November 7, 2023

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

Chemical Fingerprint of Bubble Site 19 Sheen –
October 15, 2023
Westlake Sulphur Dome Study

Dear Mr. Charpentier,

NewFields is pleased to provide you with this report of chemical fingerprinting results for a sheen sample collected on October 15, 2023 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).

This study follows eight earlier chemical fingerprinting studies at the Site.[1,2,3,4,5,6,7,8] These earlier studies included four oils from the 7B cavern well (collected between January and June 2023), 13 crude oil samples from nine Yellow Rock wells and the Yellow Rock tank battery. 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 and June 2023, indicating no local crude oil(s) had or was presently entering Cavern 7.

Several earlier studies also included eight floating surface oils/sheens/materials from five surface locations (Bubble Sites No. 14, 20, 22, and 24 and Central Lake) between January 2023 and mid-September 2023, which showed:

[1] Stout, S.A. (2023) Chemical fingerprinting of oils, Westlake Sulphur Dome Study. NewFields Report dated March 10, 2023.
[2] Stout, S.A. (2023) Chemical fingerprint of oily net – No. 20, Westlake Sulfur Dome Study. NewFields Report dated April 27, 2023.
[3] Stout, S.A. (2023) Chemical fingerprint of 7B cavern oil – March 30, 2023, Westlake Sulfur Dome Study. NewFields Report dated May 3, 2023.
[4] Stout, S.A. (2023) 7B Cavern Oil, Cavern 4 Oil, Select Yellow Rock Well Oils, and a Bubble Site 24 Sheen – May 2023, Westlake Sulphur Dome Study. NewFields Report dated July 11, 2023 – Amended July 14, 2023.
[5] Stout, S.A. (2023) Chemical fingerprint of 7B cavern oil, selected Yellow Rock well oils and a Central Lake sheen – June 2023, Westlake Sulfur Dome Study. NewFields Report dated July 25, 2023.
[6] Stout, S.A. (2023) Chemical fingerprinting of additional Yellow Rock well oils – mid- to late-August 2023, Westlake Sulphur Dome Study. NewFields Report dated Oct. 4, 2023.
[7] Stout, S.A. (2023) Chemical fingerprint of floating materials, Central Lake and Bubble Site 14 – September 11, 2023, Westlake Sulphur Dome Study. NewFields Report dated Oct. 5, 2023.
[8] Stout, S.A. (2023) Chemical fingerprint of Bubble Site 14 sheen – September 20, 2023, Westlake Sulphur Dome Study. NewFields Report dated Oct. 17, 2023.

- Any oil present in the surface samples was derived from locally produced crude oil(s), not 7B cavern oil.

The present study provides results on a floating oil sheen sample collected from a previously unsampled location, Bubble Site No. 19, on October 15, 2023. I understand the sample was collected at the request of LDNR.

Samples

Table 1 provides an inventory of samples included in this study – along with those previously studied for ease of reference. The sheen sample from Bubble Site No. 19 was collected on October 15, 2023 by personnel from ERM using a pre-cleaned Teflon net. The sample was sent to NewFields' alliance laboratory, Alpha Analytical (Alpha; Mansfield, Massachusetts, USA), on October 16 where it 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 determine the character of any oil within the Bubble Site No. 19 sheen collected October 15 and compare it to oils recovered from Cavern 7 (7B cavern oil), locally produced oils from nearby Yellow Rock wells, and previously studied surface oils/sheens. Of specific concern was whether the oil present within the sheen may be derived from recent or active seepage of subsurface oil from Cavern 7 and/or local reservoirs/wells.

Methods

This objective was pursued using specific chemical fingerprinting analyses and interpretation protocols employed in oil spill identification studies,[9] as were described in the previous reports and their attachments.[10]

As first described in the study of May 2023 oils (Footnote 4), this study also included the (re-) analysis of the cavern 7B oil collected in January 2023 (Table 1), 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. The results obtained herein for the site-specific reference oil yielded only very minor revisions to the short- and long-term relative standard deviation values (RSD_r and RSD_R) for the 30 DRs assessed throughout the on-going study. As in earlier studies, the updated RSD values identified 17 DRs with the most precisely measured DRs are presented in **Attachment 2** herein. (See Attachment 3 within Footnote 6 for additional discussion of short- and long-term precision.)

Results & Discussion

The complete Alpha Environmental Testing Report (ETR) including all sample preparation data, instrument calibrations, QC data and chromatograms is maintained on file by NewFields (ETR L2361423). The tabulated results for the targeted compounds in each analysis performed are contained in **Attachment 3**. A table comparing diagnostic ratios of the samples studied is contained in **Attachment 4**. The full-size GC/FID chromatogram obtained in Tier 1 (modified EPA

[9] 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.

[10] See Attachments 2 and 3 in the earlier reports (Footnotes 1, 3, 4, 5, and 6).

Method 8015D) analysis is provided in **Attachment 5** and selected extraction ion profiles (EIPs) obtained in Tier 2 (modified EPA Method 8270D) are provided in **Attachment 6**.

Specific results most relevant to the study's objectives are presented in **Figures 1 to 4**. Discussion of these results is provided in the following sections.

Tier 1 – General Character of the Bubble Site No. 19 Sheen

Figure 1 shows the GC/FID (C8+) chromatogram for the extractable material in the Bubble Site No. 19 sheen sample collected October 15, 2023 (Fig. 1A) and the 7B cavern (reference) oil re-analyzed herein (Fig. 1B), which are described in the following paragraphs.

The chromatogram for the Bubble Site No. 19 collected Sept. 20 shows two clusters of resolved peaks with no discernable petroleum-like pattern(s) that occur centered around ~C20 and C30. The latter cluster does include a series of odd-carbon numbered dominated n-alkanes between C25 and C35 (see Attachment 3, Table A3-1 and Attachment 6, *m/z* 85). These C25+ odd-carbon dominated n-alkanes are atypical of petroleum but common to modern plant waxes. The overall character of the two clusters of peaks is also common to modern biological (plant and/or bacterial) materials, likely consisting of sesqui-, di- and tri-terpenoids.[11] Thus, all of the resolved peaks in the Bubble Site No. 19 sheen studied herein (Fig. 1A) are not derived from oil, but rather from naturally occurring "biogenic" material. As such, it is unsurprising that the 7B cavern oil exhibits a very different chromatographic character typical of an unweathered crude oil (Fig. 1B), which has been described in previous reports.

Generally comparable "biogenic" chromatographic features were evident in three previously studied sheens collected from the Central Lake (Jan. 25 and Sept. 11, 2023) and Bubble Site No. 14 (Sept. 11, 2023). These three samples' GC/FID chromatograms are shown in **Figure 2**, including that of the Bubble Site No. 19 sheen studied herein. Comparison reveals a significant degree of comparability among the resolved peaks/compounds, which (as noted above) are derived from biogenic material present in all four of these sheens. Notably, however, the chromatograms for the Bubble Site No. 19 sheen studied herein and the Central Lake sheen from January (Fig. 2A-B) do not exhibit any unresolved complex mixture (UCM), which appears as a broad "hump" in the chromatograms for the sheens collected from Central Lake and Bubble Site No. 14 in September (Fig. 2C-D). The UCM is a long-established characteristic feature of weathered (biodegraded) petroleum and its absence/presence in these four sheens reflects and absence/presence of a petroleum component.[12]

In summary, the Tier 1 results indicate that:

- The sheen collected from Bubble Site No. 19 on October 15, 2023 is comprised of naturally occurring biogenic materials, not crude oil (or any other form of petroleum).

Tier 2 – Detailed Character/Comparison of the Bubble Site No. 19 Sheen

The Tier 1's conclusion regarding the Bubble Site No. 19 sheen (bullet above) was further investigated using GC/MS in Tier 2. **Figure 3** shows the extracted ion profiles (EIPs) for three

[11]For example; Wang, Z. et al. (2009) Forensic differentiation of biogenic organic compounds from petroleum hydrocarbons in biogenic and petrogenic compounds cross-contaminated soils and sediments. J. Chromatogr. A, 1216: 1174-1191.

[12] The weathered (biodegraded) petroleum component present in the from Central Lake and Bubble Site No. 14 sheens collected September 11, 2023 were previously shown to be consistent with locally produced crude oil (and not 7B cavern oil). See Footnote 7.

groups of targeted petroleum biomarkers [triterpanes, (dia- and regular) steranes, and triaromatic steroids] in the Bubble Site No. 19 sheen and, for comparison, those for the 7B cavern (reference) oil studied herein. Inspection shows that the Bubble Site No. 19 sheen does not contain recognizable patterns of petroleum biomarkers but is instead dominated by non-target compounds of biogenic origin (Fig. 3A, C, and E).[13] Again, unsurprisingly, the 7B cavern (reference) oil contains prominent petroleum biomarkers in characteristic patterns (Fig. 3B, D, and F).

Given the apparent absence of any oil in the Bubble Site No. 19 sheen sample studied (Figs. 1A and 3A, C, and E), a quantitative (statistical) analysis of this sample's diagnostic ratios (DRs) is unwarranted. Per the CEN (2012) oil spill identification protocol[14] the Bubble Site No. 19 sheen sample could be classified as "Inconclusive" owing to the absence of oil in the sample. Nonetheless, for consistency with previous NewFields fingerprinting reports in the on-going Sulphur Dome study, the DRs for the Bubble Site No. 19 sheen sample were calculated using the reported concentrations of "detected" diagnostic compounds (see Footnote 13). The resulting DRs were compared to those of the 7B cavern (reference) oil re-analyzed herein using the CEN protocol's 95% confidence level criteria.[15] These tabulated results are presented in Attachment 4, which (as can be seen) would warrant a classification of "Non-Match".

Review of Surface Oils/Sheens Studied to Date

In an earlier report,[16] I reviewed the character of all of the surface oil/sheen (net) samples from the Site studied to date. Part of that review included a side-by-side comparison of each sample's GC/FID (C8+) chromatogram, which I've reproduced in **Figure 4** now including the addition of the Bubble Site No. 19 sheen's chromatogram (Fig. 4A).

Inspection shows that, as also was evident above (Fig. 2A), the Bubble Site No. 19 sample studied herein exhibits no UCM hump characteristic of weathered petroleum. The only other sheen also concluded to contain no petroleum was collected from Central Lake on January 25, 2023 (Fig. 4B). Both these sheens consisted entirely of naturally occurring biogenic material.

A trace and minor amount of petroleum was present in the biogenic-rich sheens collected from Central Lake and Bubble Site No. 14 on September 11, 2023, respectively Fig. 4C-D). Each of the remaining five sheens studied were all shown to be comprised of petroleum, i.e., variably

---

[13] There are some target biomarkers reported to be present in the Bubble Site No. 19 sheen sample by Alpha (Attachment 3). However, these "detected" compounds are explained by trace amounts of co-eluting biogenic compounds that happen to produce a small peak within the retention time window of a targeted biomarker. The lack of any biomarker pattern, however, argues these small peaks are not authentically derived from petroleum.

[14] 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.

[15] 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).

[16] See Footnote 7.

evaporated and biodegraded crude oil with no biogenic material obviously present (Fig. 4E-I). Chemical fingerprinting of the crude oil in each of these five sheens demonstrated they all contained locally produced crude oil as represented by the 13 Yellow Rock oils studied to date (Table 1). As previously assessed,[17] the origin of these local crude oils in the area's near surface environment likely derives from natural oil seepage, which first promulgated oil exploration/production at Sulphur Dome more than 150/100 years ago, or from spillage over decades of local oil production.[18]

None of the nine surface sheens studied to date contain 7B cavern oil leaked from Cavern 7.

Summary of New Findings

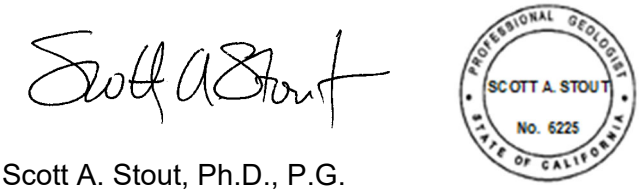
Chemical fingerprinting of a surface sheen collected from Bubble Site No. 19 on October 15, 2023 shows:

- The sheen contained no petroleum but was instead comprised of naturally-occurring biogenic material.

Along with a sample collected from Central Lake in January 2023, this sample represents the second occasion that a surface sheen in the Sulphur Dome area, which was perceived to (possibly) be or contain petroleum, did not contain petroleum.

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: Diagnostic ratio table
5: Full size GC/FID chromatograms
6: Selected GC/MS extraction ion profiles

[17] See Footnote 7.
[18] Law Engineering Testing Company (1980) Geologic characterization of Sulphur Mines SPR site, Sulphur, Louisiana. Report to Sandia Laboratories dated Oct. 10, 1980 that appears as Section II in SPR Geotechnical Division Report SAND80-7141, dated March 1981. [The Dome's first oil wells were drilled in 1867 based on surface seeps with commercial production commencing in 1915 (p. 4-12).]

Table 1: Inventory of samples from the current study and studied previously.

Current Study Samples

Client/ Field ID	Lab ID	Matrix	Date Collected	Description of Sample
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)

Previously-Studies Samples

Client/ Field ID	Lab ID	Matrix	Date Collected	Description of Sample
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

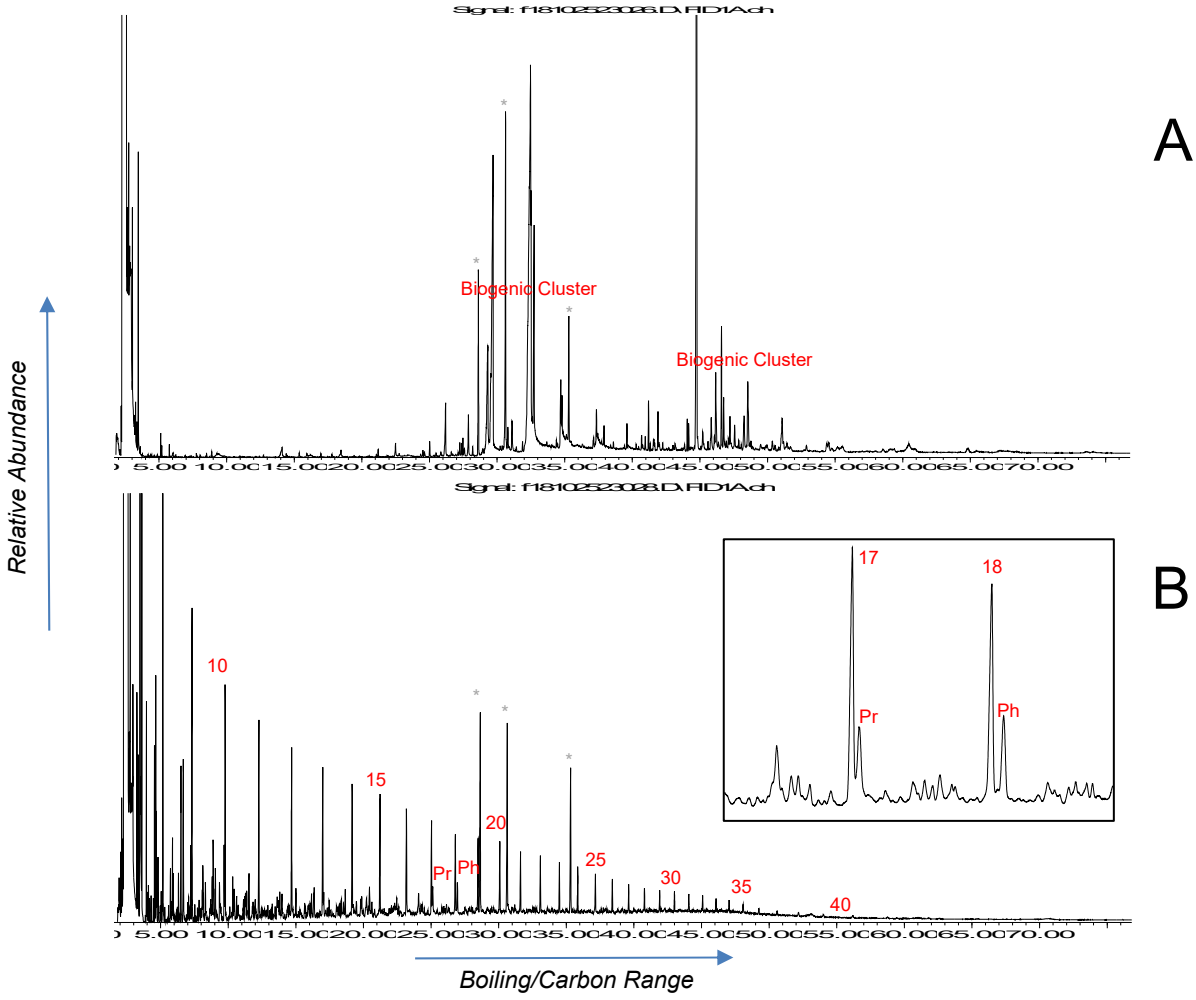


Figure 1: GC/FID (C8+) chromatograms for (A) No. 19 Sheen (October 15, 2023) and (B) 7B cavern (reference) oil (Jan. 25, 2013) re-analyzed herein. #: n-alkane carbon number; Pr: pristane; Ph: phytane; UCM: unresolved complex mixture; *: internal standard.

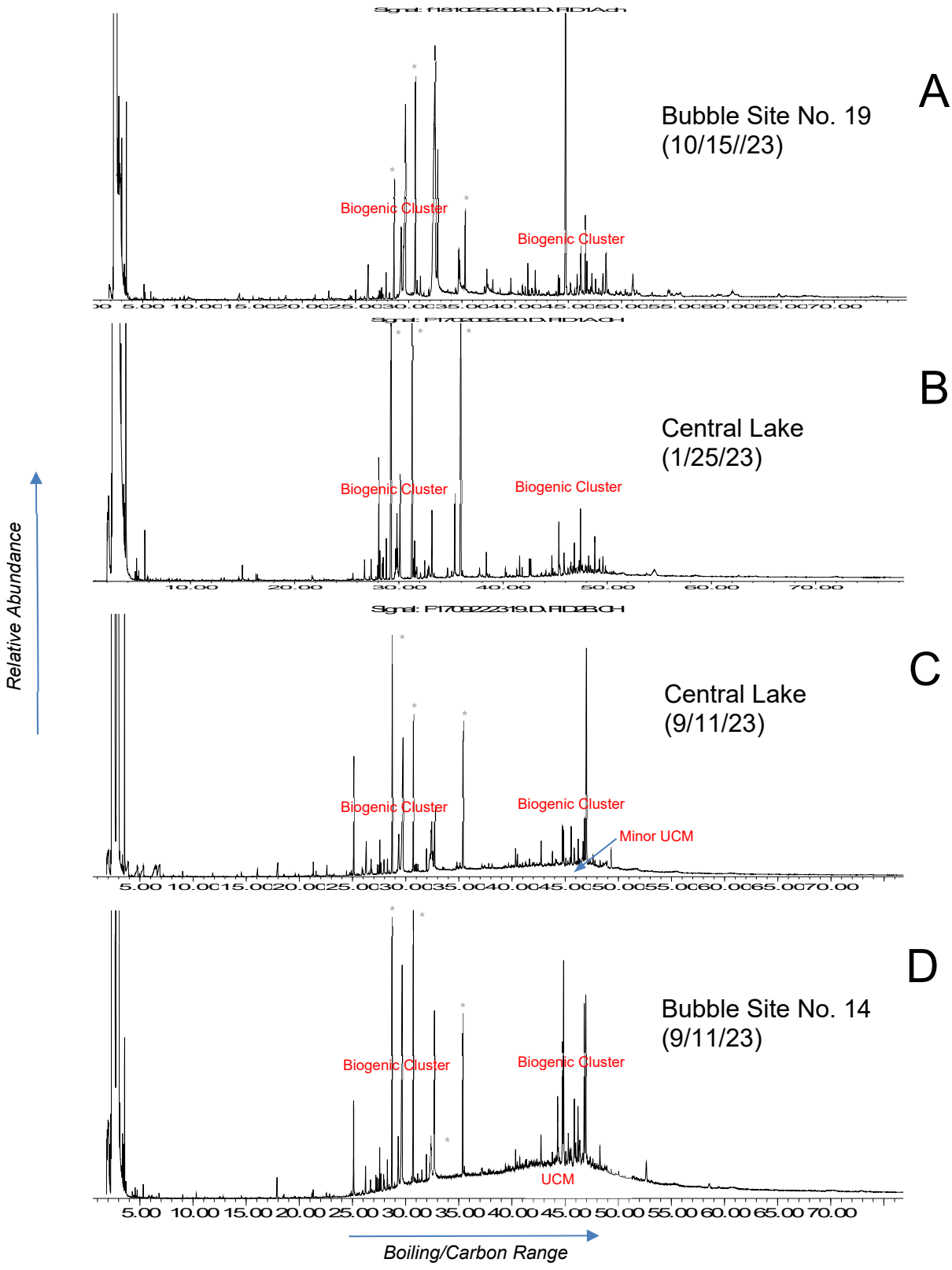


Figure 2: GC/FID (C8+) chromatograms for (A) No. 19 Sheen (October 15, 2023) and previously studied sheens containing biogenic materials; (B) Central Lake sheen (Jan. 25, 2023), (C) Central Lake sheen (Sept. 11, 2023), and (D) Bubble Site No. 14 sheen (Sept. 11, 2023). Note the absence of any observable UCM in (A) and (B) indicating an absence of an oil component. *: internal standard.

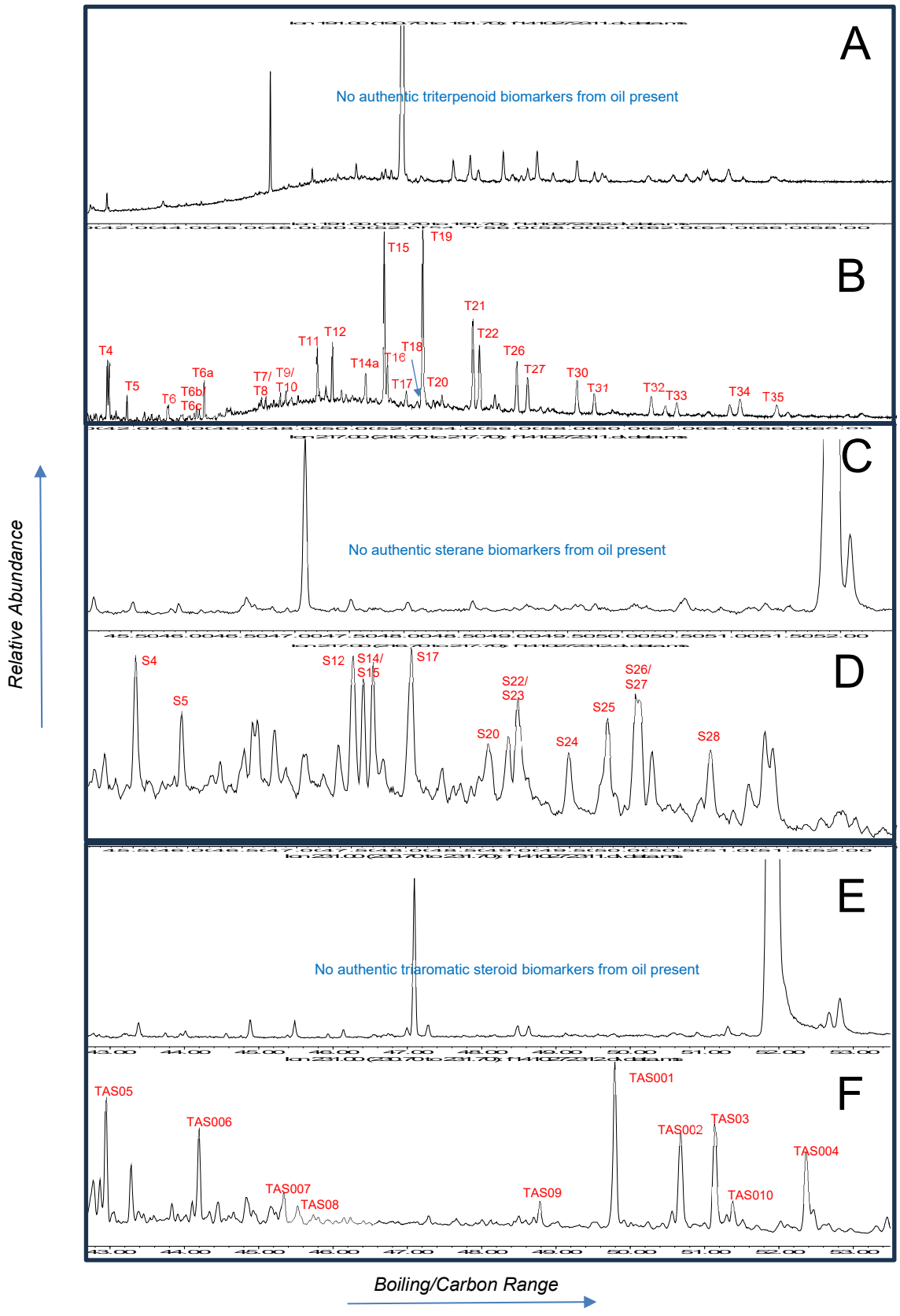


Figure 3: Partial extracted ion chromatograms [(A)-(B); *m/z* 191; (C)-(D), *m/z* 217; (E)-(F), *m/z* 231] for (A)/(C)/(E) Bubble Site No. 19 sheen (Oct. 15, 2023) and (B)/(D)/(F) 7B cavern (reference) oil (Jan. 25, 2013) analyzed herein. Red labels: various triterpenoid and sterane biomarkers, see Attachment 3, Table A3-2 for compound names. Note the absence of biomarker patterns in (A) and (C), which instead contain prominent peaks of biogenic origin, not oil.

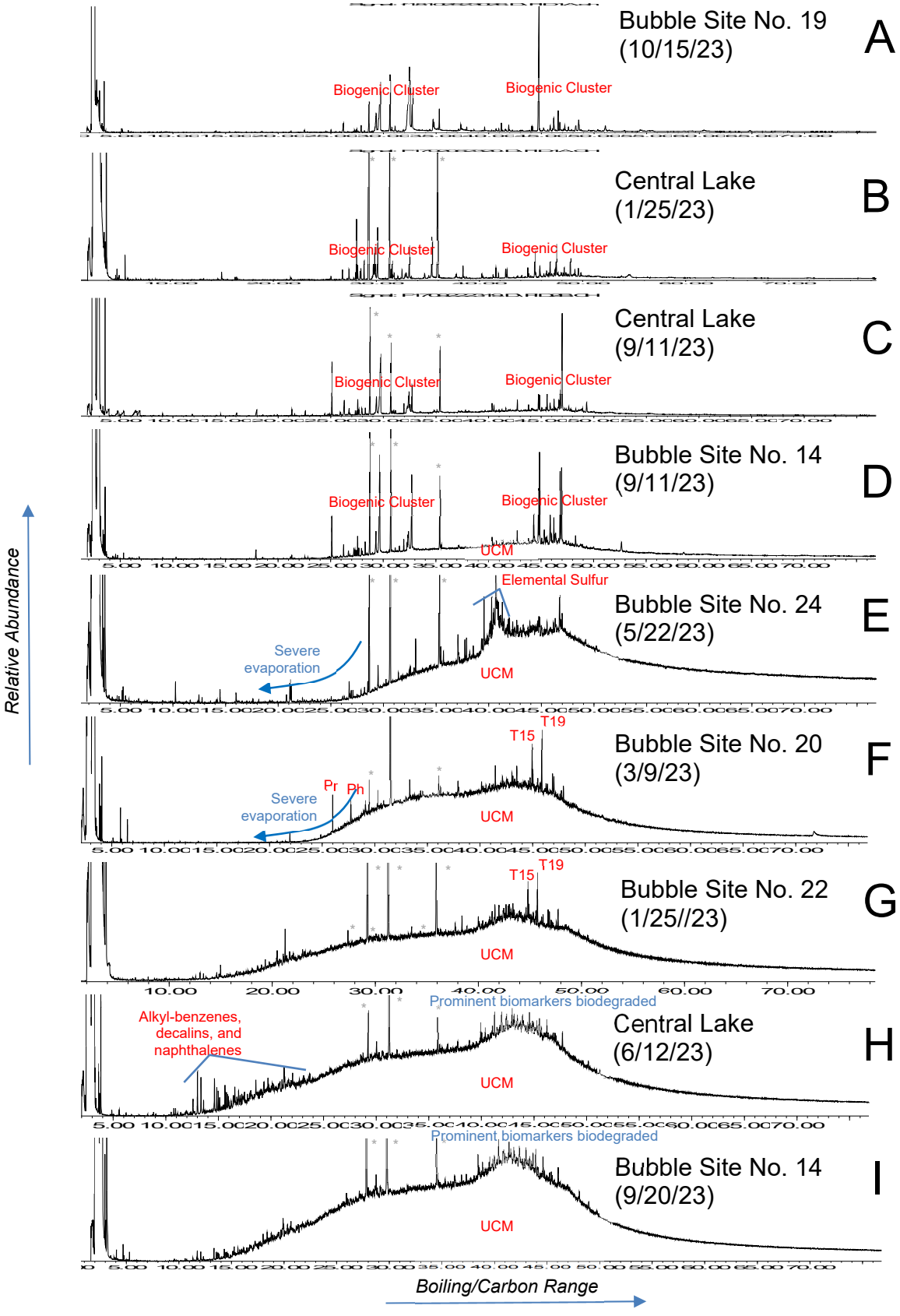


Figure 4: GC/FID (C8+) chromatograms for all surface oils/sheens from Sulphur Dome area studied to date (indicated in parentheses). The relative prominence of the UCM humps reflects relative abundance of weathered crude oil; (A) and (B) contain no measurable oil. Pr: pristane; Ph: phytane; T15: norhopane; T19: hopane; UCM: unresolved complex mixture; *: internal standard. All chromatograms (except A) were previously presented and described in earlier fingerprinting reports.

ATTACHMENTS

10/17/23 L2361423

NewFields
Perspective. Vision. Solutions.

Chain of Custody

Environmental Forensics Practice LLC

Proj. No	Proj. Name
0701093	Sulphur Dome

SAMPLERS: Signature: Brad Hayes

	DATE	TIME	LAB ID	CLIENT ID	SAMPLE DESCRIPTION	MATRIX (* see below)	GC-FID-TPH (C_6+)	GCMS-Alkyl PAH	GCMS-Biomarkers	PIANO - VOA	Organic Lead	METALS	PCB	Pesticides	PRESERVED	Total Number of Containers
-01	10-15-23	1100pm		Westlake #19	Sheen	O	X	X	X	X						1

ANALYSIS REQUESTED→ "NUMBER OF CONTAINERS"

Relinquished by:	Date/Time	Received by:	Date/Time
TAYLOR BROWN	10/16/23 17:00	FEDEX	
FEDEX 10/17/23 10:04			10/17/23 10:04

* O=Oil
SO=Soil
SE=Sediment
T=Tissue
W=Water

Samples to be shipped to: Alpha Laboratory
320 Forbes Blvd.
Mansfield, MA 02048
Tel: (508) 844-4117
Attn: Sue O'Neil

Comments:
Contact Scott Stout for further details.

Attachment 1
Chain-of-Custody

Attachment 2

Table A2-1: 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	2.0	5.1	
NR-C18/phy	C18/Ph	1.0	2.4	x
NR- pris/phy	Pr/Ph	1.7	4.5	x
NR-4-MD/1-MD	4-MDBT/1-MDBT	3.0	9.0	
NR-2-MP/1-MP	2-MP/1-MP	2.6	3.9	x
NR-27Ts/30ab	T11/T19	3.4	2.1	x
NR-27Tm/30ab	T12/T19	2.3	3.1	x
NR-28ab/30ab	T14a/T19	2.5	7.8	
NR-29ab/30ab	T15/T19	2.3	2.3	x
NR-30O/30ab	T18/T19	6.8	69.6	
NR-31abS/30ab	T21/T19	1.1	2.9	x
NR-27dbR/27dbS	S4/S5	5.1	15.2	
NR-27bb/29bb	(S14+S15)/(S26+S27)	3.7	1.9	x
NR-SC26/ RC26+SC27	TAS09/TAS01	2.5	3.0	x
NR-SC28/RC26 + SC27	TAS02/TAS01	2.8	1.8	x
NR-RC27/RC26+ SC27	TAS03/TAS01	2.1	0.8	x
NR-RC28/RC26+SC27	TAS04/TAS01	3.2	1.0	x
DR-Ts/Tm	T11/T12	2.5	3.4	x
DR-29Ts30ab	T16/T19	3.3	3.0	x
DR-29bb/29aa	(S26+S27)/(S25+S28)	4.6	13.3	
DR-C2-dbt/C2-phe	DBT2/PA2	0.8	3.7	x
DR-C3-dbt/C3-phe	DBT3/PA3	0.5	4.7	x
DR-C28C29/30ab	T7 to T10/T19	5.2	11.0	
DR-29aaS/29aaR=	S25/S28	8.8	21.6	
DR-C20TA/C21TA	TAS05/TAS06	4.5	10.4	
DR-TA21/ RC26+SC27	TS06/TAS01	4.8	6.8	
DR-C24Tet/C26Tri	T6a/T6bc	4.5	6.1	
DR-30ba/30ab	T20/T19	3.2	13.3	
DR-35ab/30ab	(T34 to T35)/T19	5.3	7.3	
DR-32abR/32abS	T27/T26	2.0	3.2	x

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

Attachment 3

Tabulated Concentrations

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

Client ID	WESTLAKE #19	7B
Lab ID	L2361423-01	L2361423-02
Date Collected	10/15/2023	1/25/2023
Date Analyzed	10/26/2023	10/26/2023
Analytes	Result	Result
n-Nonane (C9)	42	10,400
n-Decane (C10)	nd	8,740
n-Undecane (C11)	16	8,340
n-Dodecane (C12)	30	7,990
n-Tridecane (C13)	141	7,120
2,6,10 Trimethyldodecane (1380)	nd	1,420
n-Tetradecane (C14)	11	6,630
2,6,10 Trimethyltridecane (1470)	14	2,000
n-Pentadecane (C15)	322	6,300
n-Hexadecane (C16)	44	5,580
Norpristane (1650)	nd	1,310
n-Heptadecane (C17)	568	4,740
Pristane	nd	1,810
n-Octadecane (C18)	nd	4,160
Phytane	122	1,960
n-Nonadecane (C19)	22	3,560
n-Eicosane (C20)	nd	3,400
n-Heneicosane (C21)	nd	2,770
n-Docosane (C22)	nd	2,400
n-Tricosane (C23)	150	2,050
n-Tetracosane (C24)	nd	1,990
n-Pentacosane (C25)	406	1,970
n-Hexacosane (C26)	103	1,450
n-Heptacosane (C27)	836	1,170
n-Octacosane (C28)	198	954
n-Nonacosane (C29)	1,180	886
n-Triacontane (C30)	174	862
n-Hentriacontane (C31)	971	860
n-Dotriacontane (C32)	129	699
n-Tritriacontane (C33)	625	600
n-Tetratriacontane (C34)	nd	580
n-Pentatriacontane (C35)	242	554
n-Hexatriacontane (C36)	45	332
n-Heptatriacontane (C37)	381	315
n-Octatriacontane (C38)	nd	317
n-Nonatriacontane (C39)	89	262
n-Tetracontane (C40)	nd	231
Total Saturated Hydrocarbons	6,860	107,000
Total Petroleum Hydrocarbons (C9-C44)	428,000	639,000

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

		WESTLAKE #19	7B
	Client ID		
	Lab ID	L2361423-01	L2361423-02
	Date Collected	10/15/2023	1/25/2023
	Date Analyzed	10/28/2023	10/28/2023
	Analytes	Result	Result
D0	cis/trans-Decalin	nd	216
D1	C1-Decalins	nd	335
D2	C2-Decalins	nd	294
D3	C3-Decalins	nd	166
D4	C4-Decalins	nd	153
BT0	Benzothiophene	0.1	9.4
BT1	C1-Benzo(b)thiophenes	2.0	49
BT2	C2-Benzo(b)thiophenes	1.9	167
BT3	C3-Benzo(b)thiophenes	nd	276
BT4	C4-Benzo(b)thiophenes	nd	214
N0	Naphthalene	3.8	282
N1	C1-Naphthalenes	16	785
N2	C2-Naphthalenes	37	1,140
N3	C3-Naphthalenes	48	956
N4	C4-Naphthalenes	35	483
B	Biphenyl	2.1	33
DF	Dibenzofuran	2.1	28
AY	Acenaphthylene	0.4	3.9
AE	Acenaphthene	1.7	9.3
F0	Fluorene	3.0	50
F1	C1-Fluorenes	11	122
F2	C2-Fluorenes	33	201
F3	C3-Fluorenes	48	198
A0	Anthracene	7.2	nd
P0	Phenanthrene	13	102
PA1	C1-Phenanthrenes/Anthracenes	110	265
PA2	C2-Phenanthrenes/Anthracenes	47	312
PA3	C3-Phenanthrenes/Anthracenes	43	215
PA4	C4-Phenanthrenes/Anthracenes	11	110
RET	Retene	nd	nd
DBT0	Dibenzothiophene	0.8	215
DBT1	C1-Dibenzothiophenes	2.6	555
DBT2	C2-Dibenzothiophenes	2.3	716
DBT3	C3-Dibenzothiophenes	nd	570
DBT4	C4-Dibenzothiophenes	nd	309
BF	Benzo(b)fluorene	2.8	3.3
FL0	Fluoranthene	2.4	1.7
PY0	Pyrene	5.2	10
FP1	C1-Fluoranthenes/Pyrenes	20	39
FP2	C2-Fluoranthenes/Pyrenes	19	78
FP3	C3-Fluoranthenes/Pyrenes	11	101
FP4	C4-Fluoranthenes/Pyrenes	7.2	92
NBT0	Naphthobenzothiophenes	0.6	46
NBT1	C1-Naphthobenzothiophenes	2.2	149
NBT2	C2-Naphthobenzothiophenes	9.0	228
NBT3	C3-Naphthobenzothiophenes	3.2	200
NBT4	C4-Naphthobenzothiophenes	nd	139
BA0	Benz[a]anthracene	2.4	1.3
C0	Chrysene/Triphenylene	1.8	16
BC1	C1-Chrysenes	6.2	37
BC2	C2-Chrysenes	8.5	60
BC3	C3-Chrysenes	14	86
BC4	C4-Chrysenes	nd	62

Table A3-2 (cont.)

		WESTLAKE #19	7B
	Client ID		
	Lab ID	L2361423-01	L2361423-02
	Date Collected	10/15/2023	1/25/2023
	Date Analyzed	10/28/2023	10/28/2023
	Analytes	Result	Result
BBF	Benzo[b]fluoranthene	1.1	2.5
BJKF	Benzo[j]fluoranthene/Benzo[k]fluoranthene	1.0	nd
BAF	Benzo[a]fluoranthene	1.4	1.0
BEP	Benzo[e]pyrene	1.8	6.7
BAP	Benzo[a]pyrene	2.3	1.3
PER	Perylene	0.7	1.1
IND	Indeno[1,2,3-cd]pyrene	1.5	0.6
DA	Dibenz[ah]anthracene/Dibenz[ac]anthrace	0.3	0.4
GHI	Benzo[g,h,i]perylene	2.0	2.2
CAR	Carbazole	0.6	9.8
4MDT	4-Methyldibenzothiophene	1.0	242
2MDT	2/3-Methyldibenzothiophene	nd	206
1MDT	1-Methyldibenzothiophene	0.9	97
3MP	3-Methylphenanthrene	15	48
2MP	2-Methylphenanthrene	53	61
2MA	2-Methylanthracene	12.8	2.2
9MP	9/4-Methylphenanthrene	20	93
1MP	1-Methylphenanthrene	3.6	56
2MN	2-Methylnaphthalene	8.7	594
1MN	1-Methylnaphthalene	15	627
26DMN	2,6-Dimethylnaphthalene	20	505
235TMN	2,3,5-Trimethylnaphthalene	5.9	121
PY2	2-METHYLPYRENE	2.0	2.6
PY4	4-METHYLPYRENE	1.9	9.9
PY1	1-METHYLPYRENE	1.8	6.1
T4	C23 Tricyclic Terpane	nd	20
T5	C24 Tricyclic Terpane	nd	8.5
T6	C25 Tricyclic Terpane	nd	10
T6a	C24 Tetracyclic Terpane	1.6	13
T6b	C26 Tricyclic Terpane-22S	nd	4.5
T6c	C26 Tricyclic Terpane-22R	nd	3.4
T7	C28 Tricyclic Terpane-22S	nd	3.7
T8	C28 Tricyclic Terpane-22R	nd	4.5
T9	C29 Tricyclic Terpane-22S	nd	4.9
T10	C29 Tricyclic Terpane-22R	nd	5.0
T11	18a-22,29,30-Trisnorneohopane-TS	1.7	21
T11a	C30 Tricyclic Terpane-22S	nd	4.8
T11b	C30 Tricyclic Terpane-22R	nd	6.3
T12	17a(H)-22,29,30-Trisnorhopane-TM	1.8	23
T14a	17a/b,21b/a 28,30-Bisnorhopane	nd	16
T14b	17a(H),21b(H)-25-Norhopane	nd	2.7
T15	30-Norhopane	6.0	73
T16	18a(H)-30-Norneohopane-C29Ts	8.9	18
X	17a(H)-Diahopane	nd	3.5
T17	30-Normoretane	555	9.4
T18	18a(H)&18b(H)-Oleananes	nd	4.5
T19	Hopane	7.5	86
T20	Moretane	nd	7.7
T21	30-Homohopane-22S	21	51
T22	30-Homohopane-22R	13	39

Table A3-2 (cont.)

		WESTLAKE #19	7B
	Client ID		
	Lab ID	L2361423-01	L2361423-02
	Date Collected	10/15/2023	1/25/2023
	Date Analyzed	10/28/2023	10/28/2023
	Analytes	Result	Result
T22A	T22a-Gammacerane/C32-diahopane	nd	9.5
T26	30,31-Bishomohopane-22S	nd	31
T27	30,31-Bishomohopane-22R	13	24
T30	30,31-Trishomohopane-22S	24	25
T31	30,31-Trishomohopane-22R	10	16
T32	Tetrakishomohopane-22S	12	16
T33	Tetrakishomohopane-22R	9.3	12
T34	Pentakishomohopane-22S	nd	17
T35	Pentakishomohopane-22R	nd	12
S4	13b(H),17a(H)-20S-Diacholestane	2.7	27
S5	13b(H),17a(H)-20R-Diacholestane	1.9	14
S23	14b,17b-20S-Methylcholestane	1.0	31
S26	14b(H),17b(H)-20R-Ethylcholestane	1.5	34
S27	14b(H),17b(H)-20S-Ethylcholestane	0.9	32
TAS05	C20 PREGNANE	2.0	2.6
TAS06	C21 20-METHYLPREGNANE	1.9	9.9
TAS07	C22 20-ETHYLPREGNANE (A)	1.8	6.1
TAS08	C22 20-ETHYLPREGNANE (B)	nd	24.4
TAS09	C26,20S TAS	nd	22.1
TAS01	C26,20R+C27,20S TAS	2.2	156
TAS02	C28,20S TAS	1.7	108
TAS03	C27,20R TAS	1.5	118
TAS04	C28,20R TAS	nd	93
TAS10	C29,20S TAS	5.0	39.3
TAS11	C29,20R TAS	nd	15.5

Attachment 4

Diagnostic ratio comparison

(despite lack of authentic oil in the Bubble Site No. 19 sheen studied; see text)

CEN - Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	7B Cavern Oil (Jan 2023)	Bubble Site 14 Sheen
	Analysis Date	10/4/2023	10/5/2023
NR-C17/pris	C17/Pr	2.66	ndp
NR-C18/phy	C18/Ph	2.05	ndp
NR- pris/phy	Pr/Ph	0.90	ndp
NR-4-MD/1-MD	4-MDBT/1-MDBT	2.45	ndp
NR-2-MP/1-MP	2-MP/1-MP	1.01	ndp
NR-27Ts/30ab	T11/T19	0.24	0.23
NR-27Tm/30ab	T12/T19	0.27	0.23
NR-28ab/30ab	T14a/T19	0.20	0.00
NR-29ab/30ab	T15/T19	0.85	0.81
NR-30O/30ab	T18/T19	0.00	1.69
NR-31abS/30ab	T21/T19	0.63	0.00
NR-27dbR/27dbS	S4/S5	0.64	0.60
NR-27bb/29bb	(S14+S15)/(S26+S27)	0.85	0.67
NR-SC26/ RC26+SC27	TAS09/TAS01	0.13	0.35
NR-SC28/RC26 + SC27	TAS02/TAS01	0.71	0.81
NR-RC27/RC26+ SC27	TAS03/TAS01	0.76	0.57
NR-RC28/RC26+SC27	TAS04/TAS01	0.60	0.62
DR-Ts/Tm	T11/T12	0.90	1.01
DR-29Ts30ab	T16/T19	0.21	1.26
DR-29bb/29aa	(S26+S27)/(S25+S28)	1.28	1.16
DR-C2-dbt/C2-phe	DBT2/PA2	2.27	0.00
DR-C3-dbt/C3-phe	DBT3/PA3	2.45	0.00
DR-C28C29/30ab	T7 to T10/T19	0.24	1.07
DR-29aaS/29aaR=	S25/S28	1.63	ndp
DR-C20TA/C21TA	TAS05/TAS06	1.28	0.36
DR-TA21/ RC26+SC27	TS06/TAS01	0.41	0.04
DR-C24Tet/C26Tri	T6a/T6bc	1.47	1.86
DR-30ba/30ab	T20/T19	0.08	0.00
DR-35ab/30ab	(T34 to T35)/T19	0.38	0.13
DR-32abR/32abS	T27/T26	0.73	ndp
		Conclusion:	**Non-Match**

red: statistical non-match to 7B Cavern Ref. Oil (analyzed concurrently)

green:s statistical match to 7B Cavern Ref. Oil (analyzed concurrently)

grey: indicates less precision ratio (per Attachment 2)

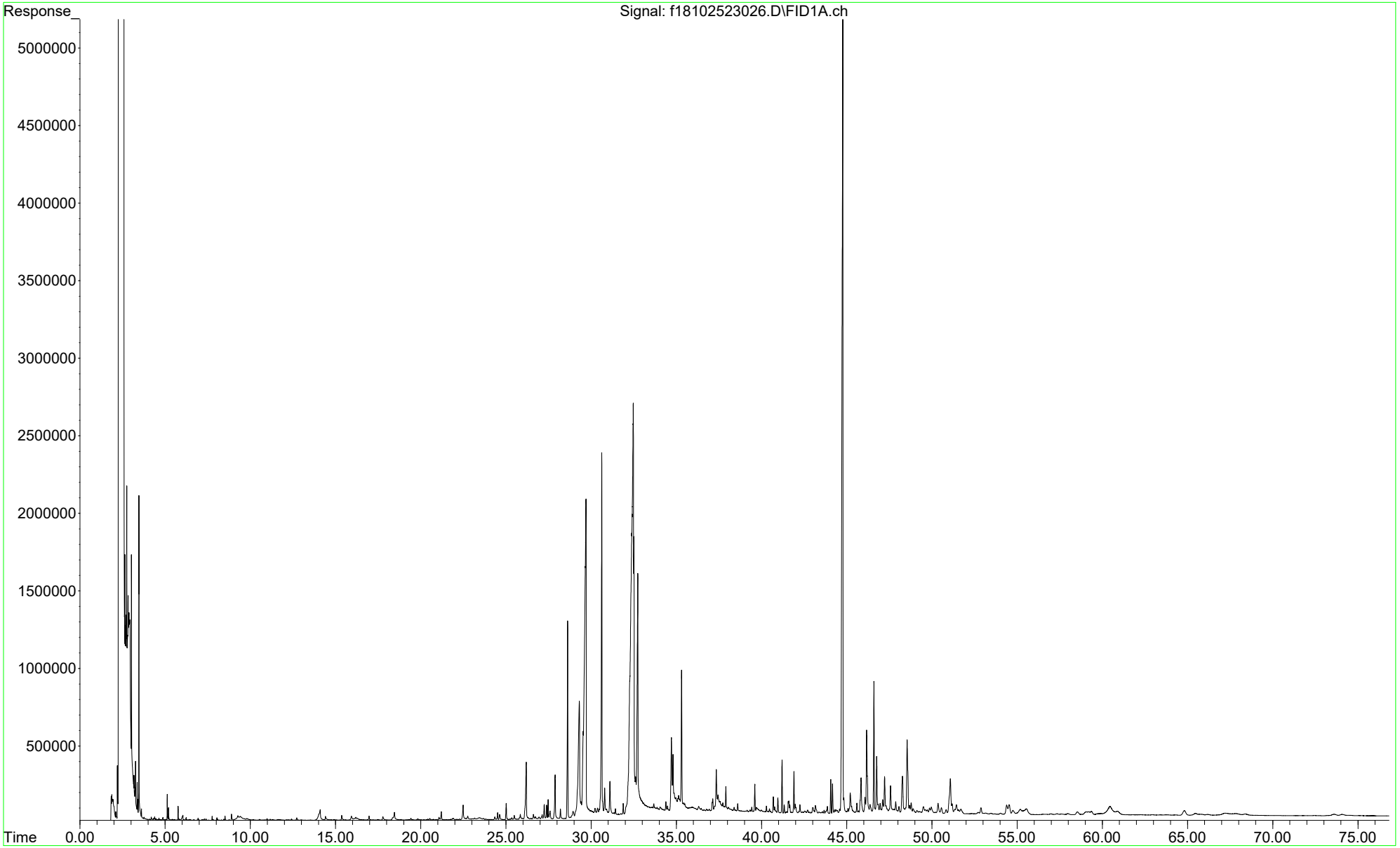
ndp: no determination possible/division by zero

Attachment 5

GC/FID Chromatograms

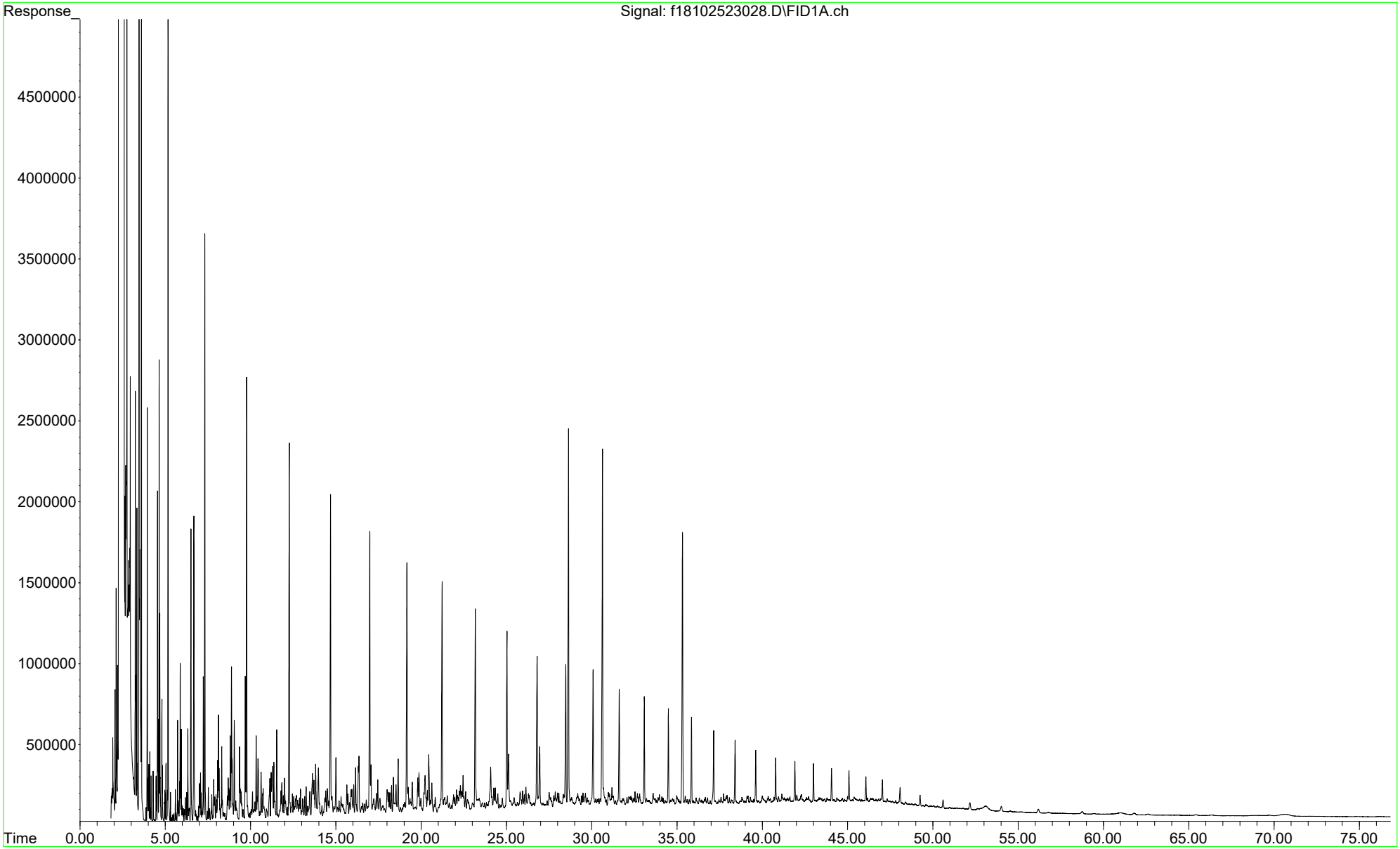
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\SH
... C\f18102523026.D
Operator : FID18:AMV
Instrument : FID 18
Acquired : 26 Oct 2023 01:57 am using AcqMethod FID18.M
Sample Name: L2361423-01
Misc Info : WG1844224,WG1843080,ICAL20298

WESTLAKE #19
L2361423-01



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\SH
... C\f18102523028.D
Operator : FID18:AMV
Instrument : FID 18
Acquired : 26 Oct 2023 03:21 am using AcqMethod FID18.M
Sample Name: L2361423-02
Misc Info : WG1844224,WG1844056,ICAL20298

7B-Reference Oil
L2361423-02

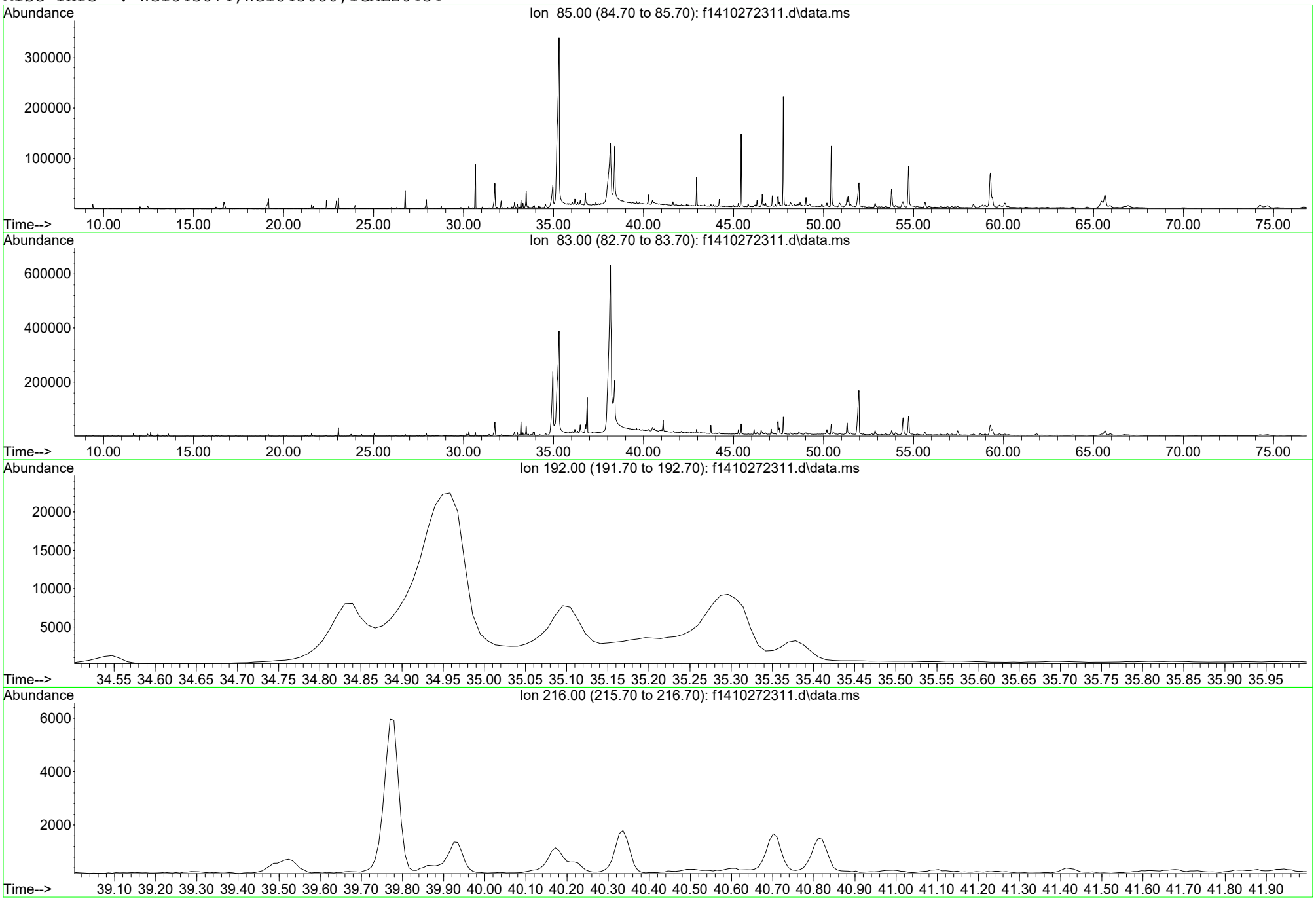


Attachment 6

GC/MS Extracted Ion Profiles

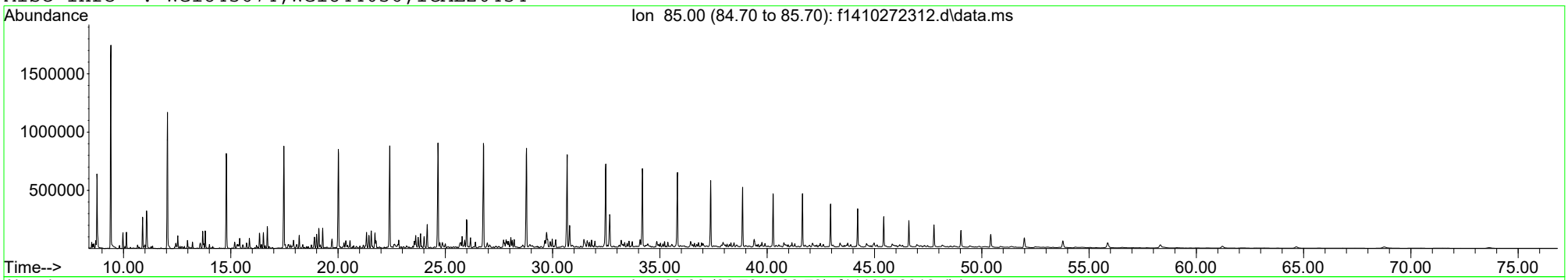
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\AL
... KPAHBIO\f1410272311.d
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 28 Oct 2023 12:02 am using AcqMethod FRNC14A.M
Sample Name: L2361423-01,32,,,R4G
Misc Info : WG1845674,WG1843080,ICAL20454

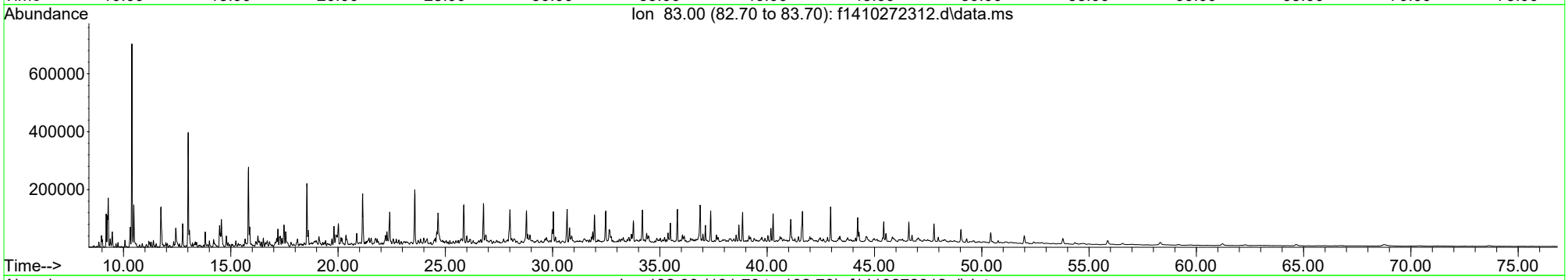
WESTLAKE #19
L2361423-01

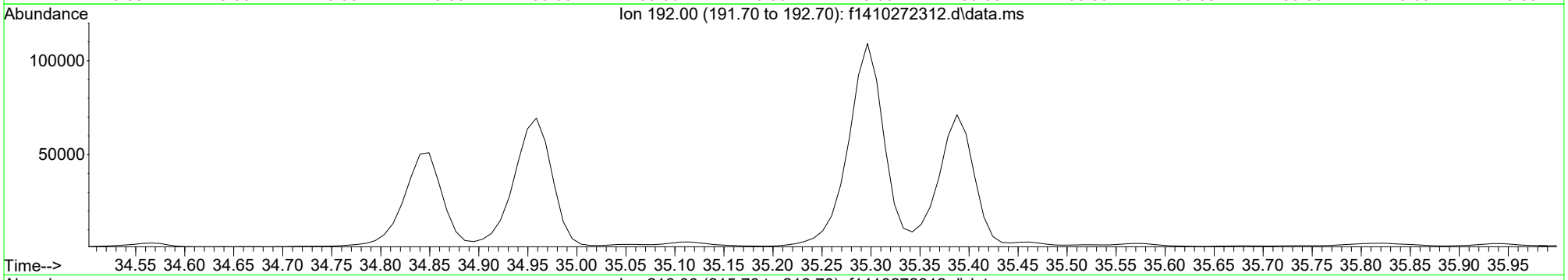


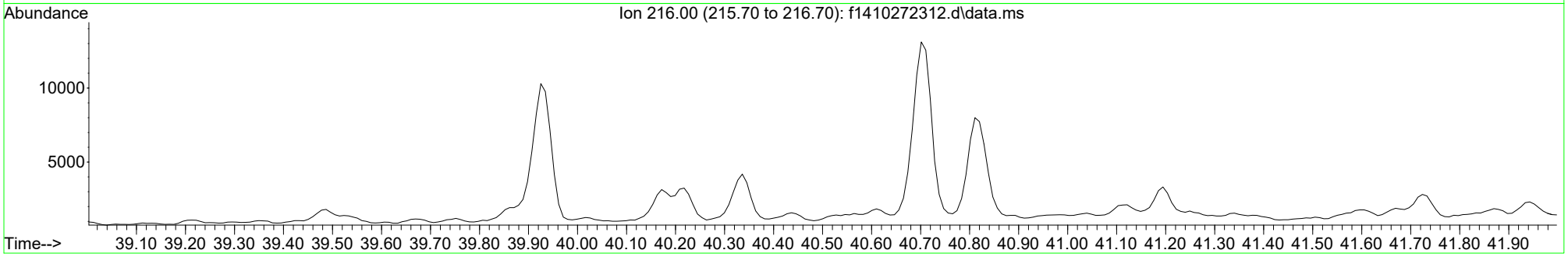
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\AL
... KPAHBIO\f1410272312.d
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 28 Oct 2023 1:27 am using AcqMethod FRNC14A.M
Sample Name: L2361423-02,32,,,R4G
Misc Info : WG1845674,WG1844056,ICAL20454

7B-Reference Oil
L2361423-02



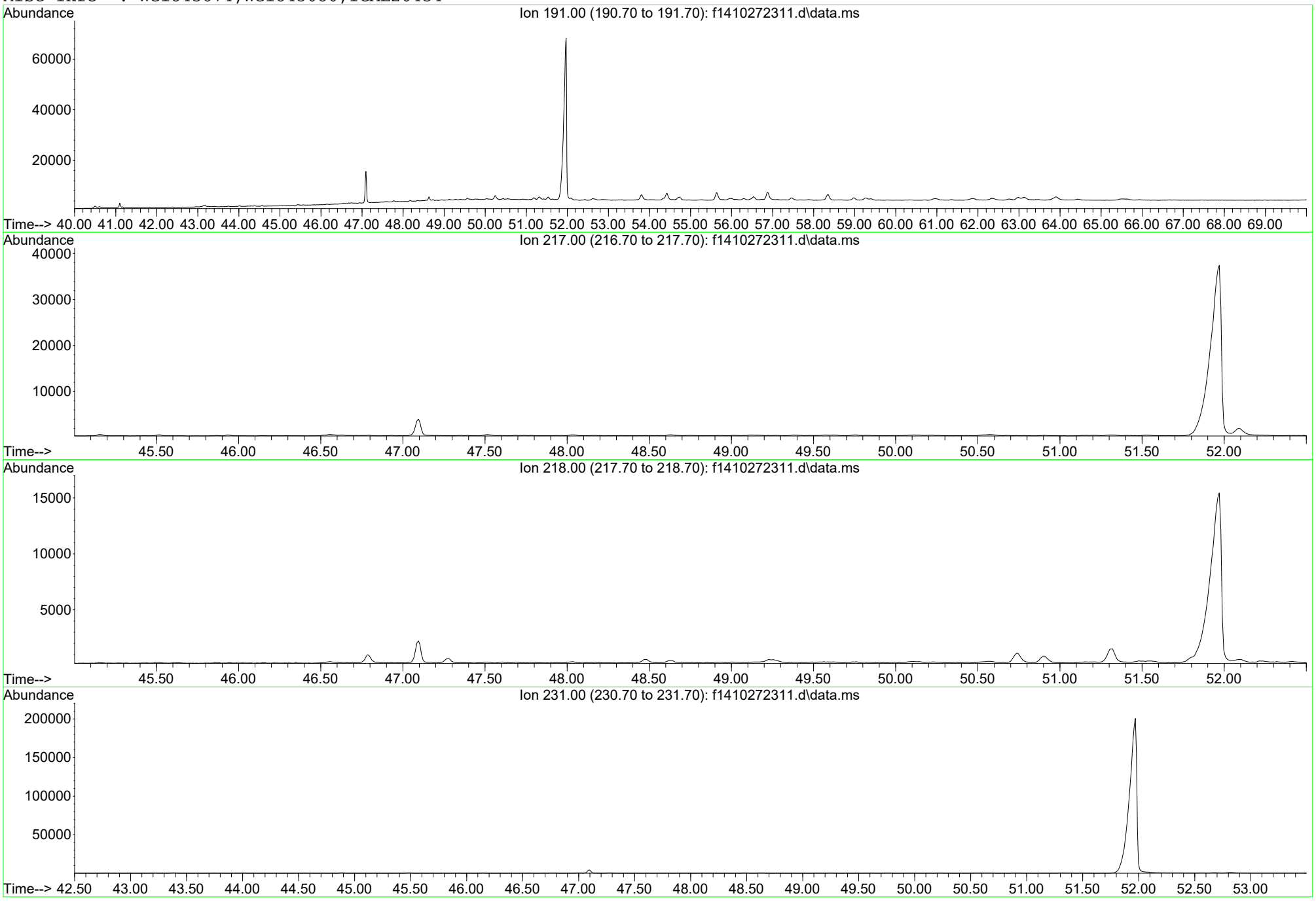






File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\AL
... KPAHBIO\f1410272311.d
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 28 Oct 2023 12:02 am using AcqMethod FRNC14A.M
Sample Name: L2361423-01,32,,,R4G
Misc Info : WG1845674,WG1843080,ICAL20454

WESTLAKE #19
L2361423-01



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2361423\AL
... KPAHBIO\f1410272312.d
Operator : PAH14:MJS
Instrument : PAH14
Acquired : 28 Oct 2023 1:27 am using AcqMethod FRNC14A.M
Sample Name: L2361423-02,32,,,R4G
Misc Info : WG1845674,WG1844056,ICAL20454

7B Reference Oil
L2361423-02