



**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 #:** 21106442  
**Lab #:** DIG-026319 - DIG-026320  
**Client:** WSP  
**Well Name:** McGlothlin Farms 4X-314  
**API #:** 05-123-44007

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Client/Well Name: WSP / McGlothlin Farms 4X-314  
Job #: 21106442  
Lab #: DIG-026319 - DIG-026320

SAMPLE INFORMATION						COMPLETE GAS ANALYSIS																	HYDROCARBON GAS ANALYSIS (normalized to total HC content)										BTU CONTENT*
Job	Lab	Well	Sample	Sample	Sample	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>16</sub>	He	H <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> +	Total Gas			
Number	Number	Name	Type	Date	Time	Date	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	mol%	BTU/R <sup>6</sup>		
21106442	DIG-026319	McGlothlin Farms 4X-314 Bradenhead gas	Bradenhead gas	10/05/21	14:50	10/05/2021	23557	5363		414292	174307	189904	37603	94320	19757	22395	13963			3016		42.9	18.03	19.65	3.89	9.76	2.04	2.32	1.44	1878			
21106442	DIG-026320	McGlothlin Farms 4X-314 Production gas	Production gas	10/05/21	14:40	10/05/2021	22132	4398	24979	682963	137148	66857	9807	24434	6571	7705	7492					72.4	14.54	7.10	1.04	2.68	0.70	0.82	0.79	1311			

SAMPLE INFORMATION						HYDROCARBON RATIOS					STABLE ISOTOPE ANALYSIS												
Job	Lab	Well	Sample	Sample	Sample	Total HC	Wetness	C <sub>2</sub> /C <sub>1</sub> +C <sub>3</sub>	Balance Ratio	Mass Spec	δ <sup>13</sup> C <sub>1</sub>	δ <sup>13</sup> C <sub>2</sub>	δ <sup>13</sup> C <sub>3</sub>	δ <sup>13</sup> IC <sub>4</sub>	δ <sup>13</sup> nC <sub>4</sub>	δ <sup>13</sup> IC <sub>5</sub>	δ <sup>13</sup> nC <sub>5</sub>	δ <sup>13</sup> CO <sub>2</sub>	δD				
Number	Number	Name	Type	Date	Time	ppm	% C <sub>2</sub> to C <sub>3</sub>	mol/mol	C <sub>2</sub> +C <sub>3</sub> /C <sub>1</sub> +C <sub>3</sub>	Date	% VPDB	% VPDB	% VPDB	% VPDB	% VPDB	% VPDB	% VPDB	% VPDB	% VSMOW		Comments		
21106442	DIG-026319	McGlothlin Farms 4X-314 Bradenhead gas	Bradenhead gas	10/05/21	14:50	946041	97.1	1.1	3.6	10/12/2021	-47.1	-31.7	-28.3	-30.0	-27.2	-26.6	-27.1		-256				
21106442	DIG-026320	McGlothlin Farms 4X-314 Production gas	Production gas	10/05/21	14:40	943067	27.6	3.3	7.1	10/12/2021	-46.9	-31.0	-28.0	-30.3	-27.2	-27.2	-27.1	-4.9	-252				

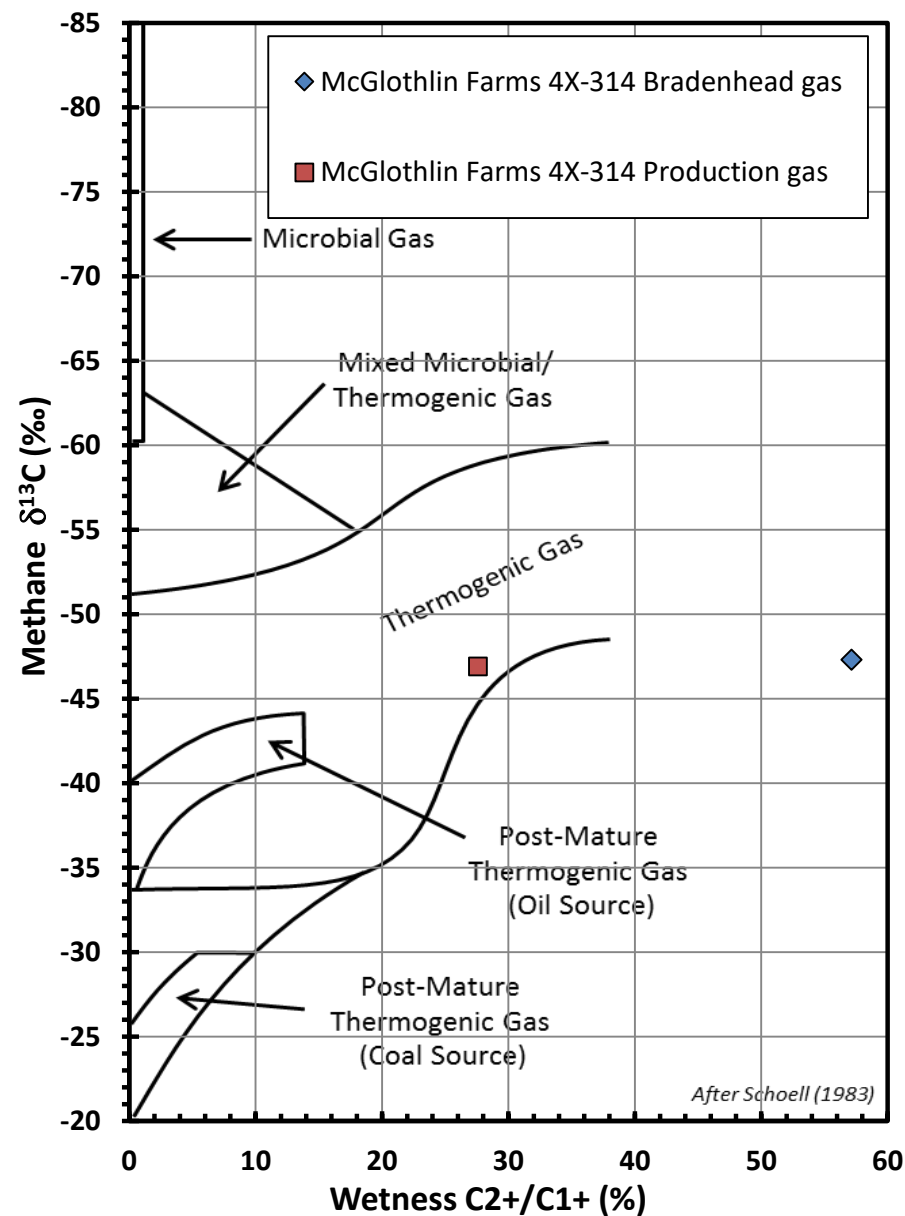
Stable isotope results based on multi-point laboratory calibration  
low signal; interpret with caution  
Precision δ<sup>13</sup>C < 0.3 ‰  
Precision δD < 5 ‰

SPECIFIC GRAVITY*	
Total Gas	HCs only
Spec Grav	Spec Grav
1.141	1.149
0.818	0.794

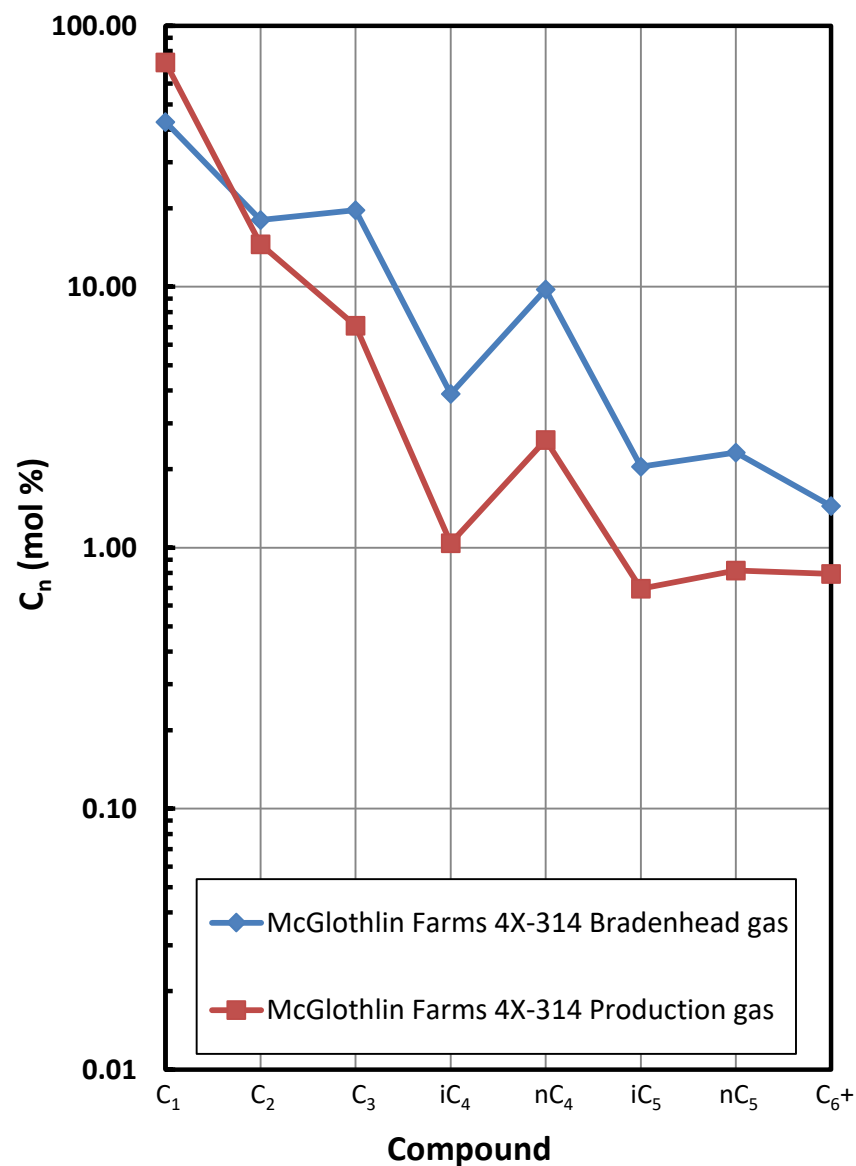
\* As ideal gas, with gas concentrations normalized to 100%;  
calculations based on GPA 2145-09 physical constants.

## INTERPRETIVE PLOTS

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

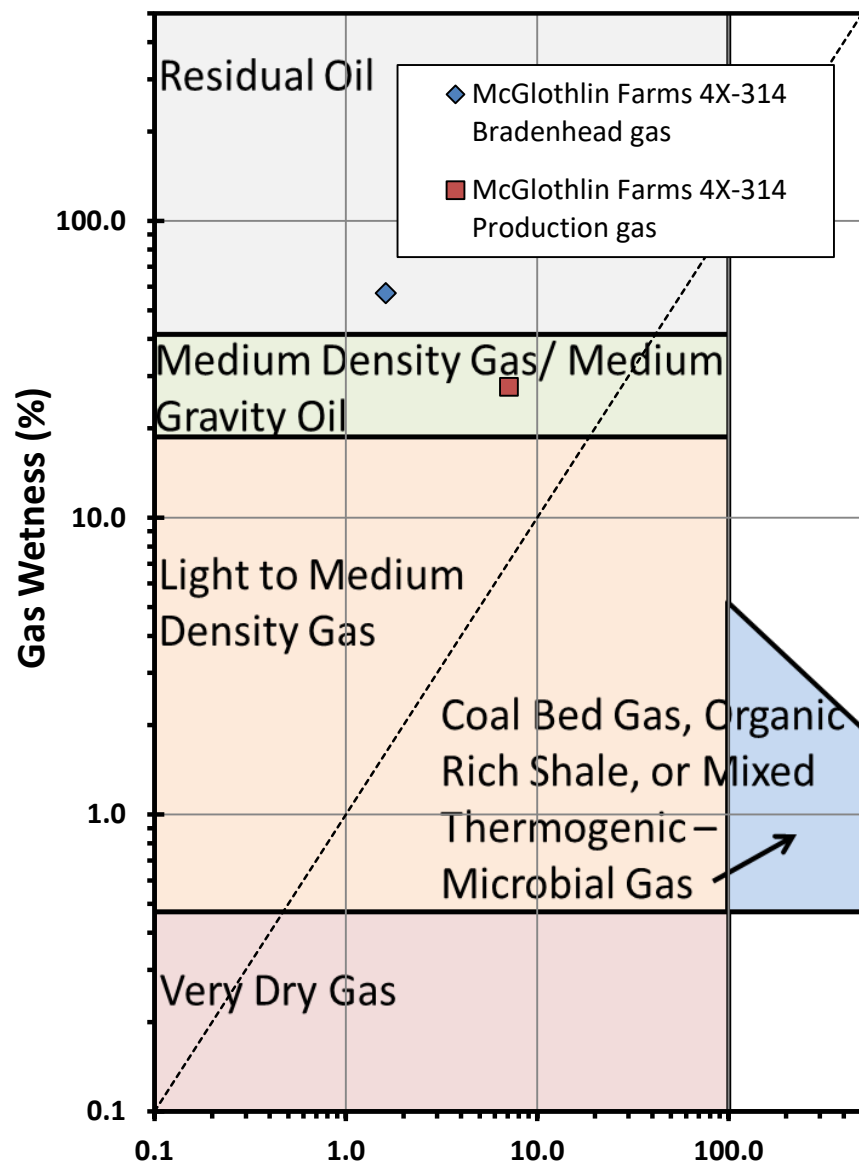


### Hydrocarbon Composition Plot

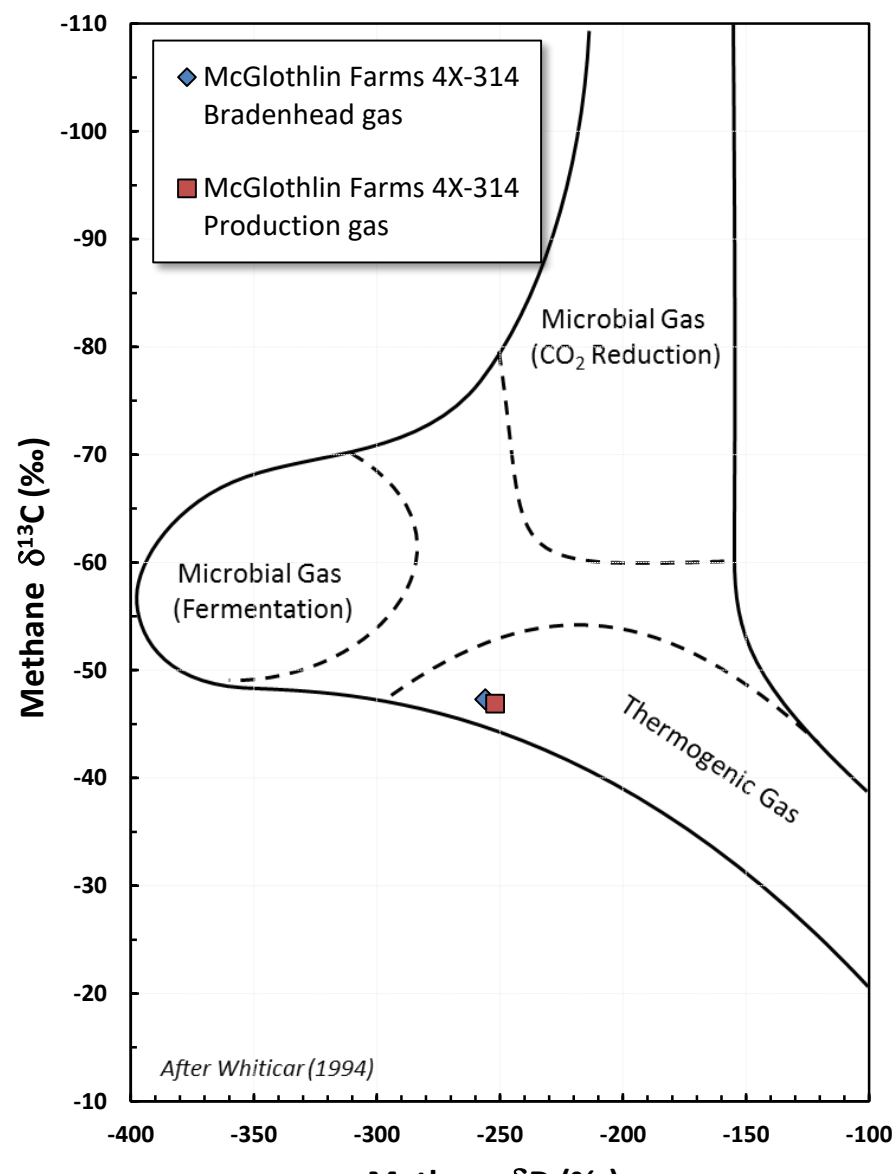


## INTERPRETIVE PLOTS

Haworth Ratio Plot - Characterization of Hydrocarbon Type



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

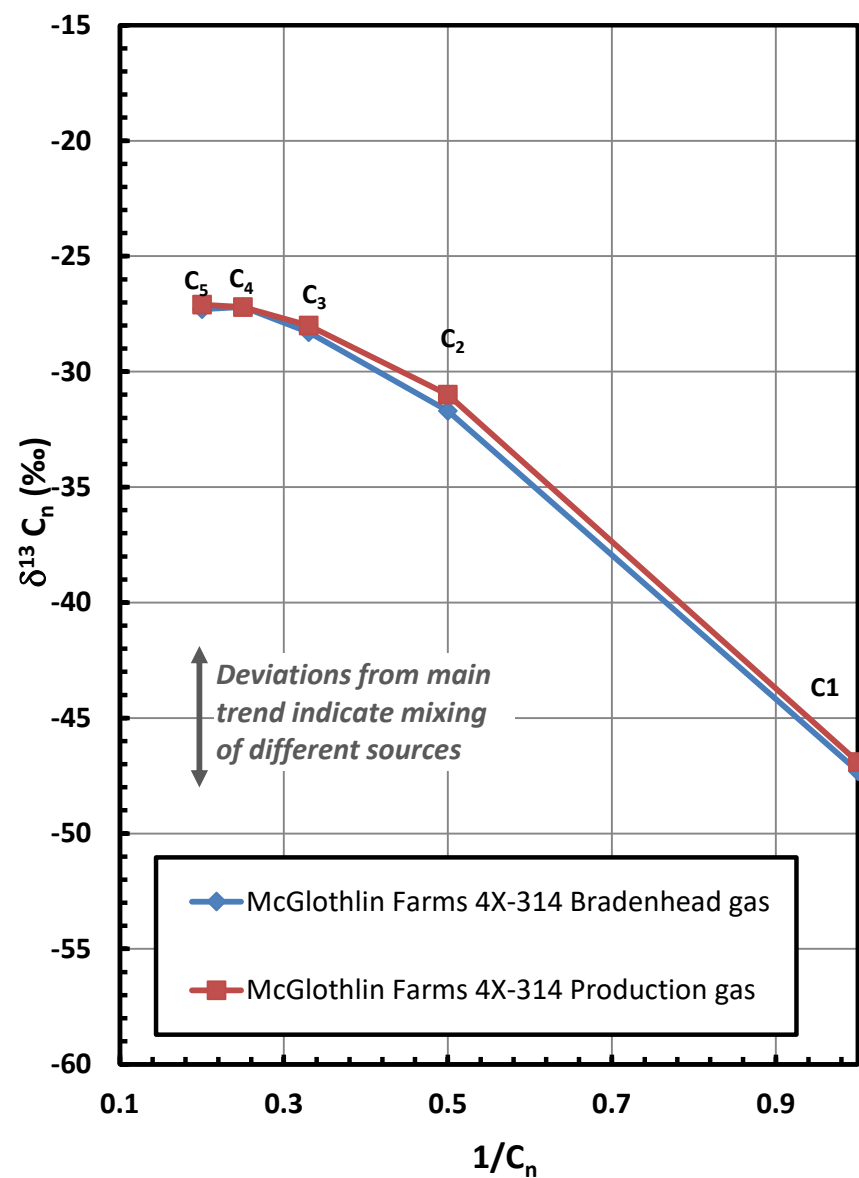


**Balance Ratio (C1+C2)/ (ΣC3-C5)**

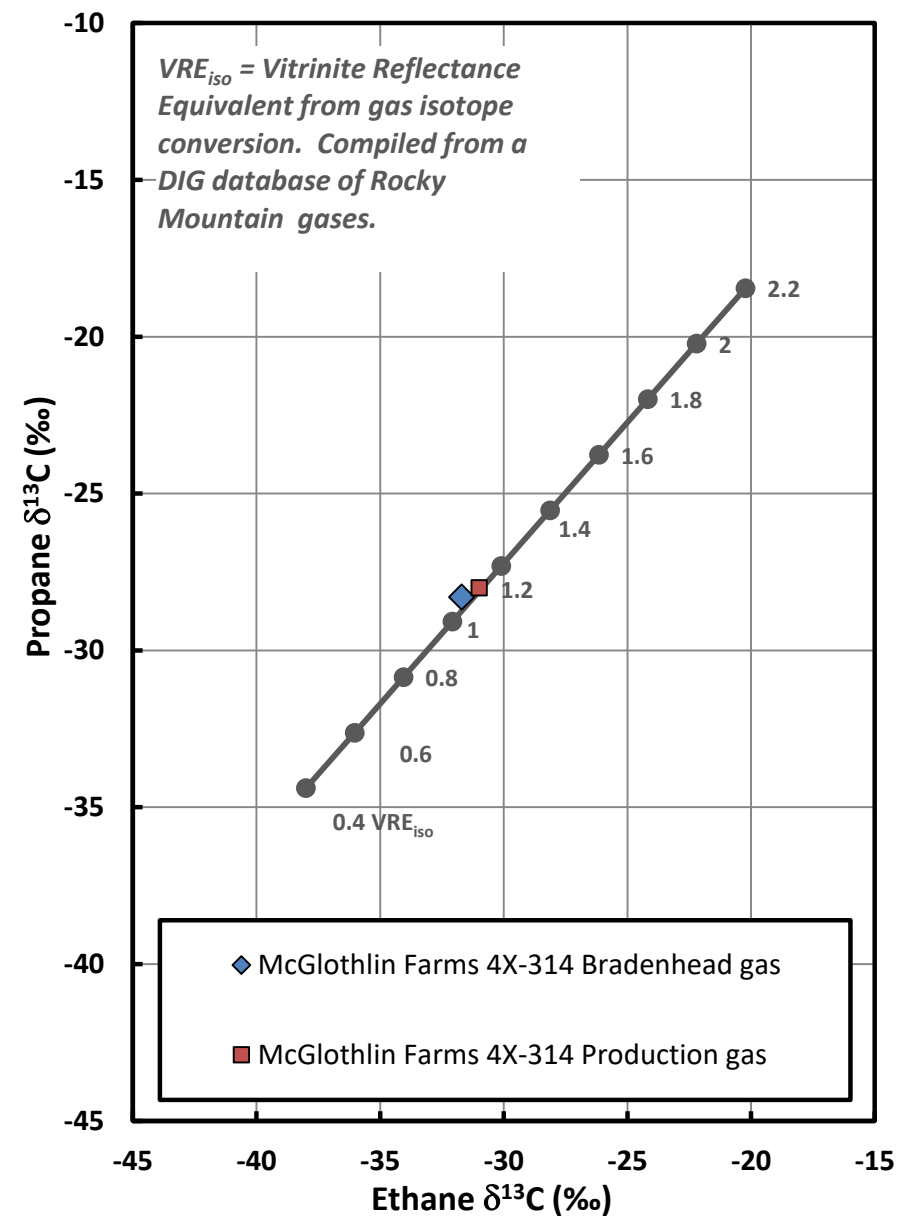
**Methane δD (‰)**

## INTERPRETIVE PLOTS

### Mixing Plot

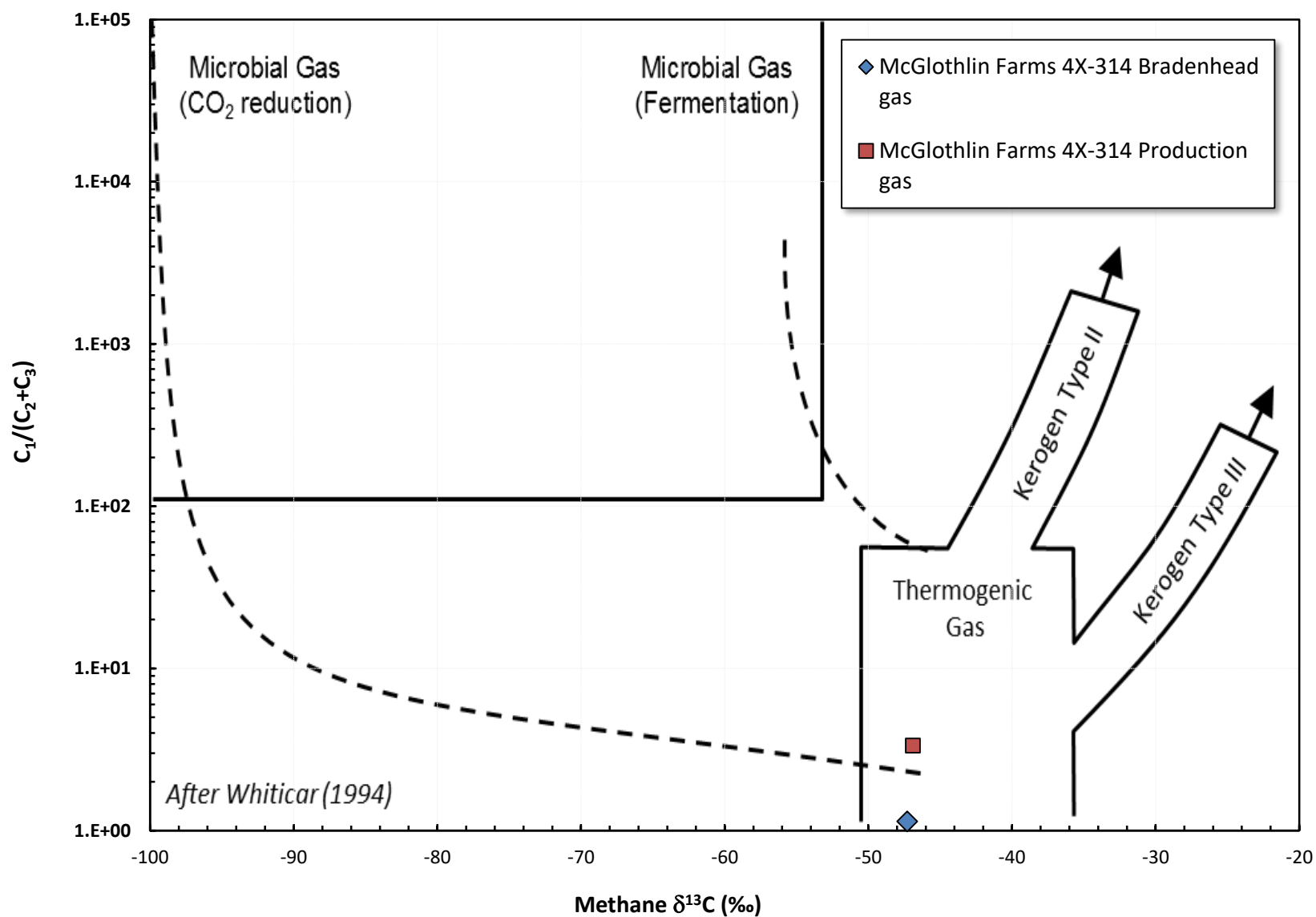


### Ethane - Propane Maturity Plot



## INTERPRETIVE PLOTS

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







[illegible]

Organization	Reporting Organization	Reporting Organization Name	Order Number	Entity Requesting Analysis	Purpose	Project
Sample	10206	Dolan Integration Group	WSP			
COCGC Facility No.	Sample Date and Time	API #	LAB Sample ID	Sample Type	Matrix	Comments
Batch	LabID	10/9/21 14:40	123-44007	DHG-D026320	GAS	Project Number Chain of Custody ID
10206	21106442	Lab Batch Identifier	Leach Date	Extract Date and Time	Extract Method	Start Date and Time
Result	CAS Number	Analysis Name	Analysis Method Modifier	Unit	Result Value	Qualifier Test Type Final Result Data Flag Dilution Fraction Type MDC Requested MDC Detection Limit Instrument Detection Limit Method Detection Limit Comments AnalyticalBatchID
O2+AR	OXYGEN + ARGON	SOP	MOL %	0.442		0.005 0.005 0.005 21106442
124-38-9	CARBON DIOXIDE	SOP	MOL %	2.511		0.005 0.005 0.005 21106442
7727-37-9	NITROGEN (N2)	SOP	MOL %	2.225		0.005 0.005 0.005 21106442
7440-59-7	Helium	SOP	MOL %	0.005		ND ND 0.005 0.005 0.005 21106442
1333-74-0	HYDROGEN	SOP	MOL %	0.005		ND ND 0.005 0.005 0.005 21106442
74-82-8	METHANE	SOP	MOL %	68.668		ND ND 0.005 0.005 0.005 21106442
74-84-0	ETHANE	SOP	MOL %	13.790		ND ND 0.005 0.005 0.005 21106442
74-85-1	ETHENE	SOP	MOL %	0.005		ND ND 0.005 0.005 0.005 21106442
74-98-6	PROPANE	SOP	MOL %	6.732		ND ND 0.005 0.005 0.005 21106442
75-28-5	ISOBUTANE	SOP	MOL %	0.986		ND ND 0.005 0.005 0.005 21106442
106-97-8	N-BUTANE	SOP	MOL %	2.457		ND ND 0.005 0.005 0.005 21106442
ICS	ISENTANE	SOP	MOL %	0.661		ND ND 0.005 0.005 0.005 21106442
109-66-0	N-PENTANE	SOP	MOL %	0.775		ND ND 0.005 0.005 0.005 21106442
92112-69-1+	C6+ (hexanes +)	SOP	MOL %	0.753		ND ND 0.005 0.005 0.005 21106442
deltal3C_C1	DELTA 13C C1	SOP	per mil	-46.9		Low Signal 21106442
deltaD_C1	DELTA D C1	SOP	per mil	-252		21106442
deltal3C_C2	DELTA 13C C2	SOP	per mil	-31.0		21106442
deltal3C_C3	DELTA 13C C3	SOP	per mil	-26.0		21106442
deltal3C_C4	DELTA 13C C4	SOP	per mil	-30.3		21106442
deltal3C_nC4	DELTA 13C nC4	SOP	per mil	-27.2		21106442
deltal3C_nC5	Delta 13C IC5	SOP	per mil	-27.2		Low Signal 21106442
deltal3C_nC5	Delta 13C nC5	SOP	per mil	-27.1		21106442
deltal3C_CO2	DELTA 13C CO2	SOP	per mil	4.0		Low Signal 21106442
BTU	BRITISH THERMAL UNITS	SOP	BTU/cuft	1313		21106442
SpGrav	SPECIFIC GRAVITY	SOP	No Unit	0.818		21106442

Send Data to:	Send Invoice to (if different):
Name: Jeff Braden	Name: Jenifer Hakkarinen
Company: WSP USA	Company: PDC Energy
Address: 4600 W. 60th Ave	Address: 1775 Sherman St #3000
City, State: Arvada, Colorado	City, State: Denver, Colorado 80203
Phone: 303-433-9788	Phone: 303-860-5815
Email: jenifer.hakkarinen@pdce.com; jeff.braden@wsp.com;kayla.n.white@wsp.com	Email: jenifer.hakkarinen@pdce.com

Turnaround Time**:	<input checked="" type="radio"/> Standard (≤ 10 Business days)	<input type="radio"/> Rush (≤ 5 Business days)
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Container Number	Sample Identification	Date Sampled	Time	Sample Type*	Gas Composition	d13C of Methane (C1)
FOEP6	McGlothlin Farms 4X-314 prod	10/5/21	1440	Production Gas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FOEP9	McGlothlin Farms 4X-314 bh	10/5/21	1450	Bradenhead gas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
				Production gas	<input type="checkbox"/>	<input type="checkbox"/>
				Bradenhead gas	<input type="checkbox"/>	<input type="checkbox"/>
				Production gas	<input type="checkbox"/>	<input type="checkbox"/>
				Bradenhead gas	<input type="checkbox"/>	<input type="checkbox"/>
				Production gas	<input type="checkbox"/>	<input type="checkbox"/>
				Bradenhead gas	<input type="checkbox"/>	<input type="checkbox"/>
				Production gas	<input type="checkbox"/>	<input type="checkbox"/>
				Bradenhead gas	<input type="checkbox"/>	<input type="checkbox"/>

Chain of Custody Record	Comments:
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Relinquished by Signature	Company	Date	Time	Received by Signature
Jeffrey D. Braden <small>Digitally signed by Jeffrey D. Braden Date: 2021.10.05 16:18:04 -0600</small>	WSP USA	10/5/21	1620	Luke Arnsberger <small>Digitally signed Date: 2021.10.0</small>

\*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 by 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 the exact total of gas present in the sample (headspace and dissolved in the water). Questions? Give us a call at 303-531-2030.

\*\* Rush and Expedited Rush turnaround time analysis will incur additional costs at 2x and 3x the standard turnaround time pricing.

**Expedited Rush ( $\leq 3$  Business days)**

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ated at the lab). RSK-175 is a specific analysis technique combined with relative concentrations and ratios (e.g., gas wetness). RSK-175 gives us an