February 14, 2025

Troy Charpentier
Partner
Kean Miller LLP
400 Convention Street, Suite 700
Baton Rouge, Louisiana 70802

Chemical Fingerprint of PPG4 & 7B Cavern Well Oils
January 2025
Westlake Sulphur Dome Study

Dear Mr. Charpentier,

NewFields is pleased to provide you with this report of chemical fingerprinting results for an oil collected from two cavern wells as part of the on-going investigation of the Westlake US 2 LLC (Westlake) salt dome caverns in the Sulphur Mines oil field, Calcasieu Parish, Louisiana (the Site). The oils were collected from the 7B cavern well as part of the repeated monitoring of oil within Cavern 7 (since January 2023) and from the PPG4 well in Cavern 4, which was previously characterized on two occasions (since May 2023).

The current study follows 14 earlier chemical fingerprinting studies at the Site (**Table 1**). These earlier studies included eight oils collected from the 7B cavern well (between January 2023 and February 2024), 13 local crude oil samples collected from nine Yellow Rock wells and the Yellow Rock tank battery, and nine surface oils/sheens. Among other conclusions, these earlier studies showed:

- The 7B cavern oils are chemically distinct from the locally-produced (Yellow Rock) crude oils studied, which varied only slightly among themselves.
- There was no change in composition of the 7B cavern oil between January 2023 and December 2024, indicating no local crude oil(s) had or was presently entering Cavern 7.
- The PPG4 cavern oils are comparable to 7B cavern oil and, as such, is unequivocally distinct from the locally-produced (Yellow Rock) crude oils.
- All surface oils/sheens studied that contained oil are local crude oils and are chemically distinct from 7B and PPG4 cavern oils.

The current study expands upon these earlier conclusions as it reports on the character of (a) a new 7B cavern oil sample, collected just one month after the most recent sample, and (b) a new PPG4 cavern oil collected five months after the most recent sample.

Samples

Table 2 provides an inventory of samples included in the current study – along with all samples from previously studies for ease of reference. The PPG4 and 7B cavern oil samples studied herein were collected on January 9, 2025. Both oils were collected from the annular space of the PPG4 and 7B cavern wells. The samples were sent to NewFields' alliance laboratory, Pace (formerly Alpha) Analytical (Mansfield, Massachusetts, USA) on January 15, 2025 where they

arrived safely the next day. A copy of the chain-of-custody document received with the shipment is found in **Attachment 1**.

Objective

The objective of the current study was to continue the temporal monitoring of the chemical composition of 7B cavern oil (Cavern 7) and PPG4 cavern oil (Cavern 4). The results were to be used to assess any change(s) in either cavern's oil composition suggesting locally-produced crude oil(s) had or may have entered either cavern since the last monitoring event.

Methods

The objective was pursued using specific chemical fingerprinting and interpretation methods based on the CEN oil spill identification protocol[1], as were described in the original study's report.[2] The chemical fingerprinting analyses performed herein remain unchanged from the previous reports (Table 1).

For this study, the 7B cavern oil collected January 9, 2025 was prepared and analyzed in duplicate. In addition, and as first described in the study of May 2023 oils,[3] this study also included the (re-)analysis of the 7B cavern well oil collected in January 2023, that was adopted as a *site-specific reference oil*. This oil is being re-analyzed for quality control with each "batch" of samples analyzed from the Sulphur Dome site to assess the long-term precision of diagnostic ratios (DRs) used in the quantitative (statistical) comparison of samples from the Site. An expanded discussion of this topic was provided earlier.[4] Based on the new results of the duplicate pair and site-specific reference oil reported herein, an updated table of the short-term and long-term precision of DRs is provided in **Attachment 2**. There are no significant changes to either short- or long-term precision attained to date.

Results & Discussion

The complete Pace Environmental Testing Report (ETR) including all sample preparation data, instrument calibrations, QC data and chromatograms is maintained on file by NewFields (ETR L2502602). The tabulated results for the targeted compounds in each analysis performed are contained in **Attachment 3**. The full-size GC/FID chromatogram obtained in Tier 1 (modified EPA Method 8015D) analysis is provided in **Attachment 4** and selected extraction ion profiles (EIPs) obtained in Tier 2 (modified EPA Method 8270D) are provided in **Attachment 5**. The crude oil assay data provided to me on the 7B and PPG4 cavern well oils studied are contained in **Attachment 6**.

Specific results most relevant to the study's objective are presented in **Tables 3 to 5** and **Figures 1 to 6**. Discussion of these results is provided in the following sections.

<u>Comparison of January 2025 and Earlier 7B Cavern Well Oils</u>

The last 7B cavern well oil was sampled and analyzed just one month prior to the sample analyzed herein (Table 1). The December 2024 7B cavern oil was demonstrated to be unchanged from all previously sampled 7B cavern oils.[5] Thus, given the passage of only one month, there was little

[1] Kienhaus, P.G.M. et al. 2016. CEN methodology for oil spill identification. In: *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed., S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, p. 685-728.
[2] See Table 1, Report 1
[3] See Table 1, Report 4.
[4] See Attachment 3 to Report 4 (per Table 1).
[5] See Report 14 (per Table 1)

expectation that the 7B oil's composition in January 2025 had changed over the past month. This expectation was confirmed by the new 7B oil data collected, which is only briefly discussed in the following paragraphs.

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Figure 1 shows the Tier 1 GC/FID (C8+) chromatogram for 7B cavern oil collected on January 9, 2025 (Fig. 1A), along with those of the 7B cavern (reference) oil collected in January 2023 that was re-prepared and re-analyzed herein (Fig. 1B) and the 7B cavern oil from December 2024 (Fig. 1C). Inspection reveals an obvious similarity between these three 7B cavern oils' chromatographic features. This same degree of similarity was also evident among the GC/FID (C8+) chromatograms for the 7B cavern oils collected in March, May, June and October 2023 and February and September 2024.[6]

The more detailed characteristics of the January 2025 7B cavern oil studied herein are revealed in the Tier 2 GC/MS extracted ion profiles (EIPs) contained in Attachment 5. **Table 3** contains the 30 diagnostic ratios (DRs) calculated from the concentrations of selected PAHs and biomarkers in all nine of the 7B cavern well oils collected to date; each DR represents the average of duplicate analysis of each oil. As anticipated, and in accordance with the CEN oil spill identification protocol, the 7B cavern oil collected in January 2025 is a "positive match" to the 7B cavern oil collected in January 2023. These results indicate:

- All eight samples of 7B cavern well oils collected since January 2023 are "positive matches" to the January 2023 cavern well oil, which indicates the Cavern 7 pad oil's composition has not changed over the ~24 months since monitoring began.

Comparison of January 2025 and Earlier PPG4 Cavern Well Oils

The Tier 1 GC/FID (C8+) chromatograms obtained for the PPG4 cavern well oil studied herein (January 2025) and previously (May and August 2023) are shown in **Figure 2**. All three of these Cavern 4 oils exhibit highly comparable features to one another (Fig. 2) – and also to the 7B cavern oils (Fig. 1).

The more detailed characteristics of the PPG4 cavern well oils studied herein are revealed in their Tier 2 GC/MS extracted ion profiles (EIPs) contained in Attachment 5. Those EIPs depicting petroleum biomarkers, i.e., triterpanes, steranes, and triaromatic steroids, commonly used in oil spill fingerprinting are shown in **Figures 3 to 5**, respectively. Each figure contains the EIPs for all three PPG4 cavern well oils analyzed to date, i.e., January 9, 2025 analyzed herein (Fig. 3A, 4A and 5A), Aug. 10, 2024 (Fig. 3B, 4B, and 5B), and May 25, 2023 January 2025 (Fig. 3C, 4C and 5C). Qualitative inspection of these EIPs further reveals the comparability of all three PPG4 cavern well oils collected over the past ~20 months.

Quantitative comparisons among the three PPG4 cavern oils was made using the 30 DRs measured throughout the Sulphur Dome studies using the CEN protocol's 95% confidence level criteria.[7] **Table 4** compares the 30 DRs for the three individual PPG4 cavern oils to one another

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[6] See Reports 3, 4, 5, 10, 12 and 13 (per Table 1)

[7] The quantitative (statistical) comparisons relied upon the 95% confidence level under conditions of repeatability ($r_{95\%}$) for each diagnostic ratio wherein:

$$r_{95\%} = 2.8 * RSD_r \text{ where } RSD_r = 5\% \text{ standard error, thus}$$

$$r_{95\%} = 14\%$$

If the $r_{95\%}$ between the measured diagnostic between two samples <14% the ratios were considered to statistically **match**, and *vice versa*. The comparable criterion ($R_{95\%}$) is used to compared precisely measured DRs under conditions of reproducibility (see Attachment 3).

and also to the average DRs for all nine 7B cavern well oils and all 13 locally-produced (Yellow Rock) oils collected to date (see Table 2). First, inspection shows that the August 2024 and January 2025 PPG4 cavern oils are "positive matches" to the May 2023 PPG4 cavern oil, i.e., the first Cavern 4 oil collected. Second, the PPG4 cavern well oil is a "positive match" to the average composition of 7B cavern well oils studied to date but is a "non-match" to the average composition of the locally-produced (Yellow Rock) oils studied to date. Thus, in summary:

- The three PPG4 cavern well oils collected over the past ~20 months (May 2023 to January 2025) are all comprised of the same unweathered crude oil whose specific character has not changed.
- The PPG4 cavern well oils are "positive matches" to the 7B cavern well oils studied to date but are "non-matches" to (i.e., distinctly different from) the locally-produced crude oils from (Yellow Rock) wells outside the salt dome.

Crude Oil Assay Results

As in previous studies, the 7B and PPG cavern well oils studied herein were also analyzed via standard crude oil assay (Attachment 6). In addition to the assay data collected for the oil samples in Table 2, the assay data for oils from the Sulphur Mines Strategic Petroleum Reserve (SPR) from 1989 were also provided by USDOE in response to a FOIA request.[8] A compilation of the available assay data most useful in assessing the similarity/differences between crude oils (API gravity, sulfur content, and metals content) are provided in **Table 5**.

Inspection of Table 5 shows the assay data collected for the 7B and PPG4 cavern well oils collected in January 2025 are in overall agreement with the results collected for their previous respective samples. This overall agreement can be visualized in **Figure 6** wherein the 7B and PPG4 cavern well oils – and the historic SPR oils – appear similar to one another but are distinct from the locally-produced (Yellow Rock) crude oils studied to date.

The ten 7B cavern oils assayed to date (Table 5) plot in tight clusters in Figure 6 demonstrating their consistent "bulk" characteristics. Interestingly however, the PPG4 cavern oil studied herein (Jan. 2025) exhibits a slightly higher sulfur content (1.691 wt%) and API gravity (33.0) than the two previous PPG4 cavern oils studied (Table 5; Fig. 6). These small variations are reasonably attributable to some minor heterogeneity in the PPG4 cavern oil or the precision of these bulk analyses. Regardless, any mixing of a locally-produced crude oil with the PPG4 cavern oil can be ruled out since both the sulfur content and API gravity of any such mixture should be lower (not higher).

Overall, the "bulk" crude oil assay metrics shows:

- The 7B cavern well oil has remained consistent (between November 2022, when it was first analyzed, and January 2025) and is clearly distinct from the locally-produced (Yellow Rock) crude oils.
- The PPG4 cavern well oil has remained mostly consistent (between May 2023 and January 2025), is generally consistent with the 7B cavern well oils, but is clearly distinct from the locally-produced (Yellow Rock) crude oils.
- Both the 7B and PPG4 cavern well oils are generally consistent with SPR oil(s) historically stored in Sulphur Dome's caverns.

The last of these conclusions tends to support the apparent presence/predominance of residual SPR oil that still exists within Caverns 7 and 4. In fact, documents provided in response to your

[8] See Attachment 8 in Report 5 (per Table 1).

FOIA request indicate that more than 100,000 bbl of non-recoverable/trapped SPR oil, reportedly "*sour crude primarily purchased from Mexico*", may have remained in the Sulphur Mines caverns upon completion of drawdown in the early 1990s.[9] Notably, both the 7B and PPG4 cavern well oils' average sulfur contents (1.371 wt% and 1.585 wt%, respectively; Table 5) are clearly "*sour*" (*def*. S > 0.5 wt%).

Summary of New Findings

Chemical fingerprinting and conventional oil assay data were collected on 7B and PPG4 cavern well oils collected January 9, 2025. These new data were compared to all previously collected data for oils from these two cavern wells – and to the fingerprinting and assay data for locally-produced crude oils from Yellow Rock wells and to the assay data for historic SPR oils historically stored at Sulphur Springs. Collectively, these data show:

- There has been no change in the specific crude oil recovered from the 7B cavern well on the nine occasions it has been sampled between Jan. 2023 and Jan. 2025 (24 months).
- There has been no change in the specific crude oil recovered from the PPG4 cavern well on the three occasions it has been sampled between May 2023 and Jan. 2025 (20 months).
- Cavern 7 and Cavern 4 contain the same specific type of crude oil, which is distinct from the locally-produced (Yellow Rock) crude oils from outside the salt dome. Thus, there is no evidence that locally-produced crude oil has historically or is currently entering Cavern 7 or Cavern 4.
- "Bulk" crude oil assay data for all of the oils collected from both Cavern 7 and Cavern 4 are comparable to SPR oils historically stored at Sulphur Springs. Thus, oil within both these caverns is believed to consist of residual (non-local) crude oil dating back to the caverns' tenure as part of the SPR.

Please let me know if you have any questions.

Sincerely,

Scott A. Stout, Ph.D., P.G.
Sr. Geochemist

Attachments:
1: Chain-of-custody
2: Updated RSD table
3: Tabulated concentrations of TPH/SHC, PAH, and biomarkers
4: Full size GC/FID chromatograms
5: Selected GC/MS extraction ion profiles
6: Bulk assay data for the sample studied

Table 1: NewFields reports on the Westlake Sulfur Dome Study prepared to date.

All reports authored by S.A. Stout

[9] DOE document: SM COARB 07-13-93; e.g., p. 29 and 31 of 73.

Report No.	Title	Report Date
1	Chemical fingerprinting of oils, Westlake Sulphur Dome Study.	Mar. 10, 2023
2	Chemical fingerprint of oily net – No. 20, Westlake Sulfur Dome Study.	Apr. 27, 2023
3	Chemical fingerprint of 7B cavern oil – March 30, 2023, Westlake Sulfur Dome Study.	May 3, 2023
4	7B Cavern Oil, Cavern 4 Oil, Select Yellow Rock Well Oils, and a Bubble Site 24 Sheen – May 2023, Westlake Sulphur Dome Study.	July 11, 2023 – Amended July 14, 2023
5	Chemical fingerprint of 7B cavern oil, selected Yellow Rock well oils and a Central Lake sheen – June 2023, Westlake Sulfur Dome Study.	July 25, 2023
6	Chemical fingerprinting of additional Yellow Rock well oils – mid- to late-August 2023, Westlake Sulphur Dome Study.	Oct. 4, 2023
7	Chemical fingerprint of floating materials, Central Lake and Bubble Site 14 – September 11, 2023, Westlake Sulphur Dome Study.	Oct. 5, 2023
8	Chemical fingerprint of Bubble Site 14 sheen – September 20, 2023, Westlake Sulphur Dome Study.	Oct. 17, 2023
9	Chemical fingerprint of Bubble Site 19 sheen – October 15, 2023, Westlake Sulphur Dome Study.	Nov. 7, 2023
10	Chemical fingerprint of 7B cavern oil – October 2023, Westlake Sulfur Dome Study.	Nov. 21, 2023
11	Chemical Fingerprint of Surface Oil near Bubble Site 24 – February 26, 2024, Westlake Sulphur Dome Study	Mar. 25, 2024
12	Chemical fingerprint of 7B cavern oil – February 2024, Westlake Sulfur Dome Study.	Apr. 4, 2024
13	Chemical fingerprint of PPG4 & 7B cavern oils – August/September 2024, Westlake Sulfur Dome Study.	Oct. 29, 2024
14	Chemical fingerprint of 7B cavern oil – December 2024, Westlake Sulfur Dome Study.	Jan. 30, 2025

Table 2: Inventory of samples from the current study and studied previously.

Current Study Samples

Client/ Field ID	Lab ID	Matrix	Date Collected	Description of Sample
#4	L2502602-01	Oil	1/9/2025	Cavern oil from brine well PPG No. 4
7B Oil*	L2502602-02	Oil	1/9/2025	Cavern oil from brine well 7B
7B**	L2502602-03	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)

Previously-Studies Samples

Client/ Field ID	Lab ID	Matrix	Date Collected	Description of Sample
7B Oil*	L2456658-02	Oil	12/18/2024	Cavern oil from brine well 7B
7B Oil*	L2456658-02	Oil	9/26/2024	Cavern oil from brine well 7B
PPG No. 004	L2456658-01	Oil	8/10/2024	Cavern oil from brine well PPG No. 4
7B**	L2361423-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
Bubble Site Oil	L2410930-01	Oil	2/26/2024	Surface oil collected near bubble site No. 24
7B**	L2361423-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
7B Oil*	L2407828-01	Oil	2/7/2024	Cavern oil from brine well 7B
7B**	L2361423-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
7B Oil*	L2363877-01	Oil	10/25/2023	Cavern oil from brine well 7B
7B**	L2361423-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
Westlake #19	L2361423-01	Net	10/15/2023	Surface sheen from bubble site No. 19
7B**	L2361423-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
No. 14 Sheen Sample	L2355855-01	Net	9/20/2023	Surface sheen from bubble site No. 14
7B**	L2355855-02	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
Algae Sample Central Lake	L2353106-02	Net	9/11/2023	Sheen with pond "scum/algae"; suspected biologic
No. 14 Sheen Sample	L2353106-03	Net	9/11/2023	Surface sheen from bubble site No. 14
7B**	L2353106-04	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
253998*	L2348036-01	Oil	6/16/2023	Yellow Rock 253998
41842	L2348036-02	Oil	6/16/2023	Yellow Rock 41842
189416 (1250')	L2348036-04	Oil	6/16/2023	Yellow Rock 189416 from 1250' (bottom of oil column)
189416 (170')	L2348036-05	Oil	6/16/2023	Yellow Rock 189416 from 170' (top of oil column)
7B**	L2348036-03	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
Pad Oil	L2335058-01	Oil	6/16/2023	Stock tank oil used as cavern blanket/pad
7B*	L2335058-02	Oil	6/16/2023	Cavern oil from brine well 7B
252112	L2335058-03	Oil	6/16/2023	Yellow Rock 252112
109963	L2335058-04	Oil	6/16/2023	Yellow Rock 109963
185997	L2335058-05	Oil	6/16/2023	Yellow Rock 185997
209459	L2335058-06	Oil	6/16/2023	Yellow Rock 209459
Sheen	L2335058-07	Net	6/12/2023	Surface sheen from central lake
7B**	L2335058-08	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
209459	L2325505-01	Oil	5/2/2023	Yellow Rock 209459
185997	L2325505-02	Oil	5/2/2023	Yellow Rock 185997
Cavern 4	L2325505-03	Oil	5/25/2023	Cavern oil from brine well PPG No. 4
Cavern 7B*	L2325505-04	Oil	5/25/2023	Cavern oil from brine well 7B
210185	L2325505-05	Oil	5/25/2023	Yellow Rock 210185
Tank Battery	L2325505-06	Oil	5/25/2023	Yellow Rock Tank Battery
7B**	L2325505-07	Oil	1/25/2023	Site-specific reference oil; 7B Cavern Oil (Jan 2023)
BS-24	L2325505-08	Net	5/22/2023	Surface sheen from bubble site No. 24
Cavern 7B*	L2317387-01	Oil	3/30/2023	Cavern oil from brine well 7B
No. 20	L2313362-01	Net	3/9/2023	Surface oil sheen on water body west of the salt dome
7B*	L2305221-04	Oil	1/25/2023	Cavern oil from brine well 7B
110159	L2305221-02	Oil	1/25/2023	Yellow Rock 110159
Stock Tank	L2305221-03	Oil	1/25/2023	Stock tank oil used as cavern blanket/pad
Brine Well 22 BS*	L2305221-01	Net	1/25/2023	Surface oil brine well 22 excavation
Central Pond	L2305221-05	Net	1/25/2023	Surface sheen from central pond

* sample prepared and analyzed in duplicate

**re-analysis of Jan. 25, 2023 oil (L2305221-04) for quality control only

Table 3: Diagnostic ratios (DRs) for the 7B cavern oil collected in January 2023 *versus* the 7B cavern oils collected in March, May, June and October 2023, February, September and December 2024, and January 2025 analyzed over a span of 24 months.

Top three ratios are derived from Tier 1 GC/FID data; all others from Tier 2 GC/MS data. Greyed-out DRs exhibit higher standard errors under repeatability and/or reproducibility conditions (RSD_r and RSD_R) using the CEN protocol's 95% confidence level criteria (per Attachment 2).

CEN - Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	Cavern Oil 7B (Jan. 25, 2023; Avg. n=2)	7B Cavern Oil (Mar. 2023; Avg; n=2)	7B Cavern Oil (May 2023; Avg; n=2)	7B Cavern Oil (June 2023; Avg; n=2)	7B Cavern Oil (Oct. 2023; Avg; n=2)	7B Cavern Oil (Feb 2024; Avg; n=2)	7B Cavern Oil (Sept 2024; Avg; n=2)	7B Cavern Oil (Dec 2024; Avg; n=2)	7B Cavern Oil (Jan 2025; Avg; n=2)
	Analysis Date	2/4/2023	4/26/2023	6/18/2023	7/15/2023	11/9/2023	3/19/2024	10/13/2024	12/31/2024	1/21/2025
NR-C17/pris	C17/Pr	2.38	2.41	2.66	2.36	2.71	2.73	2.75	2.80	2.46
NR-C18/phy	C18/Ph	2.17	2.14	2.13	2.09	2.08	2.17	2.09	2.07	2.10
NR- pris/phy	Pr/Ph	1.01	1.00	0.90	1.00	0.94	0.96	0.91	0.86	0.97
NR-4-MD/1-MD	4-MDBT/1-MDBT	2.14	2.71	2.15	2.40	2.06	2.42	2.52	2.23	2.41
NR-2-MP/1-MP	2-MP/1-MP	1.01	0.97	1.06	1.05	1.07	1.03	1.02	1.06	1.05
NR-27Ts/30ab	T11/T19	0.23	0.23	0.24	0.23	0.24	0.24	0.24	0.27	0.24
NR-27Tm/30ab	T12/T19	0.29	0.26	0.26	0.25	0.27	0.27	0.27	0.29	0.28
NR-28ab/30ab	T14a/T19	0.20	0.18	0.19	0.18	0.18	0.19	0.18	0.17	0.18
NR-29ab/30ab	T15/T19	0.84	0.83	0.83	0.85	0.83	0.86	0.84	0.87	0.90
NR-30O/30ab	T18/T19	0.04	0.03	0.00	0.04	0.00	0.05	0.05		0.04
NR-31abS/30ab	T21/T19	0.59	0.59	0.58	0.62	0.60	0.61	0.60	0.60	0.56
NR-27dbR/27dbS	S4/S5	0.50	0.53	0.46	0.45	0.44	0.54	0.50	0.44	0.47
NR-27bb/29bb	(S14+S15)/(S26+S27)	0.85	0.88	0.86	0.81	0.84	0.84	0.87	0.86	0.82
NR-SC26/ RC26+SC27	TAS09/TAS01	0.13	0.14	0.14	0.13	0.13	0.13	0.14	0.12	0.12
NR-SC28/RC26 + SC27	TAS02/TAS01	0.69	0.71	0.69	0.67	0.72	0.71	0.68	0.69	0.69
NR-RC27/RC26+ SC27	TAS03/TAS01	0.75	0.78	0.78	0.75	0.75	0.78	0.77	0.79	0.79
NR-RC28/RC26+SC27	TAS04/TAS01	0.58	0.59	0.58	0.58	0.59	0.60	0.58	0.59	0.57
DR-Ts/Tm	T11/T12	0.82	0.87	0.92	0.89	0.89	0.90	0.89	0.91	0.85
DR-29Ts30ab	T16/T19	0.21	0.20	0.20	0.21	0.19	0.20	0.19	0.20	0.21
DR-29bb/29aa	(S26+S27)/(S25+S28)	1.15	1.82	1.33	1.49	1.55	1.57	1.37	1.56	1.24
DR-C2-dbt/C2-phe	DBT2/PA2	2.28	2.07	2.06	2.16	2.21	2.30	2.20	2.17	2.32
DR-C3-dbt/C3-phe	DBT3/PA3	2.62	2.23	2.32	2.51	2.59	2.46	2.42	2.53	2.64
DR-C28C29/30ab	T7 to T10/T19	0.19	0.23	0.24	0.22	0.26	0.23	0.22	0.25	0.23
DR-29aaS/29aaR	S25/S28	1.36	1.22	1.28	1.34	1.27	1.18	1.68	1.45	1.53
DR-C20TA/C21TA	TAS05/TAS06	0.95	1.30	1.19	1.32	1.29	1.35	1.29	1.31	1.30
DR-TA21/ RC26+SC27	TS06/TAS01	0.49	0.40	0.40	0.39	0.36	0.41	0.45	0.38	0.42
DR-C24Tet/C26Tri	T6a/T6bc	1.60	1.67	1.55	1.55	1.78	1.60	2.00	1.94	1.53
DR-30ba/30ab	T20/T19	0.07	0.08	0.07	0.09	0.08	0.09	0.09	0.07	0.08
DR-35ab/30ab	(T34 to T35)/T19	0.33	0.33	0.31	0.38	0.34	0.37	0.35	0.35	0.33
DR-32abR/32abS	T27/T26	0.74	0.72	0.74	0.75	0.70	0.76	0.76	0.75	0.74
	Conclusion:		**Positive Match**	**Positive Match**	**Positive Match**	**Positive Match**	**Positive Match**	**Positive Match**	**Positive Match**	**Positive Match**

red: statistical non-match to 7B Cavern Oil (Jan. 25, 2023; Avg.)
green: statistical match to 7B Cavern Oil (Jan. 25, 2023; Avg.)
grey: indicates less precision ratio (per Attachment 2)

Table 4: Diagnostic ratios for the PPG4 cavern oil collected in May 2023 *versus* the PPG4 cavern oil collected in August 2024 and Jan. 2025, and the average of 7B cavern oils collected between Jan. 2023 and January 2025 (n=9) and the average of Yellow Rock oils collected to date (n=13).

Top three ratios are derived from Tier 1 GC/FID data; all others from Tier 2 GC/MS data. Greyed-out DRs exhibit higher standard errors under repeatability and/or reproducibility conditions (RSD_r and RSD_R) using the CEN protocol's 95% confidence level criteria (per Attachment 2).

CEN - Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	PPG4 Cavern Oil (May 2023)	PPG4 Cavern Oil (Aug. 2024)	PPG4 Cavern Oil (Jan. 2025)	7B Cavern Oil Average (n=9)	Yellow Rock Oil Average (n=13)
	Analysis Date	6/18/2023	10/12/2024	1/20/2025		
NR-C17/pris	C17/Pr	3.05	2.98	2.83	2.58	1.58
NR-C18/phy	C18/Ph	2.24	2.28	2.38	2.12	1.80
NR- pris/phy	Pr/Ph	0.88	0.93	0.95	0.95	1.94
NR-4-MD/1-MD	4-MDBT/1-MDBT	2.21	2.61	2.49	2.34	3.00
NR-2-MP/1-MP	2-MP/1-MP	1.19	1.14	1.15	1.03	1.08
NR-27Ts/30ab	T11/T19	0.23	0.23	0.25	0.24	0.19
NR-27Tm/30ab	T12/T19	0.29	0.28	0.30	0.27	0.24
NR-28ab/30ab	T14a/T19	0.05	0.06	0.05	0.18	0.07
NR-29ab/30ab	T15/T19	0.93	0.90	0.99	0.85	0.73
NR-30O/30ab	T18/T19	0.05	0.05	0.04	0.03	0.09
NR-31abS/30ab	T21/T19	0.56	0.52	0.57	0.59	0.39
NR-27dbR/27dbS	S4/S5	0.42	0.45	0.41	0.48	0.55
NR-27bb/29bb	(S14+S15)/(S26+S27)	0.80	0.80	0.82	0.85	0.73
NR-SC26/ RC26+SC27	TAS09/TAS01	0.11	0.12	0.10	0.13	0.24
NR-SC28/RC26 + SC27	TAS02/TAS01	0.80	0.76	0.76	0.69	0.79
NR-RC27/RC26+ SC27	TAS03/TAS01	0.80	0.79	0.80	0.77	0.69
NR-RC28/RC26+SC27	TAS04/TAS01	0.66	0.65	0.63	0.58	0.64
DR-Ts/Tm	T11/T12	0.79	0.79	0.84	0.88	0.79
DR-29Ts30ab	T16/T19	0.20	0.19	0.20	0.20	0.23
DR-29bb/29aa	(S26+S27)/(S25+S28)	1.57	1.42	1.37	1.43	1.20
DR-C2-dbt/C2-phe	DBT2/PA2	2.26	2.34	2.52	2.20	1.10
DR-C3-dbt/C3-phe	DBT3/PA3	2.53	2.61	2.84	2.47	1.28
DR-C28C29/30ab	T7 to T10/T19	0.19	0.16	0.19	0.22	0.12
DR-29aaS/29aaR=	S25/S28	1.17	1.55	1.44	1.38	1.18
DR-C20TA/C21TA	TAS05/TAS06	1.24	1.31	1.39	1.26	1.25
DR-TA21/ RC26+SC27	TS06/TAS01	0.45	0.48	0.52	0.41	0.31
DR-C24Tet/C26Tri	T6a/T6bc	1.84	2.59	2.12	1.71	1.85
DR-30ba/30ab	T20/T19	0.09	0.14	0.07	0.08	0.15
DR-35ab/30ab	(T34 to T35)/T19	0.27	0.26	0.29	0.34	0.15
DR-32abR/32abS	T27/T26	0.72	0.83	0.73	0.74	1.26
	Conclusion:		**Positive Match**	**Positive Match**	**Positive Match**	**Non-Match**

red: statistical non-match to Cavern 4 oil (Aug. 2024)

green:s statistical match to Cavern 4 oil (Aug. 2024)

grey: indicates less precision ratio (per Attachment 2)

Table 5: Selected crude oil assay results for the 7B cavern oils, Yellow Rock (locally produced) crude oils, and Other oils from Sulphur Dome along with historic data for Strategic Petroleum Reserve oils from Sulphur Dome from 1989. New data for 7B cavern oil and PPG4 cavern oil studied herein indicated within red boxes; na – not analyzed

	Client ID	Date Collected	API gravity	Sulfur (wt%)	V (ppm)	Ni (ppm)	V/ (V+Ni)
7B Cavern Oils							
Cavern Oils	7B Cavern Oil	11/2/2022	32.8	1.380	23	6.1	0.79
	7B Cavern Oil	1/18/2023	34.0	1.400	23	5.9	0.79
	7B Cavern Oil	1/25/2023	na	na	12	3.8	0.76
	7B Cavern Oil	3/30/2023	33.6	1.370	100	26	0.79
	7B Cavern Oil	5/25/2023	33.5	1.401	23	6.0	0.79
	7B Cavern Oil	6/16/2023	34.0	1.350	25	6.0	0.81
	7B Cavern Oil	10/25/2023	33.9	1.362	21	5.0	0.81
	7B Cavern Oil	2/7/2024	34.1	1.336	25	6.0	0.81
	7B Cavern Oil	9/26/2024	34.0	na	17	5.0	0.77
	7B Cavern Oil	12/18/2024	33.8	1.408	29.3	7.7	0.79
	7B Cavern Oil	1/9/2025	33.8	1.559	29.8	7.9	0.79
		Average	33.7	1.396	29.8	7.8	0.79
		St. Dev.	1.2	0.063	23.8	6.2	0.01
Yellow Rock (Locally Produced) Oils							
Yelllow Rock Oils	189416	11/2/2022	26.0	0.302	1.2	7.0	0.15
	110159	1/25/2023	na	na	0.4	3.7	0.10
	209459	5/2/2023	22.8	0.435	2.0	8.0	0.20
	185997	5/2/2023	21.5	0.407	2.0	9.0	0.18
	210185	5/25/2023	22.8	0.476	2.0	10.0	0.17
	Tank Battery	5/25/2023	27.0	0.327	1.0	6.0	0.14
	252112	6/16/2023	27.7	0.295	1.0	5.0	0.17
	109963	6/16/2023	24.1	0.431	2.0	8.0	0.20
	185997	6/16/2023	23.0	0.411	2.0	10.0	0.17
	209459	6/16/2023	21.6	0.433	2.0	9.0	0.18
	253998	8/17/2023	16.9	0.747	2.3	9.6	0.19
	41842	8/17/2023	26.6	0.403	2.0	22.2	0.08
	189416 (1250')	8/29/2023	20.7	0.450	<0.1	10.9	<0.01
	189416 (170')	8/29/2023	20.8	0.447	<0.1	8.3	<0.01
		Average	23.2	0.428	1.7	9.1	0.16
		St. Dev.	3.1	0.112	0.6	4.3	0.04
Other Oils							
Other	Pad Oil	1/18/2023	29.1	1.170	19	4.94	0.79
	Stock Tank	1/25/2023	na	na	19.3	4.7	0.80
	PPG4 Cavern Oil	5/25/2023	31.2	1.548	42	9	0.82
	PPG4 Cavern Oil	8/10/2024	31.4	1.515	42	9	0.82
	PPG4 Cavern Oil	1/9/2025	33.0	1.691	49.9	10.4	0.83
	Pad Oil	6/16/2023	29.3	1.265	18	5	0.78
Sulphur Mines Strategic Petroleum Reserve Oils							
SPR Oils	SM007	6/14/1989	31.9	1.69	23.1	10.1	0.70
	SM007*	6/14/1989	32.4	1.75	32.7	9.0	0.78
	SM006	5/31/1989	31.0	1.42	34.0	20.6	0.62
	SM006*	5/31/1989	32.9	1.56	41.6	11.6	0.78
	SM002	8/14/1989	32.7	1.63	52.8	10.6	0.83
	Cavern 7	1989 rpt.	32.5	1.80	na	na	na
	Cavern 6	1989 rpt.	32.7	1.60	na	na	na
	Cavern 2-4-5	1989 rpt.	32.9	1.60	na	na	na

* sample values from Word files provided by DOE; other SM### sample values from Excel file provided

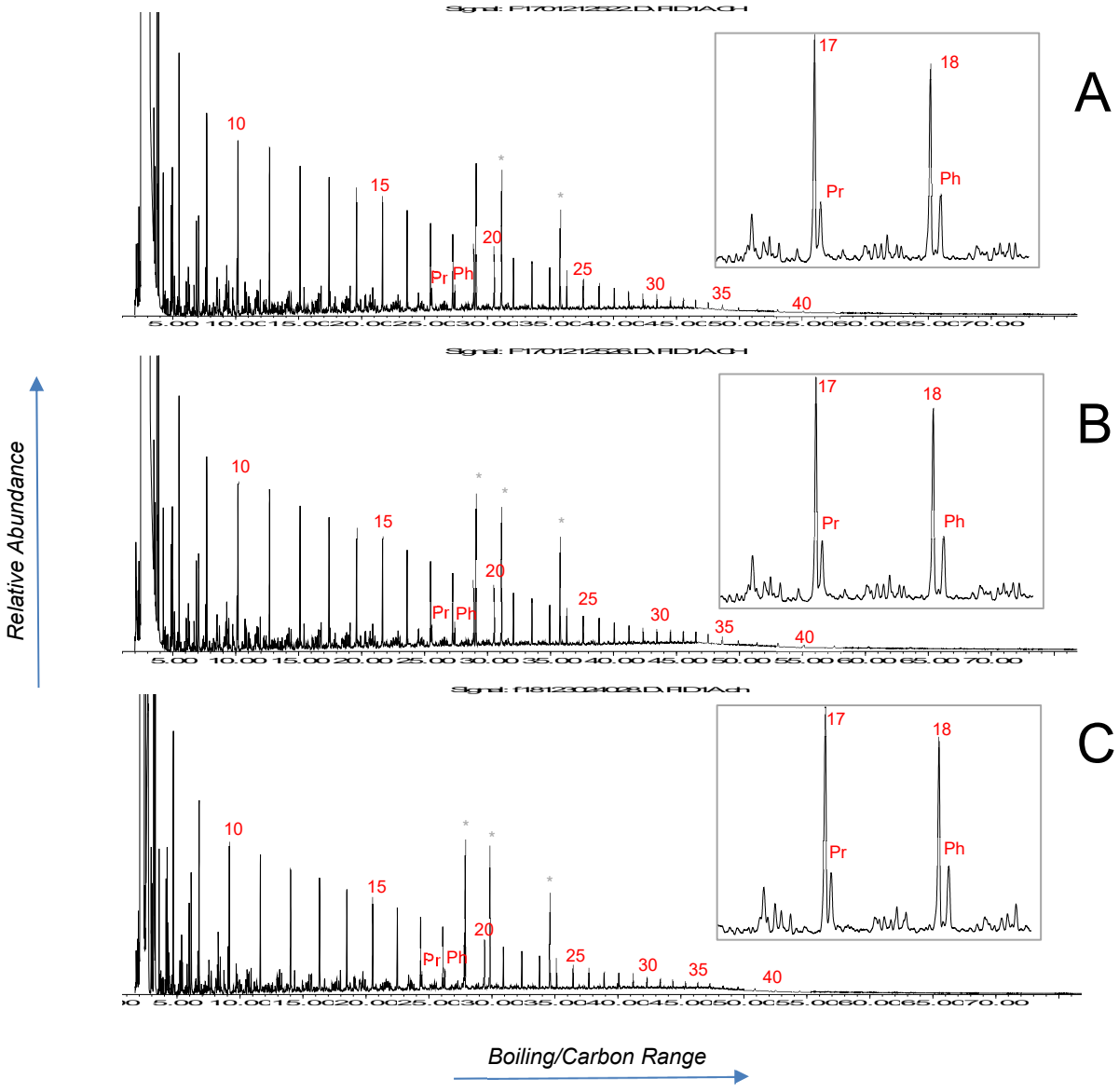


Figure 1: GC/FID (C8+) chromatograms for (A) 7B Cavern oil collected January 9, 2025 analyzed herein, (B) 7B Cavern (reference) oil collected Jan. 21, 2023 analyzed herein, (C) 7B Cavern oil collected December 18, 2024 analyzed previously. Insets show further expanded view of C17-C18 range. #: n-alkane carbon number; Pr: pristane; Ph: phytane; UCM: unresolved complex mixture; *: internal standard.

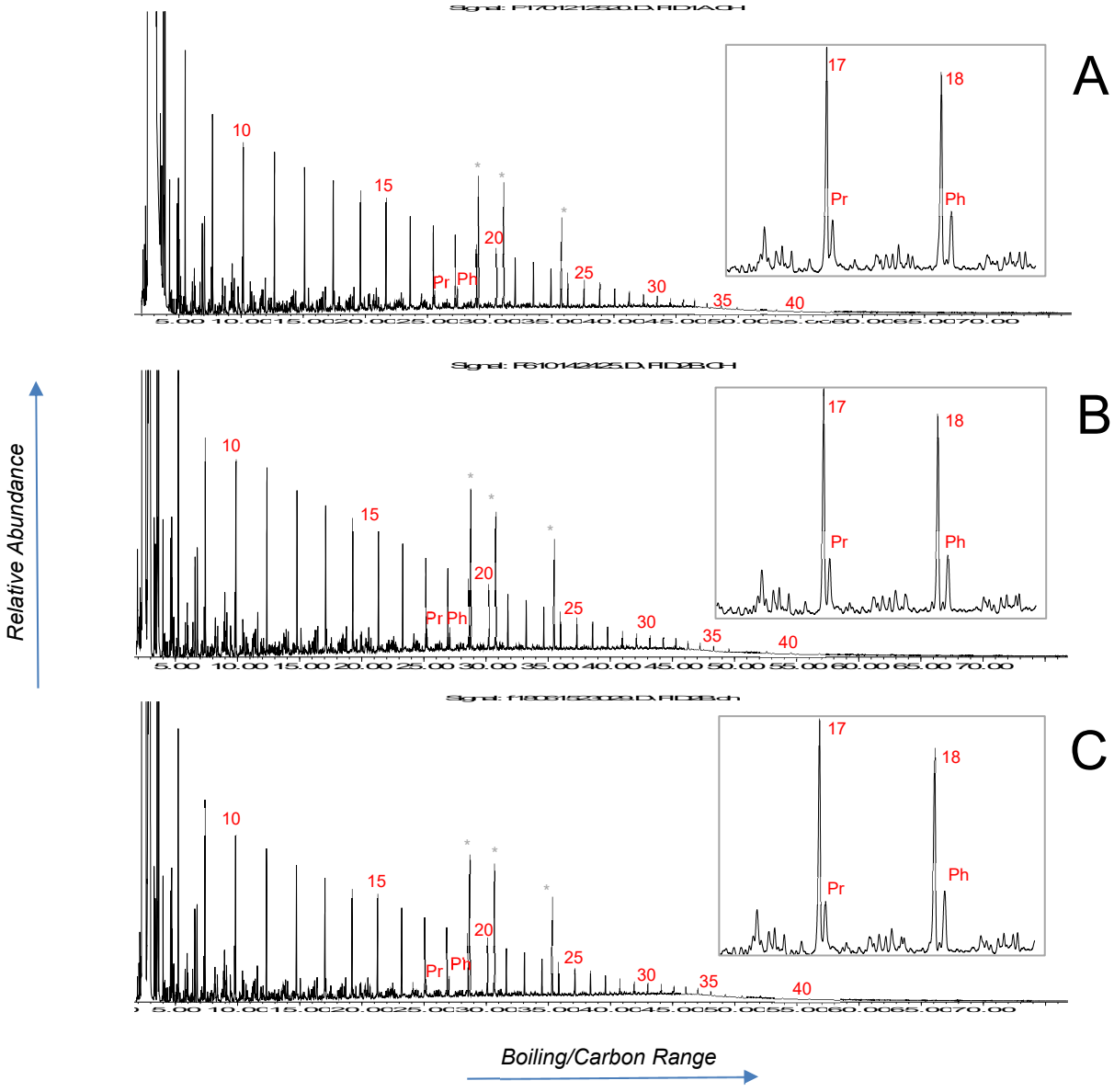


Figure 2: GC/FID (C8+) chromatograms for PPG4 cavern oils (A) collected in January 9, 2025 analyzed herein and those collected (B) Aug. 10, 2024 and (C) May 25, 2023 and analyzed previously. Insets show further expanded view of C17-C18 range. #: n-alkane carbon number; Pr: pristane; Ph: phytane; UCM: unresolved complex mixture; *: internal standard.

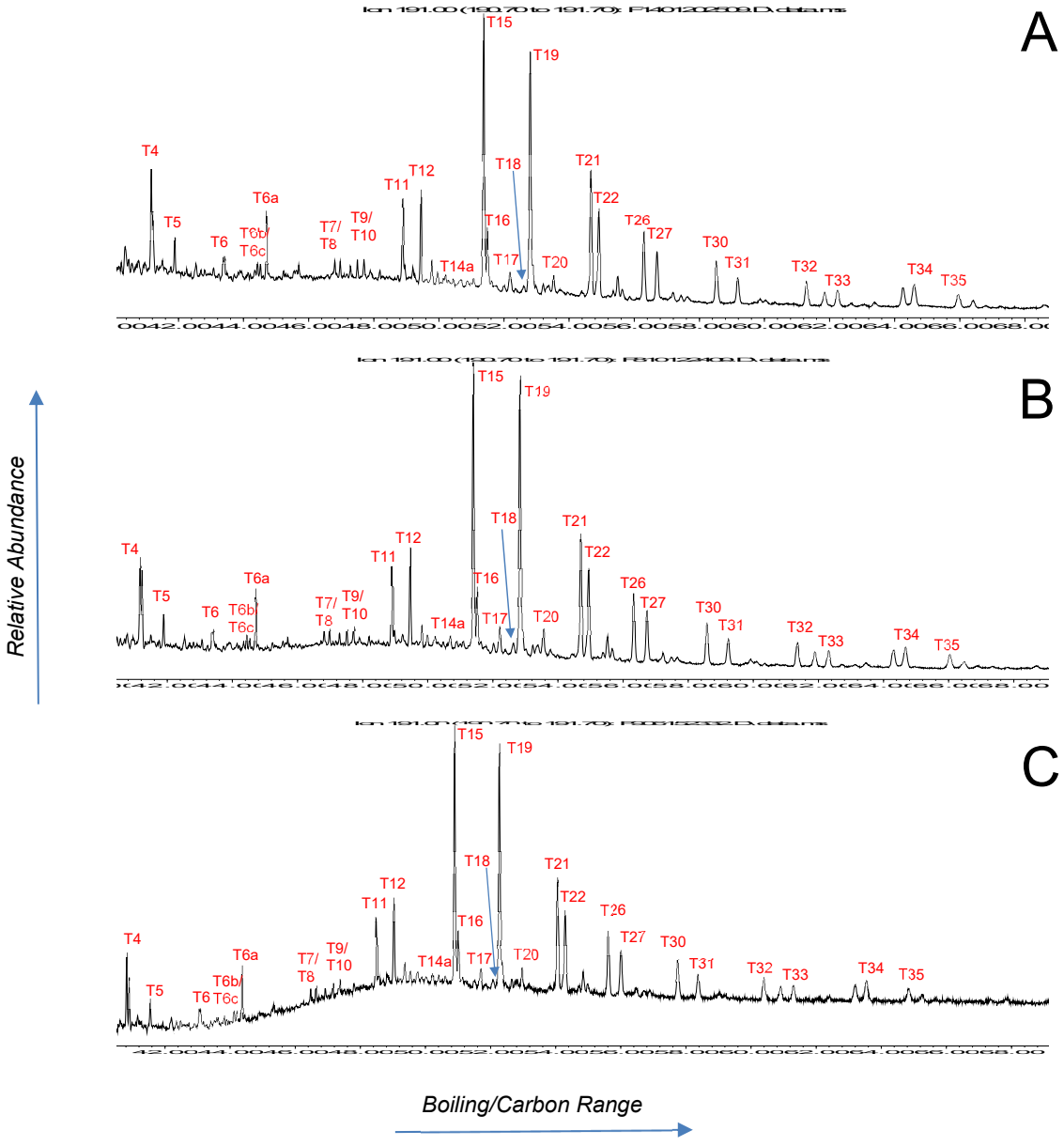


Figure 3: Partial extracted ion chromatograms (*m/z* 191) for PPG4 Cavern oils collected (A) Jan. 9, 2025 and analyzed herein, (B) August 10, 2024 and analyzed previously, and (C) May 25, 2023 and analyzed previously. red labels: various triterpane biomarkers, see Attachment 3, Table A3-2 for compound names.

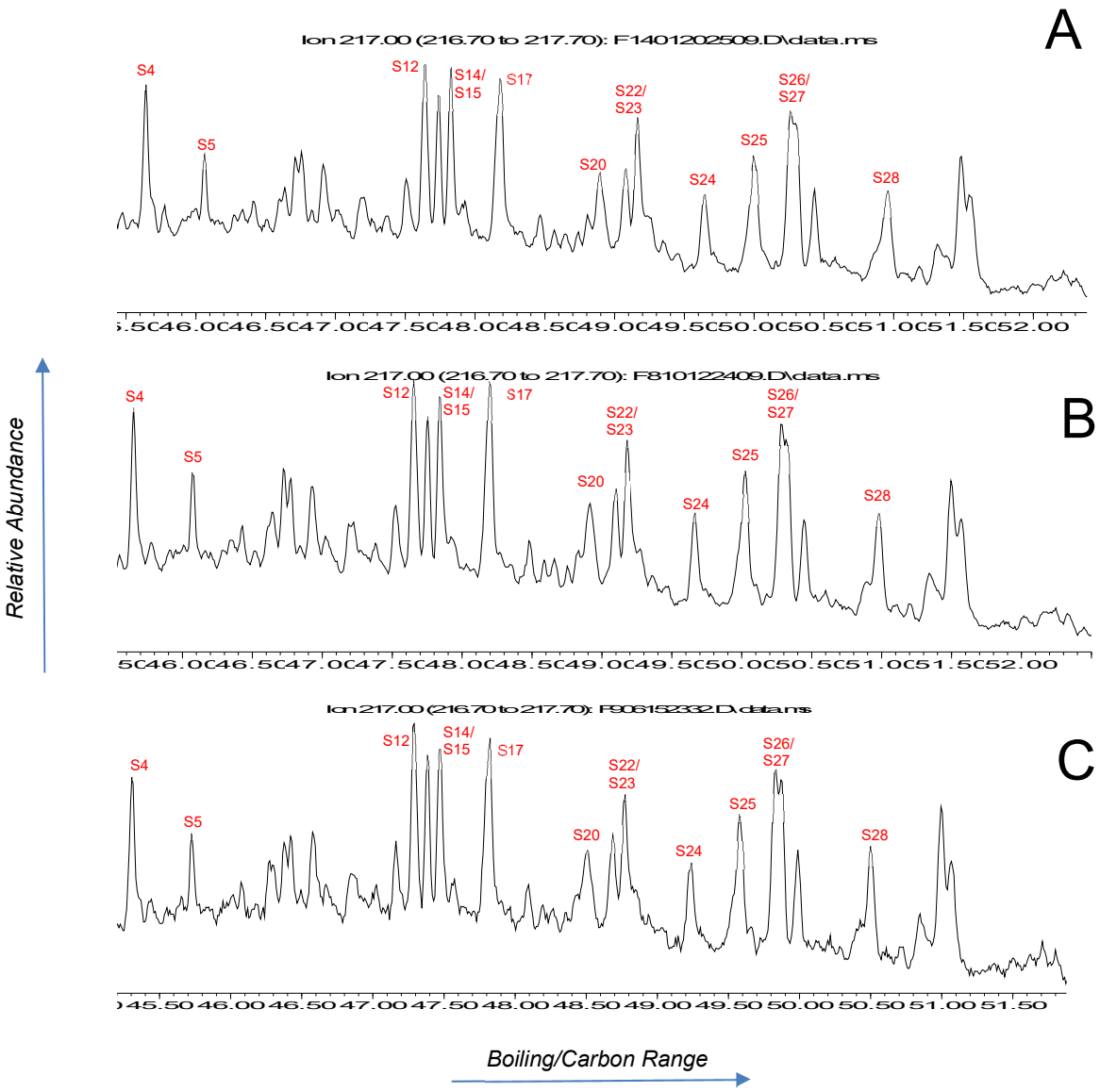


Figure 4: Partial extracted ion chromatograms (*m/z* 217) for PPG4 Cavern oils collected (A) Jan. 9, 2025 and analyzed herein, (B) August 10, 2024 and analyzed previously, and (C) May 25, 2023 and analyzed previously. red labels: various sterane biomarkers, see Attachment 3, Table A3-2 for compound names.

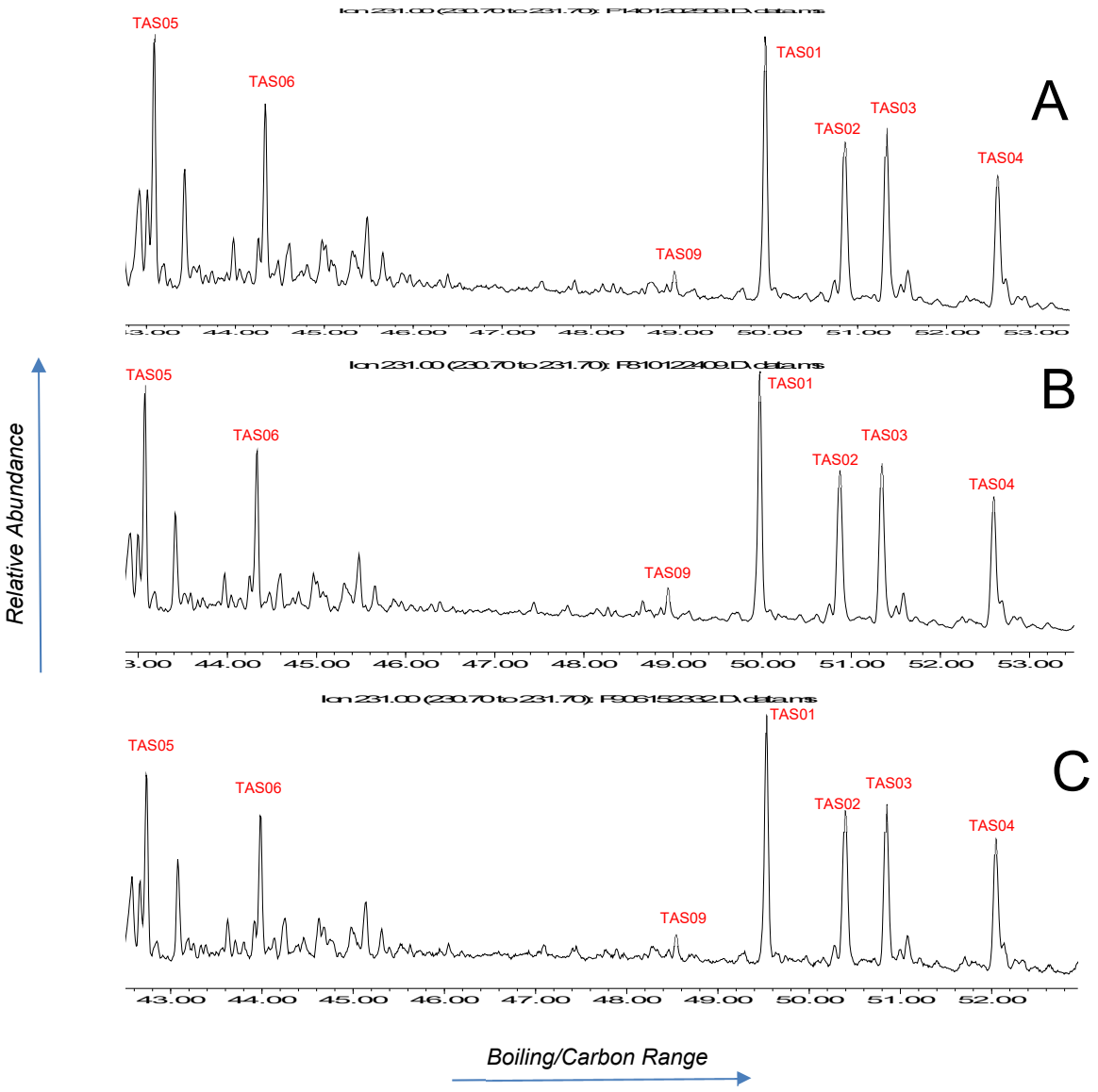
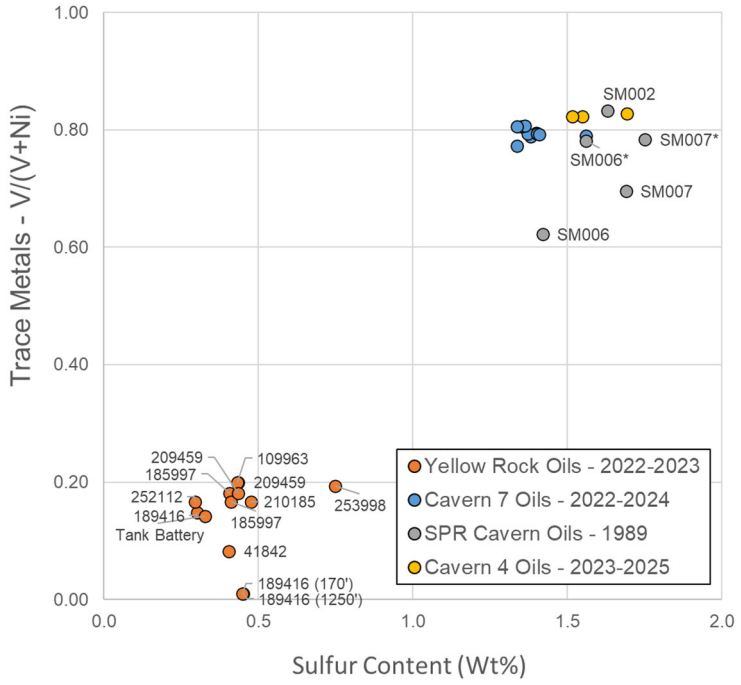


Figure 5: Partial extracted ion chromatograms (*m/z* 231) for PPG4 Cavern oils collected (A) Jan. 9, 2025 and analyzed herein, (B) August 10, 2024 and analyzed previously, and (C) May 252, 2023 and analyzed previously. red labels: various triaromatic steroid biomarkers, see Attachment 3, Table A3-2 for compound names.



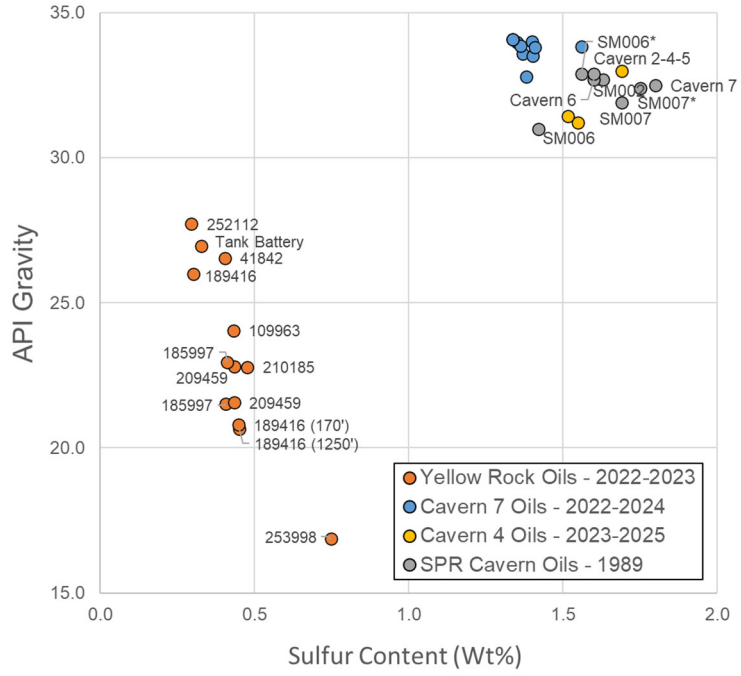


Figure 6: Crude oil assay results for the Cavern 7 oils, Cavern 4 oils, and Yellow Rock (locally produced) oils recently studied and historic SPR cavern oils from 1989. All data from Table 4.

ATTACHMENTS

CHAIN OF CUSTODY

PAGE 1 OF 1

ALPHA ANALYTICAL
WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab:

ALPHA Job #:

Client Information

Client: ERM
Address: 840 W Sam Houston Pkwy N Suite 600 Houston, TX 77024
Phone: 832-209-8811
Fax:
Email: Scott.Himes@erm.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Sulphur Dome
Project Location: Sulphur, LA
Project #: 0765886
Project Manager: Scott Himes
ALPHA Quote #:

Turn-Around Time

☑ Standard ☐ RUSH (only confirmed if pre-approved)
Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☑ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☑ Same as Client info PO #: 0765886

Regulatory Requirements/Report Limits

State /Fed Program	Criteria

Other Project Specific Requirements/Comments/Detection Limits:
Contact Scott Stout at Newfields for further details

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	GC-FID-TPH (C6+)	GCMS-Alkyl PAH	GCMS-Biomarkers	PIANO-VOA	Sample Specific Comments	Total # Bottles
	#4 Oil	1/9/25	13:40	oil	TB	X	X	X	X		2
	7B-Oil	1/9/25	14:00	oil	TB	X	X	X	X		2

SAMPLE HANDLING
Filtration
☐ Done ☑ Not needed ☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

Container Type	V	V	V	V
Preservative	A	A	A	A

Relinquished By:	Date/Time	Received By:	Date/Time
Taylar Brown FEDEX	1/16/25 10:00	FEDEX	
	1/16/25 10:04		1/16/25 10:04

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

Attachment 1

Chain-of-Custody

Attachment 2

Average short-term and long-term relative standard deviations (RSD_r and RSD_R) calculated for the 30 diagnostic ratios used in the Sulphur Dome monitoring studies to date.

		Sulphur Dome Site Precision		
		Repeatability	Reproducability	Most Precise Ratios*
CEN - Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	RSD_r	RSD_R	
NR-C17/pris	C17/Pr	1.5	5.2	
NR-C18/phy	C18/Ph	0.7	2.4	x
NR- pris/phy	Pr/Ph	1.2	4.0	x
NR-4-MD/1-MD	4-MDBT/1-MDBT	1.9	8.3	
NR-2-MP/1-MP	2-MP/1-MP	1.9	3.5	x
NR-27Ts/30ab	T11/T19	2.7	3.9	x
NR-27Tm/30ab	T12/T19	1.8	2.7	x
NR-28ab/30ab	T14a/T19	2.9	6.5	
NR-29ab/30ab	T15/T19	1.5	2.7	x
NR-30O/30ab	T18/T19	6.3	55	
NR-31abS/30ab	T21/T19	2.0	2.9	x
NR-27dbR/27dbS	S4/S5	6.9	15	
NR-27bb/29bb	(S14+S15)/(S26+S27)	2.8	2.3	x
NR-SC26/ RC26+SC27	TAS09/TAS01	2.2	4.5	x
NR-SC28/RC26 + SC27	TAS02/TAS01	2.4	2.0	x
NR-RC27/RC26+ SC27	TAS03/TAS01	1.9	1.8	x
NR-RC28/RC26+SC27	TAS04/TAS01	2.4	1.8	x
DR-Ts/Tm	T11/T12	2.4	4.6	x
DR-29Ts30ab	T16/T19	3.4	3.7	x
DR-29bb/29aa	(S26+S27)/(S25+S28)	3.6	12	
DR-C2-dbt/C2-phe	DBT2/PA2	0.5	3.8	x
DR-C3-dbt/C3-phe	DBT3/PA3	0.7	3.8	x
DR-C28C29/30ab	T7 to T10/T19	4.8	9.3	
DR-29aaS/29aaR=	S25/S28	6.8	20	
DR-C20TA/C21TA	TAS05/TAS06	3.6	9.1	
DR-TA21/ RC26+SC27	TS06/TAS01	3.3	8.2	
DR-C24Tet/C26Tri	T6a/T6bc	5.0	10.9	
DR-30ba/30ab	T20/T19	4.4	11	
DR-35ab/30ab	(T34 to T35)/T19	3.4	6.5	
DR-32abR/32abS	T27/T26	2.0	3.2	x

*both RSD_r and RSD_R < 5% based on current QC datasets

RSD_r = average RSD for sample duplicate pairs studied to date

RSR_R = average RSD for 7B cavern (reference) oil studied to date

Attachment 3

Tabulated Concentrations

Table A3-1: Concentrations (mg/kg) of n-alkanes and isoprenoids in the samples studied.

Client ID	#4-OIL	7B-OIL	7B-OIL (dup)	7B
Lab ID	L2502602-01	L2502602-02	NG2020967-4	L2502602-03
Date Collected	1/9/2025	1/9/2025	NA	1/25/2023
Date Analyzed	1/21/2025	1/22/2025	1/22/2025	1/22/2025
Analytes	Result	Result	Result	Result
n-Nonane (C9)	8,220	8,310	8,140	8,940
n-Decane (C10)	7,640	7,670	7,630	8,200
n-Undecane (C11)	7,480	7,530	7,490	8,060
n-Dodecane (C12)	6,720	6,860	6,850	7,380
n-Tridecane (C13)	6,170	6,190	6,190	6,570
2,6,10 Trimethyldodecane (1380)	1,130	1,240	1,260	1,320
n-Tetradecane (C14)	5,570	5,700	5,720	5,990
2,6,10 Trimethyltridecane (1470)	1,580	1,660	1,760	1,780
n-Pentadecane (C15)	5,420	5,500	5,500	5,820
n-Hexadecane (C16)	4,470	4,660	4,680	4,920
Norpristane (1650)	1,010	1,100	1,130	1,190
n-Heptadecane (C17)	4,110	4,190	4,200	4,400
Pristane	1,450	1,710	1,700	1,900
n-Octadecane (C18)	3,640	3,710	3,670	3,920
Phytane	1,530	1,760	1,750	1,850
n-Nonadecane (C19)	3,320	3,430	3,410	3,640
n-Eicosane (C20)	3,070	3,140	3,140	3,400
n-Heneicosane (C21)	2,480	2,540	2,540	2,730
n-Docosane (C22)	2,100	2,180	2,170	2,340
n-Tricosane (C23)	1,740	1,840	1,810	1,960
n-Tetracosane (C24)	1,690	1,820	1,810	1,930
n-Pentacosane (C25)	1,690	1,710	1,720	1,900
n-Hexacosane (C26)	1,260	1,280	1,270	1,420
n-Heptacosane (C27)	1,020	1,060	1,060	1,220
n-Octacosane (C28)	774	858	868	1,010
n-Nonacosane (C29)	649	783	775	950
n-Triacontane (C30)	579	712	721	902
n-Hentriacontane (C31)	467	582	591	822
n-Dotriacontane (C32)	532	661	657	904
n-Tritriacontane (C33)	404	494	498	721
n-Tetratriacontane (C34)	336	458	465	691
n-Pentatriacontane (C35)	267	401	405	675
n-Hexatriacontane (C36)	206	274	296	469
n-Heptatriacontane (C37)	196	268	272	475
n-Octatriacontane (C38)	156	274	276	493
n-Nonatriacontane (C39)	147	232	222	418
n-Tetracontane (C40)	141	210	191	379
Total Saturated Hydrocarbons	89,400	93,000	92,800	102,000
Total Petroleum Hydrocarbons (C9-C44)	536,000	551,000	558,000	616,000

Table A3-2: Concentrations (mg/kg) of PAHs, related compounds and petroleum biomarkers in the samples studied.

		#4-OIL	7B-OIL	7B-OIL (dup)	7B
	Client ID				
	Lab ID	L2502602-01	L2502602-02	WG2020967-4	L2502602-03
	Date Collected	1/9/2025	1/9/2025	NA	1/25/2023
	Date Analyzed	1/20/2025	1/20/2025	1/21/2025	1/21/2025
	Analytes	Result	Result	Result	Result
D0	cis/trans-Decalin	230	245	251	268
D1	C1-Decalins	387	400	411	436
D2	C2-Decalins	338	343	345	374
D3	C3-Decalins	216	224	230	252
D4	C4-Decalins	216	220	221	238
BT0	Benzothiophene	14	13	12	13
BT1	C1-Benzo(b)thiophenes	65	60	61	63
BT2	C2-Benzo(b)thiophenes	235	201	206	210
BT3	C3-Benzo(b)thiophenes	423	370	372	378
BT4	C4-Benzo(b)thiophenes	323	289	289	295
N0	Naphthalene	314	333	334	352
N1	C1-Naphthalenes	874	903	925	975
N2	C2-Naphthalenes	1,400	1,360	1,390	1,460
N3	C3-Naphthalenes	1,150	1,150	1,160	1,230
N4	C4-Naphthalenes	656	672	668	712
B	Biphenyl	42	49	47	53
DF	Dibenzofuran	25	33	33	36
AY	Acenaphthylene	4.5	4.5	4.6	4.8
AE	Acenaphthene	8.6	9.3	9.7	10.5
F0	Fluorene	52	59	60	64
F1	C1-Fluorenes	160	164	163	177
F2	C2-Fluorenes	266	259	248	272
F3	C3-Fluorenes	295	269	276	269
A0	Anthracene	9	9	9	10
P0	Phenanthrene	111	118	119	126
PA1	C1-Phenanthrenes/Anthracenes	316	311	312	311
PA2	C2-Phenanthrenes/Anthracenes	404	386	396	402
PA3	C3-Phenanthrenes/Anthracenes	298	282	276	295
PA4	C4-Phenanthrenes/Anthracenes	153	143	143	154
RET	Retene	nd	nd	nd	nd
DBT0	Dibenzothiophene	262	268	268	284
DBT1	C1-Dibenzothiophenes	710	665	661	672
DBT2	C2-Dibenzothiophenes	1,020	898	917	896
DBT3	C3-Dibenzothiophenes	845	731	741	731
DBT4	C4-Dibenzothiophenes	464	392	392	408
BF	Benzo(b)fluorene	3.7	4.4	4.2	4.4
FL0	Fluoranthene	0.8	1.1	1.2	1.2
PY0	Pyrene	10	10	11	11
FP1	C1-Fluoranthenes/Pyrenes	49	47	47	52
FP2	C2-Fluoranthenes/Pyrenes	104	99	97	104
FP3	C3-Fluoranthenes/Pyrenes	151	132	149	148
FP4	C4-Fluoranthenes/Pyrenes	138	123	130	145
NBT0	Naphthobenzothiophenes	58	56	55	59
NBT1	C1-Naphthobenzothiophenes	209	185	203	207
NBT2	C2-Naphthobenzothiophenes	325	276	287	324
NBT3	C3-Naphthobenzothiophenes	287	248	259	284
NBT4	C4-Naphthobenzothiophenes	200	172	190	199
BA0	Benz[a]anthracene	1.2	1.6	1.5	1.8
C0	Chrysene/Triphenylene	21	20	22	22
BC1	C1-Chrysenes	48	47	45	55
BC2	C2-Chrysenes	81	81	81	96
BC3	C3-Chrysenes	109	110	110	129
BC4	C4-Chrysenes	77	79	84	88

Table A3-2 (cont.)

		#4-OIL	7B-OIL	7B-OIL (dup)	7B
	Client ID				
	Lab ID	L2502602-01	L2502602-02	WG2020967-4	L2502602-03
	Date Collected	1/9/2025	1/9/2025	NA	1/25/2023
	Date Analyzed	1/20/2025	1/20/2025	1/21/2025	1/21/2025
	Analytes	Result	Result	Result	Result
BBF	Benzo[b]fluoranthene	2.4	3.5	3.2	4.0
BJKF	Benzo[j]fluoranthene/Benzo[k]fluoranthene	nd	nd	nd	nd
BAF	Benzo[a]fluoranthene	nd	nd	nd	nd
BEP	Benzo[e]pyrene	7.4	7.9	7.6	9.7
BAP	Benzo[a]pyrene	1.3	1.2	1.5	1.8
PER	Perylene	1.0	1.4	1.3	1.5
IND	Indeno[1,2,3-cd]pyrene	nd	nd	nd	nd
DA	Dibenz[ah]anthracene/Dibenz[ac]anthrace	nd	nd	nd	nd
GHI	Benzo[g,h,i]perylene	2.3	2.6	2.5	3.2
CAR	Carbazole	9.8	8.9	8.5	9.6
4MDT	4-Methyldibenzothiophene	314	294	290	298
2MDT	2/3-Methyldibenzothiophene	262	242	242	247
1MDT	1-Methyldibenzothiophene	126	120	122	117
3MP	3-Methylphenanthrene	58	55	56	55
2MP	2-Methylphenanthrene	76	72	73	71
2MA	2-Methylanthracene	3.6	3.4	3.0	3.1
9MP	9/4-Methylphenanthrene	110	108	109	109
1MP	1-Methylphenanthrene	66	69	68	68
2MN	2-Methylnaphthalene	701	716	733	766
1MN	1-Methylnaphthalene	613	642	658	701
26DMN	2,6-Dimethylnaphthalene	616	571	576	606
235TMN	2,3,5-Trimethylnaphthalene	140	142	146	156
PY2	2-METHYLPYRENE	3.2	2.9	3.0	3.2
PY4	4-METHYLPYRENE	13.7	12.2	12.2	13.7
PY1	1-METHYLPYRENE	8.3	7.5	7.4	8.3
T4	C23 Tricyclic Terpane	23	27	23	22
T5	C24 Tricyclic Terpane	9	11	10	11
T6	C25 Tricyclic Terpane	10	12	12	13
T6a	C24 Tetracyclic Terpane	16	14	15	16
T6b	C26 Tricyclic Terpane-22S	4.3	5.2	5.3	4.8
T6c	C26 Tricyclic Terpane-22R	3.3	4.3	4.5	4.5
T7	C28 Tricyclic Terpane-22S	4.2	5.6	4.6	5.7
T8	C28 Tricyclic Terpane-22R	3.7	4.9	5.4	5.3
T9	C29 Tricyclic Terpane-22S	4.0	5.9	5.9	6.4
T10	C29 Tricyclic Terpane-22R	4.8	6.2	6.4	7.1
T11	18a-22,29,30-Trisnorneohopane-TS	23	24	23	27
T11a	C30 Tricyclic Terpane-22S	3.5	4.8	5.3	5.9
T11b	C30 Tricyclic Terpane-22R	4.5	6.3	5.3	7.0
T12	17a(H)-22,29,30-Trisnorhopane-TM	27	27	28	30
T14a	17a/b,21b/a 28,30-Bisnorhopane	5	17	17	20
T14b	17a(H),21b(H)-25-Norhopane	3.2	3.8	3.1	3.5
T15	30-Norhopane	89	87	89	92
T16	18a(H)-30-Norneohopane-C29Ts	18	20	20	22
X	17a(H)-Diahopane	1.8	3.4	3.1	3.9
T17	30-Normoretane	9	8	9	11
T18	18a(H)&18b(H)-Oleananes	3.5	4.1	3.9	4.4
T19	Hopane	90	96	98	108
T20	Moretane	6.1	7.4	7.5	8.4
T21	30-Homohopane-22S	51	56	53	63
T22	30-Homohopane-22R	40	43	42	49

Table A3-2 (cont.)

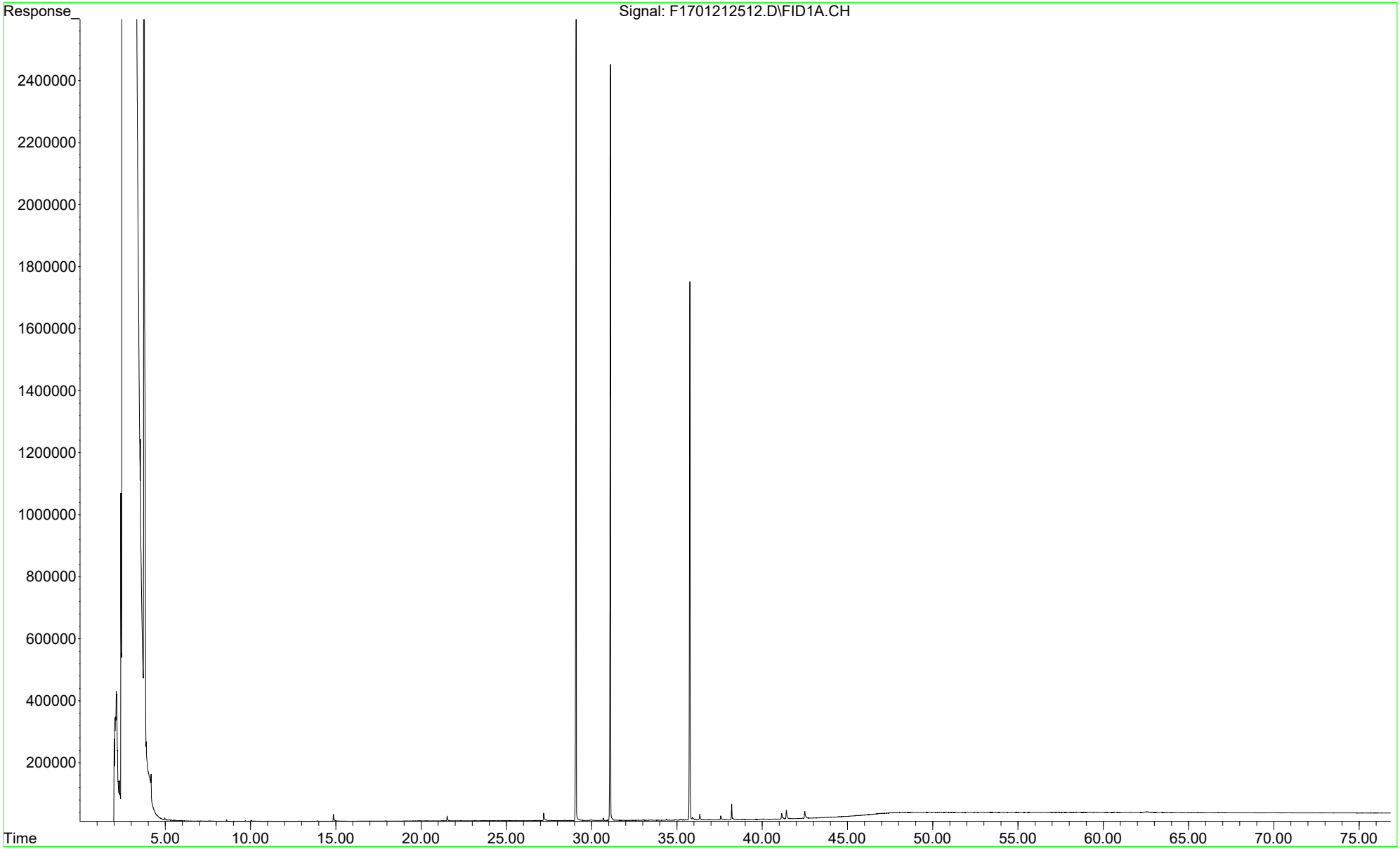
		#4-OIL	7B-OIL	7B-OIL (dup)	7B
	Client ID				
	Lab ID	L2502602-01	L2502602-02	WG2020967-4	L2502602-03
	Date Collected	1/9/2025	1/9/2025	NA	1/25/2023
	Date Analyzed	1/20/2025	1/20/2025	1/21/2025	1/21/2025
	Analytes	Result	Result	Result	Result
T22A	T22a-Gammacerane/C32-diahopane	9	10	11	12
T26	30,31-Bishomohopane-22S	31	34	34	40
T27	30,31-Bishomohopane-22R	23	26	25	28
T30	30,31-Trishomohopane-22S	22	26	25	30
T31	30,31-Trishomohopane-22R	14	17	17	20
T32	Tetrakishomohopane-22S	15	17	16	19
T33	Tetrakishomohopane-22R	11	13	12	13
T34	Pentakishomohopane-22S	16	19	20	20
T35	Pentakishomohopane-22R	10	13	12	13
S4	13b(H),17a(H)-20S-Diacholestane	21	29	27	33
S5	13b(H),17a(H)-20R-Diacholestane	9	13	14	17
S23	14b,17b-20S-Methylcholestane	30	37	36	41
S26	14b(H),17b(H)-20R-Ethylcholestane	41	46	46	52
S27	14b(H),17b(H)-20S-Ethylcholestane	26	32	37	39
TAS05	C20 PREGNANE	93.5	99.9	89.5	97.8
TAS06	C21 20-METHYLPREGNANE	67.5	73.1	73.0	79.7
TAS07	C22 20-ETHYLPREGNANE (A)	34.9	29.8	32.9	34.9
TAS08	C22 20-ETHYLPREGNANE (B)	15.3	16.4	16.4	21.0
TAS09	C26,20S TAS	12.6	19.8	20.5	25.7
TAS01	C26,20R+C27,20S TAS	131	167	178	196
TAS02	C28,20S TAS	99	118	121	131
TAS03	C27,20R TAS	105	137	134	147
TAS04	C28,20R TAS	82	97	101	111
TAS10	C29,20S TAS	25.5	42.7	45.0	49.1
TAS11	C29,20R TAS	11.1	18.0	17.8	22.0

Attachment 4

GC/FID Chromatograms

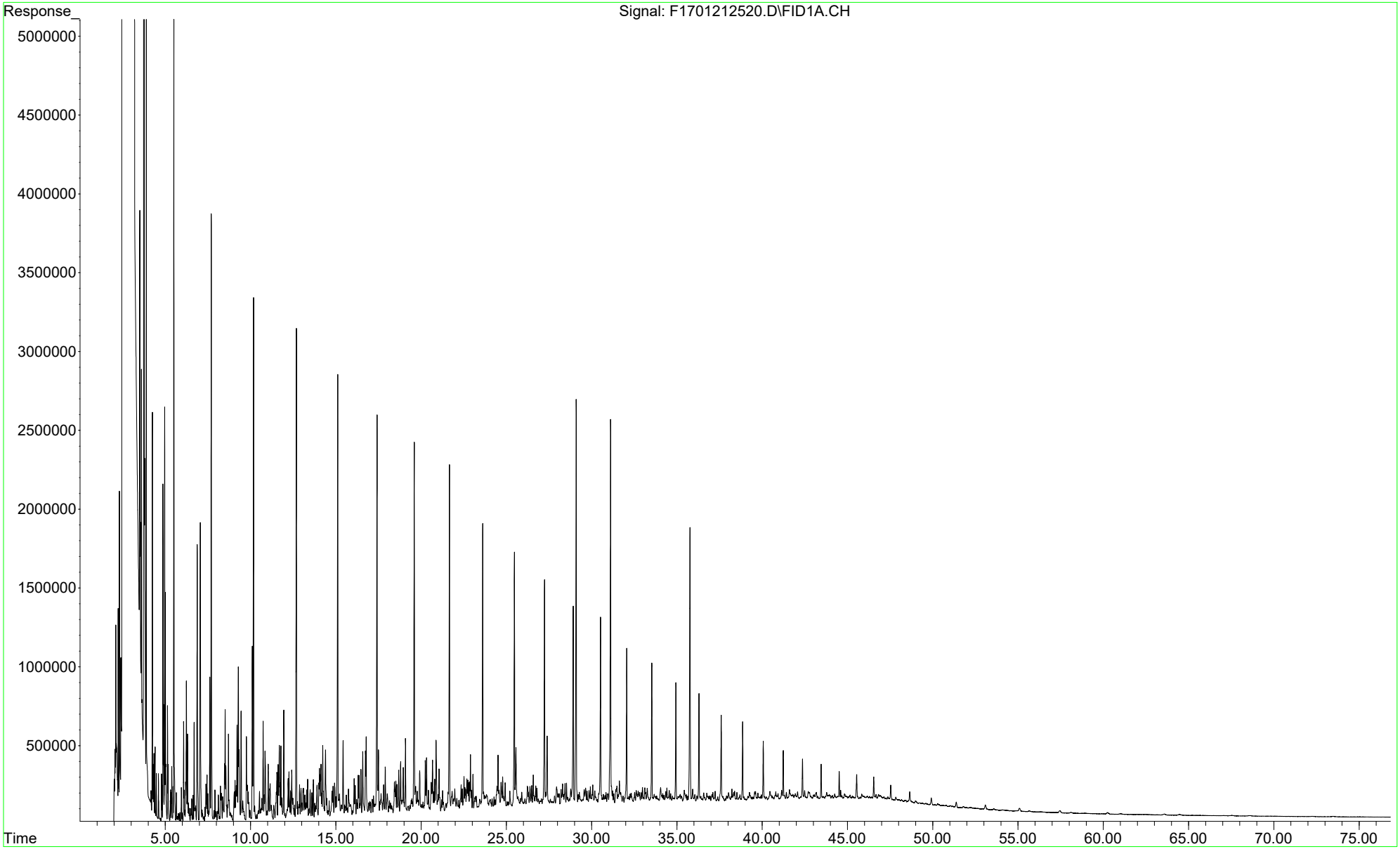
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\SH
... C\F1701212512.D
Operator : FID17:AMV
Instrument : FID17
Acquired : 21 Jan 2025 5:53 pm using AcqMethod FID17A.M
Sample Name: WG2020967-1
Misc Info : WG2022166,WG2020967,ICAL21832

Procedural Blank
WG2020967-1



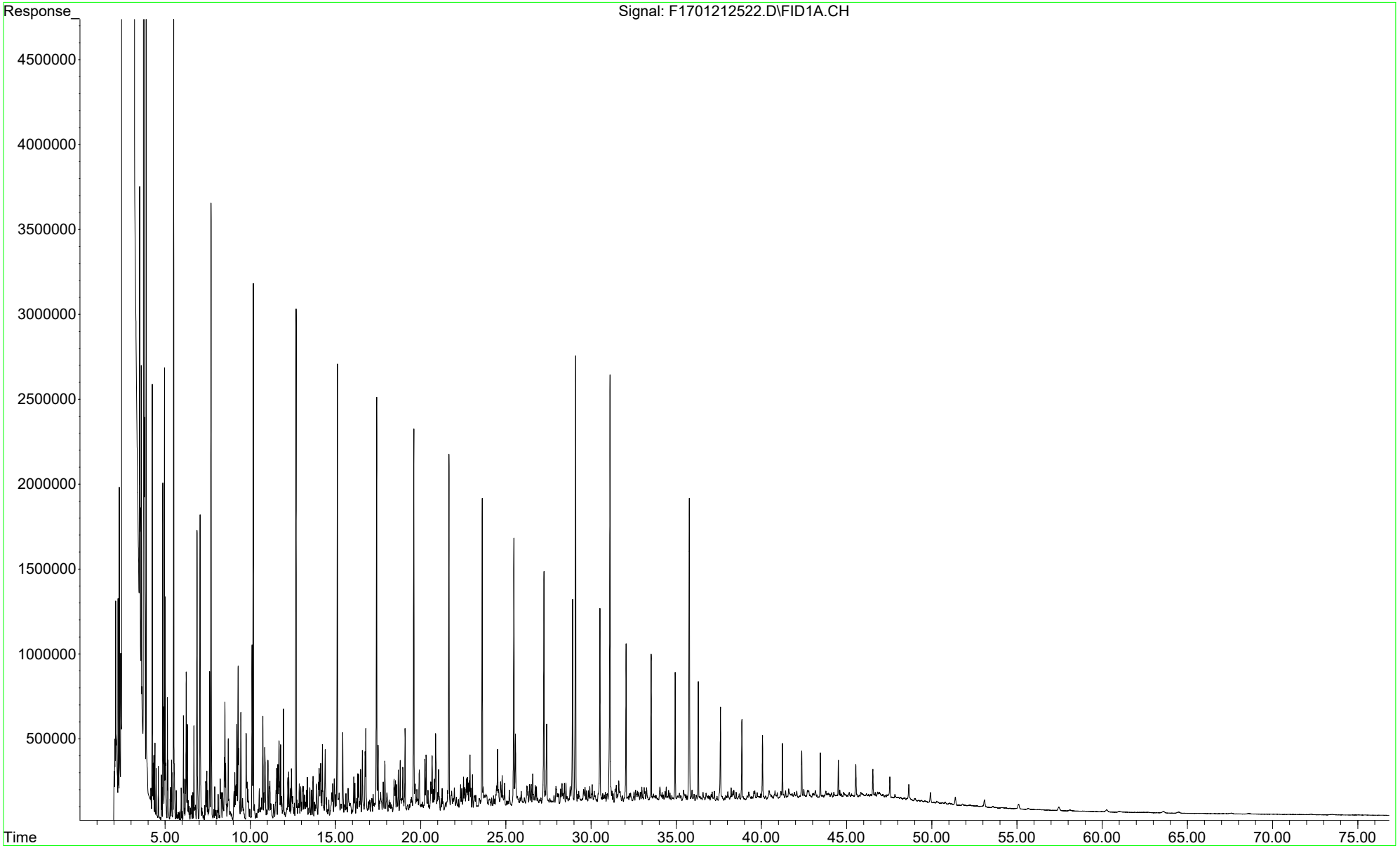
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\SH
... C\F1701212520.D
Operator : FID17:AMV
Instrument : FID17
Acquired : 21 Jan 2025 11:44 pm using AcqMethod FID17A.M
Sample Name: L2502602-01,42,,
Misc Info : WG2022166,WG2020967,ICAL21832

#4-OIL
L2502602-01



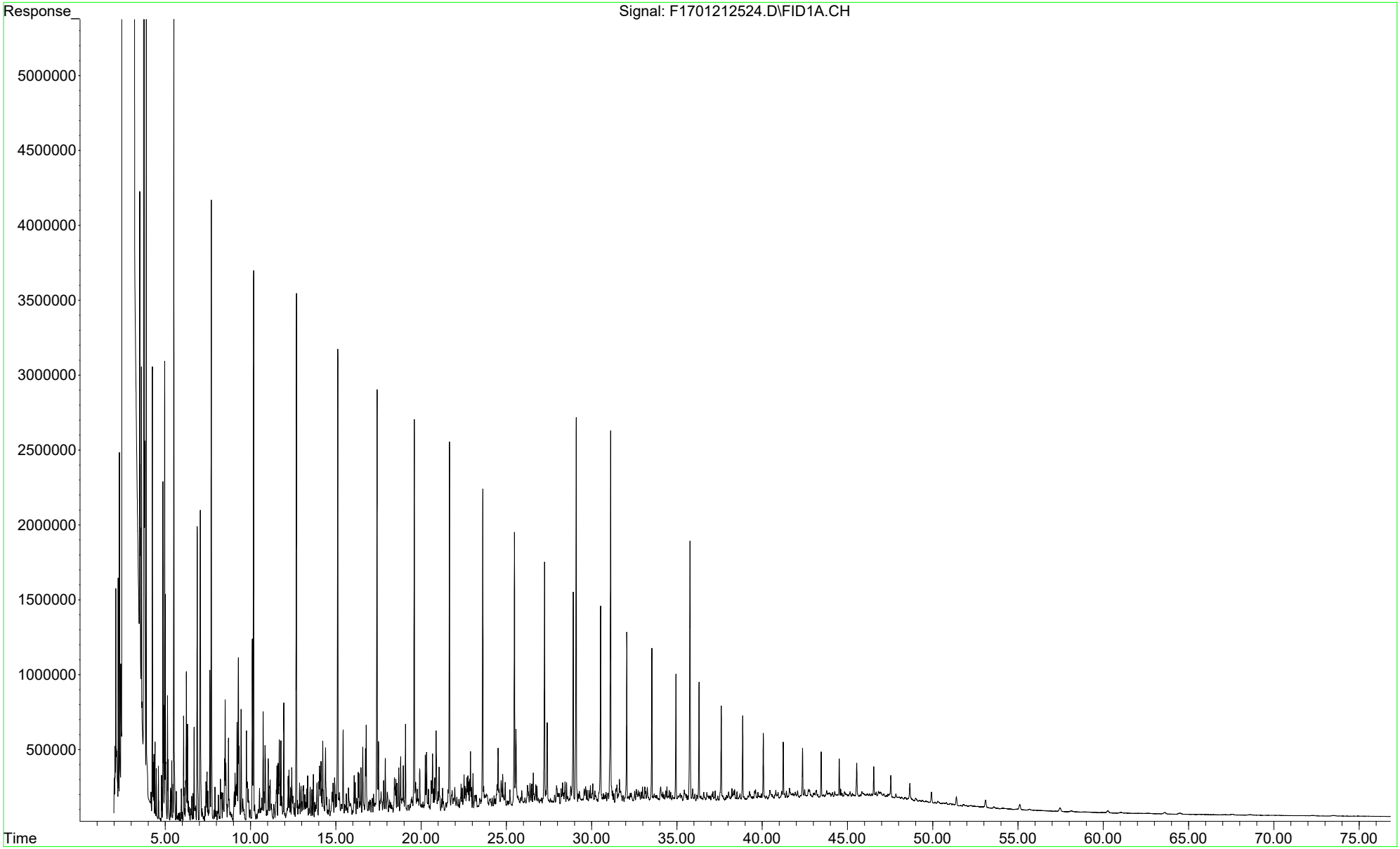
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\SH
... C\F1701212522.D
Operator : FID17:AMV
Instrument : FID17
Acquired : 22 Jan 2025 1:11 am using AcqMethod FID17A.M
Sample Name: L2502602-02,42,,
Misc Info : WG2022166,WG2020967,ICAL21832

7B-OIL
L2502602-02



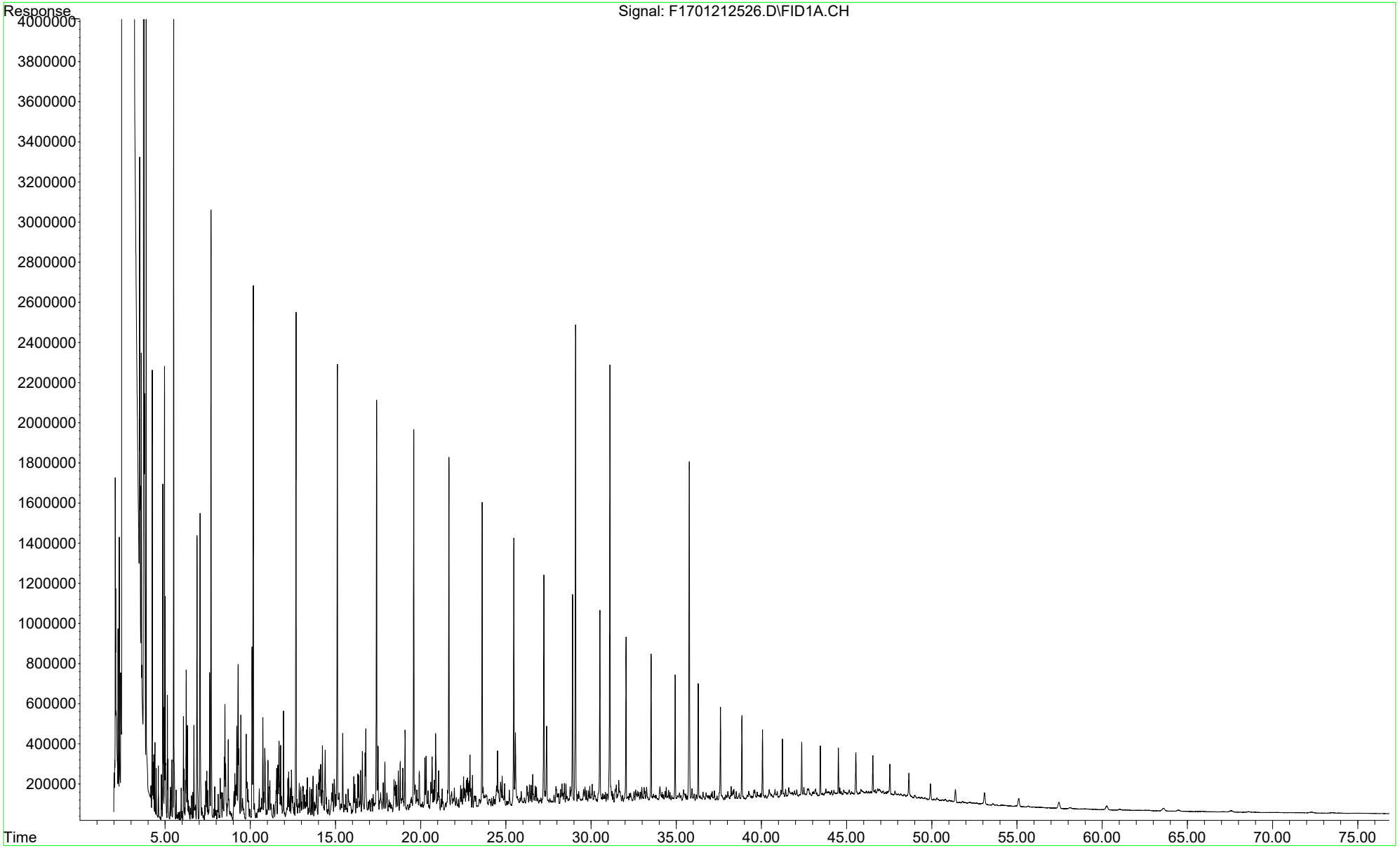
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\SH
... C\F1701212524.D
Operator : FID17:AMV
Instrument : FID17
Acquired : 22 Jan 2025 2:39 am using AcqMethod FID17A.M
Sample Name: WG2020967-4
Misc Info : WG2022166,WG2020967,ICAL21832

7B-OIL Duplicate
WG2020967-4



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\SH
... C\F1701212526.D
Operator : FID17:AMV
Instrument : FID17
Acquired : 22 Jan 2025 4:06 am using AcqMethod FID17A.M
Sample Name: L2502602-03,42,,
Misc Info : WG2022166,WG2020967,ICAL21832

7B Reference Oil
L2502602-03

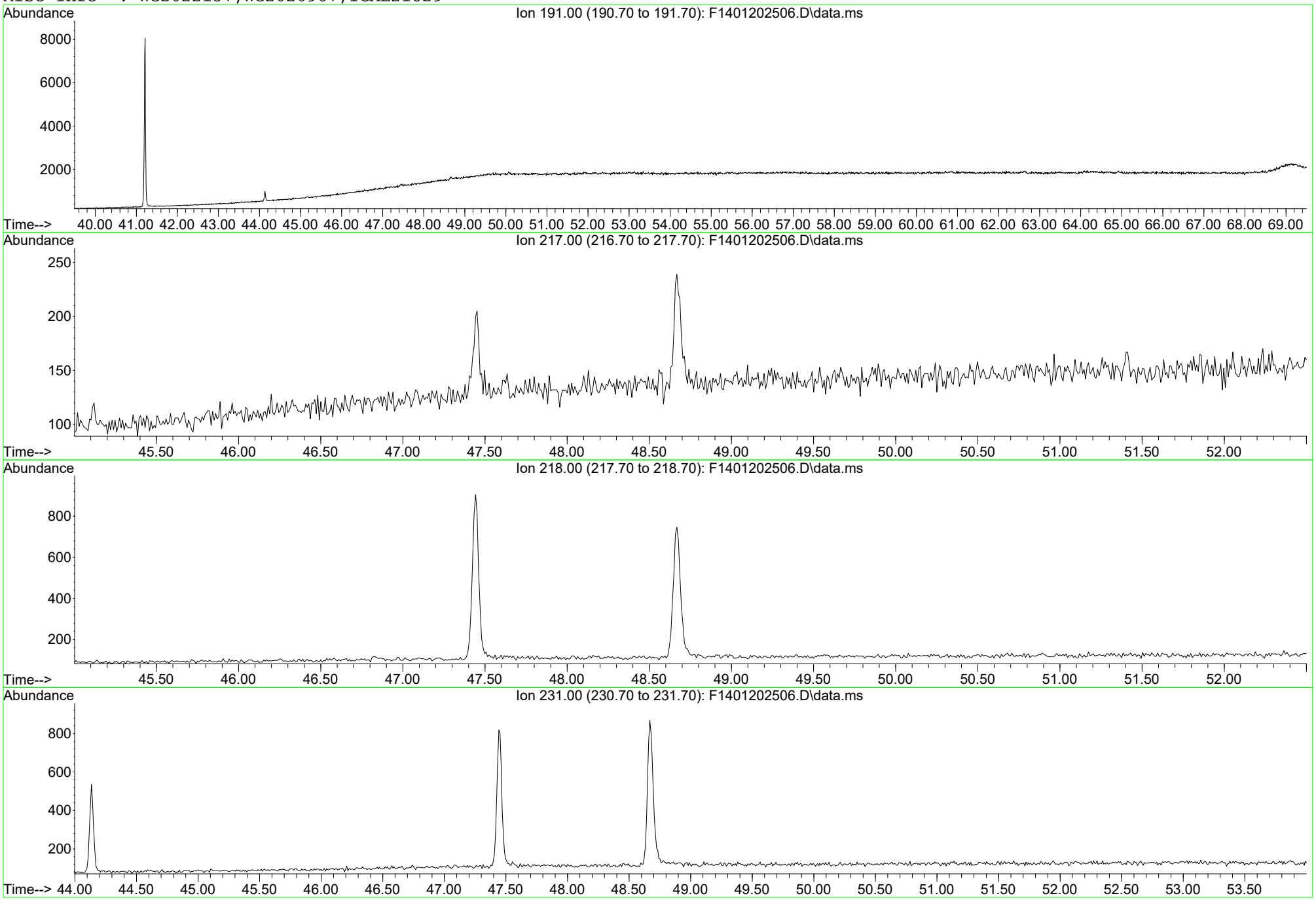


Attachment 5

GC/MS Extracted Ion Profiles

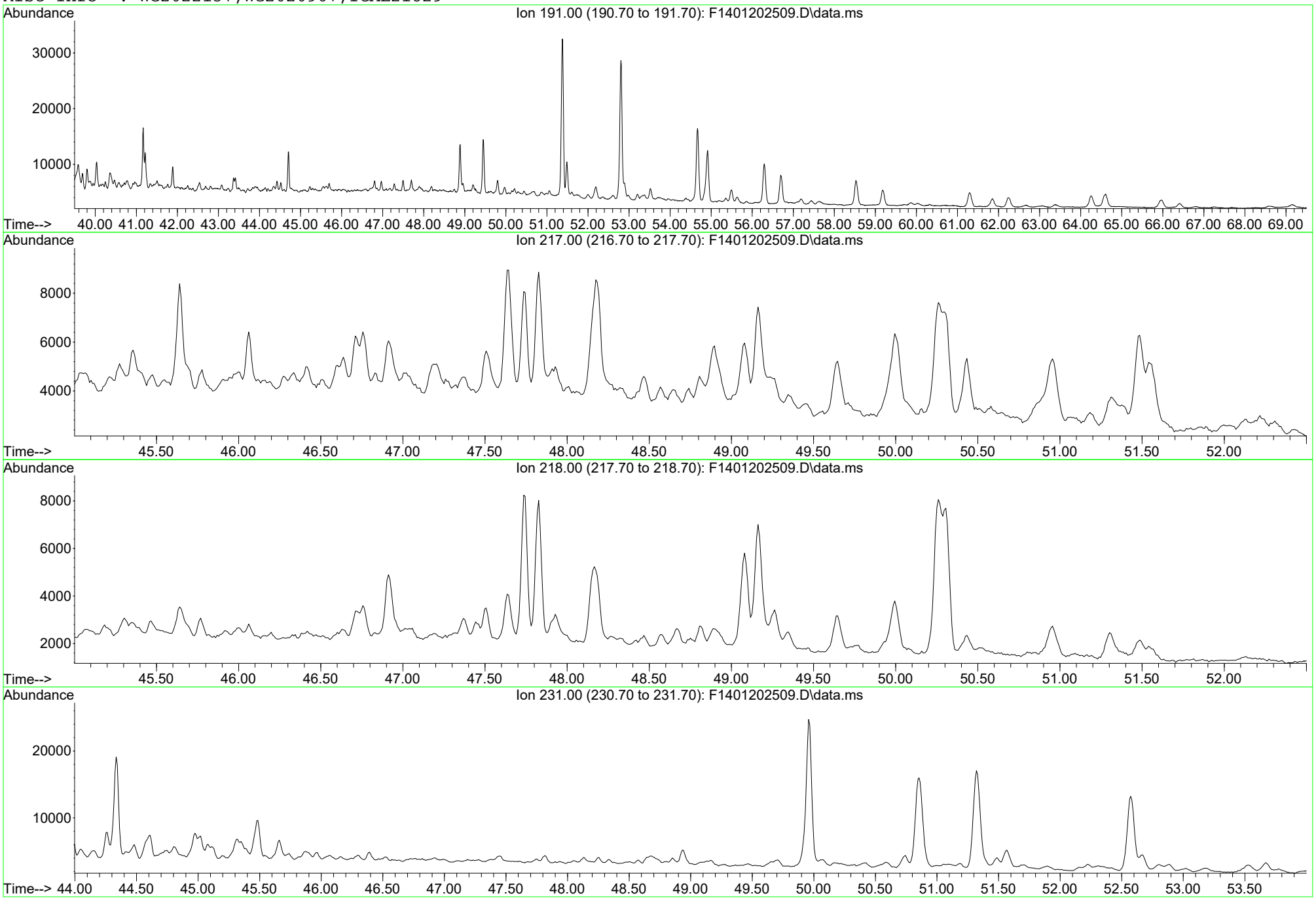
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202506.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 6:05 pm using AcqMethod FRNC14A.M
Sample Name: wg2020967-1,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

Procedural Blank
WG2020967-1



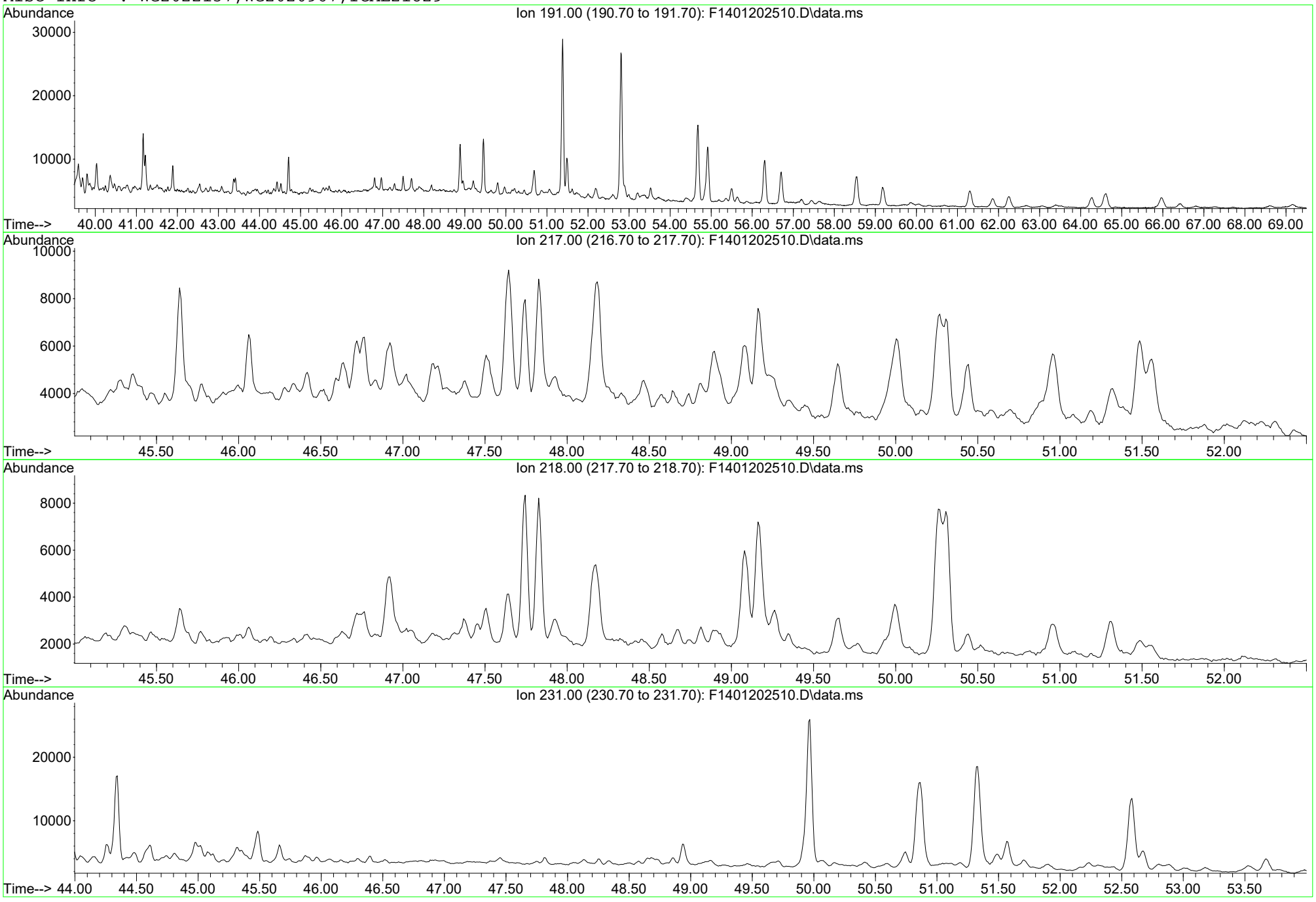
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202509.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 10:17 pm using AcqMethod FRNC14A.M
Sample Name: l2502602-01,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

#4-OIL
L2502602-01



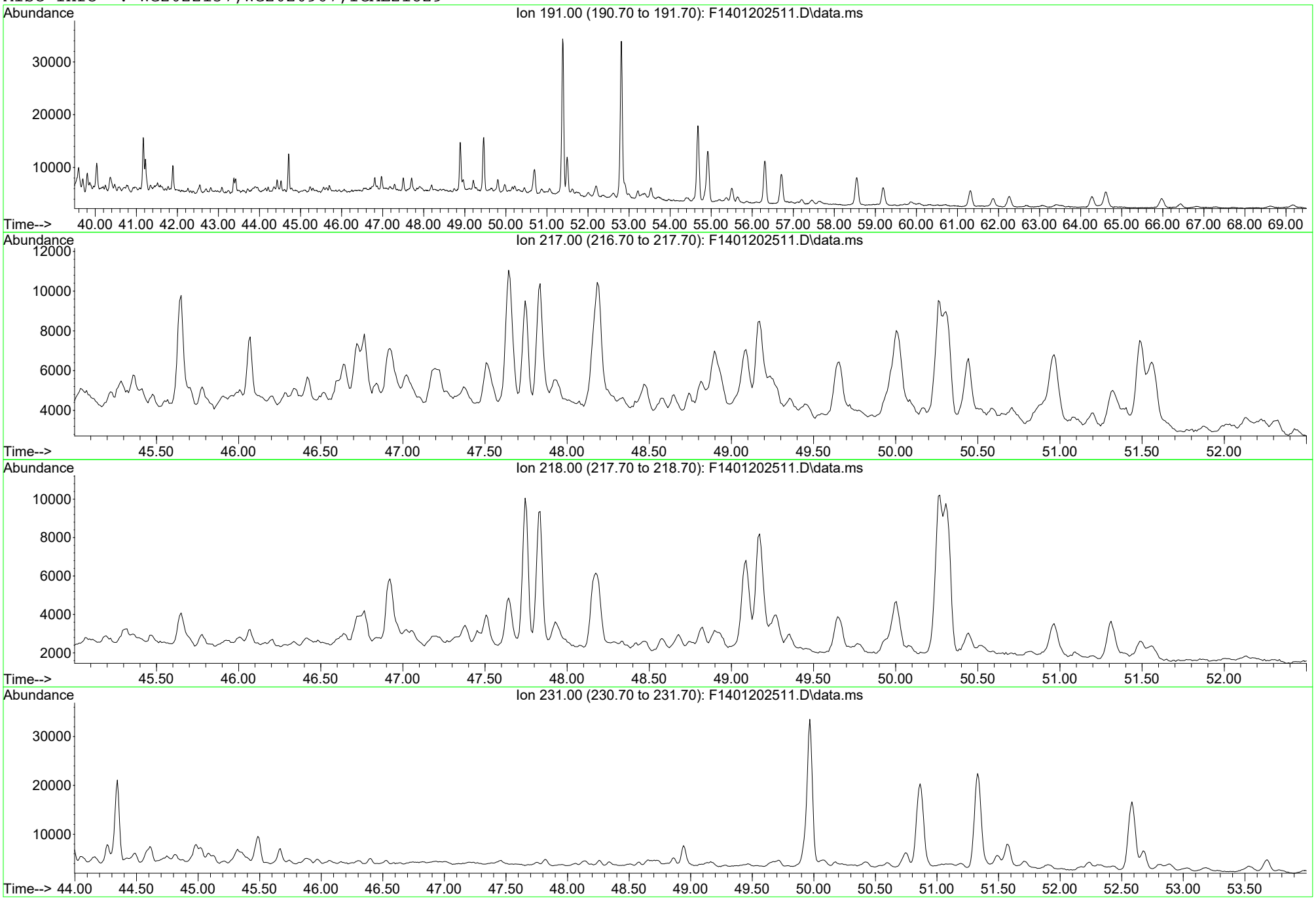
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202510.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 11:41 pm using AcqMethod FRNC14A.M
Sample Name: l2502602-02,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B-OIL
L2502602-02



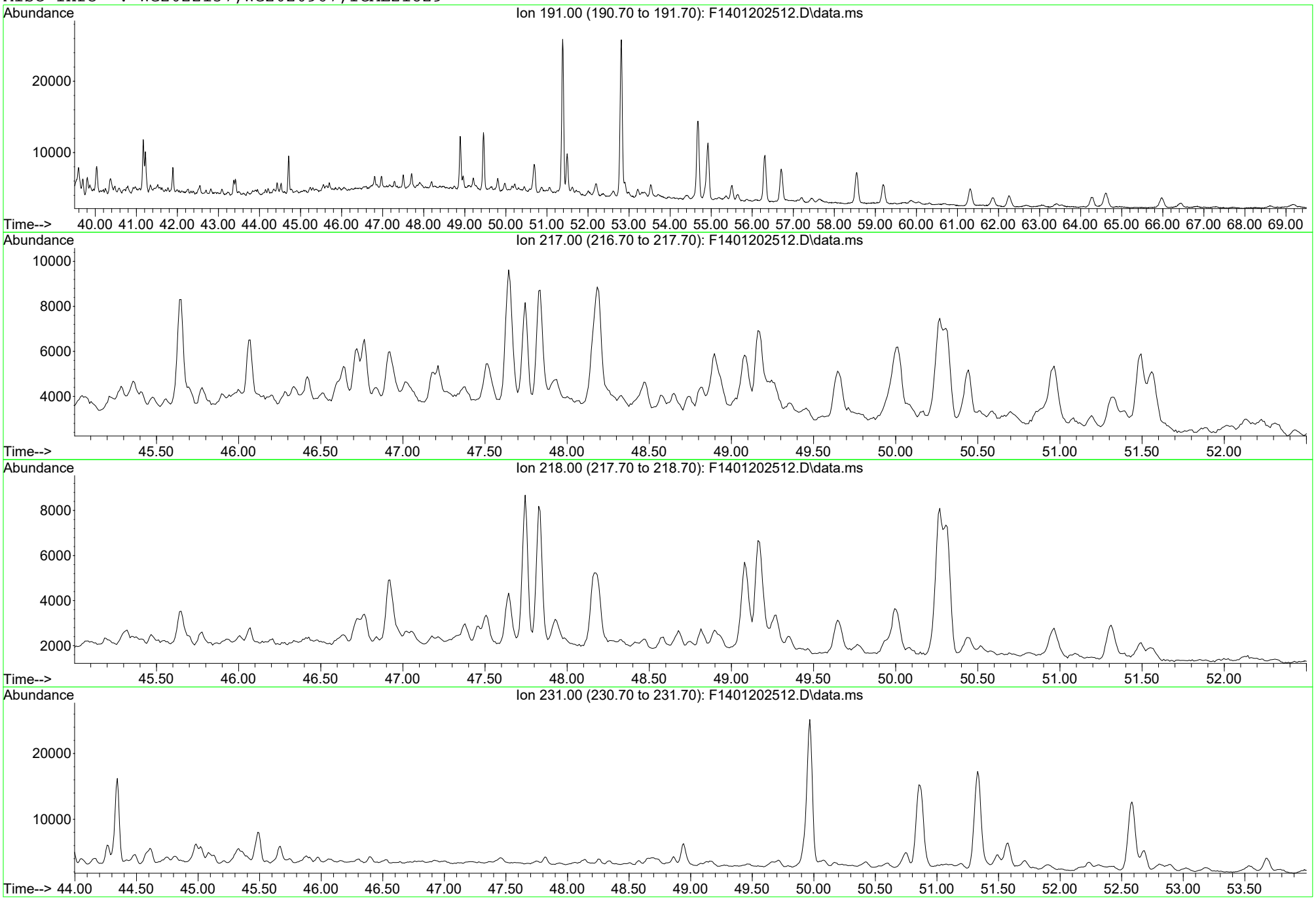
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202511.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 21 Jan 2025 1:05 am using AcqMethod FRNC14A.M
Sample Name: wg2020967-4,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B-OIL Duplicate
WG2020967-4



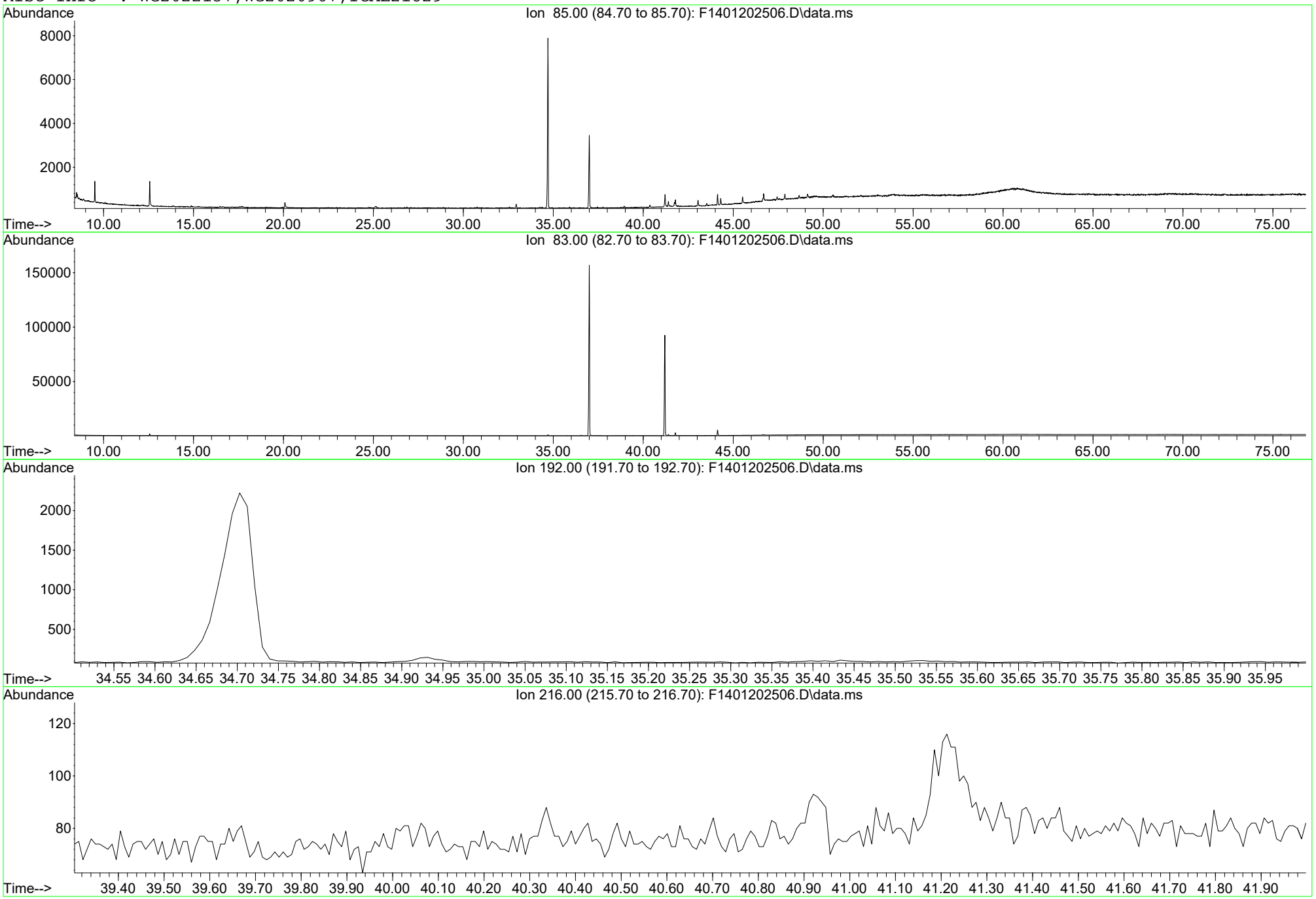
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202512.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 21 Jan 2025 2:29 am using AcqMethod FRNC14A.M
Sample Name: l2502602-03,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B Reference Oil
L2502602-03



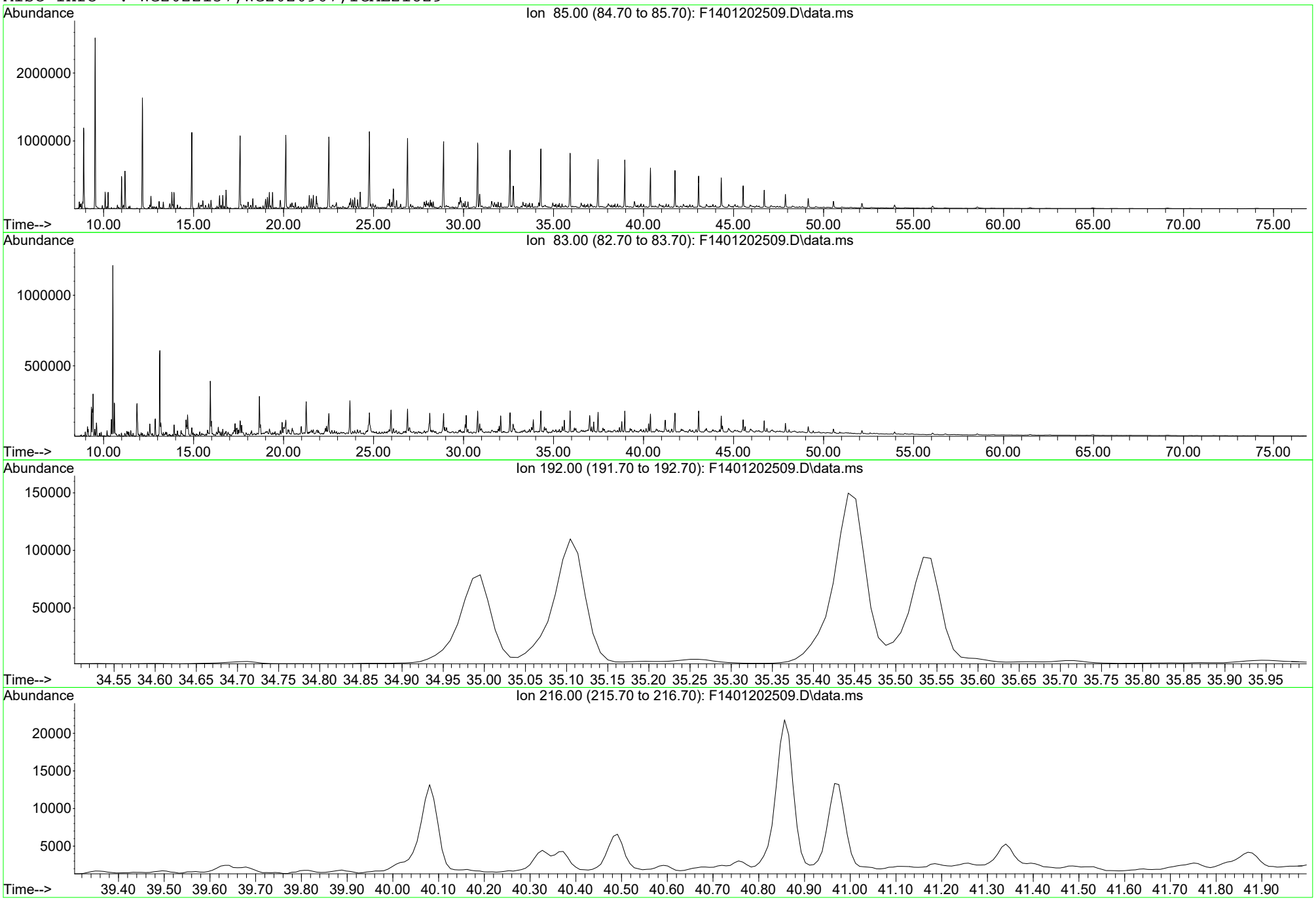
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202506.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 6:05 pm using AcqMethod FRNC14A.M
Sample Name: wg2020967-1,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

Procedural Blank
WG2020967-1



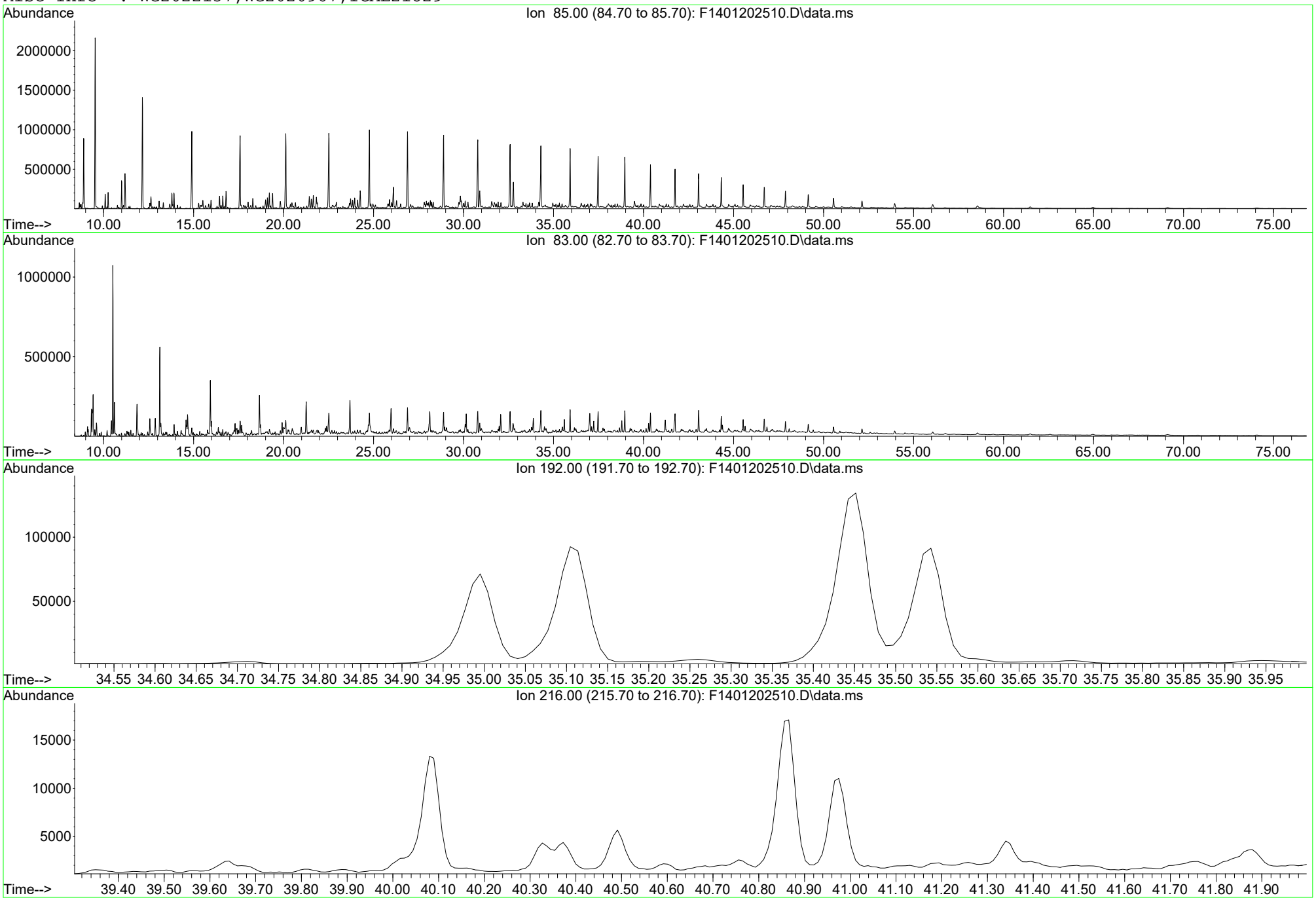
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202509.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 10:17 pm using AcqMethod FRNC14A.M
Sample Name: l2502602-01,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

#4-OIL
L2502602-01



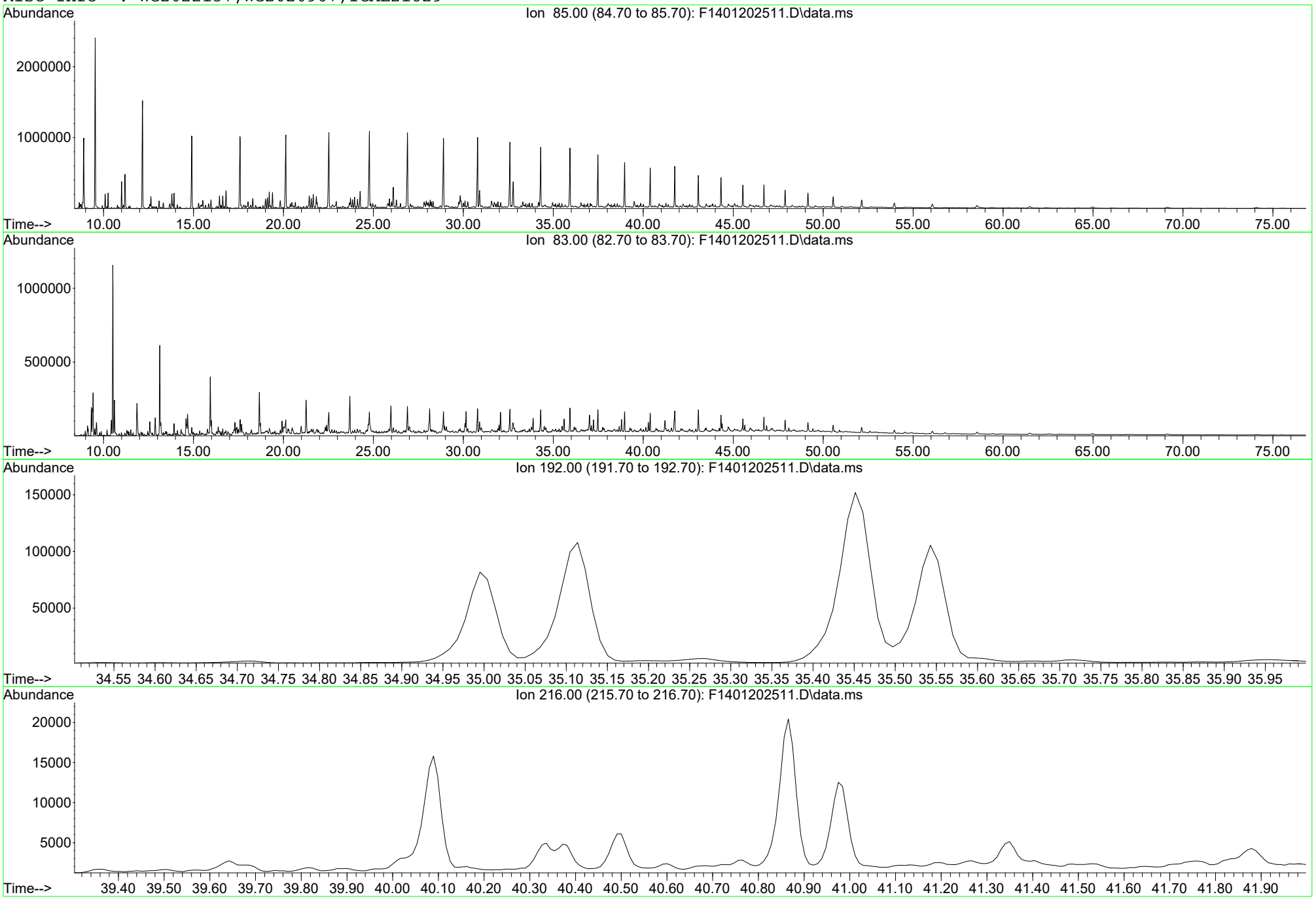
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202510.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 20 Jan 2025 11:41 pm using AcqMethod FRNC14A.M
Sample Name: l2502602-02,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B-OIL
L2502602-02



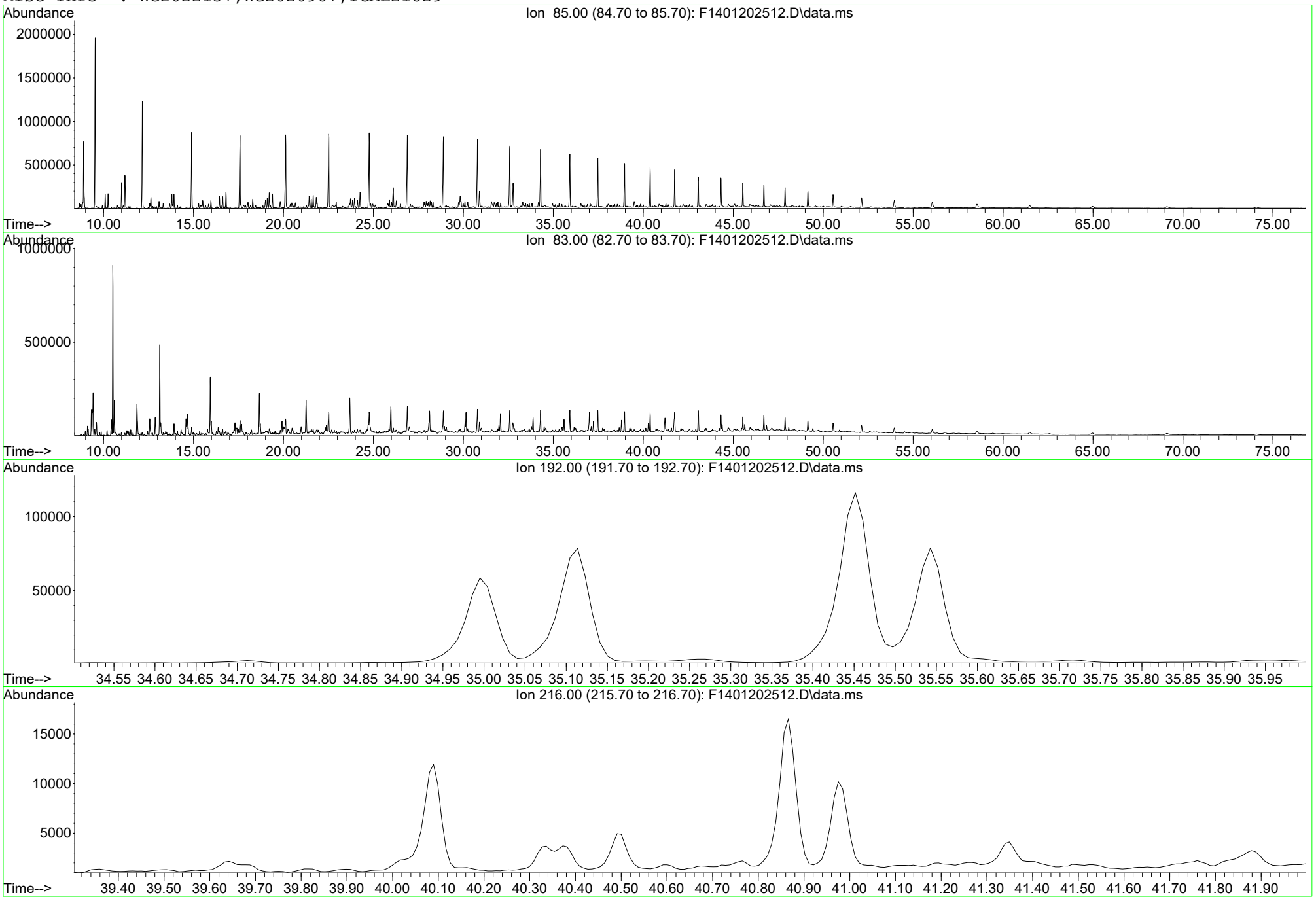
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202511.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 21 Jan 2025 1:05 am using AcqMethod FRNC14A.M
Sample Name: wg2020967-4,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B-OIL Duplicate
WG2020967-4



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2502602\AL
... KPAHBIO\F1401202512.D
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 21 Jan 2025 2:29 am using AcqMethod FRNC14A.M
Sample Name: l2502602-03,32,,
Misc Info : WG2022137,WG2020967,ICAL21829

7B Reference Oil
L2502602-03



Attachment 6

Crude Oil Assays for #4 and 7B cavern oils (Jan. 9, 2025)

Certificate of Analysis

Number: 1030-25010296-001A

Houston Laboratories
8820 Interchange Drive
Houston, TX 77054
Phone 713-660-0901

Scott Himes
ERM
840 W. Sam Houston Parkway North
Houston, TX 77024-4613

Station Name: #4 Oil
Received Date: 01/10/2025
Login Date: 01/10/2025
Method:
Analyzed: 01/27/2025 by VEJ

Report Date: 02/04/2025
Sampled By: TB
Sample Of: Liquid Spot
Sample Date: 01/09/2025 13:40
Sample Conditions:

ASTM D-86 Distillation

% Recovery	°F @ 767 mm Hg
Initial Boiling Point	122
5	222
10	278
20	374
30	NR
40	NR
50	NR
60	NR
70	NR
80	NR
85	NR
90	NR
95	NR
Final Boiling Point	400
Volume % Recovery	22.0
Volume % Residue	78.0
Volume % Loss	0

Comments: Temperatures are uncorrected for barometric pressure.
Visual color is Crude.
IBP to 400°F Naphtha Cut Mass Fraction = 0.2223

Andy Hartman, Laboratory Director

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated. The test results apply to the sample as received.

Houston Laboratories
8820 Interchange Drive
Houston, TX 77054
Phone 713-660-0901

Certificate of Analysis

Number: 1030-25010296-001A

Scott Himes
ERM
840 W. Sam Houston Parkway North
Houston, TX 77024-4613

Station Name: #4 Oil
Sample Conditions:
Received Date: 01/10/2025
Login Date: 01/10/2025

Report Date: 02/04/2025
Sampled By: TB
Sample Of: Liquid Spot
Sample Date: 01/09/2025 13:40

Analytical Data

Test	Method	Result	Units	Detection Limit	Lab Tech.	Analysis Date
Salt in Crude Oil	ASTM D-3230	8.6	lbs/1000 bbls		EC	01/20/2025
Sulfur Content by X-ray	ASTM D-4294	1.691	wt%		EC	01/17/2025
Organic Chloride	ASTM D-4929	<1.0	ppmw		MG	01/29/2025
API Gravity @ 60.01 °F	ASTM D-5002	33.00	°		RMR	01/29/2025
Specific Gravity @ 60.01/60.01 °F	ASTM D-5002	0.8602	_		RMR	01/29/2025
Density @ 60.01 °F	ASTM D-5002	0.8593	g/ml		RMR	01/29/2025

Comments:
AS-D-4929: Sample analyzed by ASTM D-4929 procedure B.
- Mass Fraction = 0.1690

Andy Hartman, Laboratory Director

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated. The test results apply to the sample as received.

SOUTHERN PETROLEUM LABORATORIES, INC.
8820 INTERCHANGE DRIVE
77054, HOUSTON
United States

Attention of : Mrs. T. Hynson
Your reference :

Analysis Report

Report number : **13051/00072342.1/L/25**
Report Date : 01-14-2025
Date of issue : 01-14-2025
Sample object : SPL-Houston
Sample type : Submitted
Sample submitted as : Petroleum Distillates
Marked : #4 Oil 25010296-001B

Submitted date : 01-14-2025
Sample submitted at : Saybolt LP, Deer Park
Date received : 01-14-2025
Date completed : 01-14-2025
Sample number : 17348394

NAME	METHOD	UNIT	RESULT
Metals by ICP	ASTM D 5708		
Procedure			A
Iron (Fe)		mg/kg	2.02
Nickel (Ni)		mg/kg	10.4
Vanadium (V)		mg/kg	49.9

Signed by: Sandra Kaluza - Laboratory Coordinator
Issued by: Saybolt LP
Place and date of issue: Deer Park - 01-14-2025

Certificate of Analysis

Number: 1030-25010296-002A

Houston Laboratories
8820 Interchange Drive
Houston, TX 77054
Phone 713-660-0901

Scott Himes
ERM
840 W. Sam Houston Parkway North
Houston, TX 77024-4613

Station Name: 7B Oil
Received Date: 01/10/2025
Login Date: 01/10/2025
Method:
Analyzed: 01/29/2025 by EC

Report Date: 02/04/2025
Sampled By: TB
Sample Of: Liquid Spot
Sample Date: 01/09/2025 14:00
Sample Conditions:

ASTM D-86 Distillation

% Recovery	°F @ 762.51 mm Hg
Initial Boiling Point	130
5	218
10	260
20	368
30	NR
40	NR
50	NR
60	NR
70	NR
80	NR
85	NR
90	NR
95	NR
Final Boiling Point	400
Volume % Recovery	23.0
Volume % Residue	77.0
Volume % Loss	0

Comments: Temperatures are uncorrected for barometric pressure.
Visual color is Crude.
IBP to 400°F Naphtha Cut Mass Fraction = 0.1690

Andy Hartman, Laboratory Director

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated. The test results apply to the sample as received.

Houston Laboratories
8820 Interchange Drive
Houston, TX 77054
Phone 713-660-0901

Certificate of Analysis

Number: 1030-25010296-002A

Scott Himes
ERM
840 W. Sam Houston Parkway North
Houston, TX 77024-4613

Station Name: 7B Oil
Sample Conditions:
Received Date: 01/10/2025
Login Date: 01/10/2025

Report Date: 02/04/2025
Sampled By: TB
Sample Of: Liquid Spot
Sample Date: 01/09/2025 14:00

Analytical Data

Test	Method	Result	Units	Detection Limit	Lab Tech.	Analysis Date
Salt in Crude Oil	ASTM D-3230	5.0	lbs/1000 bbls		EC	01/20/2025
Sulfur Content by X-ray	ASTM D-4294	1.559	wt%		EC	01/17/2025
Organic Chloride	ASTM D-4929	<1.0	ppmw		MG	01/29/2025
API Gravity @ 60.01 °F	ASTM D-5002	33.84	°		RMR	01/29/2025
Specific Gravity @ 60.01/60.01 °F	ASTM D-5002	0.8558			RMR	01/29/2025
Density @ 60.01 °F	ASTM D-5002	0.8549	g/ml		RMR	01/29/2025

Comments:
AS-D-4929: Sample analyzed by ASTM D-4929 procedure B.
- Mass Fraction = 0.1690

Andy Hartman, Laboratory Director

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated. The test results apply to the sample as received.

SOUTHERN PETROLEUM LABORATORIES, INC.
8820 INTERCHANGE DRIVE
77054, HOUSTON
United States

Attention of : Mrs. T. Hynson
Your reference :

Analysis Report

Report number	: **13051/00072342.1/L/25**	Submitted date	: 01-14-2025
		Sample submitted at	: Saybolt LP, Deer Park
Report Date	: 01-14-2025	Date received	: 01-14-2025
Date of issue	: 01-14-2025	Date completed	: 01-14-2025
Sample object	: SPL-Houston	Sample number	: 17348395
Sample type	: Submitted		
Sample submitted as	: Petroleum Distillates		
Marked	: 7B Oil 25010296-002B		

NAME	METHOD	UNIT	RESULT
Metals by ICP	ASTM D 5708		
Procedure			A
Iron (Fe)		mg/kg	0.29
Nickel (Ni)		mg/kg	7.90
Vanadium (V)		mg/kg	29.8

Signed by: Sandra Kaluza - Laboratory Coordinator
Issued by: Saybolt LP
Place and date of issue: Deer Park - 01-14-2025

SPL, Inc.
Analysis Request Chain of Custody Record

SPL

SPL Work Order No.:	Acct. Mate Code:	Dept. Code	Page	Pages
			1	1

Report To: (Company Name):	ERM			Project/Station Name:	Project/Station Number:	Project/Station Location:	Requested TAT*
Address:	840 W. Sam Houston Parkway North Suite 600			Sulphur Dome	765886	Sulphur, LA	
City/State/Zip:	Houston	TX	77024-4613	Special Instructions:			10 business days
Contact:	Scott Himes	Scott.Himes@erm.com		Indicate Billing Type: (Place "X", where appropriate)	Net 30 day Acct.	Check #	
Phone:	832-209-8811	Fax:			Credit Card	<<<Contact SPL, Inc for CC payment arrangements.	* Surcharges May Apply (See quote for details)
Invoice To: (Company Name):	ERM						
Address:	840 W. Sam Houston Parkway North Suite 600			† Terms: Cylinders will be rented for $10/cyl. All cylinders checked out are to be returned within 21 days, whether they contain sample or not. Cylinders not returned after 30 days will be considered lost and will be billed at current replacement cost.			
City/State/Zip:	Houston	TX	77024-4613				
Contact:	Scott Himes	Scott.Himes@erm.com					
Phone:	832-209-8811	Fax:					
Client PO# or Ref. No.:							
Contract/Proposal #: (i.e. SPLQ####)	SPLQ10978						

Sample ID (used to log/track sample)	Sample Date	Sample Time	Sample Type (Gas/Liq. /Solid)	Duplicate	Composite	Spot	Cylinder Tracking Info† Cylinder #	Date Out	Date In	AS-D-5002	AS-D-4294	ASTM D-5708	AS-D-3230	ASTM D-86-IBP-400°F	AS-D-4929							Comments
										Requested Analysis (Place an "X" next to Sample ID below)												
#4 Oil	01/09/25	13:40	Liq Oil			X				X	X	X	X	X	X							
7B-Oil	01/09/25	14:00	Liq Oil			X				X	X	X	X	X	X							

12:40
1/10/25

Sampled By-Print Name:	Taylar Brown			Received By-Company:	
Signature:	Taylar Brown				
Relinquished By-Print Name:	Taylar Brown	Date: 01/10/25	Time: 12:45	Received By-Print Name:	Bryan Mendez
Signature:	Taylar Brown			Signature:	BM
Relinquished By-Print Name:		Date:	Time:	Received By-Print Name:	Date: Time:
Signature:				Signature:	
Relinquished By-Print Name:		Date:	Time:	Received By-Print Name:	Date: Time:
Signature:				Signature:	

Note - As a convenience to our clients, this form is available in an electronic format. Please contact one of our offices above for the form to be e-mailed to you.