Domestic Sweet / WTI Specifications

COQA- February 2010 New Orleans, LA

Dennis Sutton- Marathon Petroleum

COQG

Domestic Sweet / WTI Specifications

- Review
- Current Work
- Future Plans

Pre-2009

- In 2005, COQG began working on developing specifications for WTI/Domestic Sweet at Cushing, OK.
- Early data indicated the need for better definition of sampling and analytical procedures.
- An article in the July 17, 2008 Oil Daily highlighted COQG's efforts in developing more comprehensive Domestic Sweet specifications

2009

- In 2009, conference calls (open to all interested parties) have been used to complement the COQG meetings to progress in a more timely manner.
- Commercial labs were surveyed to determine their capabilities and interest in conducting analyses.
- Using tightly defined sampling and lab procedures, a comprehensive testing program was agreed upon in order to develop specifications.

Domestic Sweet - Lab Testing

- We have agreed on the following slate of analytical testing for WTI/Domestic Sweet:
  1. API Gravity by ASTM D287
  2. Total sulfur by ASTM D4294
     - Centrifuge to eliminate free water
  3. Total Acid Number (TAN) by ASTM D664 using the first inflection point
  4. Nickel by ASTM D5708B
  5. Vanadium by ASTM D5708B
  6. MCRT by D4530
  7. High Temperature GC Simulated Distillation (HTSD) by ASTM D7169. Report 20% point, 50% point, and Recovery @ 1020F.

2009

- By late 2009, Clifford Mills had received data for 61 WTI/Domestic Sweet samples (all taken at Cushing), sampled over a several month time frame, supplied by four different sources and analyzed by three different commercial laboratories.
- Overall, the data was good but there were some questions, particularly regarding the HTSD data. Subsequently, some samples were rerun for HTSD.

Review of Recent Conference Calls

- December 8, 2009- Most, but not all samples, had been completed. There was a need for improved HTSD data.
- December 18, 2009- In an effort to improve our HTSD data, Dr. Dan Villilanti, President of Triton Analytics, gave an excellent seminar of obtaining accurate and precise HTSD results.

Review of Recent Conference Calls (cont.)

- January 7, 2010- A lengthy call as Clifford Mills detailed the analytical results. Subsequently, one lab agreed to rerun their HTSD samples.
- January 14, 2010- To help us learn more about enforcement of specifications, Patti Edens, Shell Pipeline, was kind enough to share her experiences managing the Capline LLS specifications program. Over the years, there have been changes to the testing frequency, parameters and limits.

Review of Domestic Sweet Data

COQA Meeting @ New Orleans
02 / 11 / 10
Clifford Mills – Consultant

- All data sources and laboratories are confidential.
- After an earlier attempt to better define the domestic Sweet Stream (Data covering 1996 to early 2009) CQTA members developed a rigorous sampling and analysis plan for Domestic Sweet deliveries at Cushing.
- Some pages will show a portion of this early data and statistics developed.

- Following development of the sampling and analysis, 4 sources and three laboratories agreed to participate and 61 samples were obtained and analyzed.

Data review

- **Part 1 - All samples from all sources and labs**
  - **Duplicate samples were treated as individual samples from each lab**
  - **2 Sigma outliers were rejected and limits recalculated**
  - **Plots will show the outliers but limits based on above calculations.**
  - **The charts show all data since 1/1/2007**

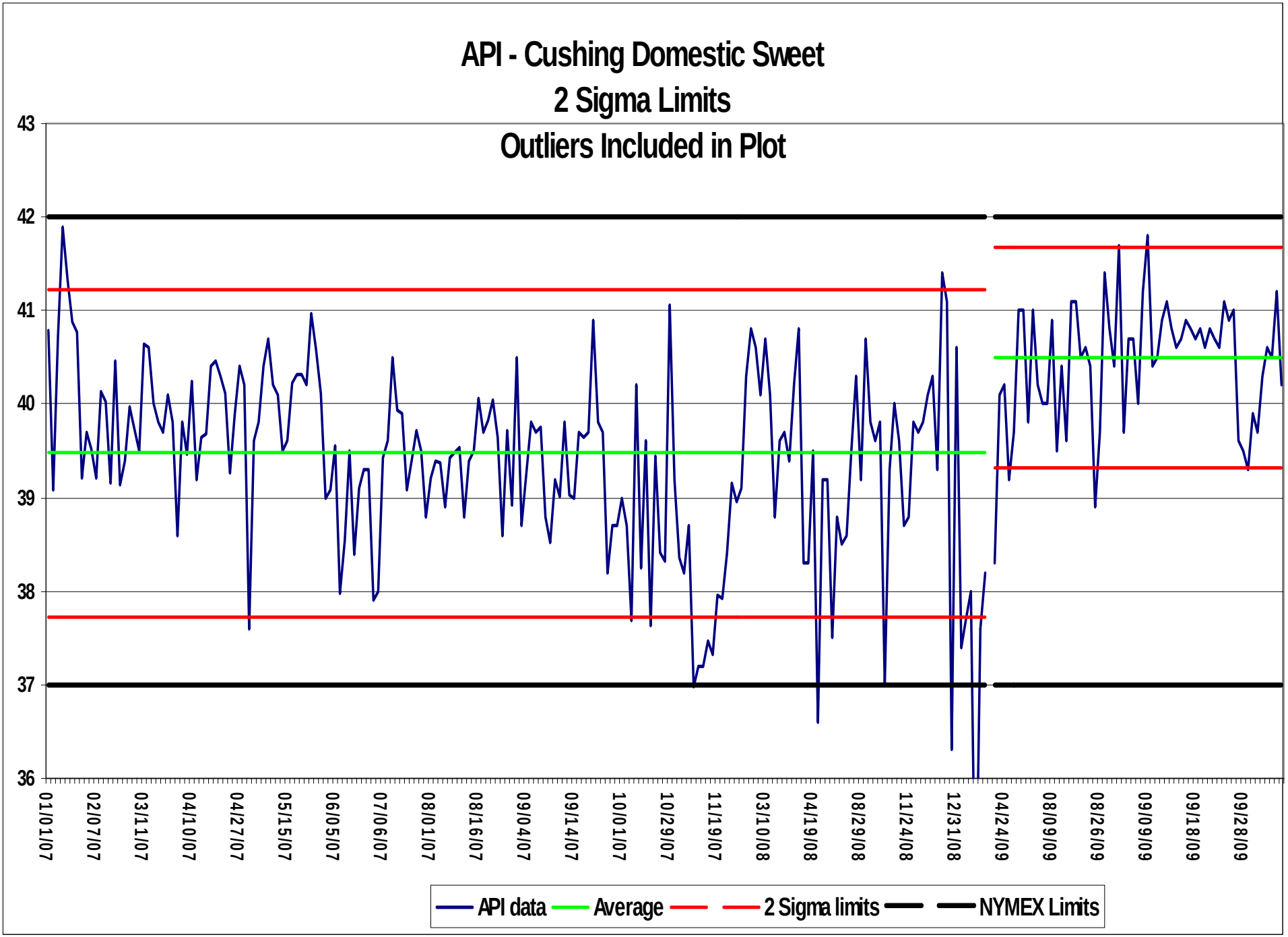
- **Part 2 – Duplicates**
  - **Seven duplicate samples were submitted to each of the three participating labs**
  - **No outlier rejection was attempted due to the small number of samples/data points**

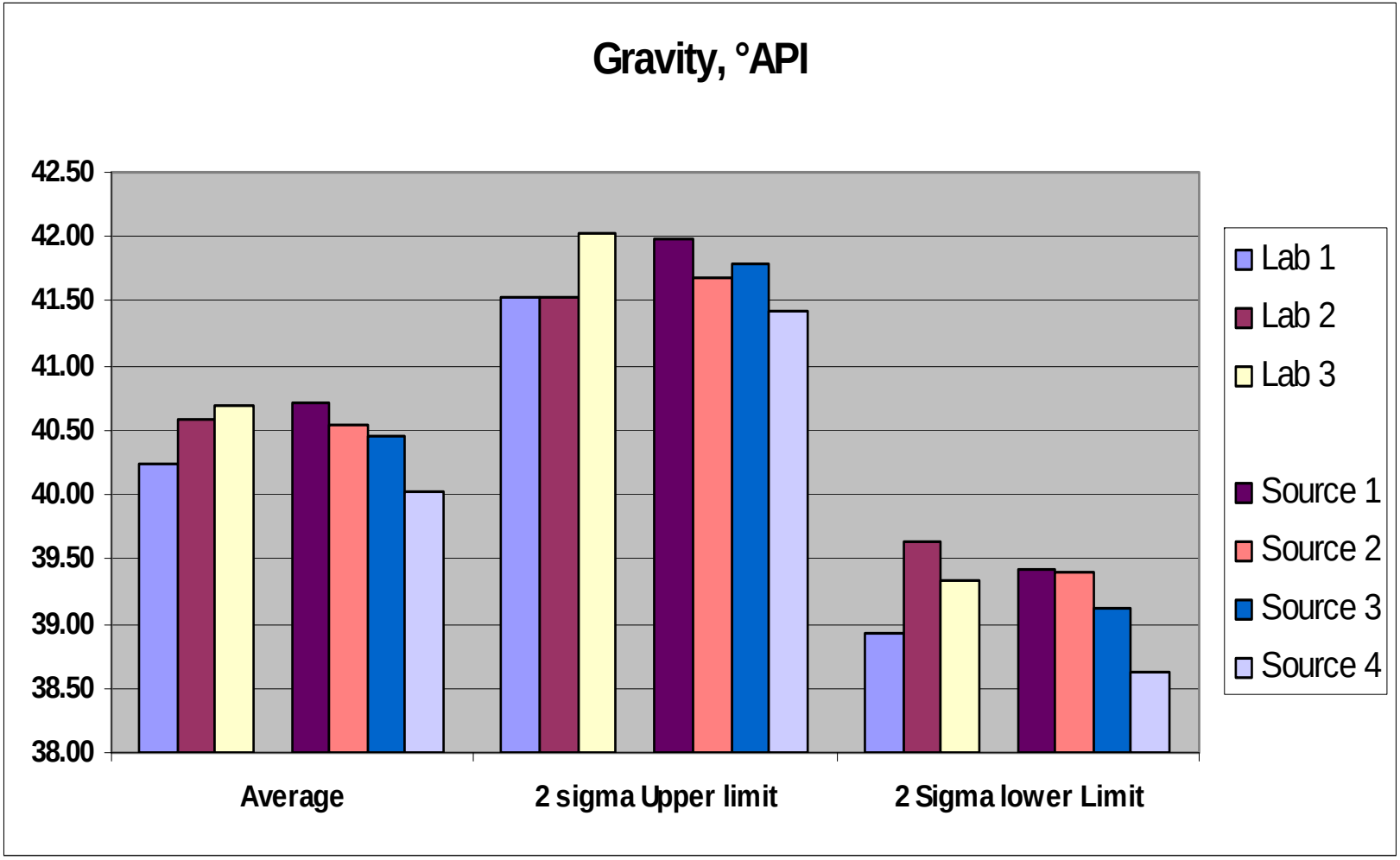
Part 1

Density by D287, °API

- **Outlier examination done only on the complete data set.**
- **All Data in the new study falls within the NYMEX limits**
- **There appears to be a shift upward in the average and the variability has decreased significantly**
- **No significant between lab or source differences**

API	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	40.43	40.49	39.48	40.23	40.58	40.68	40.71	40.54	40.45	40.03
SD	0.67	0.59	0.88	0.65	0.47	0.67	0.64	0.57	0.67	0.70
2 sigma Upper limit	41.78	41.67	41.23	41.54	41.52	42.03	41.99	41.69	41.80	41.43
2 Sigma lower Limi	39.08	39.32	37.72	38.93	39.64	39.34	39.43	39.39	39.11	38.63
Count	61	59	384	22	19	17	11	15	22	13
Max	41.8	41.8	41.9	41.1	41.2	41.8	41.7	41.1	41.8	41.2
min	38.3	39.2	37.0	38.9	39.5	39.3	39.7	39.3	38.9	38.3

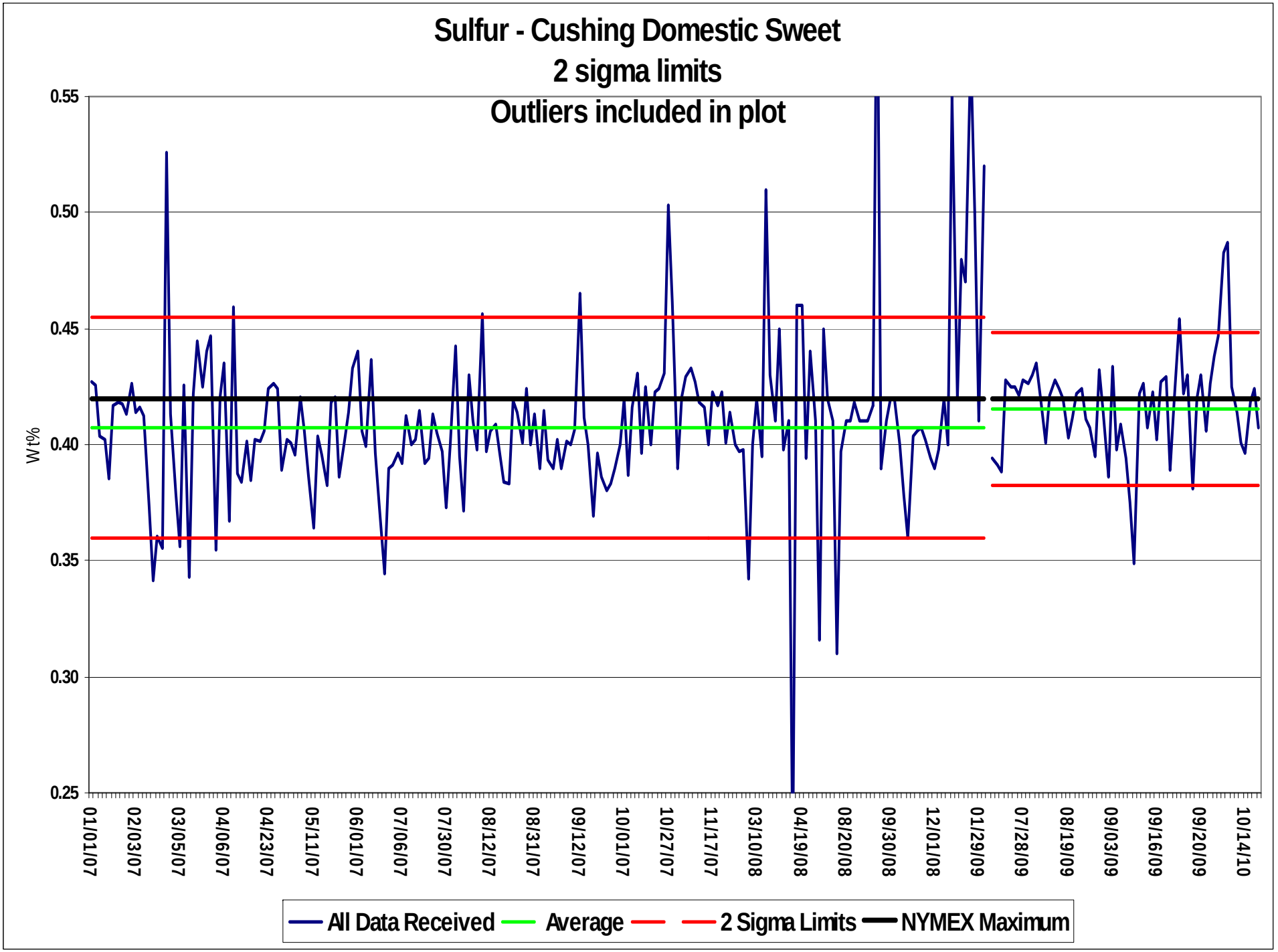

API - Cushing Domestic Sweet
2 Sigma Limits
Outliers Included in Plot
43
42
41
40
39
38
37
36
01/01/07
02/07/07
03/11/07
04/10/07
04/27/07
05/15/07
06/05/07
07/06/07
08/01/07
08/16/07
09/04/07
09/14/07
10/01/07
10/29/07
11/19/07
03/10/08
04/19/08
08/29/08
11/24/08
12/31/08
04/24/09
08/09/09
08/26/09
09/09/09
09/18/09
09/28/09
API data
Average
2 Sigma limits
NYMEX Limits

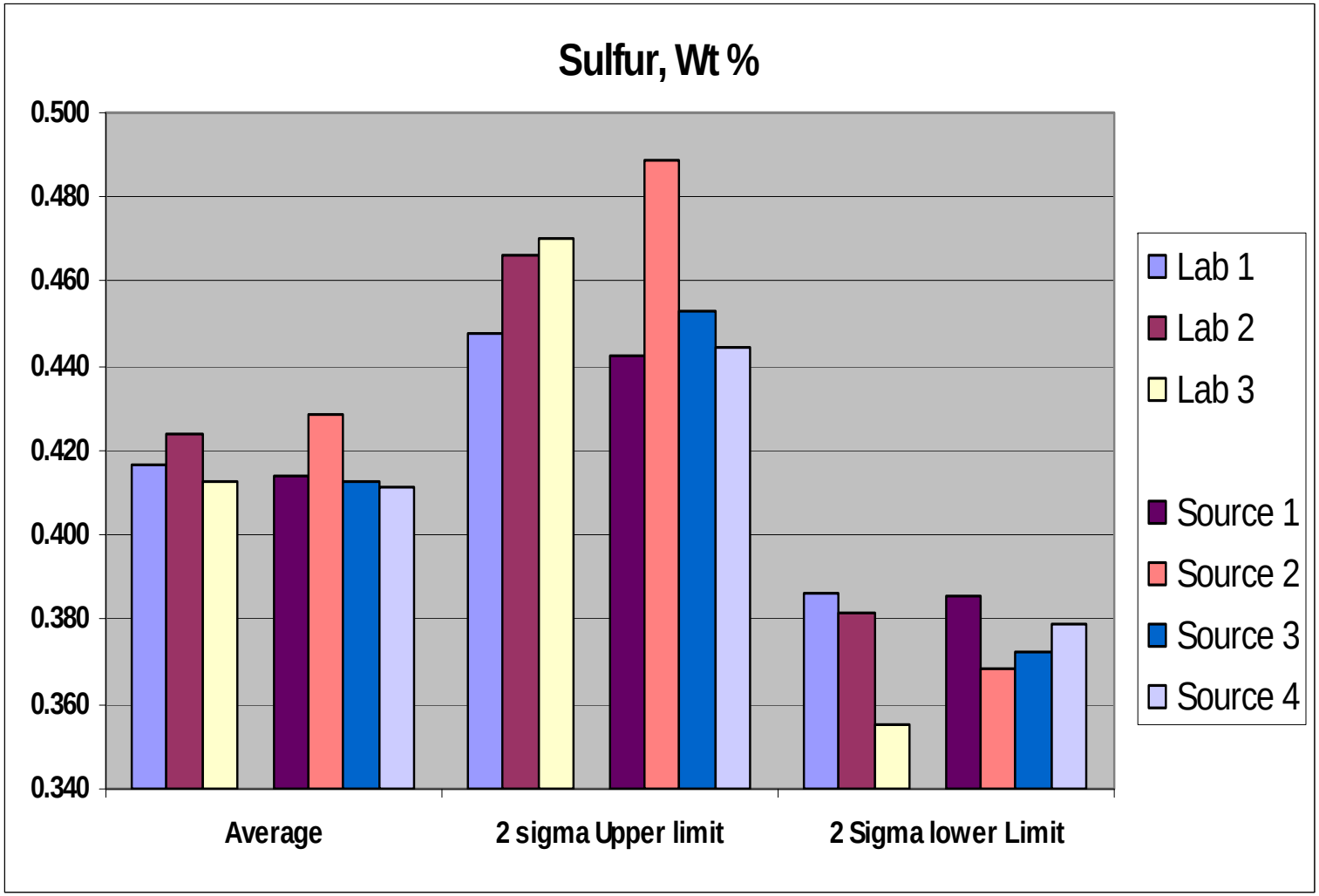

Gravity, °API
42.50
42.00
41.50
41.00
40.50
40.00
39.50
39.00
38.50
38.00
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

Sulfur by D4294, Wt%

- **Outlier examination done only on the complete data set.**
- **Many of the data points fall above the NYMEX limit of 0.42 Wt%**
- **There appears to be a shift upward in the average and the variability has decreased significantly**
- **Data from both Lab 2 and Source 2 tend to be somewhat higher than the other data**

Sulfur	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	0.417	0.416	0.407	0.417	0.424	0.413	0.414	0.429	0.413	0.412
SD	0.022	0.016	0.024	0.015	0.021	0.029	0.014	0.030	0.020	0.016
2 sigma Upper limit	0.461	0.448	0.455	0.448	0.466	0.470	0.443	0.489	0.453	0.444
2 Sigma lower Limit	0.372	0.383	0.360	0.386	0.382	0.355	0.385	0.368	0.372	0.379
Count	61	58	372	22	19	17	11	15	22	13
Max	0.487	0.454	0.470	0.447	0.483	0.487	0.428	0.487	0.434	0.435
min	0.349	0.375	0.340	0.381	0.375	0.349	0.386	0.381	0.349	0.388


Sulfur - Cushing Domestic Sweet
2 sigma limits
Outliers included in plot
Wt%
0.55
0.50
0.45
0.40
0.35
0.30
0.25
01/01/07
02/03/07
03/05/07
04/06/07
04/23/07
05/11/07
06/01/07
07/06/07
07/30/07
08/12/07
08/31/07
09/12/07
10/01/07
10/27/07
11/17/07
03/10/08
04/19/08
08/20/08
09/30/08
12/01/08
01/29/09
07/28/09
08/19/09
09/03/09
09/16/09
09/20/09
10/14/10
All Data Received
Average
2 Sigma Limits
NYMEX Maximum

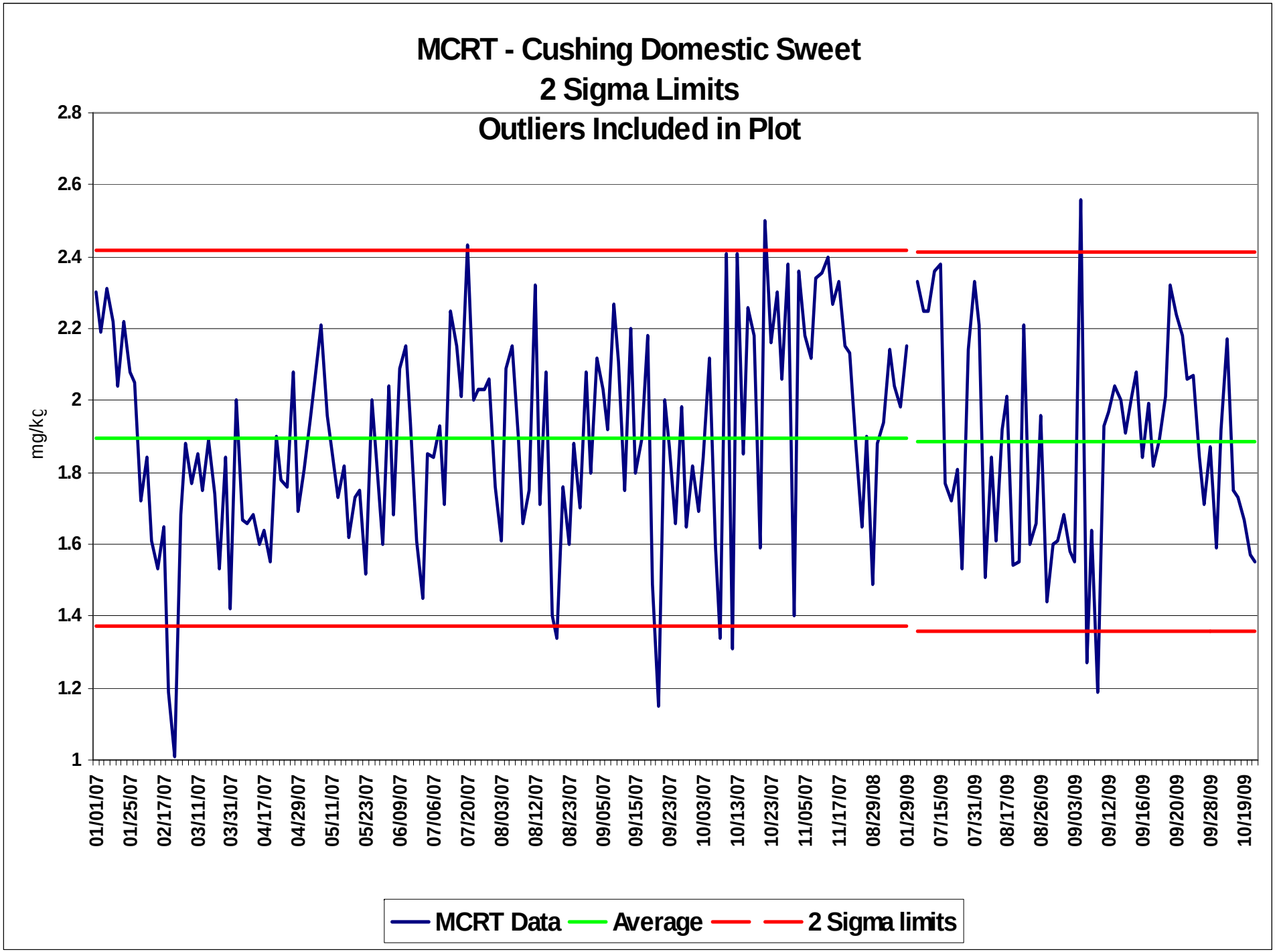

Sulfur, Wt %
0.500
0.480
0.460
0.440
0.420
0.400
0.380
0.360
0.340
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

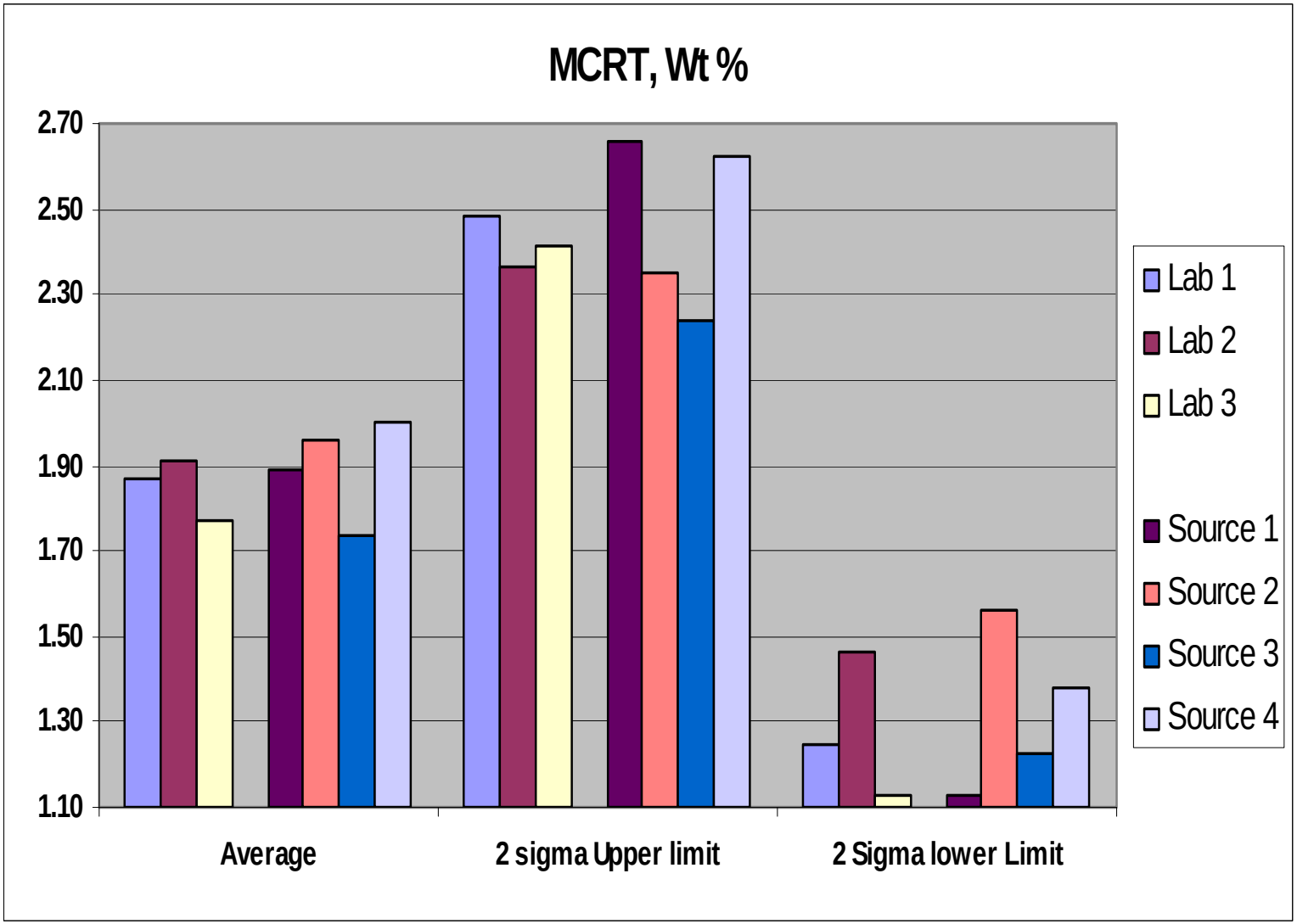
MCRT by D4530, Wt%

- **Outlier examination done only on the complete data set.**
- **Data closely reflects earlier data.**
- **Some slight lab/source bias may be present but there is not enough data to validate.**

- **Data supports an upper control of 2.4 to 2.6 Wt%**

MCRT	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	1.874	1.885	1.896	1.866	1.914	1.771	1.893	1.956	1.735	2.002
SD	0.296	0.263	0.261	0.309	0.224	0.320	0.383	0.197	0.253	0.311
2 sigma Upper limit	2.467	2.411	2.417	2.485	2.362	2.411	2.658	2.351	2.241	2.623
2 Sigma lower Limit	1.282	1.358	1.374	1.247	1.465	1.130	1.127	1.561	1.228	1.380
Count	61	58	154	22	19	17	11	15	22	13
Max	2.56	2.38	2.43	2.36	2.38	2.56	2.56	2.32	2.08	2.36
min	1.19	1.44	1.31	0.40	0.43	1.19	1.44	1.59	1.19	1.55


MCRT - Cushing Domestic Sweet
2 Sigma Limits
Outliers Included in Plot
mg/kg
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
01/01/07
01/25/07
02/17/07
03/11/07
03/31/07
04/17/07
04/29/07
05/11/07
05/23/07
06/09/07
07/06/07
07/20/07
08/03/07
08/12/07
08/23/07
09/05/07
09/15/07
09/23/07
10/03/07
10/13/07
10/23/07
11/05/07
11/17/07
08/29/08
01/29/09
07/15/09
07/31/09
08/17/09
08/26/09
09/03/09
09/12/09
09/16/09
09/20/09
09/28/09
10/19/09
MCRT Data
Average
2 Sigma limits

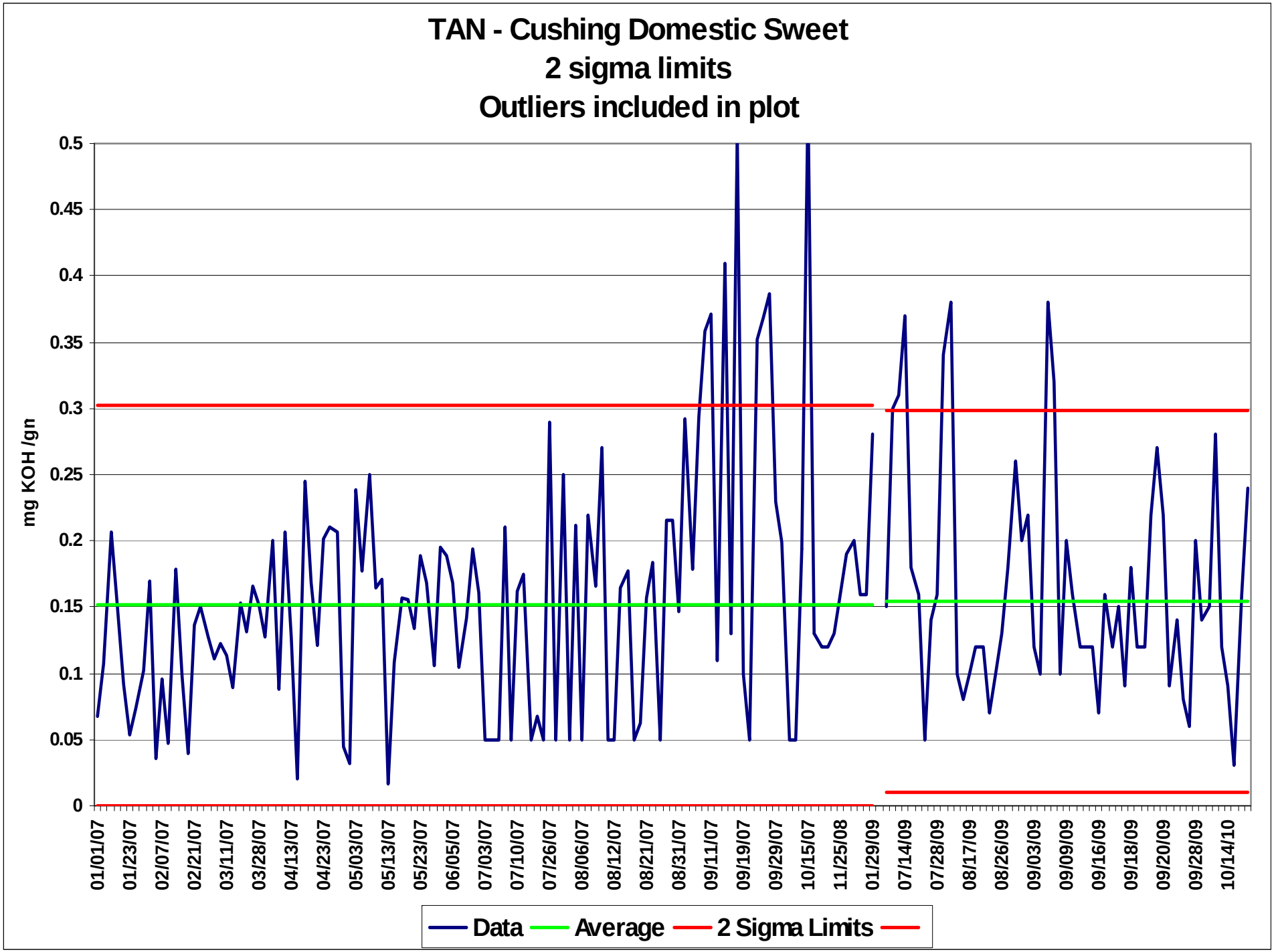

MCRT, Wt %
2.70
2.50
2.30
2.10
1.90
1.70
1.50
1.30
1.10
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

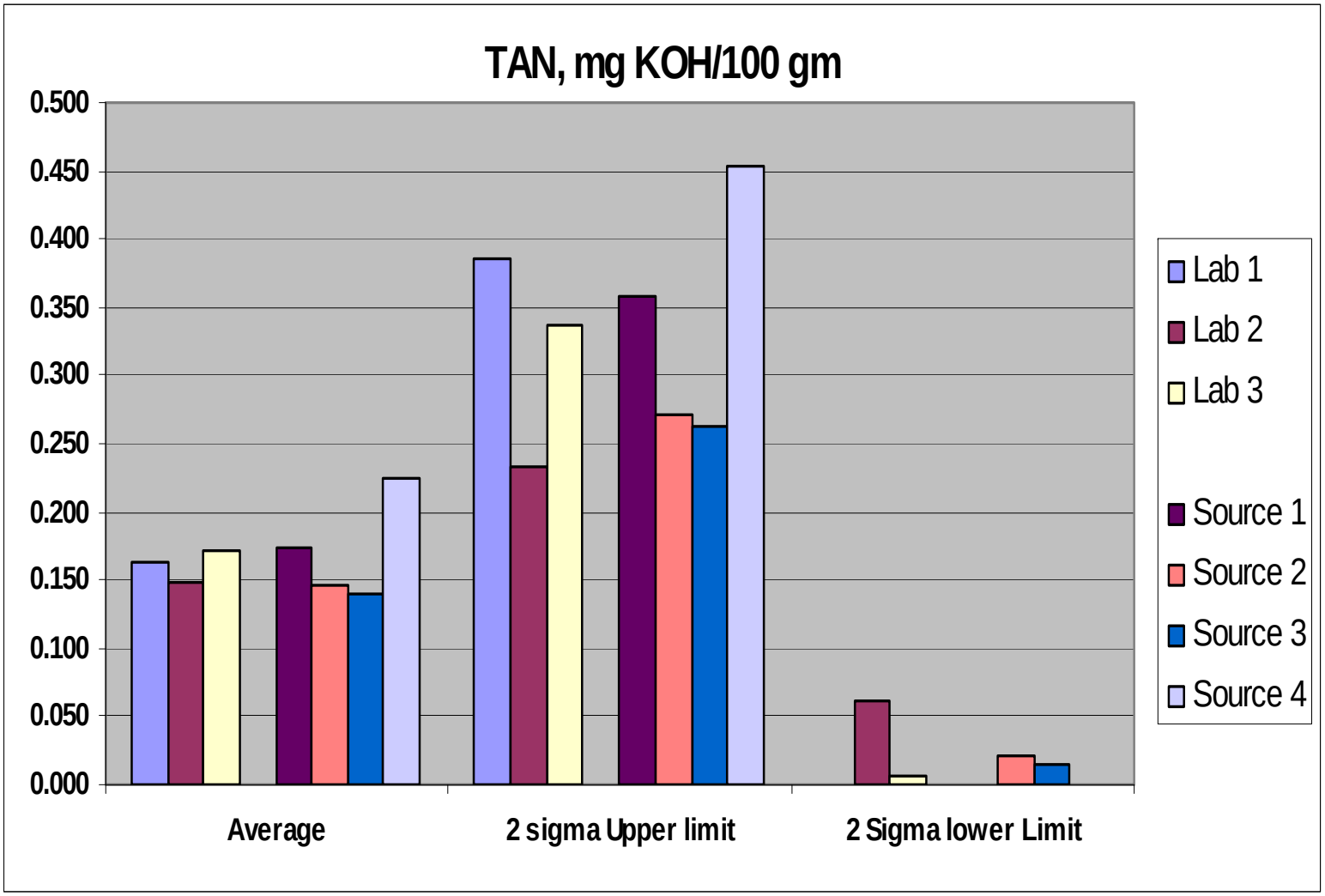
TAN by D664, mg KOH/gm

- **Outlier examination done only on the complete data set.**
- **Data slightly higher and more variable than earlier data.**
- **Very definite source biases are shown.**

- **Based on data, an upper limit of 0.30 is supported.**
  - **Validation of cause of bias and variability shown should be investigated to better define this control point.**
  - **Several data points were reported as < values (<.05, <.10) and were excluded from the statistics. This exclusion leads to a higher average.**

TAN	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	0.166	0.154	0.152	0.164	0.148	0.172	0.174	0.146	0.139	0.225
SD	0.086	0.072	0.076	0.111	0.043	0.082	0.092	0.063	0.062	0.114
2 sigma Upper limit	0.339	0.299	0.303	0.386	0.234	0.336	0.358	0.272	0.263	0.453
2 Sigma lower Limit	0.000	0.010	0.000	0.000	0.062	0.007	0.000	0.020	0.015	0.000
Count	57	54	183	20	17	17	9	15	20	13
Max	0.38	0.34	0.37	0.38	0.27	0.38	0.38	0.27	0.32	0.38
min	0.03	0.03	0.01	0.05	0.10	0.03	0.05	0.06	0.07	0.03


TAN - Cushing Domestic Sweet
2 sigma limits
Outliers included in plot
mg KOH /gn
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
01/01/07
01/23/07
02/07/07
02/21/07
03/11/07
03/28/07
04/13/07
04/23/07
05/03/07
05/13/07
05/23/07
06/05/07
07/03/07
07/10/07
07/26/07
08/06/07
08/12/07
08/21/07
08/31/07
09/11/07
09/19/07
09/29/07
10/15/07
11/25/08
01/29/09
07/14/09
07/28/09
08/17/09
08/26/09
09/03/09
09/09/09
09/16/09
09/18/09
09/20/09
09/28/09
10/14/10
Data
Average
2 Sigma Limits

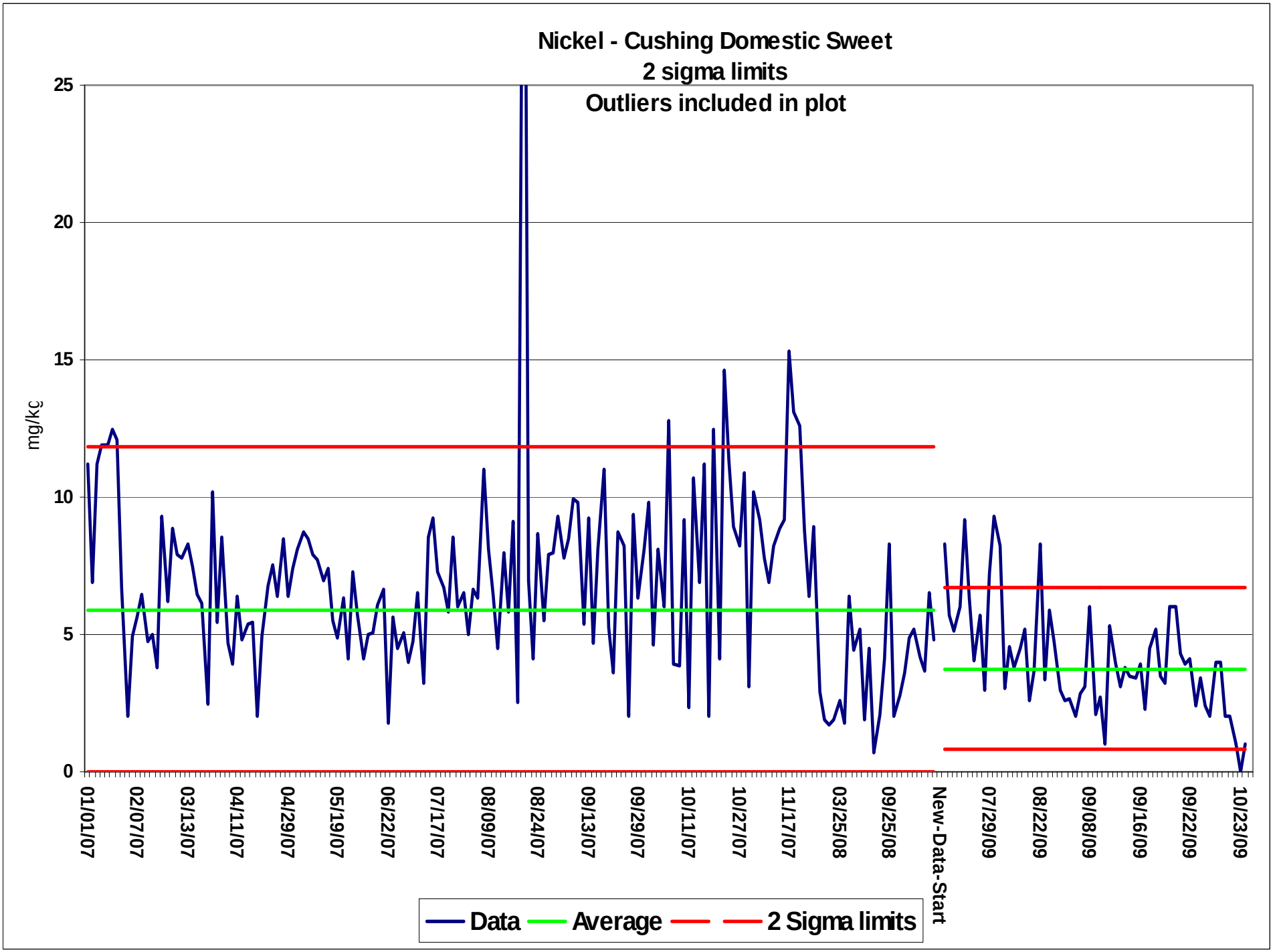

TAN, mg KOH/100 gm
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

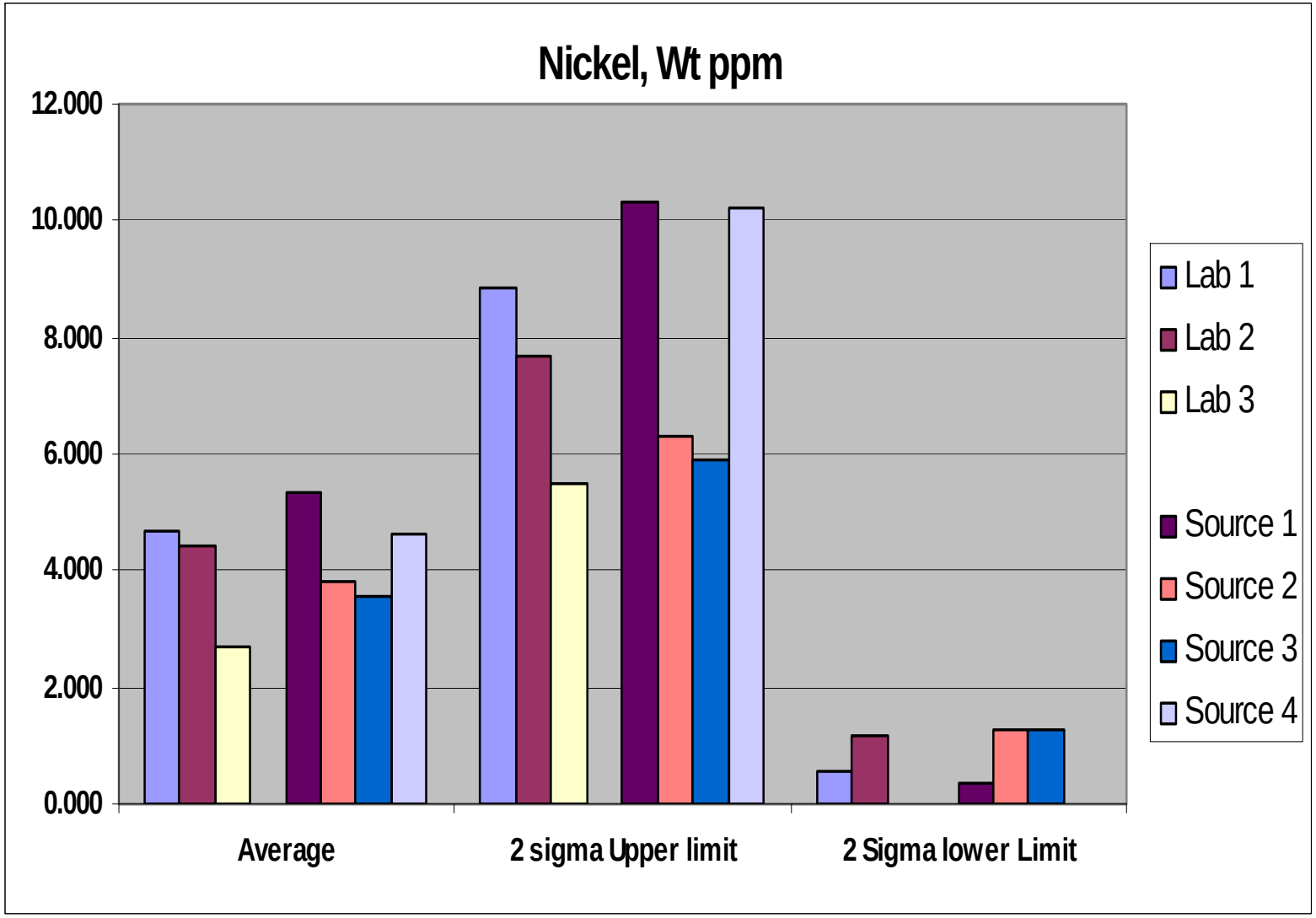
Nickel by D5708B, Wt ppm

- **Outlier examination done only on the complete data set.**
- **Data significantly lower and less variable than earlier data.**
- **Very definite lab and source biases are shown.**
  - **Lab 3 is significantly lower than others**
  - **Sources 1 and 4 are significantly higher than sources 2 and 3**
- **Levels appear to be decreasing throughout the study**

- **Again, the source of the bias shown should be identified to better set the control limits**

Nickel	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	4.16	3.75	5.91	4.69	4.42	2.72	5.34	3.79	3.57	4.64
SD	1.96	1.46	2.95	2.07	1.62	1.38	2.50	1.26	1.16	2.80
2 sigma Upper limit	8.08	6.68	11.81	8.83	7.67	5.48	10.34	6.32	5.88	10.23
2 Sigma lower Limit	0.24	0.83	0.00	0.55	1.17	0.00	0.35	1.26	1.25	0.00
Count	60	55	203	22	19	16	11	15	22	12
Max	9.3	7.2	13.1	9.3	9.2	6.0	9.2	6.0	5.9	9.3
min	1.0	1.0	0.7	2.1	2.4	1.0	2.0	2.0	1.0	1.0


Nickel - Cushing Domestic Sweet
2 sigma limits
Outliers included in plot
mg/kg
25
20
15
10
5
0
01/01/07
02/07/07
03/13/07
04/11/07
04/29/07
05/19/07
06/22/07
07/17/07
08/09/07
08/24/07
09/13/07
09/29/07
10/11/07
10/27/07
11/17/07
03/25/08
09/25/08
New-Data-Start
07/29/09
08/22/09
09/08/09
09/16/09
09/22/09
10/23/09
Data
Average
2 Sigma limits


Nickel, Wt ppm
12.000
10.000
8.000
6.000
4.000
2.000
0.000
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

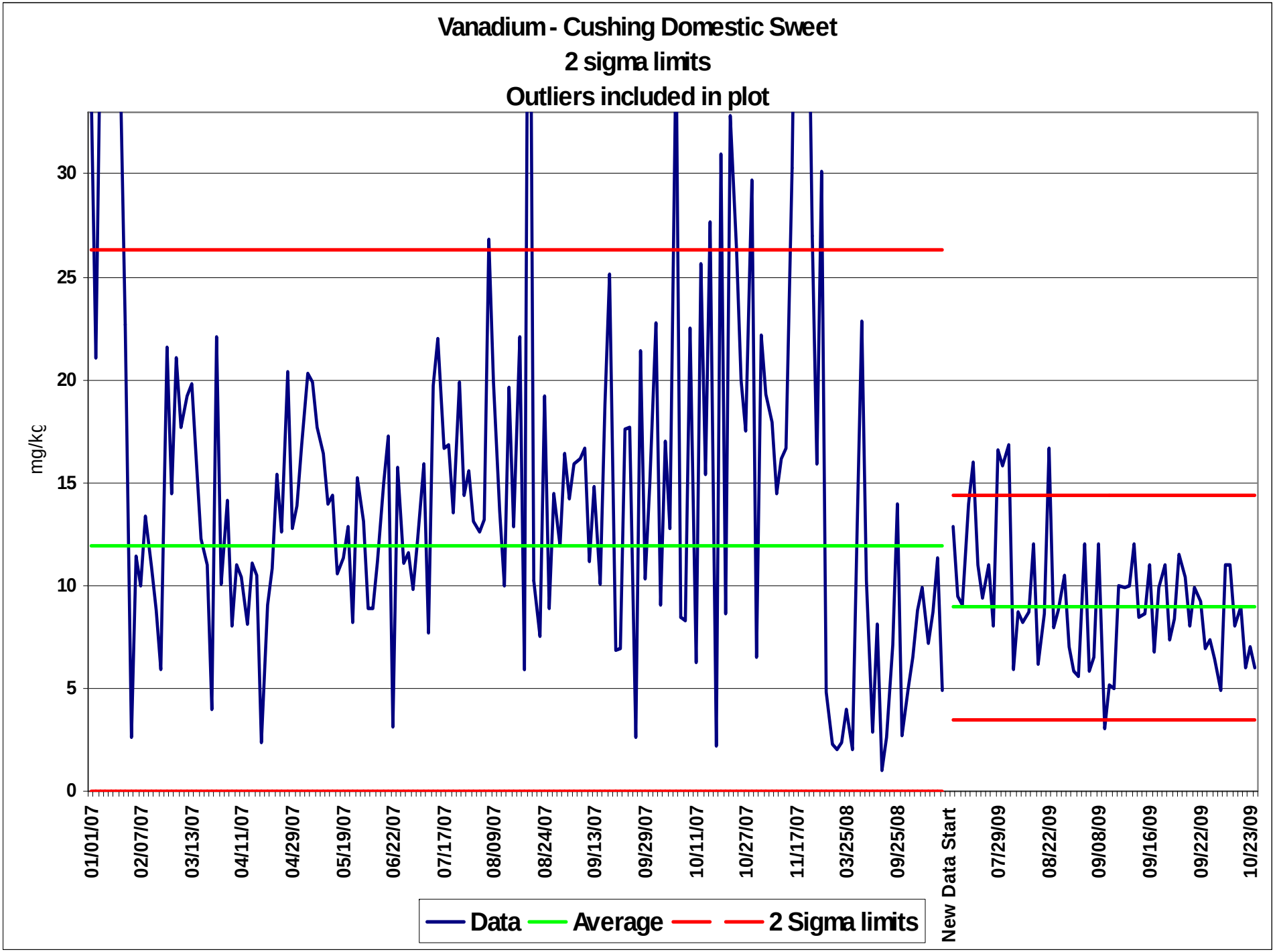
COQG

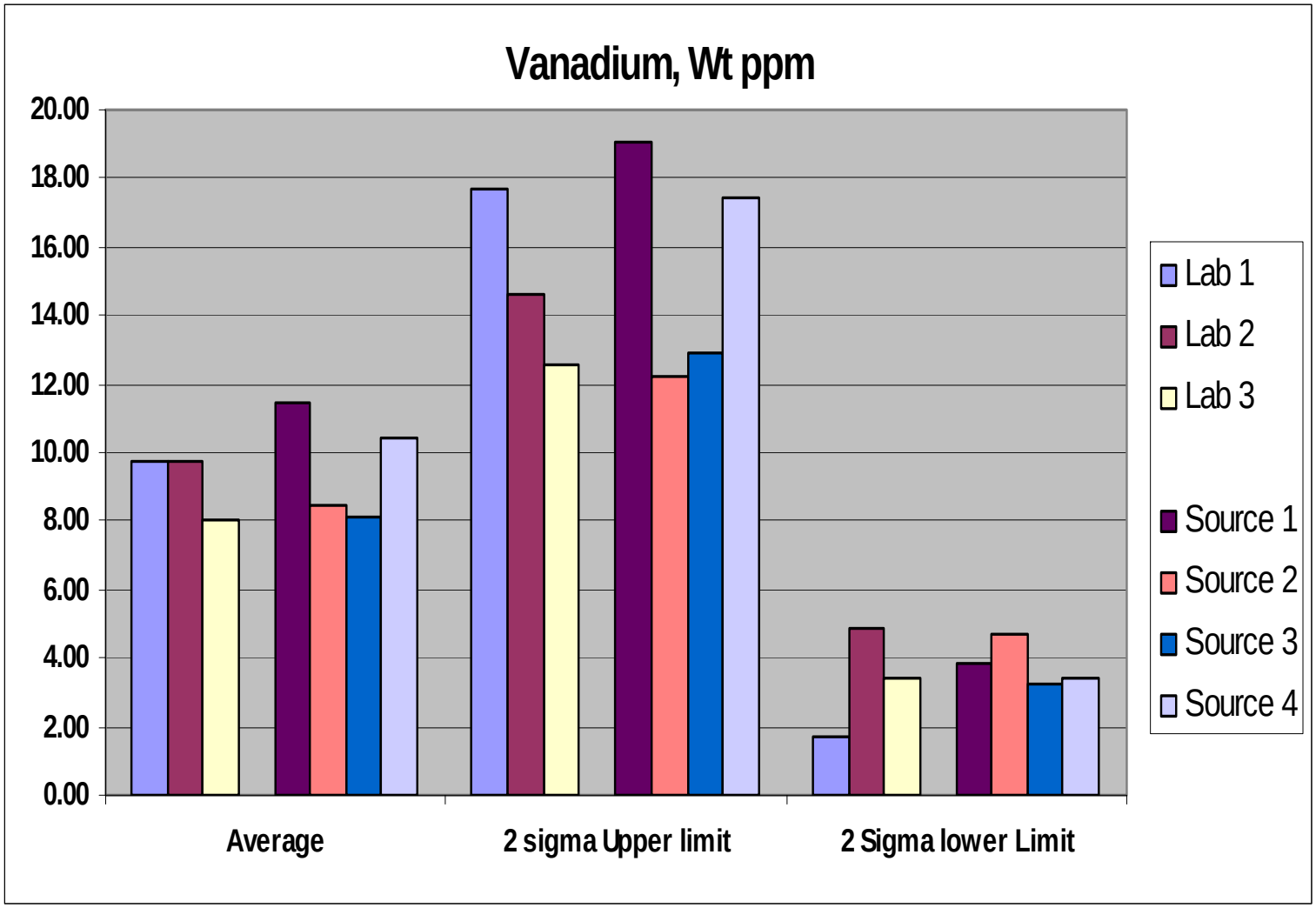
Vanadium by D5708B, Wt ppm

- **Outlier examination done only on the complete data set.**
- **Data significantly lower and less variable than earlier data.**
- **Very definite lab and source biases are shown.**
  - **Lab 3 is significantly lower than others**
  - **Sources 1 and 4 are significantly higher than sources 2 and 3**
- **Levels appear to be decreasing throughout the study**

- **Again, the source of these biases should be identified to better set the control limits**

Vanadium	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	9.29	8.93	11.96	9.71	9.76	8.00	11.44	8.45	8.09	10.45
SD	3.09	2.73	7.18	4.00	2.42	2.27	3.80	1.87	2.41	3.51
2 sigma Upper limit	15.47	14.39	26.32	17.71	14.60	12.54	19.03	12.18	12.92	17.48
2 Sigma lower Limit	3.10	3.48	0.00	1.71	4.91	3.46	3.85	4.72	3.26	3.42
Count	61	58	195	22	19	17	11	15	22	13
Max	16.8	16.8	32.8	16.8	16.0	12.0	16.8	11.5	12.0	16.6
min	3.1	3.1	1.0	3.1	5.2	4.9	6.0	4.9	3.1	6.0

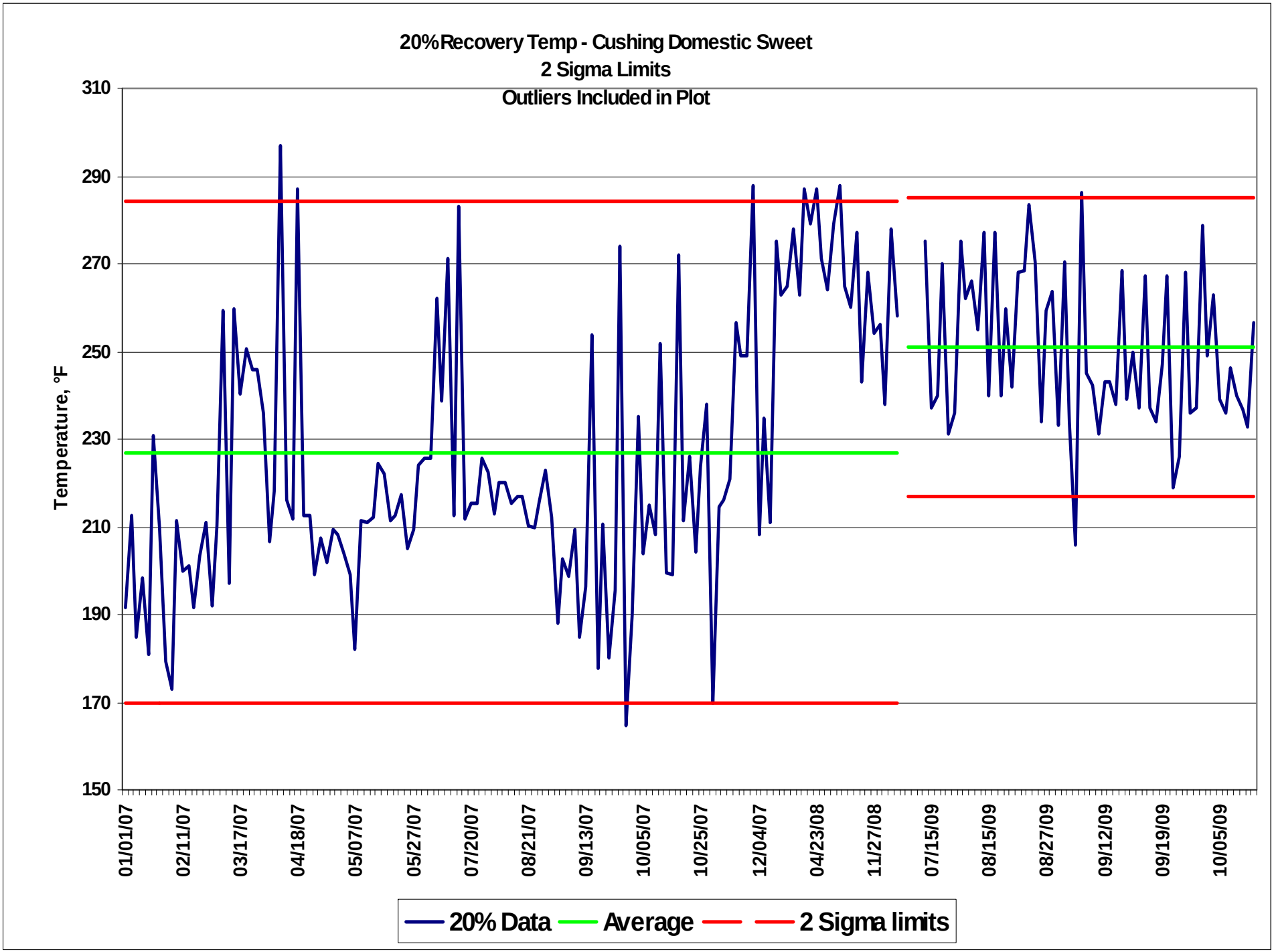

Vanadium - Cushing Domestic Sweet
2 sigma limits
Outliers included in plot
mg/kg
0
5
10
15
20
25
30
01/01/07
02/07/07
03/13/07
04/11/07
04/29/07
05/19/07
06/22/07
07/17/07
08/09/07
08/24/07
09/13/07
09/29/07
10/11/07
10/27/07
11/17/07
03/25/08
09/25/08
New Data Start
07/29/09
08/22/09
09/08/09
09/16/09
09/22/09
10/23/09
Data
Average
2 Sigma limits

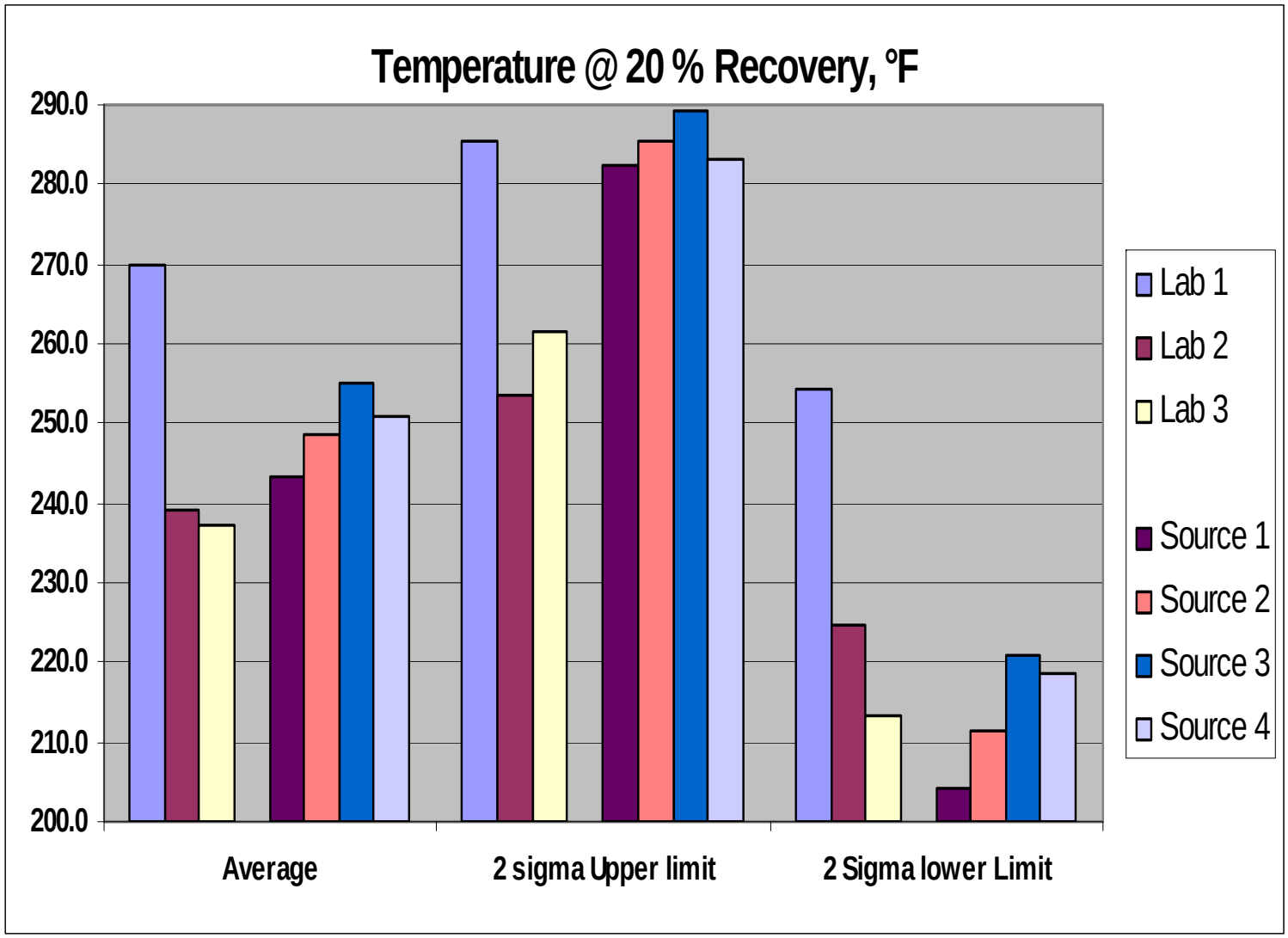

Vanadium, Wt ppm
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

20 Wt% Recovery Temperature by D7169, °F

- First time review
- Outlier examination done only on the complete data set.
- Data significantly higher and less variable than earlier data.
- Very definite lab bias is shown.
  - Lab 1 data is significantly higher than labs 2 and 3.
  - Impact is across the board to all sources
  - Upper control limit excluding Lab1 drops 25 to 30°

20% Recovery Temperature	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	250.2	251.0	227.0	269.8	239.0	237.4	243.3	248.4	255.0	250.9
SD	17.85	16.99	28.57	7.7	7.2	12.0	19.5	18.6	17.0	16.1
2 sigma Upper limit	285.9	285.0	284.1	285.3	253.4	261.4	282.3	285.6	289.1	283.1
2 Sigma lower Limit	214.5	217.0	169.8	254.3	224.6	213.3	204.2	211.3	221.0	218.8
Count	58	57	144	22	19	17	11	15	22	13
Max	286	286	287	286	250	263	270	279	286	276
min	206	219	170	255	219	206	206	219	231	233

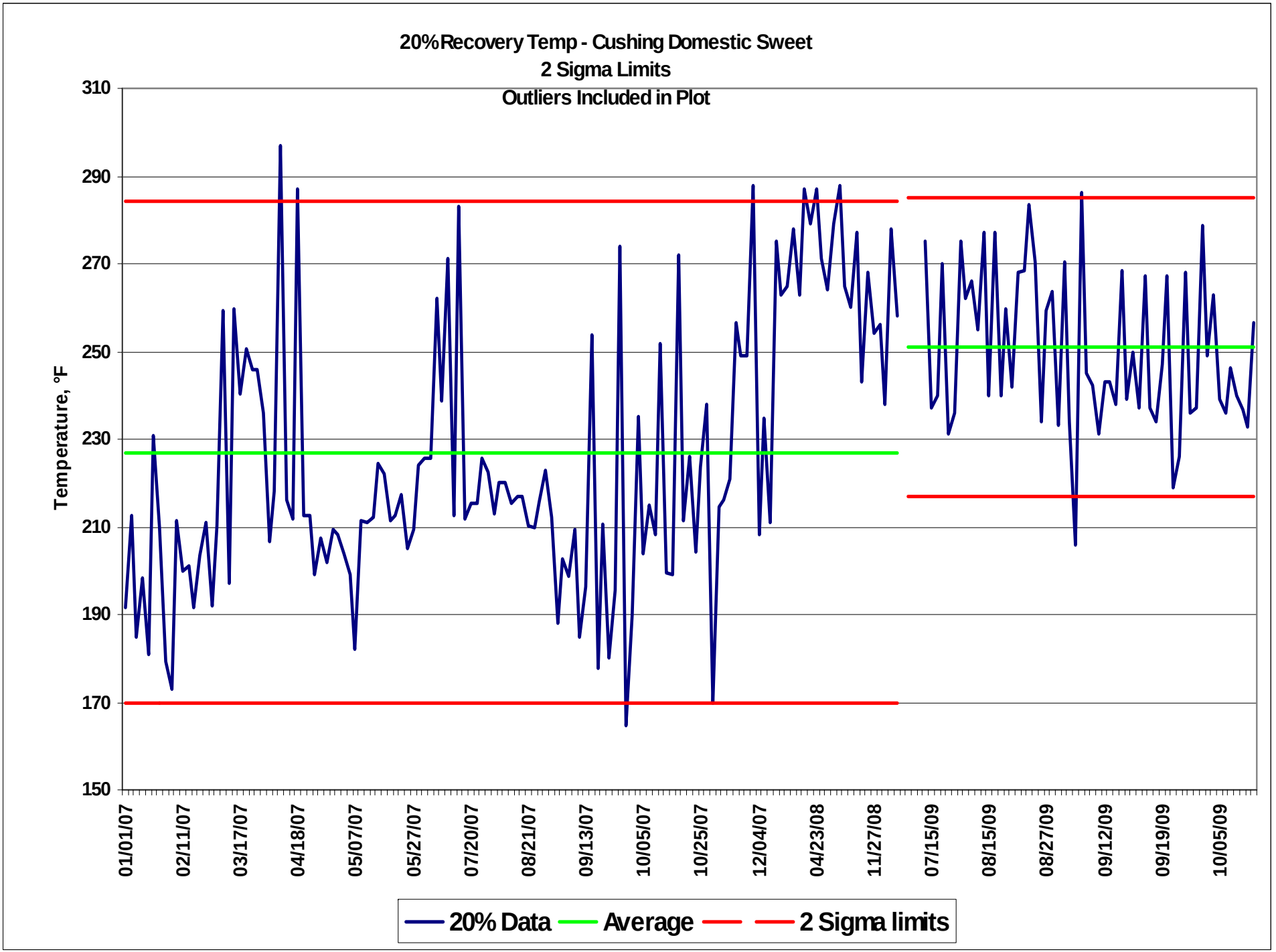

20% Recovery Temp - Cushing Domestic Sweet
2 Sigma Limits
Outliers Included in Plot
Temperature, °F
310
290
270
250
230
210
190
170
150
01/01/07
02/11/07
03/17/07
04/18/07
05/07/07
05/27/07
07/20/07
08/21/07
09/13/07
10/05/07
10/25/07
12/04/07
04/23/08
11/27/08
07/15/09
08/15/09
08/27/09
09/12/09
09/19/09
10/05/09
20% Data
Average
2 Sigma limits

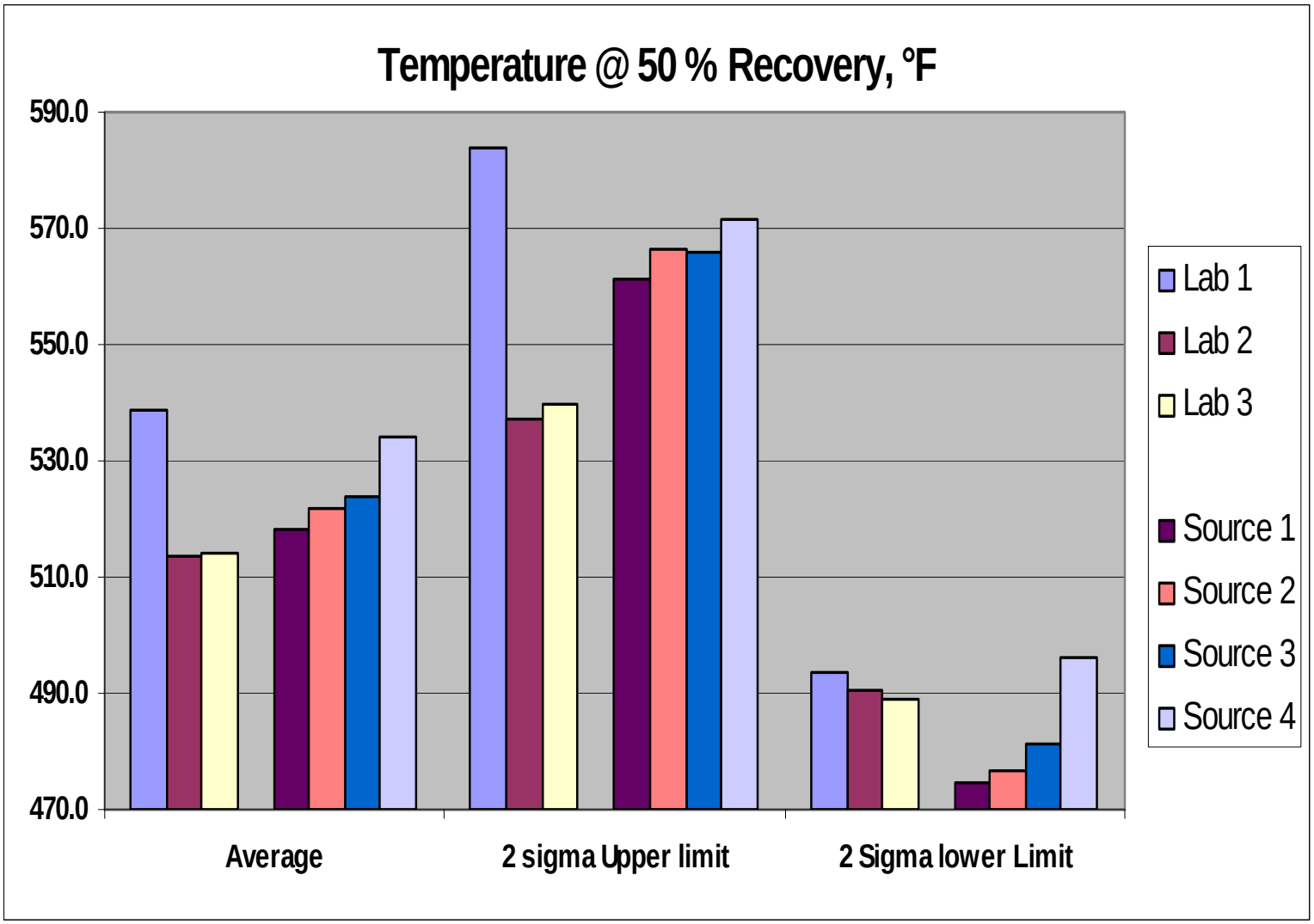

Temperature @ 20 % Recovery, °F
290.0
280.0
270.0
260.0
250.0
240.0
230.0
220.0
210.0
200.0
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

50 Wt% Recovery Temperature by D7169, °F

- First time review
- Outlier examination done only on the complete data set.
- Data significantly higher and less variable than earlier data.
- Very definite lab bias is shown.
  - Lab 1 data is significantly higher than labs 2 and 3.
  - Impact is across the board to all sources
  - Upper control limit excluding Lab1 drops 15 to 20°

50% Recovery Temperature	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	523.4	521.1	502.8	538.7	513.8	514.3	518.2	521.6	523.7	533.9
SD	20.5	16.5	29.6	22.5	11.6	12.7	21.7	22.5	21.1	18.9
2 sigma Upper limit	564.4	554.2	561.9	583.6	537.0	539.8	561.5	566.6	566.0	571.6
2 Sigma lower Limit	482.4	488.0	443.7	493.8	490.6	488.9	474.9	476.5	481.4	496.2
Count	58	56	142	22	19	17	11	15	22	13
Max	599	556	571	599	550	536	556	577	599	581
min	494	494	440	508	499	494	494	499	505	516

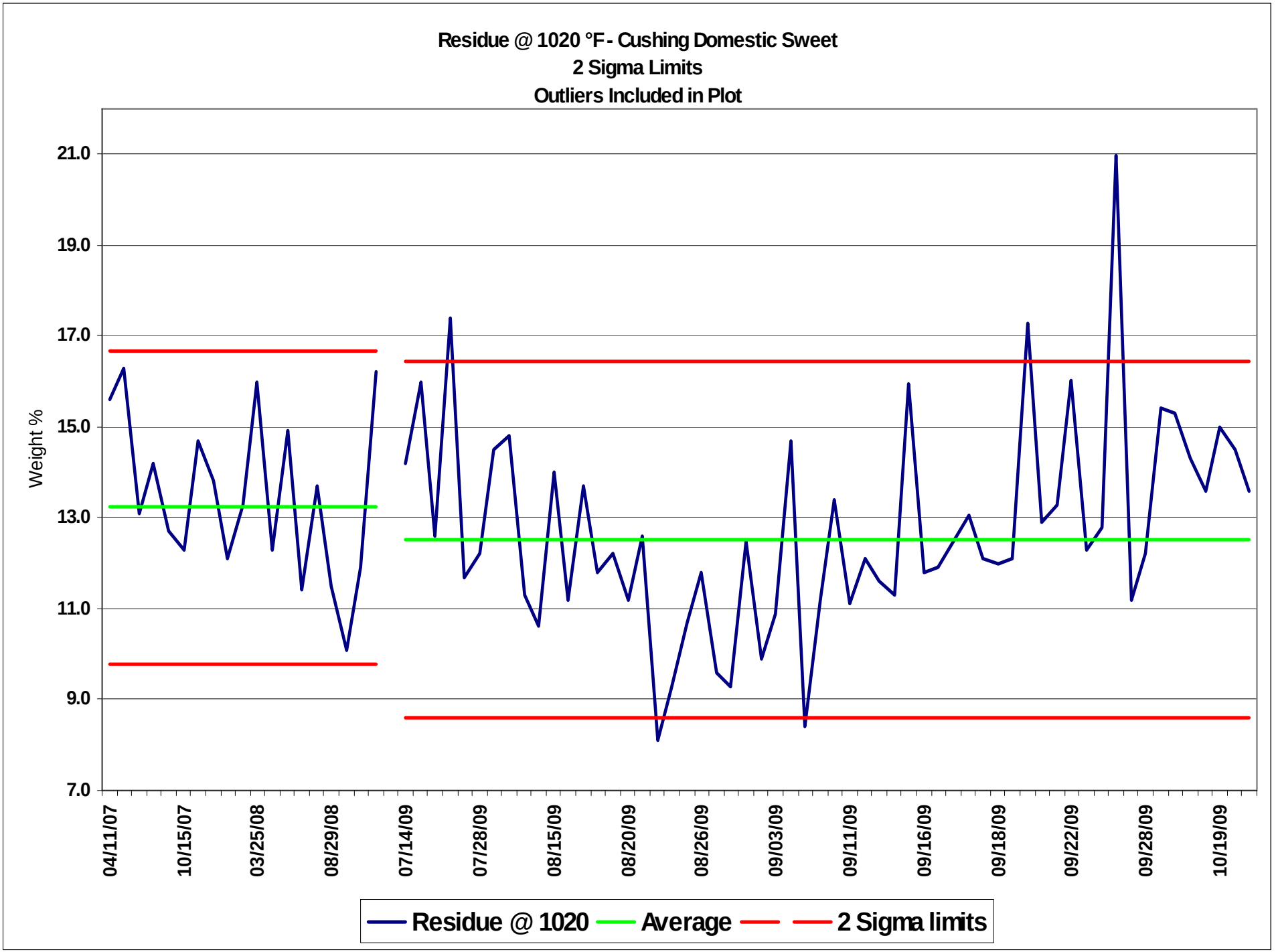

20% Recovery Temp - Cushing Domestic Sweet
2 Sigma Limits
Outliers Included in Plot
Temperature, °F
310
290
270
250
230
210
190
170
150
01/01/07
02/11/07
03/17/07
04/18/07
05/07/07
05/27/07
07/20/07
08/21/07
09/13/07
10/05/07
10/25/07
12/04/07
04/23/08
11/27/08
07/15/09
08/15/09
08/27/09
09/12/09
09/19/09
10/05/09
20% Data
Average
2 Sigma limits

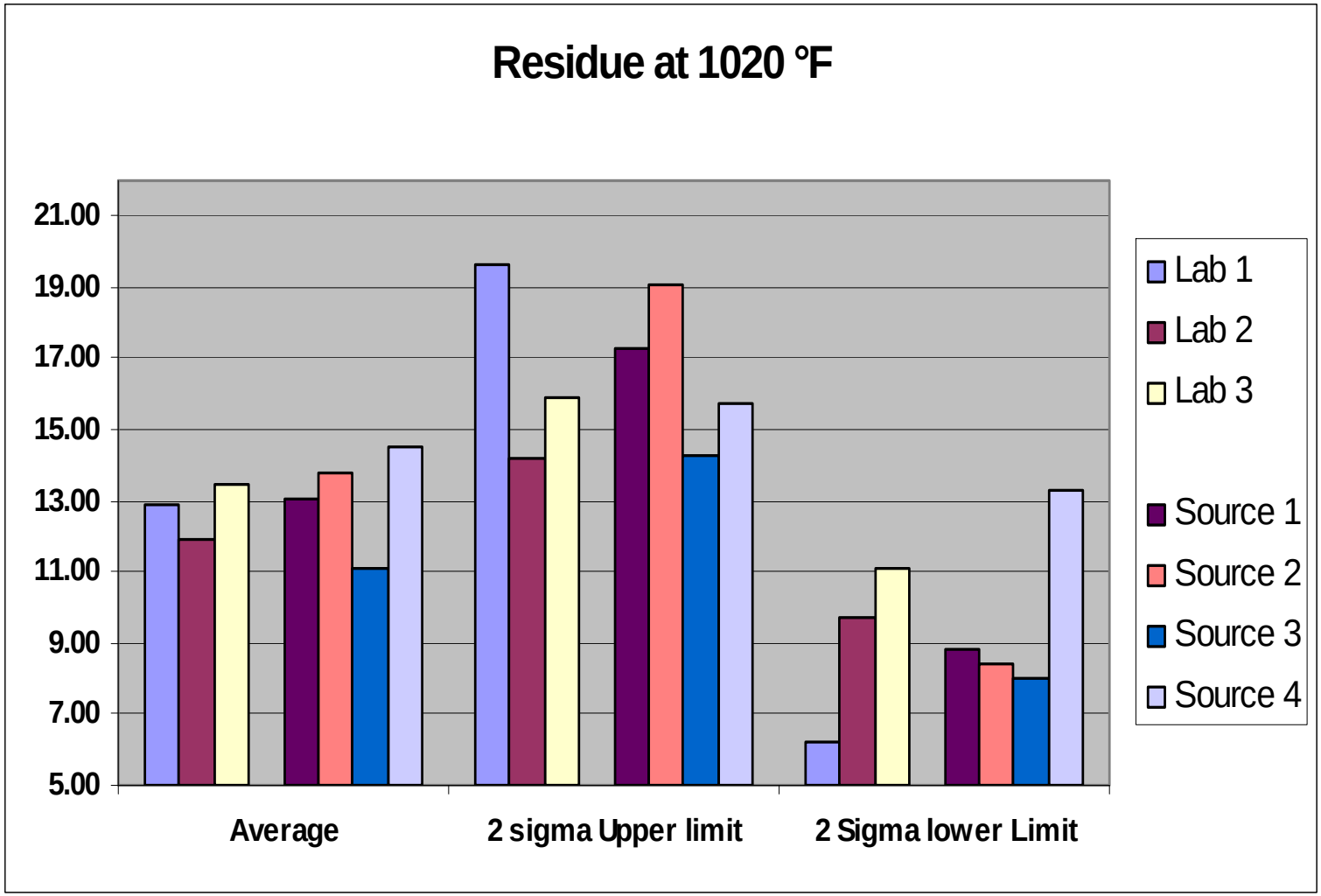

Temperature @ 50 % Recovery, °F
590.0
570.0
550.0
530.0
510.0
490.0
470.0
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

Recovery @ 1020 °F by D7169, Wt%

- First time review
- Outlier examination done only on the complete data set.
- Very limited data available prior to this study.
- Much data was reported with ~100% recovery.
  - Hopefully Dan's presentation will help labs with the simdis analysis.
  - Impact is across the board to all sources
- Source 4 has the highest residue as well as the least variable data.

% Recovery @ 1020 °F	All New Study Data	New Robust data	Previous Robust Data	Data Lab 1	Data Lab 2	Data Lab 3	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Average	12.76	12.53	13.23	12.90	11.95	13.48	13.04	13.76	11.14	14.52
SD	2.31	1.96	1.72	3.35	1.12	1.21	2.10	2.66	1.57	0.63
2 sigma Upper limit	17.37	16.45	16.68	19.60	14.19	15.89	17.24	19.08	14.28	15.77
2 Sigma lower Limit	8.14	8.61	9.79	6.20	9.70	11.07	8.83	8.44	8.00	13.27
Count	58	56	23	22	19	17	11	15	22	10
Max	21.0	17.3	16.3	21.0	16.0	15.4	17.4	21.0	14.0	15.4
min	8.1	8.1	10.1	8.1	10.9	11.8	10.6	11.2	8.1	13.6


Residue @ 1020 °F - Cushing Domestic Sweet
2 Sigma Limits
Outliers Included in Plot
Weight %
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
04/11/07
10/15/07
03/25/08
08/29/08
07/14/09
07/28/09
08/15/09
08/20/09
08/26/09
09/03/09
09/11/09
09/16/09
09/18/09
09/22/09
09/28/09
10/19/09
Residue @ 1020
Average
2 Sigma limits


Residue at 1020 °F
21.00
19.00
17.00
15.00
13.00
11.00
9.00
7.00
5.00
Average
2 sigma Upper limit
2 Sigma lower Limit
Lab 1
Lab 2
Lab 3
Source 1
Source 2
Source 3
Source 4

Part 2 – Review of duplicates

Duplicates Review (Page 1)

- Seven duplicate sets of samples were submitted to 3 labs.
- No outlier examination was performed.
- Sample set #1 came from source #1.
- Sample set #2 came from Source #3.
- Sample sets #3→7 came from Source #2.
- Data from the three labs was plotted against each other and general observation made.
- Since these are “live” samples not standards.
  - No assessment of accuracy can be made.
  - Direct comparison to ASTM R and r can not be made.
    - But could look at averages as compared to ASTM R for reference.

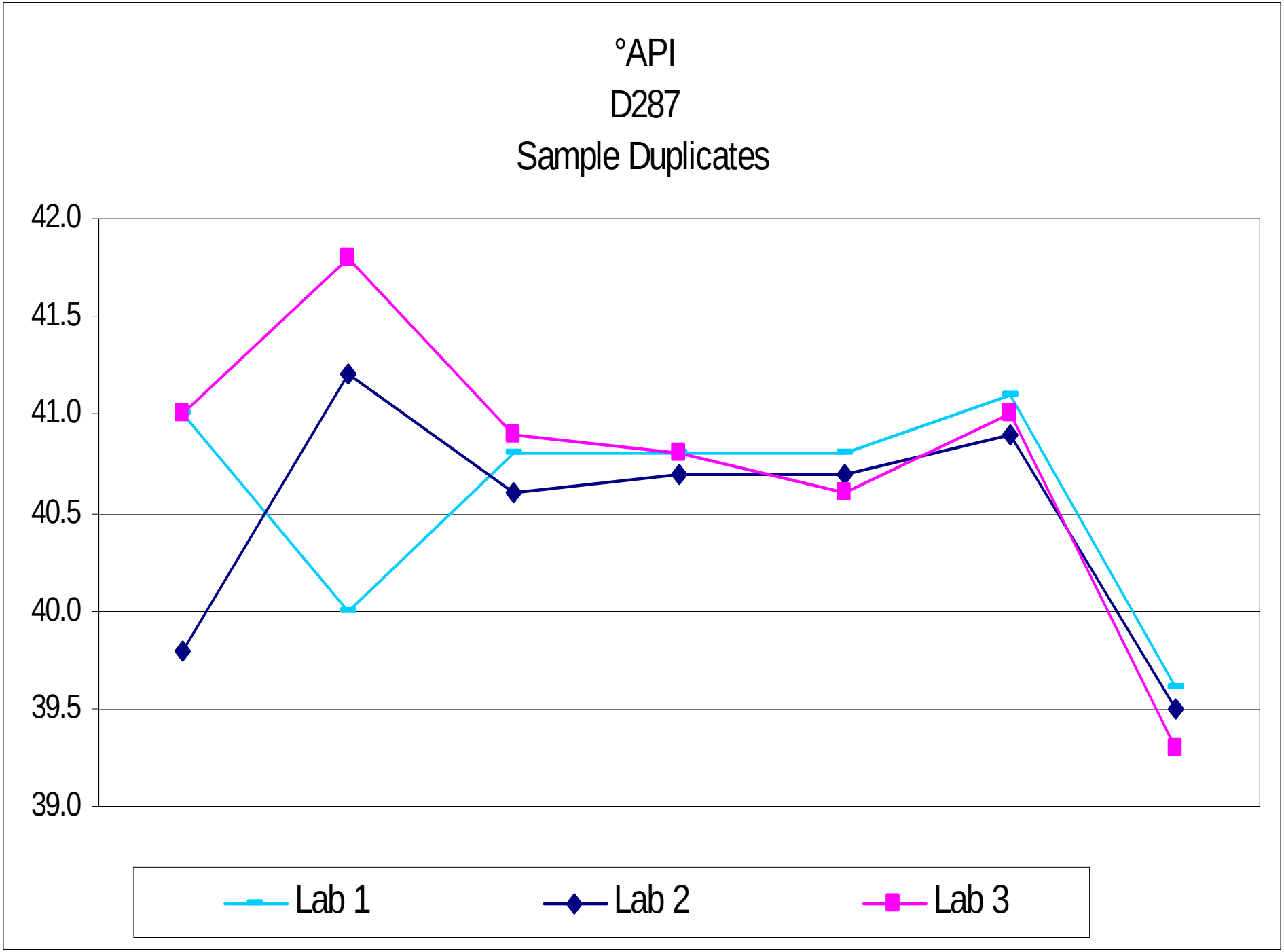
Duplicates Review (Page 2)

- Some of the variability may be caused by the method of collection and submission of the duplicates.
- Since the sample set is so small, any statistics noted may not be as accurate as wanted.

	API by D287	Sulfur (wt %) D4294	MCRT by D4530	TAN by D664	Nickel (ppm) D5708B	Vanadium (ppm) D5708B	20% point (°F)	50% point (°F)	Recovery @ 1020°F (wt%)	Residue @1020°F
Lab 1 Average	40.59	0.4099	1.854	0.129	3.92	8.52	272.2	545.9	84.42	15.58
Lab 2 Average	40.49	0.4304	1.923	0.170	4.21	8.83	236.6	509.3	88.11	11.89
Lab 3 Average	40.77	0.4201	1.723	0.153	2.64	6.71	239.3	512.1	87.37	12.63
Average all	40.61	0.4201	1.833	0.150	3.59	8.02	249.4	522.4	86.63	13.37
Lab 1 Standard Deviation	0.56	0.0213	0.332	0.102	1.19	2.72	7.3	17.3	3.95	3.95
Lab 2 Standard Deviation	0.61	0.0330	0.198	0.054	1.45	2.28	9.8	11.0	0.61	0.61
Lab 3 Standard Deviation	0.75	0.0427	0.317	0.047	1.07	1.29	11.5	11.7	0.56	0.56
Seven samples analyzed by all three participating labs										

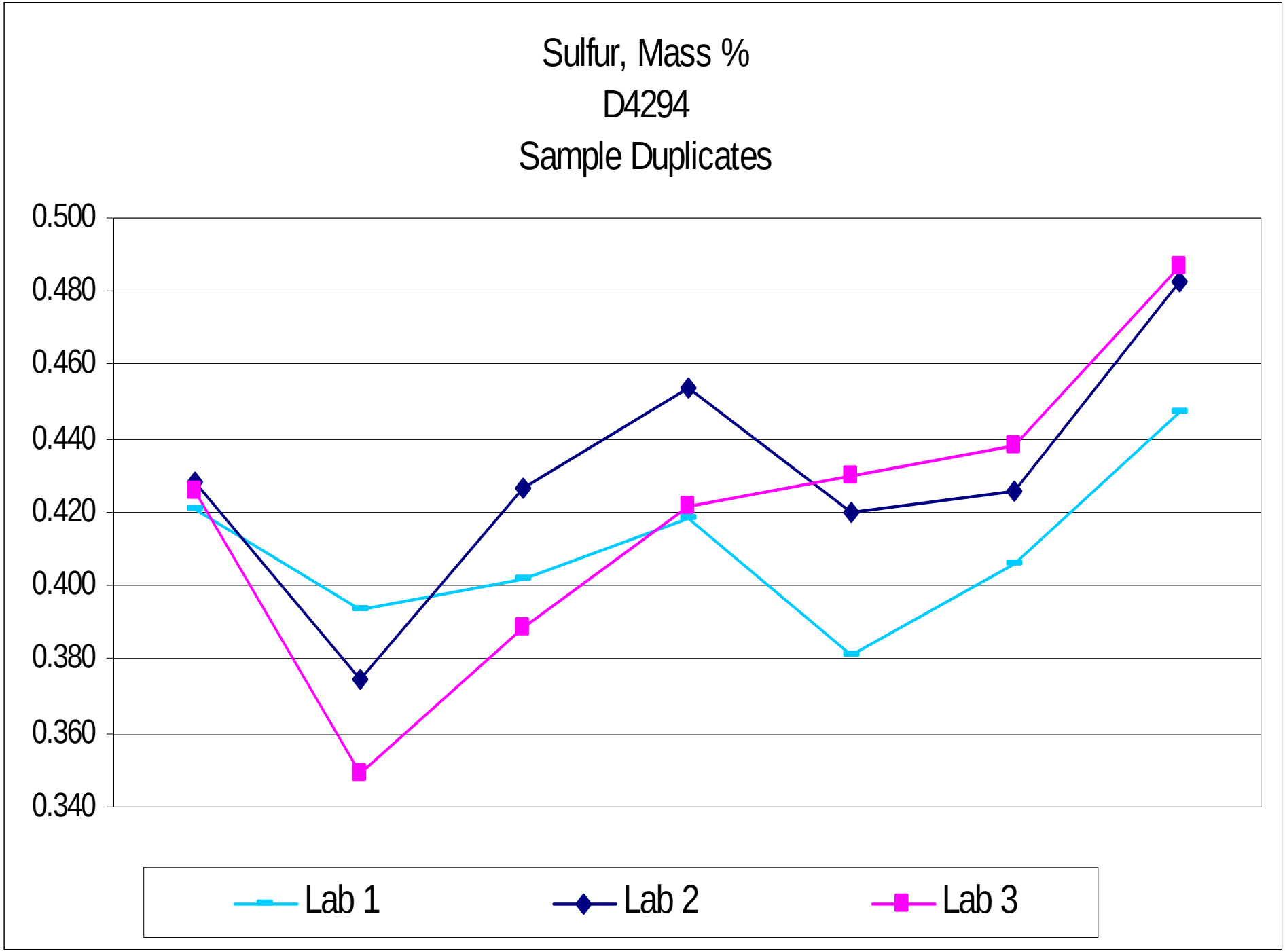
API Duplicates

- Sample sets #1 and #2 show more variability than the other sets
- Although the data is from only a small set of samples
  - Lab 3 shows the highest average and the highest Standard Deviation
- Each labs average result is within ASTM's Reproducibility of 0.5 °API from the mean.


°API
D287
Sample Duplicates
42.0
41.5
41.0
40.5
40.0
39.5
39.0
Lab 1
Lab 2
Lab 3

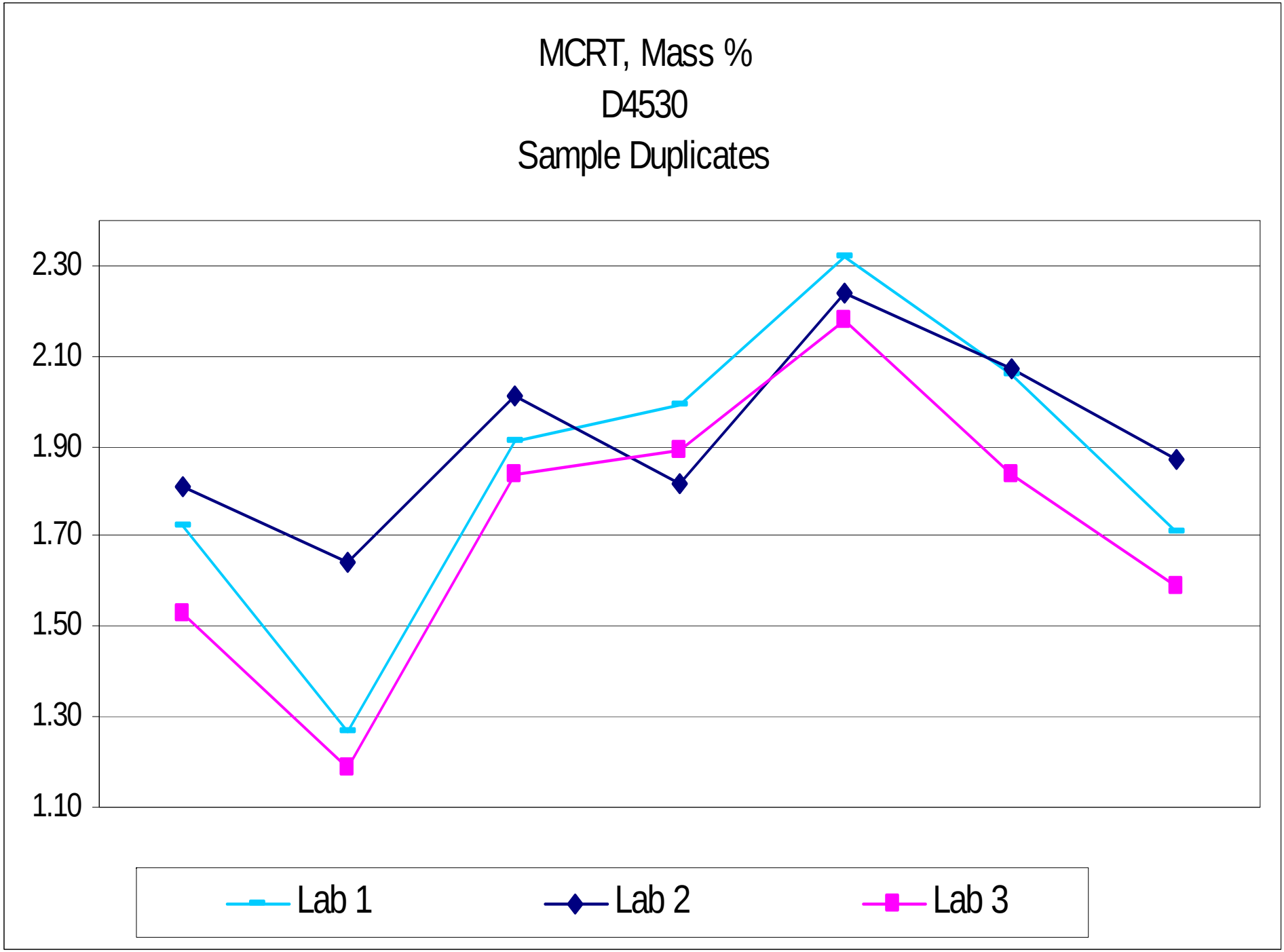
Sulfur Duplicates

- **Significant differences are noted in the labs Standard Deviations**
- **Lab #3 show the most variation in data but average is equal to the average of all data reported**
  - **Reported both the highest and lowest value in the 15 data points.**
- **On the last 5 samples, Labs # 1 and #2 track each other with approximately a 0.03 % offset**


Sulfur, Mass %
D4294
Sample Duplicates
0.500
0.480
0.460
0.440
0.420
0.400
0.380
0.360
0.340
Lab 1
Lab 2
Lab 3

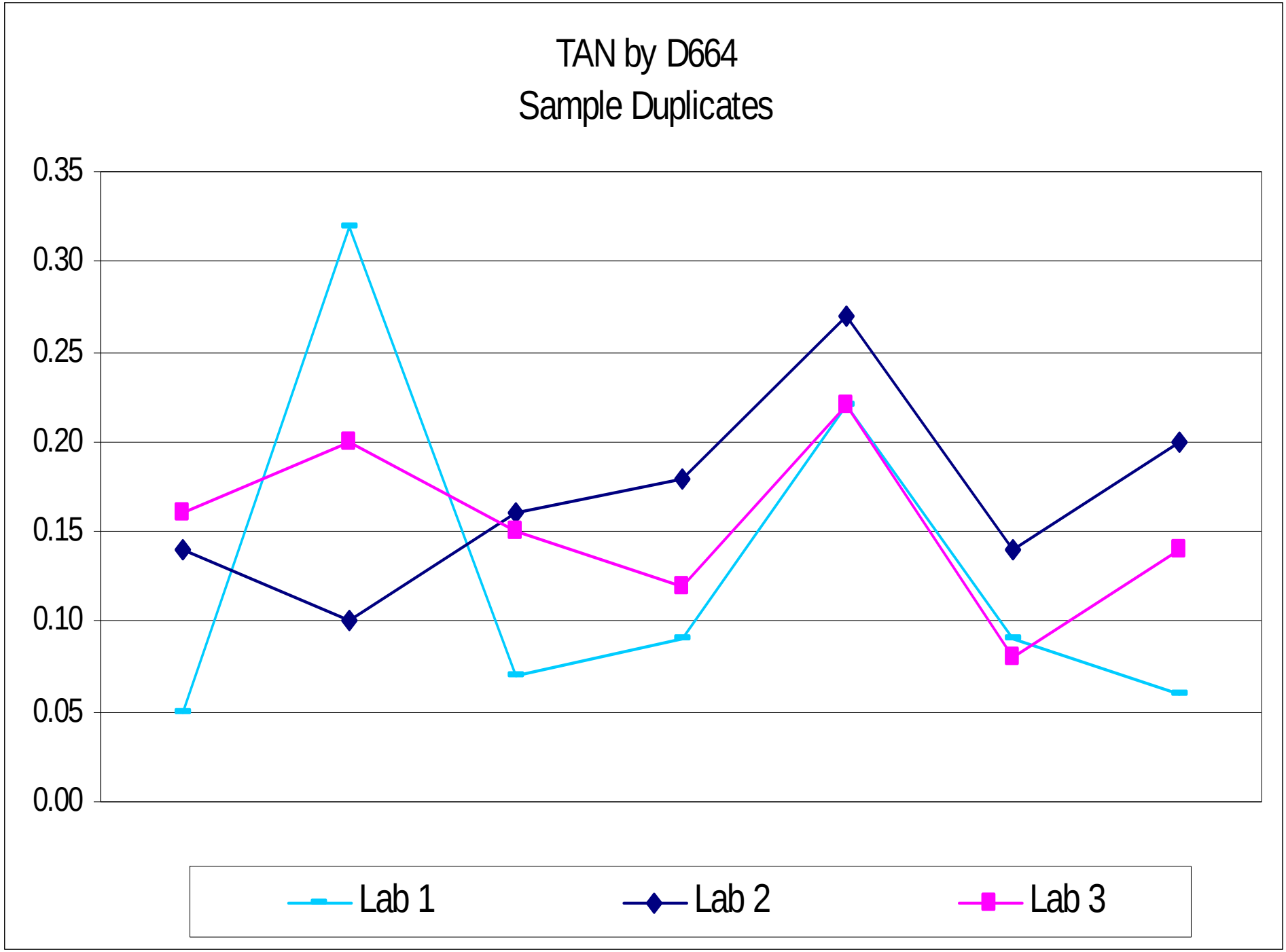
MCRT Duplicates

- Sample set #2 shows more variability than the other sets.
- Lab #3 shows the lowest value on every set except one.
- Lab #2 reports the highest average value but has the lowest variability in data.


MCRT, Mass %
D4530
Sample Duplicates
2.30
2.10
1.90
1.70
1.50
1.30
1.10
Lab 1
Lab 2
Lab 3

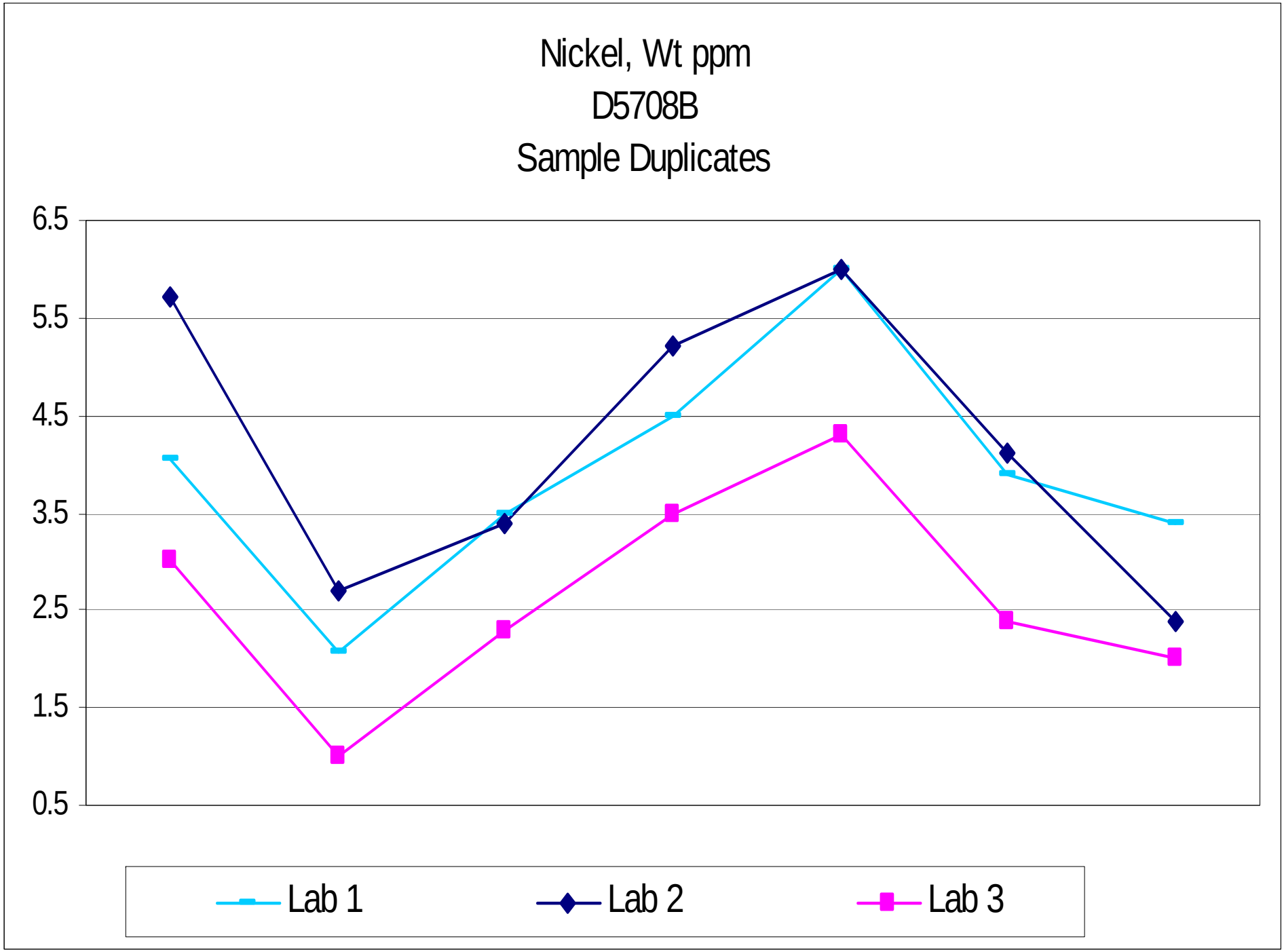
TAN Duplicates

- Sample set #2 shows widely divergent values
- Since the third sample set , Lab 2 has consistently showed higher values than the other 2 labs
- Lab #1 Shows the lowest average value but shows the highest variability.


TAN by D664
Sample Duplicates
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Lab 1
Lab 2
Lab 3

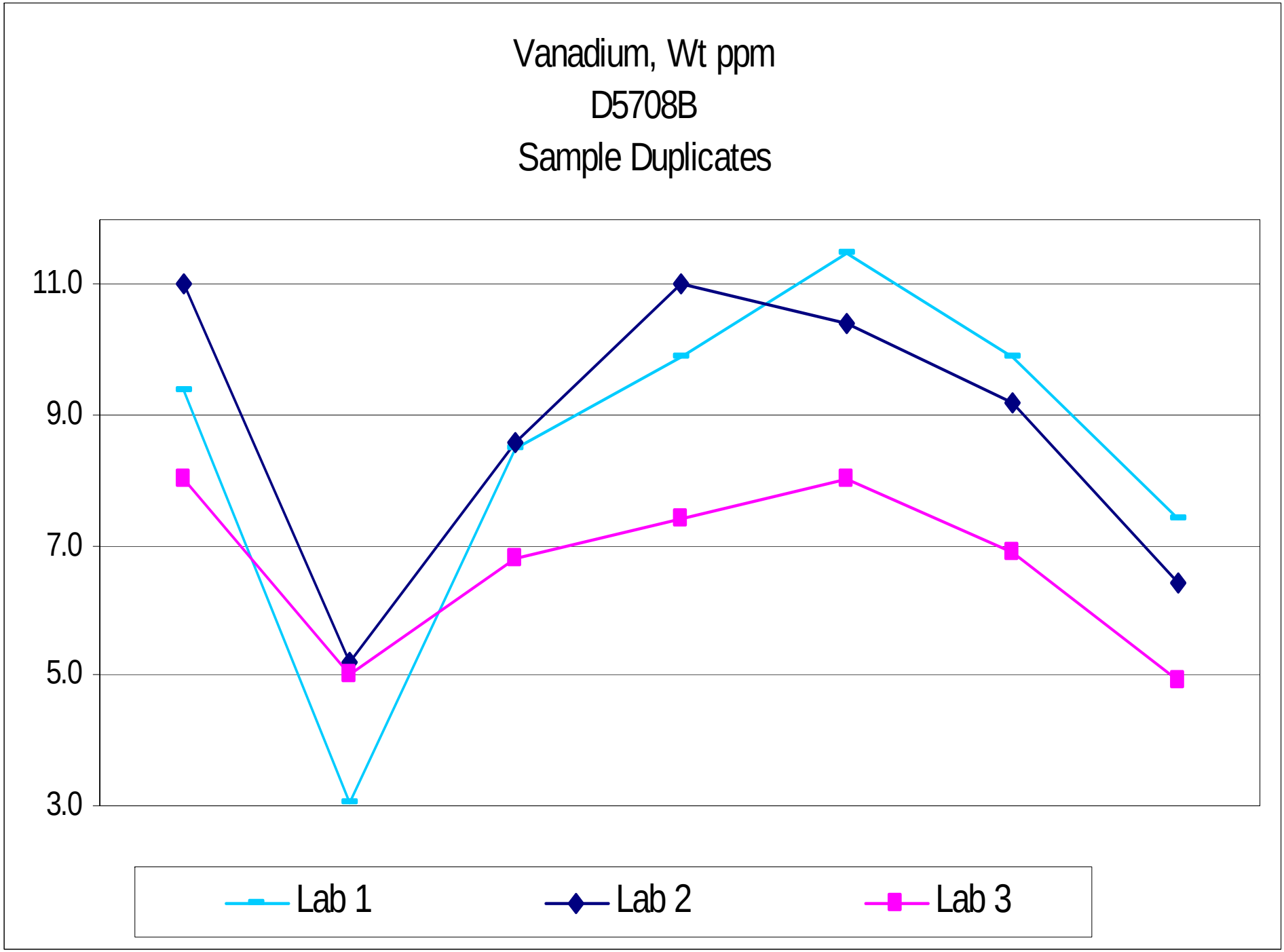
Nickel Duplicates

- Data from Labs #1 and #2 track each other very well
- Lab #3 reported the lowest Ni value on each set of data
  - Consistently 1.5 mass ppm lower than the other labs


Nickel, Wt ppm
D5708B
Sample Duplicates
6.5
5.5
4.5
3.5
2.5
1.5
0.5
Lab 1
Lab 2
Lab 3

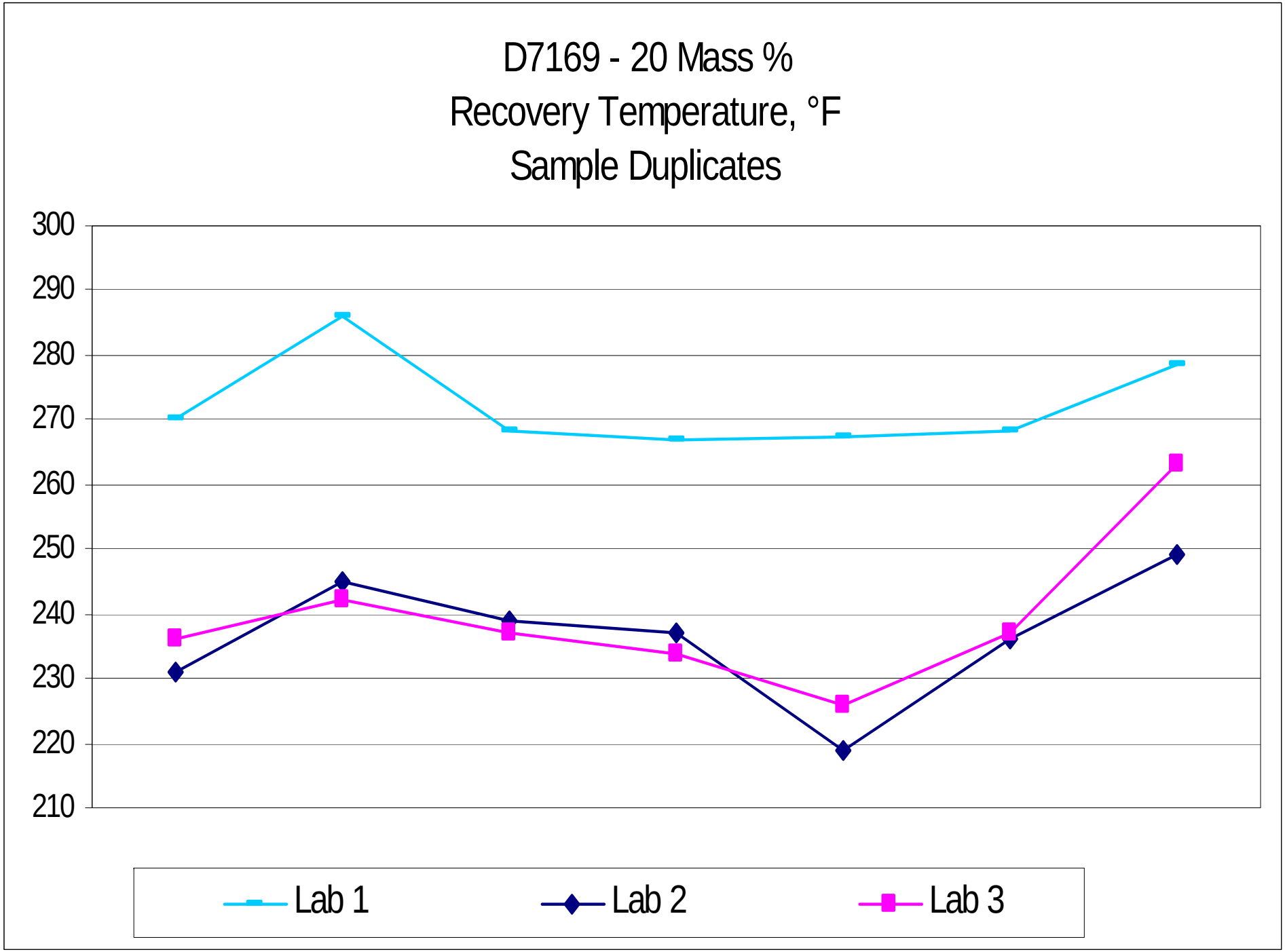
Vanadium Duplicates

- Data from Labs #1 and #2 track each other very well
- Lab #3 normally reported the lowest V value on each set of data
  - Average about 2.0 mass ppm lower than the other labs


Vanadium, Wt ppm
D5708B
Sample Duplicates
11.0
9.0
7.0
5.0
3.0
Lab 1
Lab 2
Lab 3

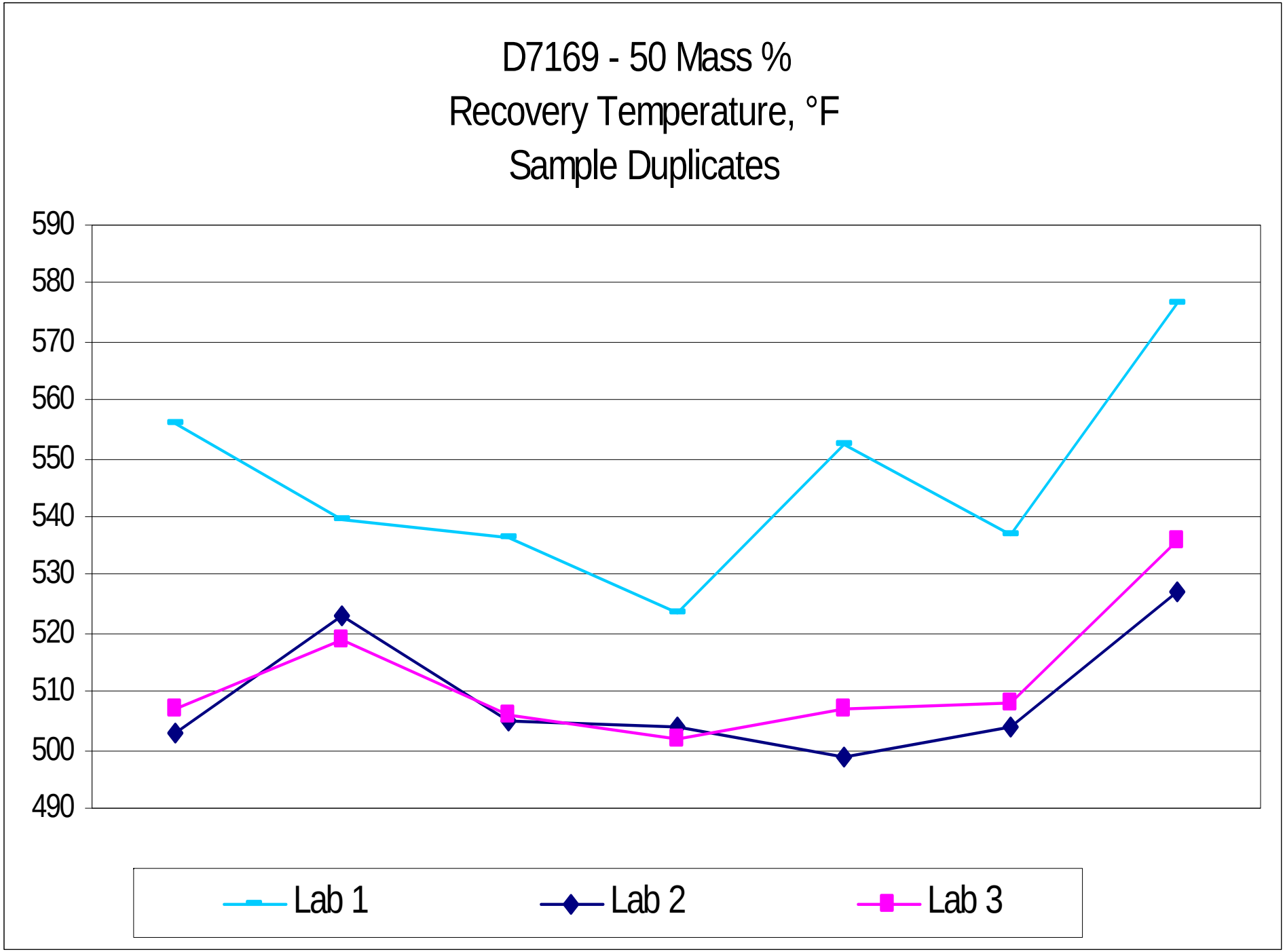
20% Recovery Temperature, °F

- Data from Labs #2 and #3 track each other very well
- Lab #1 consistently reported the highest temperature value on each set of data
  - Average about 35 °F higher than the other labs


D7169 - 20 Mass %
Recovery Temperature, °F
Sample Duplicates
300
290
280
270
260
250
240
230
220
210
Lab 1
Lab 2
Lab 3

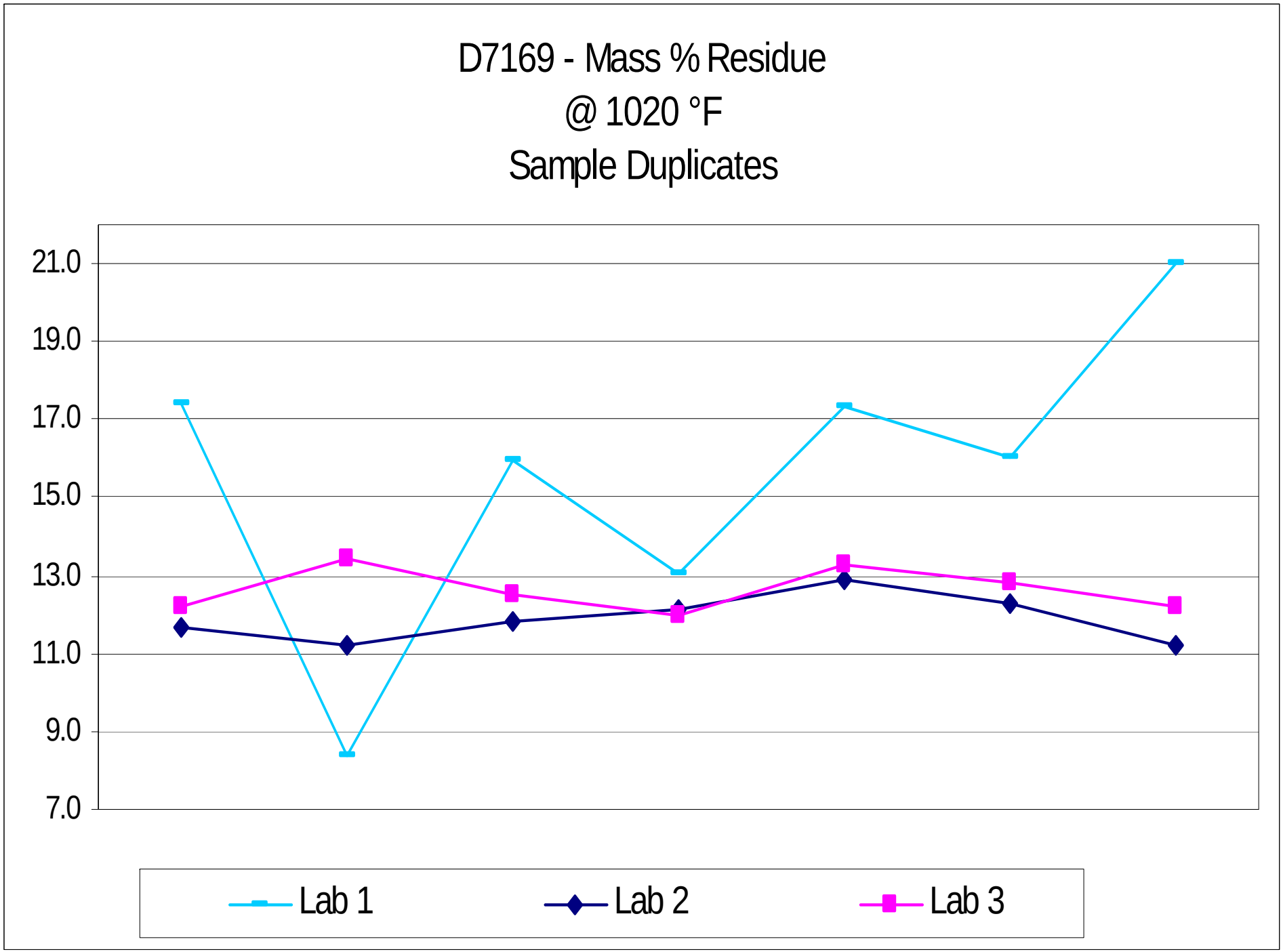
50 % Recovery Temperature, °F

- Data from Labs #2 and #3 track each other very well
- Lab #1 consistently reported the highest temperature value on each set of data
  - Average about 35 °F higher than the other labs


D7169 - 50 Mass %
Recovery Temperature, °F
Sample Duplicates
590
580
570
560
550
540
530
520
510
500
490
Lab 1
Lab 2
Lab 3

Residue at 1020 °F

- Data from Labs #2 and #3 track each other very well
- Lab #1 reported the highest residue value on each set of data except one.
  - Average (excluding sample #2) about 4.5 % higher than the other labs.


D7169 - Mass % Residue
@ 1020 °F
Sample Duplicates
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
Lab 1
Lab 2
Lab 3

- **Thanks to all the labs and shippers for obtaining the samples and analyses required for development of this review.**

- **Any additional questions, please contact me at:**

  email: cliff.suzie@gmail.com

  phone: 580-762-8563

Conclusions

- The results obtained to date are encouraging!
- Better definition of the sampling and analytical testing requirements has resulted in better precision.
- Our data, from multiple terminals at Cushing, over several months, will provide a basis for the development of meaningful specifications for WTI/Domestic Sweet.

Conclusions

- NYMEX API Gravity Specification of 37-42.
  - Data consistent with this range. No desire to change
- NYMEX maximum Sulfur specification of 0.42 wt%
  - No desire to change specification.
  - Much concern that so many batches do NOT meet this specification.
- MCRT- widespread support for a maximum spec of 2.4%

Conclusions

- TAN- All data indicates Domestic Sweet is a low TAN crude. While there is some debate, a maximum specification of 0.25 or 0.30 is appropriate.
- Nickel- Upper spec in the 7-10 ppm range. 8 ppm seemed to be the group's leaning.
- Vanadium- General agreement on an upper specification of 15 ppm.

Conclusions

- HTSD
  - Lab 1 was to rerun samples.
  - % Vacuum Residuum >1020°F- discussion centered on a maximum spec of 16 or 17 weight %.
  - Concern around the front end specification- 20% point
    - Because we are not analyzing for light ends (as LLS does), the front end spec is the only control for condensate and butane blending. In Section 200.02, the NYMEX Rulebook specifically excludes condensates from the Light Sweet Crude Oil contract.

Conclusions

- Compliance
  - The Capline LLS, NYMEX Light Sweet Crude programs and others do not define enforcement procedures.
  - LLS experience shows that while it may be challenging initially, compliance with more comprehensive WTI/Domestic Sweet specs can be achieved.
  - There should be an initial time of monitoring prior to enforcement.
  - Initial specs are not unchangeable.

What Next?

Future Plans -

- Agree on specifications for Domestic Sweet
  - API >37 and <42
  - Sulfur <0.42 weight percent
  - Nickel and Vanadium (ppm)
  - MCRT
  - TAN
  - HTSD

Future Plans - Implementation

- COQA representatives should contact their individual anti-trust attorneys and be sure legal is aware of COQA's efforts and to provide appropriate counsel.