



dig
Dolan Integration Group

Geochemistry for Energy

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Westminster, CO 80021
p: 303.531.2030

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

Job #: 21035515
Lab #: DIG-025043 - DIG-025044
Client: WSP
Well Name: Antelope Federal 34-20-17XRLNC(459885)

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Client/Well Name: WSP / Antelope Federal 34-20-17XRLNC(459885)
 Job #: 21035515
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SAMPLE INFORMATION							COMPLETE GAS ANALYSIS														HYDROCARBON GAS ANALYSIS (normalized to total HC content)										BTU CONTENT*	
Job Number	Lab Number	Well Name	Sample Type	Sample Date	Sample Time	GC Date	N ₂ ppm	O ₂ + Ar ppm	CO ₂ 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 ₇ H ₁₆ ppm	He ppm	H ₂ ppm	C ₁ mol%	C ₂ mol%	C ₃ mol%	iC ₄ mol%	nC ₄ mol%	iC ₅ mol%	nC ₅ mol%	C ₆ + mol%	Total Gas BTU/ft ³			
21035515	DIG-025043	Antelope Federal 34-20-17XRLNC(459885) Bradenhead gas	Bradenhead gas	03/19/21	13:38	4/7/2021	308426	15285		15797	1255	421		85			159	315		703051	89.2	7.08	2.38		0.49				0.90	50		
21035515	DIG-025044	Antelope Federal 34-20-17XRLNC(459885) Production gas	Production gas	03/19/21	14:20	4/7/2021	42093	973	20465	194791	320955	98987	15667	53626	14630	15298	12787				63.8	33.97	10.59	3.68	5.96	1.57	2.07	1.37	1485			

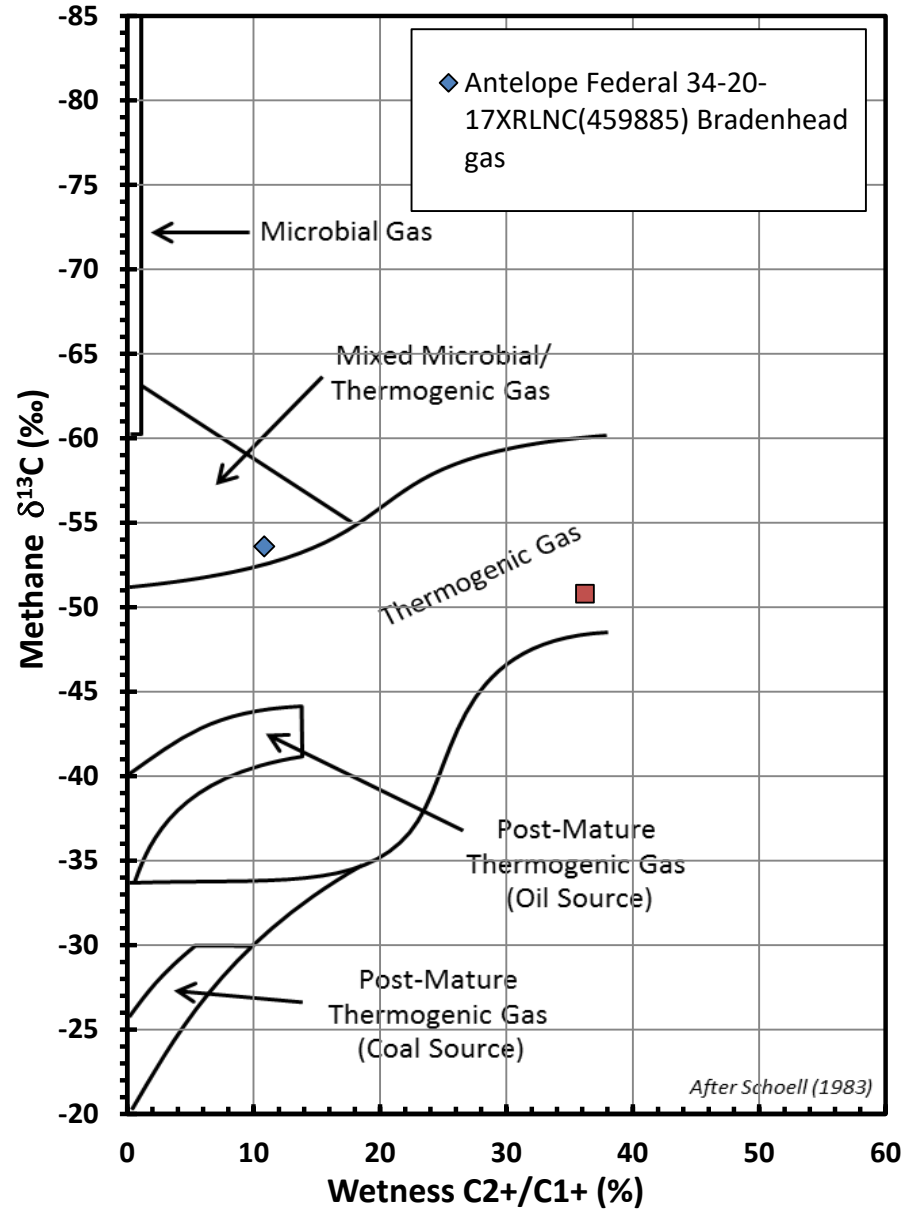
SAMPLE INFORMATION							HYDROCARBON RATIOS				STABLE ISOTOPE ANALYSIS									
Job Number	Lab Number	Well Name	Sample Type	Sample Date	Sample Time	Total HC ppm	Wetmass % C ₁ to C ₂	C ₂ /C ₁ +C ₂ mol/mol	Balance Ratio C ₃ /C ₂ /C ₃ -C ₄	Mass Spec Date	δ ¹³ C ₁ ‰ VPDB	δ ¹³ C ₂ ‰ VPDB	δ ¹³ C ₃ ‰ VPDB	δ ¹³ C ₄ ‰ VPDB	δ ¹³ C ₅ ‰ VPDB	δ ¹³ C ₆ ‰ VPDB	δ ¹³ C _{CO₂} ‰ VPDB	δD ‰ VSMOW	Comments	
21035515	DIG-025043	Antelope Federal 34-20-17XRLNC(459885) Bradenhead gas	Bradenhead gas	03/19/21	13:38	17718	10.8	9.4	33.6	4/8/2021	-53.6	-39.1	-31.5						-289	
21035515	DIG-025044	Antelope Federal 34-20-17XRLNC(459885) Production gas	Production gas	03/19/21	14:20	932541	36.2	2.7	3.5	4/8/2021	-50.8	-35.9	-31.7	-32.0	-29.6	-27.6	-29.0	0.4	-285	

Stable isotope results based on multi-point laboratory calibration
 low signal; interpret with caution
 Precision δ¹³C < 0.5 ‰
 Precision δD < 5 ‰

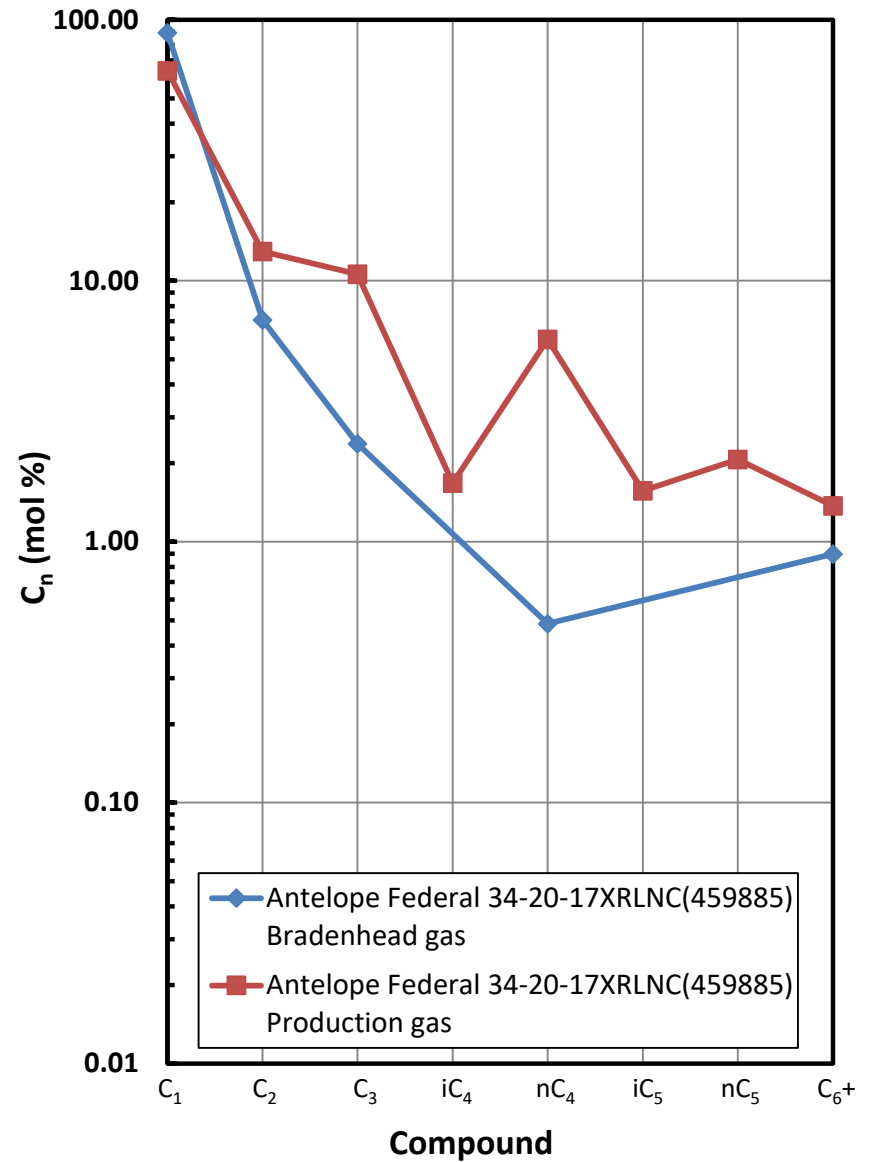
SPECIFIC GRAVITY*	
Total Gas Spec Grav	HCs only Spec Grav
0.956	0.640
0.949	0.934

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

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

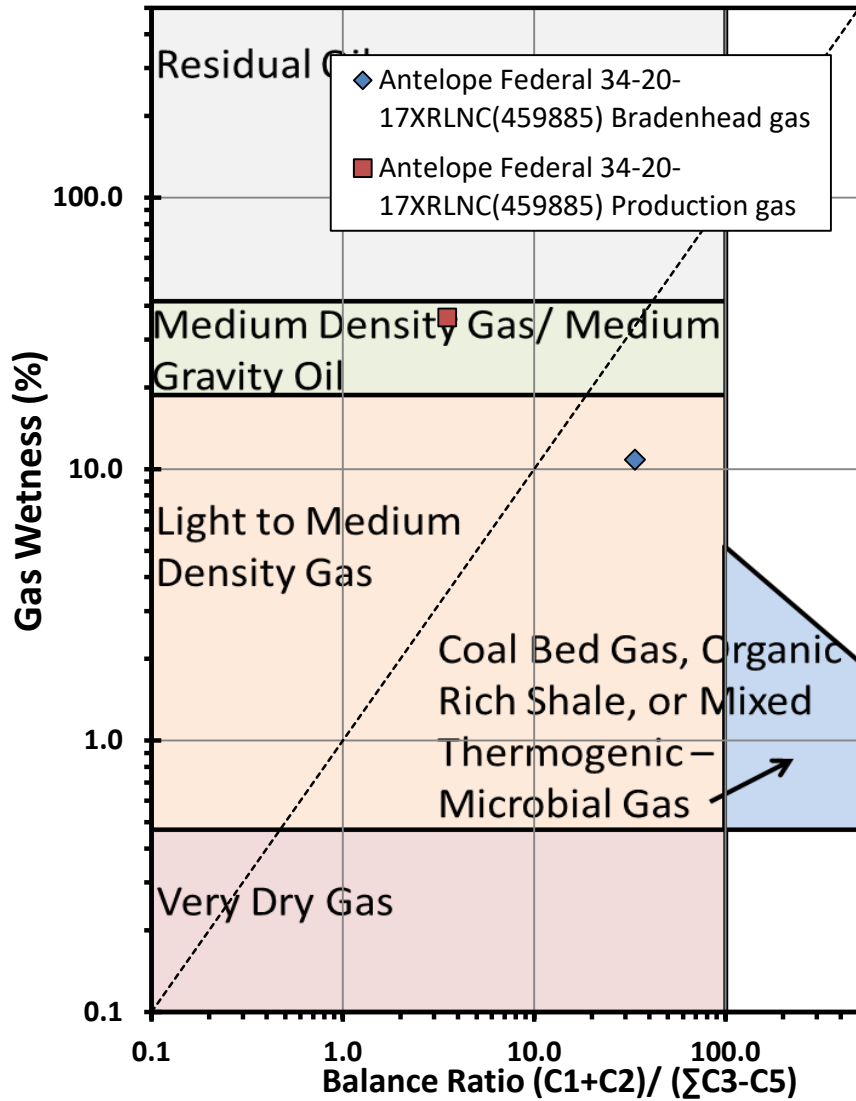


Hydrocarbon Composition Plot

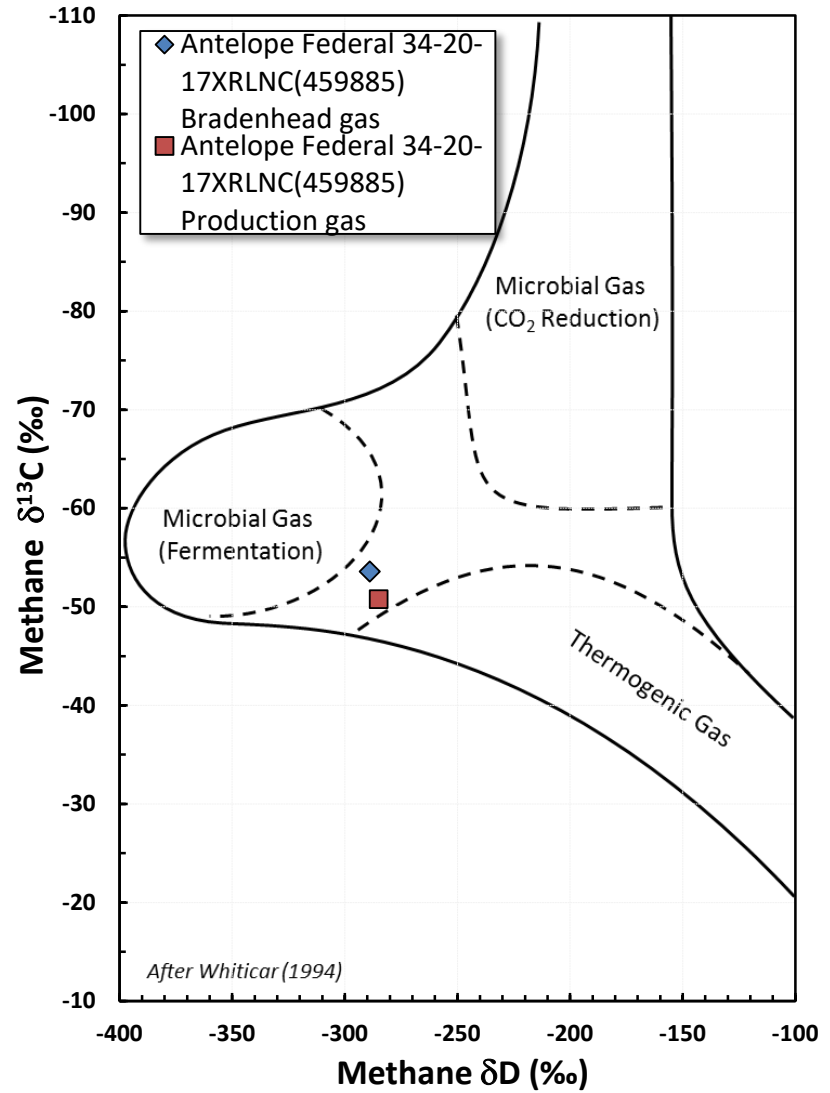


INTERPRETIVE PLOTS

Haworth Ratio Plot - Characterization of Hydrocarbon Type

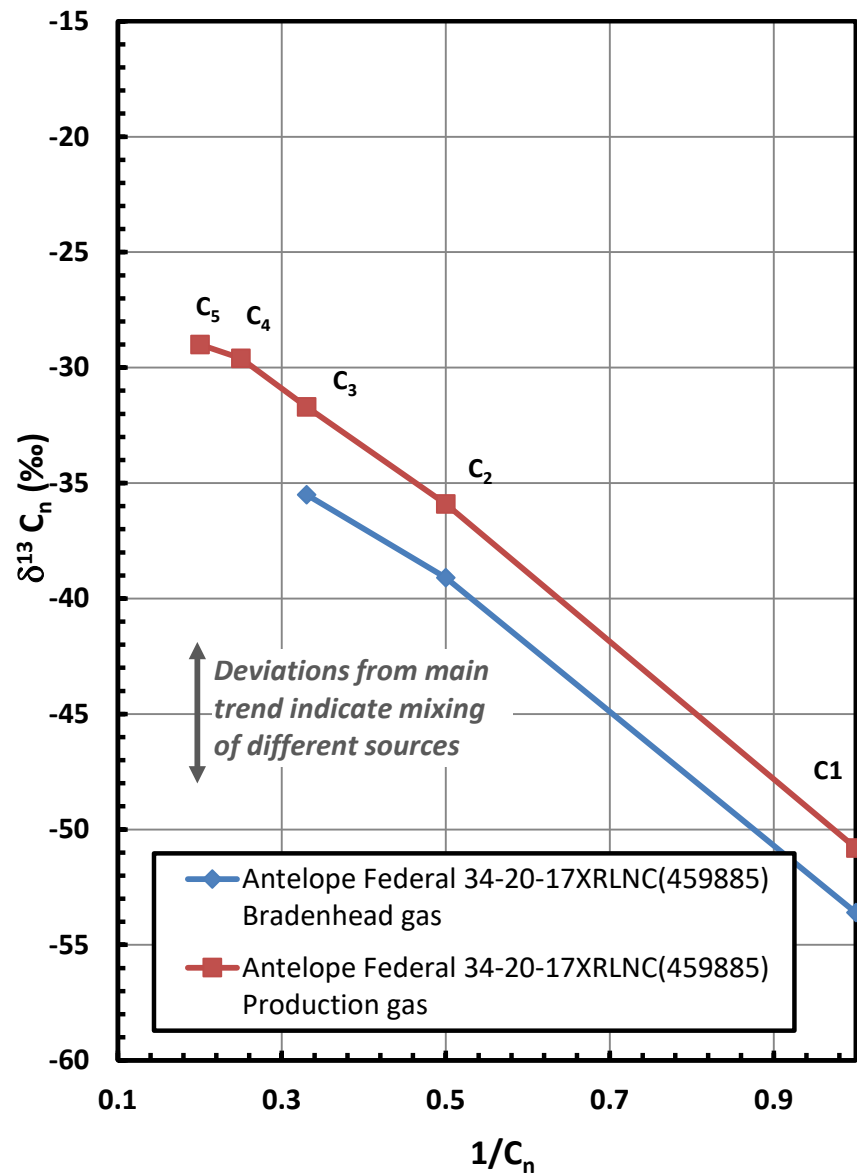


Methane $\delta^{13}C$ vs δD Genetic Classification Plot

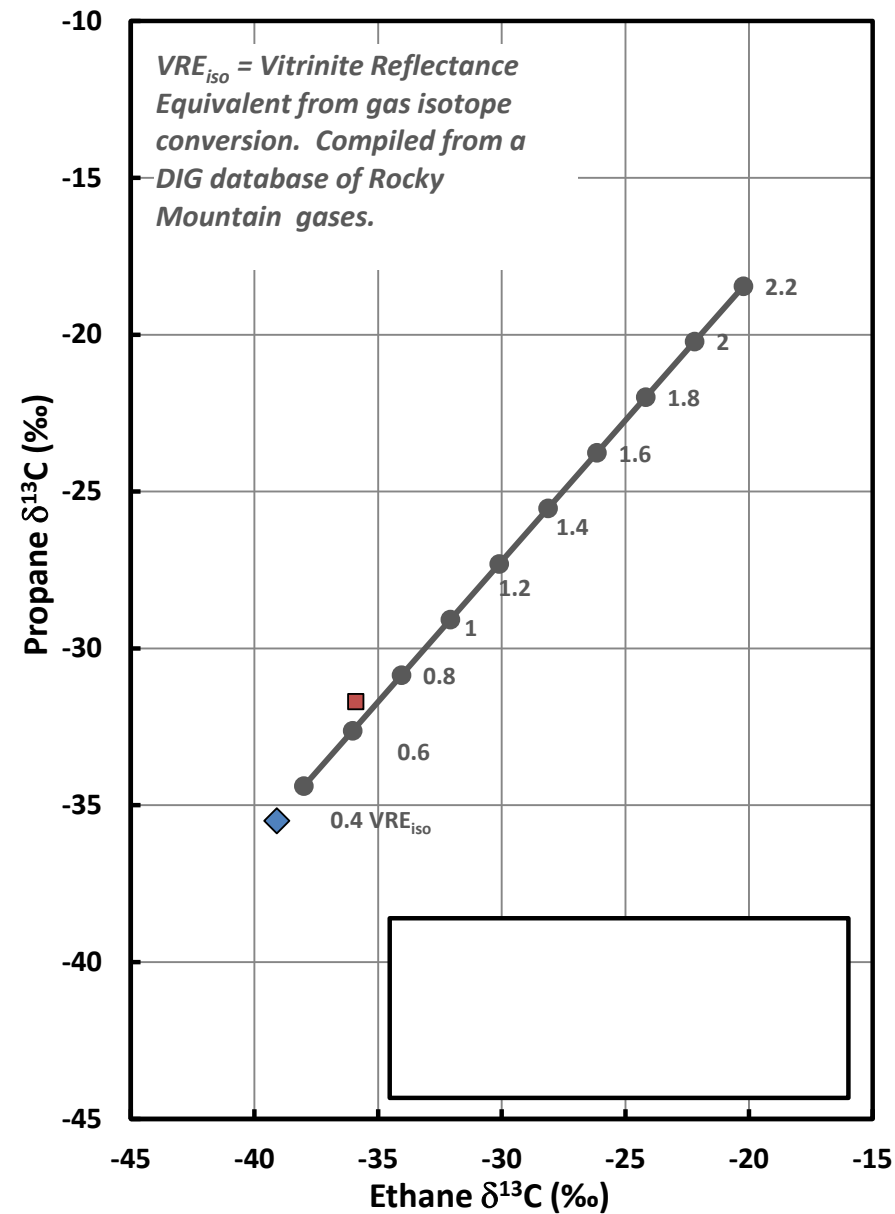


INTERPRETIVE PLOTS

Mixing Plot

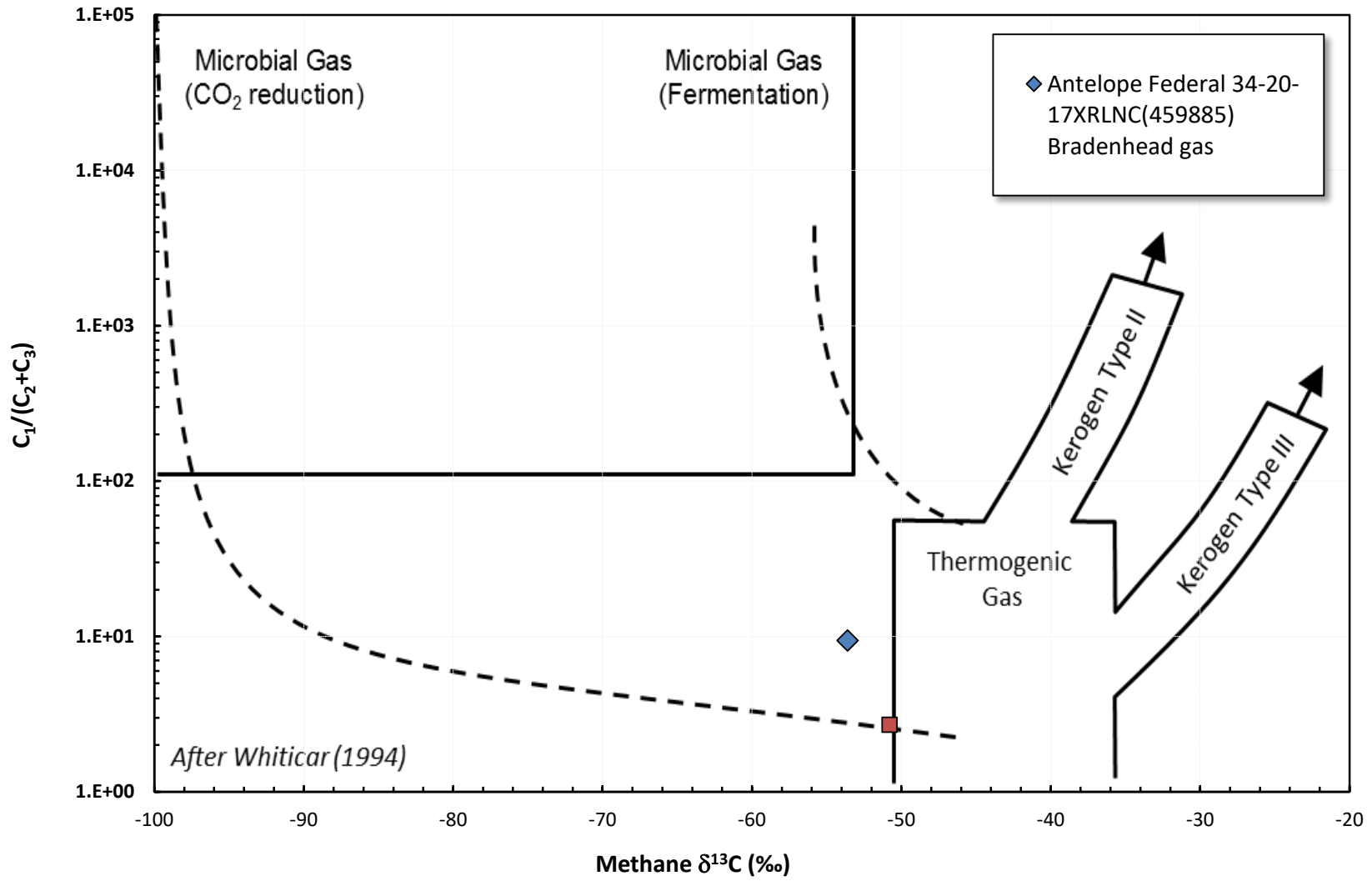


Ethane - Propane Maturity Plot



INTERPRETIVE PLOTS

Methane $\delta^{13}C$ vs $C_1/(C_2+C_3)$ Genetic Classification Plot



Organization	Reporting Organization	Reporting Organization Name	Order Number	Entry Requesting Analysis	Purpose	Project																
	10206	Dolan Integration Group		WSP																		
Sample	COGCC Facility No.	Sample Date and Time	API #	LAB Sample ID	Sample Type	Matrix	Comments	Project Number	Chain of Custody ID	Date Received by Lab												
		3/19/21 13:38		DIG-025043	Gas				Antelope Federa	3/25/2021												
Batch	LabID	Lab Batch Identifier	Leach Date	Extract Date and Time	Extract Method	Start Date and Time	Conc Method	Init Vol	Final Vol	Init Vol Units	Final Vol Units	Analysis Date and Time	Report Basis	Comments	File Name	Column #						
	10206	21035515																				
Result	CAS Number	Analysis Name	Analysis Method	Analytical Method Modifier	Unit	Result Value	Qualifier	Test Type	Result Text	Data Flag	Dilution	Fraction Type	MDC	Requested MDC	Detection Limit	Instrument Detection Limit	Method Detection Limit	Comments	AnalyticalBatchID			
	O2+AR	OXYGEN + ARGON	SOP		MOL %	1.46									0.005	0.005	0.005		21035515			
	124-38-9	CARBON DIOXIDE	SOP		MOL %	0.01	ND								0.005	0.005	0.005		21035515			
	7727-37-9	NITROGEN (N2)	SOP		MOL %	25.52									0.005	0.005	0.005		21035515			
	7440-59-7	Helium	SOP		MOL %	0.01	ND								0.005	0.005	0.005		21035515			
	1333-74-0	HYDROGEN	SOP		MOL %	67.29									0.005	0.005	0.005		21035515			
	74-82-8	METHANE	SOP		MOL %	1.51									0.005	0.005	0.005		21035515			
	74-84-0	ETHANE	SOP		MOL %	0.12									0.005	0.005	0.005		21035515			
	74-85-1	ETHENE	SOP		MOL %	0.03									0.005	0.005	0.005		21035515			
	74-98-6	PROPANE	SOP		MOL %	0.04									0.005	0.005	0.005		21035515			
	75-28-5	ISOBUTANE	SOP		MOL %	0.01	ND								0.005	0.005	0.005		21035515			
	106-97-8	N-BUTANE	SOP		MOL %	0.01									0.005	0.005	0.005		21035515			
	ICS	ISOPENTANE	SOP		MOL %	0.01	ND								0.005	0.005	0.005		21035515			
	109-66-0	N-PENTANE	SOP		MOL %	0.01	ND								0.005	0.005	0.005		21035515			
	92112-69-1+	CS+ (Hexanes +)	SOP		MOL %	0.02									0.005	0.005	0.005		21035515			
	delta13C_C1	DELTA 13C C1	SOP		per mil	-53.6									0.005	0.005	0.005		21035515			
	deltaD_C1	DELTA D C1	SOP		per mil	-289													21035515			
	delta13C_C2	DELTA 13C C2	SOP		per mil	-39.1				Low Signal									21035515			
	delta13C_C3	DELTA 13C C3	SOP		per mil	-35.5				Low Signal									21035515			
	BTU	BRITISH THERMAL UNITS	SOP		BTU/cuft	60													21035515			
	SpGrav	SPECIFIC GRAVITY	SOP		No Unit	0.956													21035515			



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JOB 21035515
DIG-025043

Send Data to:
Name: Jeremy Pike
Company: WSP USA, INC.
Address: 4600 W. 60th Avenue
City, State: Arvada, Colorado
Phone: 303.433.9788
Email: jeremy.pike@wsp.com, chris.roy@wsp.com
Regulatory@Bonanzacr.com

Send invoice to (if different):
Name:
Company:
Address:
City, State:
Phone:
Email:

Additional Information:
AFE #:
Project:
PO #: TE034520047, Task 1.00
Location: Whiteloaf 0-20 Pad
Sampled By: WSP
Notes:

Turnaround Time: Standard (1-10 business days) Rush (1-5 business days) Expedited Rush (1-3 business days)

Sample Description				Analysis Requested						Comments
Container Number	Sample Identification	Date Sampled	Time	Gas Composition* N ₂ , O ₂ , Ar, CO ₂ , He, H ₂ , C ₁ , C ₂ , C ₃ , C ₄ , C ₅ , C ₆ , C ₇	RSK-175: N ₂ , O ₂ , Ar, CO ₂ , He, H ₂ , C ₁ -C ₆ , with dissolved C ₁ , C ₂ , & C ₃ (water samples only)	δ ¹³ C Methane (Carbon)	δD Methane (Hydrogen)	δ ¹³ C Ethane-Pentane (C ₂ -C ₅ if present)	δ ¹³ C CO ₂ (if present)	
FOAL6	Whiteloaf Fedem 34-20-17 PRLAC (97) SS	3/19/21	13:38	X		X	X	X	X	Braken Head

Chain-of-Custody Record

	Signature	Company	Date	Time
Relinquished by	<u>Drew Bulent</u>	WSP	3/26/21	13:07
Received by	<u>Keey Nagy</u>	DIG	3/26/21	13:07
Relinquished by				
Received by				
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 analyzed 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 303-431-2030.



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Dolan Integration Group

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Office and Lab 11025 Dover St • Ste 800 • Westminster, CO 80021

JOB 21035515
DIG-025044

Send Data to:	
Name:	Jeremy Pike
Company:	WSP USA, INC.
Address:	4600 W. 60th Avenue
City, State:	Arvada, Colorado
Phone:	303.433.9788
Email:	jeremy.pike@wsp.com, chris.roy@wsp.com Regulatory@BonanzaCrk.com

Send invoice to (if different):	
Name:	
Company:	
Address:	
City, State:	
Phone:	
Email:	

Additional Information:	
AFE #:	
Project:	
PO #:	TE034520047, Task 1.00
Location:	Antelope O-20 Pad
Sampled By:	WSP
Notes:	

Turnaround Time:	<input checked="" type="checkbox"/> Standard (4-10 business days)	<input type="checkbox"/> Rush (5-6 business days)	<input type="checkbox"/> Expedited Rush (3 business days)
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Sample Description				Analysis Requested						Comments
Container Number	Sample Identification	Date Sampled	Time	Gas Composition* N ₂ , O ₂ +Ar, CO ₂ , CO, He, H ₂ , C ₁ -C ₆ + C ₆ +	RSK-175: N ₂ , O ₂ +Ar, CO ₂ , He, H ₂ , C ₁ -C ₆ + with dissolved C ₁ , C ₂ , & C ₃ (water samples only)	δ ¹³ C Methane (Carbon)	δD Methane (Hydrogen)	δ ¹³ C Ethane-Pentane (C ₂ -C ₅ if present)	δ ¹³ C CO ₂ (if present)	
FOALD	Antelope Federal 34-20-17XRLWC(452883)PROP	3/19/21	14:20	X		X	X	X	X	Production

Chain-of-Custody Record

Signature	Company	Date	Time
Relinquished by <i>Drew Butler</i>	WSP	3/26/21	13:07
Received by <i>WSP</i>	DIG	3/26/21	13:07
Relinquished by			
Received by			
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.