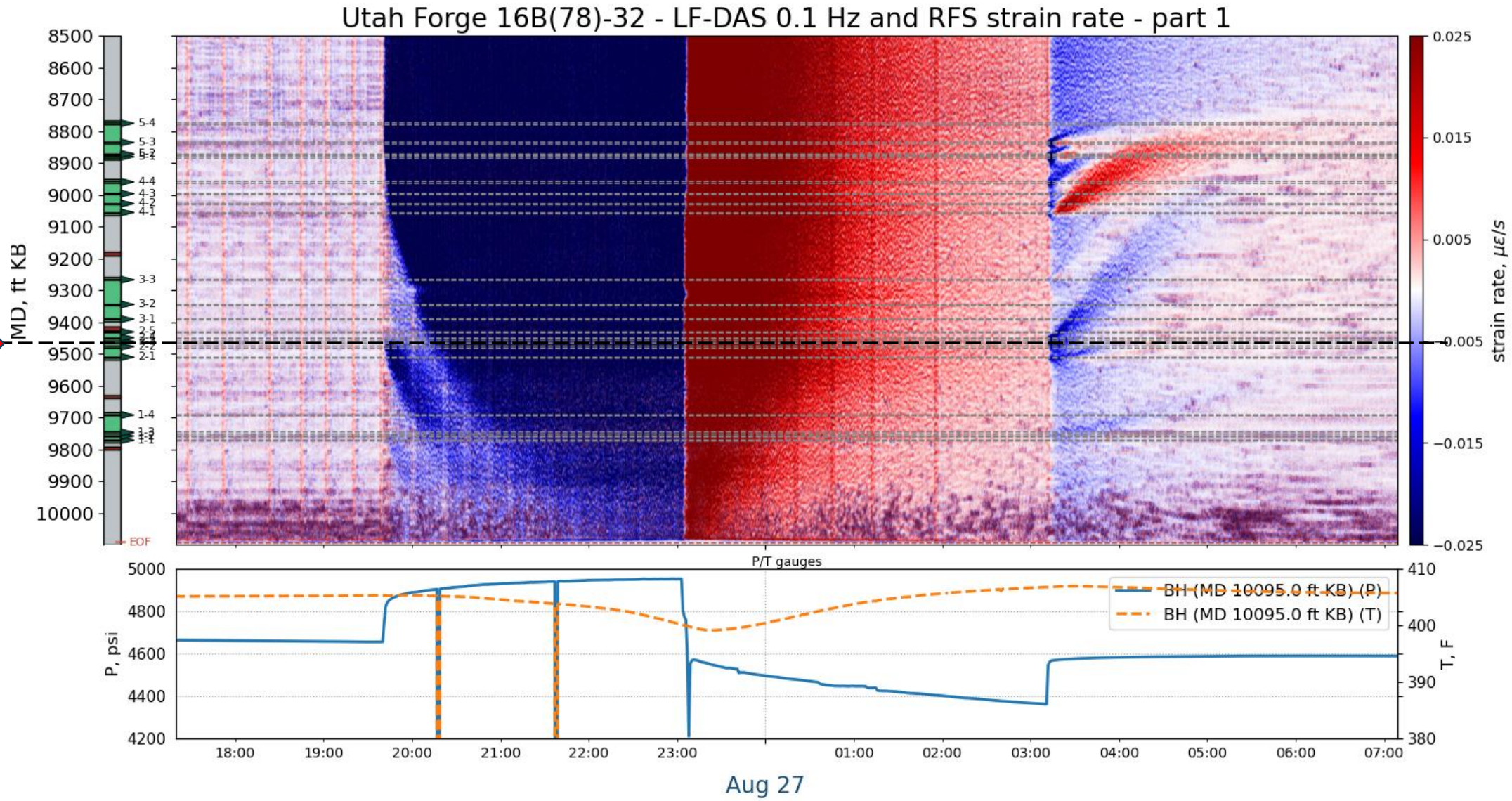
Well 16B – LF-DAS with 0.1 Hz cutoff (DAS Strain Rate Data)



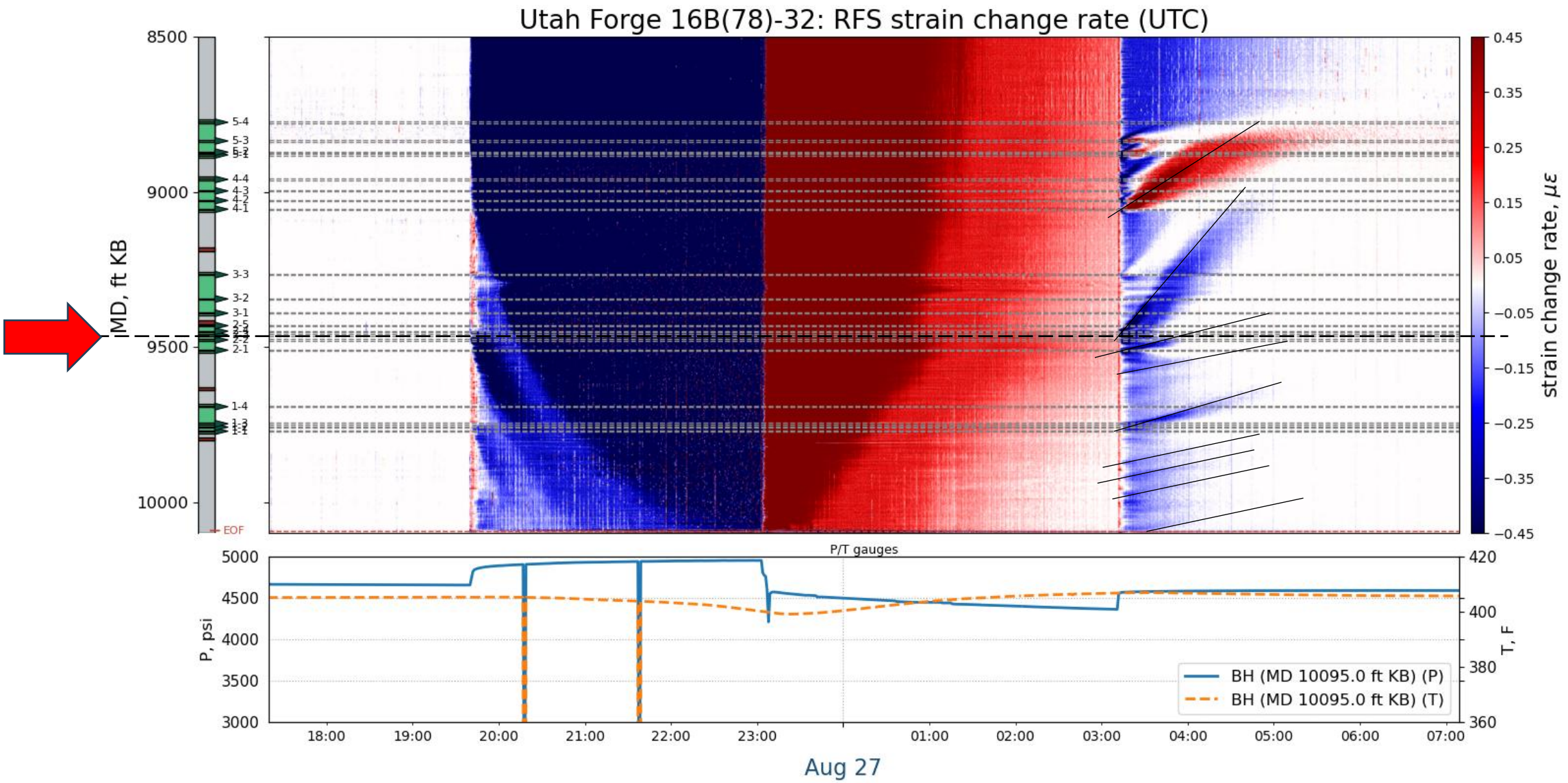
Well 16B – LF-DAS with 0.1 Hz cutoff (DAS Strain Rate Data)



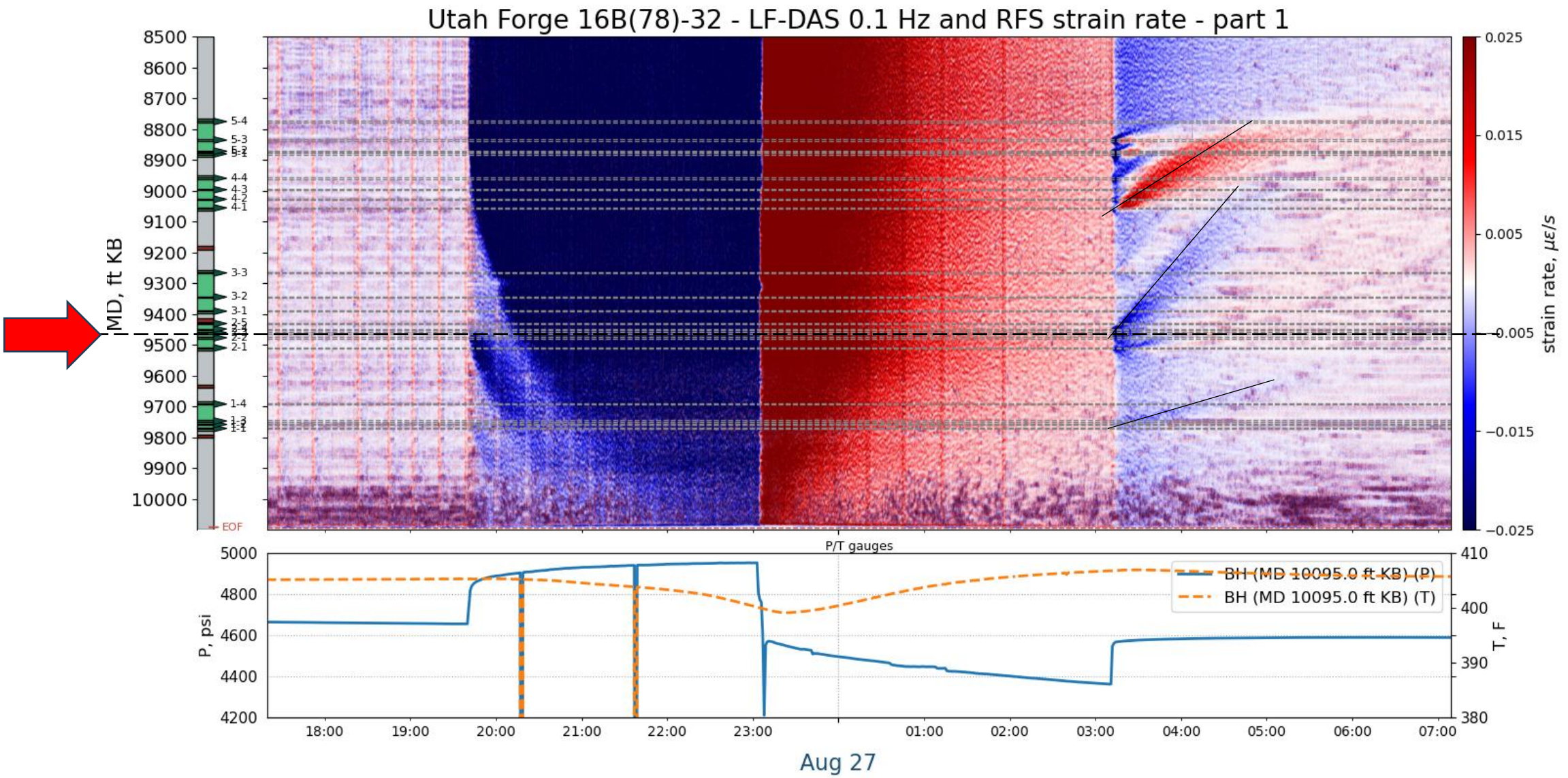
Well 16B – LF-DAS with 0.1 Hz cutoff (DAS Strain Rate Data)



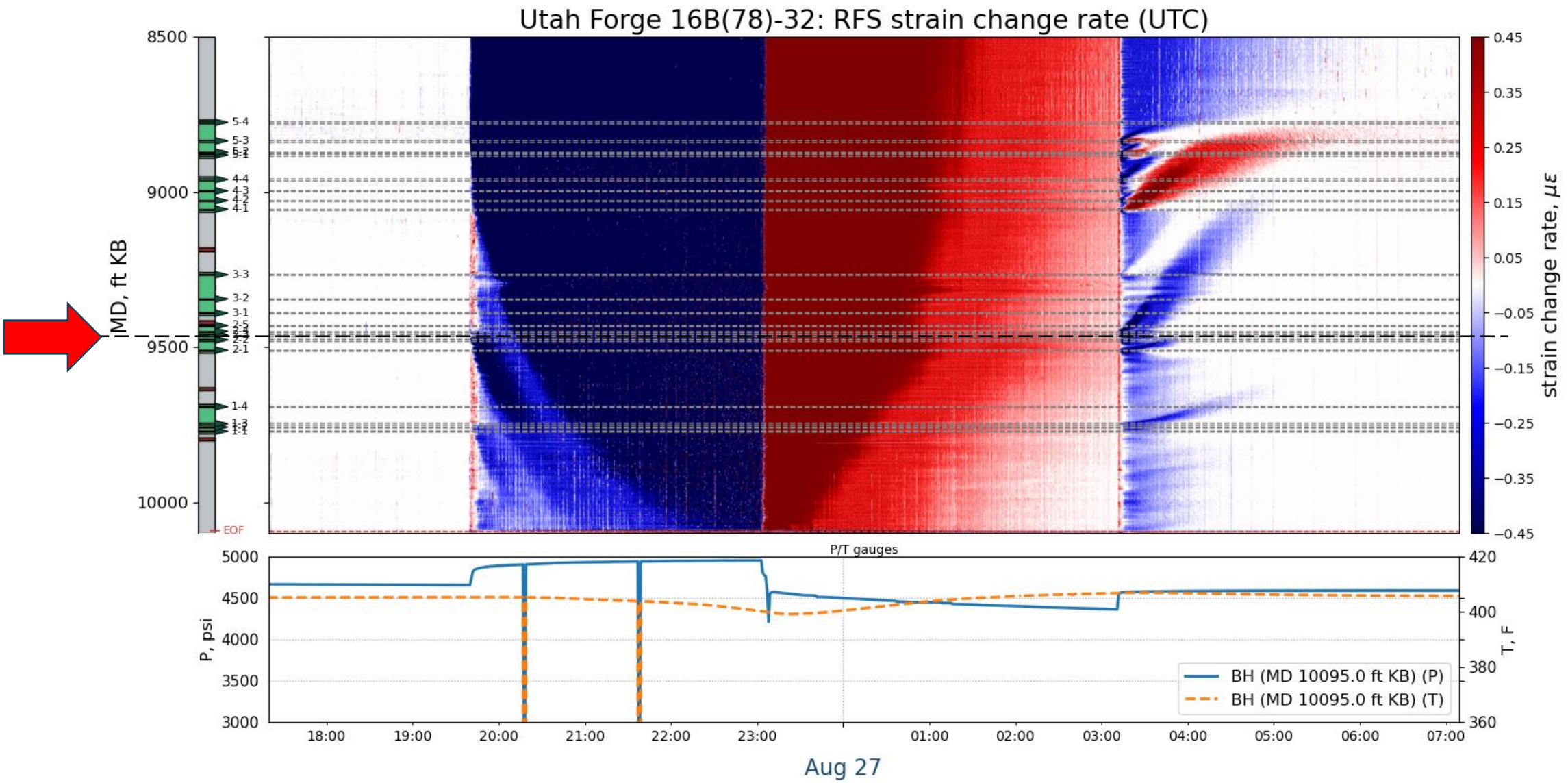
Well 16B – RFS strain change rate for comparison to DAS



Well 16B – LF-DAS with 0.1 Hz cutoff (DAS Strain Rate Data)



Well 16B – RFS strain change rate for comparison



End of Technical Report and Contact Information

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