



*Expert Environmental
Support Services for Site
Investigation & Remediation*

October 17, 2017

Erik Mickelson, PG,
Sr. HSE Representative
Kerr-McGee Oil & Gas Onshore LP
1099 18th Street, #1800
Denver, Colorado 80202

Via: E-Mail: Erik.Mickelson@anadarko.com

**Re: Firestone Stray Gas Site: Post-Remediation Soil Gas Monitoring Report
Vista Project #17137.01**

Dear Mr. Mickelson:

Attached is the Summary Report for the soil gas monitoring activities conducted at the Firestone stray gas remediation site in Firestone, Colorado. Three monthly gas sampling events were conducted from July through September 2017, and the results are summarized in the attached report.

Please feel free to contact us if you have any questions regarding the report, methods, survey results, or interpretation.

Sincerely,

John V. Fontana, PG
President & CEO



Daily Activities Summary Report
Firestone Stray Gas Site:
Post-Remediation Soil Gas Monitoring Events
July through September 2017
Firestone, Colorado

Prepared for:
Kerr-McGee Oil & Gas Onshore LP
Denver, CO

October 17, 2017

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1 Post SVE System Shut-Down Monitoring - Overview

Kerr-McGee Oil & Gas Onshore LP (KMOGO) contracted Vista GeoScience (VGS) to conduct a soil gas investigation at two areas in and near the Oak Meadows subdivision in Firestone, Colorado (Site). Data obtained from the investigation were utilized to design and implement two soil vapor extraction (SVE) remediation systems at the Site.

Following the apparent successful conclusion of the SVE remediation activities, gas samples were collected from all 63 vent wells (on June 27 & 28, 2017) in order to confirm the efficacy of the systems. Laboratory analytical results indicate that no hydrocarbons were detected in any of the 63 vent wells. The data from the sampling event was provided to the Colorado Oil and Gas Conservation Commission (COGCC) in an eForm 27 update dated July 10, 2017.

Based on the results from the sampling of all 63 vent wells, a monthly monitoring plan was proposed to the COGCC to further demonstrate the effectiveness of the SVE systems and the lack of any rebound of hydrocarbons in the soil gas. The sampling plan was proposed to the COGCC in the July 10, 2017 eForm 27 update. The COGCC approved the sampling plan on July 11, 2017.

The wells to be sampled as part of the approved sampling plan included VW-06, VW-08, VW-17, VW-21, VW-31 (In the western area), and VW-37, VW-38, VW-41, VW-45, VW-58, and VW-59 (in the eastern area). These wells are circled on the map in Appendix A: Figure 1. Note that VW-45 is a riser mounted on the French drain vent at the 6310 Twilight residence. The vent wells were sampled in July, August and September of 2017, near the end of each month.

2 Vent Well Soil Gas Sampling Procedure

The following procedure was used to sample the vent wells during each sampling event. Photos of the sampling procedure are shown in Appendix B.

1. Before collecting samples, the Landtec GEM gas meter is calibrated according to the manufacturer's instructions. The primary detectors on the Landtec GEM measure air components down to 0.1% by volume in air, including methane, carbon dioxide, and oxygen. Nitrogen is calculated as the balance gas. Calibration gas standard mixtures used included methane, carbon dioxide, and oxygen. Ambient air is also used in the calibration procedure. The optional hydrogen sulfide and carbon monoxide detectors on the Landtec GEM meter measure these gases at part per million (ppm) levels, and are also calibrated using the manufacturer recommended gas standards. The calibration gas standard mixtures used included:
 - a. 50% methane and 35% carbon dioxide
 - b. 2.5% methane, 18% oxygen, 10 ppm hydrogen sulfide, and 50 ppm carbon monoxide
 - c. 100% Air check (20.9% oxygen, 79.1% nitrogen, 0.0% methane, 0.0% carbon dioxide)
2. The 3-way valve at a vent well is connected to a Landtec GEM gas meter at one port on the valve, and a squeeze bulb with a new evacuated 1-liter Cali-5-Bond gas sampling bag at the other port, using short lengths of clean tubing.

3. The valve is turned from the closed position to the Landtec GEM gas meter intake, and the meter is used to purge the well until oxygen and carbon dioxide readings stabilize. Readings are recorded on a VGS soil gas sampling form. Stable readings indicate the well has been sufficiently purged to remove air and interfering gases from the sampling tubing, and soil gas is being collecting from the formation.
4. At this point, the valve is switched to allow gas flow into the evacuated gas sample bag. The gas bag is disconnected from the squeeze bulb, and a Schrader valve keeps the bag sealed. The squeeze bulb is then pumped several times to purge the bulb and the tubing. A check valve in the squeeze bulb prevents air from entering the well.
5. The gas bag is reconnected to the squeeze bulb via the Schrader valve, and is pumped until the gas bag is approximately 2/3 full. The gas sampling bag is then detached from the squeeze bulb, and the Schrader valve automatically seals the bag. The sample ID is written on the gas sampling bag.
6. A chain of custody (COC) form is completed for the samples collected. The sample ID, depth, sampling date & time (military), container type, and volume are recorded on the COC form. Sample Names used the following coding: [LOCATION ID]-[DATE]-[TIME]. Example: VW08-050817-1435 (Vent Well #08, collected on May 8, 2017, at 14:35).
7. The soil Gas samples are delivered to Dolan Integration Group (DIG) in Westminster, CO, requesting the following analysis on a rush turnaround time:
 - Gas Composition (C1-C5 hydrocarbons and fixed atmospheric gases)
 - $\delta^{13}\text{C}$ & δH of Methane
 - $\delta^{13}\text{C}$ of CO_2
 - $\delta^{13}\text{C}$ of C2-5 if present in sufficient concentrations.

Note: Stable Isotopes can only be run if sufficient gas concentrations are present.

3 Results

Samples were collected at the 11 selected monitoring wells near the end of each month in July, August and September, 2017. The results of the sample analysis from all three sampling events are presented in Appenix A: Table 1. Detailed analysis reports for each sample are included in Appendix C.

The SVE systems were shut down on June 7th, 2017. As of the September 26th 2017 sampling event, after a total of 113 days post shut-down, no hydrocarbons (methane through hexane range gases) have been detected, and no rebound is indicated, in any of the monitoring wells tested.

Appendix A: Tables and Figures

Table 1. Summary Table of Monthly Monitoring Laboratory Results

Figure 1. Map of Vent Well Monitoring Locations

Appendix A: Table 1. Monthly Gas Samples Analytical Results: Gas Composition Stable Isotopes
 Firestone Stray Gas Investigation Remediation, Firestone, CO

Sample ID	Sample Date	Sample Time	COMPLETE GAS ANALYSIS																STABLE ISOTOPE ANALYSIS		Comments
			GC Date	N ₂ ppm	O ₂ + Ar ppm	CO ₂ ppm	CO ppm	C ₁ ppm	C ₂ ppm	C ₃ ppm	iC ₄ ppm	nC ₄ ppm	iC ₅ ppm	nC ₅ ppm	C ₆ + ppm	C ₂ H ₄ ppm	He ppm	H ₂ ppm	Mass Spec Date	δ ¹³ CO ₂ ‰ VPDB	
VW-06072717-1303	7/27/2017	13:03	7/28/2017	791086	151016	54535	58	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-27.4		
VW-08-072717-1224	7/27/2017	12:24	7/28/2017	802011	178649	21758	18	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-25.7		
VW-17-072717-1339	7/27/2017	13:39	7/28/2017	780891	153830	65843	11	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-21.8		
VW-21-072717-1256	7/27/2017	12:56	7/28/2017	781885	142307	74569	12	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-23.4		
VW-31-072717-1344	7/27/2017	13:44	7/28/2017	786350	168777	40005	14	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-19.2		
VW-37-072717-1359	7/27/2017	13:59	7/28/2017	823412	118923	44964	9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-31.8		
VW-38-072717-1405	7/27/2017	14:05	7/28/2017	779698	187402	21858	15	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-24.1		
VW-41-072717-1410	7/27/2017	14:10	7/28/2017	793292	166086	28227	11	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-28.6		
VW-45-072717-1502	7/27/2017	15:02	7/28/2017	764581	223960	454	16	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-12.2	Low signal	
VW-45-072717-1505	7/27/2017	15:05	7/28/2017	766282	224775	576	16	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-8.2		
VW-58-072717-1418	7/27/2017	14:18	7/28/2017	778623	190515	22193	15	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-22.8		
VW-59-072717-1422	7/27/2017	14:22	7/28/2017	797980	151966	26645	12	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	7/27/2017	-29.1		
VW37-082817-1232	8/28/2017	12:32	8/28/2017	808684	125783	55912	12	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-29.5		
VW38-082817-1314	8/28/2017	13:14	8/28/2017	783983	185060	25186	15	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-23.6		
VW41-082817-1208	8/28/2017	12:08	8/28/2017	802355	146761	40969	13	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-27.4		
VW45-082817-1252	8/28/2017	12:52	8/28/2017	779577	219635	563	17	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	na		
VW58-082817-1330	8/28/2017	13:30	8/28/2017	800284	167621	24162	16	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-24.6		
VW59-082817-1325	8/28/2017	13:25	8/28/2017	806890	146948	37629	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-29.2		
VW06-082817-1124	8/28/2017	11:24	8/28/2017	800061	123204	66506	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-28.2		
VW08-082817-1134	8/28/2017	11:34	8/28/2017	808247	146863	33335	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-26.3		
VW17-082817-1145	8/28/2017	11:45	8/28/2017	784668	130789	74563	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-23.1		
VW21-082817-1156	8/28/2017	11:56	8/28/2017	789655	121899	77000	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-24.5		
VW31-082817-1203	8/28/2017	12:03	8/28/2017	784129	147905	58002	11	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	8/29/2017	-20.4		
VW06-092617-1002	9/26/2017	10:02	9/26/2017	801915	118583	72473.7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/29/2017	-27.1		
VW08-092617-1019	9/26/2017	10:19	9/26/2017	816612	136386	42772.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/29/2017	-24.5		
VW17-092617-1033	9/26/2017	10:33	9/26/2017	780893	160970	59192.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/29/2017	-21.9		
VW17-092617-1035B	9/26/2017	10:35	9/26/2017	780796	160310	59894.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/29/2017	-22.1		
VW21-092617-1045	9/26/2017	10:45	9/26/2017	795763	117555	83571.6	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/29/2017	-22.8		
VW17-092617-103	9/26/2017	11:02	9/26/2017	786550	164449	50028.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-18.7		
VW37-092617-1345	9/26/2017	13:45	9/26/2017	778942	176993	45513.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-25.6		
VW38-092617-1338	9/26/2017	13:38	9/26/2017	774757	209973	18925.7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-21.4		
VW41-092617-1332	9/26/2017	13:32	9/26/2017	786501	175665	38369.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-24.9		
VW45-092617-1350	9/26/2017	13:50	9/26/2017	774792	231829	469.433	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-12.8		
VW58-092617-1404	9/26/2017	14:04	9/26/2017	809718	160941	27514.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-24.4		
VW58-092617-1404B	9/26/2017	14:04	9/26/2017	810301	159954	27747.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-24.2		
VW59-092617-1358	9/26/2017	13:58	9/26/2017	790688	166633	41075.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9/30/2017	-13.6		

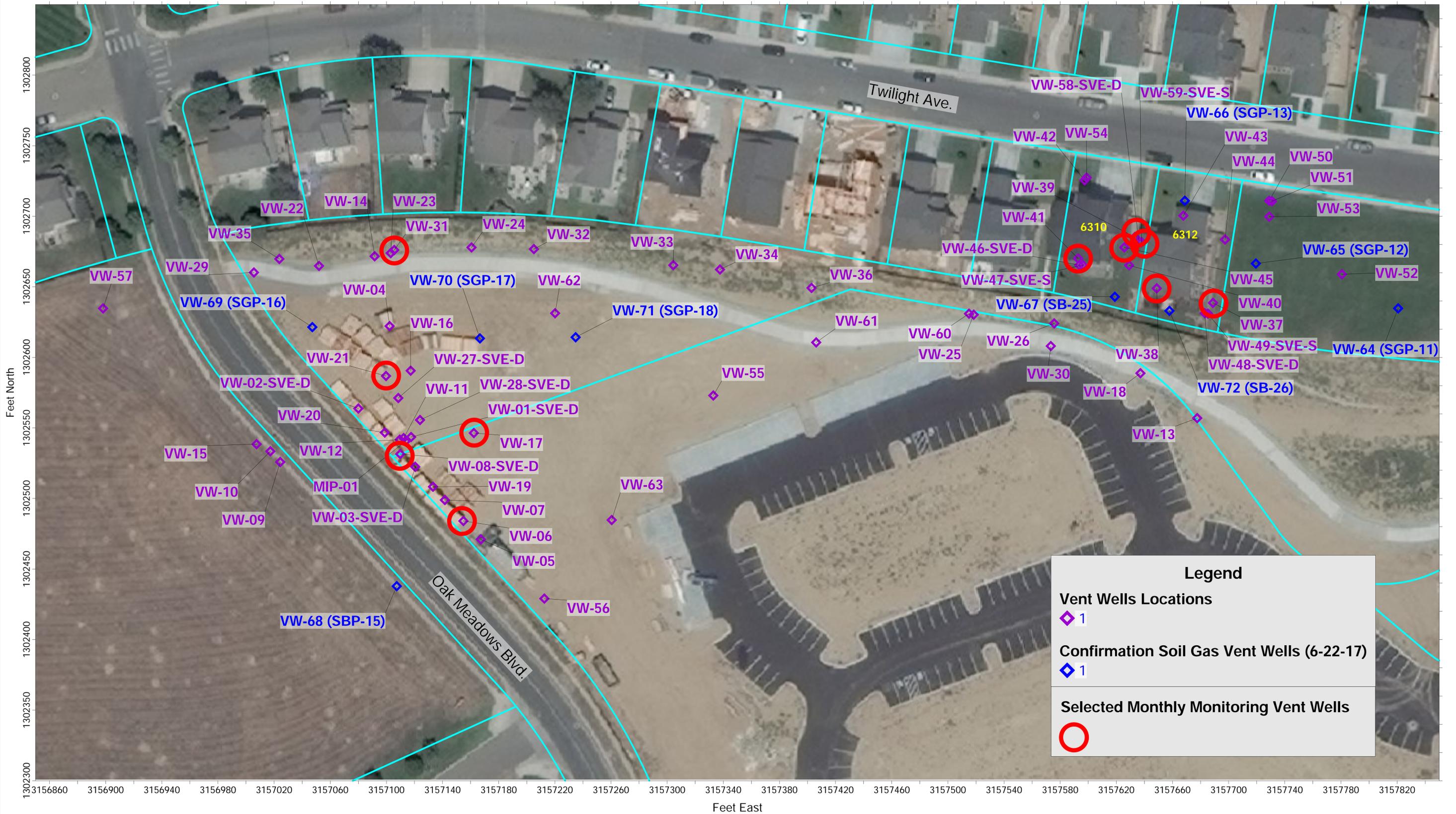
nd = non-detect

na = not analyzed

ppm = parts per million (by volume)

‰ VPDB = parts per thousand measured against the Vienna Pee Dee Belemnite standard

SEE DIG LAB REPORTS FOR MORE DETAILS



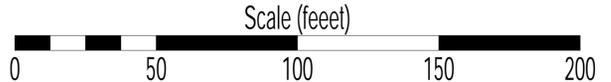
Legend

Vent Wells Locations
 1

Confirmation Soil Gas Vent Wells (6-22-17)
 1

Selected Monthly Monitoring Vent Wells

Figure 1. All Monitoring Vent Wells Installed & Selected Monthly Monitoring Locations



Appendix B: Photos



Typical soil gas monitor well stick-up showing addition of slip cap, Teflon seal, polyethylene drop tube, silicone tubing through cap, and 3-way valve in the closed position.



Vent well sampling setup showing Landtec GEM being used to purge well and screen soil gas readings, and Cali-5-Bond gas sampling bag connected with squeeze bulb pump.



Filling a Cali-5-Bond gas sampling bag with soil gas using squeeze bulb pump.

Appendix C: Detailed Laboratory Reports



dig
Dolan Integration Group

Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303.531.2030

RUSH!

JOB #7071020
DIG 011768-01775

Send Data and Invoice to:

Name: John Fontana
Company: Vista GeoScience
Address: 130 Capital Dr. Ste C
Golden, CO 80401
Phone: 303-277-1694
Fax: 303-278-0104
Email: jfontana@vistageoscience.com
agorody@gmail.com

AFE #: _____
Report Ctr: _____
Project: 17137.01
PO #: JVF051517
Location: Firestone
Sampled By: Jon Meyer

Analysis Requested	
Gas Composition* N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ +	RSK-175* N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ +
	(less composition with dissolved Cl ₂ , C ₂ & C ₃)
	δ ¹³ C Methane (Carbon)
	δD Methane (Hydrogen)
	δ ¹³ C Ethane-Pentane (C ₂ s, if present)

Sample Description

Container #	Sample Identification	Date Sampled	Time	Gas Composition*	RSK-175*	δ ¹³ C Methane (Carbon)	δD Methane (Hydrogen)	δ ¹³ C Ethane-Pentane (C ₂ s, if present)	Comments
	VW060727171303	07-27-17	1303	X		X	X	X	
	VW080727171224	07-27-17	1224	X		X	X	X	+D13C CO2
	VW170727171339	07-27-17	1339	X		X	X	X	+D13C CO2
	VW210727171256	07-27-17	1256	X		X	X	X	+D13C CO2
	VW310727171344	07-27-17	1344	X		X	X	X	+D13C CO2
	VW370727171359	07-27-17	1359	X		X	X	X	+D13C CO2
	VW380727171405	07-27-17	1405	X		X	X	X	+D13C CO2
	VW410727171410	07-27-17	1410	X		X	X	X	+D13C CO2

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by	Vista Geoscience	7-27-17	16:02
Received by	DIG	7-27-17	16:02
Relinquished by			
Received by			

*Gas composition vs RSK-175- Gas composition is a basic analysis of the concentration (ppm) of gases within the headspace of the sample (headspace is created at the lab). RSK-175 is a specific analysis technique combined with calculations to give the total dissolved gas of each species in the water sample (mg/L).

Why one or the other? Gas composition gives us a quick, general look at relative concentrations and ratios (e.g., gas wetness). RSK-175 gives us an exact total of gas present in the sample (headspace and dissolved in the water). Questions? Give us a call at 303-531-2030



dig
Dolan Integration Group

Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303.531.2030

RUSH!

JOB 17071020

DIG 011776-011779

Send Data and Invoice to:

Name: John Fontana
Company: Vista GeoScience
Address: 130 Capital Dr. Ste C
Golden, CO 80401
Phone: 303-277-1694
Fax: 303-278-0104
Email: jfontana@vistageoscience.com
agorody@gmail.com

AFE #: _____
Report Ctr: _____
Project: 17137.01
PO #: JVF051517
Location: Firestone
Sampled By: Jon McFar

Analysis Requested						
Gas Composition* N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ +						
RSK-175* (gas composition) N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ +						
with dissolved Cl ₂ , C ₂ & C ₃						
δ ¹³ C Methane (Carbon)						
δD Methane (Hydrogen)						
δ ¹³ C Ethane-Pentane (C ₂ s, if present)						

Sample Description

Container #	Sample Identification	Date Sampled	Time	Gas Composition*	RSK-175*	δ ¹³ C Methane	δD Methane	δ ¹³ C Ethane-Pentane	Comments
	VW45072717 1303			X		X	X	X	
	VW45072717			X		X	X	X	+D13C CO2
	VW45072717 ¹⁵⁰² 1302	07-27-17	1502	X		X	X	X	+D13C CO2
	VW45072717 ¹⁵⁰⁵ 1305	07-27-17	1505	X		X	X	X	+D13C CO2
	VW58072717 1418	07-27-17	1418	X		X	X	X	+D13C CO2
	VW59072717 1422	07-27-17	1422	X		X	X	X	+D13C CO2
				X		X	X	X	+D13C CO2
				X		X	X	X	+D13C CO2

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by <i>[Signature]</i>	Vista Geo science	7-27-17	16:02
Received by <i>[Signature]</i>	DIG	7-27-17	16:02
Relinquished by			
Received by			

*Gas composition vs RSK-175- Gas composition is a basic analysis of the concentration (ppm) of gases within the headspace of the sample (headspace is created at the lab). RSK-175 is a specific analysis technique combined with calculations to give the total dissolved gas of each species in the water sample (mg/L).

Why one or the other? Gas composition gives us a quick, general look at relative concentrations and ratios (e.g., gas wetness). RSK-175 gives us an exact total of gas present in the sample (headspace and dissolved in the water). Questions? Give us a call at 303-531-2030



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Dolan Integration Group

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Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011768
Client: Vista Geoscience
Sample Name(s): VW060727171303

The analytical results, opinions, or interpretations contained in this report are based upon information and material supplied by the client for whose exclusive and confidential use this report has been made. The analytical results, opinions, or interpretations expressed represent the best judgment of Dolan Integration Group based on its experience, but any interpretation of test or other data, and any recommendation(s) based upon such interpretations, are opinions based upon inferences from measurements and empirical relationships and assumptions which are not infallible, and with respect to which professional engineers and analysts may differ. Accordingly, Dolan Integration Group makes no warranty or representation, expressed or implied, of any type, and expressly disclaims same as to the productivity, proper operations, or profitability of any oil, gas, coal, or other mineral, property, well, or sand in connection with which such report is used or relied upon for any reason whatsoever. This report shall not be reproduced, in whole or in part, without the written approval of Dolan Integration Group.

Dolan Integration Group shall use commercially reasonable efforts to maintain the Samples it receives from Customer in the condition in which same were initially received, and shall store, free of charge, any portion(s) of the Sample(s) not consumed or altered in the course of testing and analysis for a period of 90 days after their initial receipt, after which time the Samples will be destroyed. At Customer's written request and expense, Dolan Integration Group shall return unused Samples to Customer. At Customer's written request, Dolan Integration Group will also store and maintain Customer's Samples beyond the Free Storage Period for a monthly fee in accordance with Dolan Integration Group's the current storage rates. If Customer fails to timely pay any applicable storage charges, Dolan Integration Group shall

Analytical Report



Job #: 17071020
 Lab #: DIG-011768
 Client: Vista Geoscience
 Sample Name: VW060727171303
 Date Sampled: 07/27/17
 Time Sampled: 13:03
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/28/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	791086	79.37	-			
Oxygen + Argon (O ₂ +Ar)	151016	15.15	-			
Carbon Dioxide (CO ₂)	54535	5.47	-	-27.4		
Carbon Monoxide (CO)	58	0.01	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

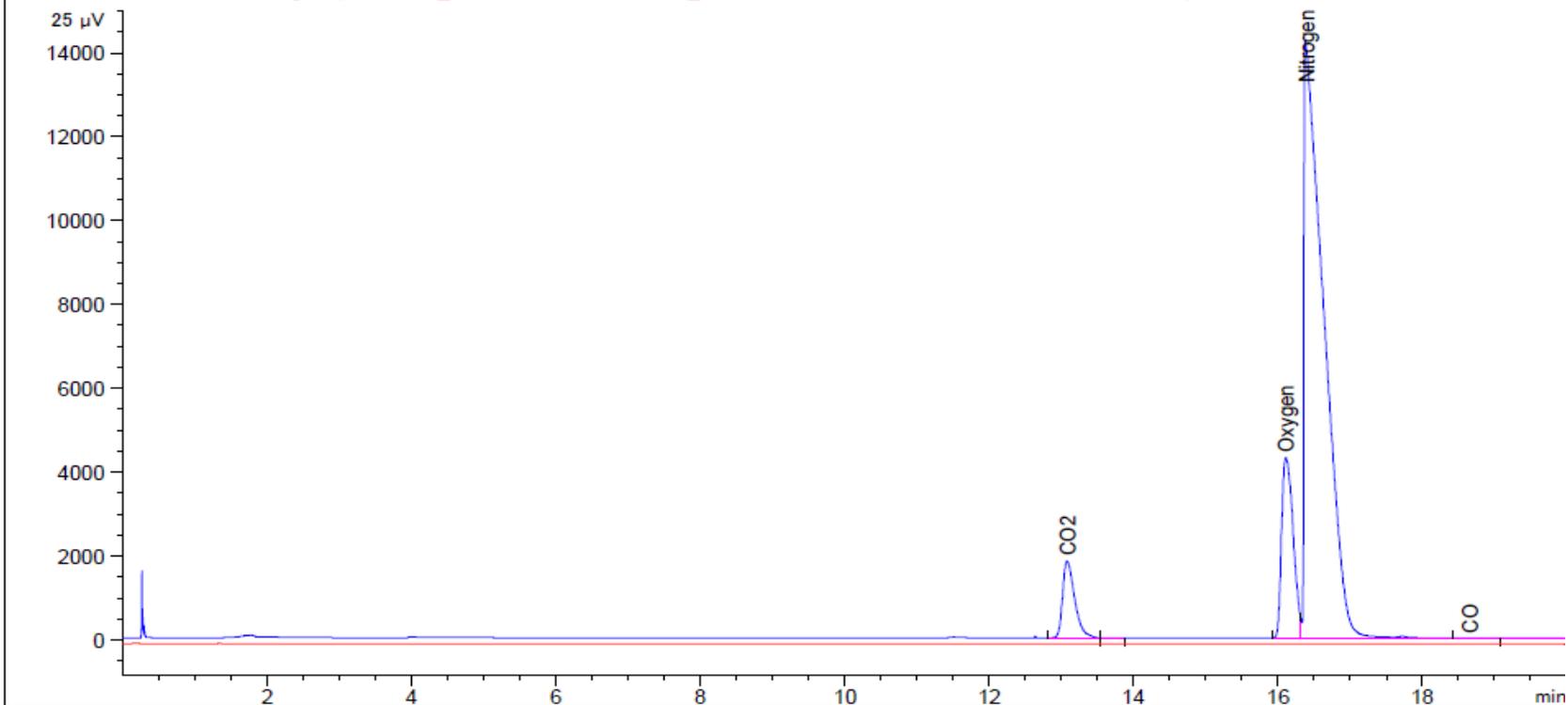
Error δD < 5.0 ‰

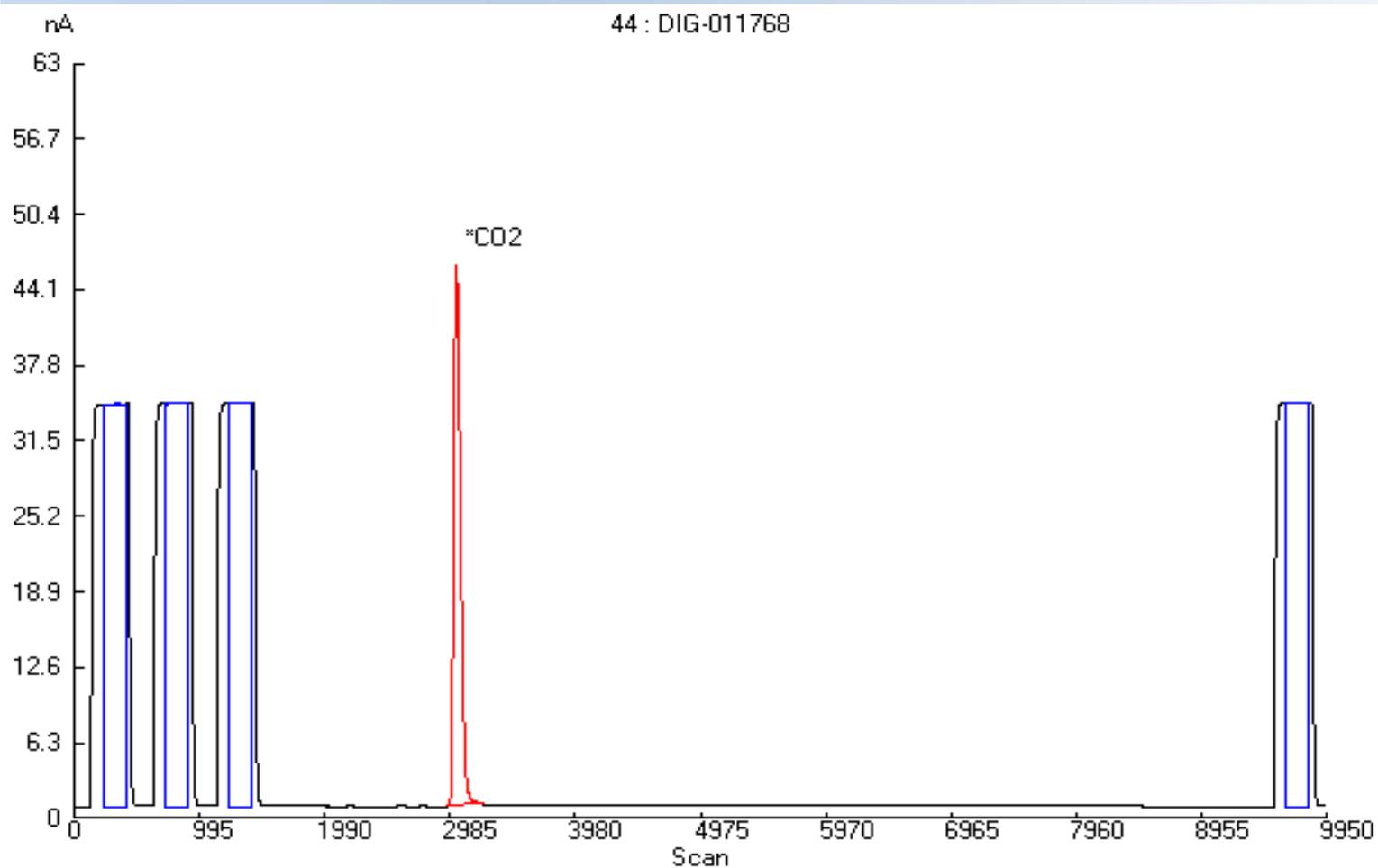
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011768.D)

TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011768.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011769
Client: Vista Geoscience
Sample Name(s): VW080727171224

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Analytical Report



Job #: 17071020
 Lab #: DIG-011769
 Client: Vista Geoscience
 Sample Name: VW080727171224
 Date Sampled: 07/27/17
 Time Sampled: 12:24
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/28/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	802011	80.01	-			
Oxygen + Argon (O ₂ +Ar)	178649	17.82	-			
Carbon Dioxide (CO ₂)	21758	2.17	-	-25.7		
Carbon Monoxide (CO)	18	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

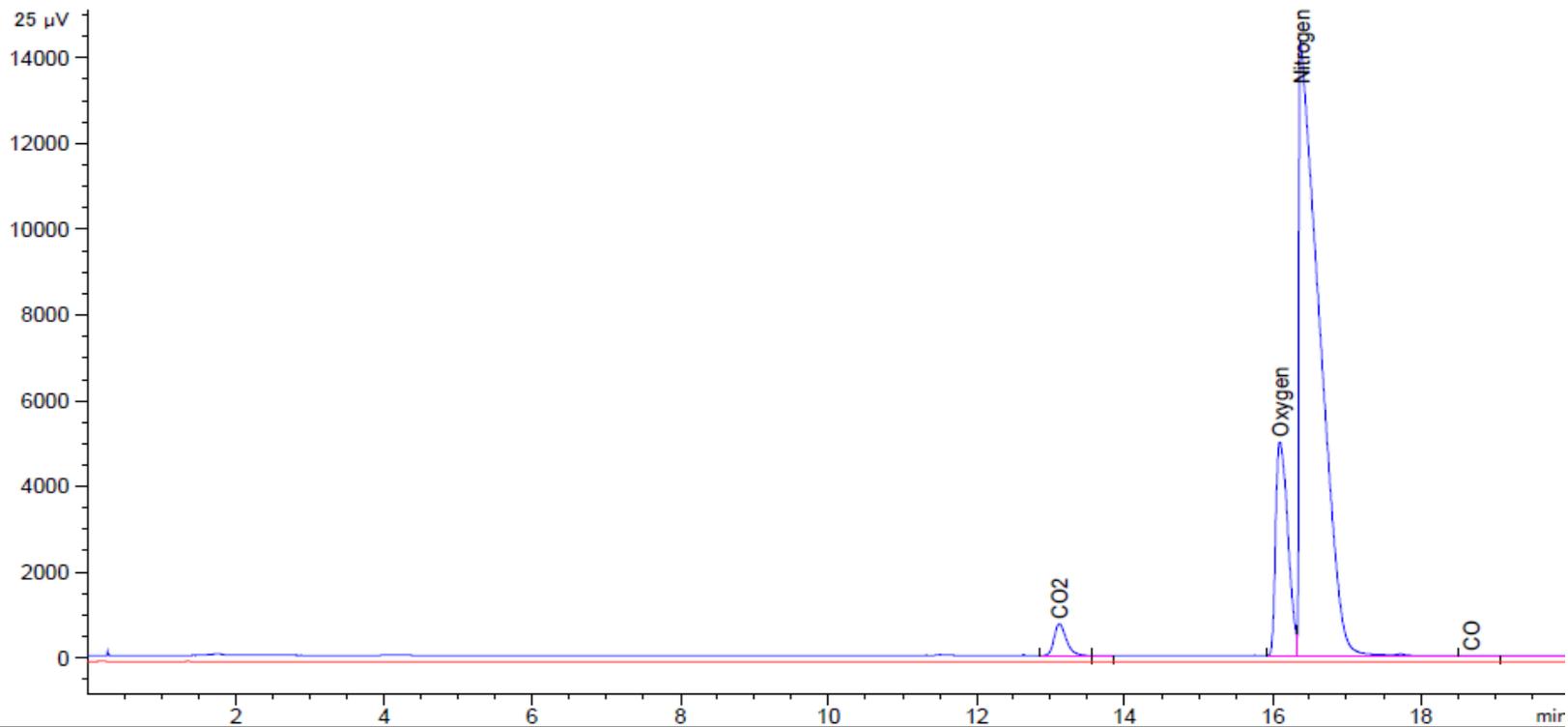
Error δD < 5.0 ‰

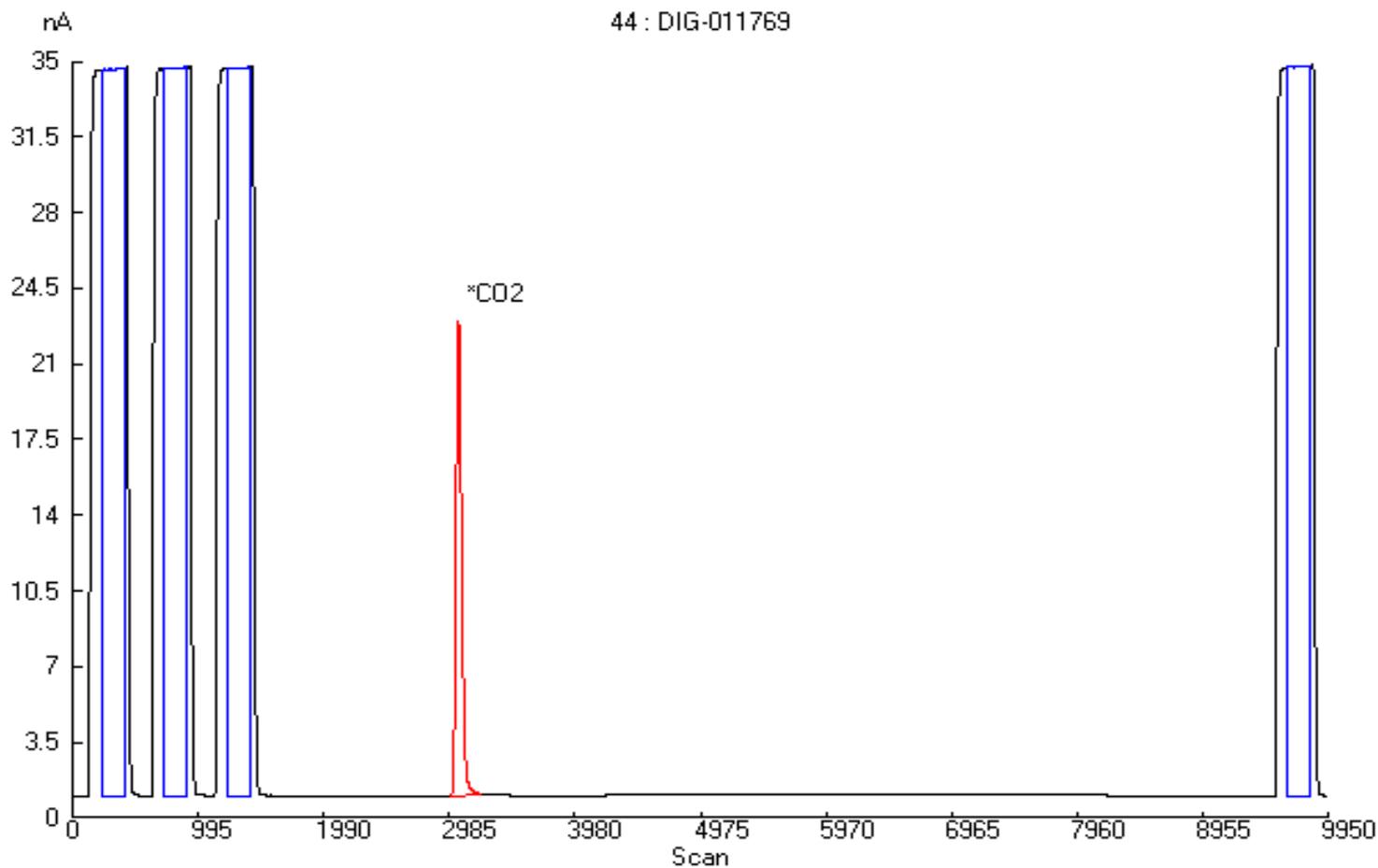
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011769.D)

TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011769.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011770
Client: Vista Geoscience
Sample Name(s): VW170727171339

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Analytical Report



Job #: 17071020
 Lab #: DIG-011770
 Client: Vista Geoscience
 Sample Name: VW170727171339
 Date Sampled: 07/27/17
 Time Sampled: 13:39
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	780891	78.04	-			
Oxygen + Argon (O ₂ +Ar)	153830	15.37	-			
Carbon Dioxide (CO ₂)	65843	6.58	-	-21.8		
Carbon Monoxide (CO)	11	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

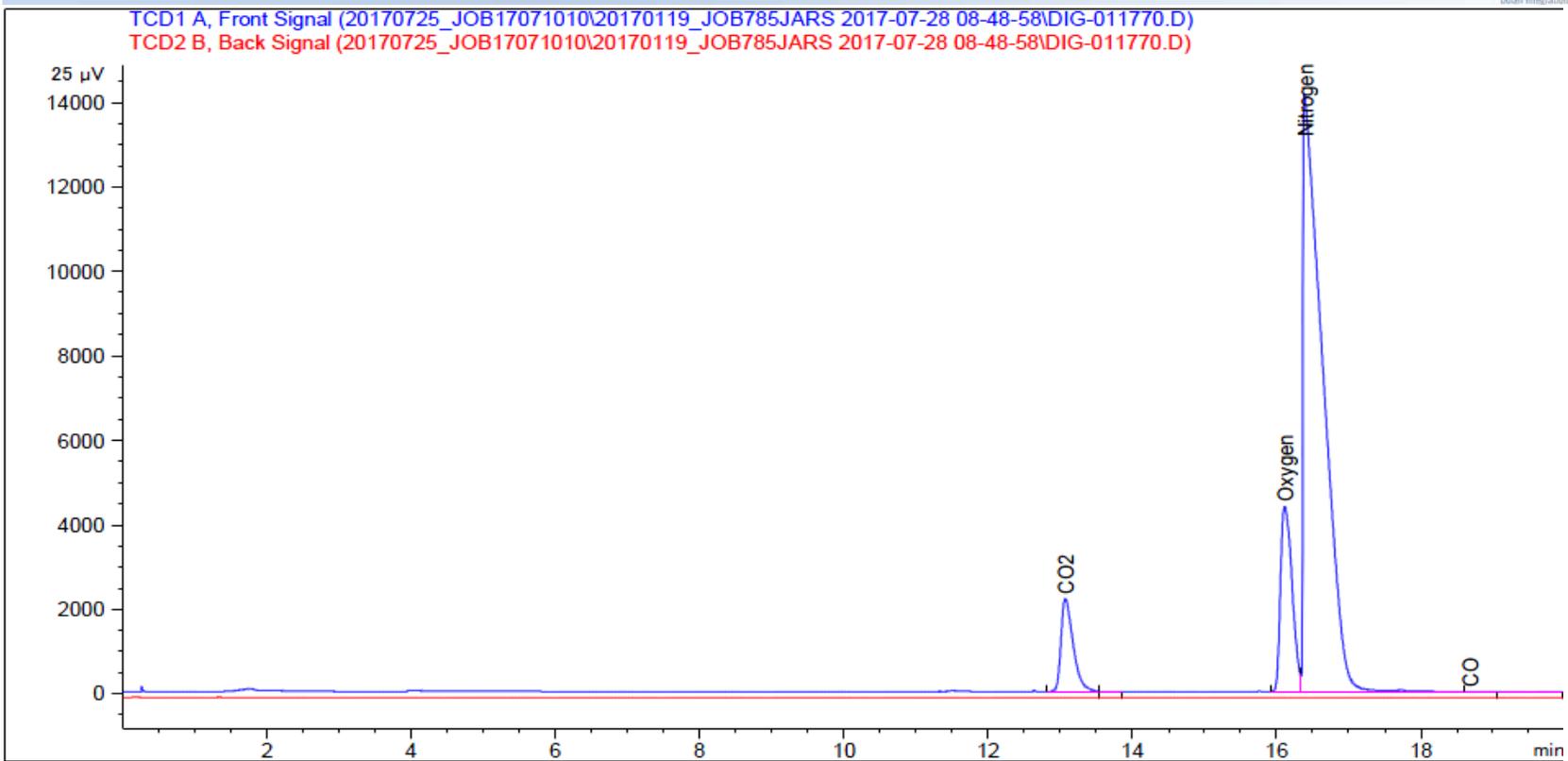
Error δD < 5.0 ‰

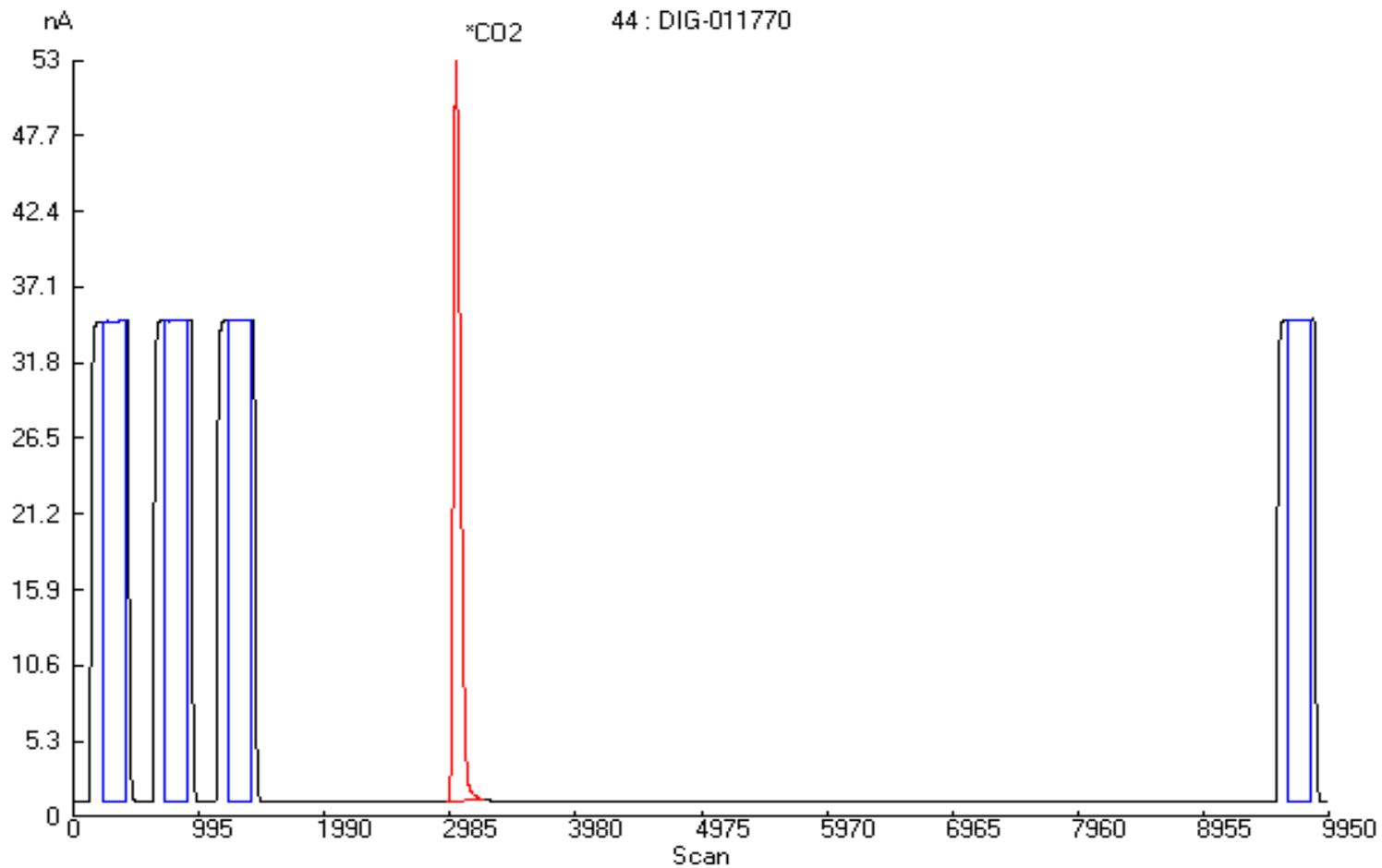
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011770.D)

TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011770.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011771
Client: Vista Geoscience
Sample Name(s): VW210727171256

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Analytical Report



Job #: 17071020
 Lab #: DIG-011771
 Client: Vista Geoscience
 Sample Name: VW210727171256
 Date Sampled: 07/27/17
 Time Sampled: 12:56
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	781885	78.28	-			
Oxygen + Argon (O ₂ +Ar)	142307	14.25	-			
Carbon Dioxide (CO ₂)	74569	7.47	-	-23.4		
Carbon Monoxide (CO)	12	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

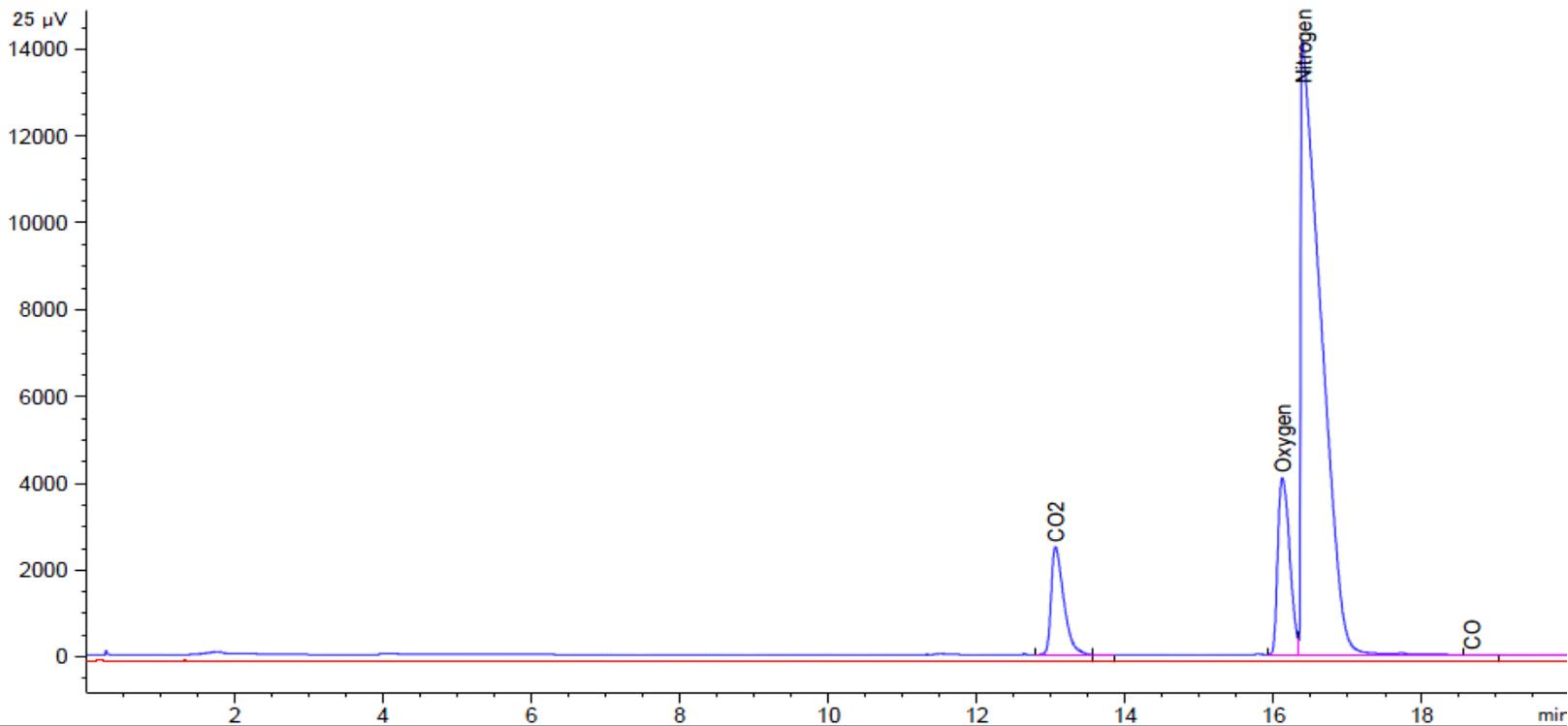
Error δD < 5.0 ‰

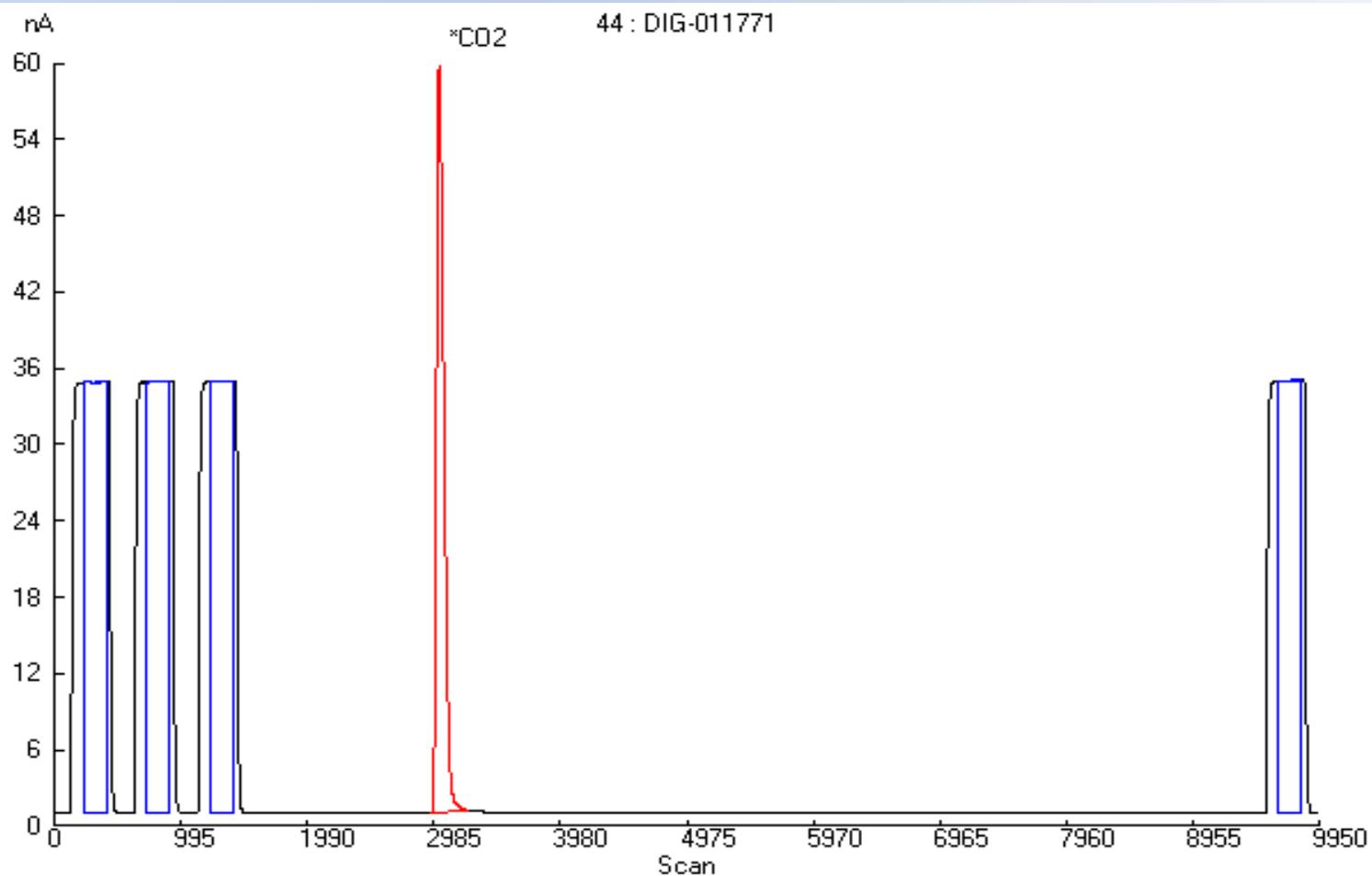
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011771.D)

TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011771.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011772
Client: Vista Geoscience
Sample Name(s): VW310727171344

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Analytical Report



Job #: 17071020
 Lab #: DIG-011772
 Client: Vista Geoscience
 Sample Name: VW310727171344
 Date Sampled: 07/27/17
 Time Sampled: 13:44
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	786350	79.02	-			
Oxygen + Argon (O ₂ +Ar)	168777	16.96	-			
Carbon Dioxide (CO ₂)	40005	4.02	-	-19.2		
Carbon Monoxide (CO)	14	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

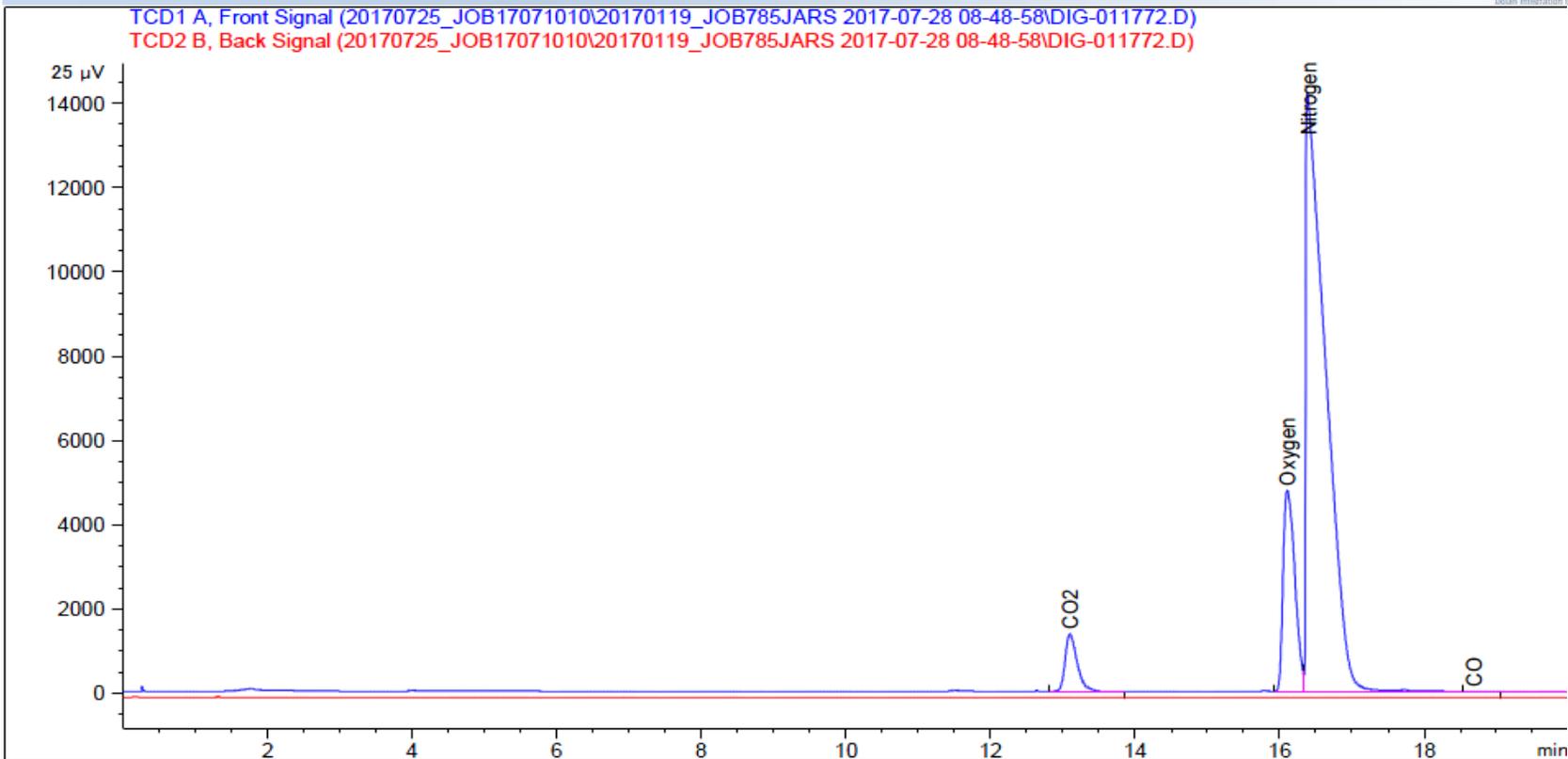
Error $\delta^{13}\text{C}$ < 0.5 ‰

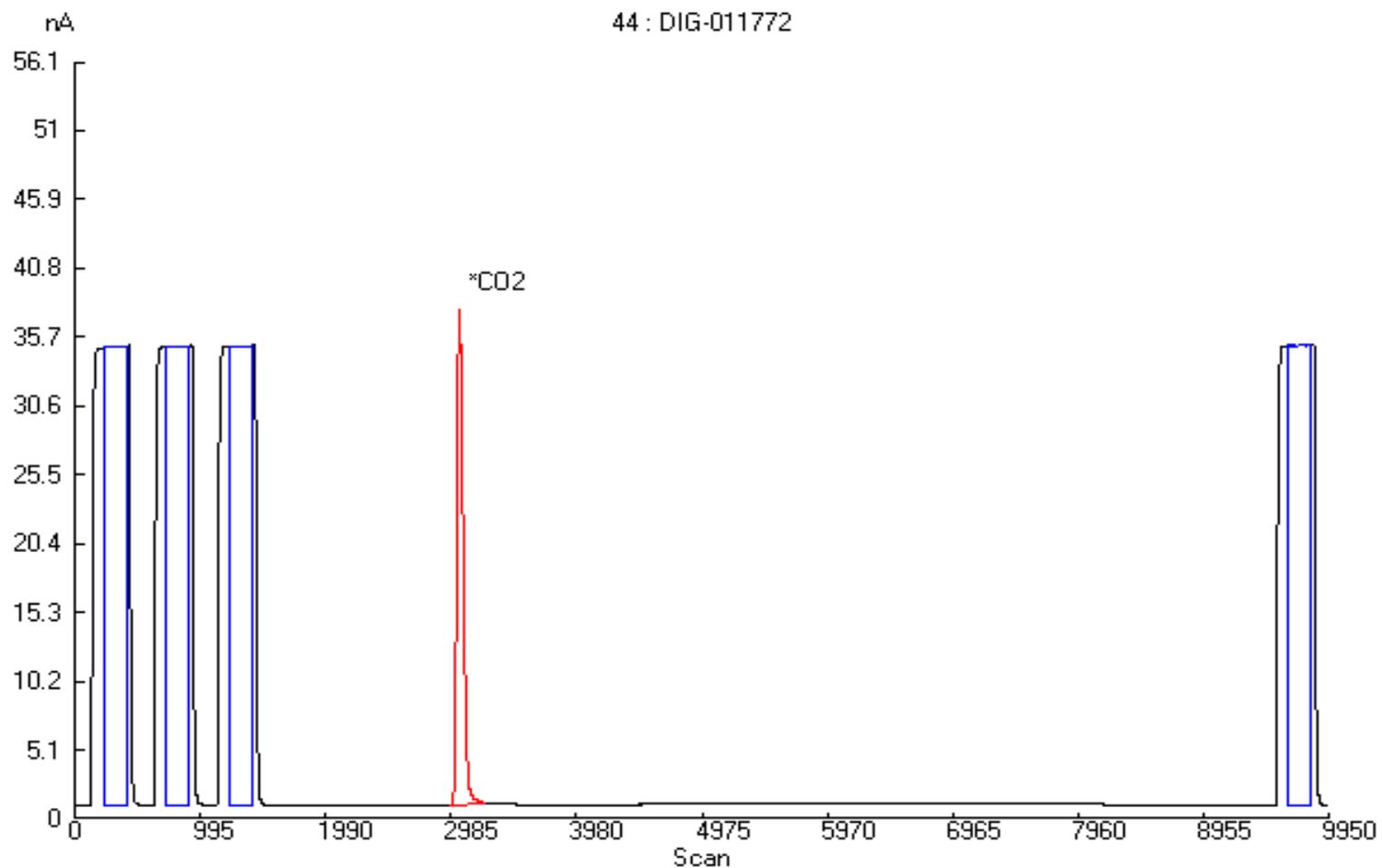
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011772.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011772.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG011773
Client: Vista Geoscience
Sample Name(s): VW370727171359

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Analytical Report



Job #: 17071020
 Lab #: DIG011773
 Client: Vista Geoscience
 Sample Name: VW370727171359
 Date Sampled: 07/27/17
 Time Sampled: 13:59
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	823412	83.40	-			
Oxygen + Argon (O ₂ +Ar)	118923	12.05	-			
Carbon Dioxide (CO ₂)	44964	4.55	-	-31.8		
Carbon Monoxide (CO)	9	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

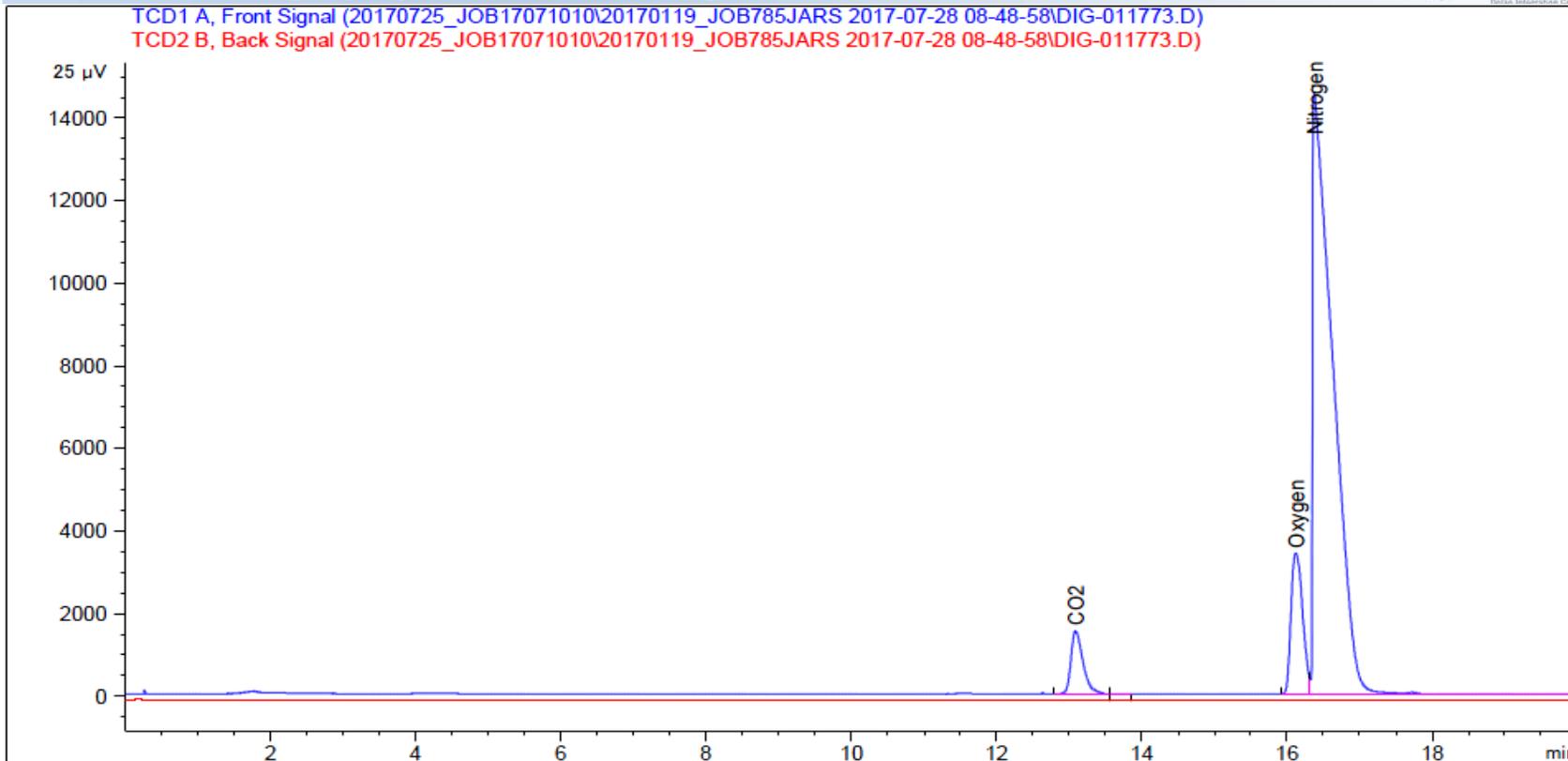
Error $\delta^{13}\text{C}$ < 0.5 ‰

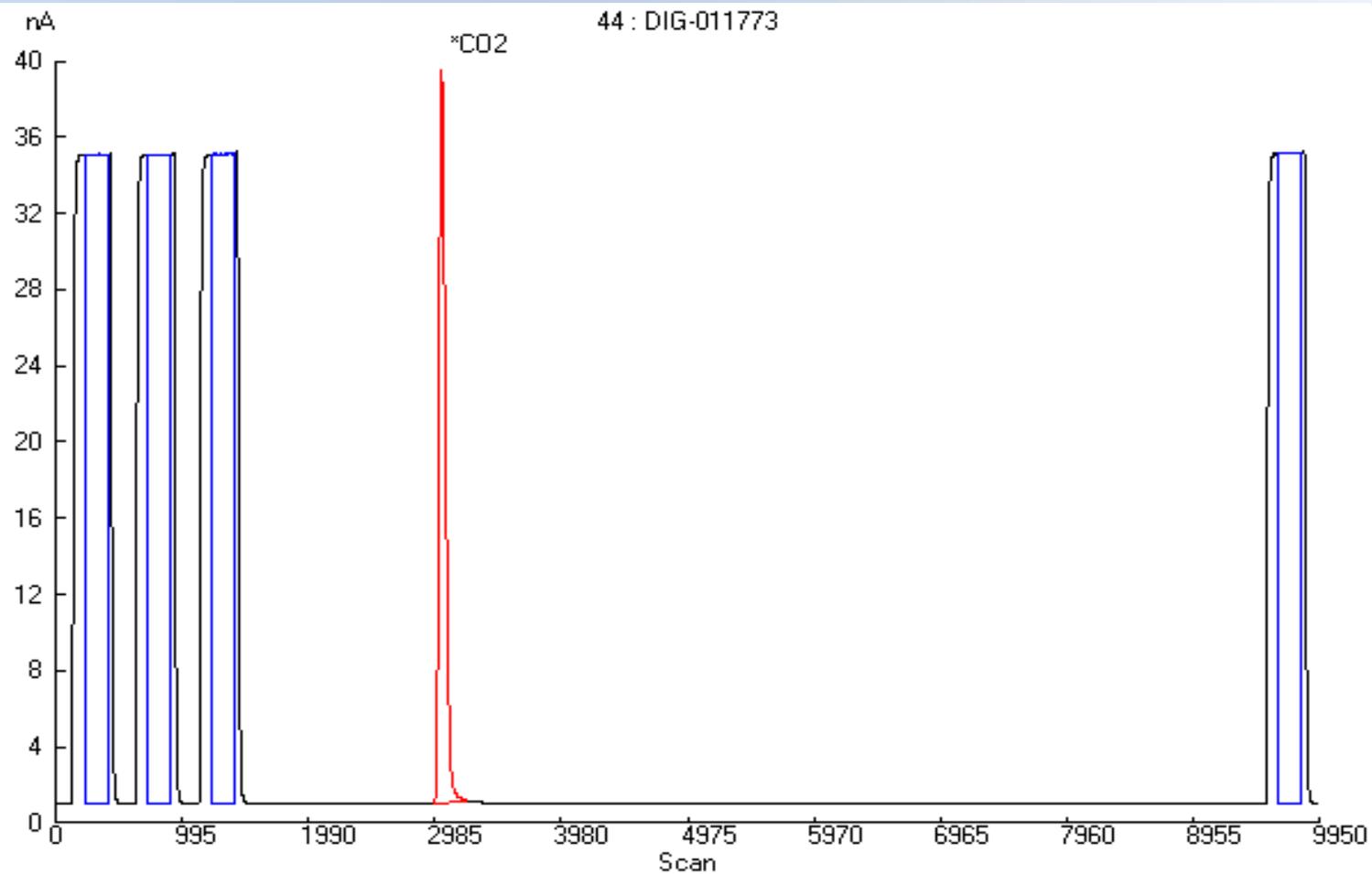
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011773.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011773.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011774
Client: Vista Geoscience
Sample Name(s): VW380727171405

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Analytical Report



Job #: 17071020
 Lab #: DIG-011774
 Client: Vista Geoscience
 Sample Name: VW380727171405
 Date Sampled: 07/27/17
 Time Sampled: 14:05
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	779698	78.84	-			
Oxygen + Argon (O ₂ +Ar)	187402	18.95	-			
Carbon Dioxide (CO ₂)	21858	2.21	-	-24.1		
Carbon Monoxide (CO)	15	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

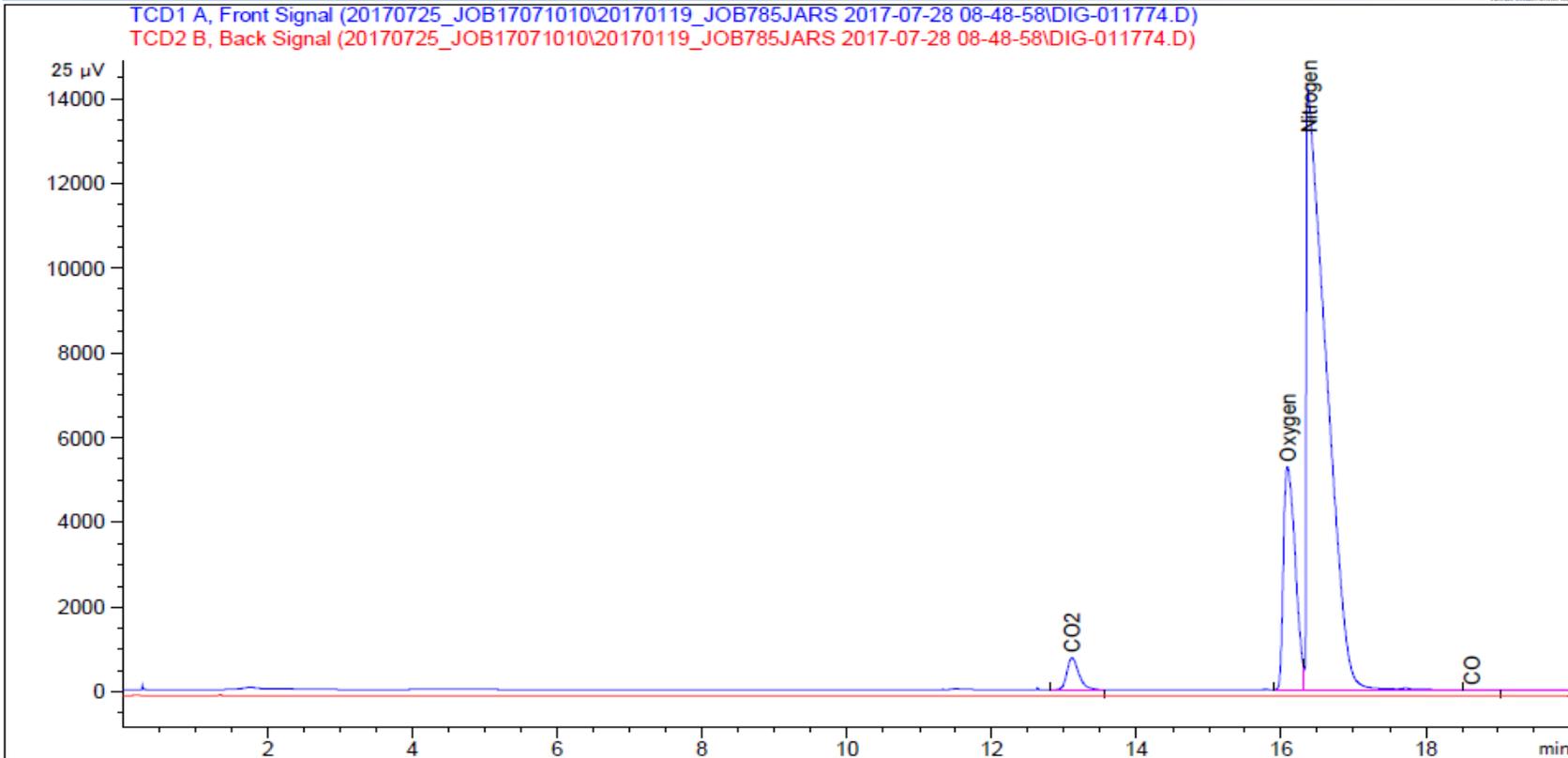
Error $\delta^{13}\text{C}$ < 0.5 ‰

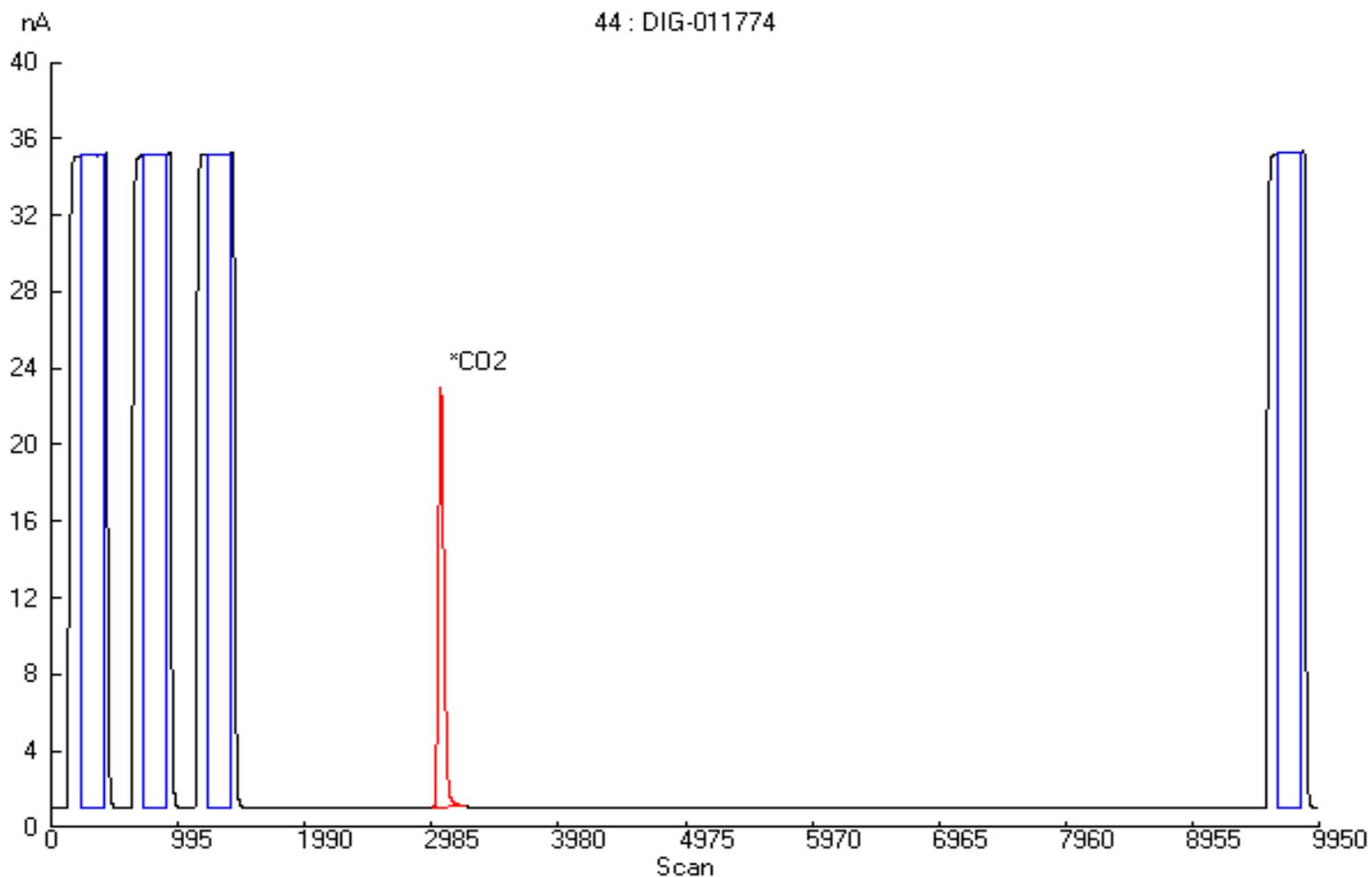
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011774.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011774.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011775
Client: Vista Geoscience
Sample Name(s): VW410727171410

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Analytical Report



Job #: 17071020
 Lab #: DIG-011775
 Client: Vista Geoscience
 Sample Name: VW410727171410
 Date Sampled: 07/27/17
 Time Sampled: 14:10
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported:
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	793292	80.32	-			
Oxygen + Argon (O ₂ +Ar)	166086	16.82	-			
Carbon Dioxide (CO ₂)	28227	2.86	-	-28.6		
Carbon Monoxide (CO)	11	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

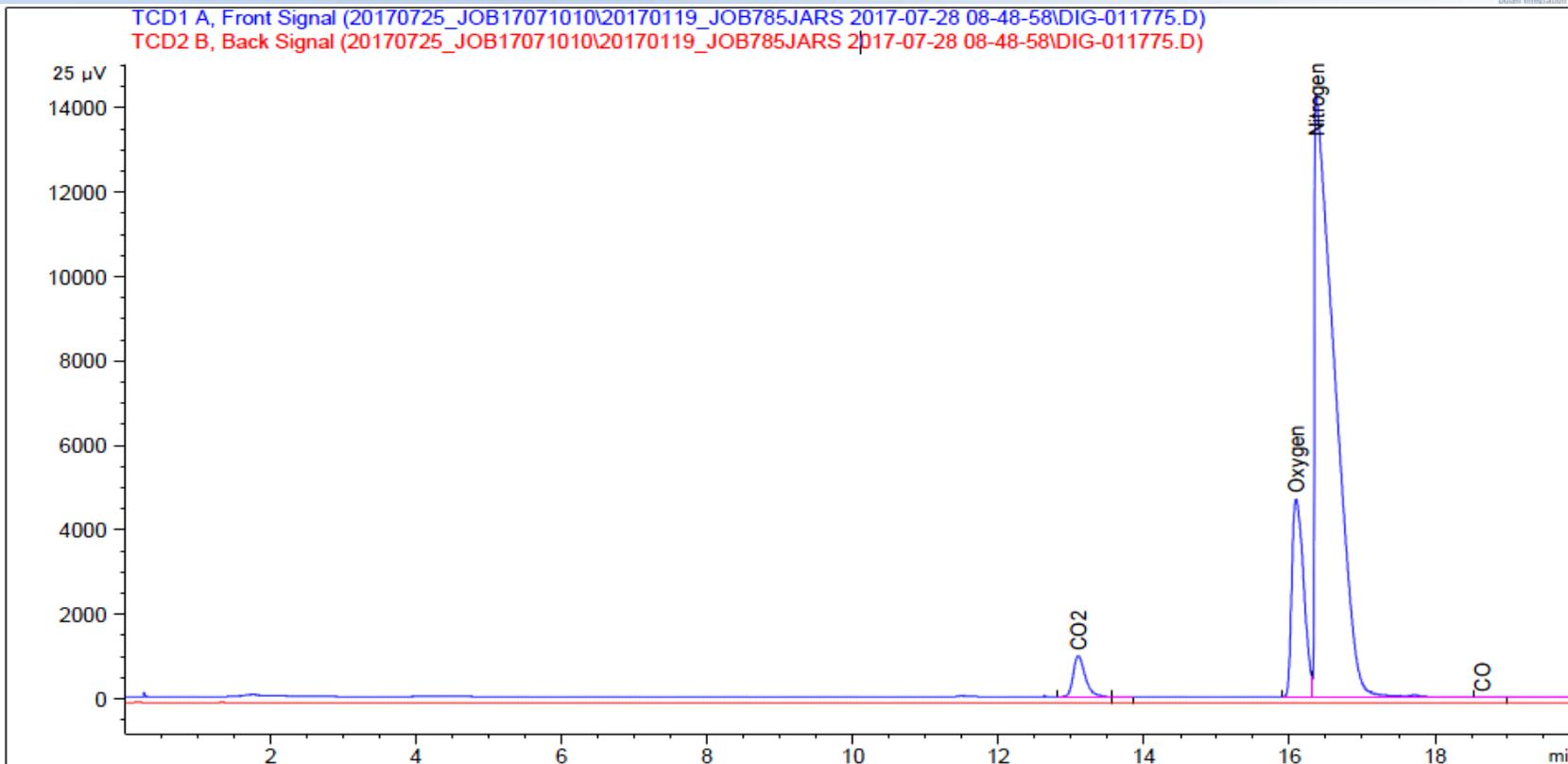
Error $\delta^{13}\text{C}$ < 0.5 ‰

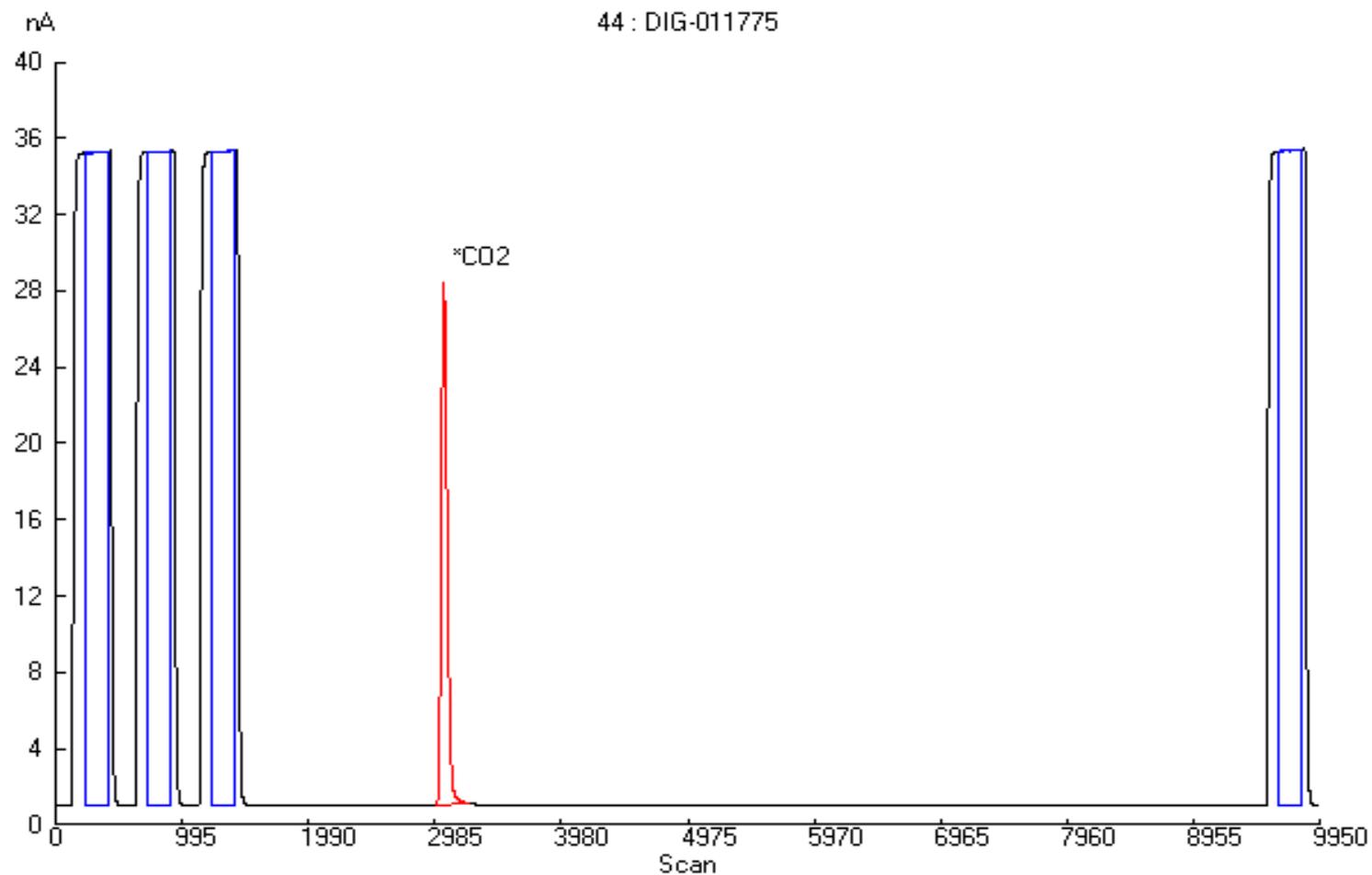
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011775.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011775.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011776
Client: Vista Geoscience
Sample Name(s): VW450727171502

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Analytical Report



Job #: 17071020
 Lab #: DIG-011776
 Client: Vista Geoscience
 Sample Name: VW450727171502
 Date Sampled: 07/27/17
 Time Sampled: 15:02
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	764581	77.31	-			
Oxygen + Argon (O ₂ +Ar)	223960	22.64	-			
Carbon Dioxide (CO ₂)	454	0.05	-	-12.2		Low signal
Carbon Monoxide (CO)	16	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

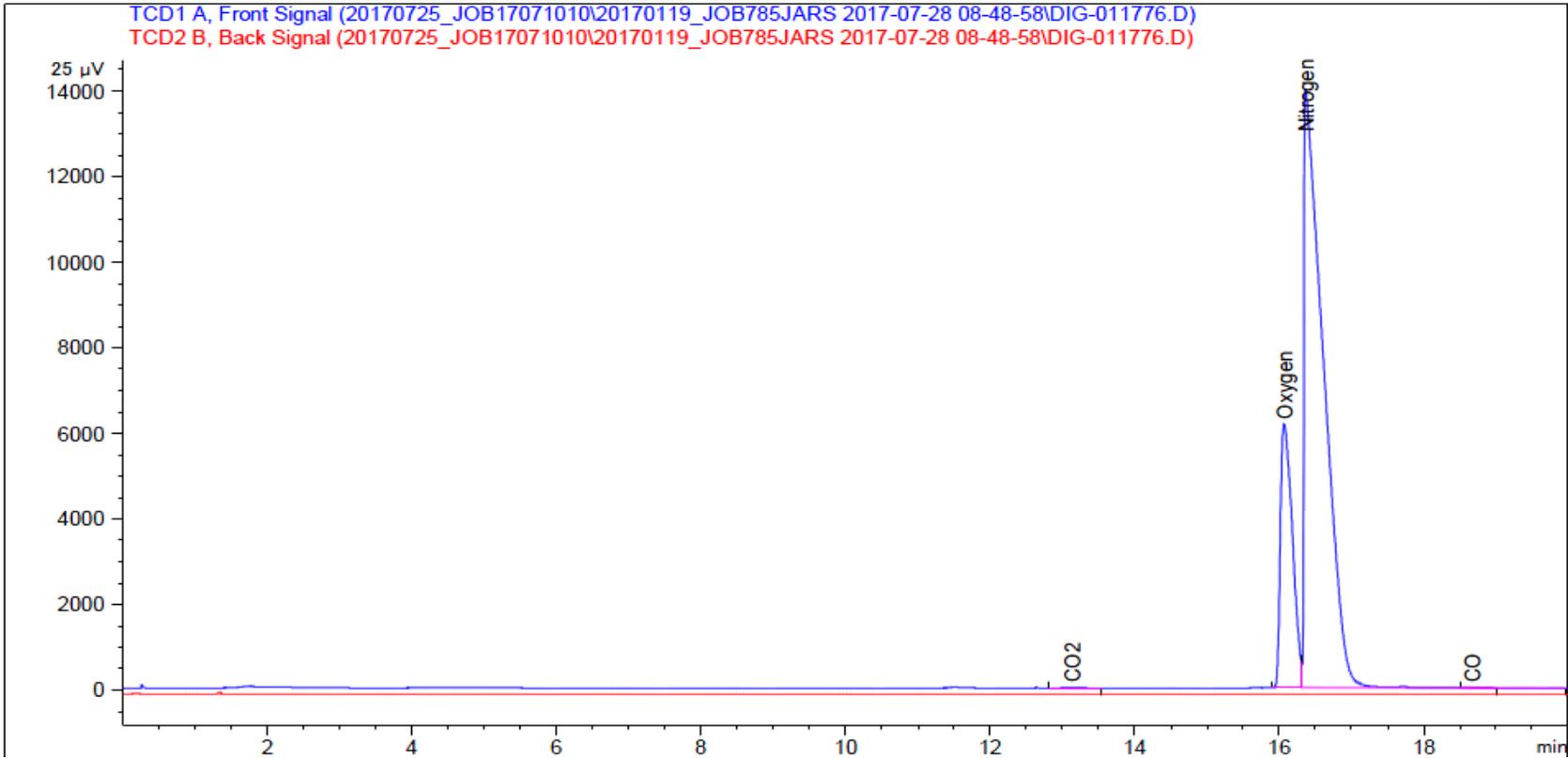
Error $\delta^{13}\text{C}$ < 0.5 ‰

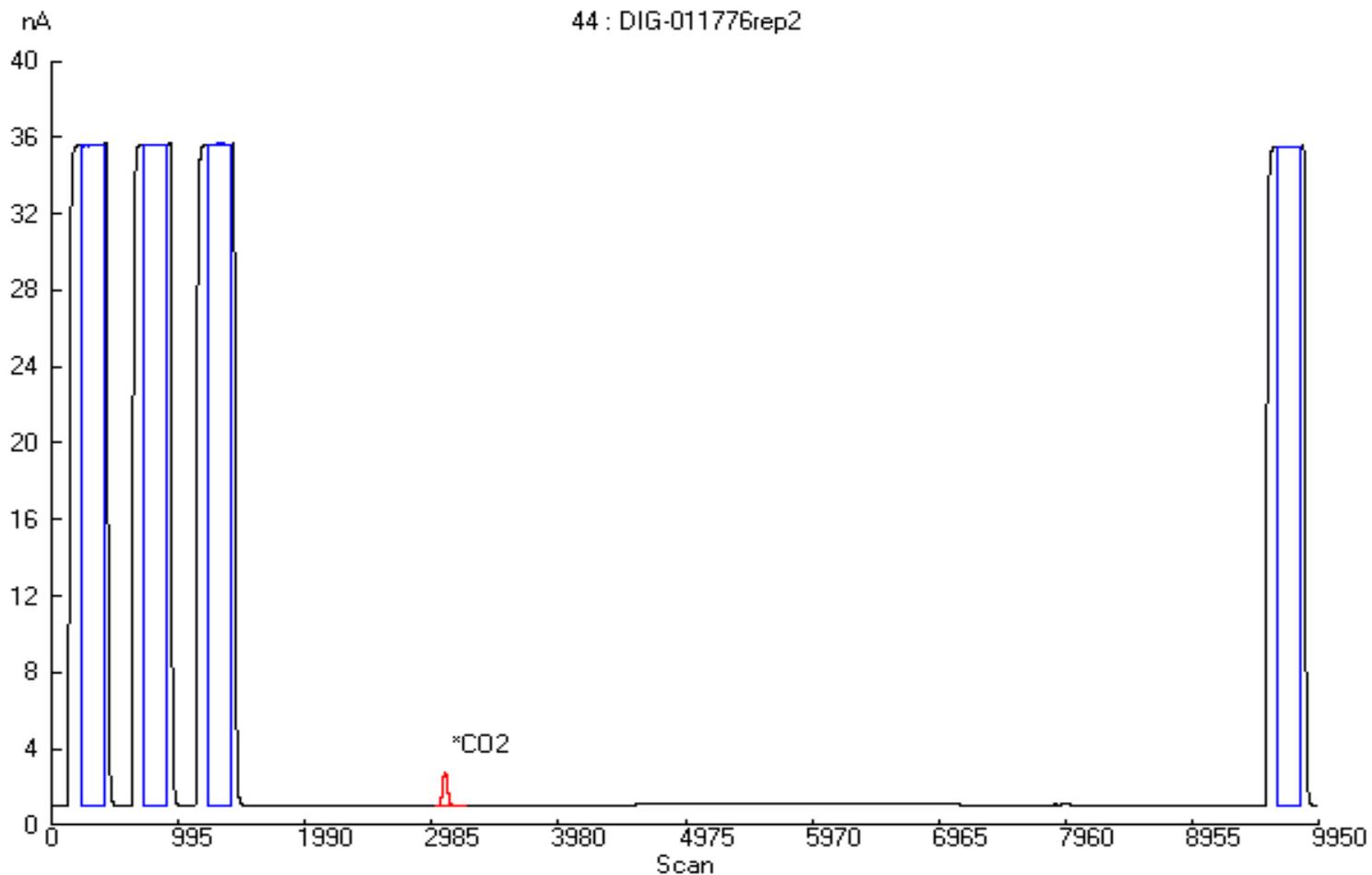
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011776.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011776.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011777
Client: Vista Geoscience
Sample Name(s): VW450727171505

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Analytical Report



Job #: 17071020
 Lab #: DIG-011777
 Client: Vista Geoscience
 Sample Name: VW450727171505
 Date Sampled: 07/27/17
 Time Sampled: 15:05
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	766282	77.27	-			
Oxygen + Argon (O ₂ +Ar)	224775	22.67	-			
Carbon Dioxide (CO ₂)	576	0.06	-	-8.2		
Carbon Monoxide (CO)	16	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

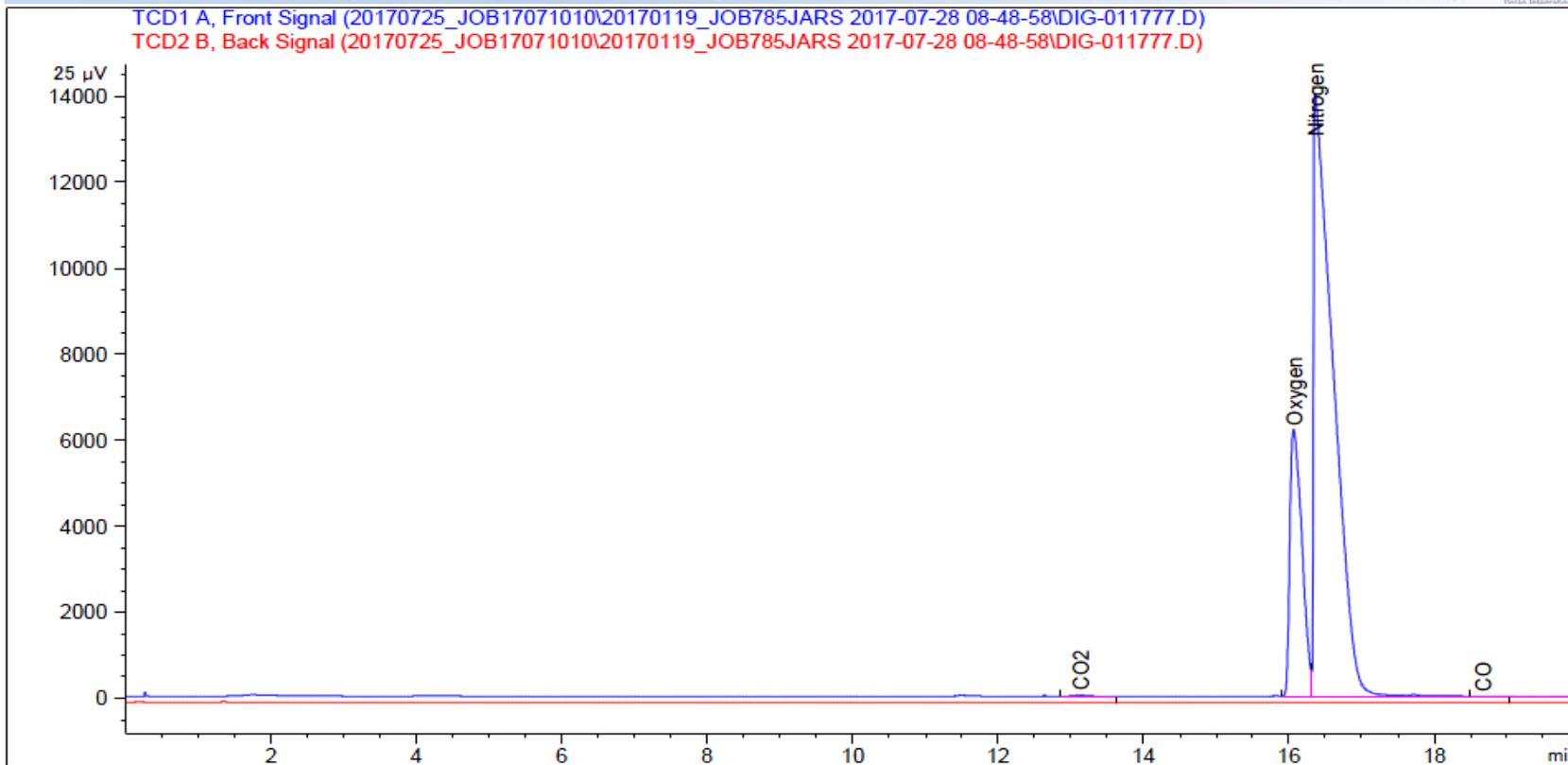
Error $\delta^{13}\text{C}$ < 0.5 ‰

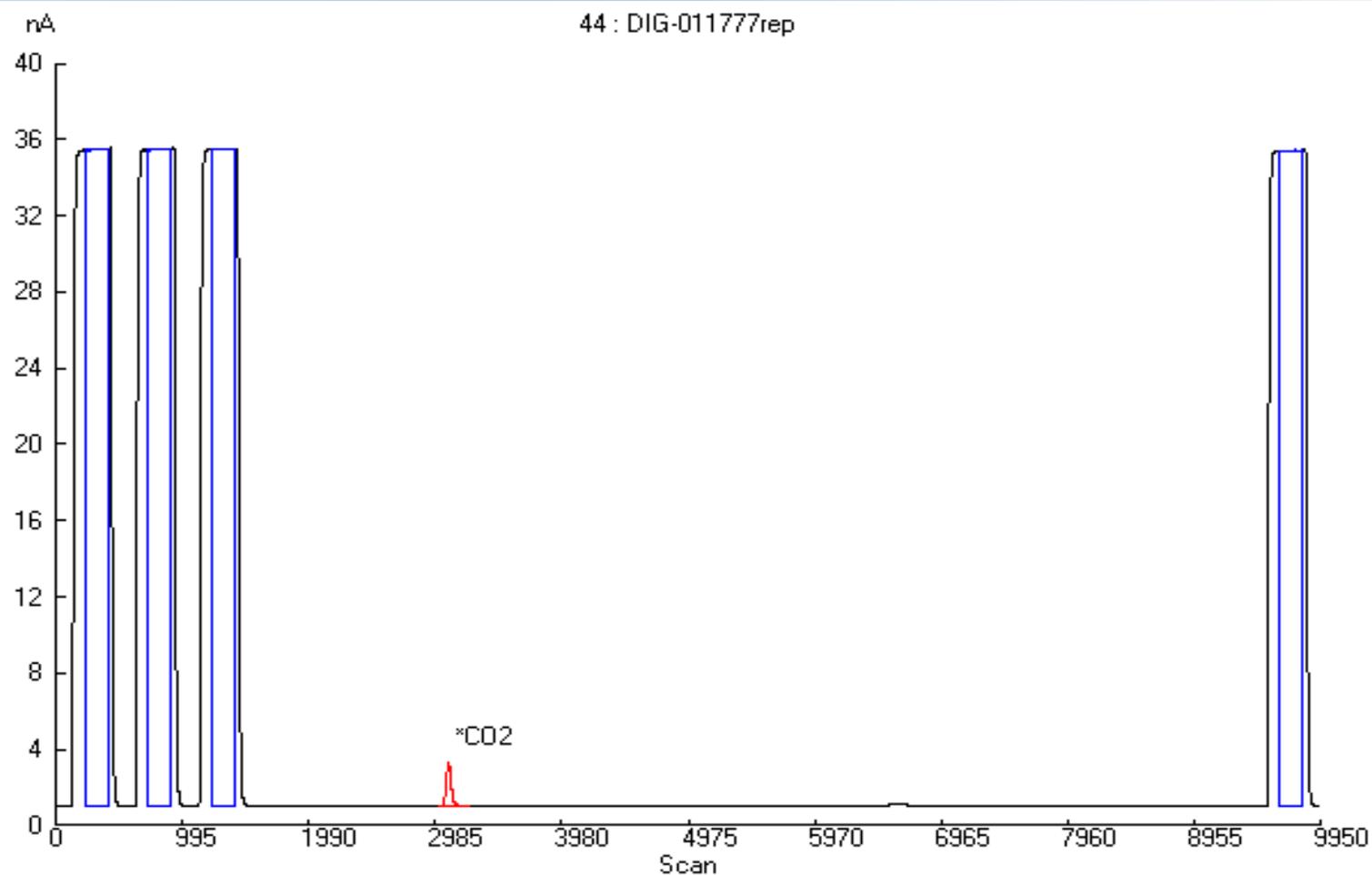
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011777.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011777.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011778
Client: Vista Geoscience
Sample Name(s): VW580727171418

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Analytical Report



Job #: 17071020
 Lab #: DIG-011778
 Client: Vista Geoscience
 Sample Name: VW580727171418
 Date Sampled: 07/27/17
 Time Sampled: 14:18
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	778623	78.54	-			
Oxygen + Argon (O ₂ +Ar)	190515	19.22	-			
Carbon Dioxide (CO ₂)	22193	2.24	-	-22.8		
Carbon Monoxide (CO)	15	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

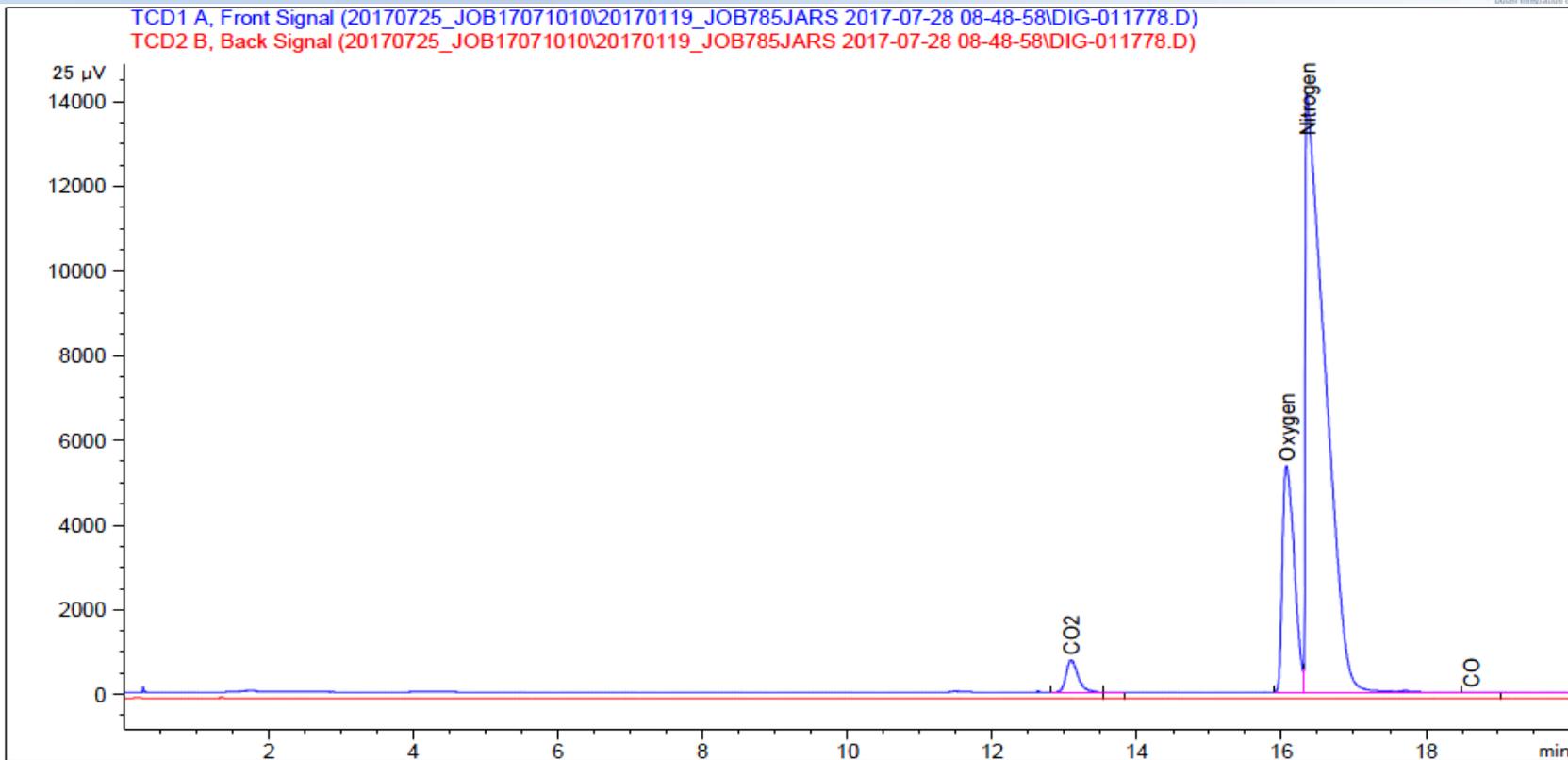
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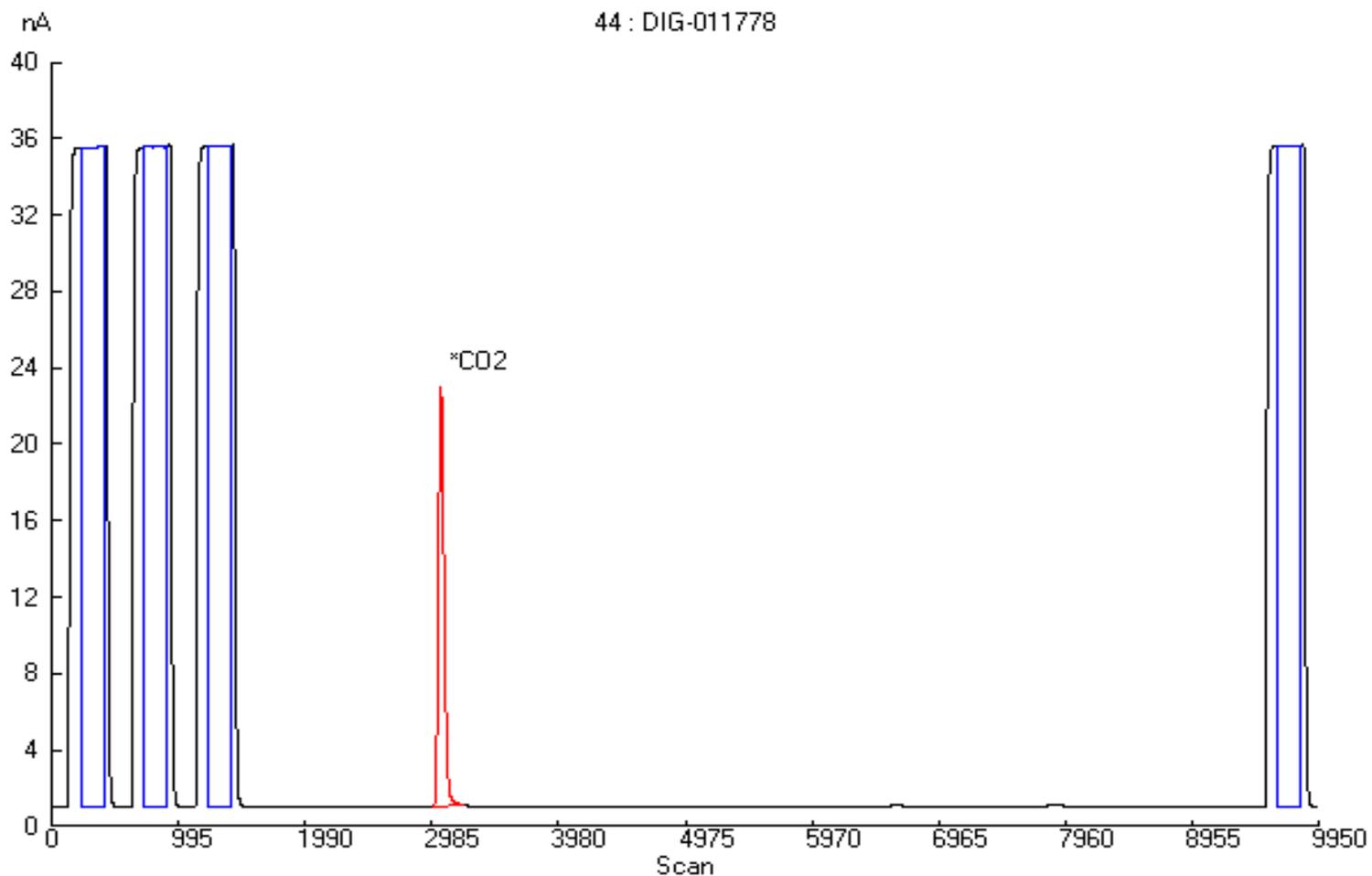
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011778.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011778.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17071020
Lab #: DIG-011779
Client: Vista Geoscience
Sample Name(s): VW590727171422

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Analytical Report



Job #: 17071020
 Lab #: DIG-011779
 Client: Vista Geoscience
 Sample Name: VW590727171422
 Date Sampled: 07/27/17
 Time Sampled: 14:22
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 07/27/17
 Date Analyzed: Gas Composition: 07/28/2017 $\delta^{13}\text{C}$: 07/27/2017
 Date Reported: 07/28/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	797980	81.71	-			
Oxygen + Argon (O ₂ +Ar)	151966	15.56	-			
Carbon Dioxide (CO ₂)	26645	2.73	-	-29.1		
Carbon Monoxide (CO)	12	0.00	-			
Helium (He) ^b	nd	nd	-			
Hydrogen (H ₂)	nd	nd	-			
Methane (CH ₄)	nd	nd	nd			
Ethane (C ₂ H ₆)	nd	nd	nd			
Ethene (C ₂ H ₄)	nd	nd	nd			
Propane (C ₃ H ₈)	nd	nd	nd			
Propene (C ₃ H ₆)	nd	nd	nd			
iso-Butane (C ₄ H ₁₀)	nd	nd	nd			
n-Butane (C ₄ H ₁₀)	nd	nd	nd			
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd			
n-Pentane (C ₅ H ₁₂)	nd	nd	nd			
Hexanes + (C ₆ H ₁₄)	nd	nd	nd			

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	#DIV/0!
C ₁ /(C ₂ +C ₃) (mol/mol)	#VALUE!

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

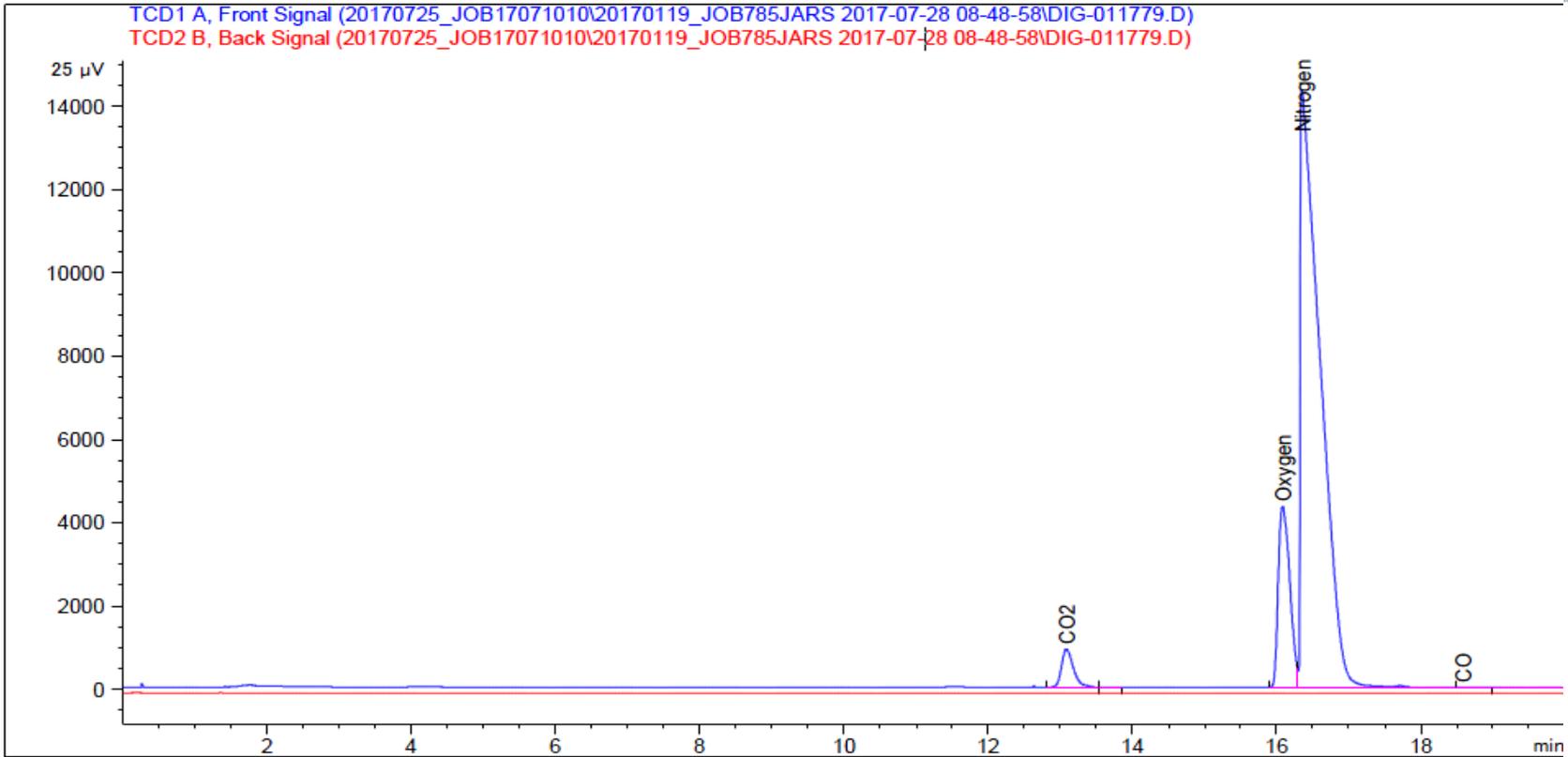
Error $\delta^{13}\text{C}$ < 0.5 ‰

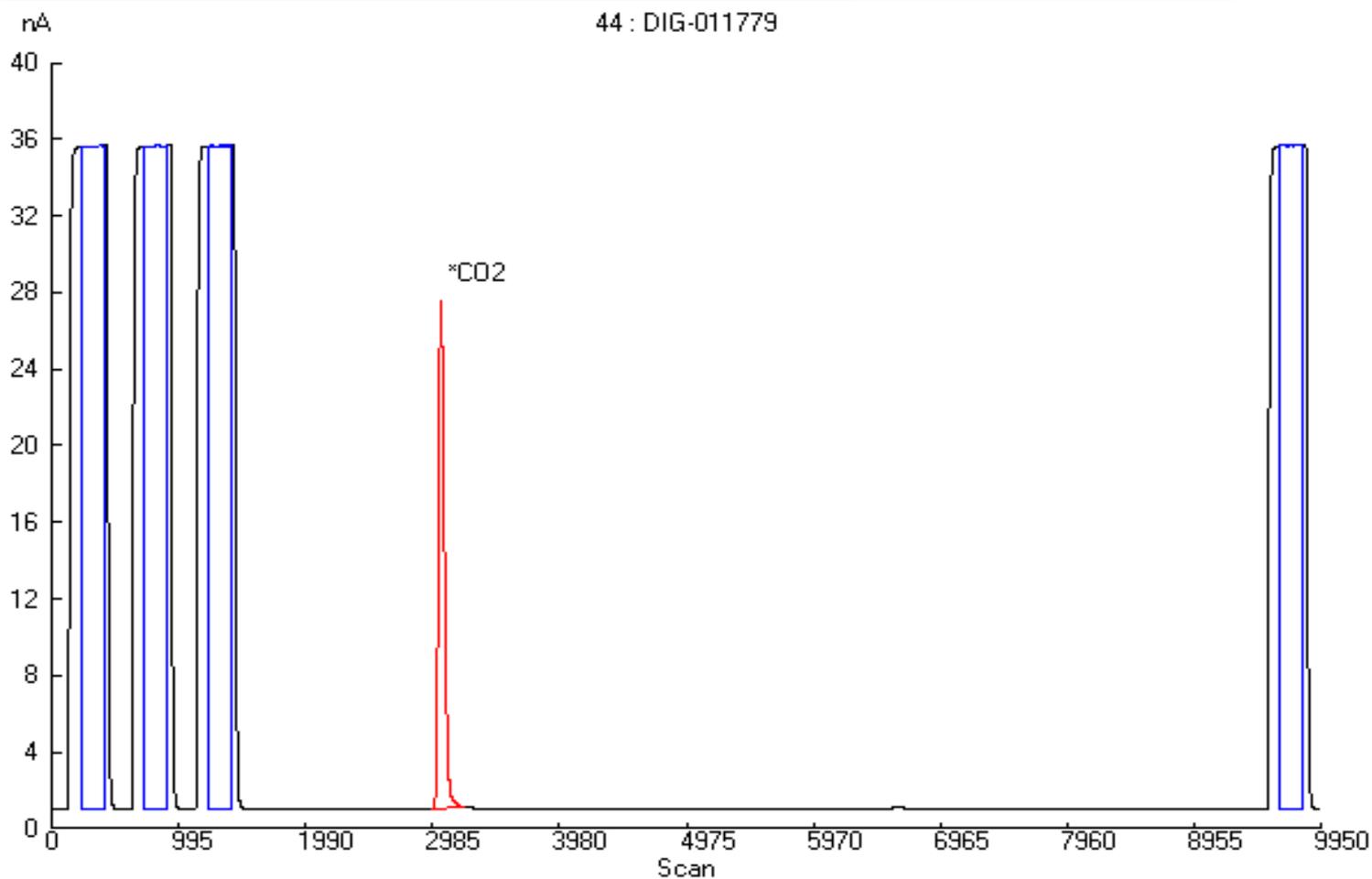
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011779.D)
TCD2 B, Back Signal (20170725_JOB17071010\20170119_JOB785JARS 2017-07-28 08-48-58\DIG-011779.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Job 17081046

DIG-011997 → 012001

Send Data and Invoice to:

Name: Patrick Travers & Stephen Hodgetts
John Fontana

Company: Dolan Integration Group
Vista Geoscience

Address: 1317 W 121st Avenue
130 Capital Dr. Ste. C
Golden, CO 80401
Westminster, CO 80234

Phone: 303-531-2030 *1713701* 303 277-1694

Fax: _____

Email: fontana@vistageoscience.com
ptravers@digforenergy.com
tstockwell@vistageoscience.com
shodgetts@digforenergy.com

AFE #: _____

Report Ctr: _____

Project: 17137.01

PO #: _____

Location: Firestone

Sampled By: Ted Stockwell

Analysis Requested					
<i>0-18 O, Fe and H₂O/H₂O-1</i>	<i>DATE-ANALYTIC</i>	<i>Composition</i>	<i>d13C C₁ → C₅</i>	<i>dD C₁</i>	<i>d13C CO₂</i>

Sample Description

Container #	Sample Identification	Date Sampled	Time	<i>0-18 O, Fe and H₂O/H₂O-1</i>	<i>DATE-ANALYTIC</i>	<i>Composition</i>	<i>d13C C₁ → C₅</i>	<i>dD C₁</i>	<i>d13C CO₂</i>	Comments
1	VW06-082817-1124	8-28-17	11:24			✓	✓	✓		
1	VW08-082817-1134	↓	11:34			↓	↓	↓		
1	VW17-082817-1145		11:45			↓	↓	↓		
1	VW21-082817-1156		11:56			↓	↓	↓		
1	VW23-082817-1203		12:03			↓	↓	↓		
1	VW31-082817-1203		12:03			↓	↓	↓		

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by	Dolan integration Group		
Received by			
Relinquished by <i>Ted Stockwell</i>	Vista Geoscience	8-28-17	15:00
Received by <i>Shodgetts</i>	DIG	8-28-17	15:00
Relinquished by			
Received by			



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Dolan Integration Group

Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303-531-2030

Job 17081046
DIG-011991 → 011996

Send Data and Invoice to:

Name: John Fontana
Patrick Travers & Stephen Hodgetts

Company: Vista Geoscience
Dolan Integration Group

Address: 130 Capital Dr. Ste. C
1317 W 121st Avenue
Golden, CO, 80401
Westminster, CO. 80234

Phone: 303-531-2030-303-277-1694

Fax: _____
Email: Jfontana@vista.geoscience.com

p.travers@digforenergy.com
tstockwell@vista.geoscience.com
shodgetts@digforenergy.com

AFE #: _____

Report Ctr: _____

Project: 17137.01

PO #: _____

Location: Firestone

Sampled By: Ted Stockwell

Analysis Requested					
0-18 O-16 and H-27-1 of water					
DIC-EDC					
Composition					
d13C C1-2C6					
dD C1					
d13C CO2					

Sample Description

Container #	Sample Identification	Date Sampled	Time	Analysis Requested		Comments
1	VW37-082817-1232	8-28-17	12:32			
1	VW38-082817-1314	↓	13:14			
1	VW41-082817-1208		12:08			
1	VW45-082817-1252		12:52			
1	VW58-082817-1330		13:30			
1	VW59-082817-1325		13:25			

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by	Dolan integration Group		
Received by			
Relinquished by <u>Ted Stockwell</u>	Vista Geoscience	8-28-17	15:00
Received by <u>S.Hodgetts</u>	DIG.	8-28-17	15:00
Relinquished by			
Received by			



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Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011991
Client: Vista Geoscience
Sample Name(s): VW37-082817-1232

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Analytical Report



Job #: 17081046
 Lab #: DIG-011991
 Client: Vista Geoscience
 Sample Name: VW37-082817-1232
 Date Sampled: 08/28/17
 Time Sampled: 12:32
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	808684	81.65	-	-	-	
Oxygen + Argon (O ₂ +Ar)	125783	12.70	-	-	-	
Carbon Dioxide (CO ₂)	55912	5.65	-	-29.5	-	
Carbon Monoxide (CO)	12	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

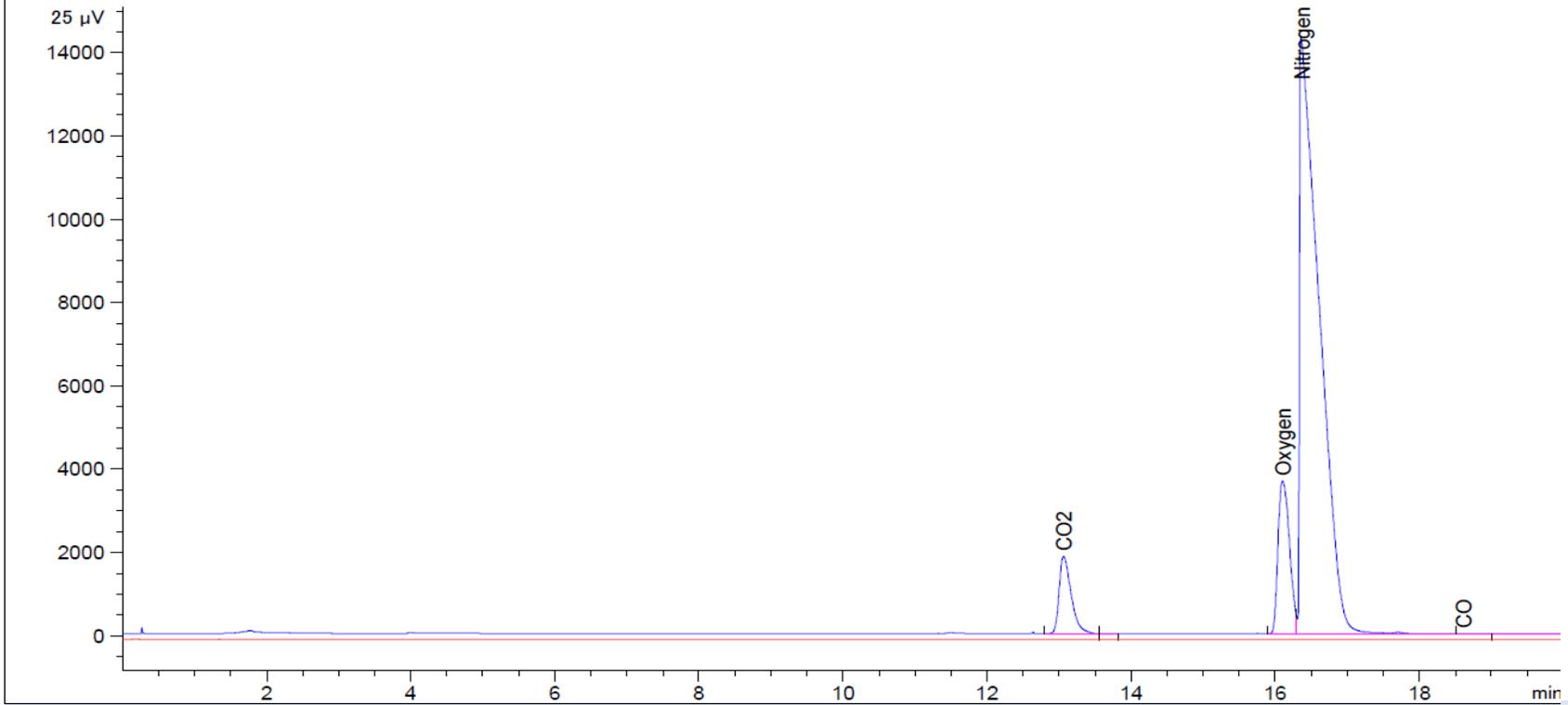
Error δD < 5.0 ‰

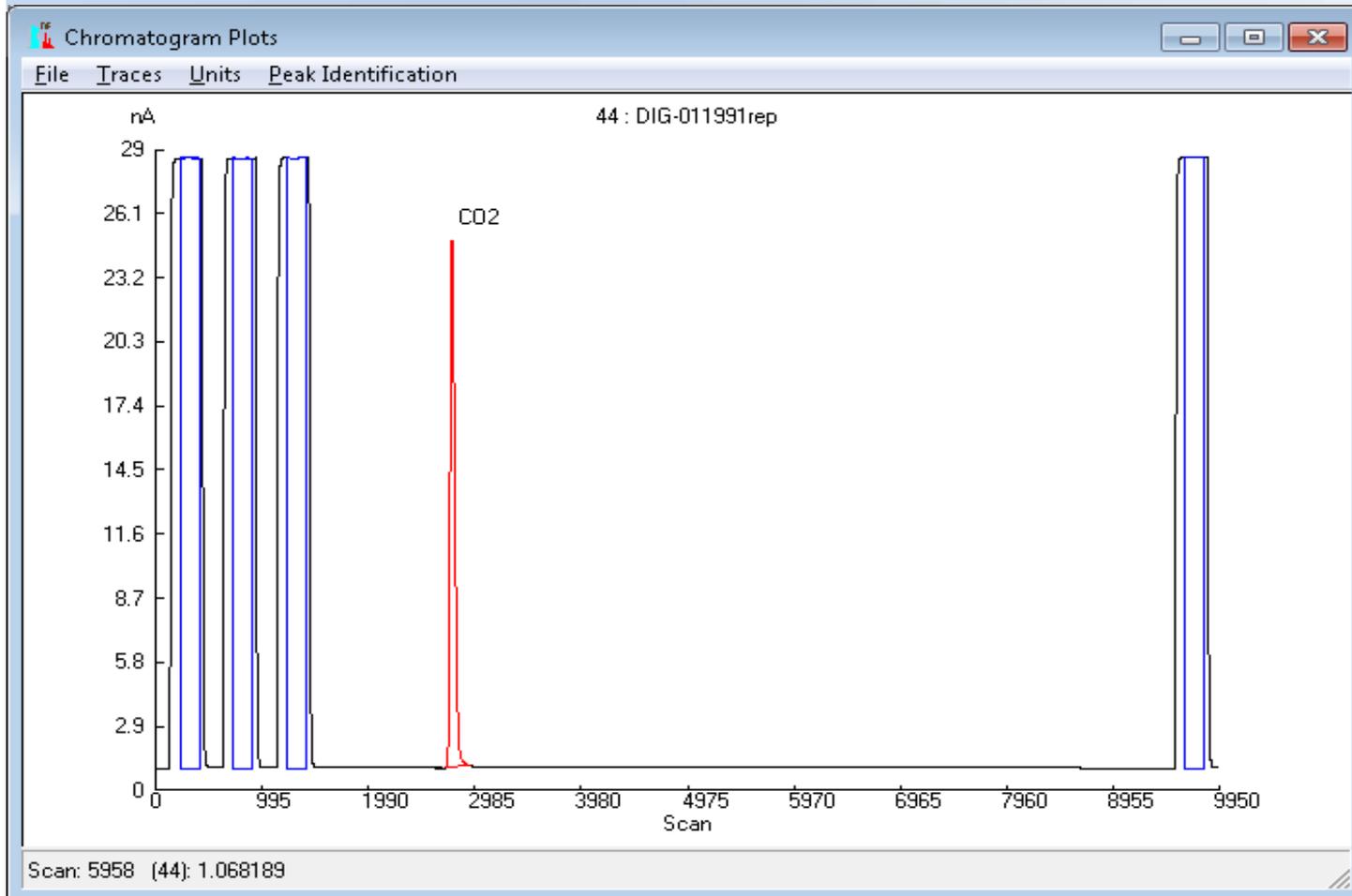
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011991.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011991.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011992
Client: Vista Geoscience
Sample Name(s): VW38-082817-1314

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Analytical Report



Job #: 17081046
 Lab #: DIG-011992
 Client: Vista Geoscience
 Sample Name: VW38-082817-1314
 Date Sampled: 08/28/17
 Time Sampled: 13:14
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/30/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	783983	78.85	-	-	-	
Oxygen + Argon (O ₂ +Ar)	185060	18.61	-	-	-	
Carbon Dioxide (CO ₂)	25186	2.53	-	-23.6	-	
Carbon Monoxide (CO)	15	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

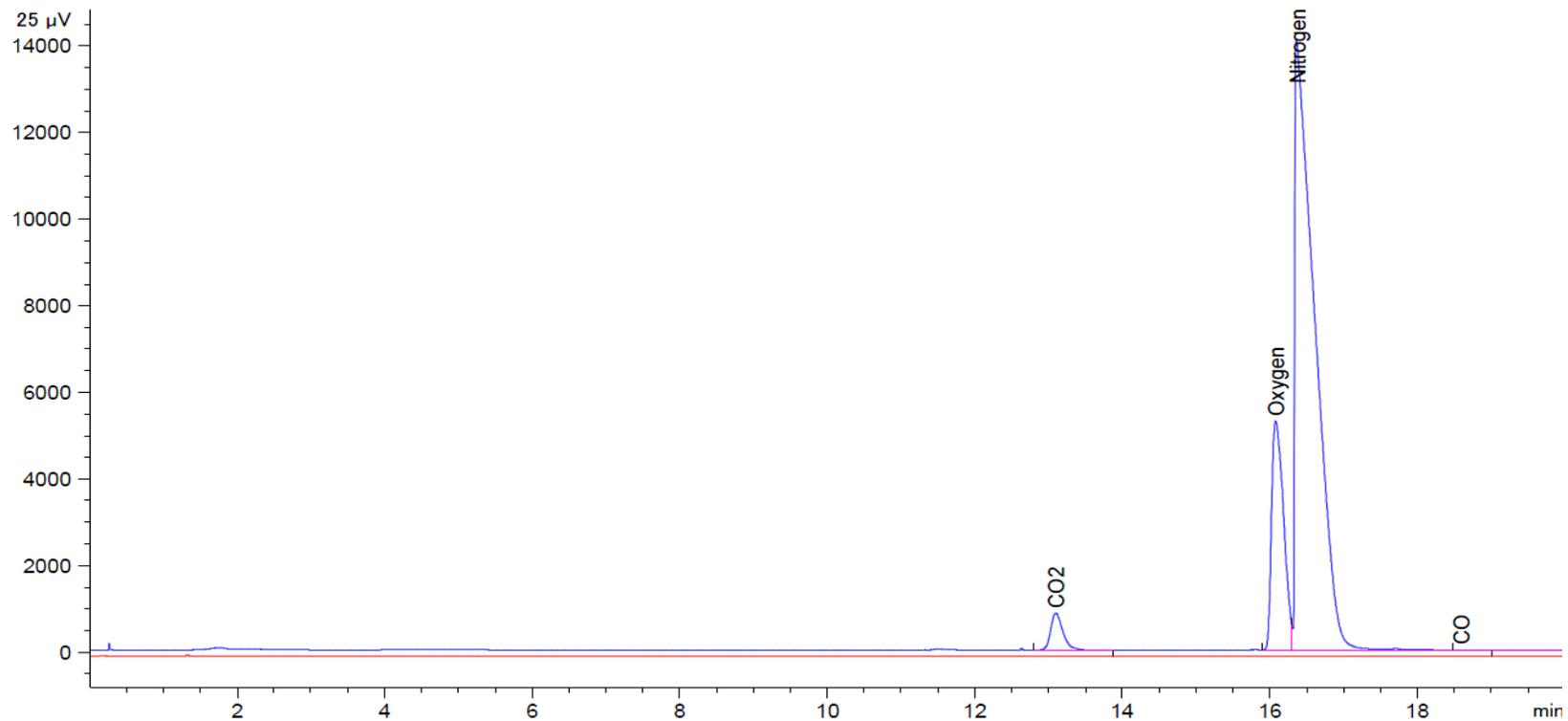
Error δD < 5.0 ‰

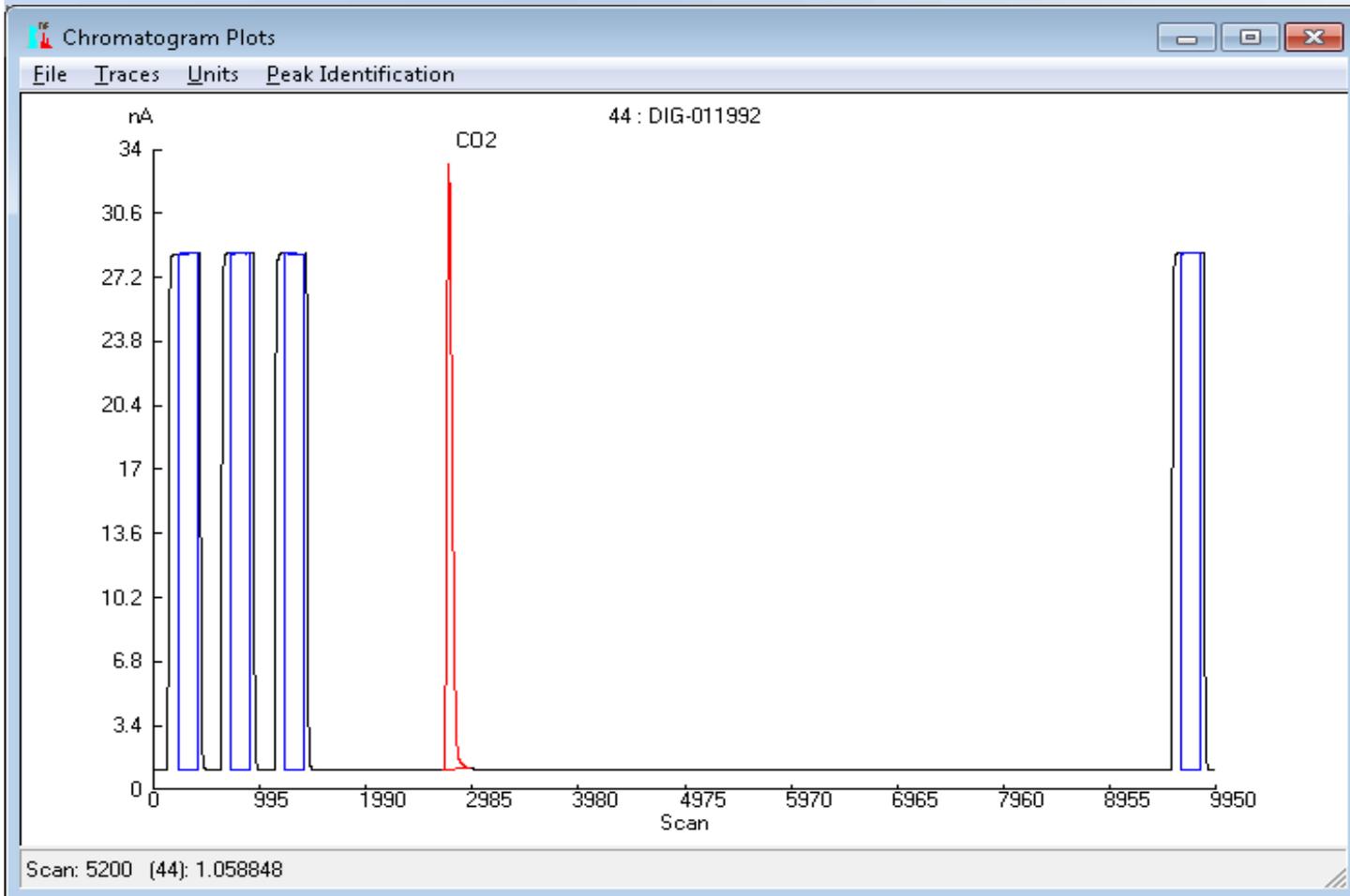
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011992.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011992.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011993
Client: Vista Geoscience
Sample Name(s): VW41-082817-1208

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Analytical Report



Job #: 17081046
 Lab #: DIG-011993
 Client: Vista Geoscience
 Sample Name: VW41-082817-1208
 Date Sampled: 08/28/17
 Time Sampled: 12:08
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	802355	81.04	-	-	-	
Oxygen + Argon (O ₂ +Ar)	146761	14.82	-	-	-	
Carbon Dioxide (CO ₂)	40969	4.14	-	-27.4	-	
Carbon Monoxide (CO)	13	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

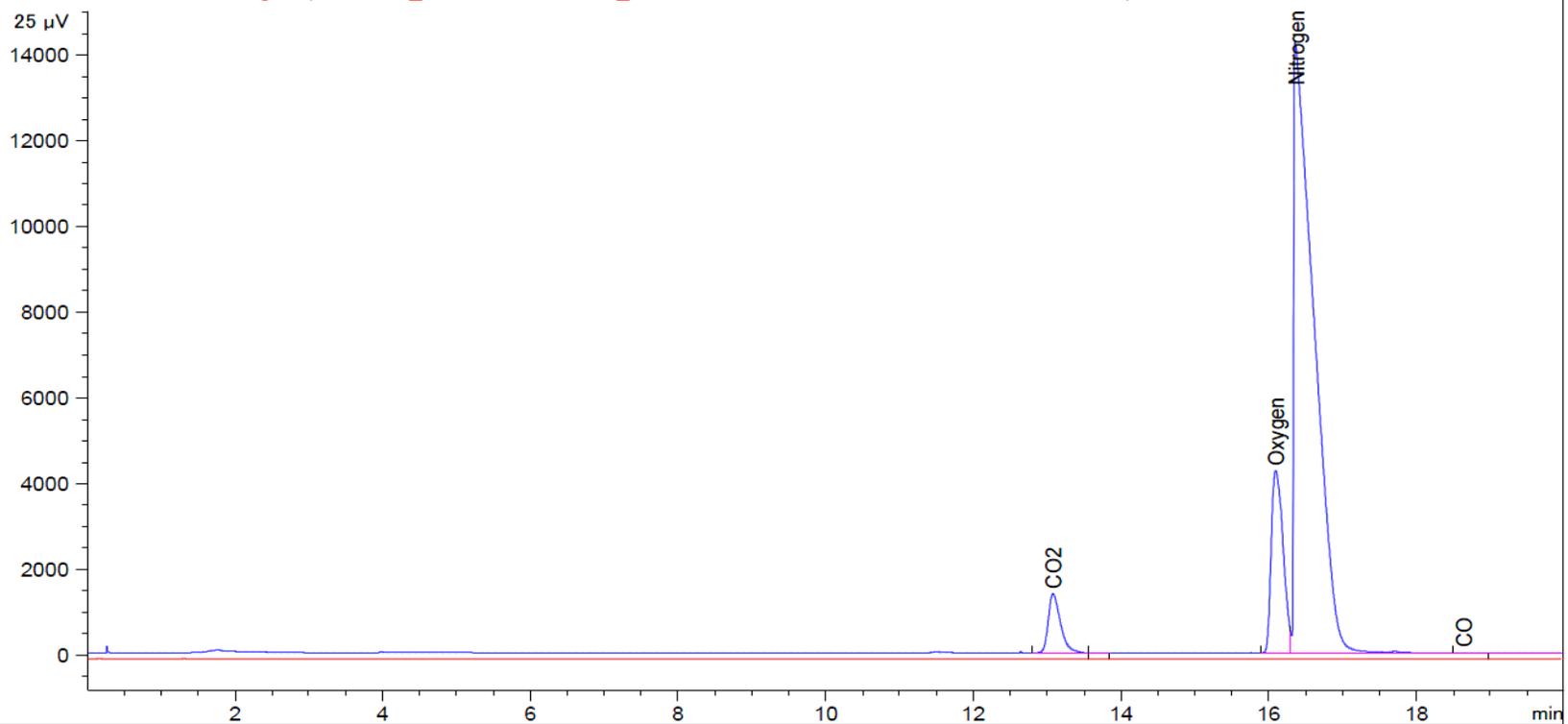
Error δD < 5.0 ‰

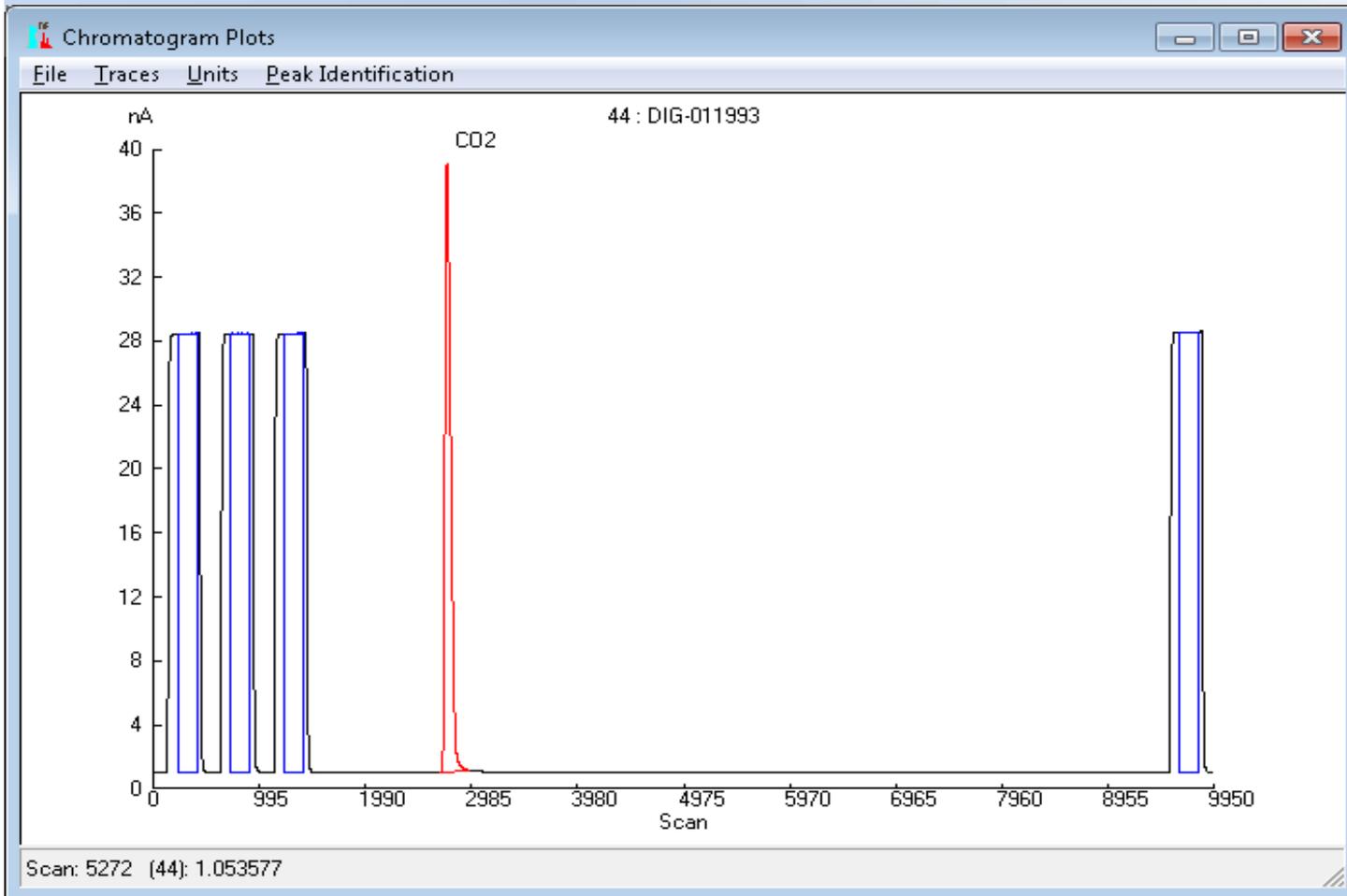
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011993.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011993.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Dolan Integration Group

Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011994
Client: Vista Geoscience
Sample Name(s): VW45-082817-1252

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Analytical Report



Job #: 17081046
 Lab #: DIG-011994
 Client: Vista Geoscience
 Sample Name: VW45-082817-1252
 Date Sampled: 08/28/17
 Time Sampled: 12:52
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	779577	77.97	-	-	-	
Oxygen + Argon (O ₂ +Ar)	219635	21.97	-	-	-	
Carbon Dioxide (CO ₂)	563	0.06	-	-	-	
Carbon Monoxide (CO)	17	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

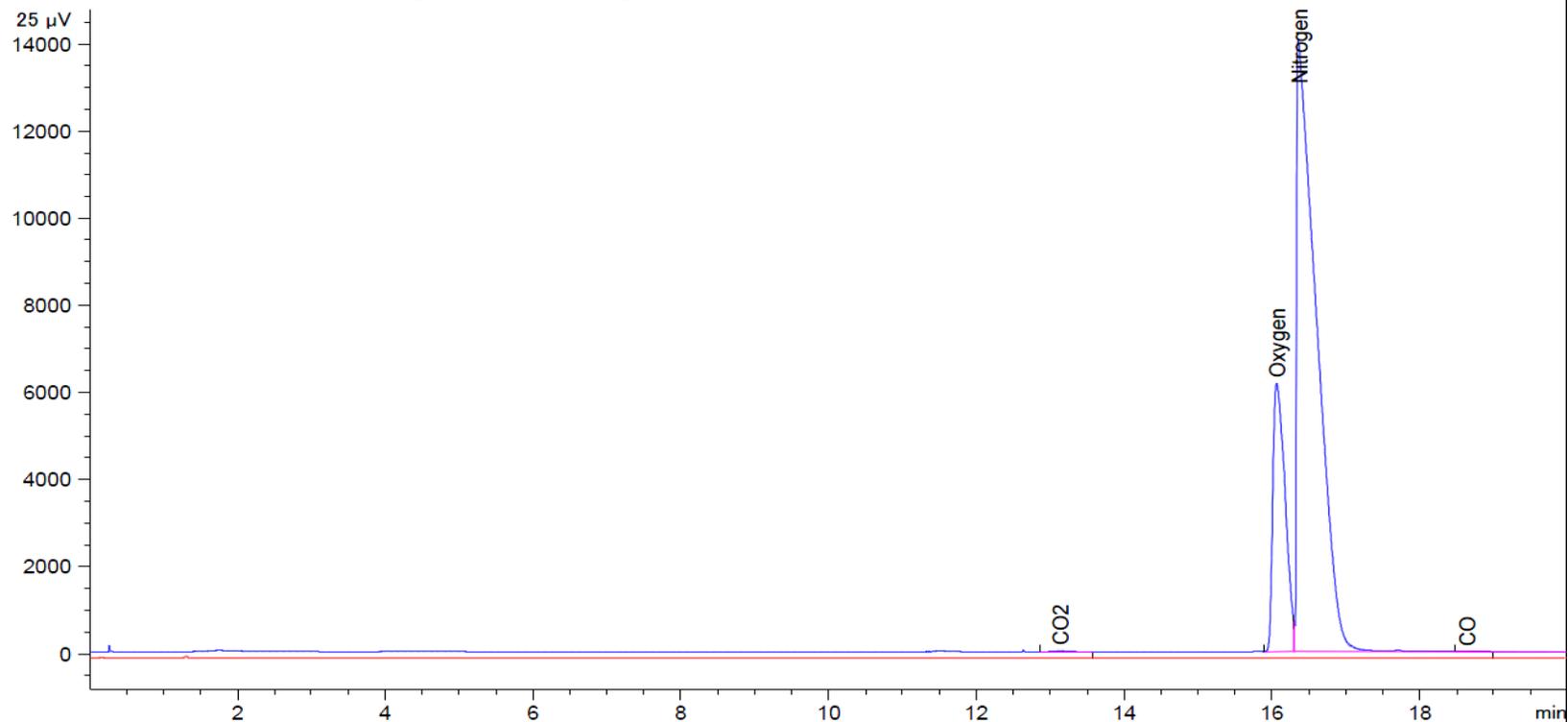
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011994.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011994.D)



* Concentrations too low for stable carbon isotope analysis

* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011995
Client: Vista Geoscience
Sample Name(s): VW58-082817-1330

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Analytical Report



Job #: 17081046
 Lab #: DIG-011995
 Client: Vista Geoscience
 Sample Name: VW58-082817-1330
 Date Sampled: 08/28/17
 Time Sampled: 13:30
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	800284	80.67	-	-	-	
Oxygen + Argon (O ₂ +Ar)	167621	16.90	-	-	-	
Carbon Dioxide (CO ₂)	24162	2.44	-	-24.6	-	
Carbon Monoxide (CO)	16	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

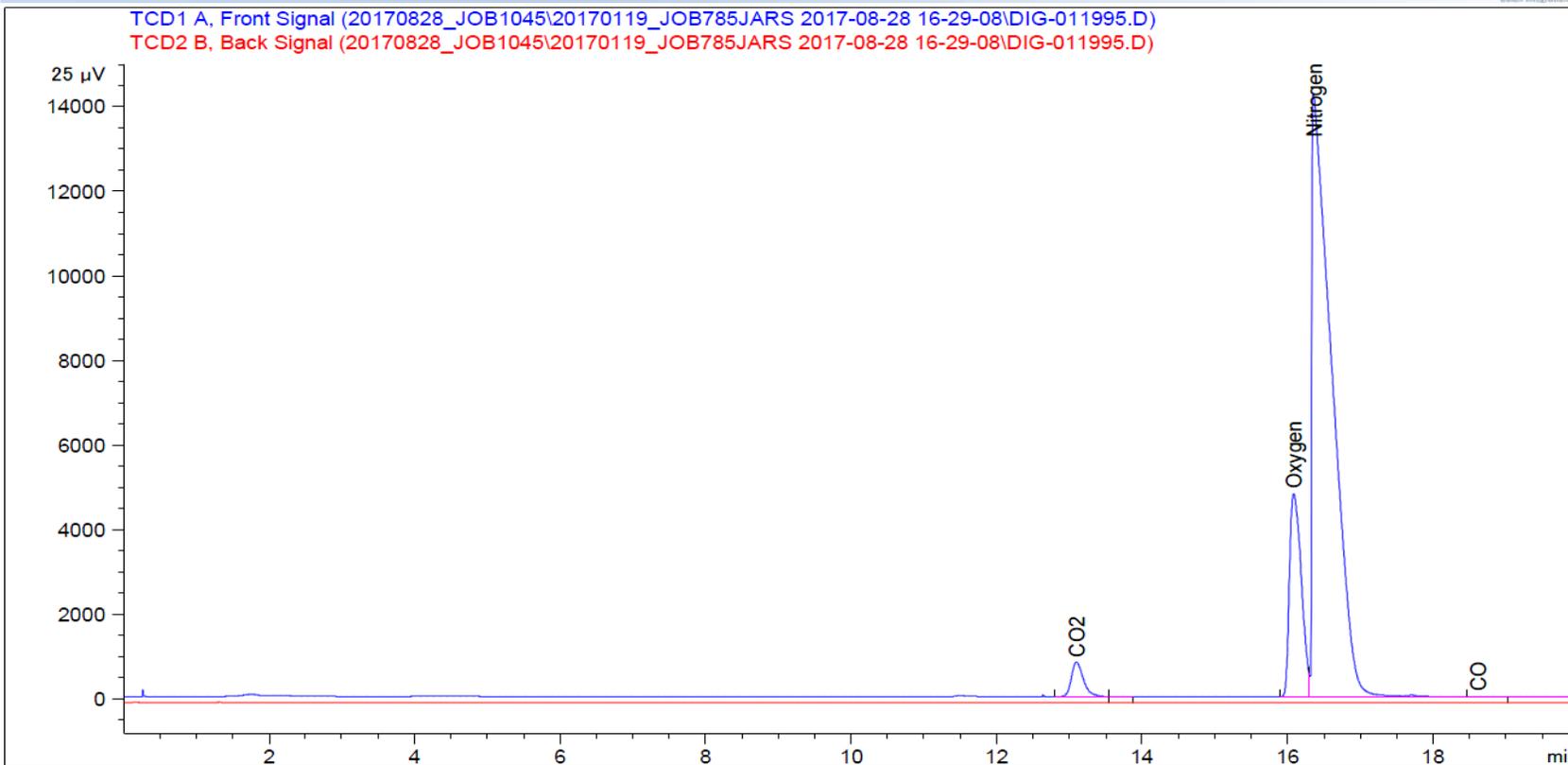
Error δD < 5.0 ‰

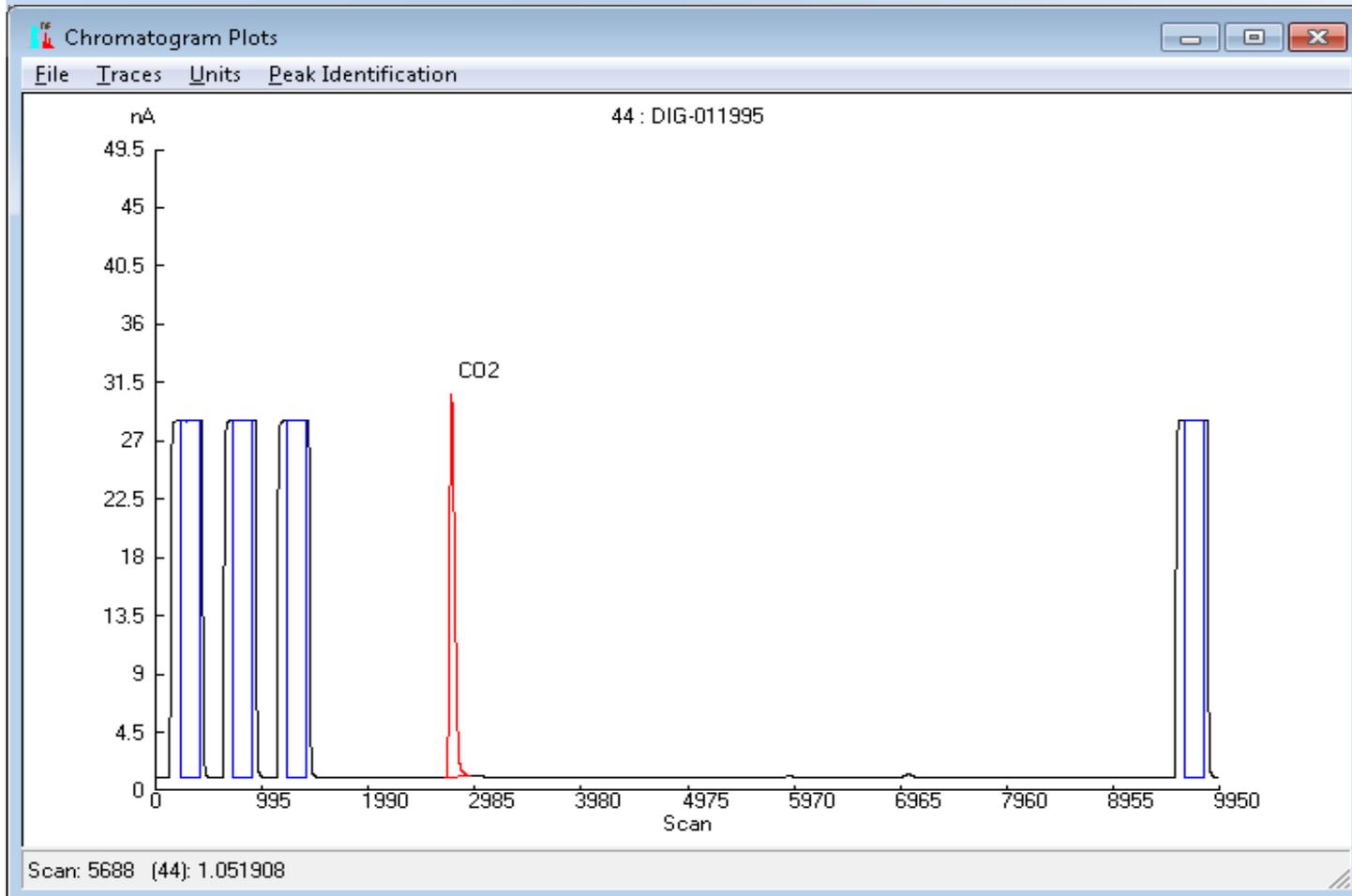
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011995.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011995.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011996
Client: Vista Geoscience
Sample Name(s): VW59-082817-1325

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Analytical Report



Job #: 17081046
 Lab #: DIG-011996
 Client: Vista Geoscience
 Sample Name: VW59-082817-1325
 Date Sampled: 08/28/17
 Time Sampled: 13:25
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	806890	81.38	-	-	-	
Oxygen + Argon (O ₂ +Ar)	146948	14.82	-	-	-	
Carbon Dioxide (CO ₂)	37629	3.80	-	-29.2	-	
Carbon Monoxide (CO)	10	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

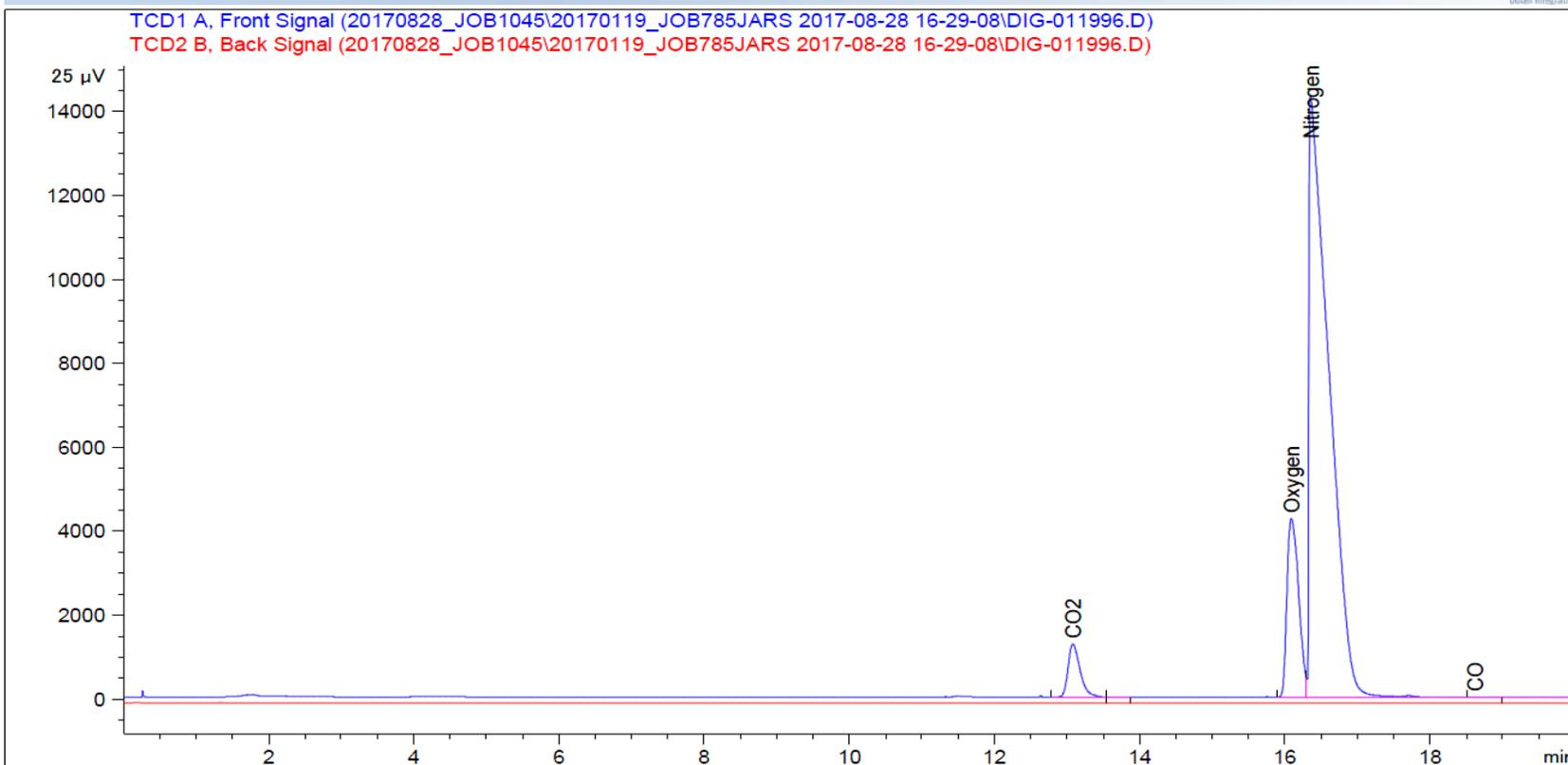
Error δD < 5.0 ‰

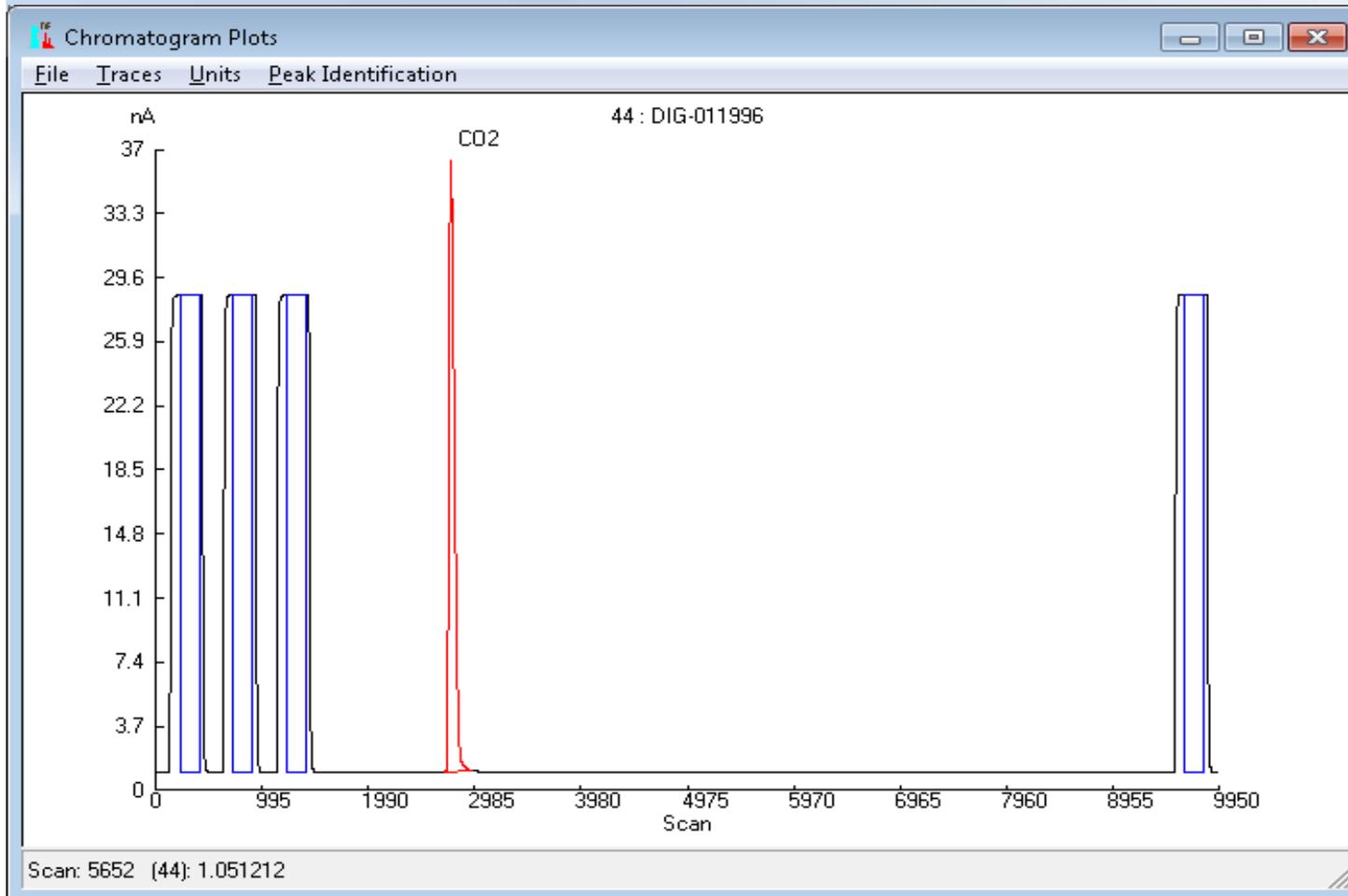
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011996.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011996.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011997
Client: Vista Geoscience
Sample Name(s): VW06-082817-1124

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Analytical Report



Job #: 17081046
 Lab #: DIG-011997
 Client: Vista Geoscience
 Sample Name: VW06-082817-1124
 Date Sampled: 08/28/17
 Time Sampled: 11:24
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	800061	80.83	-	-	-	
Oxygen + Argon (O ₂ +Ar)	123204	12.45	-	-	-	
Carbon Dioxide (CO ₂)	66506	6.72	-	-28.2	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

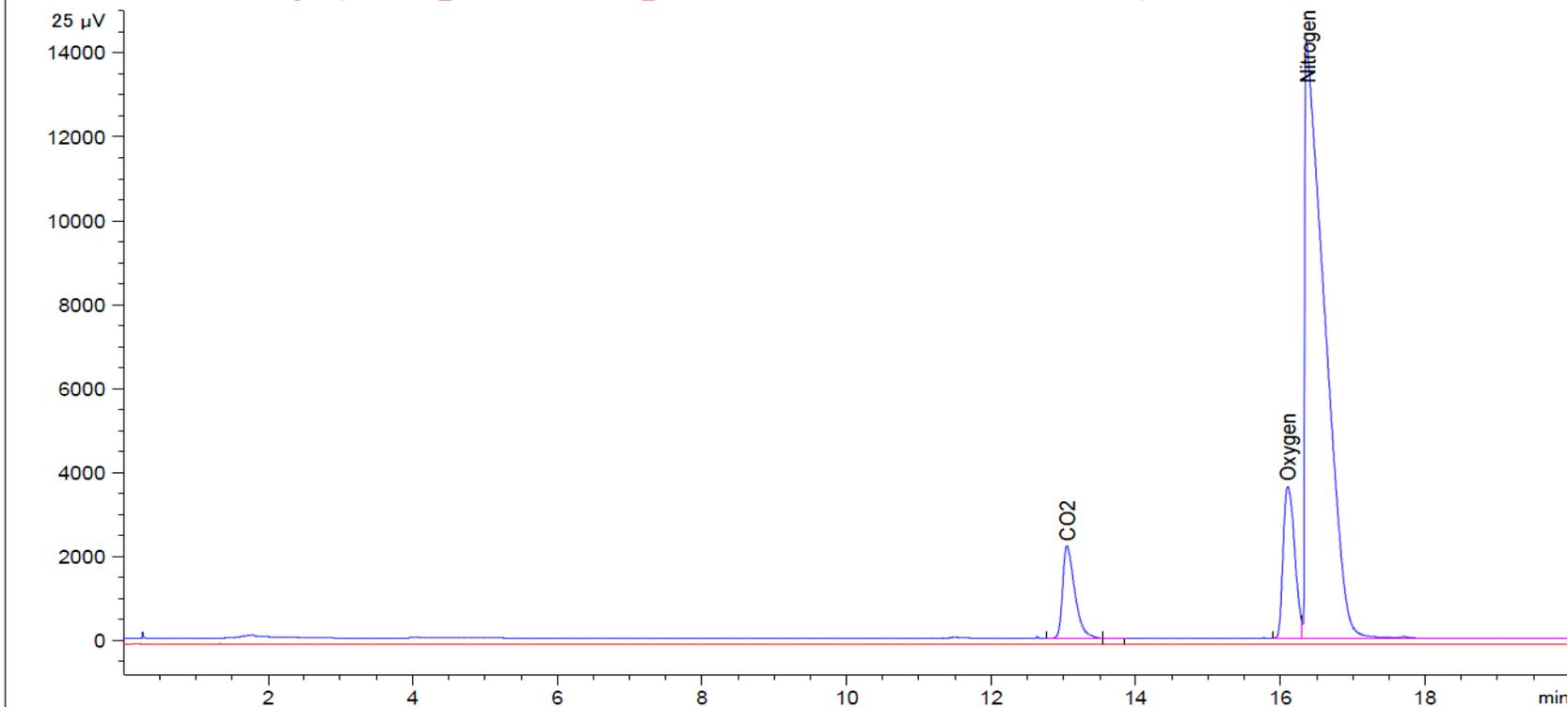
Error δD < 5.0 ‰

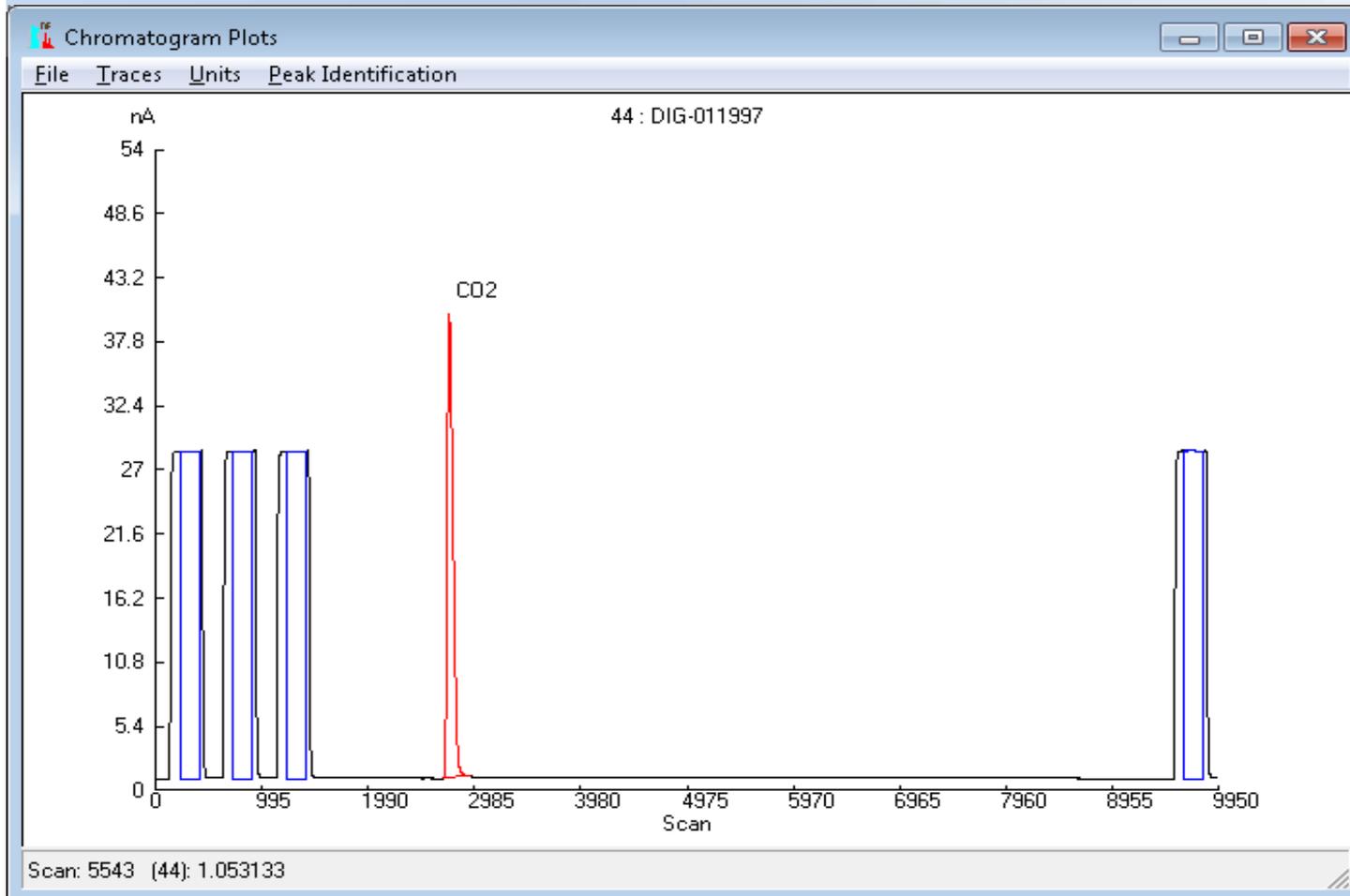
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011997.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011997.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011998
Client: Vista Geoscience
Sample Name(s): VW08-082817-1134

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Analytical Report



Job #: 17081046
 Lab #: DIG-011998
 Client: Vista Geoscience
 Sample Name: VW08-082817-1134
 Date Sampled: 08/28/17
 Time Sampled: 11:34
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/2017 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	808247	81.77	-	-	-	
Oxygen + Argon (O ₂ +Ar)	146863	14.86	-	-	-	
Carbon Dioxide (CO ₂)	33335	3.37	-	-26.3	-	
Carbon Monoxide (CO)	10	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

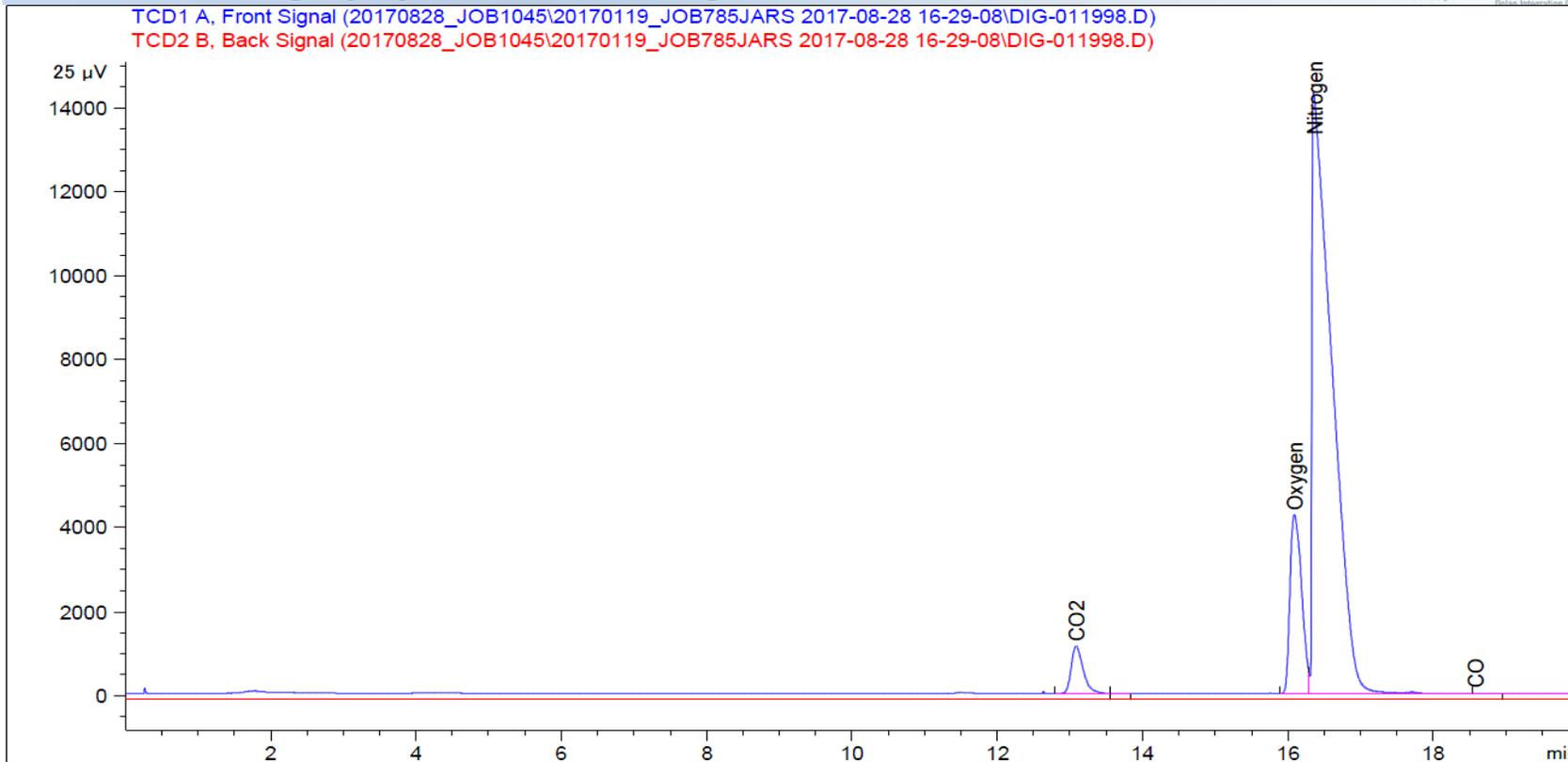
Error $\delta^{13}\text{C}$ < 0.5 ‰

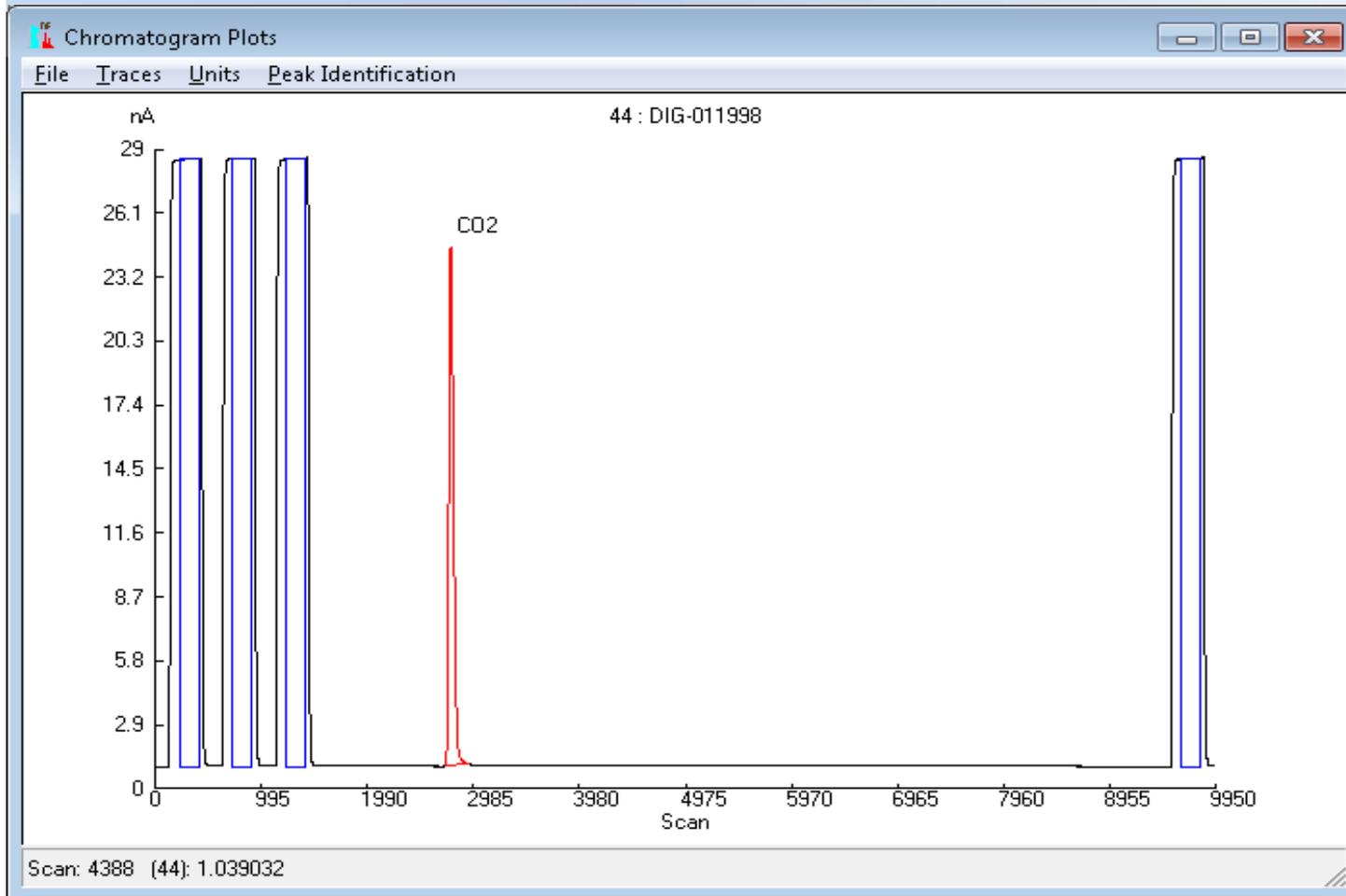
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011998.D)
TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011998.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-011999
Client: Vista Geoscience
Sample Name(s): VW17-082817-1145

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Analytical Report



Job #: 17081046
 Lab #: DIG-011999
 Client: Vista Geoscience
 Sample Name: VW17-082817-1145
 Date Sampled: 08/28/17
 Time Sampled: 11:45
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/29/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	784668	79.26	-	-	-	
Oxygen + Argon (O ₂ +Ar)	130789	13.21	-	-	-	
Carbon Dioxide (CO ₂)	74563	7.53	-	-23.1	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

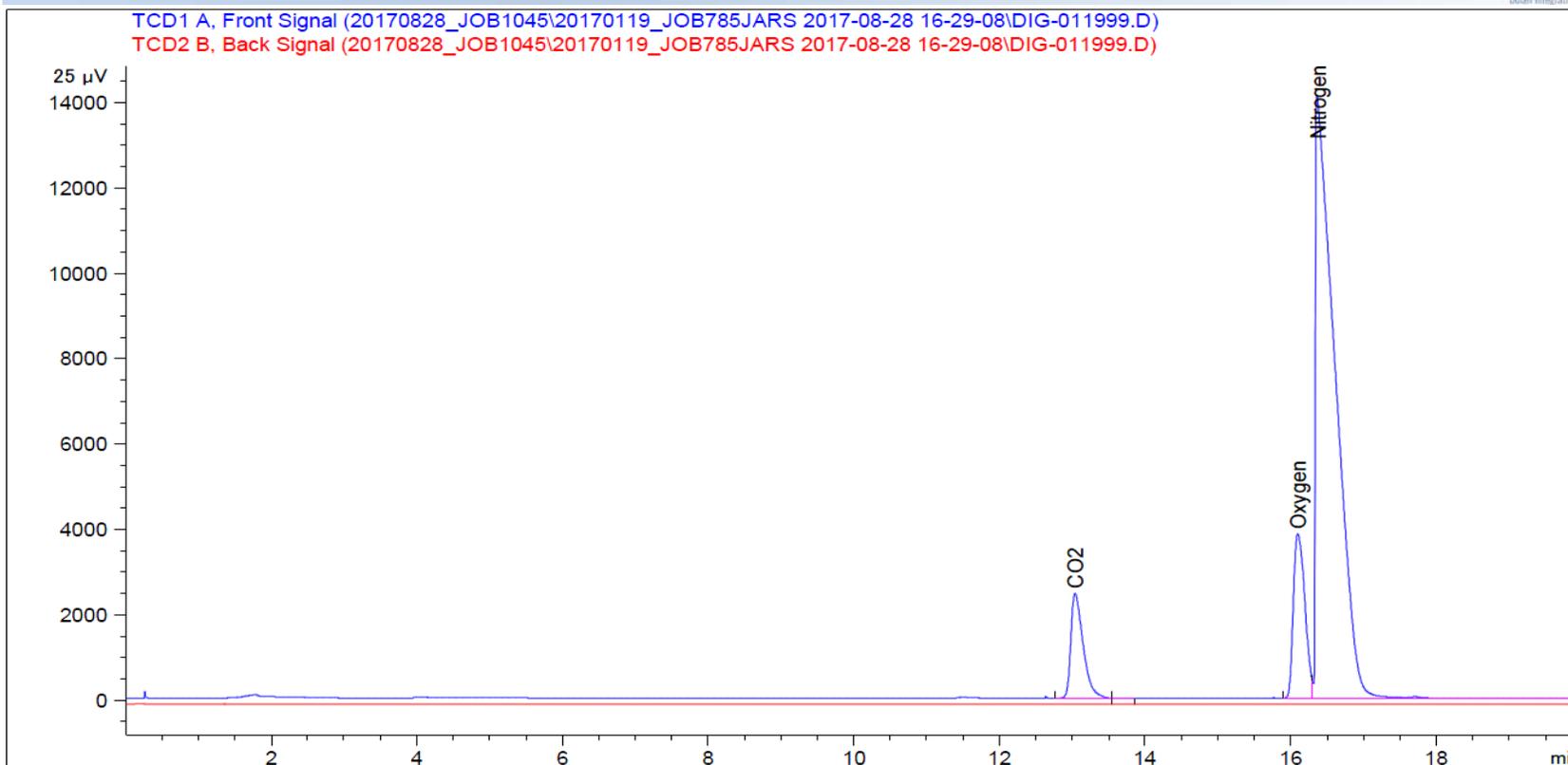
Error δD < 5.0 ‰

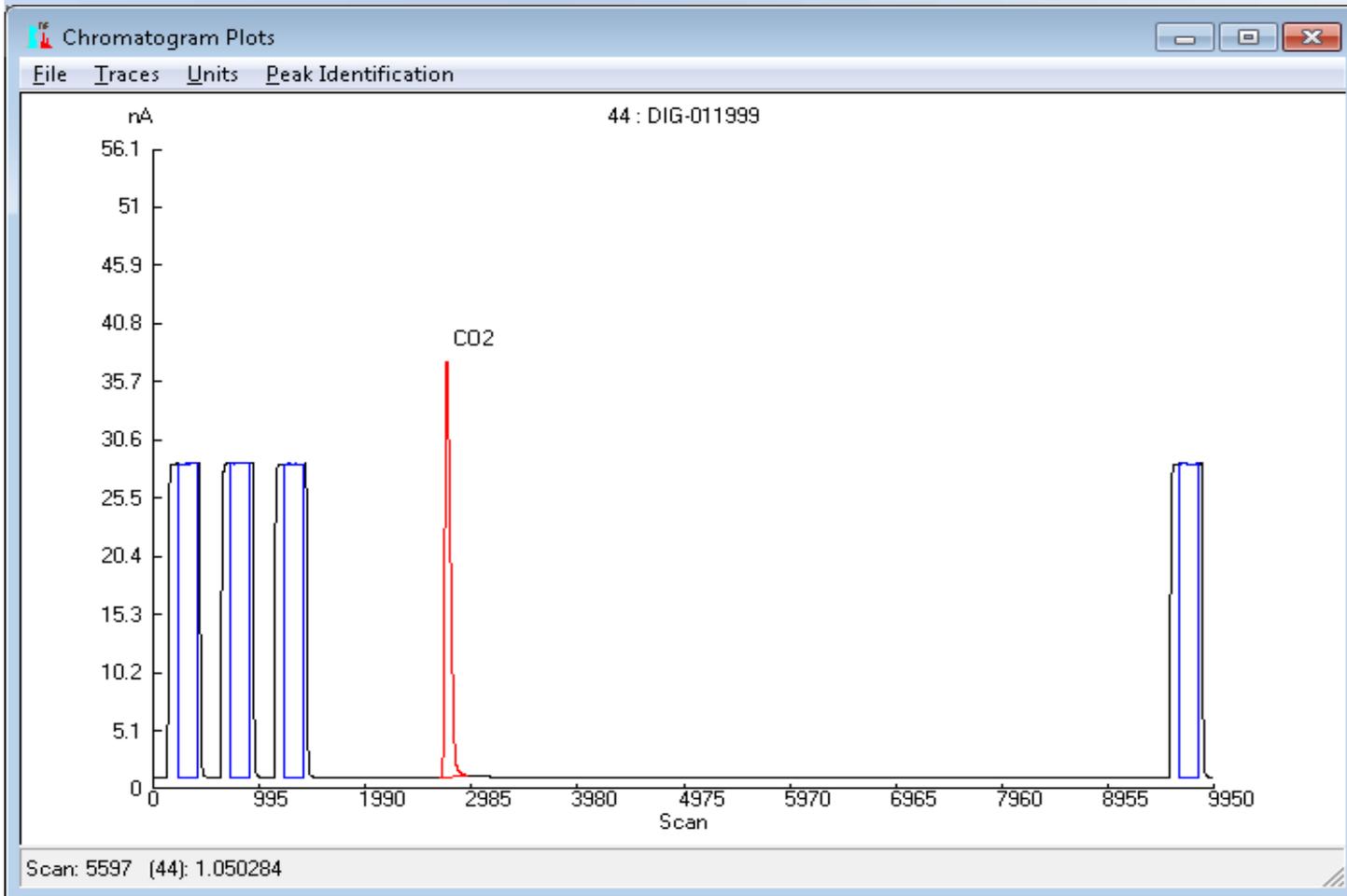
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011999.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-011999.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-012000
Client: Vista Geoscience
Sample Name(s): VW21-082817-1156

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Analytical Report



Job #: 17081046
 Lab #: DIG-012000
 Client: Vista Geoscience
 Sample Name: VW21-082817-1156
 Date Sampled: 08/28/17
 Time Sampled: 11:56
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	789655	79.88	-	-	-	
Oxygen + Argon (O ₂ +Ar)	121899	12.33	-	-	-	
Carbon Dioxide (CO ₂)	77000	7.79	-	-24.5	-	
Carbon Monoxide (CO)	10	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

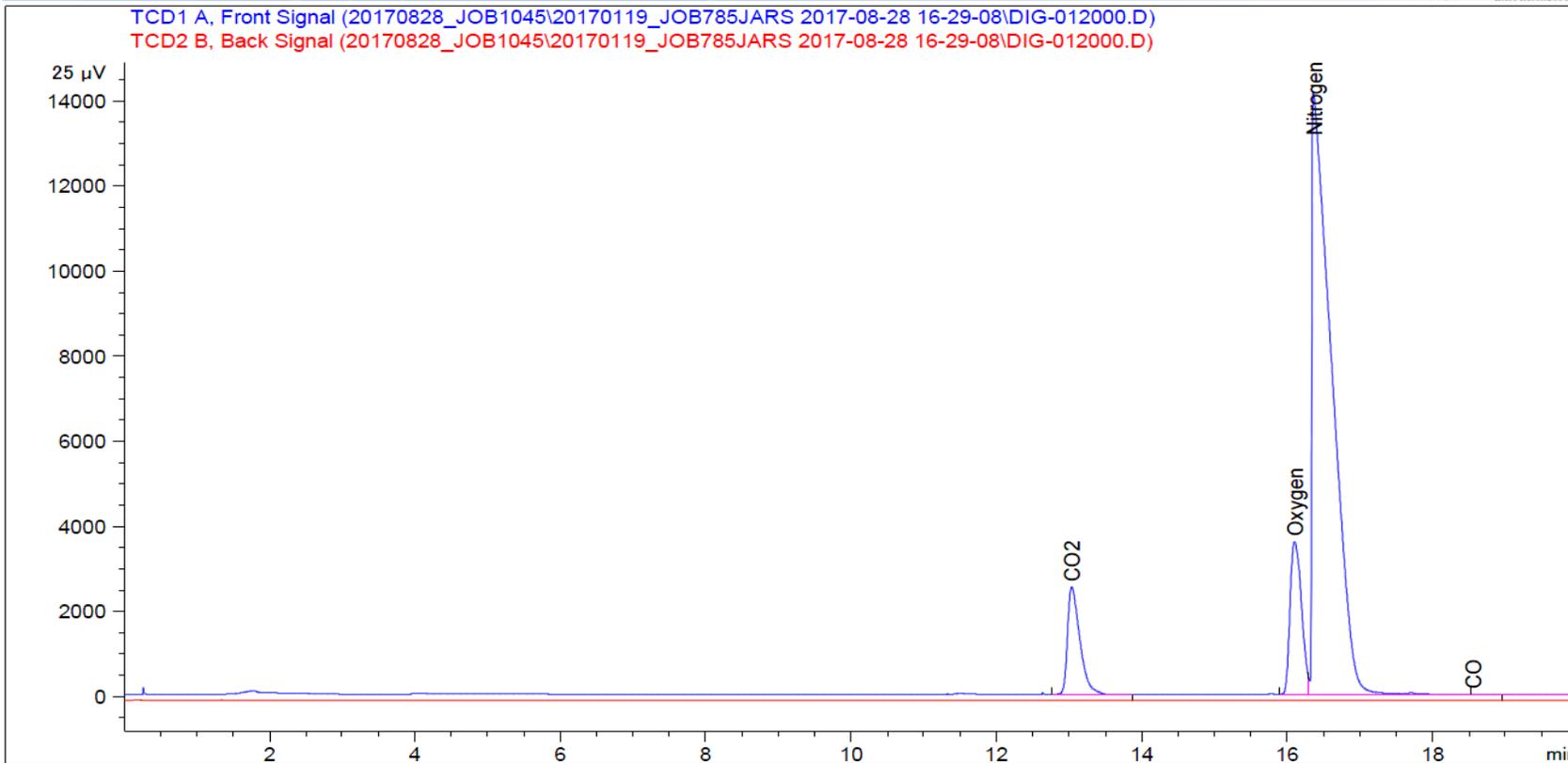
Error $\delta^{13}\text{C}$ < 0.5 ‰

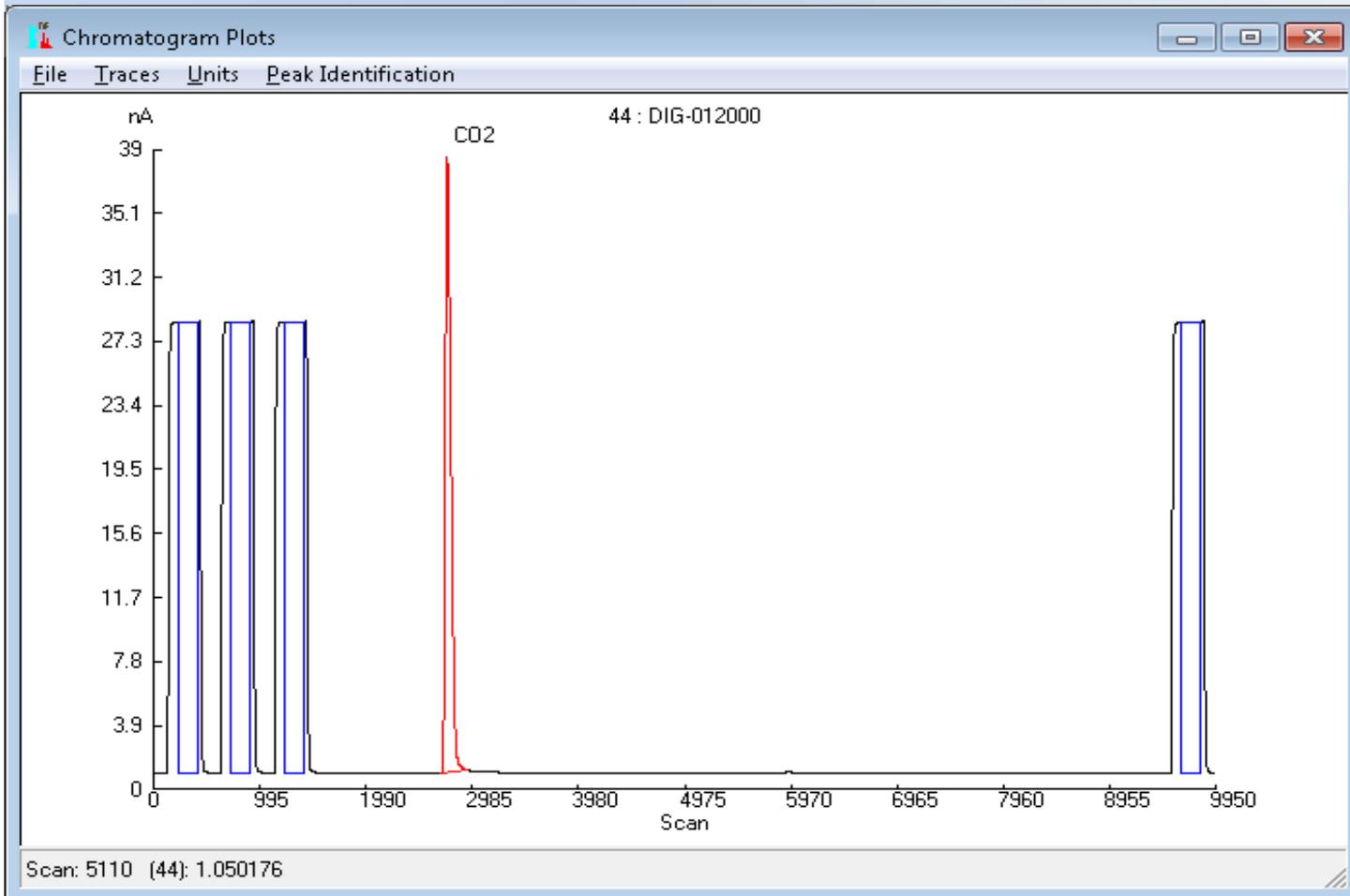
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-012000.D)
TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-012000.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

1317 West 121st Ave
Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17081046
Lab #: DIG-012001
Client: Vista Geoscience
Sample Name(s): VW31-082817-1203

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Analytical Report



Job #: 17081046
 Lab #: DIG-012001
 Client: Vista Geoscience
 Sample Name: VW31-082817-1203
 Date Sampled: 08/28/17
 Time Sampled: 12:03
 Sample Description: cali-5-bond bag
 Sampling Notes:
 Date Received: 08/28/17
 Date Analyzed: Gas Composition:8/28/17 $\delta^{13}\text{C}$:8/29/17
 Date Reported: 09/01/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	784129	79.20	-	-	-	
Oxygen + Argon (O ₂ +Ar)	147905	14.94	-	-	-	
Carbon Dioxide (CO ₂)	58002	5.86	-	-20.4	-	
Carbon Monoxide (CO)	11	0.00	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	-	-	
Ethane (C ₂ H ₆)	nd	nd	nd	-	-	
Ethene (C ₂ H ₄)	nd	nd	nd	-	-	
Propane (C ₃ H ₈)	nd	nd	nd	-	-	
Propene (C ₃ H ₆)	nd	nd	nd	-	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	-	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	-	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

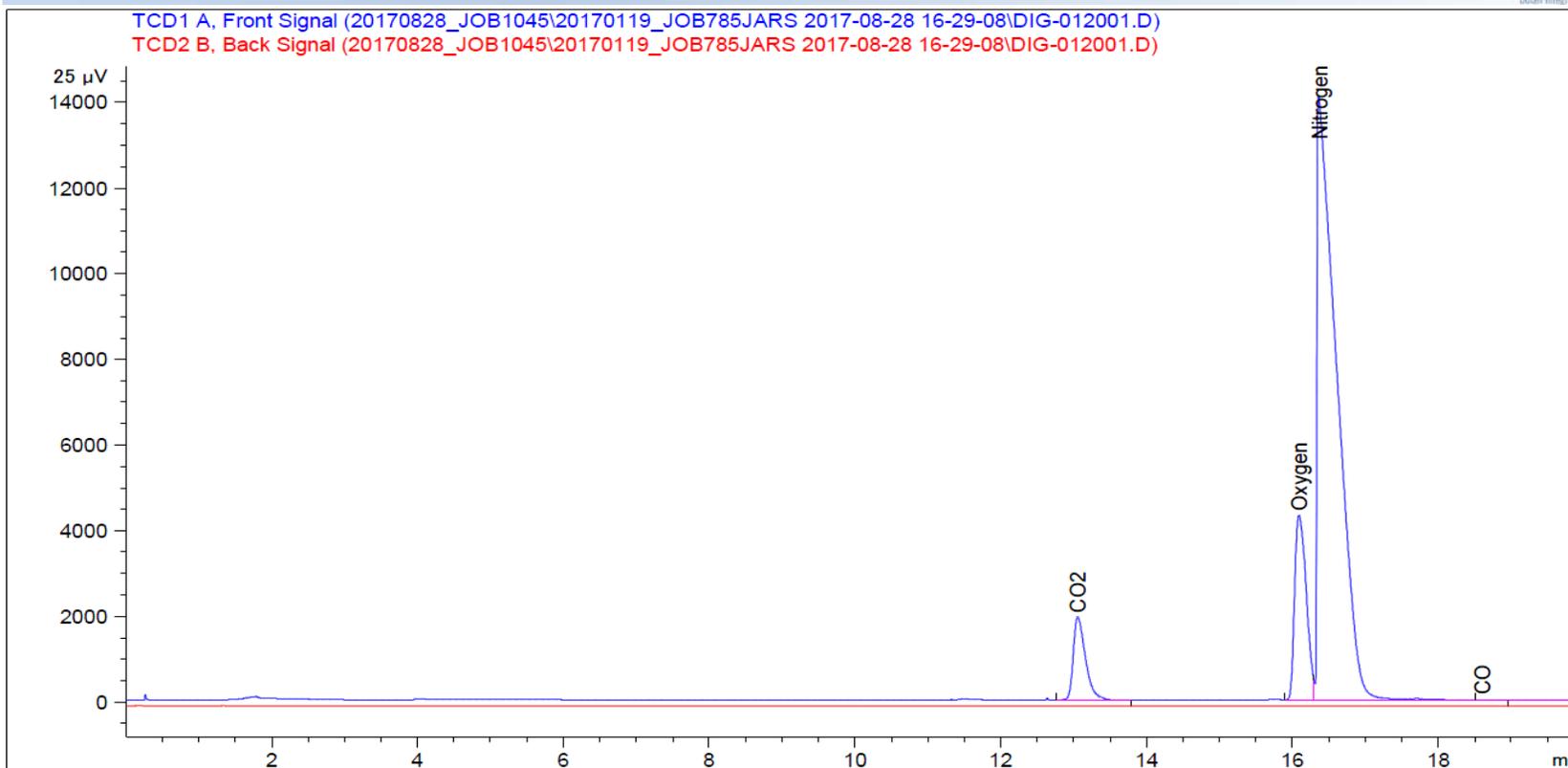
Error δD < 5.0 ‰

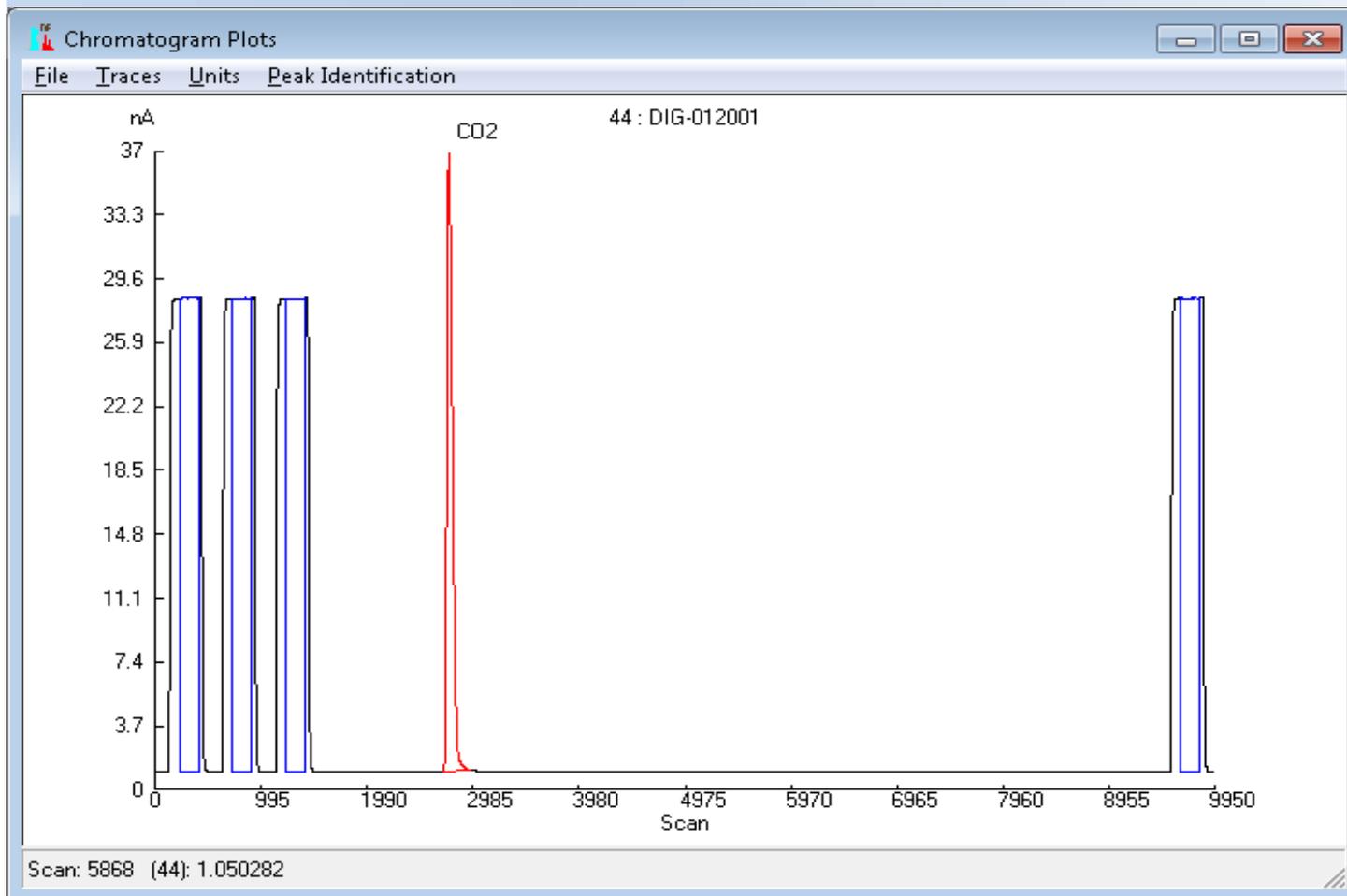
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-012001.D)

TCD2 B, Back Signal (20170828_JOB1045\20170119_JOB785JARS 2017-08-28 16-29-08\DIG-012001.D)





* Methane concentration too low for stable hydrogen isotope analysis

JOB 17091088
 DIG-012740-612747

Send Data and Invoice to:

Name: John Fontana
 Company: Vista Geoscience
 Address: 130 Capital Dr. Ste C.
80401, Golden, CO
 Phone: 130 Capital Dr. ³⁰³⁻²⁷⁷⁻¹⁶⁹⁴
 Fax: _____
 Email: jfontana@vistageoscience.com

AFE #: _____
 Report Ctr: _____
 Project: 17137.01
 PO #: _____
 Location: Firestone, CO
 Sampled By: Test Stockwell

Analysis Requested	
O-18/O-16 and H-2/H-1 of water	Gas Composition N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ + with dissolved C ₁ , C ₂ & C ₃
δ ¹³ C Methane (Carbon)	δ ¹³ C Methane (Hydrogen)
δ ¹³ C Ethane-Pentane (C ₂ s, if present)	

Sample Description

Container #	Sample Identification	Date Sampled	Time	O-18/O-16 and H-2/H-1 of water	Gas Composition N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ + with dissolved C ₁ , C ₂ & C ₃	δ ¹³ C Methane (Carbon)	δ ¹³ C Methane (Hydrogen)	δ ¹³ C Ethane-Pentane (C ₂ s, if present)	Comments
1	VW06-092617-1002	9-26-17	10:02	✓	✓				
1	VW08-092617-1019	9-26-17	10:19	✓	✓				
1	VW17-092617-1033	9-26-17	10:33	✓	✓				
1	VW17-092617-1035B	9-26-17	10:35B	✓	✓				
1	VW21-092617-1045	9-26-17	10:45	✓	✓				
1	VW31-092617-1102	9-26-17	11:02	✓	✓				
1	VW37-092617-1345	9-26-17	13:45	✓	✓				
1	VW38-092617-1338	9-26-17	13:38	✓	✓				

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by <u>Test Stockwell</u>	Vista Geoscience	9-26-17	14:57
Received by <u>alexander mass</u>	DIG	9/26/17	15:00
Relinquished by			
Received by			
Relinquished by			
Received by			

JOB 17091088
 DIG-012748-012752

Send Data and Invoice to:

Name: John Fontana
 Company: Vista Geoscience
 Address: 130 Capital Dr St. C
Lakewood CO, 80401
 Phone: 303-277-1694
 Fax: _____
 Email: jfontana@vistageoscience.com

AFE #: _____
 Report Ctr: _____
 Project: 17137.01
 PO #: _____
 Location: Firestone, CO
 Sampled By: Ted Stokewell

Analysis Requested	
O-18/O-16 and H-2/H-1 of water	
Gas Composition N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ + with dissolved Cl ₂ , C ₂ & C ₃	
δ ¹³ C Methane (Carbon)	
δD Methane (Hydrogen)	
δ ¹³ C Ethane-Pentane (C ₂ -C ₅ if present)	

Sample Description

Container #	Sample Identification	Date Sampled	Time	O-18/O-16 and H-2/H-1 of water	Gas Composition N ₂ , O ₂ , CO ₂ , He, H ₂ , C ₁ -C ₆ + with dissolved Cl ₂ , C ₂ & C ₃	δ ¹³ C Methane (Carbon)	δD Methane (Hydrogen)	δ ¹³ C Ethane-Pentane (C ₂ -C ₅ if present)	Comments
1	VW41-0926171332	9-26-17	1332		✓	✓			
1	VW45-092617-1350	9-26-17	1350		✓	✓			
1	VW58-0926171404	9-26-17	1404		✓	✓			
1	VW58-092617-1404B	9-26-17	1404		✓	✓			
1	VW59-092617-1358	9-26-17	1358		✓	✓			

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by <u>Ted Stokewell</u>	<u>Vista Geoscience</u>	<u>9-26-17</u>	<u>14:57</u>
Received by <u>Edward M. Mess</u>	<u>DIG</u>	<u>9/26/17</u>	<u>1500</u>
Relinquished by			
Received by			
Relinquished by			
Received by			



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Geochemistry for Energy

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p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012740
Client: Vista Geoscience
Sample Name(s): VW06-092617-1002

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Analytical Report



Job #: 17091088
 Lab #: DIG-012740
 Client: Vista Geoscience
 Sample Name: VW06-092617-1002
 Date Sampled: 09/26/17
 Time Sampled: 10:02
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/29/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	801915	80.76	-	-	-	
Oxygen + Argon (O ₂ +Ar)	118583	11.94	-	-	-	
Carbon Dioxide (CO ₂)	72474	7.30	-	-27.1	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

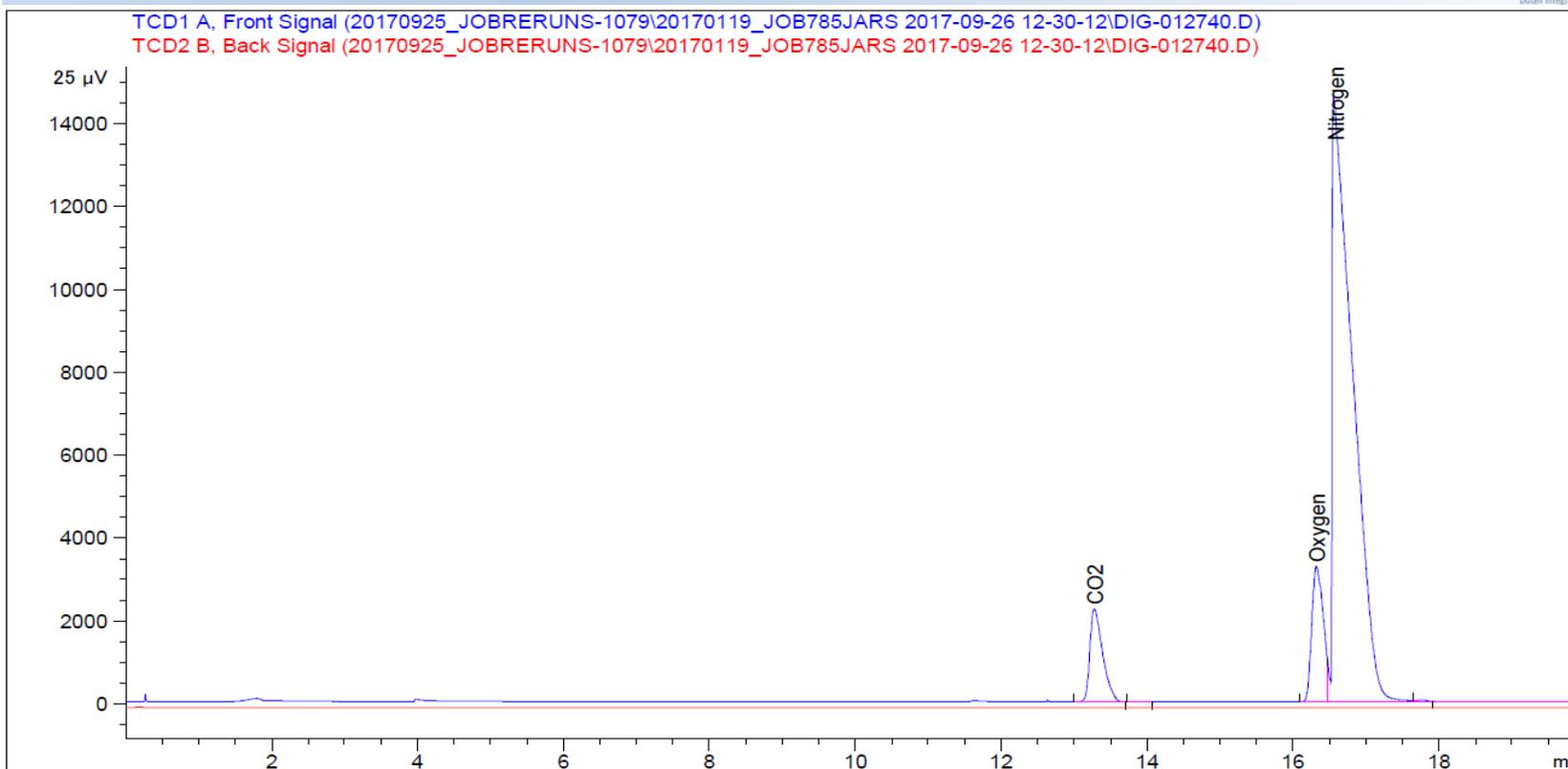
Error δD < 5.0 ‰

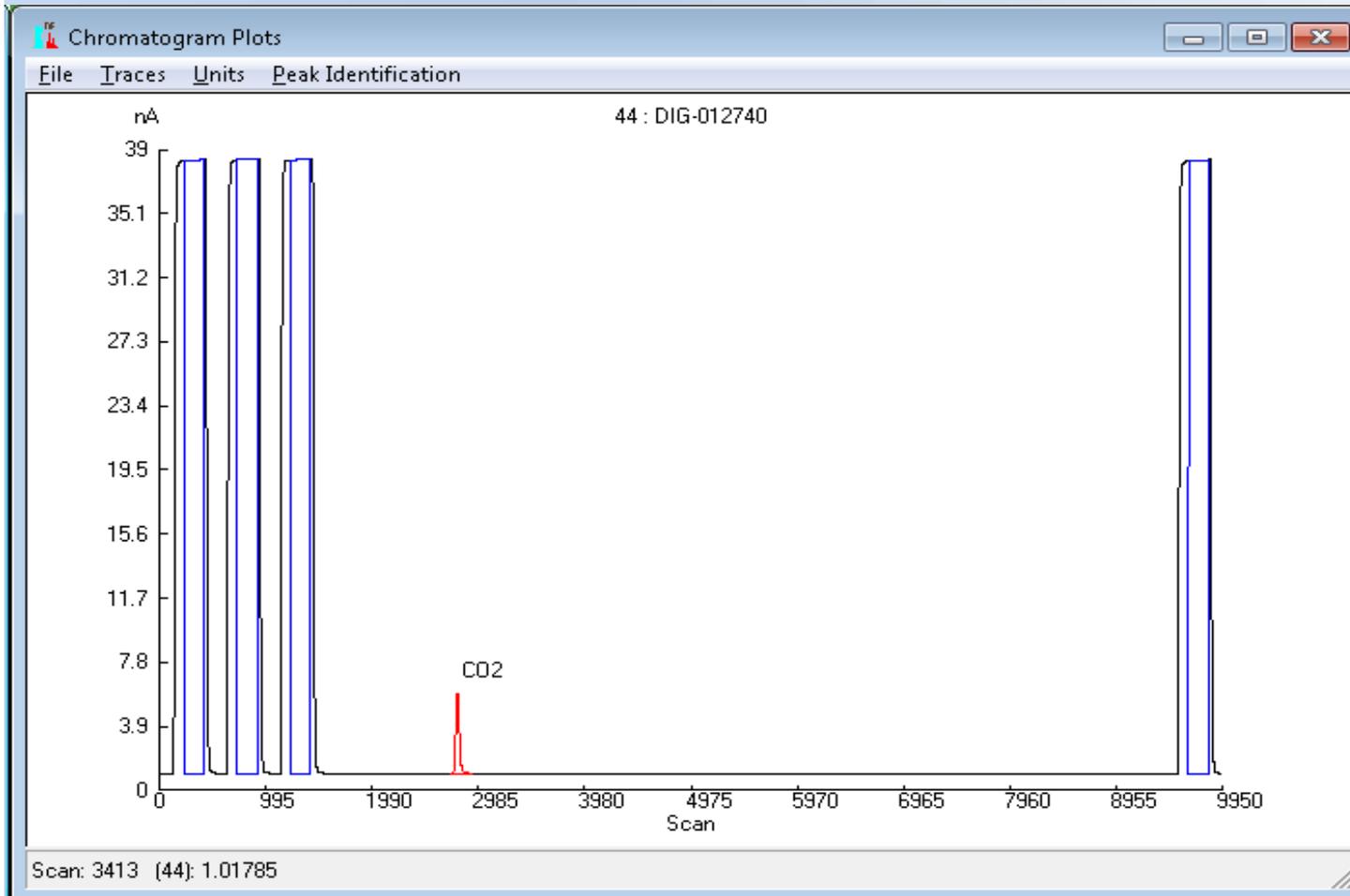
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 12-30-12\DIG-012740.D)

TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 12-30-12\DIG-012740.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012741
Client: Vista Geoscience
Sample Name(s): VW08-092617-1019

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Analytical Report



Job #: 17091088
 Lab #: DIG-012741
 Client: Vista Geoscience
 Sample Name: VW08-092617-1019
 Date Sampled: 09/26/17
 Time Sampled: 10:19
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/29/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	816612	82.01	-	-	-	
Oxygen + Argon (O ₂ +Ar)	136386	13.70	-	-	-	
Carbon Dioxide (CO ₂)	42772	4.30	-	-24.5	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

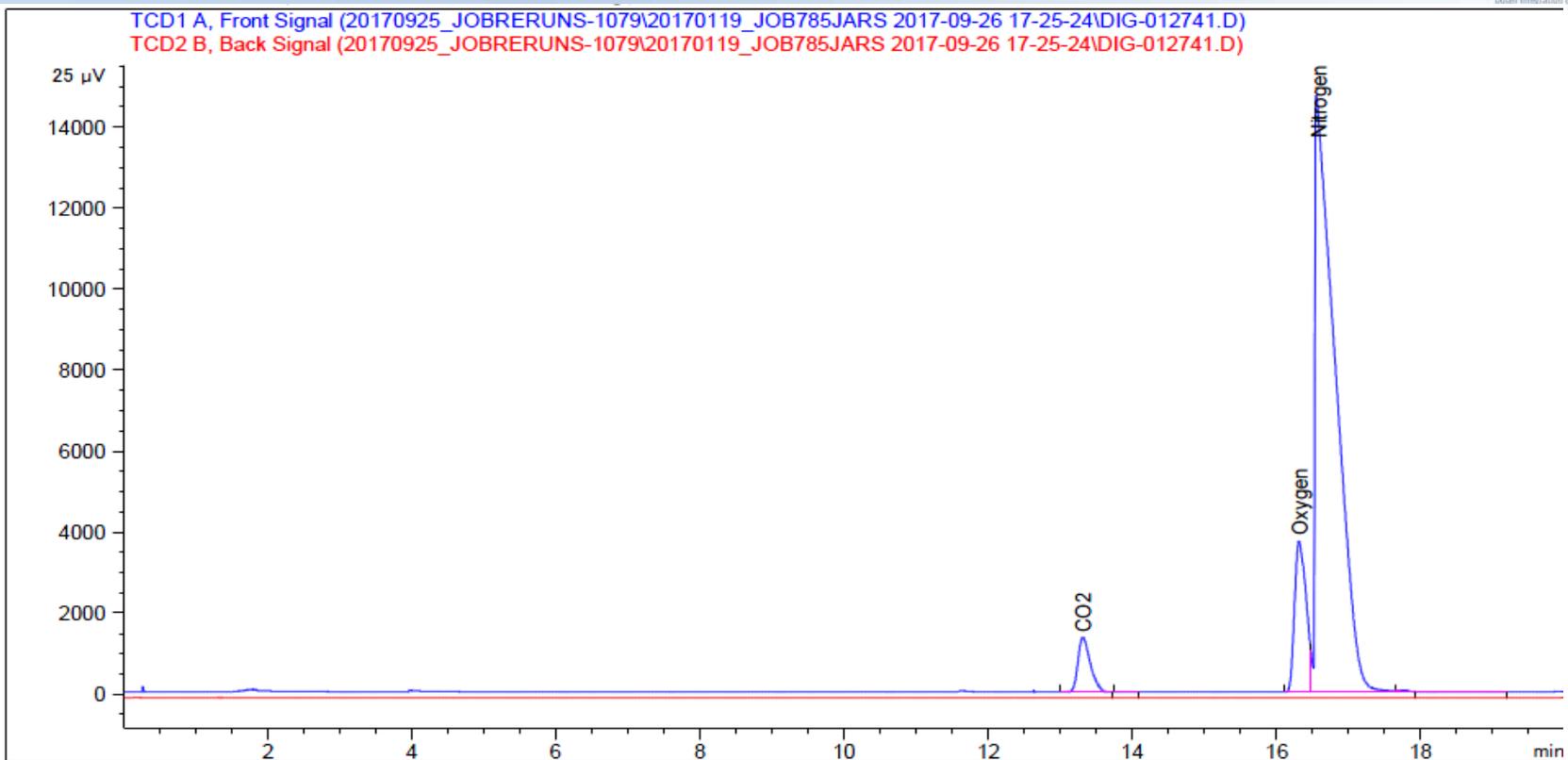
Error δD < 5.0 ‰

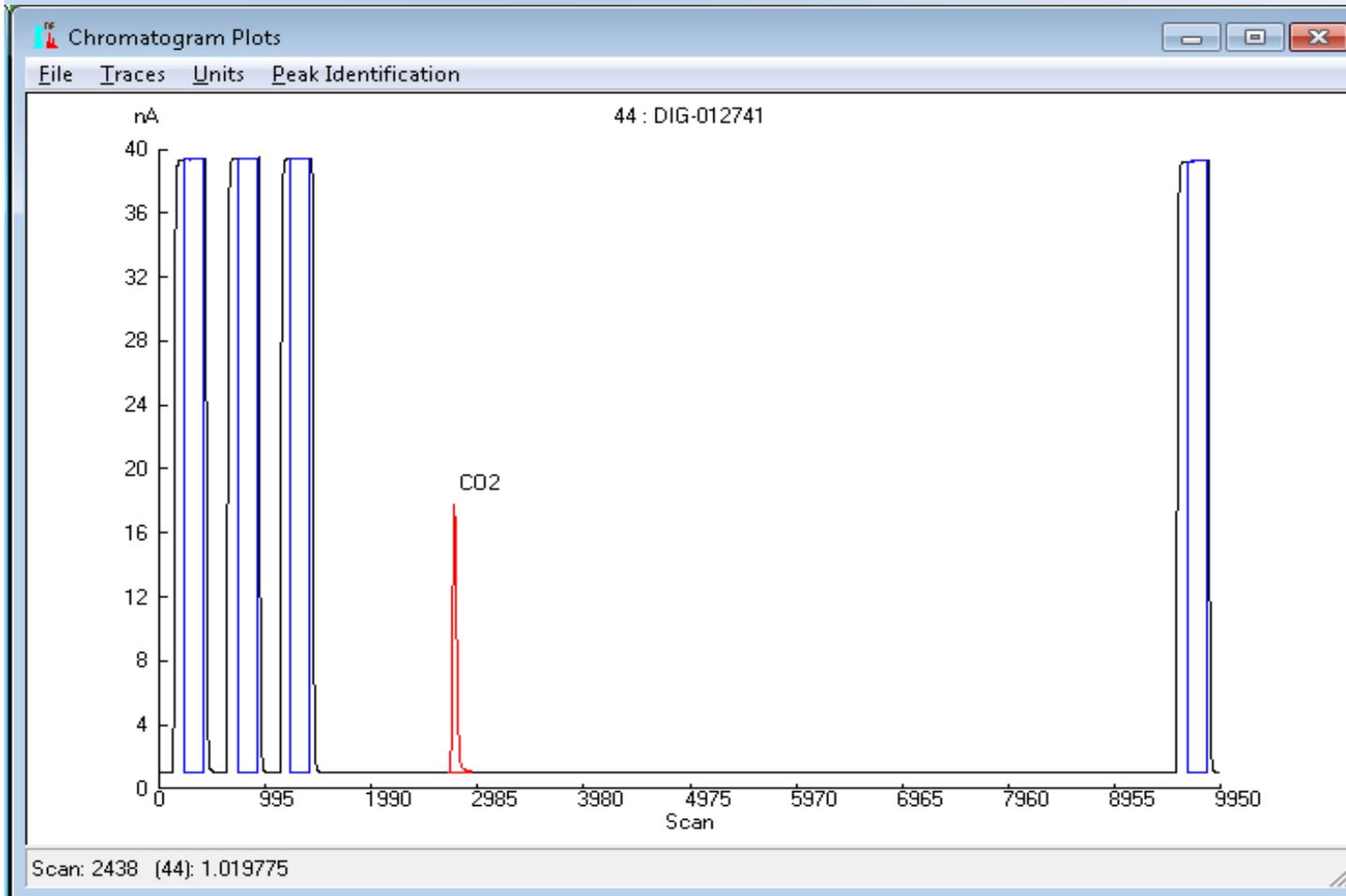
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012741.D)

TCD2 B, Back Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012741.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012742
Client: Vista Geoscience
Sample Name(s): VW17-092617-1033

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Analytical Report



Job #: 17091088
 Lab #: DIG-012742
 Client: Vista Geoscience
 Sample Name: VW17-092617-1033
 Date Sampled: 09/26/17
 Time Sampled: 10:33
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/29/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	780893	78.01	-	-	-	
Oxygen + Argon (O ₂ +Ar)	160970	16.08	-	-	-	
Carbon Dioxide (CO ₂)	59192	5.91	-	-21.9	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

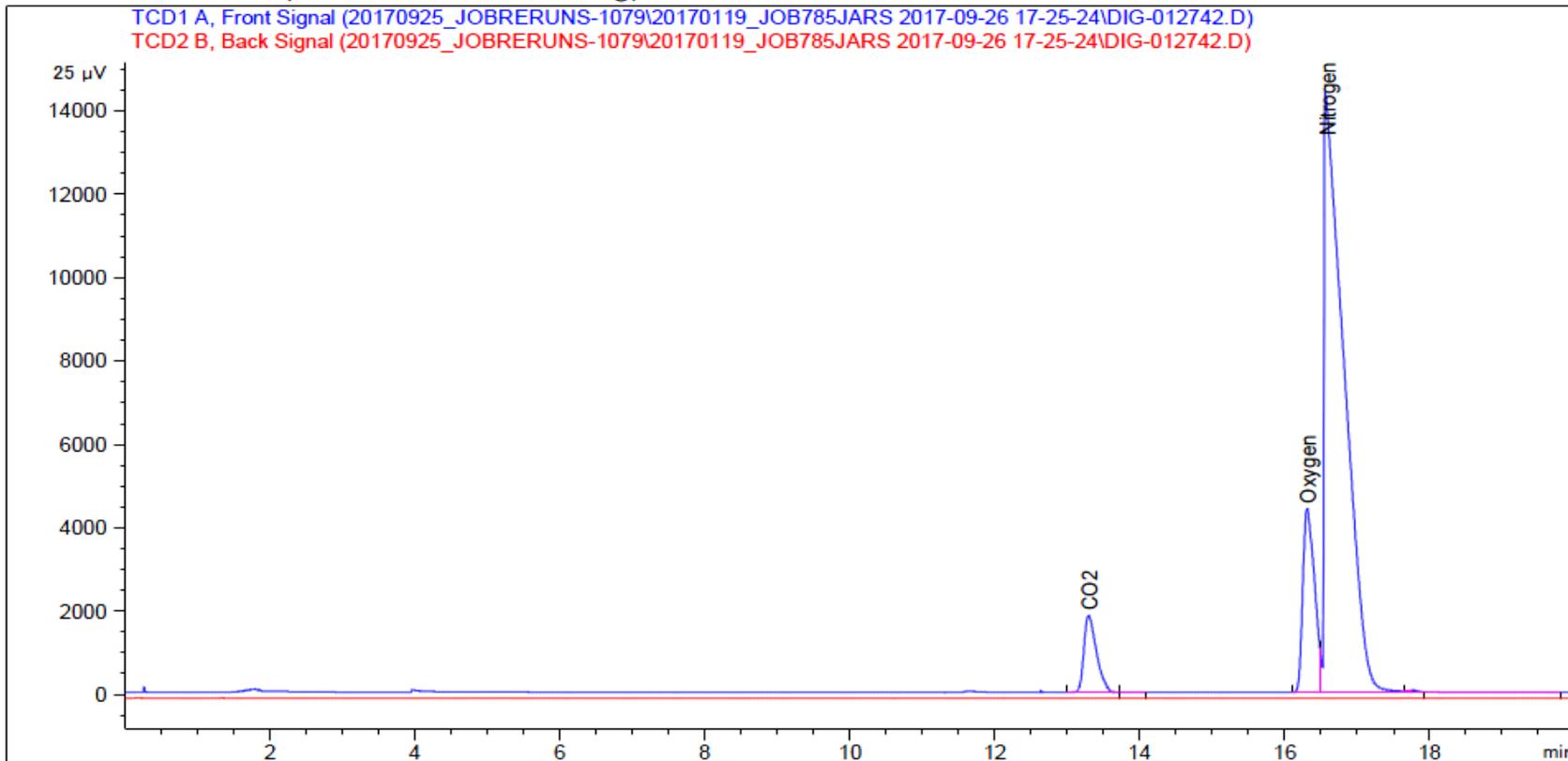
Error $\delta^{13}\text{C}$ < 0.5 ‰

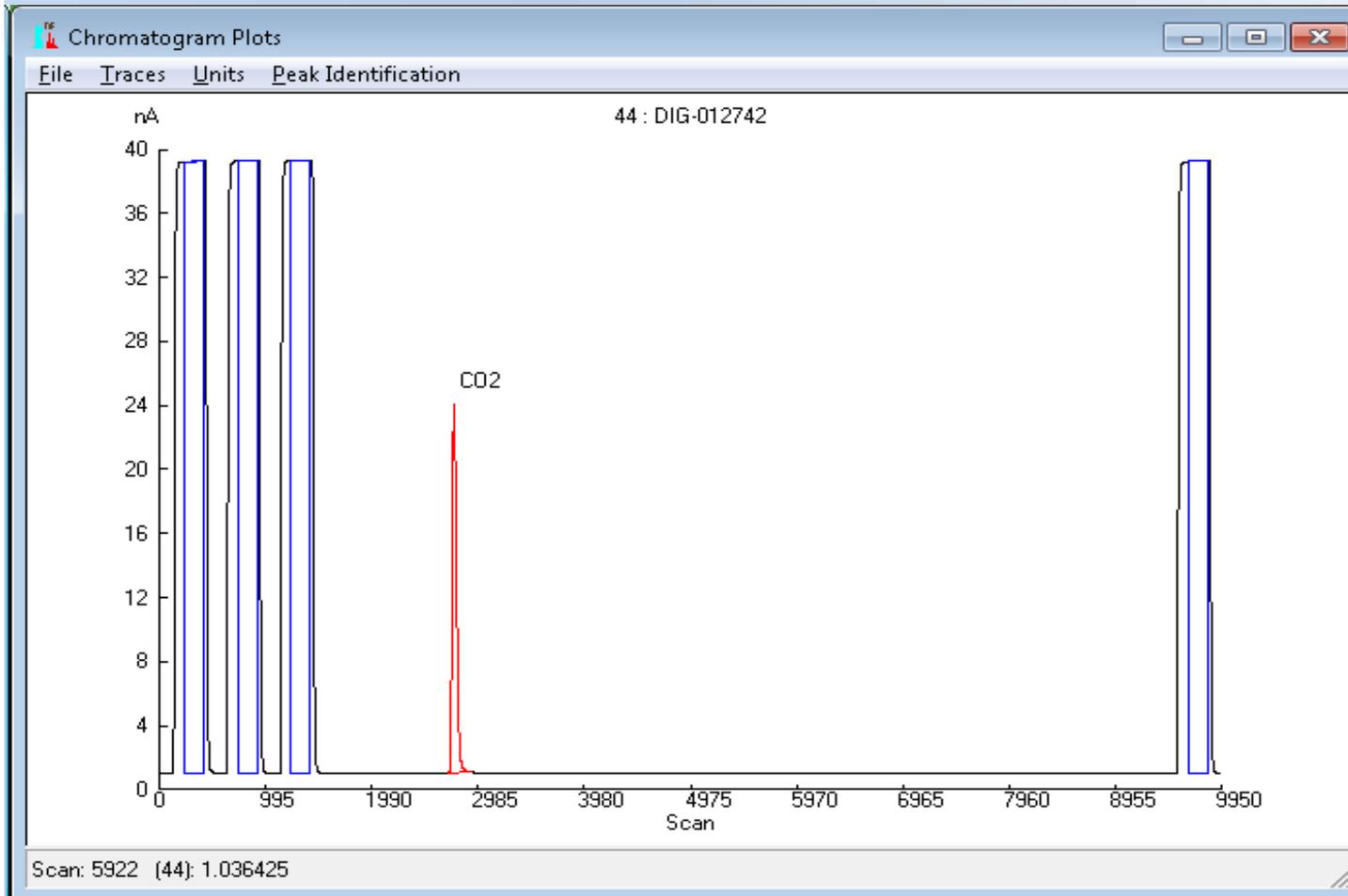
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012742.D)
TCD2 B, Back Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012742.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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Westminster, CO 80234
p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012743
Client: Vista Geoscience
Sample Name(s): VW17-092617-1035B

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Analytical Report



Job #: 17091088
 Lab #: DIG-012743
 Client: Vista Geoscience
 Sample Name: VW17-092617-1035B
 Date Sampled: 09/26/17
 Time Sampled: 10:35
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/29/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	780796	78.00	-	-	-	
Oxygen + Argon (O ₂ +Ar)	160310	16.02	-	-	-	
Carbon Dioxide (CO ₂)	59895	5.98	-	-22.1	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

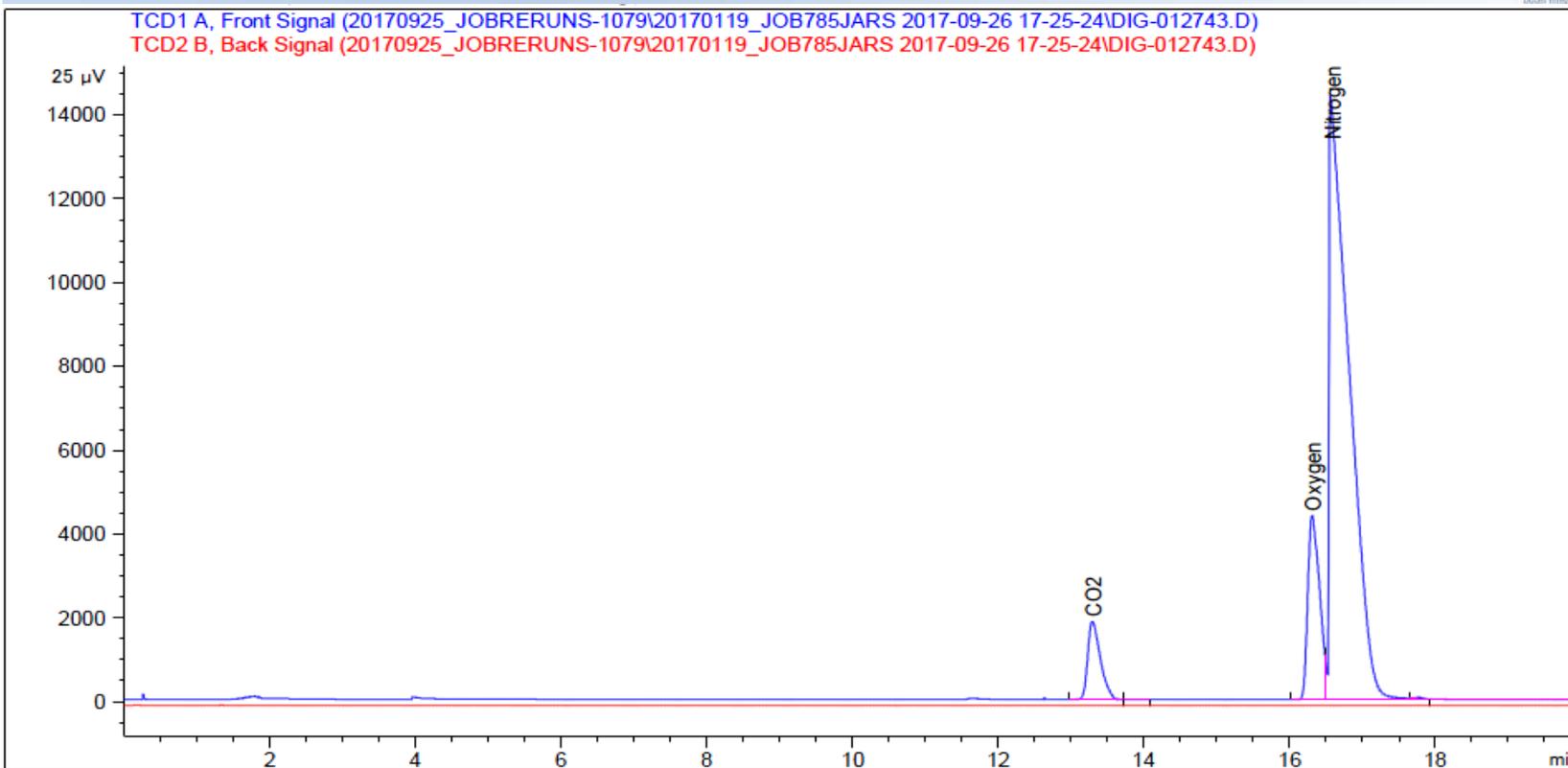
Error δD < 5.0 ‰

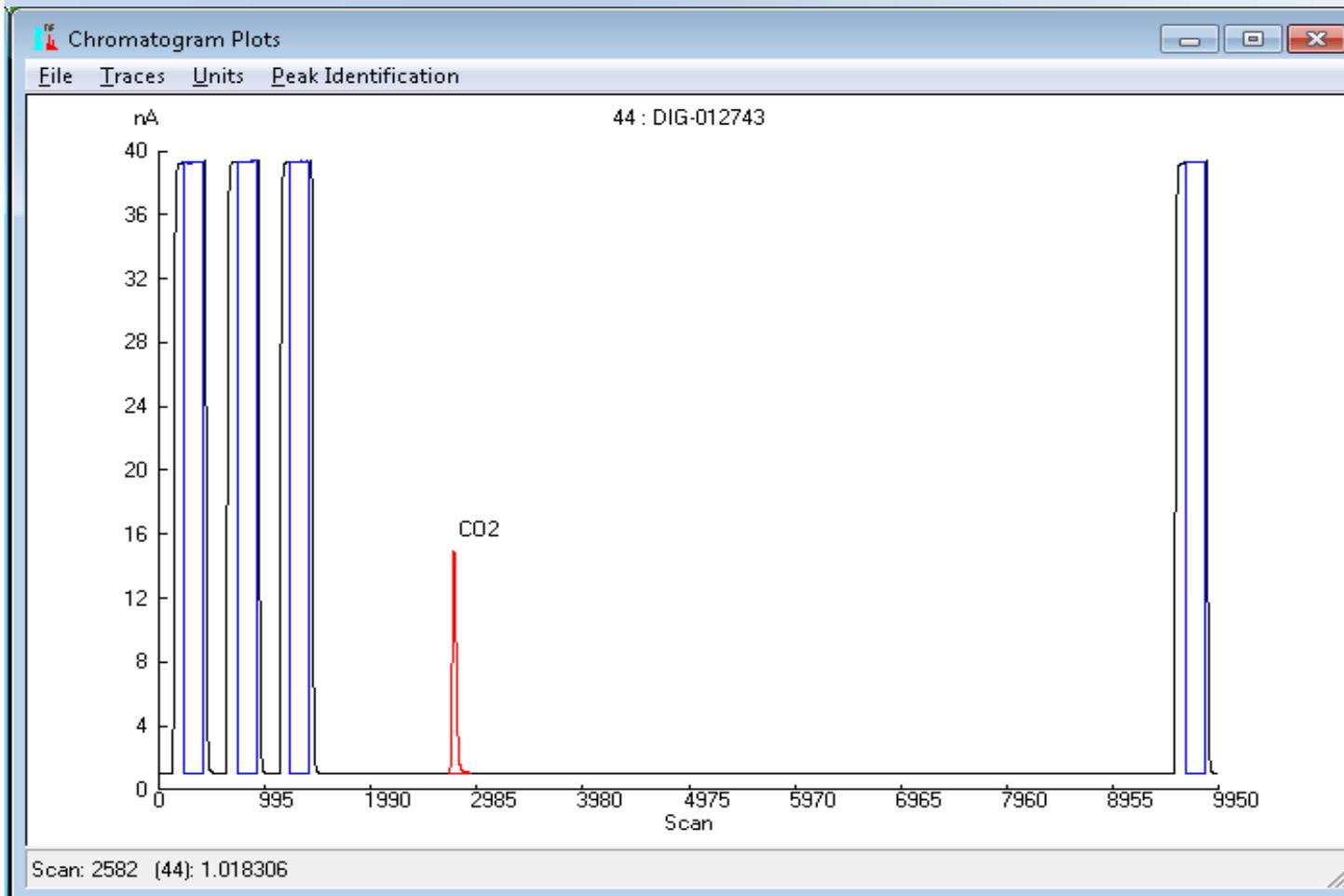
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012743.D)

TCD2 B, Back Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012743.D)





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012744
Client: Vista Geoscience
Sample Name(s): VW21-092617-1045

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Analytical Report



Job #: 17091088
 Lab #: DIG-012744
 Client: Vista Geoscience
 Sample Name: VW21-092617-1045
 Date Sampled: 09/26/17
 Time Sampled: 10:45
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/29/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	795763	79.82	-	-	-	
Oxygen + Argon (O ₂ +Ar)	117555	11.79	-	-	-	
Carbon Dioxide (CO ₂)	83572	8.38	-	-22.8	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

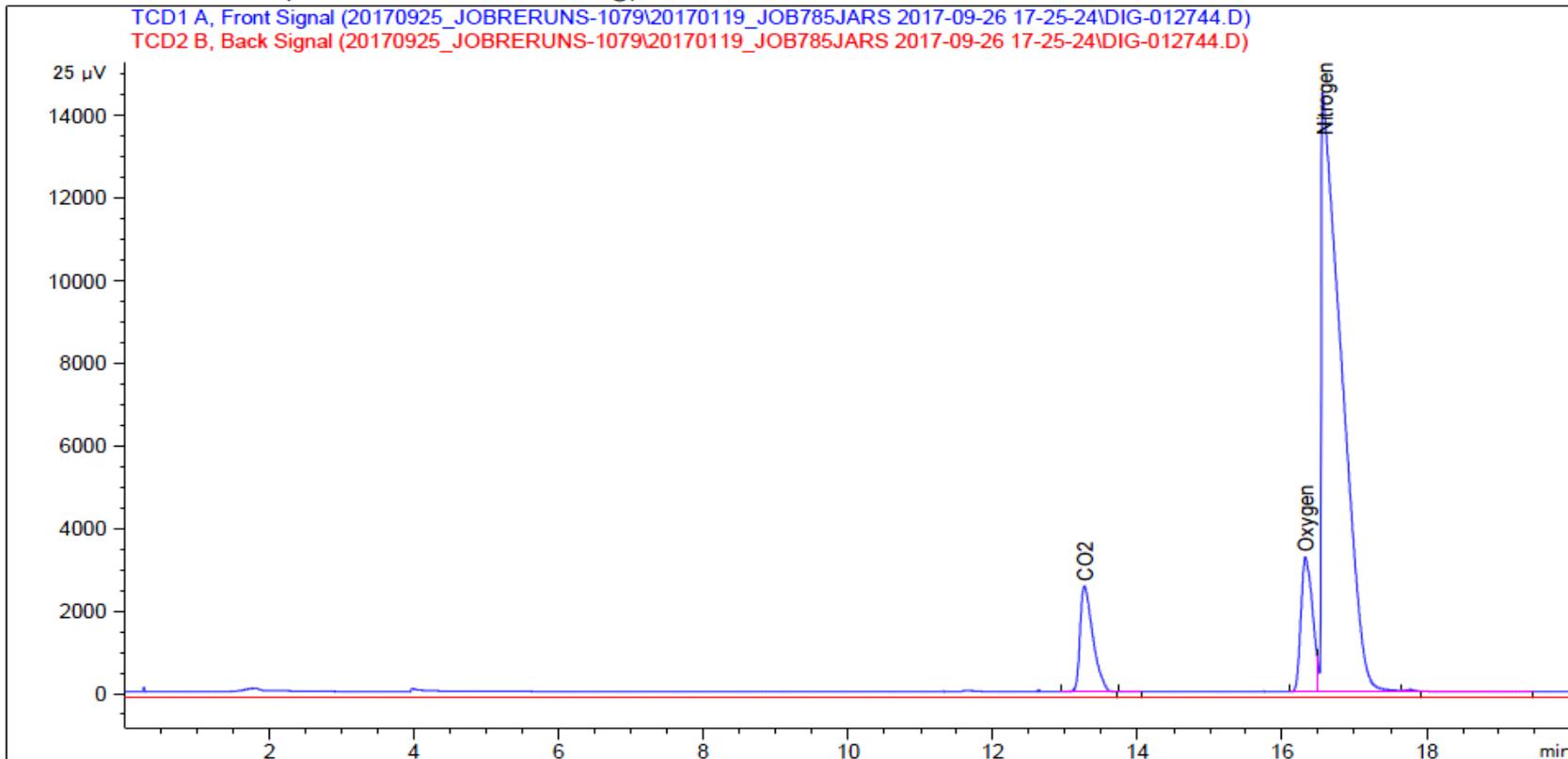
Error δD < 5.0 ‰

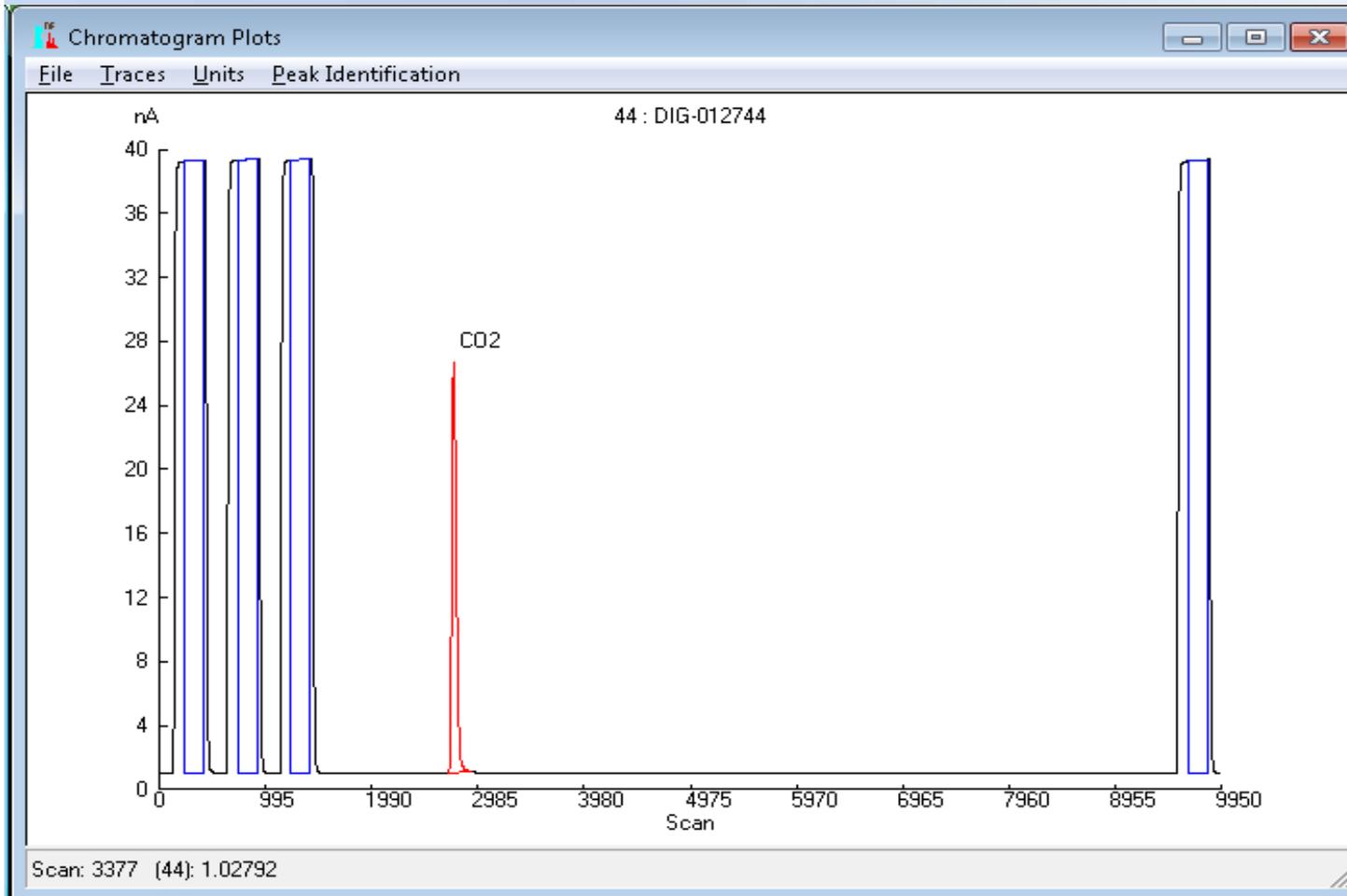
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012744.D)

TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012744.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012745
Client: Vista Geoscience
Sample Name(s): VW31-092617-1102

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Analytical Report



Job #: 17091088
 Lab #: DIG-012745
 Client: Vista Geoscience
 Sample Name: VW31-092617-1102
 Date Sampled: 09/26/17
 Time Sampled: 11:02
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	786550	78.57	-	-	-	
Oxygen + Argon (O ₂ +Ar)	164449	16.43	-	-	-	
Carbon Dioxide (CO ₂)	50028	5.00	-	-18.7	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

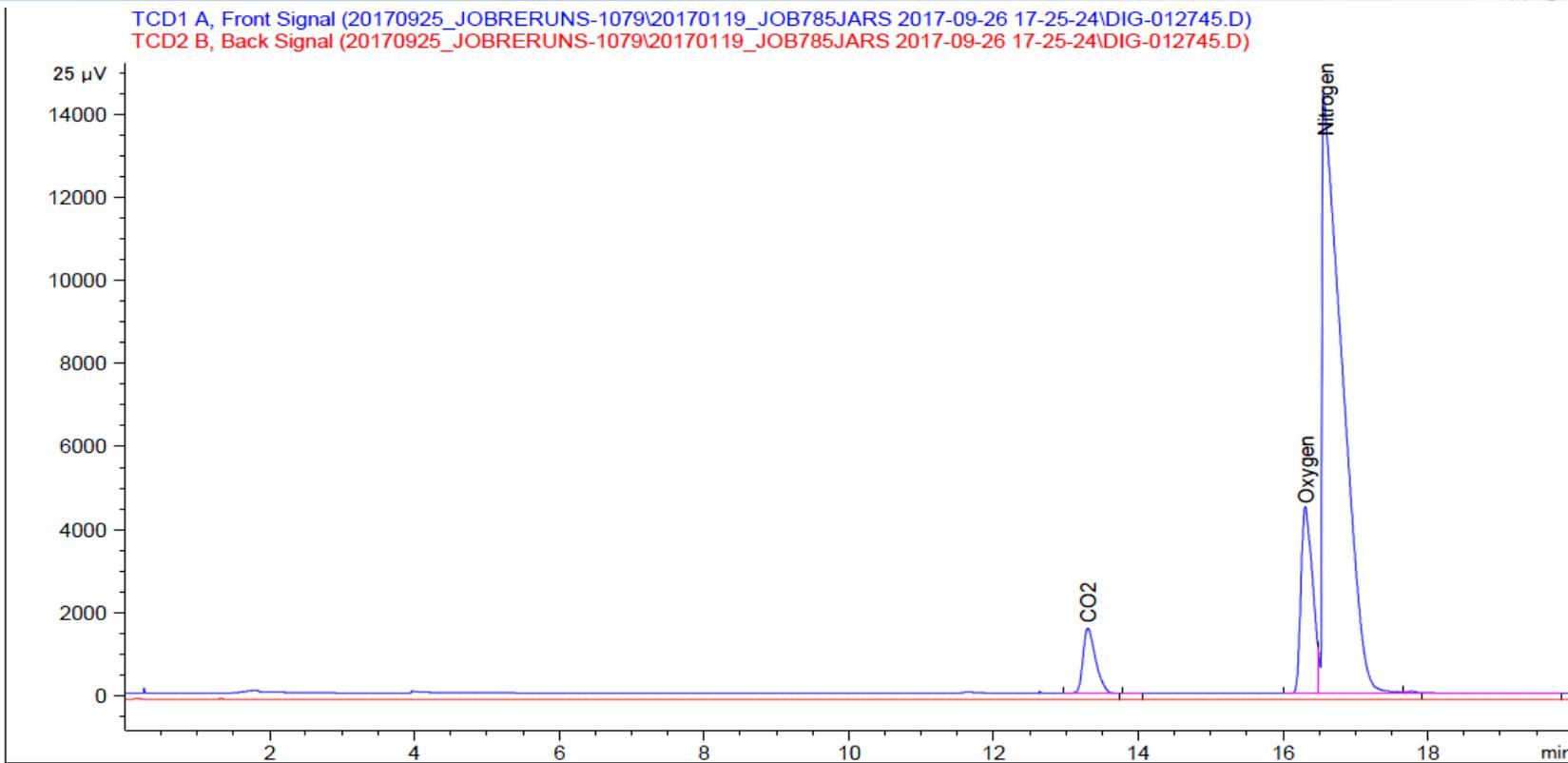
Error δD < 5.0 ‰

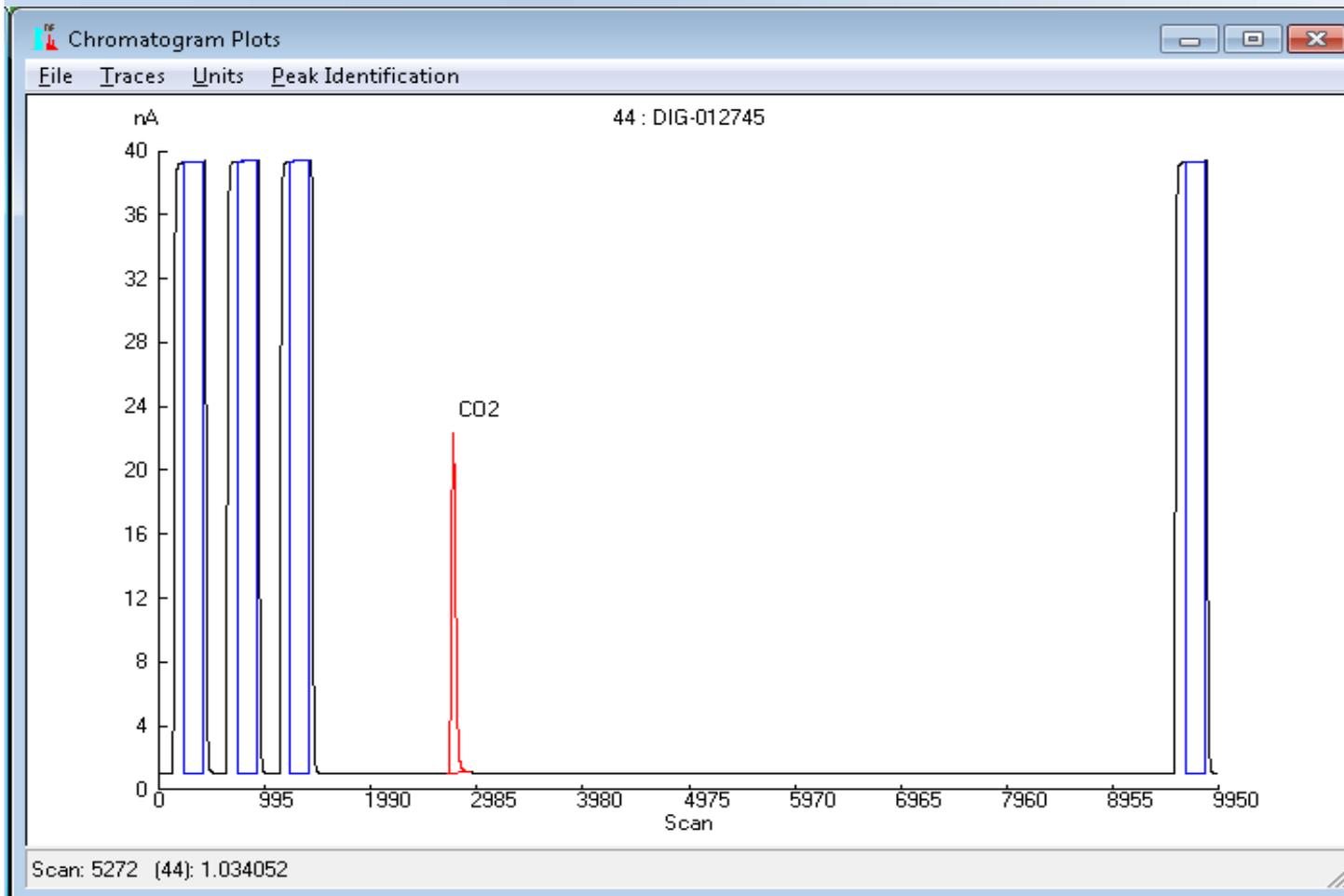
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012745.D)

TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012745.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012746
Client: Vista Geoscience
Sample Name(s): VW37-0926171345

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Analytical Report



Job #: 17091088
 Lab #: DIG-012746
 Client: Vista Geoscience
 Sample Name: VW37-0926171345
 Date Sampled: 09/26/17
 Time Sampled: 13:45
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	778942	77.78	-	-	-	
Oxygen + Argon (O ₂ +Ar)	176993	17.67	-	-	-	
Carbon Dioxide (CO ₂)	45513	4.54	-	-25.6	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

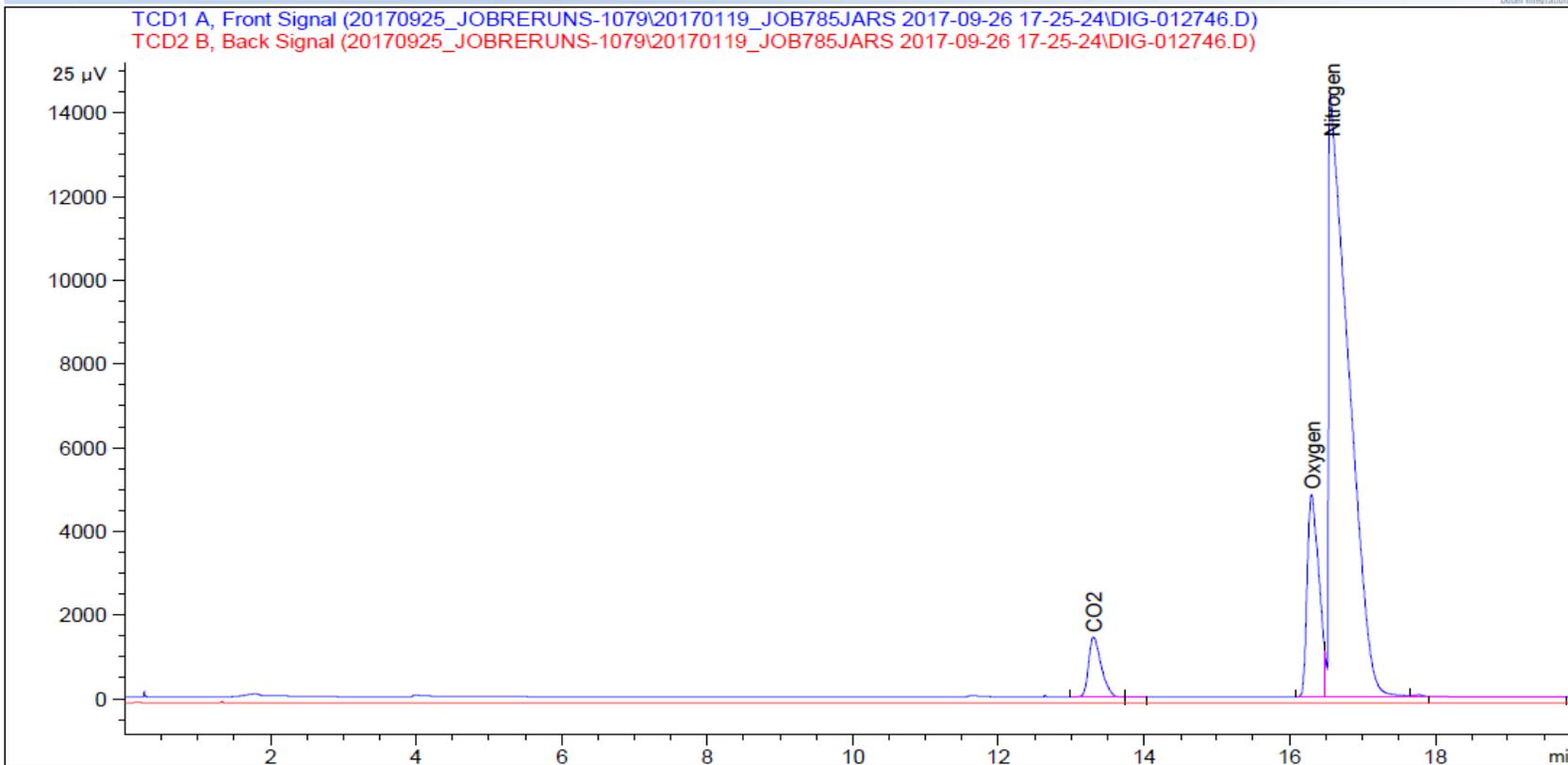
Error δD < 5.0 ‰

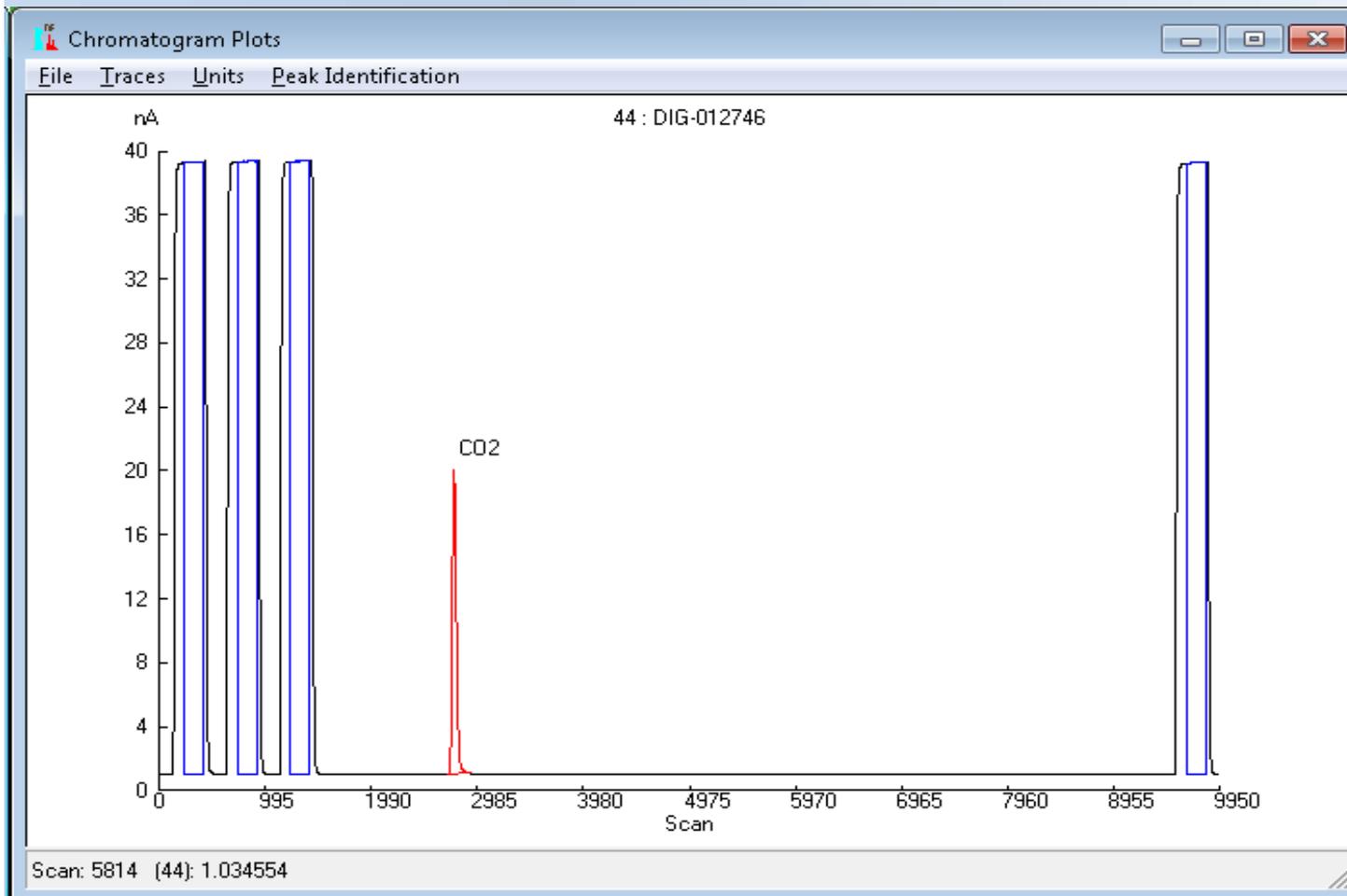
Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012746.D)

TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012746.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012747
Client: Vista Geoscience
Sample Name(s): VW38-092617-1338

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Analytical Report



Job #: 17091088
 Lab #: DIG-012747
 Client: Vista Geoscience
 Sample Name: VW38-092617-1338
 Date Sampled: 09/26/17
 Time Sampled: 13:38
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	774757	77.19	-	-	-	
Oxygen + Argon (O ₂ +Ar)	209973	20.92	-	-	-	
Carbon Dioxide (CO ₂)	18926	1.89	-	-21.4	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

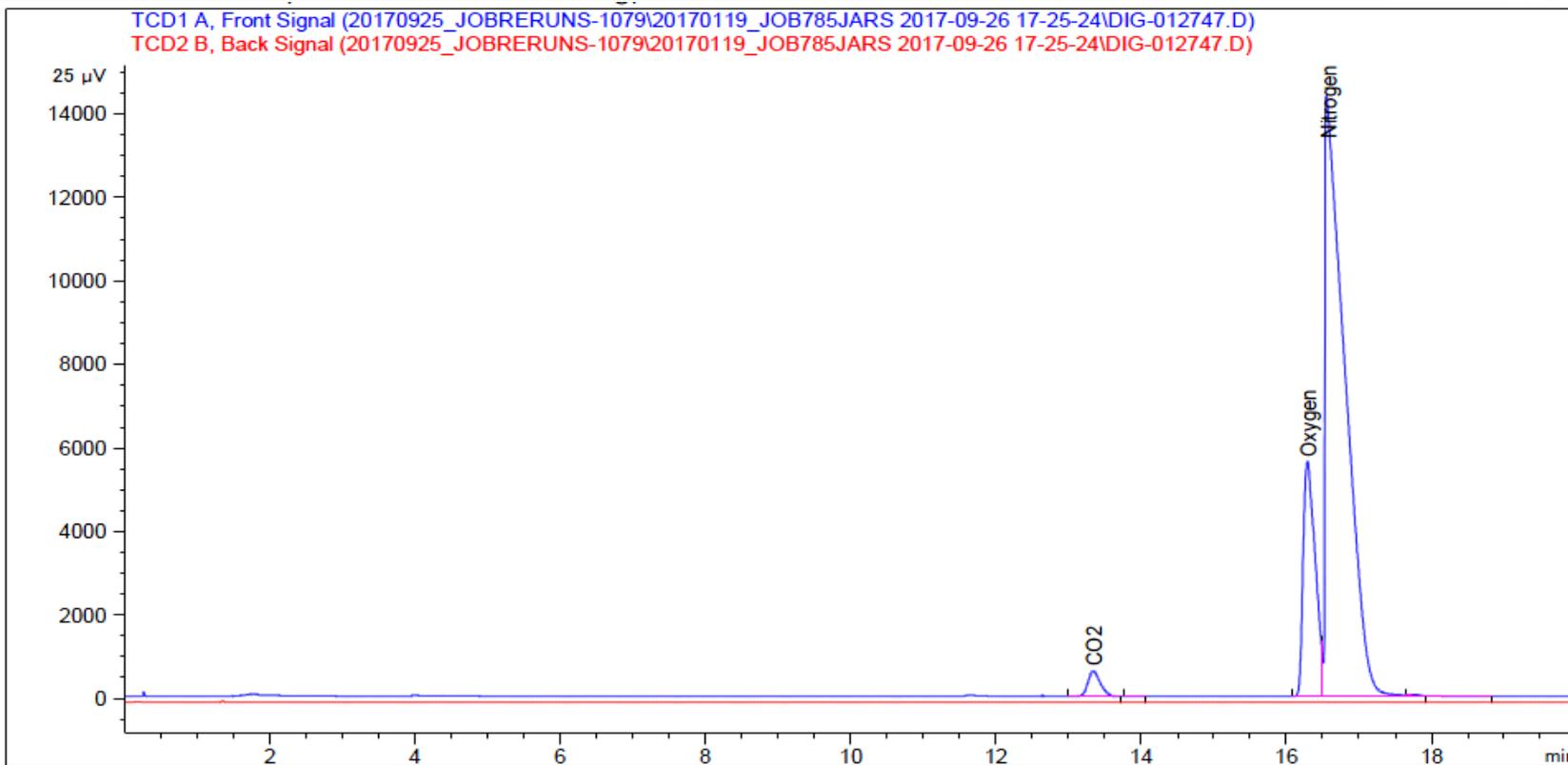
na = not analyzed

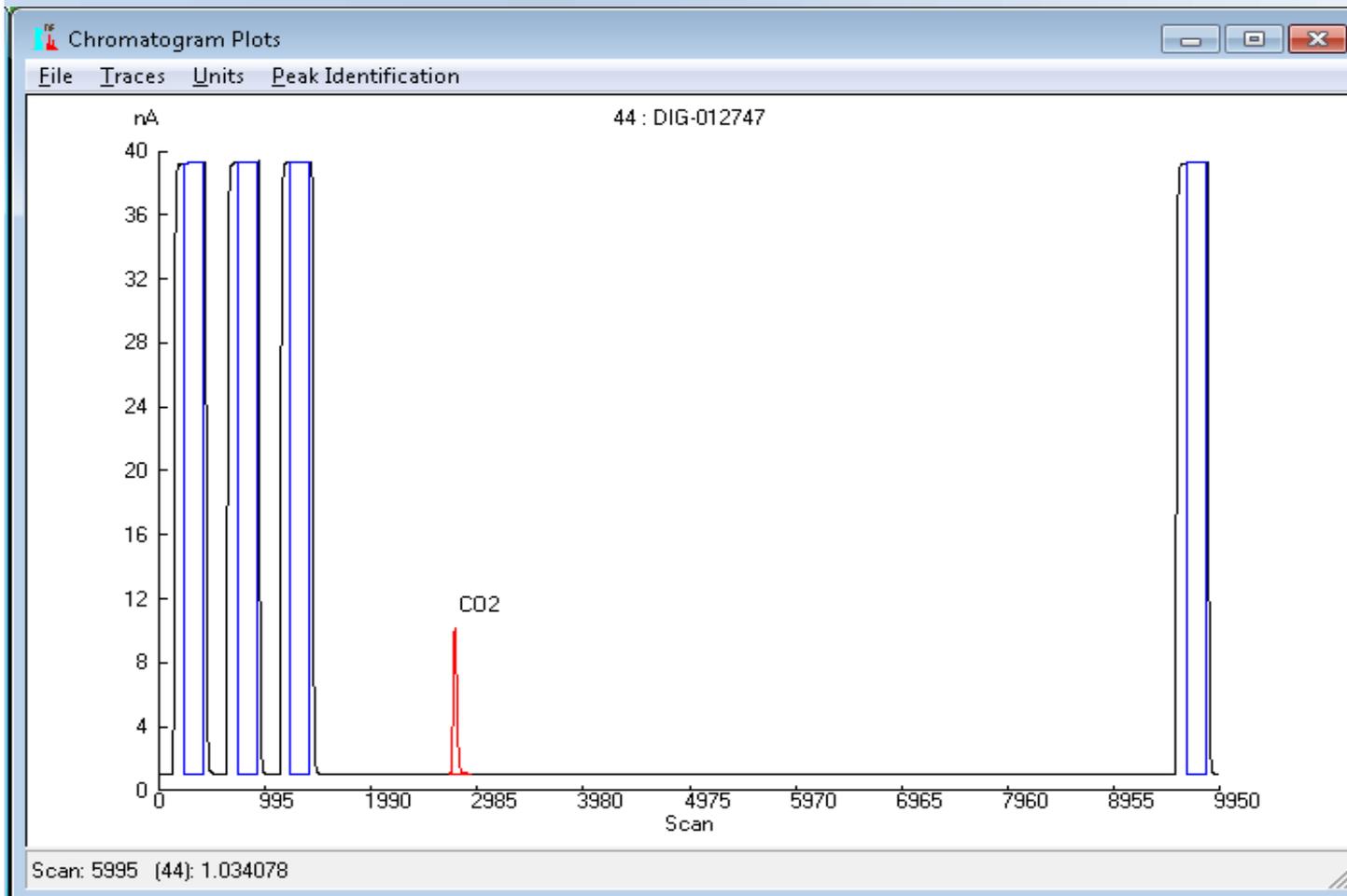
Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012748
Client: Vista Geoscience
Sample Name(s): VW41-092617-1332

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Analytical Report



Job #: 17091088
 Lab #: DIG-012748
 Client: Vista Geoscience
 Sample Name: VW41-092617-1332
 Date Sampled: 09/26/17
 Time Sampled: 13:32
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	786501	78.61	-	-	-	
Oxygen + Argon (O ₂ +Ar)	175665	17.56	-	-	-	
Carbon Dioxide (CO ₂)	38370	3.83	-	-24.9	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

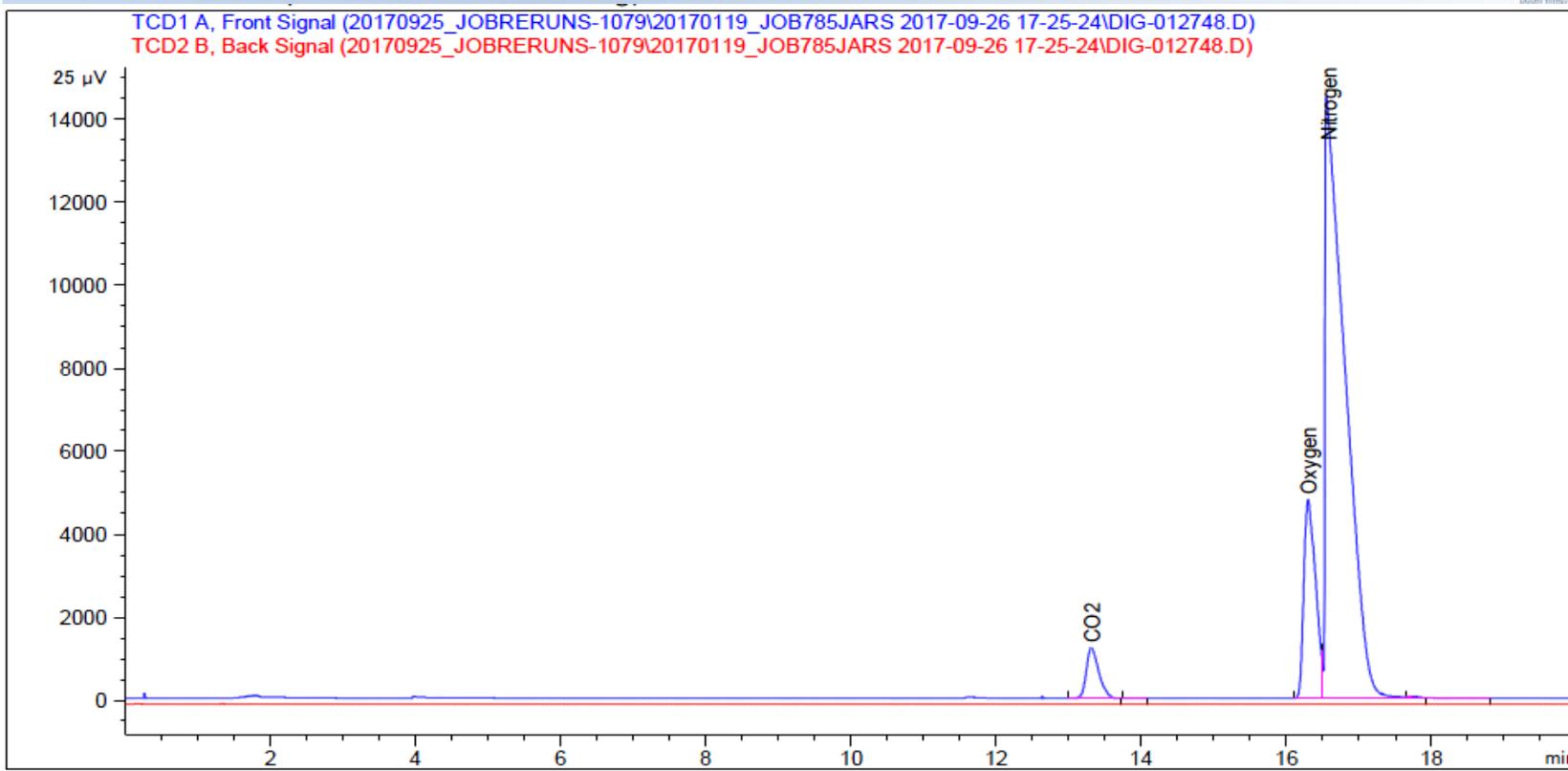
na = not analyzed

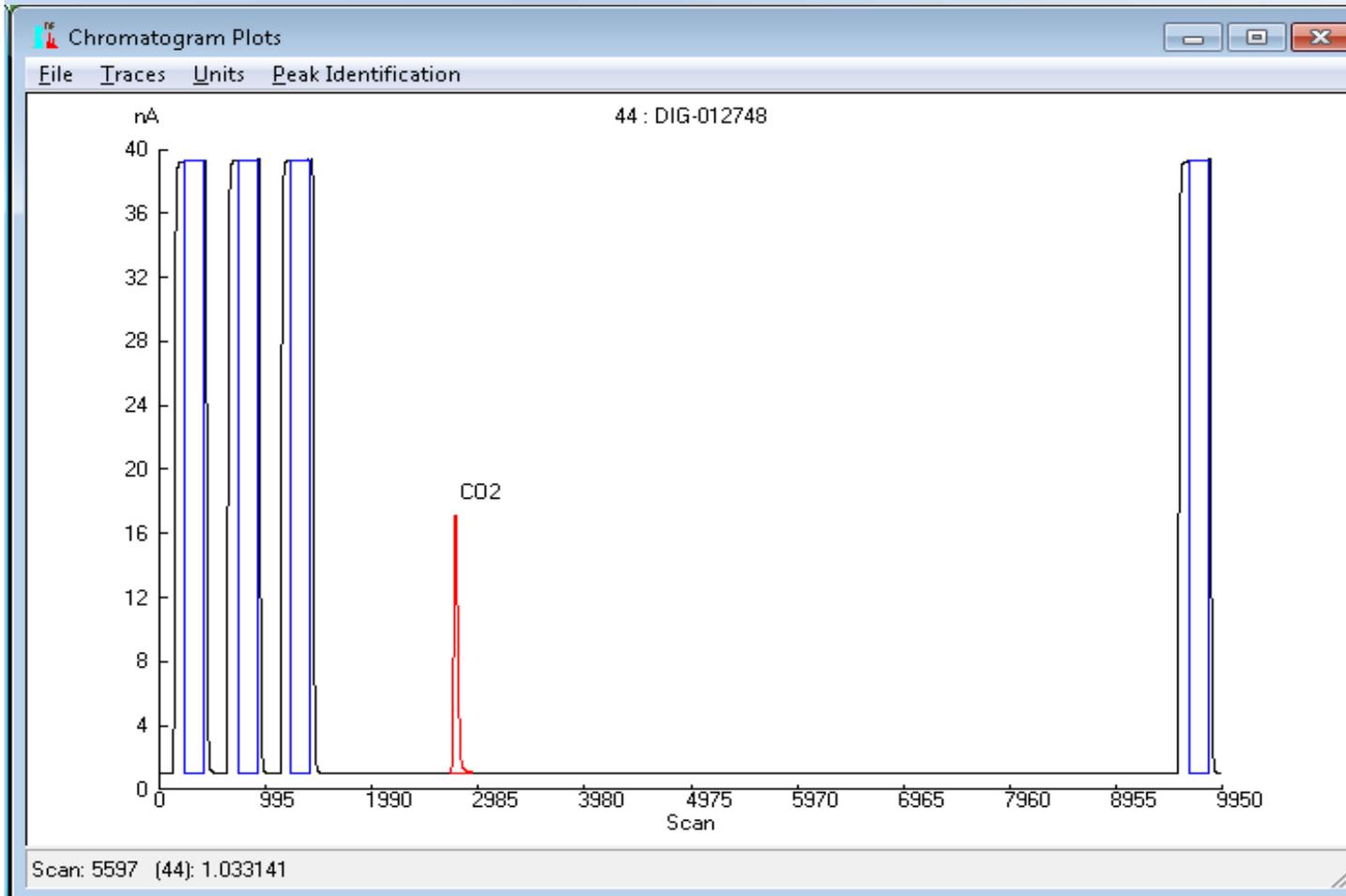
Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram





* Methane concentration too low for stable hydrogen isotope analysis



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Geochemistry for Energy

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p: 303.531.2030

**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012749
Client: Vista Geoscience
Sample Name(s): VW45-092617-1350

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Analytical Report



Job #: 17091088
 Lab #: DIG-012749
 Client: Vista Geoscience
 Sample Name: VW45-092617-1350
 Date Sampled: 09/26/17
 Time Sampled: 13:50
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	774792	76.93	-	-	-	
Oxygen + Argon (O ₂ +Ar)	231829	23.02	-	-	-	
Carbon Dioxide (CO ₂)	469	0.05	-	-12.8	-	Low signal
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

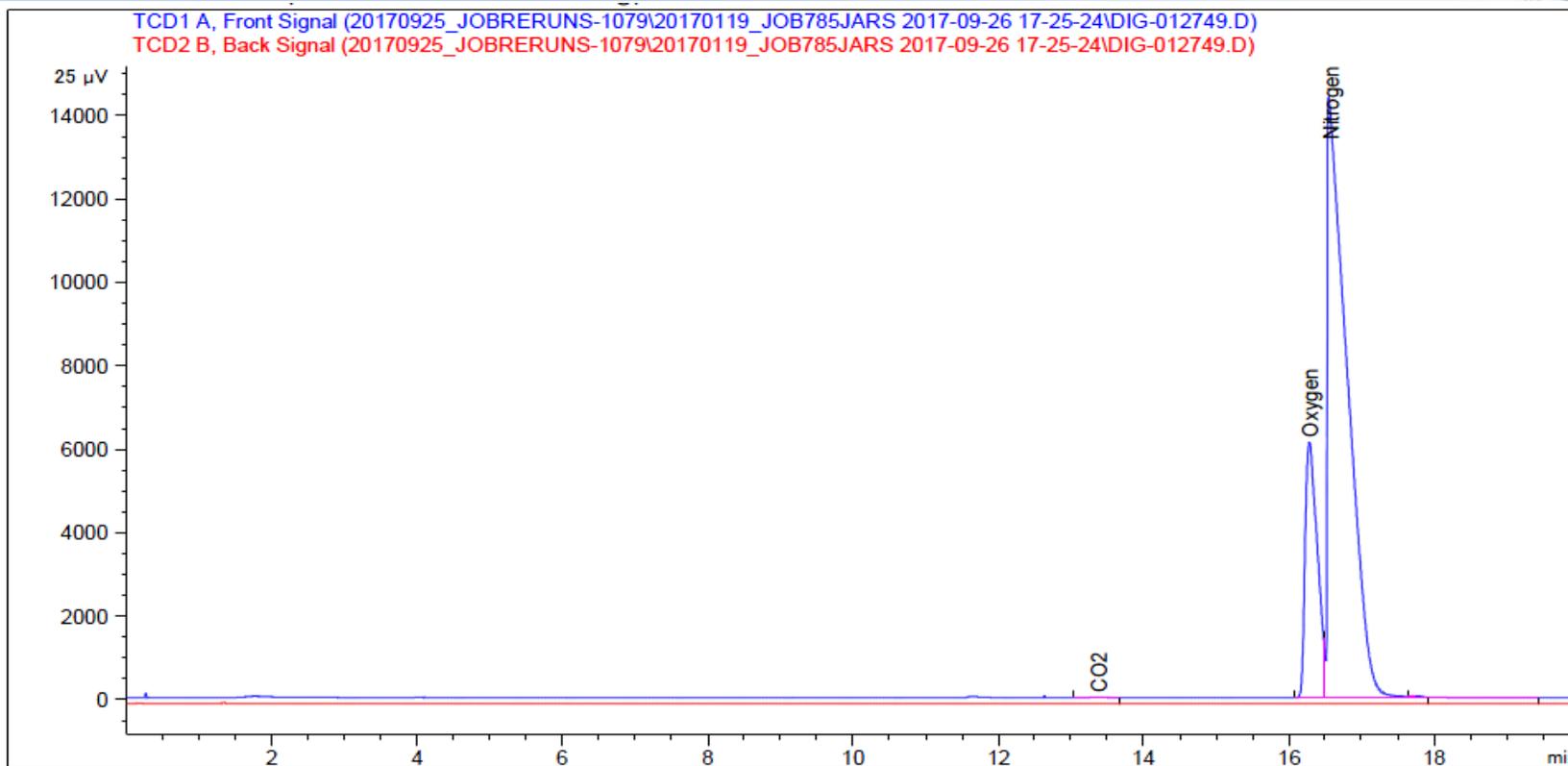
na = not analyzed

Stable isotope results based on multi-point laboratory calibration

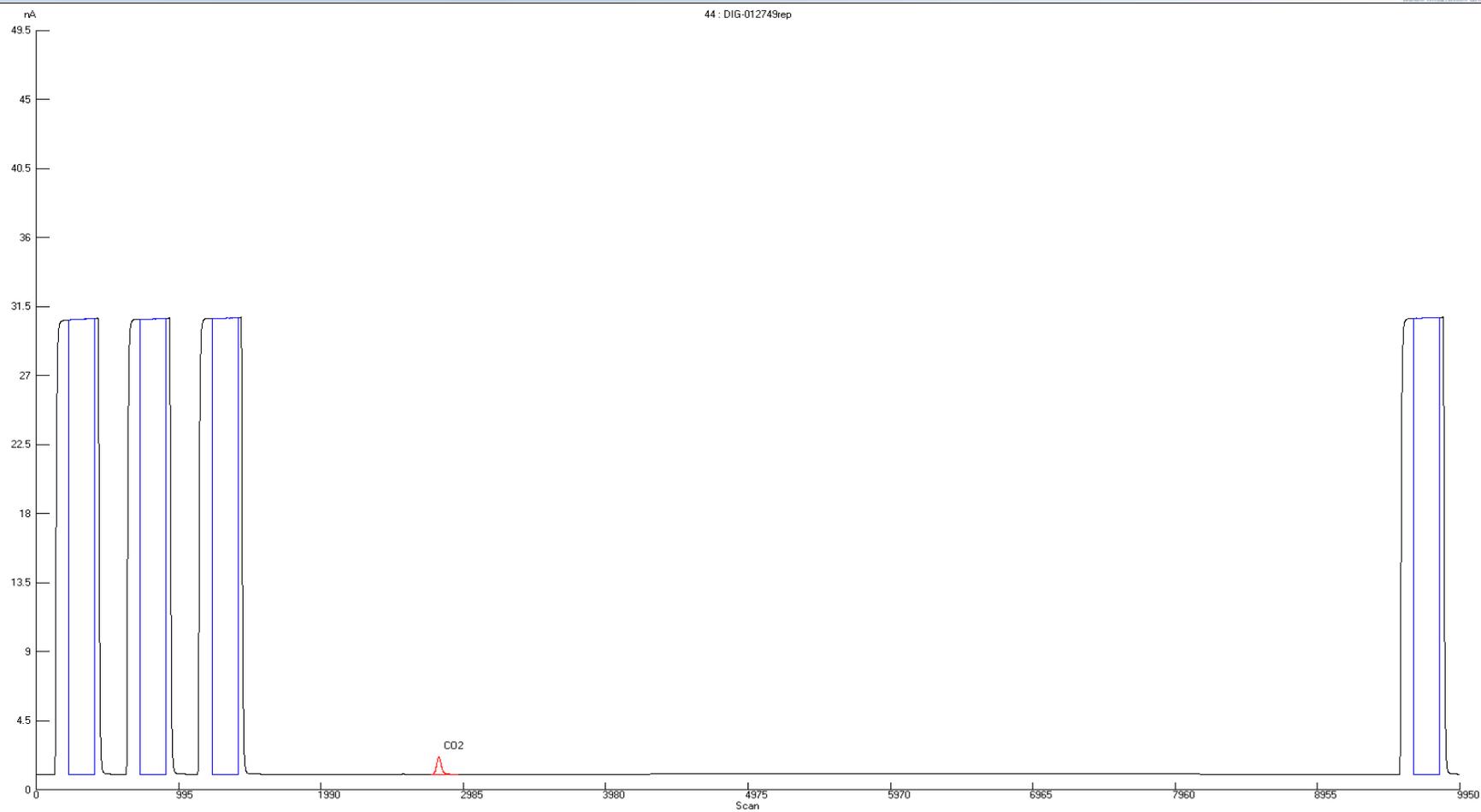
Error $\delta^{13}\text{C}$ < 0.5 ‰

Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



44 : DIG-012749rep



* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012750
Client: Vista Geoscience
Sample Name(s): VW58-092617-1404

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Analytical Report



Job #: 17091088
 Lab #: DIG-012750
 Client: Vista Geoscience
 Sample Name: VW58-092617-1404
 Date Sampled: 09/26/17
 Time Sampled: 14:04
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	809718	81.12	-	-	-	
Oxygen + Argon (O ₂ +Ar)	160941	16.12	-	-	-	
Carbon Dioxide (CO ₂)	27514	2.76	-	-24.4	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

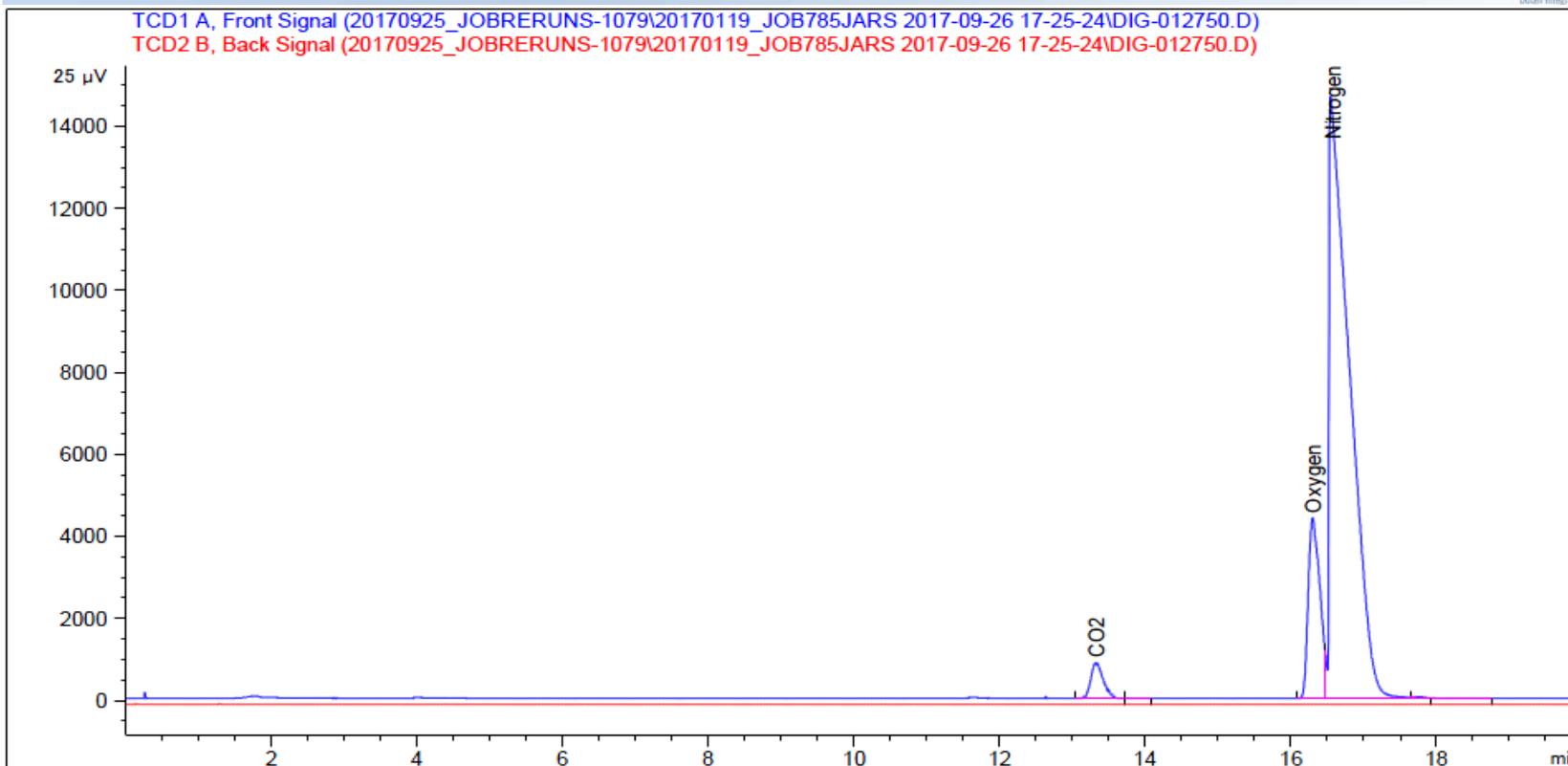
Error $\delta^{13}\text{C}$ < 0.5 ‰

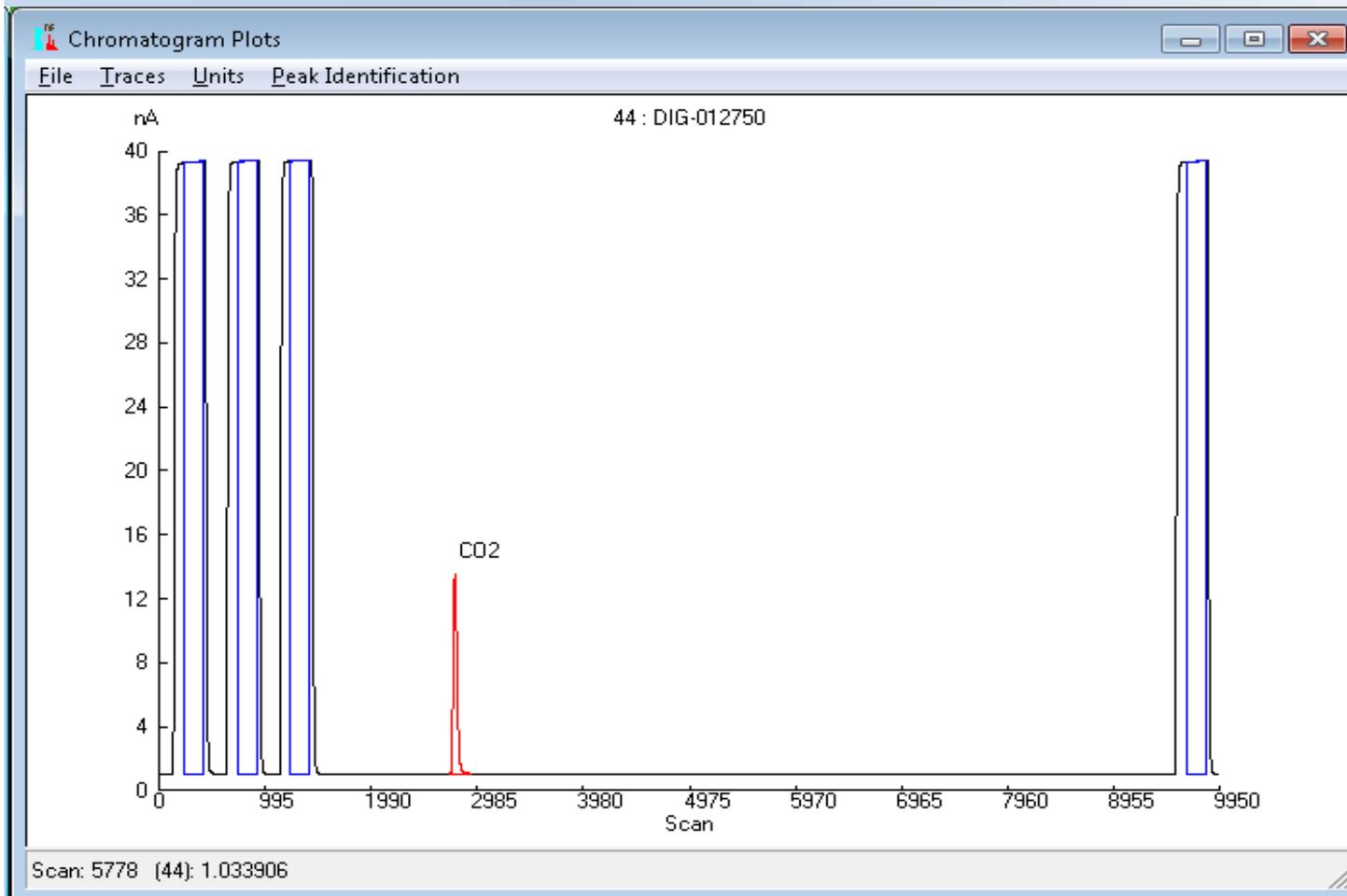
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012750.D)
TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012750.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012751
Client: Vista Geoscience
Sample Name(s): VW58-092617-1404B

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Analytical Report



Job #: 17091088
 Lab #: DIG-012751
 Client: Vista Geoscience
 Sample Name: VW58-092617-1404B
 Date Sampled: 09/26/17
 Time Sampled: 14:04
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	810301	81.19	-	-	-	
Oxygen + Argon (O ₂ +Ar)	159954	16.03	-	-	-	
Carbon Dioxide (CO ₂)	27747	2.78	-	-24.2	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

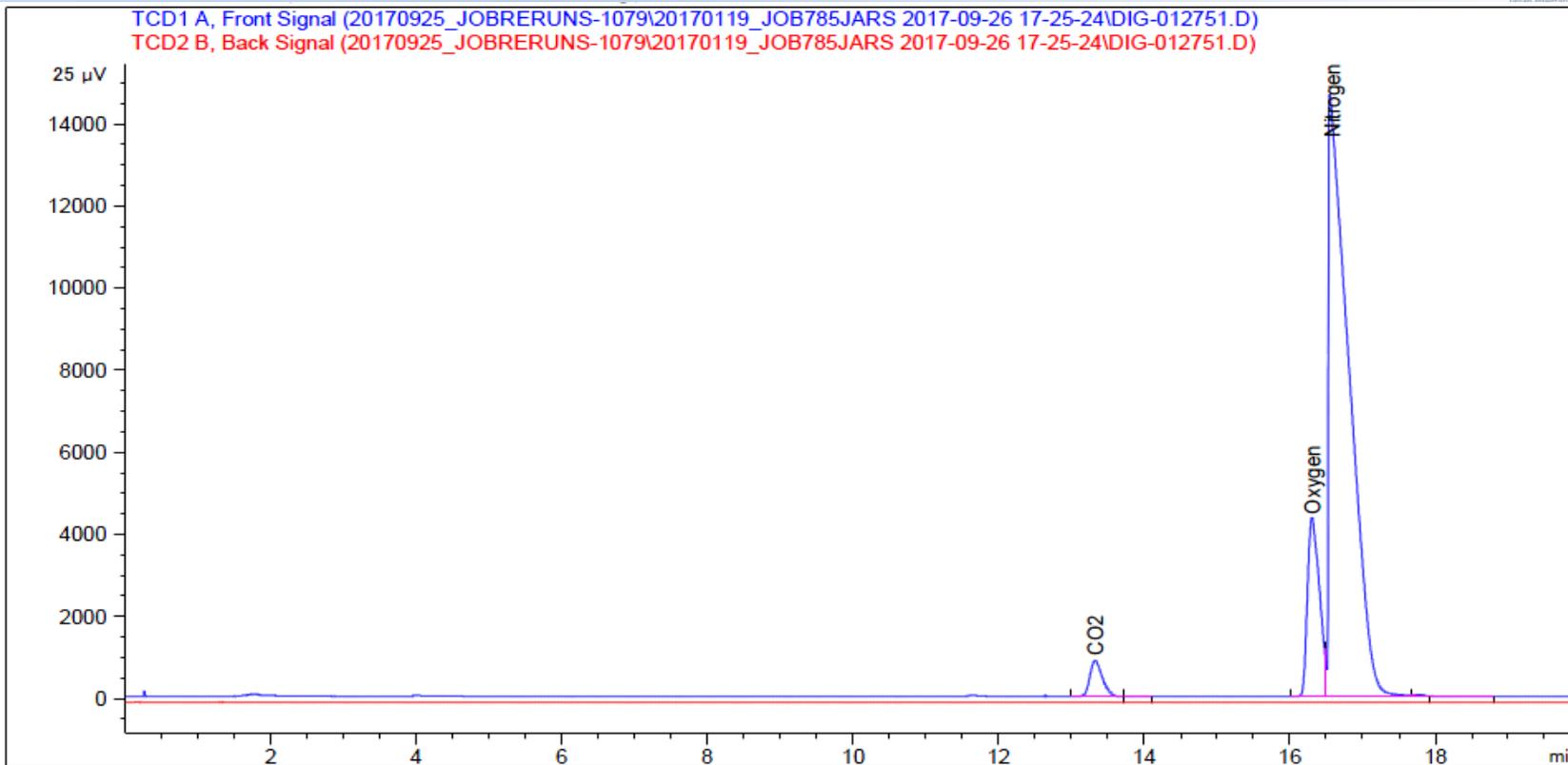
Error $\delta^{13}\text{C}$ < 0.5 ‰

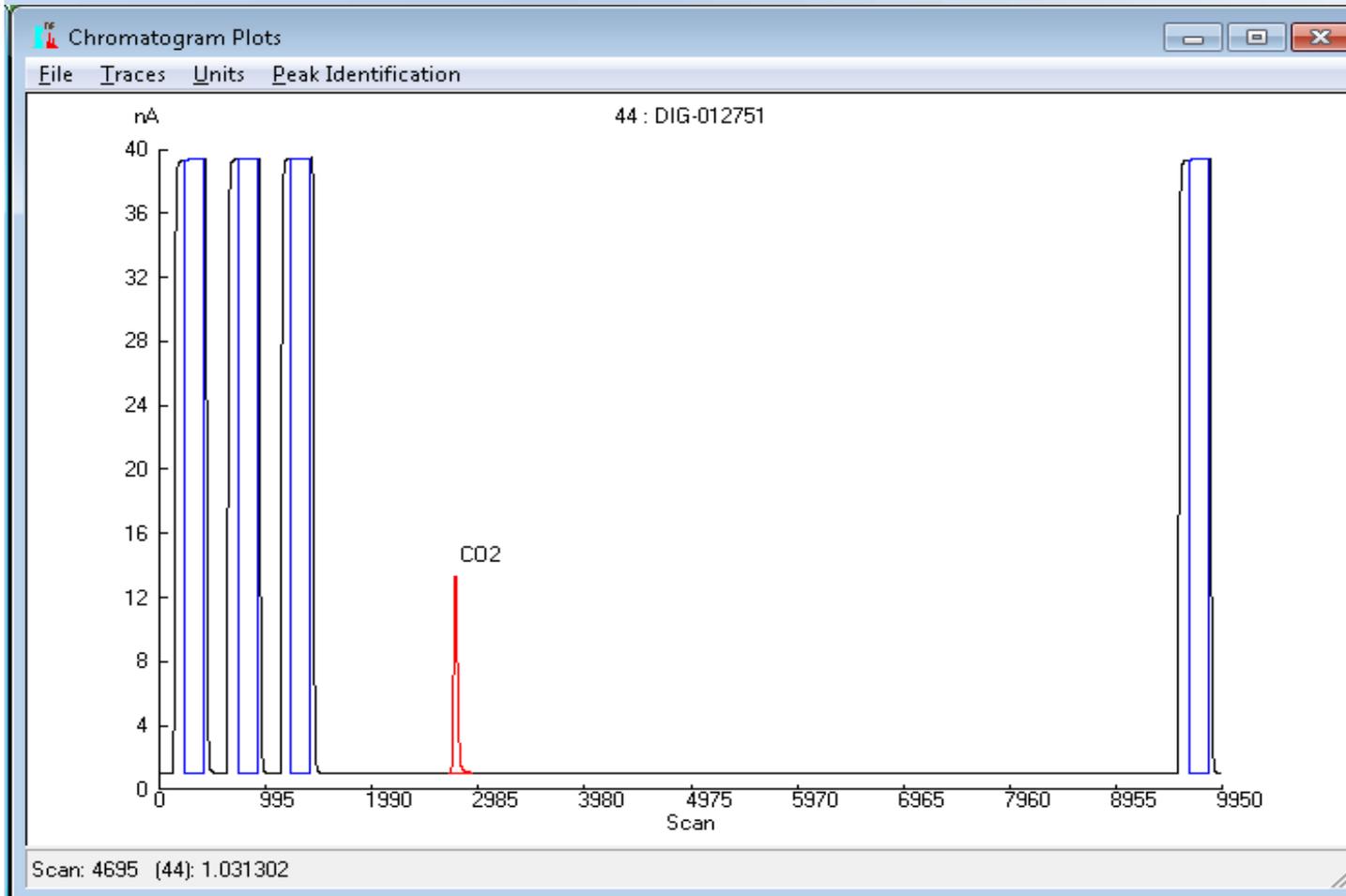
Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



TCD1 A, Front Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012751.D)
TCD2 B, Back Signal (20170925_JOBRRERUNS-1079\20170119_JOB785JARS 2017-09-26 17-25-24\DIG-012751.D)





* Methane concentration too low for stable hydrogen isotope analysis



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**Hydrocarbon Gas Composition and Stable Isotopes
Data and Interpretation**

Job #: 17091088
Lab #: DIG-012752
Client: Vista Geoscience
Sample Name(s): VW59-092617-1358

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Analytical Report



Job #: 17091088
 Lab #: DIG-012752
 Client: Vista Geoscience
 Sample Name: VW59-092617-1358
 Date Sampled: 09/26/17
 Time Sampled: 13:58
 Sample Description: isobag
 Sampling Notes:
 Date Received: 09/26/17
 Date Analyzed: Gas Composition:9/26/17 $\delta^{13}\text{C}$: 9/30/17
 Date Reported: 10/02/17
 Comments:

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	790688	79.20	-	-	-	
Oxygen + Argon (O ₂ +Ar)	166633	16.69	-	-	-	
Carbon Dioxide (CO ₂)	41076	4.11	-	-13.6	-	
Carbon Monoxide (CO)	nd	nd	-	-	-	
Helium (He) ^b	nd	nd	-	-	-	
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	nd	nd	nd	nd	nd	
Ethane (C ₂ H ₆)	nd	nd	nd	nd	-	
Ethene (C ₂ H ₄)	nd	nd	nd	nd	-	
Propane (C ₃ H ₈)	nd	nd	nd	nd	-	
Propene (C ₃ H ₆)	nd	nd	nd	nd	-	
iso-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
n-Butane (C ₄ H ₁₀)	nd	nd	nd	nd	-	
iso-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	-	-	

Calculated Values:	
Total HCs (ppm)	0
Gas Wetness (mol % C ₂ +/C ₁ +))	
C ₁ /(C ₂ +C ₃) (mol/mol)	

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

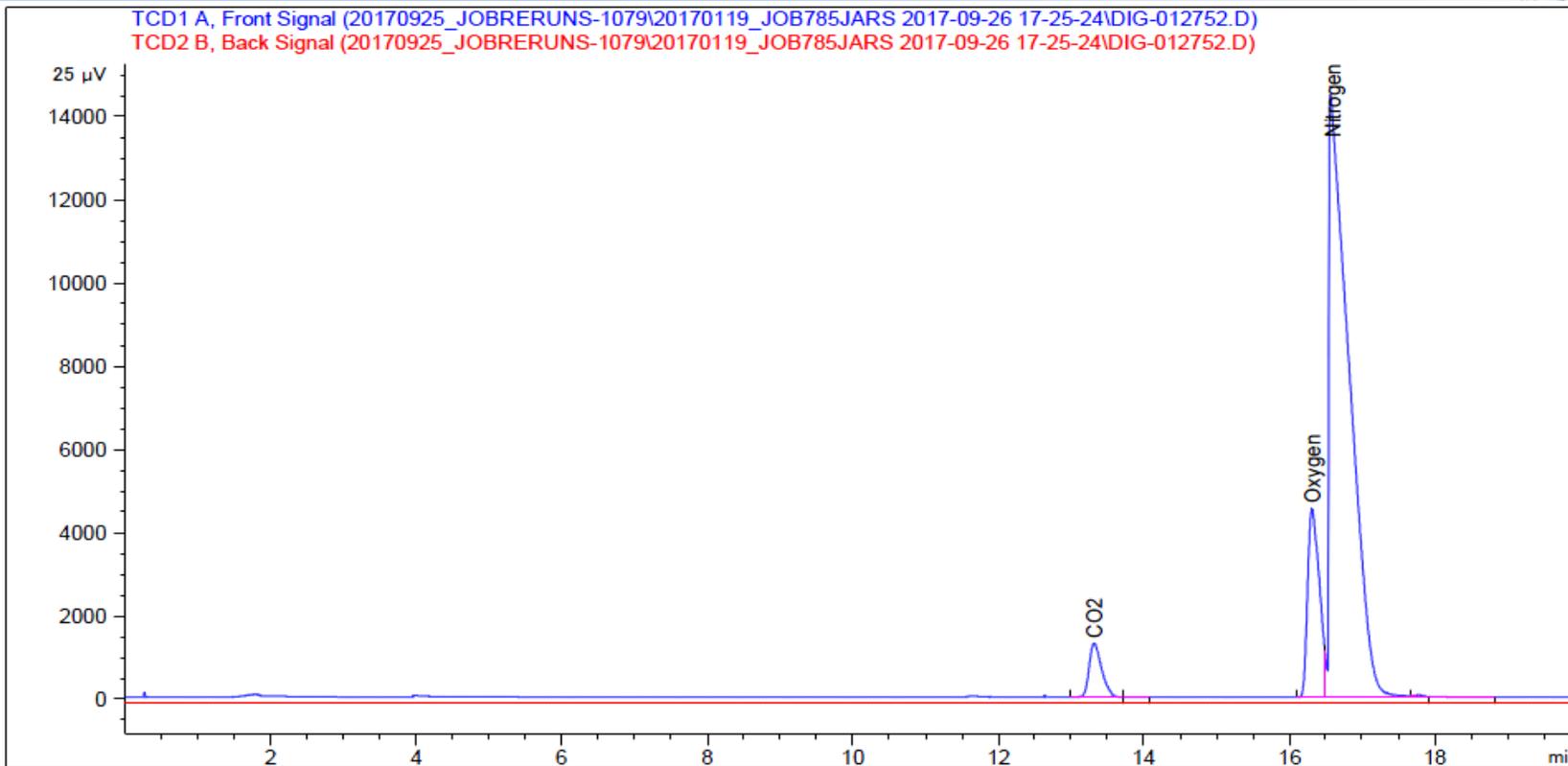
Error $\delta^{13}\text{C}$ < 0.5 ‰

Error δD < 5.0 ‰

Gas Chromatography (GC) Chromatogram



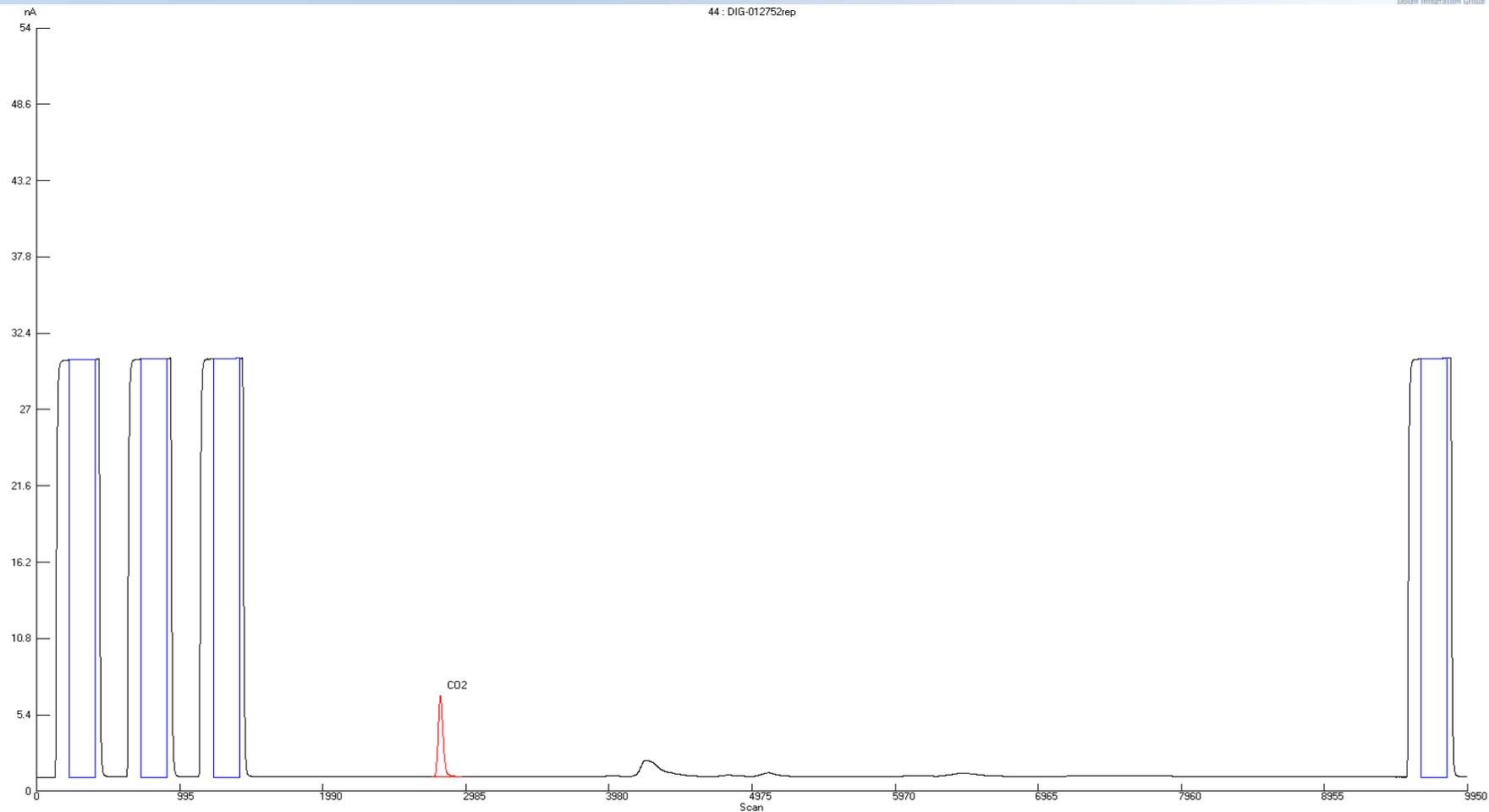
TCD1 A, Front Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012752.D)
TCD2 B, Back Signal (20170925_JOB785JARS 2017-09-26 17-25-24\DIG-012752.D)



Gas Chromatography - Combustion - Isotope Ratio Mass Spectrometry (GC-C-IRMS) Chromatogram



44 : DIG-012752rep



* Methane concentration too low for stable hydrogen isotope analysis