ANALYSIS OF CHEROKEE GROUP CUTTINGS SAMPLES FOR GAS CONTENT -- DART CHEROKEE BASIN OPERATING COMPANY #D1-12 McGUIRE; NW NE sec. 12-T.30S.-R.15E.; WILSON COUNTY, KANSAS

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SUMMARY

Cuttings samples from the Pennsylvanian Cherokee Group were collected from the Dart Cherokee Basin #D1-12 McGuire, 12-T.30S.-R.15E., Wilson County, KS. The samples calculate as having the following gas contents:

Unknown coal at 610'	(scf/ton)
Unknown shale at 686' depth ²	(42 scf/ton)
Unknown coal at 725' depth ¹	(scf/ton)
Unknown coal at 766' depth ¹	(scf/ton)
Unknown coal at 816' depth ³	(98 scf/ton)
Unknown coal at 895' depth ⁴	(426 scf/ton)
Unknown coal at 895' depth (2nd SAMPLE) ⁴	(309 scf/ton)
Unknown coal at 1032' depth ³	(135 scf/ton)
Unknown coal at 1078' depth ¹	(scf/ton)
	Unknown coal at 610 ¹¹ Unknown shale at 686' depth ² Unknown coal at 725' depth ¹ Unknown coal at 766' depth ¹ Unknown coal at 816' depth ³ Unknown coal at 895' depth ⁴ Unknown coal at 895' depth (2nd SAMPLE) ⁴ Unknown coal at 1032' depth ³ Unknown coal at 1078' depth ¹

¹no significant coal or dark shale in sample

²no significant coal in sample

³assuming accompanying dark shales in sample desorb 3 scf/ton

⁴assuming accompanying dark shales in sample desorb 20 scf/ton

BACKGROUND

The Dart Cherokee Basin #D1-12 McGuire, 12-T.30S.-R.15E., Wilson County, KS, was selected for cuttings desorption tests in association with an on-going coalbed gas research project at the Kansas Geological Survey. The samples were gathered January 17, 2006 by personnel from Dart Cherokee Basin L.L.C., and soon turned over to LeaAnn Davidson of the Kansas Geological Survey. Samples were obtained during normal drilling of the well, with no cessation of drilling before zones of interest (i.e., coals and dark shales in the Cherokee Group) were penetrated.

The samples were canistered, with surface time and canistering times noted. These samples were collected in canisters that were supplied by Dart Cherokee Basin L.L.C. and the Kansas Geological Survey. Lag times for samples to reach the surface (important were determined b the wellsite geologist and driller.

The cuttings samples from the Pennsylvanian Cherokee Group were:

•	Unknown coal at 610 ¹	(749 grams)
•	Unknown shale at 686' derth ²	(571 grams)
•	Unknown coal at 725' depth ¹	(825 grams)
•	Unknown coal at 766' depth ¹	(1080 grams)
•	Unknown coal at 816' depth ³	(1416 grams)
٠	Unknown coal at 895' depth ⁴	(1253 grams)
•	Unknown coal at 895' depth (2nd SAMPLE) ⁴	(1538 grams)
•	Unknown coal at 1032' depth ³	(1281 grams)
٠	Unknown coal at 1()78' depth ¹	(1572 grams)

If correct wellsite procedures were followed, the cuttings were caught in kitchen strainers as they exited the air-stream pipe emptying to the mud pit. The samples were then washed in water while in the kitchen strainers to rid them of as much drilling mud as possible before the cuttings were placed in desorption canisters. Water with zephyrn chloride biocide was then added to the canisters, with a headspace of 1 to 2 inches being preserved at the top of the canister.

Desorption measurements at the Kansas Geological Survey in Lawrence, KS were continued at approximately 70 °F. Desorption measurements were periodically made until the canisters produced negligible gas with daily testing for at least two successive days.

DESORPTION MEASUREMENTS

The equipment and method for measuring desorption gas is that prescribed by McLennan and others (1995). The volumetric displacement apparatus is a set of connected dispensing burettes, one of which measures the gas evolved from the desorption canister. The other burette compensates for the compression that occurs when the desorbed gas displaces the water in the measuring burette. This compensation is performed by adjusting the cylinders so that their water levels are identical, then figuring the amount of gas that evolved by reading the difference in water level using the volumetric scale on the side of the burette.

The desorption canisters were obtained from SSD, Inc. in Grand Junction, CO. These canisters are 12.5 inches high (32 cm), 3 1/2 inches (9 cm) in diameter, and enclose a volume of approximately 150 cubic inches (2450 cm³). The desorbed gas that collected in the desorption canisters was periodically released into the volumetric displacement apparatus and measured as a function of time, temperature and atmospheric pressure.

The time and atmospheric pressure were measured in the field using a portable weather station (model BA928) marketed by Oregon Scientific (Tualatin, OR). The atmospheric pressure was displayed in millibars on this instrument, however, this measurement was not the actual barometric pressure, but rather an altitude-compensated barometric pressure automatically converted to a sea-level-equivalent pressure. In order to translate this measurement to actual atmospheric pressure, a regression correlation was determined over several weeks by comparing readings from the Oregon Scientific instrument to that from a pressure transducer in the Petrophysics Laboratory in the Kansas Geological Survey in Lawrence, Kansas (Figure 1). The regression equation shown graphically in Figure 1 was entered into a spreadsheet and was used to automatically convert the millibar measurement to barometric pressure in pounds per square inch (psi).

A spreadsheet program written by K.D. Newell (Kansas Geological Survey) was used to convert all gas volumes at standard temperature and pressure. Conversion of gas volumes to standard temperature and pressure was by application of the perfect-gas

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equation, obtainable from basic college chemistry texts:

n = PV/RT

where n is moles of gas, T is degrees Kelvin (i.e., absolute temperature), V is in liters, and R is the universal gas constant, which has a numerical value depending on the units in which it is measured (for example, in the metric system R = 0.0820 liter atmosphere per degree mole). The number of moles of gas (i.e., the value n) is constant in a volumetric conversion, therefore the conversion equation, derived from the ideal gas equation, is:

 $(P_{stp}V_{stp})/(RT_{stp}) = (P_{rig}V_{rig})/(RT_{rig})$

Customarily, standard temperature and pressure for gas volumetric measurements in the oil industry are 60 °F and 14.7 psi (see Dake, 1978, p. 13), therefore P_{stp} , V_{stp} , and T_{stp} , respectively, are pressure, volume and temperature at standard temperature and pressure, where standard temperature is degrees Rankine (°R = 460 + °F). P_{rig} , V_{rig} , and T_{rig} , respectively, are ambient pressure, volume and temperature measurements taken at the rig site or in the desorption laboratory.

The universal gas constant R drops out as this equation is simplified and the determination of Vstp becomes:

 $V_{stp} = (T_{stp}/T_{rig}) (P_{rig}/P_{stp}) V_{rig}$

The conversion calculations in the spreadsheet were carried out in the English metric system, as this is the customary measure system used in American coal and oil industry. V is therefore converted to cubic feet; P is psia; T is °R.

The desorbed gas was summed over the time period for which the coal samples evolved all of their gas.

Lost gas for samples (i.e., the gas lost from the sample from the time it was drilled, brought to the surface, to the time it was canistered) are normally determined using the direct method (Kissel and others, 1975; also see McLennan and others, 1995, p. 6.1-6.14) in which the cumulative gas evolved is plotted against the square root of elapsed time. Time zero is assumed to be the moment that the rock is cut and its cuttings circulated off bottom. Lost gas, however, had to be inferred for the samples collected from this well because no desorption apparatus was on site when those samples were collected. The procedure used to infer lost gas for these samples is outlined in the section below on Lost Gas.

LITHOLOGIC ANALYSIS

Upon removal from the canisters, the cuttings were washed of drilling mud, and dried in air for at least a week. After drying, the cuttings were weighed and then dry sieved into 5 size fractions: >0.0930", >0.0661", >0.0460", >0.0331", and <0.0331". For large sample sizes, the cuttings were ran through a sample splitter and a lesser portion (approximately 75 grams) were sieved and weighed, and the derived size-fraction ratios were applied to the entire sample.

The size fractions were then inspected and sorted by hand under a dissecting microscope. Three major lithologic categories were differentiated: coal, dark shales (generally Munsell rock colors N3 (dark gray), N2 (grayish black), and N1 (black) on dry surface), and lighter-colored lithologies and/or dark and light-colored carbonates. The lightercolored lithologies are considered to be incapable of generating significant amounts of gas. After sorting, and for every size class, each of these three lithologic categories was weighed and the proportion of coal dark shale and light-colored lithologies were determined for the entire cuttings sample based on the weight percentages.

DATA PRESENTATION

Data and analyses accompanying this report are presented in the following order: 1) data tables for the desorption analyses, 2) lost-gas graphs, 3) "lithologic component sensitivity analyses" showing the interdependence of gas evolved from dark shale versus coal in each sample, 4) a summary component analysis for all samples showing relative reliability of the data from all the samples.

Data Tables of the Desorption Analyses (Table 1)

These are the basic data used for lost-gas analysis and determination of total gas desorbed from the cuttings samples. Basic temperature, volume, and barometric measurements are listed at left. Farther to the right, these are converted to standard temperature, pressure and volumes. The volumes are cumulatively summed, and converted to scf/ton based on the total weight of coal and dark shale in the sample. At the right of the table, the time of the measurements are listed and converted to hours (and square root of hours) since the sample was drilled.

Lost-Gas Graphs (Figure 2)

To infer an approximate lost-gas value for each sample, a correlation of the total gas desorbed from a sample after it had been canistered to its rate of lost gas was developed using desorption data accumulated for 42 cuttings samples obtained from air-drilled wells in the Cherokee basin in southeastern Kansas (Figure 2). The rate of lost gas used in this correlation was that amount of gas lost by the square root of 0.6 hours (the square root of 0.36 hours). By knowing the total gas given up by the sample after canistering (i.e., the total gas desorbed) a hypothetical rate of lost-gas could be calculated using the a regression line:

lost gas rate per square root of 0.36 hours = 0.1241 X (total gas desorbed in ccs) + 48.14

Once the hypothetical lost-gas rate was calculated, the lost gas could be calculated by taking the square root of the bottom-hole to canister time (derived from subtracting the lag time from the surface time), and multiplying it times the hypothetical lost-gas rate. Analysis of the lithology of the cuttings used in this correlation revealed no consistent relationship (see Figure 2), therefore further refinement of the relationship of the rate of lost gas to the total gas desorbed after canistering is not possible at this point in time.

"Lithologic Component Sensitivity Analyses" (Figures 3-6)

The rapidity of penetration of an air-drilled well makes collection of pure lithologies from relatively thin-bedded strata rather difficult. Mixed lithologies are more the norm rather than the exception. Some of this mixing is due to cavings from strata farther up hole. The mixing may also be due to collection of two or more successively drilled lithologies in the kitchen sieve at the exit line, or differential lifting of relatively lessdense coal compared to other lithologies, all of which are more dense than coal.

The total gas evolved from the sample is due to gas being desorbed from both the coal and dark shale. Both lithologies are capable of generating gas, albeit the coal will be richer in gas than the dark-colored shale. Even though dark-colored shale is less rich in sorbed gas than coal, if a sample has a large proportion of dark, organic-rich shale and only a minor amount of coal, the total volume of gas evolved from the dark-shale component may be considerable. The lighter-colored lithologies are considered to be incapable of generating significant amounts of gas.

The total amount of gas evolved from a cuttings sample can be expressed by the following equation:

Total gas $(cm^3) = [weight_{coal} (grams) X gas content_{coal} (cm^3/gram)] + [weight_{dark shale} (grams) X gas content_{dark shale} (cm^3/gram)]$

A unique solution for gas $content_{coal}$ in this equation is not possible because gas $content_{dark \ shale}$ is not known exactly. An answer can only be expressed as a linear solution to the above equation. The richer in gas the dark shales are, the poorer in gas the admixed coal has to be, and visa versa. If there is little dark shale in a sample, a relatively well constrained answer for gas $content_{coal}$ can be obtained. Conversely, if considerable dark shale is in a sample, the gas $content \ of a \ coal \ will \ be \ hard \ to \ precisely \ determine.$

The lithologic-component-sensitivity-analysis diagram therefore expresses the bivariant nature inherent in the determination of gas content in mixed cuttings. The gas content of dark shales in Kansas can vary greatly. Proprietary desorption analyses of dark shales in cores from southeastern Kansas have registered as much as 50 scf/ton, but can be as low as 2-4 scf/ton.

A value of 3 scf/ton for average dark shale is based on the assay of the gas content of cores of dark shales in nearby wells. However, high-gamma-ray shales (such as the Excello Shale), also colloquially known as "hot shales", typically have more organic

matter and associated gas content than dark shales with no excessive gamma-ray level. Determination of gas content for a coal associated with a "hot" shale therefore carries more uncertainty than if the coal were associated with a shale without a high gamma-ray value.

In general, shale gas content does not have to be very much greater that 10 scf/ton before the associated coal starts to have a gas content less than that of the dark shale. In all the lithologic-component-sensitivity-analysis diagrams, a "break-even" point is therefore noted where the gas content of the coal is equal to that of the dark shale. This "breakeven" point corresponds to the minimum gas content assignable to the coal and maximum gas content assignable to the dark shale. It can also be thought of the scf/ton gas content of the cuttings sample minus the weight of any of the lighter-colored lithologies, which are assumed to have no inherent gas content. Conversely though, to assume that all the gas evolved from a cuttings sample is derived solely from the coal would result in an erroneously high gas content for the coal.

Summary Component Analysis for all Samples (Figure 7)

This diagram is a summary of the individual "lithologic component sensitivity analyses" for each sample, all set at a common scale. The steeper the angle of the line for a sample, the more uncertainty is attached to the results (i.e., *gas content_{coal}*) for that sample. If the coal content is miniscule (i.e., < approximately 5%), the results are a better reflection of the *gas content_{dark shale}*.

RESULTS and DISCUSSION

Samples with less that 1% coal and/or less than 5% dark shale are considered to have invalid results due to insufficient quantities of gas-generating lithologies. The best constrained data are that associated with the coals at 816' and 1032'. The least constrained data are associated with the coal at 895'.

The two samples at 895' have identical lithologies, but have gas contents ranging from 309 scf/ton to 426 scf/ton, assuming accompanying black shales desorb 20 scf/ton. The reason for this variation is not known. Possible variation in gas calculations could occur when only 2% of the sample is coal, however.

REFERENCES

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- McLennan, J.D., Schafer, P.S., and Pratt, T.J., 1995, A guide to determining coalbed gas content: Gas Research Institute, Chicago, IL, Reference No. GRI-94/0396, 180 p.

FIGURES and TABLES

- FIGURE 1. Correlation of field barometer to Petrophysics Lab pressure transducer..
- TABLE 1. Desorption measurements for samples.
- FIGURE 2. Correlation of the rate of lost gas to the total gas desorbed after canistering.
- FIGURE 3. Sensitivity analysis for unknown shale at 686' depth.
- FIGURE 4. Sensitivity analysis for unknown coal at 816' depth.
- FIGURE 5. Sensitivity analysis for unknown coal at 895' depth.
- FIGURE 6. Sensitivity analysis for unknown coal at 1032' depth.
- FIGURE 7. Lithologic component sensitivity analyses for all samples.



Correlation of Field Barometer to KGS Petrophysics Lab Barometer

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FIGURE 1.

TABLE 1 -- Desorption data for Dart J. McGuire D1-12, SW SW SW 12-T.30SR.15E., Wilson County, KS

SAMPLE: 610', u	unidentified	coal, in SSI	D caniste	r DCB05 #19							NOTE: lost gas is	estimated by tin	me interv	al between at s	urface and ca	nister times,	, and total gas evolved
	Ib	58. 9	grams								est. lost gas (cc)	TIME OF:					elapsed time (off bottom to canistering)
dry sample weight:		0.0203	9.21									1 6 off bottom		at surface	in cania	ster	5.0 minutes
												1/13/06	10:15	1/13/08 1	0:17 1/13	/06 10:20	0.083 hours
RIG/LAB MEASUREMEN	NTS	(CONVER	SION OF RIGIL	AB MEASU	REMENTS TO STP	(@60 deg F; 14.7 psi)	CUMULATIVE VO	LUMES	SCF/TON	SCF/TON			TIME SINCE			0.288675134 SQRT (hrs)
measured cc measured	red T (F) m	neasured P d	cubic ft	absolute T (R) psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF ME	ASURE	off bottom	in canis	ster	SQRT hrs. (since off bottom)
62	68	1076	0.0022	528	8 13.966	0.002048676	58.01	0.002048676	58.01	201.69	257.	57 1/17/08	15:36	101:21	:00	101:18:00	10.06727371
- 3	68	1080	-1E-04	528	8 14.016	-9.9498E-05	-2.82	0.001949178	55.19	192.08	247.	78 1/20/06	13:57	171:42	2:00	171:37:00	13.10343466
-11	67	1081	-4E-04	527	7 14.031	-0.00036586	-10.36	0.001583321	44.83	156.03	211.	71 1/30/06	15:26	413:11	:00	413:06:00	20.32691155

Sample air dried for approximately one week

SAMPLE:	686', uniden	tified coa	I, in SSI	D caniste	er DCB05 #	\$22							NOTE: lost gas	s is estim	vated by tim	e interv	al between at s	urface	and caniste	r times,	and total gas evolved
		lbs.		grams									est. lost gas (c	c) = TI	ME OF:						elapsed time (off bottom to canistering)
dry sample we	eight:	0	.2053	93.13										19 of	f bottom		at surface		in canister		8.0 minutes
															1/13/06	10:42	1/13/06 1	0:45	1/13/08	10:48	0.100 hours
RIG/LAB MEAS	UREMENTS			CONVER	SION OF RI	GALAB	MEASU	REMENTS TO STP (@ 60 deg F	; 14.7 psi)	CUMULATIVE VO	LUMES	SCF/TON	SCF/TON				TIME SINCE				0.316227766 SQRT (hrs)
measured cc	measured T	(F) meas	ured P	cubic ft	absolute T	(R)	psia	cubic ft (@STP) cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	П	ME OF MEA	SURE	off bottom		in canister		SQRT hrs. (since off bottom)
110)	68	1076	0.0039		528	13.966	0.003634747	102.92	0.003634747	102.92	35.41	4	1.94	1/17/08	15:39	100:53	:00	100	:51:00	10.04736772
0)	68	1080	0		528	14.018	0	0.00	0.003634747	102.92	35.41	4	1.94	1/20/06	13:59	171:17	:00	171	:11:00	13.06752587
- 5	5	67	1081	-2E-04		527	14.031	-0.0001663	-4.71	0.003468449	98.22	33.79	4	0.32	1/30/06	15:27	412:4	5:00	412	:39:00	20.31624965
Operate stade	ad far annuul	match. on	an wook																		

Sample air dried for approximately one week

SAMPLE:	725', unide	entified	coal, in SSI	D caniste	er DCB05 #	11								NOTE: lost gas	is estim	ated by tim	ne interv	al between a	t surface	e and caniste	r times,	and total gas evolved
		Ib	08. 9	grama										est. lost gas (cc	;) = TI	ME OF:						elapsed time (off bottom to canistering
dry sample we	eight:		0.0255	11.57											24 of	bottom		at surface		in canister		10.0 minutes
																1/13/06	10:55	1/13/08	11:00	1/13/06	11:05	0.167 hours
RIG/LAB MEAS	UREMENTS		(CONVER	SION OF RIG	AB	MEASUR	REMENTS TO STP	(@60 deg F; 14.7 pe	8i)	CUMULATIVE VO	LUMES	SCF/TON	SCF/TON				TIME SINCE				0.408248290 SQRT (hrs)
measured cc	measured	T (F) m	neasured P o	cubic ft	absolute T	(R) p	aia	cubic ft (@STP)	cc (@STP)		cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	11	ME OF MEA	SURE	off bottom		in canister		SQRT hrs. (since off bottom)
84	4	68	1076	0.003	5	26 1	3.966	0.002775625	78	.60	0.002775625	5 78.60	217.70	264	4.18	1/17/06	15:38	100	:43:00	100	:33:00	10.03578936
- 6	6	68	1086	-2E-04	5	528 1	4.096	-0.0002001	- 5	.87	0.002575524	72.93	202.01	266	8.49	1/20/06	14:00	171	:05:00	170	:55:00	13.07966277
- 9	9	67	1081	-3E-04	5	27 1	4.031	-0.00029934	-8	.46	0.002276187	84.45	178.53	245	5.01	1/30/06	15:28	412	:33:00	412	:23:00	20.31132689
0			and an and the																			

Sample air dried for approximately one week

S	SAMPLE:	766', unide	entified	coal, in S	SD canist	er DCB05 #	18							NOTE: lost gas is	estimated b	y time inter	rval between at surfa	ce and canister times,	, and total gas evolved
			1	bs.	grama									est. lost gas (cc)	TIME OF	8			elepsed time (off bottom to canistering
d	irv samole we	eight:		0.1259	57.08	9									1 off botto	m	at surface	in canister	7.0 minutes
	, , , , , , , , , , , , , , , , , , , ,														1/13/	06 11:13	3 1/13/06 11:1	5 1/13/08 11:20	0.117 hours
F	RIG/LAB MEAS	UREMENTS			CONVER	SION OF RI	G/LA	BMEASU	REMENTS TO STP	(@60 deg F; 14.7 psi)	CUMULATIVE VC	UMES	SCF/TON	SCF/TON			TIME SINCE		0.341565025 SORT (hrs)
п	neasured cc	measured	T (F) r	measured P	cubic ft	absolute T	(R)	psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)) cc (@STP)	without lost gas	with lost gas	TIME OF	MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
	94	\$	68	1076	0.0033	3	528	13.966	0.003106057	67.95	0.003106053	7 87.95	49.38	61.	14 1/17/	06 15:36	100:23:00	100:16:00	10.01914633
	10	0	68	1080	0.0004		528	14.016	0.00033186	9.39	0.003437717	7 97.34	54.63	66.	41 1/20/	06 13:57	170:44:00	170:37:00	13.0664966
	- 1	5	65	1089	-4E-05	5	525	14,135	-3.3633E-05	-0.95	0.003404083	3 96.39	54.09	65.	88 1/24/	06 15:11	267:58:00	267:51:00	16.38968743
	4		67	1081	0.0001		527	14.031	0.000133039	3.77	0.003537122	2 100.16	58.21	67.	99 1/30/	06 15:28	412:15:00	412:06:00	20.3039405
	1		67	1080	4E-05	5	527	14.018	3.32289E-05	0,94	0.00357035	1 101.10	56.73	68.	52 2/3/	06 16:14	509:01:00	508:54:00	22.56139771
	- 6	6	67	1091	-2E-04		527	14.161	-0.0002014	-5.70	0.003366947	7 95.40	53.53	65.	32 2/7/	06 16:11	604:58:00	604:51:00	24.59607015
	C)	67	1088	0)	527	14.122	0	0.00	0.003368947	7 95.40	53.53	65.	32 2/10/	06 12:44	673:31:00	673:24:00	25.95219985

Sample air dried for approximately one week

SAMPLE:	616', unider	tified coal,	in SSD	caniste	r DCB05 #18							NOTE: lost gas	s estima	ated by tim	interv	al between at su	face and ca	nister times	, and total gas evolved
		lbs.	gr	ams								est. lost gas (cc)	= TIN	VE OF:					elapsed time (off bottom to canistering)
dry sample wei	aht:	0.1	231	55.82									16 off	bottom		at surface	in cani	ster	6.0 minutes
														1/13/06	11:37	1/13/06 11	40 1/13	/08 11:43	0.100 hours
RIG/LAB MEASU	REMENTS		C	ONVER	SION OF RIG/L/	AB MEASU	REMENTS TO STR	(@60 deg F; 14.7 pai)	CUMULATIVE VOL	LUMES	SCF/TON	SCF/TON				TIME SINCE			0.316227766 SQRT (hrs)
measured cc	measured T	(F) measur	ed P cu	bic ft	absolute T (R) psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIM	AE OF MEA	SURE	off bottom	in cani	ster	SQRT hrs. (since off bottom)
68		68 1	076 0	0.0024	521	3 13.966	0.002248935	83.63	0.002246935	63.63	36.52	46	.85	1/17/06	15:43	100:06:	00	100:00:00	10.00499875
9		68 1	080 0	0.0003	520	3 14.018	0.000296494	8.45	0.002545429	72.08	41.37	51	.70	1/20/06	14:01	170:24:	00	170:18:00	13.0537351
5		67 1	081 0	0.0002	52	7 14.031	0.000186298	4.71	0.002711727	76.79	44.07	54	.41	1/30/08	15:29	411:52:	00	411:48:00	20.29449843
- 1		67 1	080	4E-05	52	7 14.018	-3.3229E-05	-0.94	0.002878498	75.85	43.53	53	.67	2/3/06	16:15	508:38:	00	508:32:00	22.55290077
- 7		67 1	091 -:	2E-04	52	7 14.161	-0.00023497	-6.65	0.002443527	89.19	39.71	50	.05	2/7/06	16:12	604:35:	00	604:29:00	24.56627634
- 1		67 1	088 -	4E-05	523	7 14.122	-3.3475E-05	-0.95	0.002410052	88.24	39.17	49	.50	2/10/06	12:45	673:08:	00	673:02:00	25.94481323

Sample air dried for approximately one week

Ibs. grams est. lost gas (oc) = TIME 0F: elapsed time (off bottom to canis dry sampla weight: 0.6647 392.22 56 off bottom at surface in canister 14.0 minutes Orca op Measures CONVERSION OF FIGURENTS TO STP (@60 deg F: 147 pa) CUMULATIVE VOLUMES SCE/TON SCE/TON TIME 5INCE 0.483045891 SORT (hrs)	
dry sampla weight: 0.6647 392.22 56 off bottom at surface in canister 14.0 minutes orca on Measure 1/13/06 11:56 1/13/06 12:07 1/13/06 12:12 0.233 hours orca on Measure 0.000 MEASUREMENTS CONVERSION OF FIGURAR MEASUREMENTS TO STP (0.60 deg F: 14.7 page) CONVERSION OF FIGURAR MEASUREMENTS SCE/TON SCE/TON TIME SINKE 0.4830458913 (5.00 minutes)	histering
1/13/06 11:56 1/13/06 12:07 1/13/06 12:12 0.233 hours DICALAD MEASUREMENTS CONVERSION OF RIGH AR MEASUREMENTS TO STP (0/00 deg F: 14.7 ps) CUMULATIVE VOLUMES SCEPTON SCEPTON TIME SINCE 0.483045891 SORT (hrs)	
DICAT AD MEASUREMENTS CONVERSION OF RICH AD MEASUREMENTS TO STP (060 deg F: 14.7 ps) CUMULATIVE VOLUMES SOFTON SOFTON TIME SINCE 0.483045891 SORT (http)	
	/8)
measured c measured T (F) measured P cubic ft absolute T (R) psia cubic ft (@STP) cc (@STP) without lost gas with lost gas TIME OF MEASURE off bottom in canister SQRT hrs. (since off bottom)	
486 68 1076 0.0172 528 13.966 0.018056975 454.74 0.016058975 454.74 37.14 41.72 1/17/08 15:50 99:52:00 99:38:00 9.99333111	
47 08 1080 0.0017 528 14.018 0.001556802 44.14 0.01761777 496.88 40.75 45.32 1/20/08 14:02 170:04:00 169:50:00 13.04096111	
15 65 1089 0.0005 525 14.135 0.000504502 14.29 0.018122279 513.16 41.92 48.49 1/24/08 15:13 267:15:00 267:01:00 16.34778272	
25 67 1081 0.0009 527 14.031 0.000831492 23.55 0.018953771 536.71 43.84 46.41 1/30/06 15:30 411:32:00 411:18:00 20.28628436	
8 67 1080 0.0003 527 14.018 0.000265831 7.53 0.019219603 544.24 44.45 49.03 2/3/06 18:18 508:18:00 508:04:00 22.54550953	
- 8 67 1091 - 3E-04 527 14.181 - 0.00026654 -7.60 0.018951064 536.63 43.63 48.41 2/7/08 18:13 604:15:00 604:01:00 24.58149711	
3 67 1088 0.0001 527 14.122 0.000100425 2.84 0.019051489 539.48 44.07 48.64 2/10/06 12:46 672:48:00 672:34:00 25.93838854	

Sam	ple a	ir dri	ed 1	or ap	proxi	mate	y one	wee
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SAMPLE:	895', Ill2nd	Sample	III unider	ntified coa	I, in SSD cani	ster DCB	05 #7					NOTE: lost gas is	stimated by ti	me inter	al between at surfac	e and canister times,	and total gas evolved
		lbs.		grams								est. lost gas (cc) =	TIME OF:				elapsed time (off bottom to canistering)
dry sample we	alght:		1.1200	508.02								5	8 off bottom		at surface	in canister	14.0 minutes
													1/13/06	11:58	1/13/06 12:07	1/13/06 12:12	0.233 hours
RIG/LAB MEAS	UREMENTS			CONVER	SION OF RIGIL	AB MEAS	JREMENTS TO STP	(@60 deg F; 14.7 psi)	CUMULATIVE VOI	LUMES	SCF/TON	SCF/TON			TIME SINCE		0.483045891 SQRT (hrs)
measured cc	measured "	(F) mea	sured P	cubic ft	absolute T (R) psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF ME	ASURE	off bottom	in canister	SQRT hrs. (since off bottom)
436	5	68	1076	0.0154	52	8 13.96	8 0.014406817	407.95	0.014406617	407.95	25.73	29.3	8 1/17/08	15:50	99:52:00	99:38:00	9.99333111
62	2	68	1080	0.0022	52	8 14.01	0.002056292	56.23	0.016463109	466.16	29.40	33.0	6 1/20/08	14:02	170:04:00	169:50:00	13.04096111
28	3	85	1089	0.001	52	5 14.13	5 0.000941737	26.67	0.017404846	492.85	31.08	34.7	4 1/24/08	15:13	267:15:00	267:01:00	16.34778272
33	3	67	1081	0.0012	52	7 14.03	0.00109757	31.06	0.018502418	523.93	33.04	36.7	0 1/30/08	15:30	411:32:00	411:18:00	20.26828436
1.4		67	1080	0.0005	52	7 14.01	8 0.000485205	13.17	0.018967621	537.10	33.87	37.5	3 2/3/06	16:16	508:18:00	508:04:00	22.54550953
- 2	2	67	1091	-7E-05	52	7 14.16	-6.7135E-05	-1.90	0.018900487	535.20	33.75	37.4	1 2/7/06	16:13	604:15:00	604:01:00	24.56149711
7	,	67	1088	0.0002	52	7 14.12	0.000234325	8.64	0.019134612	541.84	34.17	37.8	3 2/10/08	12:46	672:48:00	672:34:00	25.93838854
16	3	68	1074	0.0006	52	6 13.94	0.000529714	15.00	0.019664526	556.84	35.12	36.7	7 2/14/06	15:09	771:11:00	770:57:00	27.77018785
-12	2	88	1095	-4E-04	52	8 14.21	-0.00040352	-11.43	0.019261007	545.41	34.39	36.0	5 2/19/06	14:01	890:03:00	889:49:00	29.83370577
12	2	66	1082	0.0004	52	6 14.04	4 0.000400245	11.33	0.019661252	556.74	35.11	36.7	7 2/24/06	14:42	1010:44:00	1010:30:00	31.79203254
9)	66	1075	0.0003	52	6 13.95	3 0.000298242	8.45	0.019959494	565.19	35.64	39.3	0 2/27/06	17:22	1085:24:00	1085:10:00	32.94540939
- 1 ()	67	1094	-4E-04	52	7 14.20	-0.0003366	-9.53	0.019622697	555.66	35.04	38.7	0 3/3/06	16:53	1180:55:00	1180:41:00	34.38446808
1.0	3	87	1074	0.0006	52	7 13.94	0.000594798	16.64	0.020217895	572.50	36.10	39.7	6 3/7/06	16:15	1276:17:00	1276:03:00	35.72510788
- 4	4	66	1089	-1E-04	52	6 14.13	-0.00013426	-3.80	0.020083418	566.70	35.86	39.5	2 3/14/06	15:27	1443:29:00	1443:15:00	37.99320115
1 :	5	66	1068	0.0005	52	6 13.66	2 0.000493833	13.96	0.020577249	562.68	36.75	40.4	0 3/30/06	15:47	1827:49:00	1827:35:00	42.75297261
	1	66	1074	-4E-05	52	6 13.94	-3.3107E-05	-0.94	0.020544142	561.74	36.69	40.3	4 4/5/08	14:41	1970:43:00	1970:29:00	44.39275466
	1	66	1071	-4E-05	52	8 13.90	1 -3.3015E-05	-0.93	0.020511128	580.81	36.63	40.2	8 4/14/06	16:17	2188:19:00	2166:05:00	46.77944705

Sample air dried lor approximately one week

SAMPLE:	1032', uni	dentifie	d coal, in S	SD cania	ster DCB05 #1	2						NOTE: lost gas	is estin	nated by tim	e interv	al between at surfac	e and canister times,	and total gas evolved
		1	bs.	grams								est. lost gas (cc) = 1	IME OF:				elapsed time (on bottom to canistering)
dry samole we	ight:		0.2247	101.92									23 0	ff bottom		at surface	in canister	8.0 minutes
														1/13/06	12:54	1/13/08 12:58	1/13/08 13:02	0.133 hours
RIG/LAB MEASI	UREMENTS			CONVER	SION OF RIGIL	AB MEASU	REMENTS TO STP	(@60 deg F; 14.7 psi)	CUMULATIVE VOI	LUMES	SCF/TON	SCF/TON				TIME SINCE		0.365148372 SQRT (hrs)
measured cc	measured	Т (F) г	neasured P	cubic ft	absolute T (R) psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (OSTP)	without lost gas	with lost gas	П	IME OF MEA	SURE	off bottom	in canister	SQRT hrs. (since off bottom)
96		68	1076	0.0034	521	8 13.966	0.003172143	89,82	0.003172143	69.82	26.23	35	5.46	1/17/08	15:36	98:42:00	98:34:00	9.934787366
1 1		68	1080	0.0004	521	8 14.018	0.000364626	10.33	0.003536969	100.16	31.46	36	3.71	1/20/06	13:57	189:03:00	168:55:00	13.00192293
- 1		65	1089	-4E-05	52	5 14.135	-3.3633E-05	-0.95	0.003503336	99.20	31.16	36	3.41	1/24/06	15:11	268:17:00	266:09:00	16.31819026
1 1		67	1081	0.0004	52	7 14.031	0.000365857	10.38	0.003869192	109.56	34.44	41	.87	1/30/08	15:28	410:34:00	410:26:00	20.26244474
4		67	1080	0.0001	52	7 14.016	0.000132916	3.78	0.004002108	113.33	35.62	42	2.85	2/3/08	16:14	507:20:00	507:12:00	22.52406121
- 6		67	1091	-2E-04	52	7 14.181	-0.0002014	-5.70	0.003800704	107.62	33.83	41	.06	2/7/06	16:11	603:17:00	603:09:00	24.56182675
3		67	1088	0.0001	52	7 14.122	0.000100425	2.84	0.003901129	110.47	34.72	41	.95	2/10/06	12:44	671:50:00	671:42:00	25.91974794

Sample air dried for approximately one week

SAMPLE: 1078', unidentified coal, in SSD canister DCB05 #24	NOTE: lost gas is estimated by time interval between at surface and canister times, and total gas evolved
lbs. grams	est. lost gas (cc) = TIME OF: elapsed time (off bottom to canistering)
dry sample weight: 0.0989 44.88	17 off bottom at surface in canister 4.0 minutes
	1/13/06 13:06 1/13/08 13:08 1/13/06 13:10 0.087 hours
RIG1.AB MEASUREMENTS CONVERSION OF RIG1.AB MEASUREMENTS TO STP (@ 60 deg F; 14.7 pei) CUMULATIVE VOLUMES SCF/TON	SCF/TON TIME SINCE 0.256198890 SQRT (hrs)
measured c measured T (F) measured P cubic ft absolute T (R) psia cubic ft (@STP) cc (@STP) cubic ft (@STP) cc (@STP) without lost gas	with lost gas TIME OF MEASURE off bottom in canister SQRT hrs. (since off bottom)
140 68 1076 0.0049 528 13.966 0.004626042 130.99 0.004626042 130.99 93.5	51 105.64 1/17/08 15:58 96:52:00 98:48:00 9.943171881

7	68	1080 0.0002	528 14.018 0.000232162	6.57 0.004858204 137.57	98.20	10.34 1/20/06	14:04 168:58:00	168:54:00 12.99871789
- 4	67	1081 -1E-04	527 14.031 -0.00013304	-3.77 0.004725165 133.80	95.51 1	07.65 1/24/06	15:32 266:26:00	266:22:00 16.32278571
- 1	67	1080 -4E-05	527 14.018 -3.3229E-05	-0.94 0.004691936 132.86	94.84	1/30/06	16:18 411:12:00	411:08:00 20.27806697



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FIGURE 2.

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LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of unidentified shale at 686'



FIGURE 3.

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LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of unidentified coal at 816'



LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of unidentified coal at 895'



Desorption Characteristics of Cuttings Samples Dart Cherokee Basin #D1-12 McGuire, NW NE 12-T.30S.-R.15E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of unidentified coal at 1032'



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LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for all samples



FIGURE 7.