Replacing Carbon Monoxide in the IRMS Lab

Paul Eby

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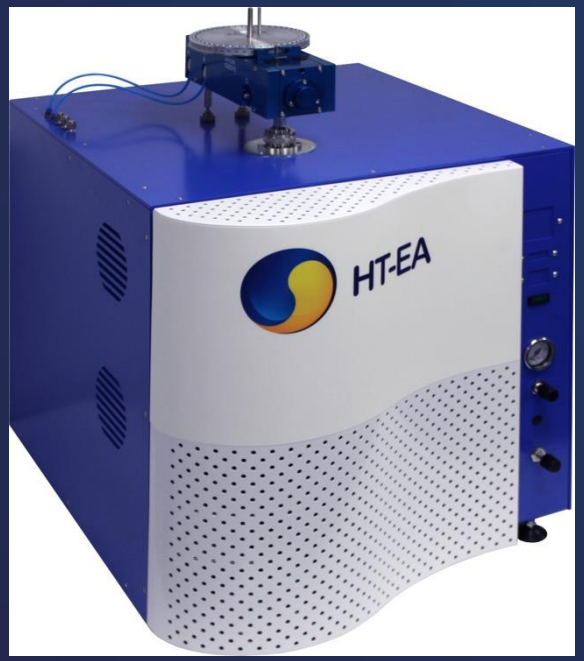
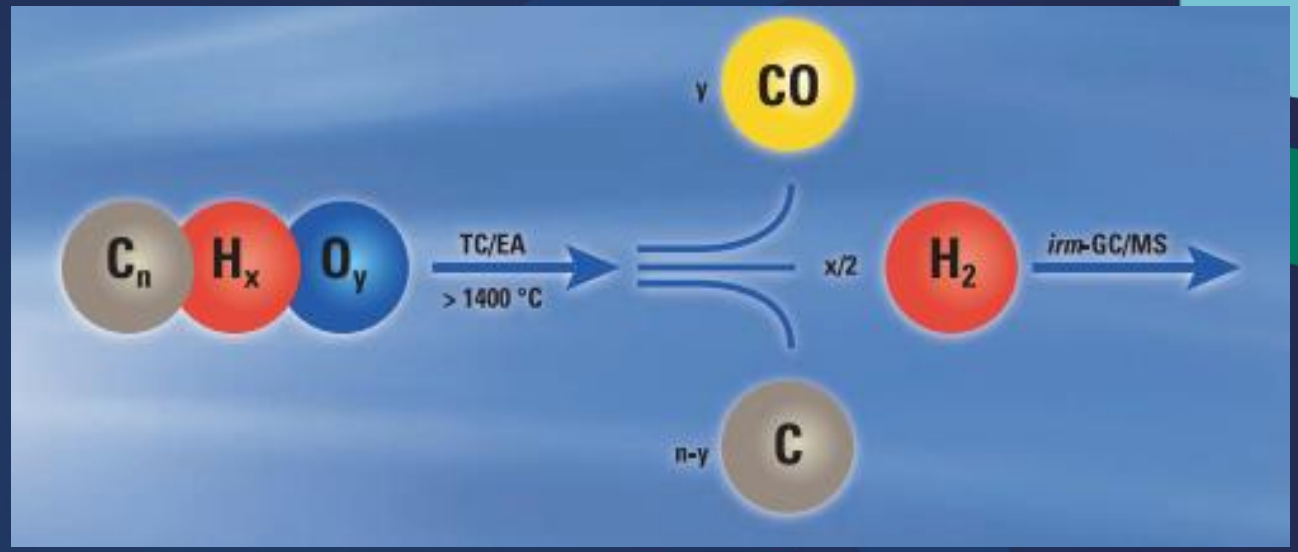
Why CO?





Carbon Monoxide:

- Odorless
- Colourless
- Poisonous

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Carbon Monoxide Analogues:

A) N_2 (mass 28/29)

B) N_2 + 0.2% NO (mass 28/29/30)

C) CO fragment from CO_2 in the source

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Carbon Monoxide Analogues: Isobaric Compound (same weight)

$^{12}C^{16}O$ = mass 28 (29 & 30)
$^{14}N^{14}N$ = mass 28 (29)
$^{14}N^{16}O$ = mass 30

Does N_2 with 0.2% NO = CO?

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TEST CASE

Replacing N_2 with CO?
ASITA 2019

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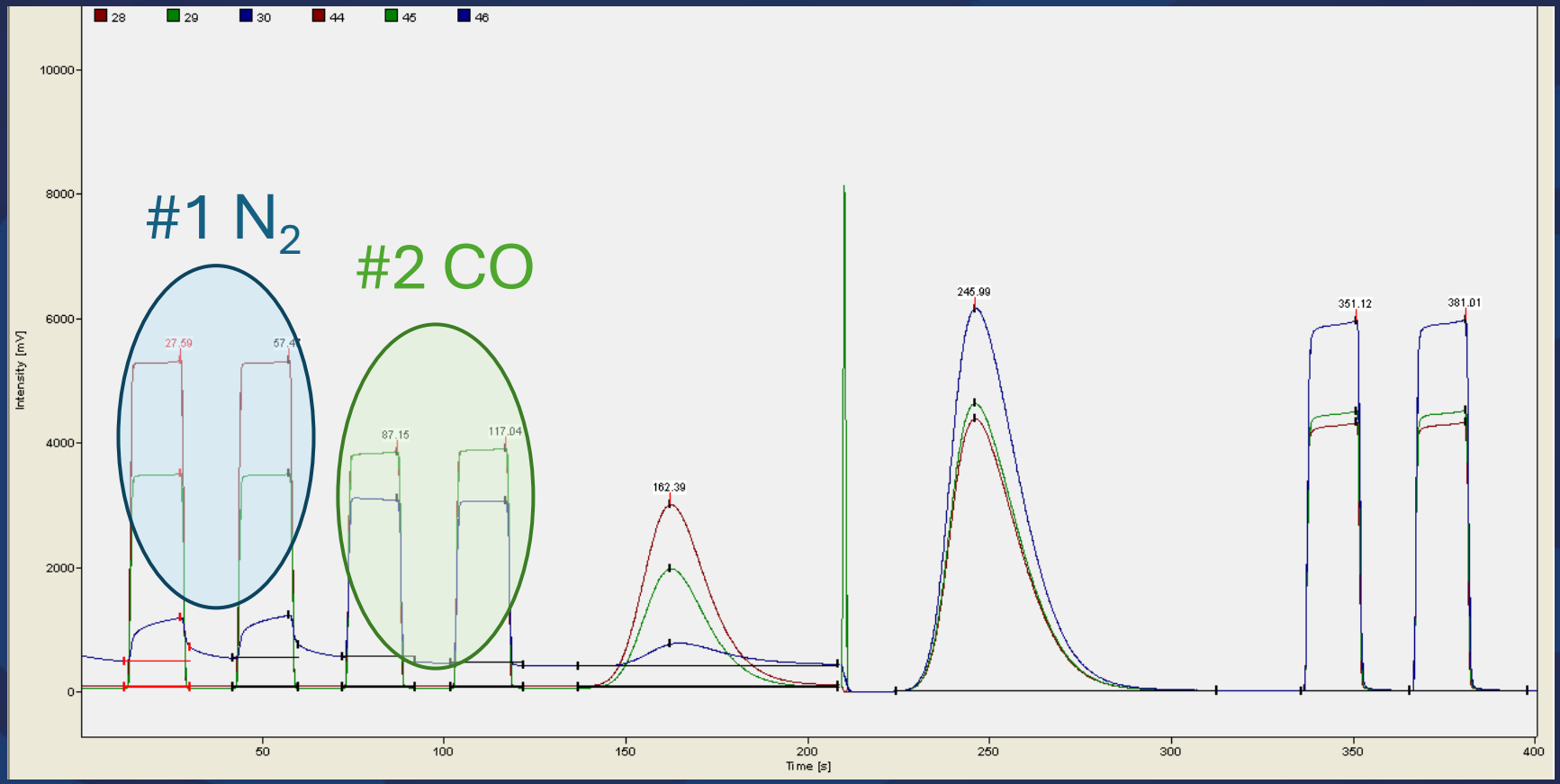
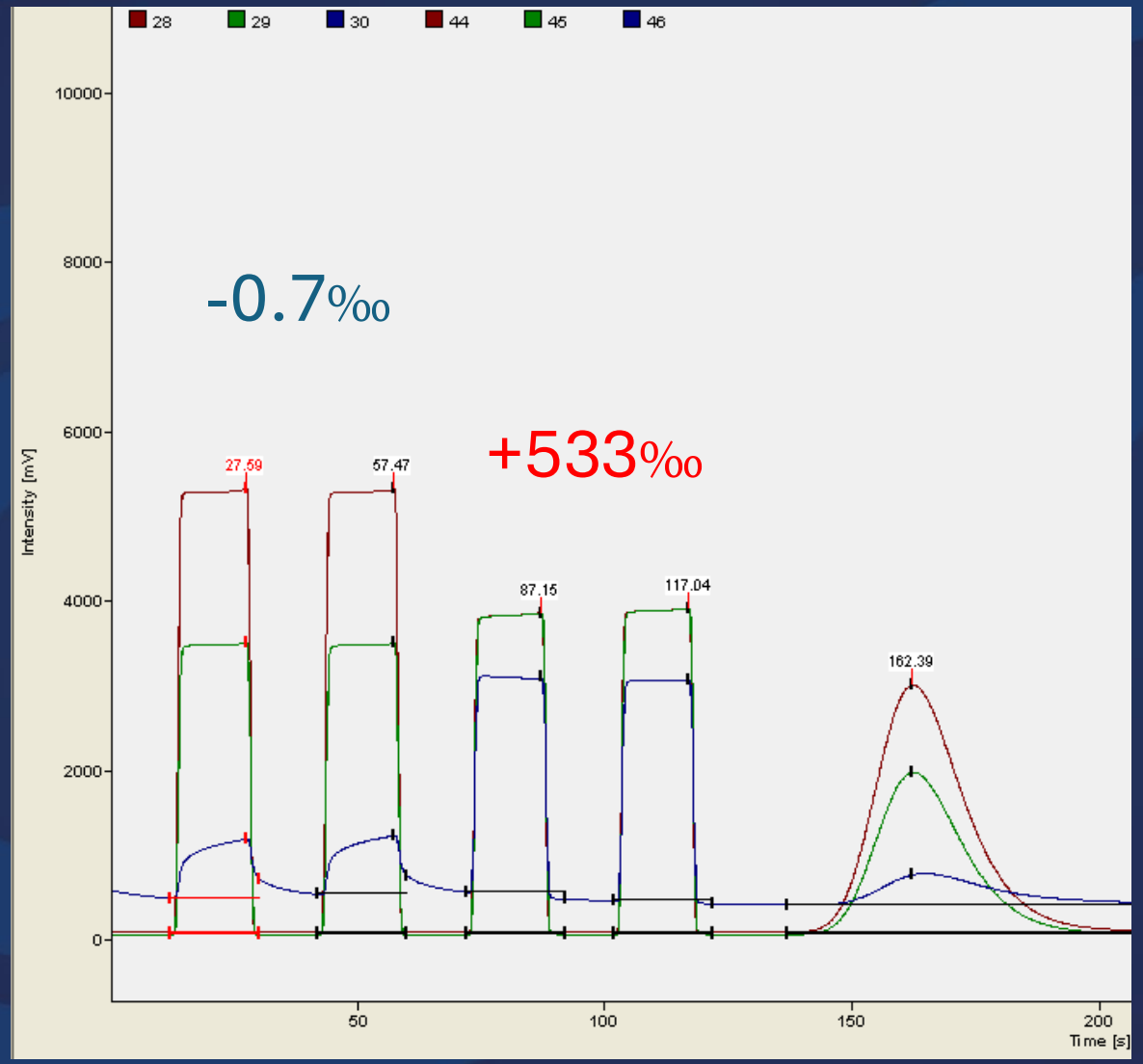
^{15}N EA-IRMS With Two Ref Gases



^{14}N EA-IRMS With Two Ref Gases



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^{14}N EA-IRMS With Two Ref Gases

Sample	Run #	Raw 1	Calc 1	Raw 2	Calc 2	$\Delta^{15}N$
STD1	1	-3.72	-4.43	-3.80	-4.42	0.01
STD2	1	47.90	47.42	47.81	47.43	0.00
Unknown #1	1	0.80	0.11	0.69	0.09	-0.02
Unknown #1	2	0.81	0.12	0.70	0.10	-0.02
Unknown #1	3	0.81	0.13	0.66	0.06	-0.06
Unknown #1	4	0.76	0.07	0.63	0.03	-0.04
Unknown #2	1	17.67	17.06	17.61	17.09	0.03
Unknown #3	1	1.85	1.17	1.77	1.18	0.01
Unknown #4	1	16.23	15.61	16.14	15.61	0.00
Unknown #5	1	7.55	6.89	7.43	6.86	-0.03
Unknown #1	5	0.77	0.08	0.67	0.07	0.00
Unknown #6	1	37.36	36.83	37.25	36.82	-0.01
STD1	2	-3.79	-4.50	-3.90	-4.52	-0.02
STD2	2	48.16	47.68	48.08	47.70	0.02
Unknown #7	1	48.13	47.65	48.03	47.65	-0.01
Unknown #7	2	47.85	47.36	47.75	47.37	0.00
blank	1	-12.66	-13.40	-12.75	-13.41	0.00
Unknown #1	6	0.73	0.04	0.64	0.04	0.00
Unknown #1	7	0.81	0.12	0.72	0.12	0.01
Unknown #8	1	1.93	1.25	1.79	1.20	-0.05
Unknown #9	1	18.73	18.12	18.62	18.10	-0.01
Unknown #10	1	-0.56	-1.25	-0.64	-1.24	0.01
Unknown #11	1	24.23	23.64	24.15	23.66	0.02
Unknown #12	1	14.74	14.12	14.65	14.12	0.00
STD1	3	-3.86	-4.57	-3.95	-4.57	0.00
STD2	3	48.18	47.70	48.06	47.68	-0.02

slope	1.004
intercept	-0.69

slope	1.004
intercept	-0.60

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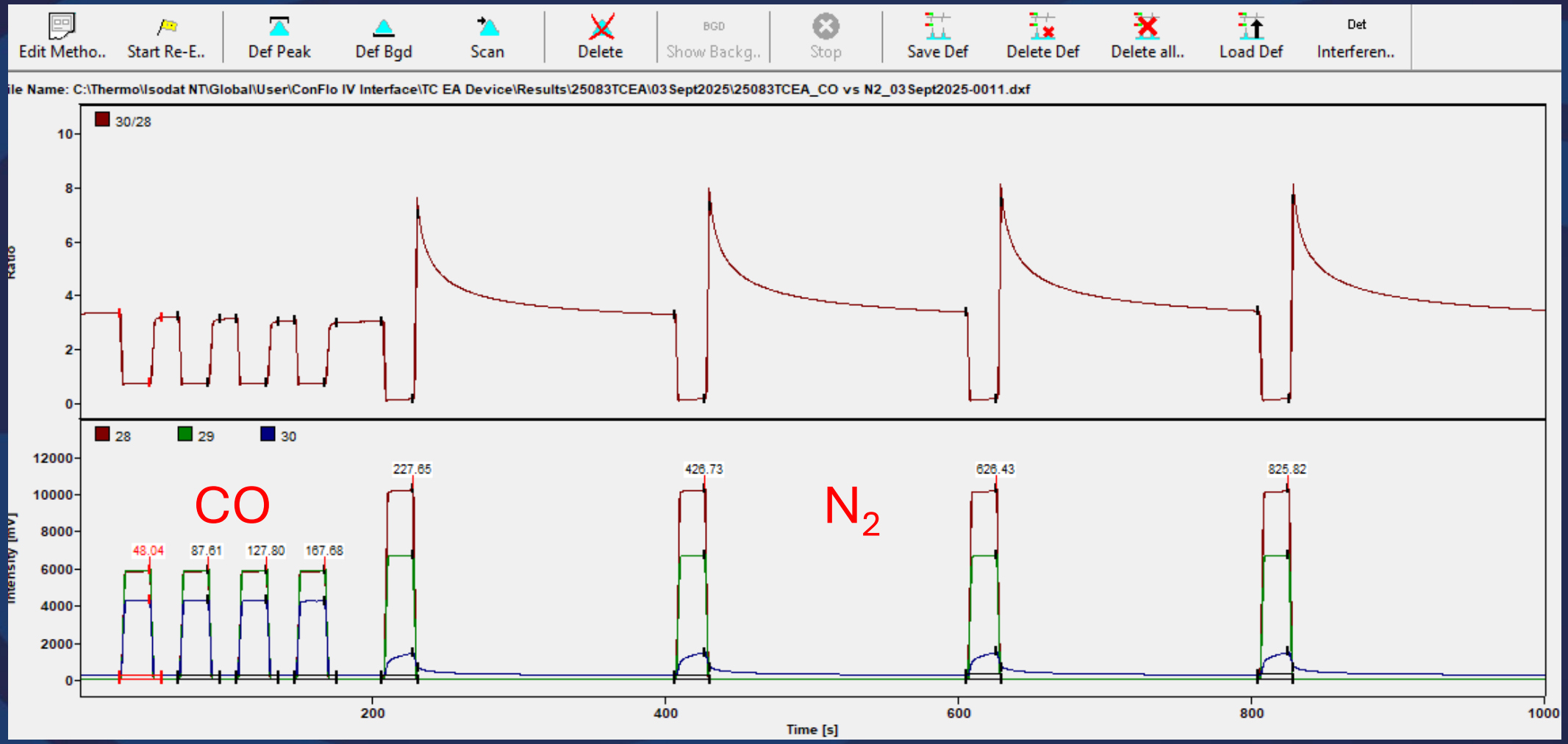
CO Replaced With N_2



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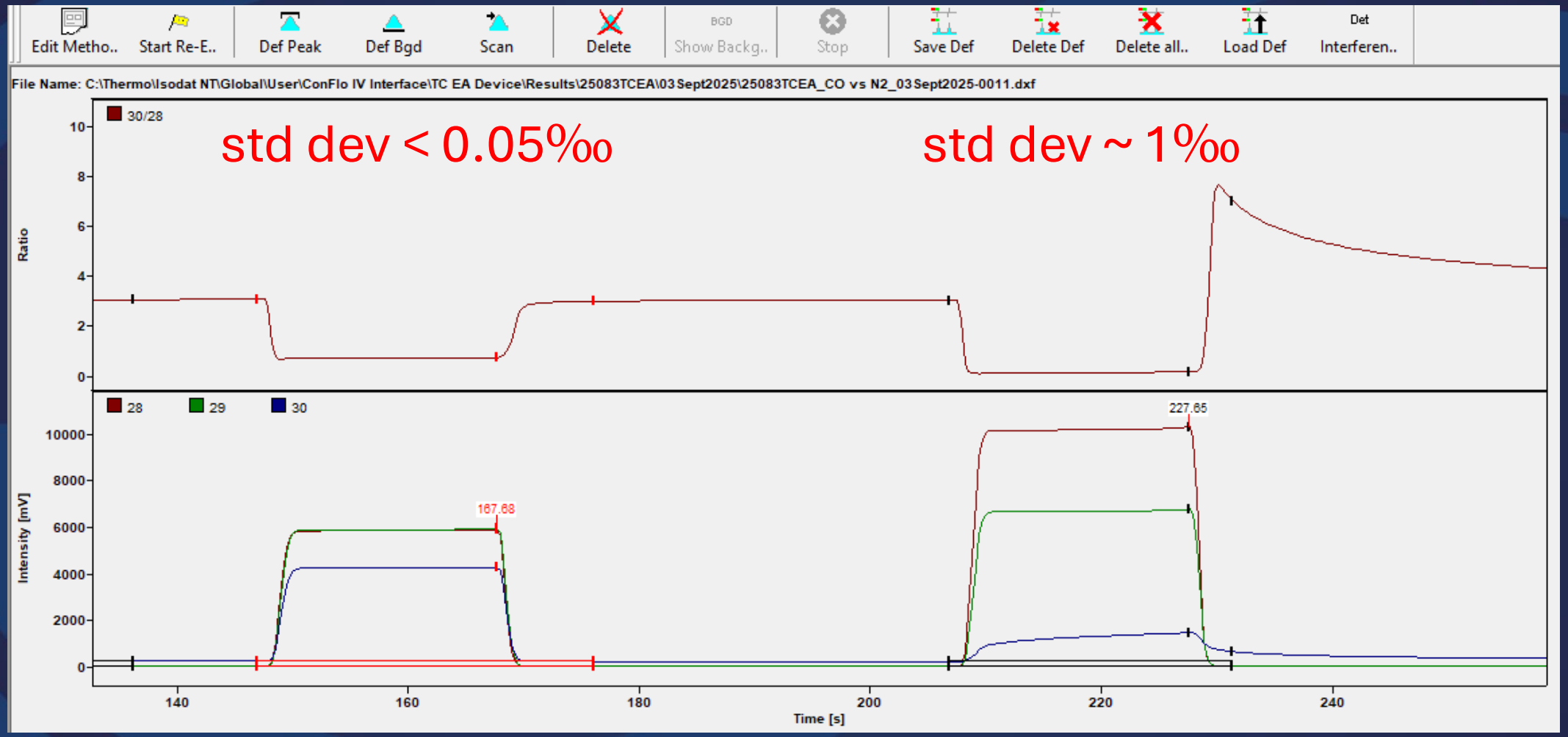
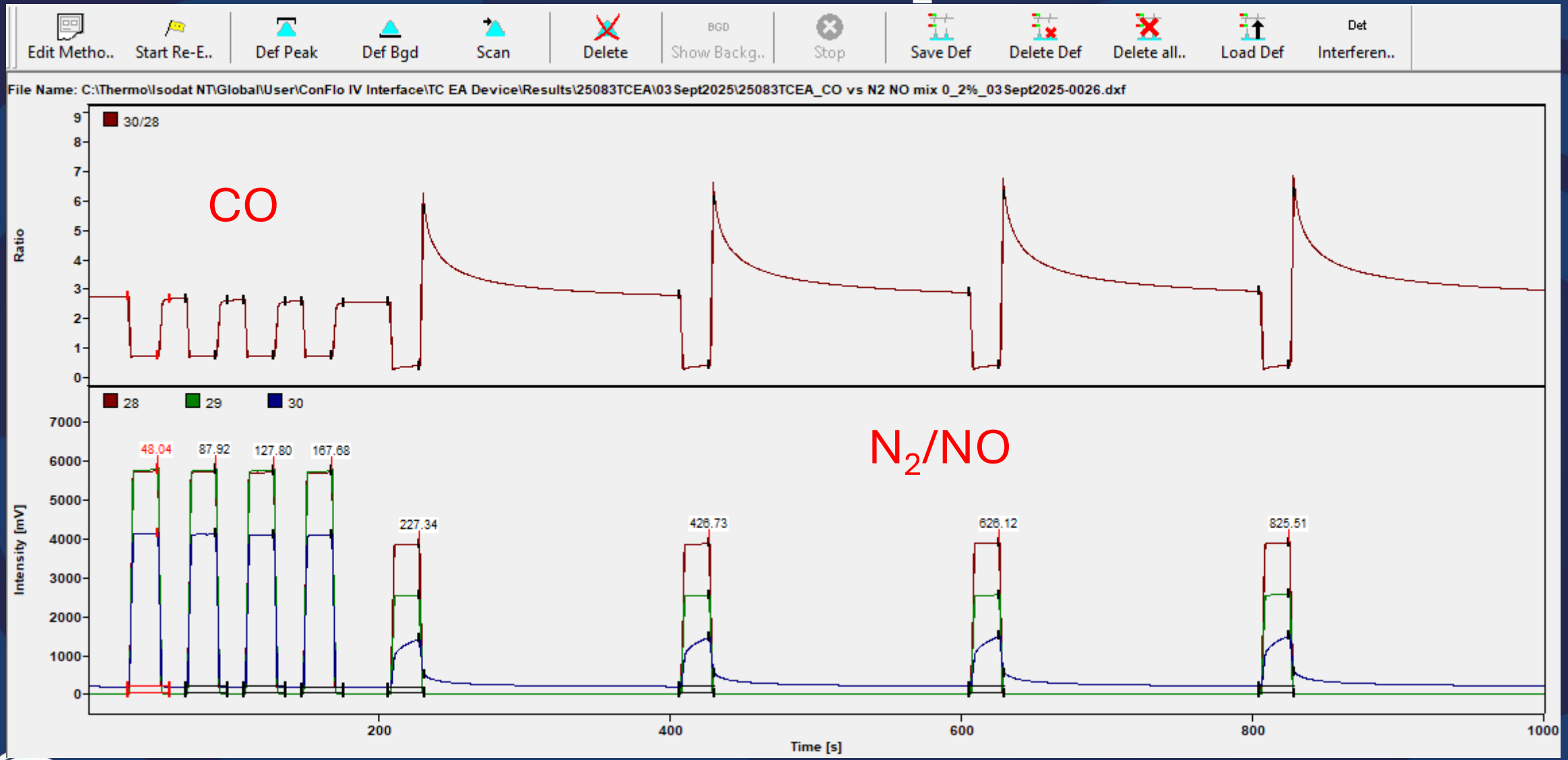


CO Replaced With N_2+ 0.2% NO



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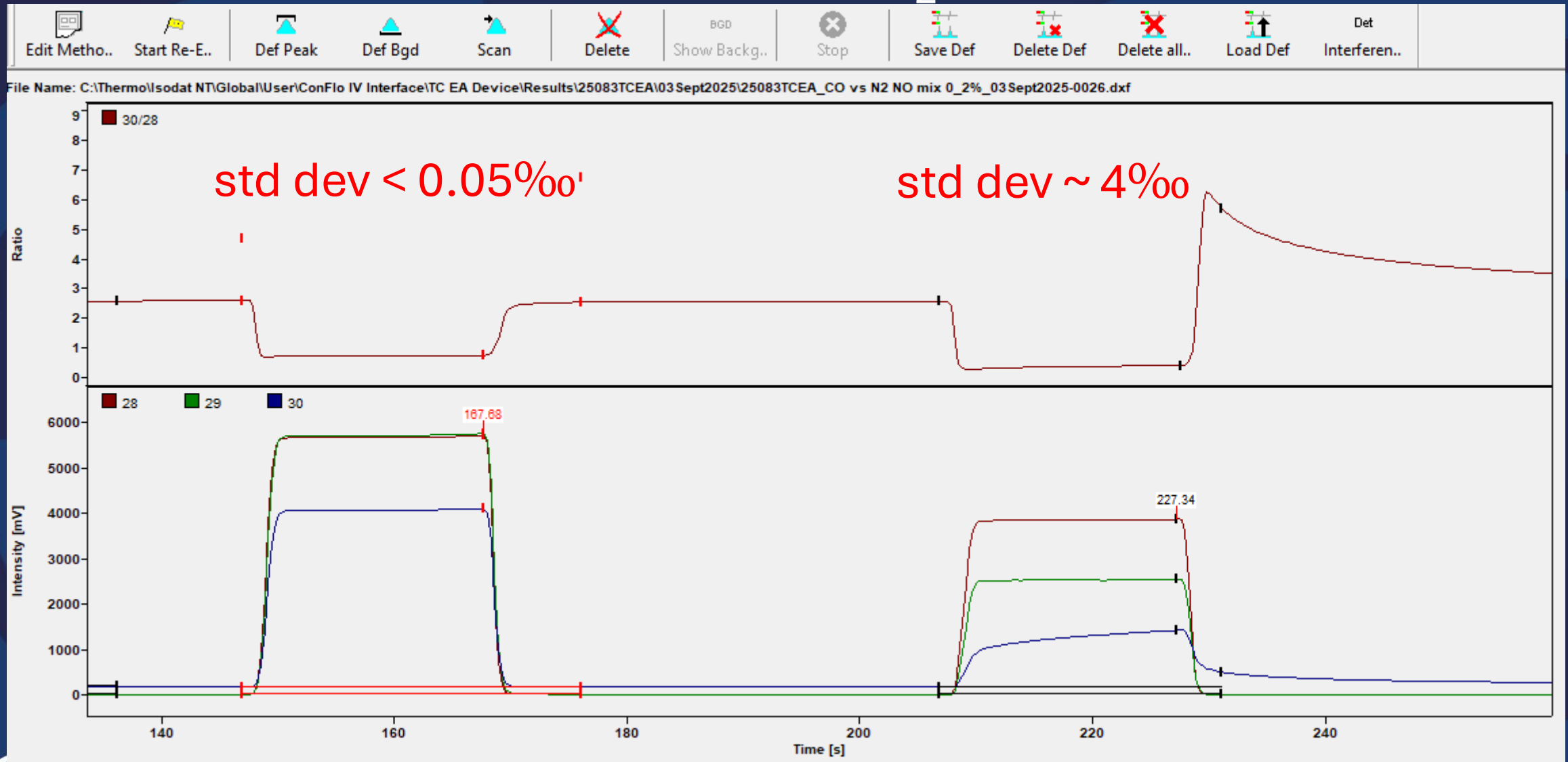
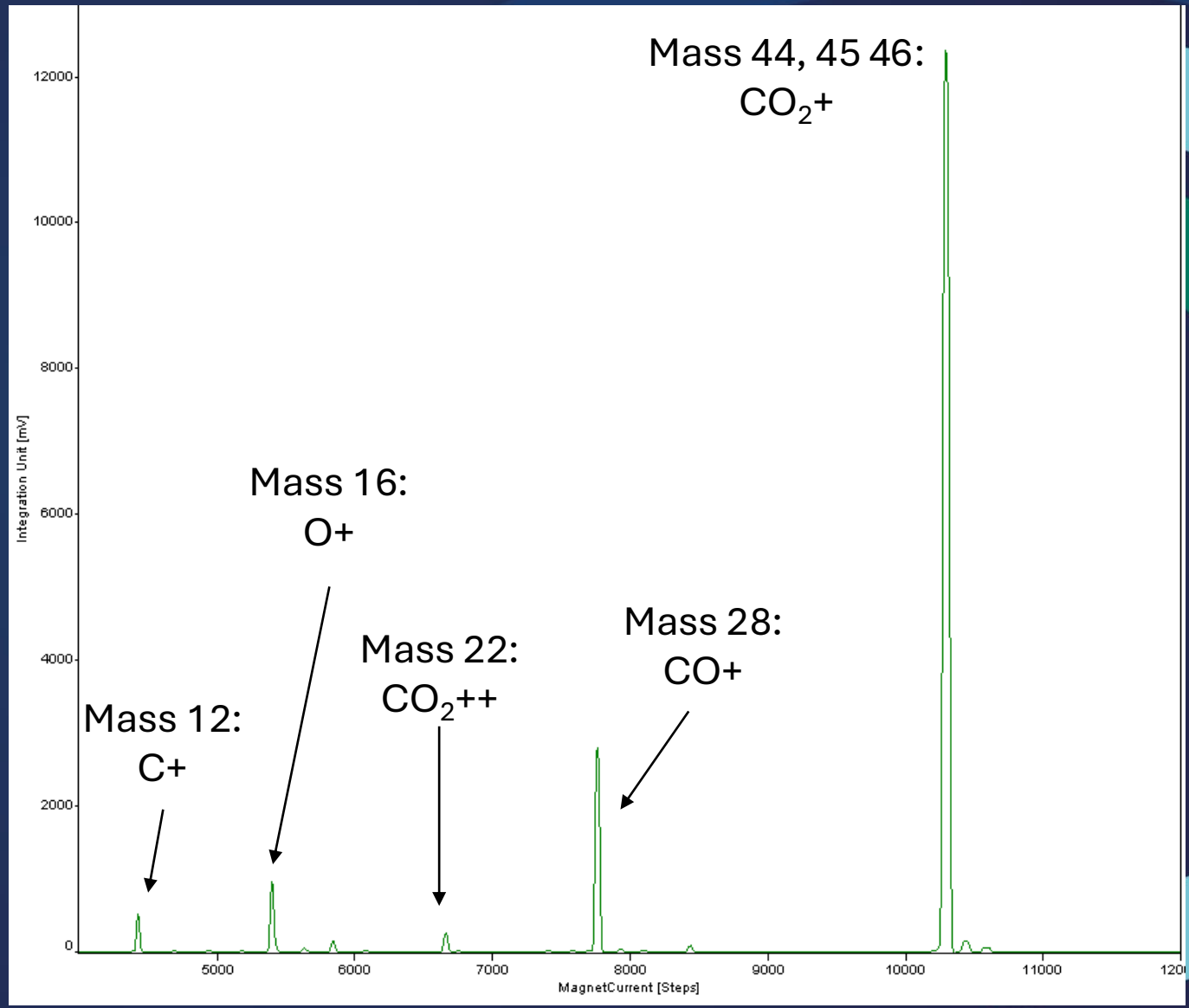
CO Replaced With N_2+ 0.2% NO



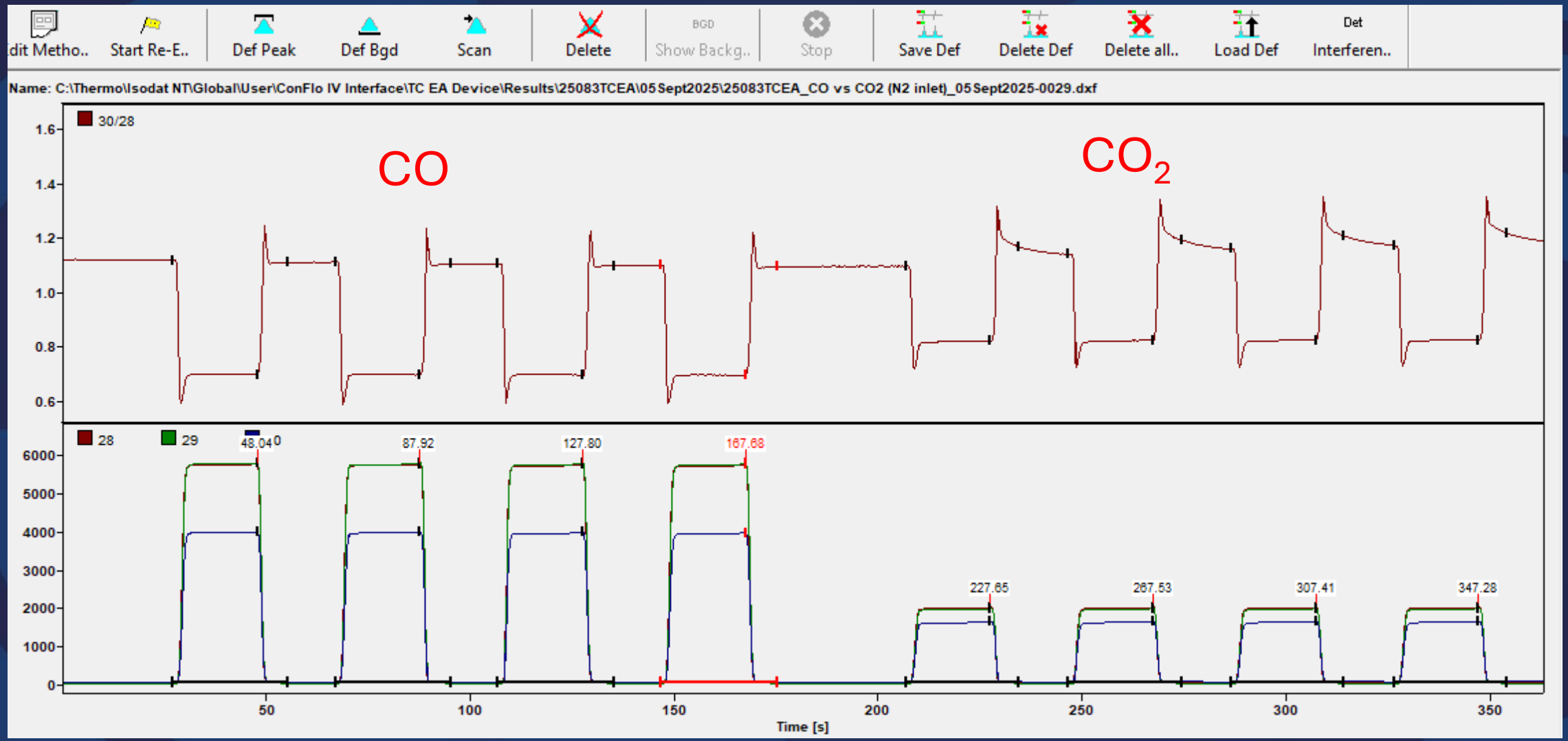
Carbon Monoxide Analogues:

CO fragment from CO_2 in the source

ASITA 2007



CO Replaced With CO_2 Fragment



CO Replaced With CO_2 Fragment

What is the role of monitoring gas?

1. Peak center
2. Tuning
3. Stable anchor between runs

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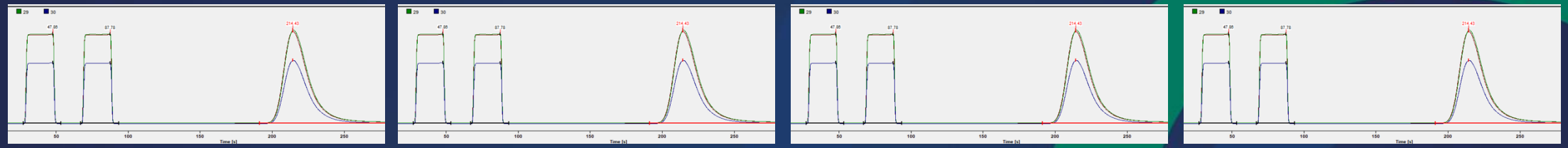
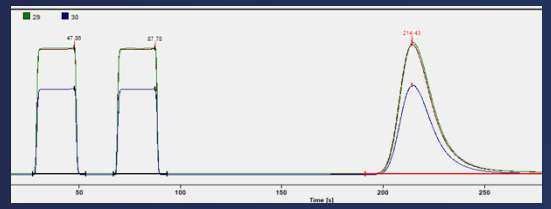
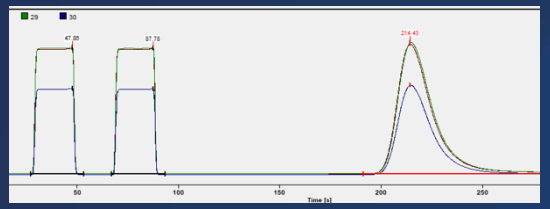
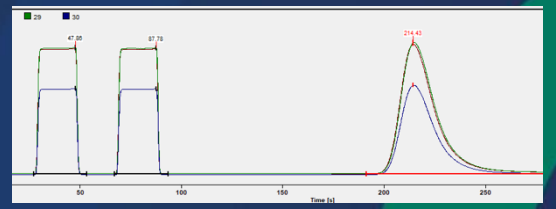
What is the role of monitoring gas?

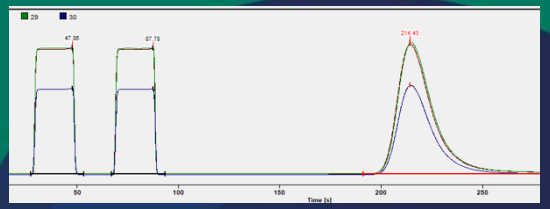


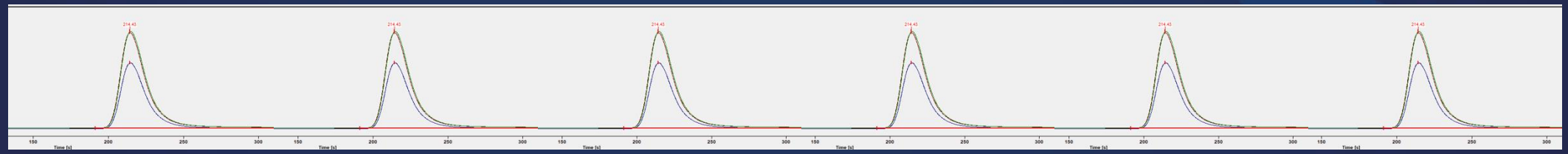
What is the role of monitoring gas?



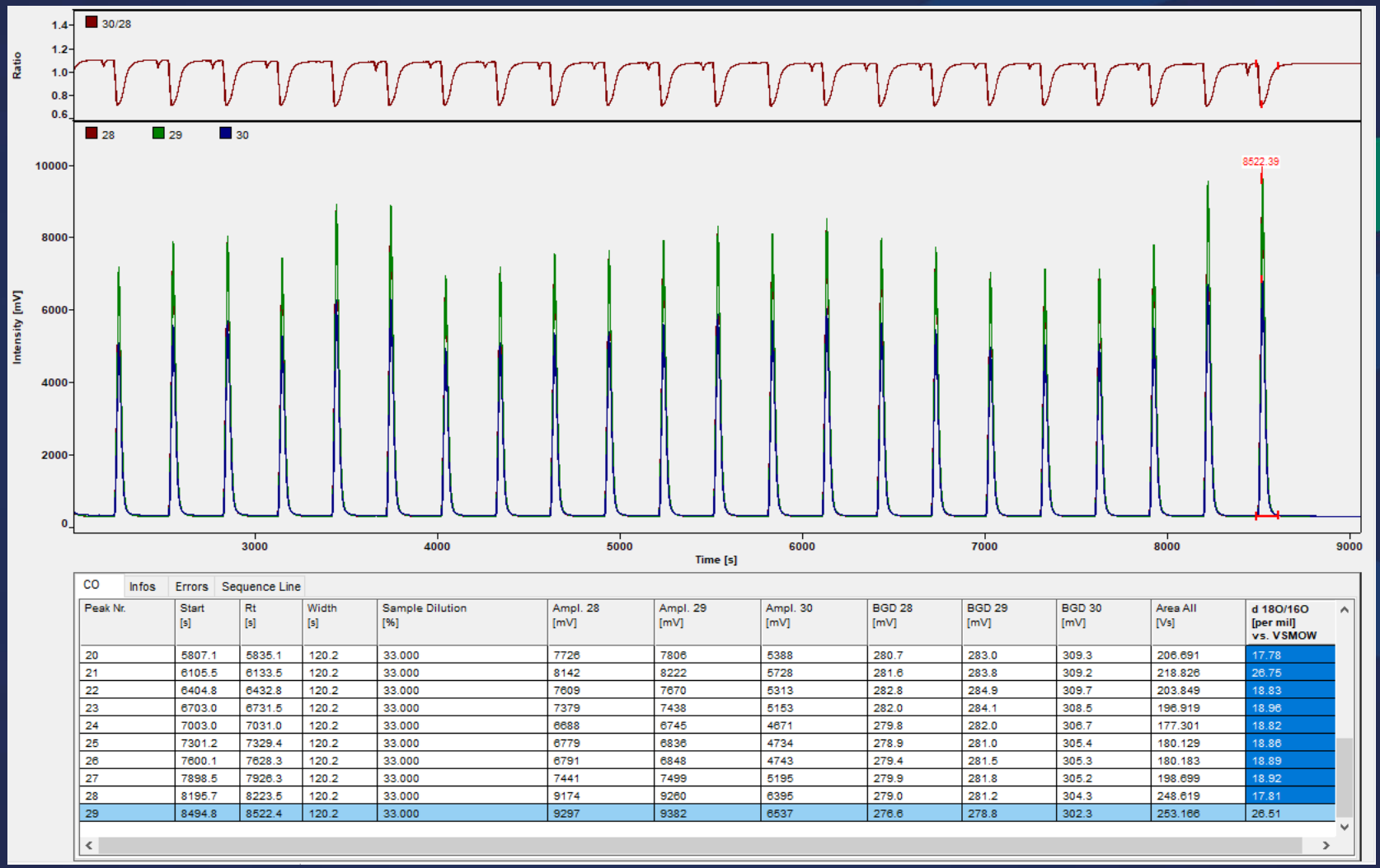








TC/EA runs: no monitoring gas!



CO | Infos | Errors | Sequence Line

Peak Nr.	Start [s]	Rt [s]	Width [s]	Sample Dilution [%]	Ampl. 28 [mV]	Ampl. 29 [mV]	Ampl. 30 [mV]	BGD 28 [mV]	BGD 29 [mV]	BGD 30 [mV]	Area All [Vs]	d 18O/16O [per mil] vs. VSMOW
20	5807.1	5835.1	120.2	33.000	7726	7806	5388	280.7	283.0	309.3	206.691	17.78
21	6105.5	6133.5	120.2	33.000	8142	8222	5728	281.6	283.8	309.2	218.826	26.75
22	6404.8	6432.8	120.2	33.000	7609	7670	5313	282.8	284.9	309.7	203.849	18.83
23	6703.0	6731.5	120.2	33.000	7379	7438	5153	282.0	284.1	308.5	196.919	18.96
24	7003.0	7031.0	120.2	33.000	6688	6745	4671	279.8	282.0	306.7	177.301	18.82
25	7301.2	7329.4	120.2	33.000	6779	6836	4734	278.9	281.0	305.4	180.129	18.86
26	7600.1	7628.3	120.2	33.000	6791	6848	4743	279.4	281.5	305.3	180.183	18.89
27	7898.5	7926.3	120.2	33.000	7441	7499	5195	279.9	281.8	305.2	198.699	18.92
28	8195.7	8223.5	120.2	33.000	9174	9260	6395	279.0	281.2	304.3	248.619	17.81
29	8494.8	8522.4	120.2	33.000	9297	9382	6537	276.6	278.8	302.3	253.166	26.51

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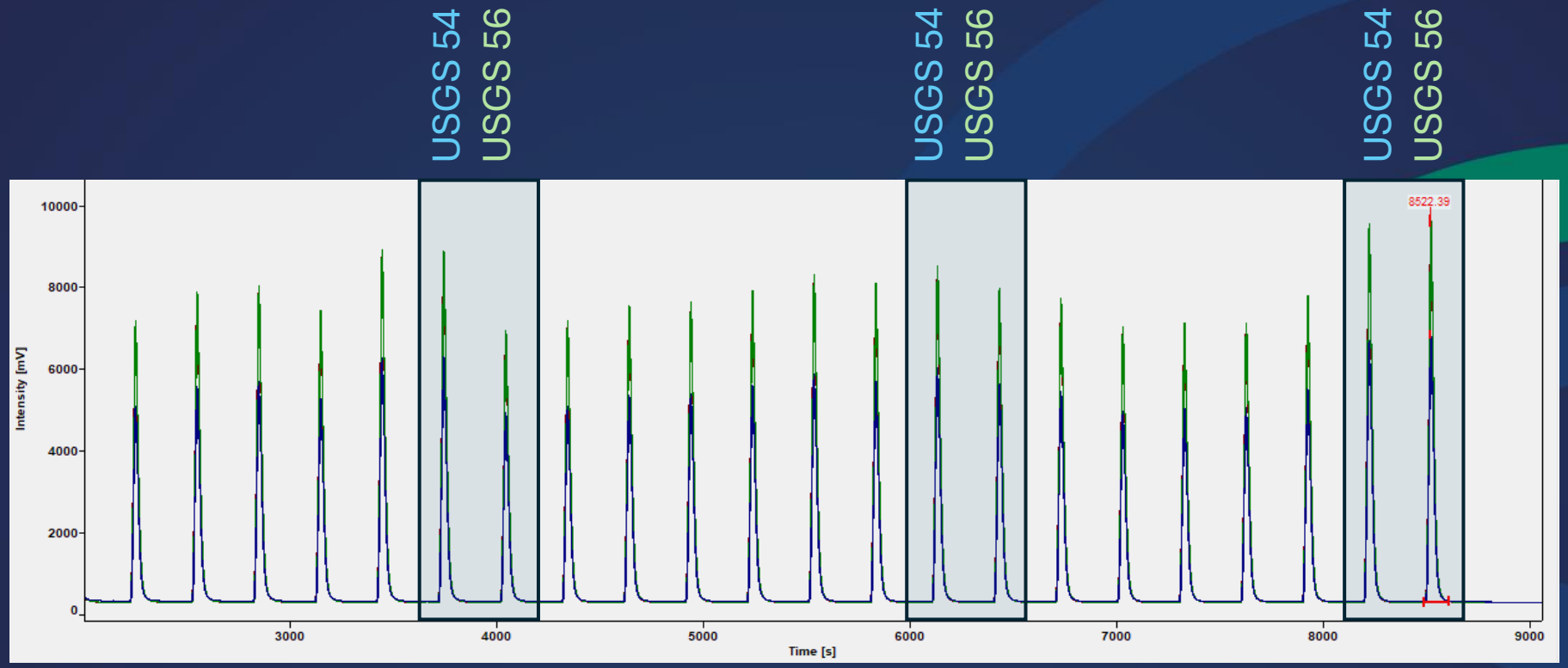
^{18}O TC/EA runs: no monitoring gas!



The test: USGS 55

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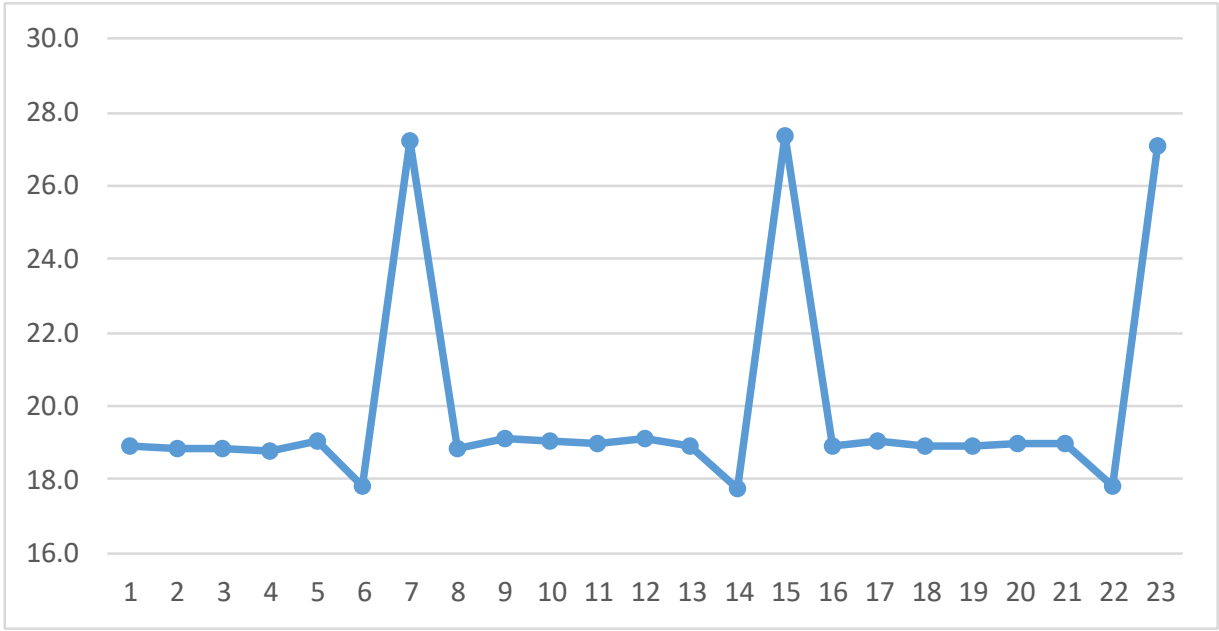
^{18}O TC/EA runs: no monitoring gas!

sample	raw 18O	calc 18O
USGS 55	18.9	18.9
USGS 55	18.7	18.8
USGS 55	18.8	18.9
USGS 55	18.7	18.8
USGS 55	19.0	19.0
USGS 54	17.8	17.8
USGS 56	26.6	27.2
USGS 55	18.8	18.8
USGS 55	19.0	19.1
USGS 55	18.9	19.0
USGS 55	18.9	19.0
USGS 55	19.0	19.1
USGS 55	18.8	18.9
USGS 54	17.8	17.8
USGS 56	26.8	27.4
USGS 55	18.8	18.9
USGS 55	19.0	19.0
USGS 55	18.8	18.9
USGS 55	18.9	18.9
USGS 55	18.9	19.0
USGS 55	18.9	19.0
USGS 54	17.8	17.8
USGS 56	26.5	27.1

standard	actual	calc	ave	stdev
USGS 54	17.79	17.8	17.8	0.02
USGS 56	27.23	27.2	26.6	0.12
USGS 55	19.12	18.9	18.9	0.09

slope	1.07
intercept	-1.21



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What's Next?

A) Test long run stability

B) Investigate relationship between CO and N_2 (CO_2) tuning/linearity

C) Comparison data

D) Peak jumping for $^{2}H/^{18}O$ runs

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