



**Nicholson GeoSolutions, LLC**

3433 East Lake Drive  
Centennial, CO 80121

January 25, 2021

Mr. Don Wilbourn  
Berry Petroleum Company  
235 Callahan Avenue  
Parachute, Colorado 81635

**Subject: P-32 Water Facility Additional Methane Isotope Analyses**

Dear Don:

This report provides the methane isotope results for the two air samples that were collected from the pipeline near the P-32 monitoring well MW-3 and an existing well on the I-02 well pad. These samples were hand-delivered to SGS North America Laboratory in Wheat Ridge, Colorado and then forwarded to Dolan Integration Group in Westminster, Colorado for stable isotope analysis. Stable isotope interpretive plots were provided with the stable isotope report and are included with the DIG lab report in Appendix A. In addition, two interpretive diagrams are attached as Figures 1 and 2.

The results for the air samples from this sampling event indicate post-mature, thermogenic gas. Both samples plot in the thermogenic field on both diagrams and very close to each other. Previous methane results from the groundwater in well MW-3 plot within the kerogen type II thermogenic field. As shown on the Figures 1 and 2, the previous result from well MW-3 lies along the migration and mixing/migration lines, shown best on Figure 1. The methane in well MW-3 is interpreted as gas with a thermogenic origin that is mixed with and/or has been affected by microbial organisms (methanogens). It is notable that the groundwater methane is dryer than the produced gas in the air samples. This may have been caused by geochemical reactions with the Green River Formation solids through which the methane migrated.

Nicholson GeoSolutions LLC

A handwritten signature in blue ink that reads "DK Nicholson".

David K. Nicholson, P.G.  
Principal Geologist

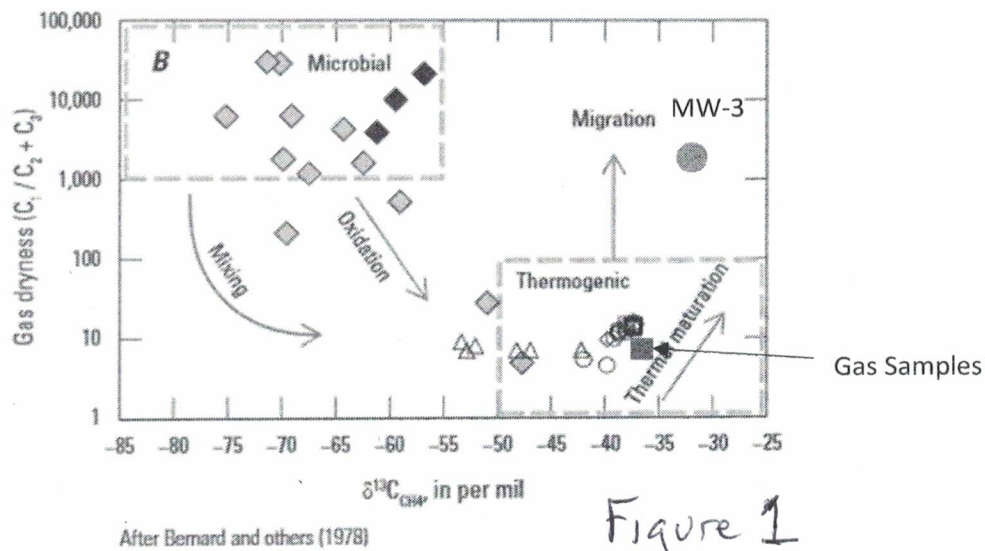


Figure 1

### Methane $\delta^{13}C$ vs $\delta D$ Genetic Classification Plot

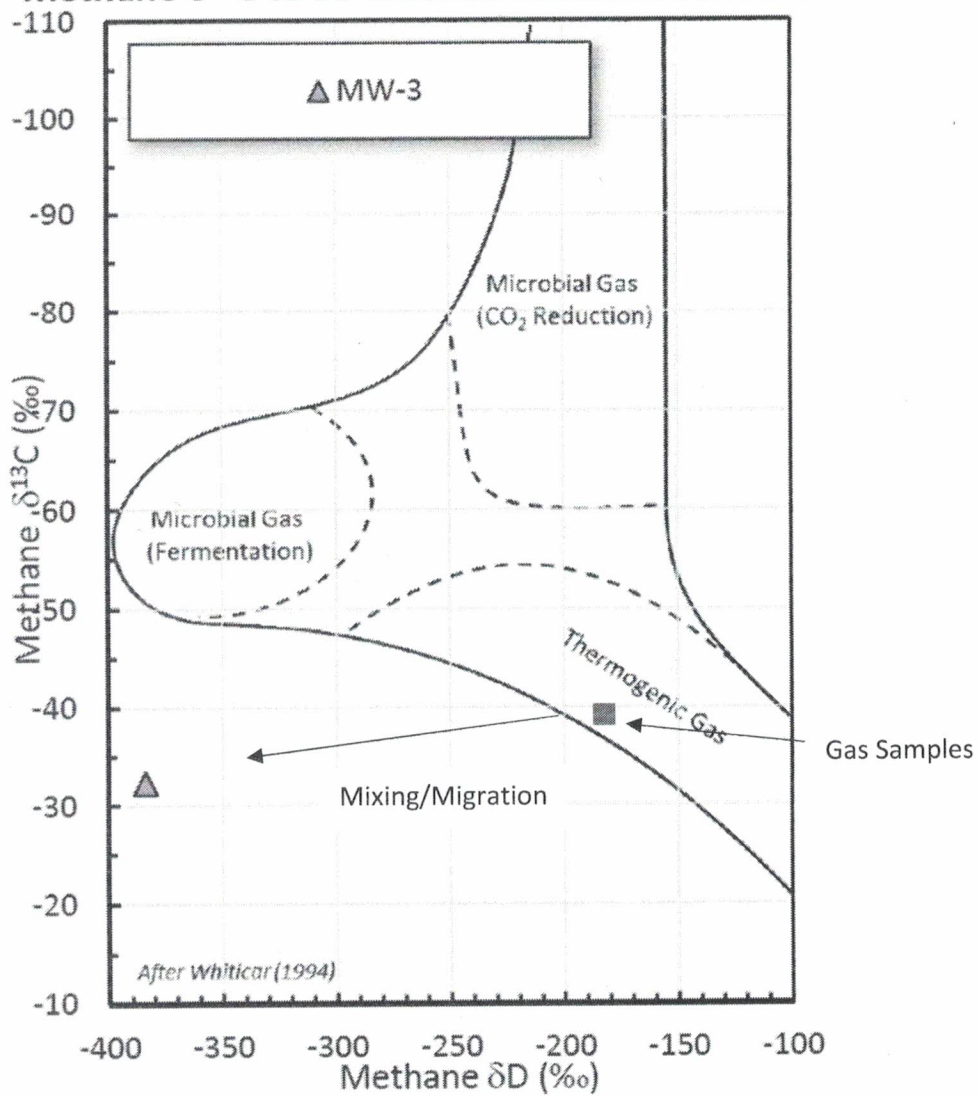


Figure 2

**APPENDIX A**  
**Methane Stable Isotope Report**

The results set forth herein are provided by SGS North America Inc.

*e-Hardcopy 2.0*  
*Automated Report*

## Technical Report for

**Nicholson GeoSolutions**

**Nicholson GeoSolutions**

**SGS Job Number: DA31540X**

**Sampling Date: 12/28/20**

### Report to:

**Nicholson GeoSolutions  
3433 East Lake Drive  
Centennial, CO 80121  
dknicholson@q.com**

**ATTN: Dave Nicholson**

**Total number of pages in report: 16**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.



**Jason Savoie**  
**General Manager**

**Client Service contact: Elizabeth Sutcliffe 303-425-6021**

Certifications: CO (CO00049), NE (NE-OS-06-04), ND (R-027), UT (NELAP CO00049)  
LA (LA150028), TX (T104704511), WY (8TMS-L)

This report shall not be reproduced, except in its entirety, without the written approval of SGS.  
Test results relate only to samples analyzed.

# Table of Contents

-1-

Section 1: Sample Summary .....

Section 2: Subcontract Lab Data .....

Section 3: Misc. Forms .....

3.1: Chain of Custody .....

3

4

15

16



Sample Summary

Nicholson GeoSolutions  
Nicholson GeoSolutions

Job No: DA31540X

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
DA31540-1X	12/28/20	09:25 DN	12/31/20	AIR	Air	OLD MTN. IO2 OM 16A
DA31540-2X	12/28/20	09:50 DN	12/31/20	AIR	Air	OLD MTN. CDP PIPE LINE

Subcontract Lab Data

Report of Analysis



**dig**  
Dolan Integration Group

Geochemistry for Energy

11025 Dover Street Unit 800  
Westminster, CO 80021  
p: 303.531.2030

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

**Job #:** 21015061  
**Lab #:** DIG-024424 - DIG-024425  
**Client:** SGS Accutest  
**Well Name:** DA31540-1

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 60 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





Client/Well Name: 563 Acornst / DA31540X.1  
Job #: 21010061  
Lab #: DQ 024624 - DQ 084925

COMPLETE GAS ANALYSIS										HYDROCARBON GAS ANALYSIS (concentrated to total HC content)										BTU CONTENT*						
Sample	Well	Lab	GC	N <sub>2</sub>	O <sub>2</sub> + Ar	CO <sub>2</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	iC <sub>4</sub>	nC <sub>4</sub>	iC <sub>5</sub>	nC <sub>5</sub>	C <sub>6</sub> +	C <sub>7</sub> H <sub>8</sub>	C <sub>8</sub> +	HC Total	HC Total	HC Total	HC Total	HC Total	HC Total	HC Total	HC Total	HC Total	HC Total
21010061	DQ 024624	3272.02	DA31540X.1	3272.02	501	1/9/2021	11097	20.1	20977	69813	71208	2193	1948	652	316	747	1113	1113	1113	1113	1113	1113	1113	1113	1113	1113
21010061	DQ 024624	3272.02	DA31540X.1	3272.02	501	1/9/2021	11097	20.1	20977	69813	71208	2193	1948	652	316	747	1113	1113	1113	1113	1113	1113	1113	1113	1113	1113

HYDROCARBON FACTORS										HYDROCARBON FACTORS										BTU CONTENT*							
Sample	Well	Lab	Total HC	Wet Basis	C <sub>2</sub> /C <sub>1</sub>	C <sub>3</sub> /C <sub>1</sub>	Balanced Ratio	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	W <sub>4</sub>	W <sub>5</sub>	W <sub>6</sub>	W <sub>7</sub>	W <sub>8</sub>	W <sub>9</sub>	W <sub>10</sub>	W <sub>11</sub>	W <sub>12</sub>	W <sub>13</sub>	W <sub>14</sub>	W <sub>15</sub>	W <sub>16</sub>	W <sub>17</sub>	W <sub>18</sub>	W <sub>19</sub>	W <sub>20</sub>
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6

SAMPLE FACTOR ANALYSIS										COMMENTS																	
Sample	Well	Lab	Total HC	Wet Basis	C <sub>2</sub> /C <sub>1</sub>	C <sub>3</sub> /C <sub>1</sub>	Balanced Ratio	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	W <sub>4</sub>	W <sub>5</sub>	W <sub>6</sub>	W <sub>7</sub>	W <sub>8</sub>	W <sub>9</sub>	W <sub>10</sub>	W <sub>11</sub>	W <sub>12</sub>	W <sub>13</sub>	W <sub>14</sub>	W <sub>15</sub>	W <sub>16</sub>	W <sub>17</sub>	W <sub>18</sub>	W <sub>19</sub>	W <sub>20</sub>
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6

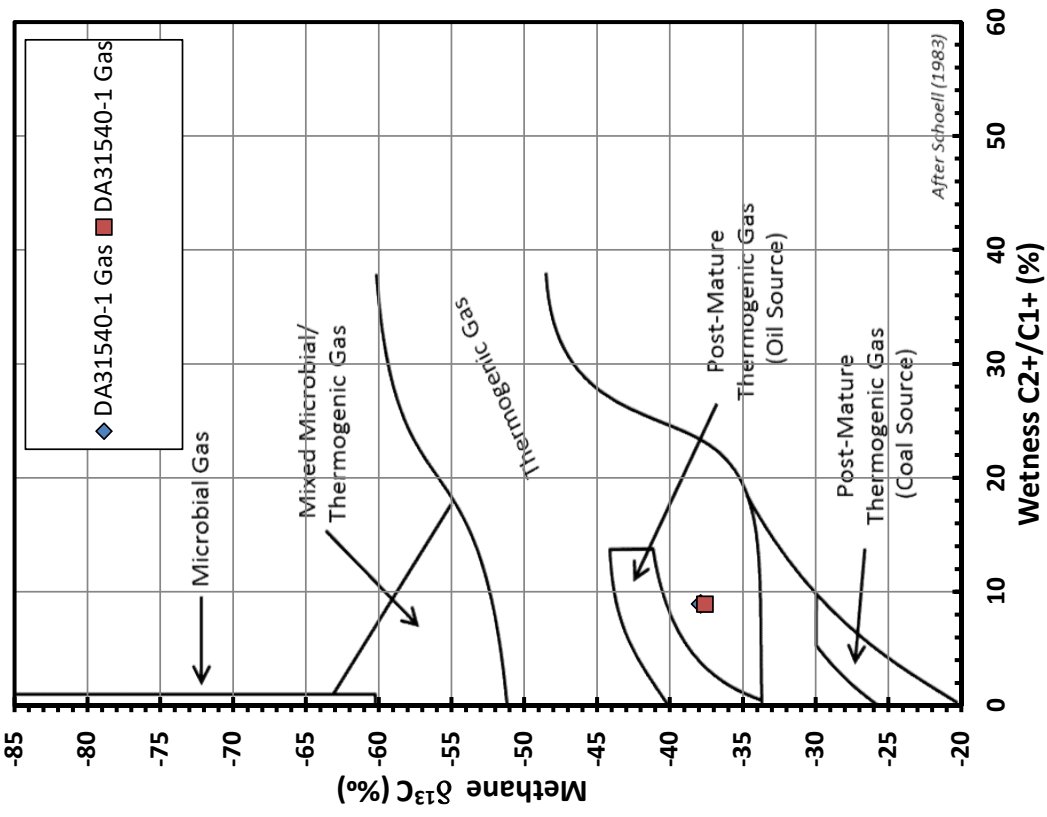
SPECIFIC GRAVITY*																											
Sample	Well	Lab	Total HC	Wet Basis	C <sub>2</sub> /C <sub>1</sub>	C <sub>3</sub> /C <sub>1</sub>	Balanced Ratio	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>	W <sub>4</sub>	W <sub>5</sub>	W <sub>6</sub>	W <sub>7</sub>	W <sub>8</sub>	W <sub>9</sub>	W <sub>10</sub>	W <sub>11</sub>	W <sub>12</sub>	W <sub>13</sub>	W <sub>14</sub>	W <sub>15</sub>	W <sub>16</sub>	W <sub>17</sub>	W <sub>18</sub>	W <sub>19</sub>	W <sub>20</sub>
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
21010061	DQ 024624	3272.02	501	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6

Notes: \* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on multi-point laboratory calibration.  
\* Specific Gravity is based on

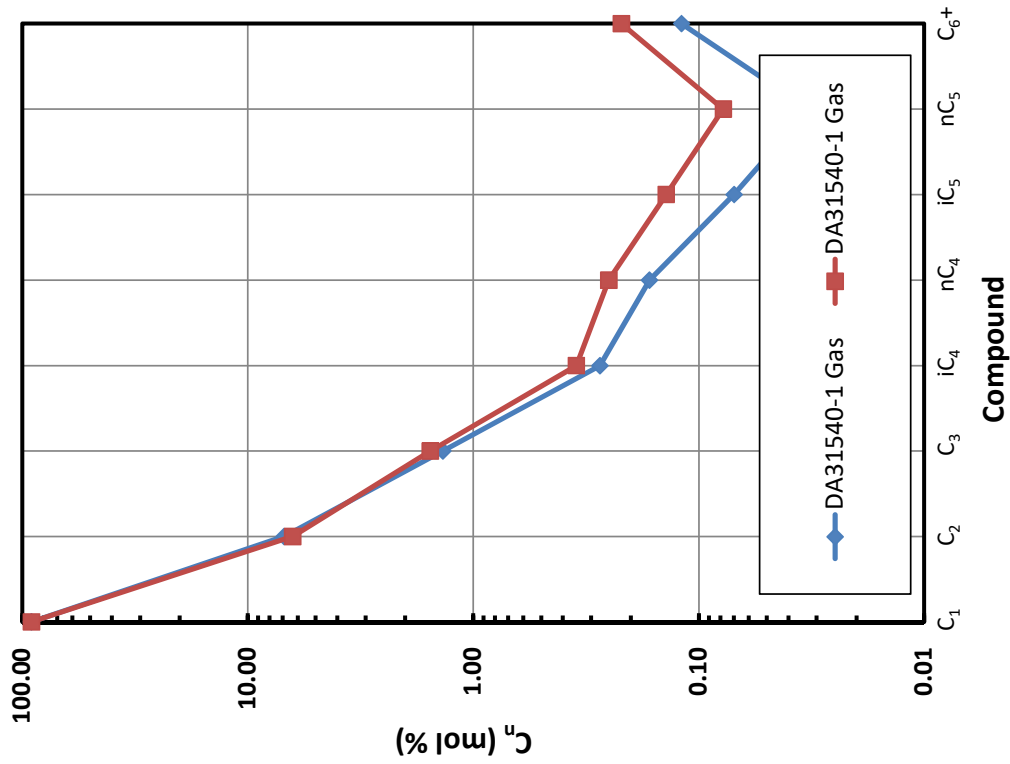
Stable isotope results based on multi-point laboratory calibration  
Precision:  $\delta^{13}C$   $\pm 0.3$  ‰  
\* All listed gas values are based on a 100% methane gas standard  
calculations based on 0.92148 C<sub>1</sub> physical constants.



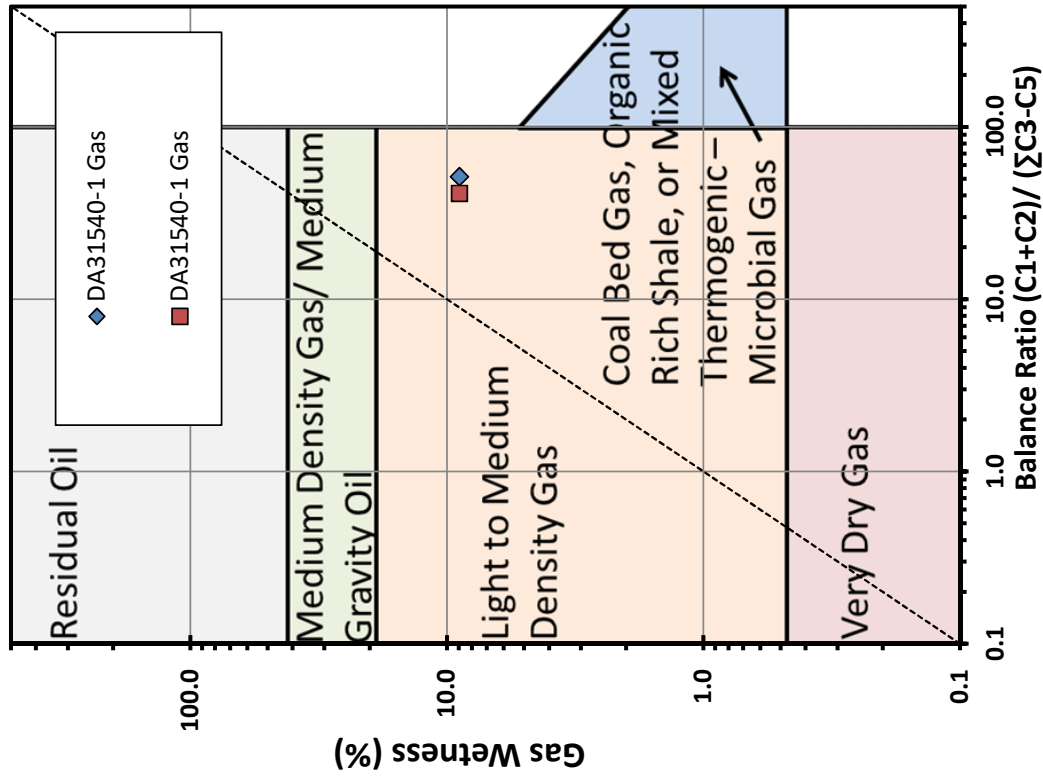
Methane  $\delta^{13}\text{C}$  vs Wetness Genetic Classification Plot



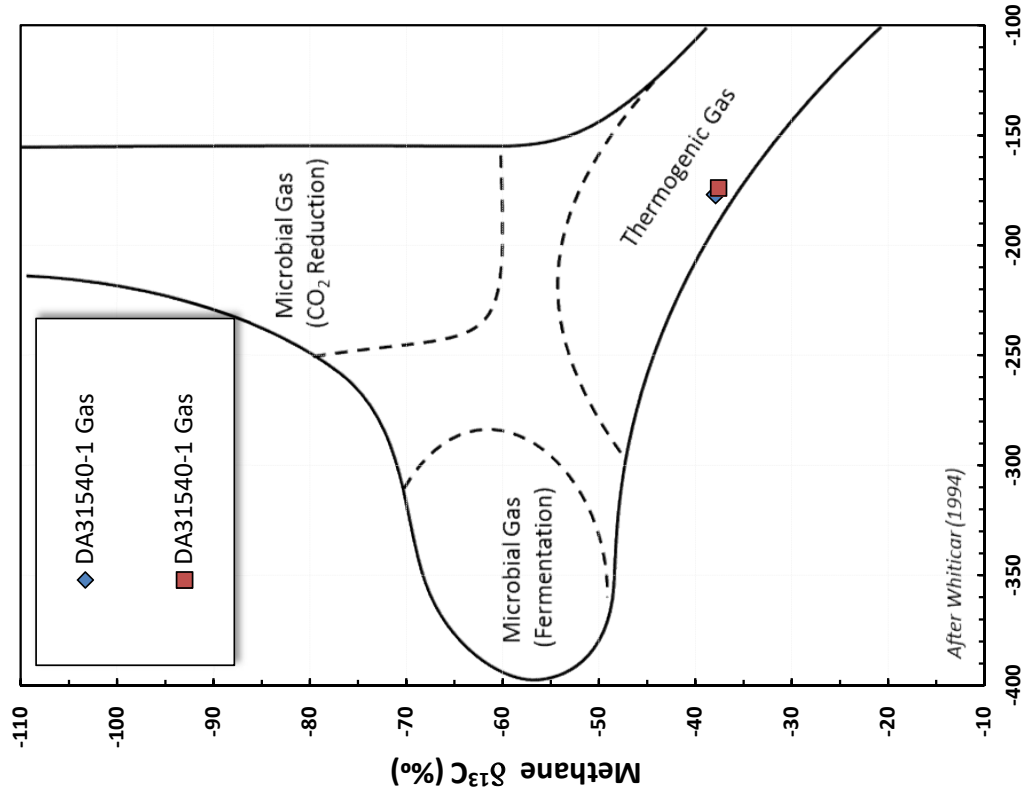
Hydrocarbon Composition Plot



## Haworth Ratio Plot - Characterization of Hydrocarbon Type

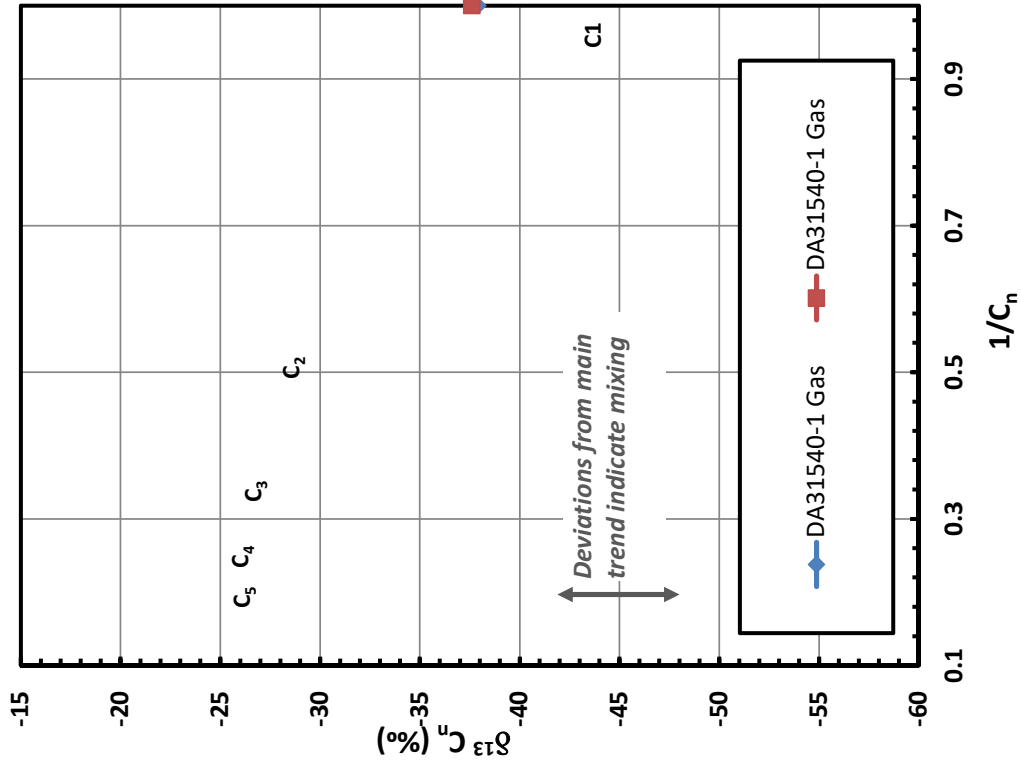


## Methane $\delta^{13}\text{C}$ vs $\delta\text{D}$ Genetic Classification Plot

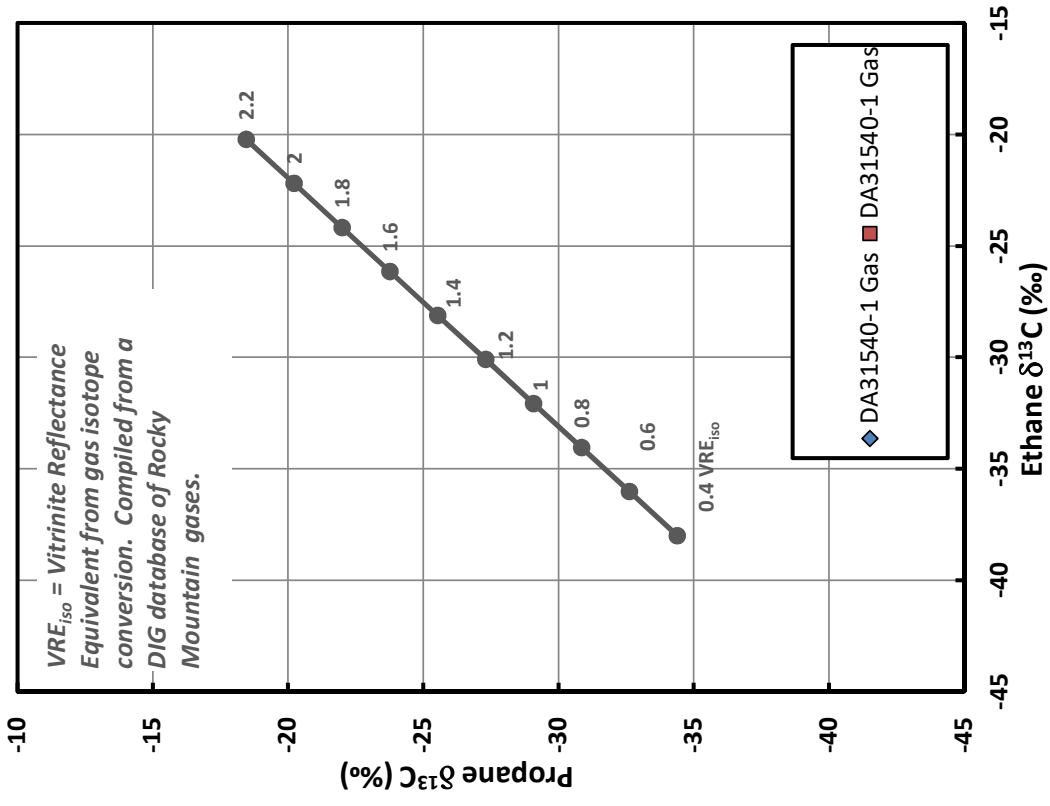


Methane  $\delta D$  (‰)

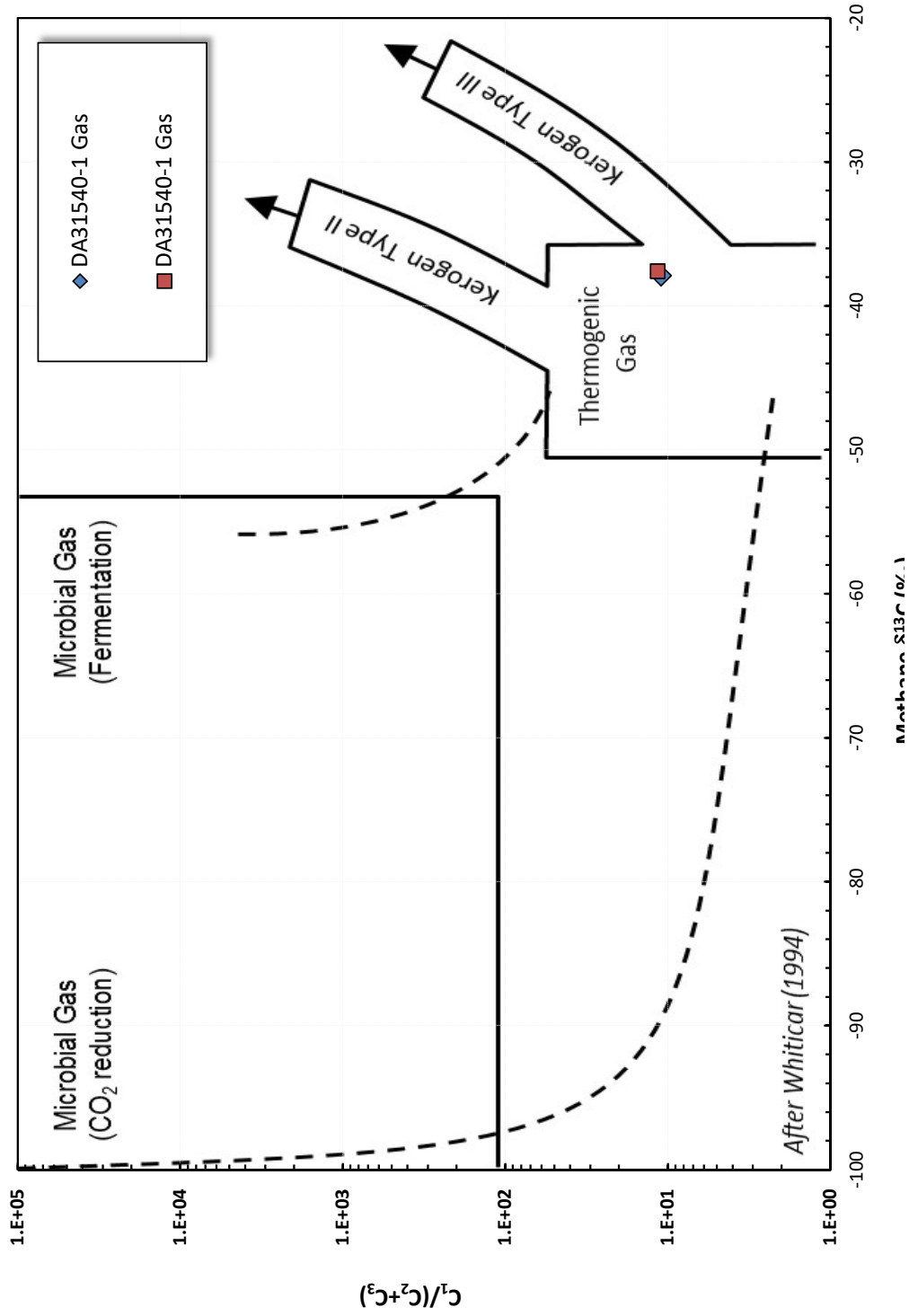
### Mixing Plot



### Ethane - Propane Maturity Plot



## Methane $\delta^{13}\text{C}$ vs $\text{C}_1/(\text{C}_2+\text{C}_3)$ Genetic Classification Plot







## CHAIN OF CUSTODY

SGS North America Inc. - Wheat Ridge  
4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303.425.6021 FAX: 303.425.6854

[www.sgs.com/ehsusa](http://www.sgs.com/ehsusa)

**Send Report and Invoice to:**

Elizabeth.Sutcliffe@sgs.com; Carissa.Cumine@sgs.com;  
Janel.Mulholland@sgs.com; Angela.Wu2@sgs.com;  
Jason.Savoie@sgs.com; Larisa.Dimarco@sgs.com

[illegible]



024425

Page 1 of 1

Bottle Order Control #	
SGS Job #	DA31540X
d Analysis ( see TEST CODE sheet)	
Matrix Codes	
DW - Drinking Water GW - Ground Water WW - Wastewater SW - Surface Water SO - Soil SL - Sludge SED - Sediment OL - Oil LIQ - Other Liquid AIR - Air SOL - Other Solid WP - Wipe FB - Field Blank EB - Equipment Blank RB - Rinse Blank TB - Trip Blank	
LAB USE ONLY	
Comments / Special Instructions	
Please Call Cariss - a.s. client write Cannistus back For instruction <a href="http://www.sgs.com/en/terms-and-conditions">http://www.sgs.com/en/terms-and-conditions</a>	
Every	
Date Time: 10:00 15/2009	Received By: Lutz Annaberg 2
Date Time:	Received By:
	4
and where applicable:	On ice Cooler Temp.
<input type="checkbox"/> Therm. St.	<input type="checkbox"/>

## Misc. Forms

### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody

### CHAIN OF CUSTODY RECORD

## CHAIN OF CUSTODY RECORD

### CHAIN OF CUSTODY RECORD

DA 31540

CO. NAME: Nicholson GeoSolutions LLC	CONTACT NAME: Dave Nicholson	TELE. NO.:	LAB PROJECT NO.
Sampler (PRINT NAME): Gate McEndree	Signature: <i>Gate McEndree</i>	FAX NO:	
PROJECT INFO.: NO.			

[illegible]

**COMMENTS:**

Please contact Melissa at EMPACT for cylinder pick up after completions of results, 303-637-0150.

Relinquished by: (Signature) <i>[Signature]</i>	Date: <i>12/3/82</i>	Received by: (Signature) <i>[Signature]</i>	Time: <i>10<sup>00</sup></i>	Date: <i>12/3/82</i>
Relinquished by: (Signature)	Date:	Received by: (Signature)	Time:	Date:
Laboratory: <i>6646</i>	Received for Laboratory: <i>6646</i>	Received for Laboratory by:	Time:	Date:
Method of Shipment:	Dispatched by: (Signature)	Dispatched by: (Signature)	Time:	Date:

## DA31540X: Chain of Custody

Page 1 of 1