ANALYSIS OF MARMATON AND CHEROKEE GROUP CUTTINGS SAMPLES FOR GAS CONTENT -- DART CHEROKEE BASIN OPERATING COMPANY #B2-2 SOUTHWINDS BUFFALO RANCH; SE NW sec. 2-T.34S.-R.14E.; MONTGOMERY COUNTY, KANSAS

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SUMMARY

Seven cuttings samples from the Pennsylvanian Marmaton Group and Cherokee Group were collected from the Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch well; SE NW sec. 2-T.34S.-R.14E. in Montgomery County, KS. The samples calculate as having the following gas contents:

- Little Osage Shale at 994' to 998' depth[1,2] (19.8 scf/ton)
- Excello Shale at 1025' to 1030' depth[1] (25.6 scf/ton)
- Iron Post coal at 1050' to 1051' depth[3] (45.7 scf/ton)
- Croweburg coal at 1076' to 1078' depth[3] (152.1 scf/ton)
- Weir-Pittsburg coal at 1192' to 1195' depth[4] (---- scf/ton)
- Dry Wood coal at 1324' to 1325' depth[5] (---- scf/ton)
- Rowe coal at 1404' to 1406' depth[3] (346.1 scf/ton)

[1]no coal in sample
[2]a slight leak was detected in the canister after desorption finished, therefore this gas content should be considered a mimimim gas content
[3]assuming accompanying dark shales in sample desorb 3 scf/ton
[4]no valid result due to leak in canister
[5]reliability of result is unclear due to small amount of coal in the sample

BACKGROUND

The Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch well, SE NW sec. 2-T.34S.-R.14E. in Montgomery 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 March 24, 2004, by Gary Bogue of Dart Cherokee Basin L.L.C., and March 25, 2004, by K.D. Newell of the Kansas Geological Survey (with assistance of Gary Bogue). 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 Marmaton Group and Cherokee Group) were penetrated. The well was drilled using an air rotary rig owned by McPherson Drilling.

The samples obtained March 24, 2004, by Gary Bogue were canistered, with surface time and canistering times noted. These samples, as were the ones collected the following day, were collected in canisters that were supplied by Dart Cherokee Basin L.L.C. Subsequent testing revealed a slight leak in the canister for the Little Osage Shale (994' to 998') and a bad leak in the canister used for the Weir-Pittsburg (1192' to 1195') coal. No valid results were therefore obtained for the Weir-Pittsburg sample.

Lag times for samples to reach the surface (important for assessing lost gas) were determined by using the lag times from a nearby air-drilled well (Dart Cherokee Basin #CH-1 Holder; sec. 1-T.30S.-R.14E., Wilson County, KS), which was also drilled using this particular drilling rig. The lag times were determined by periodically noting the time it took for cuttings to reach the surface following resumption of drilling after new pipe was added to the drill string.

Seven cuttings samples from the Pennsylvanian Marmaton and Cherokee Groups were collected:

- Little Osage Shale at 994' to 998' depth (462 grams dry wt.)
- Excello Shale at 1025' to 1030' depth (329 grams dry wt.)
- Iron Post coal at 1050' to 1051' depth (308 grams dry wt.)
- Croweburg coal at 1076' to 1078' depth (292 grams dry wt.)
- Weir-Pittsburg coal at 1192' to 1195' depth (sample not saved)
- Dry Wood coal at 1324' to 1325' depth (1170 grams dry wt.)
- Rowe coal at 1404' to 1406' depth (1053 grams dry wt.)

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.

Temperature baths for the desorption canisters were on site for the samples collected on March 25, with temperature kept at approximately 75 ˚F. All samples were transported in the evening of March 25 to the laboratory at the Kansas Geological Survey in Lawrence, KS, and desorption measurements were continued at approximately the same temperature. 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 cm^3). 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, KS (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 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 collected March 25 (i.e., the gas lost from the sample from the time it was drilled, brought to the surface, to the time it was canistered) was 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. Characteristically, the cumulative gas evolved from the sample, when plotted against the square root of time, is linear for a short time after the sample reaches ambient surface pressure conditions, therefore lost gas is determined by a line projected back to time zero. The period of linearity generally is about an hour for cuttings samples.

Lost gas had to be inferred for the samples collected March 24 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 an oven at 150 °F for 1 to 3 days. 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 run 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 lighter-colored 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) lag time to surface for the well cuttings, 2) data tables for the desorption analyses, 3) lost-gas graphs, 4) "lithologic component sensitivity analyses" showing the interdependence of gas evolved from dark shale versus coal in each sample, 5) a summary component analysis for all samples showing relative reliability of the data from all the samples, and 6) a desorption graph for all the samples.

Graph of Lag-time to Surface for Well Cuttings (Figure 2)

Lag time of cuttings to surface varied, but there is a general trend of longer lag times for greater depth. The lag times accepted for cuttings were taken to be a visual average of the trend (defined by the scatter of data points on this graph) at the depth at which the samples were taken.

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 (Figures 3-6)
For the sample collected March 24, a new method had to be devised to ascertain an approximation of the gas lost. To these purposes, 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 3). 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 substracting 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 3), 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.

For the samples collected March 25, gas lost prior to the canistering of the sample was estimated by the more traditional means of extrapolation of the first few data points after the sample was canistered. The linear characteristic of the initial desorption measurements is usually lost within the first hour after the cuttings leave the bottom of the hole, thus data are presented in the lost-gas graphs for only up to one hour after cuttings are off bottom.

"Lithologic Component Sensitivity Analyses" (Figures 7-12)
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 less-dense 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:

$$\text{Total gas (cm}^3\text{)} = [\text{weight}_{\text{coal}}\text{ (grams) X gas content}_{\text{coal}}\text{ (cm}^3\text{/gram)}] + [\text{weight}_{\text{dark shale}}\text{ (grams) X gas content}_{\text{dark shale}}\text{ (cm}^3\text{/gram)}]$$

A unique solution for gas $\text{content}_{\text{coal}}$ in this equation is not possible because gas $\text{content}_{\text{dark shale}}$ 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 vice versa. If there is little dark shale in a sample, a relatively well constrained answer for gas contentcoal 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 "break-even" 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, 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 13)
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 $gas\ content_{dark\ shale}$.

Desorption Graph (Figure 14)
This is a desorption graph (gas content per weight vs. square root of time) for all the samples. The rate at which gas is evolved from the samples is thus comparable at a common scale. The final value represents the standard cubic feet of gas per ton (scf/ton) calculated for the sample, using the combined weight of the coal and dark shale in the sample.

RESULTS and DISCUSSION

The Little Osage Shale and the Excello samples did not contain any significant coal. Colors of the shale were gradational between very dark gray (N1) and light gray (N7) for the Little Osage Shale, thus it was impossible to pick out any single, distinct shale in this sample that could have been representative of this interval. Nearby cores of the Summit coal/Little Osage Shale interval are not dominated by coal, but rather this zone is a carbonaceous shale having varying amounts of carbonaceous material, thus the sample is probably reflective of the Summit zone at this locality.

All samples contained less than 15% coal, which indicates that much of the coal is probably pulverized to dust by the air-drill percussion bit and not retained in the catching sieve. This lack of coal in the samples imparts some uncertainty to the desorption measurements, but an approximation of their gas content is nevertheless obtained. An estimate for gas content for the coal in this samples can be made, assuming the admixed dark shale in the sample desorb 3 scf/ton.

The Excello Shale sample contained no coal. This sample was dominated by a very dark to black shale (N1, N2). The Excello is very rich in organic matter and has a high gamma ray reading associated with it. According to the summary diagram for the sensitivity analyses (Figure 13), the best constrained results (in which the resultant coal gas content varies the least with shale gas content) is for the Rowe and Iron Post coals, with slightly less-constarined results for the Croweburg coal. The least constrained results are for the Dry Wood coal, and its gas content is thus considered not valid.

REFERENCES

Dake, L.P., 1978, Fundamentals of Reservoir Engineering, Elsevier Scientific Publishing, New York, NY, 443 p.

Kissel, F.N., McCulloch, C.M., and Elder, C.H., 1975, The direct method of determining methane content of coals for ventilation design: U.S. Bureau of Mines, Report of Investigations, RI7767.

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

Correlation of Field Barometer to KGS Petrophysics Lab Barometer

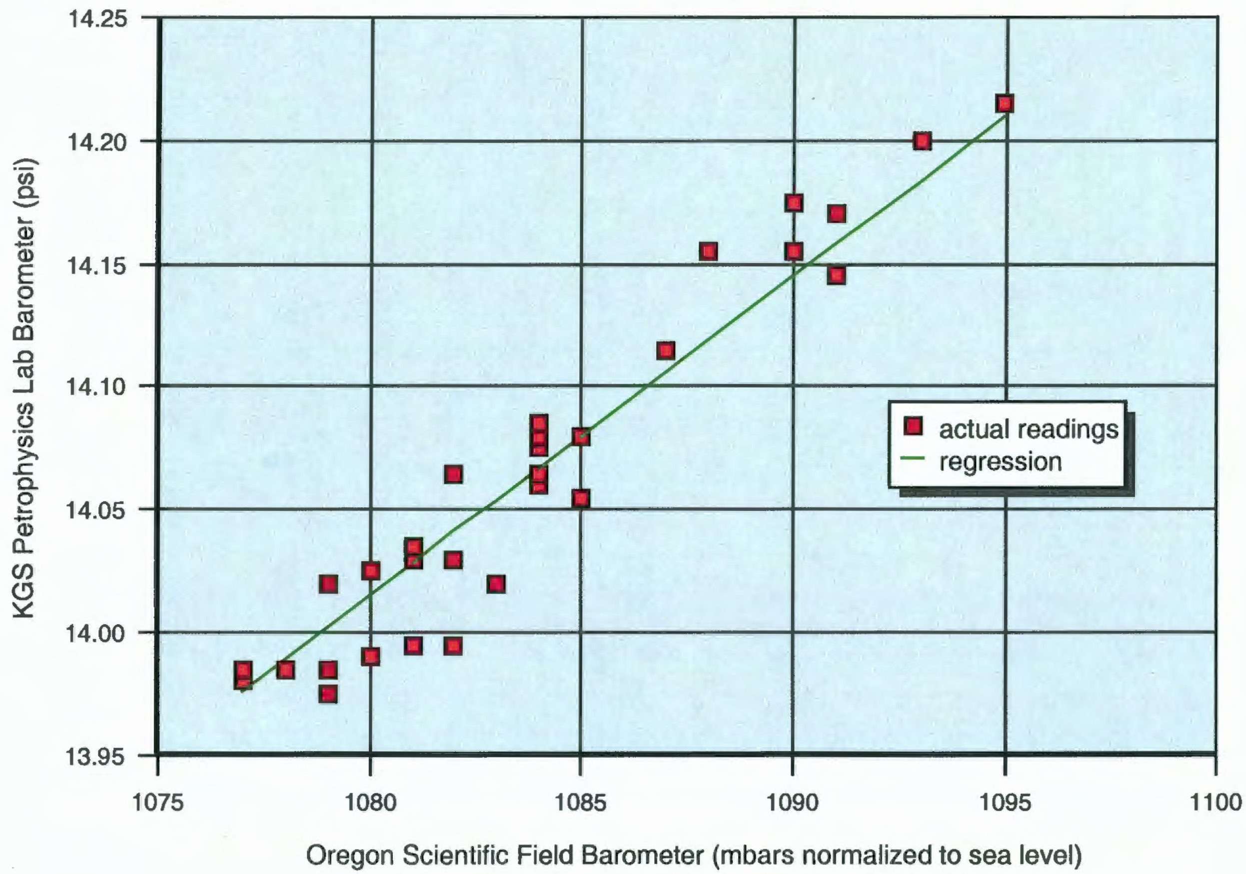


FIGURE 1.

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS
(based on lag times from Dart Cherokee Basin #CH-1 Holder; sec. 1-T.30S.-R.14E., Wilson County, KS
lag-time to surface for well cuttings

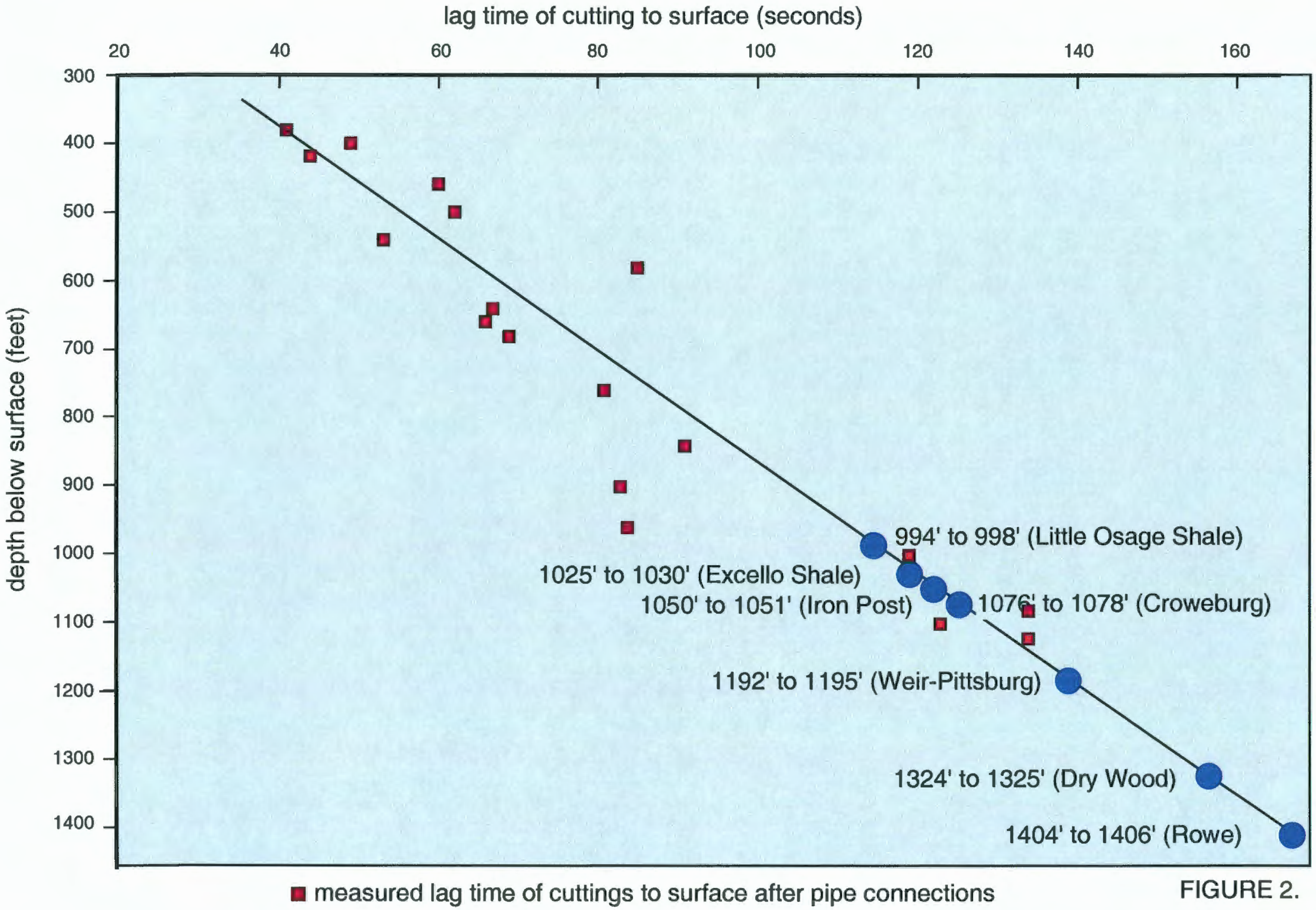


FIGURE 2.

TABLE 1 -- Desorption data for DART CHEROKEE BASIN SOUTHWINDS BUFFALO RANCH #B2-2; SE NW sec. 2-T.34S.-R.14E., Montgomery County, KS

SAMPLE: 994' to 998' (Little Osage Shale) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	0.9816	445.23

NOTE: lost gas is estimated by time interval between at surface and canister times, and total gas evolved

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
28	off bottom	at surface	in canister	7.7 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:06	0.128 hours
				0.358238421 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
163	71	1088	0.0058	531	14.122	0.005415333	153.34	0.005415333	153.34	11.03	13.05	3/25/04 11:27	23:28:24	23:20:42	4.84492862
61	72	1084	0.0022	532	14.070	0.002015351	57.07	0.007430684	210.41	15.14	17.16	3/26/04 14:48	50:49:24	50:41:42	7.129048557
25	71	1076	0.0009	531	13.986	0.000821412	23.26	0.008252096	233.67	16.81	18.83	3/27/04 16:28	76:29:24	76:21:42	8.745856182
7	70	1084	0.0002	530	14.070	0.000232143	6.57	0.008484239	240.25	17.29	19.30	3/28/04 12:31	96:32:24	96:24:42	9.825477088
3	63	1086	0.0001	523	14.096	0.000101007	2.86	0.008585246	243.11	17.49	19.51	3/29/04 16:53	124:54:24	124:46:42	11.17616511
-3	63	1088	-0.0001	523	14.122	-0.000101193	-2.87	0.008484053	240.24	17.29	19.30	3/30/04 20:02	152:03:24	151:55:42	12.33112593
0	64	1088	0	524	14.122	0	0.00	0.008484053	240.24	17.29	19.30	3/31/04 2:13	158:14:24	158:06:42	12.57934815
7	69	1084	0.0002	529	14.070	0.000232581	6.59	0.008716634	246.83	17.76	19.78	4/1/04 9:46	189:47:24	189:39:42	13.77642915
-2	65	1089	-7E-05	525	14.135	-6.7267E-05	-1.90	0.008649367	244.92	17.62	19.64	4/2/04 11:12	215:13:24	215:05:42	14.67049193
0	66	1088	0	526	14.122	0	0.00	0.008649367	244.92	17.62	19.64	4/3/04 17:01	245:02:24	244:54:42	15.65375354
-1	65	1087	-4E-05	525	14.109	-3.35717E-05	-0.95	0.008615795	243.97	17.56	19.57	4/4/04 15:21	287:22:24	267:14:42	16.35155448
0	65	1087	0	525	14.109	0	0.00	0.008615795	243.97	17.56	19.57	4/5/04 21:08	297:09:24	297:01:42	17.2382327

DESORPTION TERMINATED 4/6/2004 DUE TO NO MORE GAS BEING EVOLVED (CANISTER HAS SLIGHT LEAK!); sampled air dried for 25 days

SAMPLE: 1025' to 1030' (Excello Shale) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	0.9093	412.43

NOTE: lost gas is estimated by time interval between at surface and canister times, and total gas evolved

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
24	off bottom	at surface	in canister	4.8 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:03	0.080 hours
				0.282351239 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
179	70	1088	0.0063	530	14.122	0.00595812	168.71	0.00595812	168.71	13.11	14.97	3/25/04 11:20	23:21:27	23:16:40	4.832959756
72	72	1084	0.0025	532	14.070	0.002378775	67.36	0.008336895	236.07	18.34	20.20	3/26/04 14:49	50:50:27	50:45:40	7.130275824
32	71	1078	0.0011	531	13.966	0.001051407	29.77	0.009388302	265.85	20.85	22.51	3/27/04 16:29	76:30:27	76:25:40	8.746856578
10	70	1084	0.0004	530	14.070	0.000331632	9.39	0.009719934	275.24	21.38	23.24	3/28/04 12:32	96:33:27	98:28:40	9.826367589
7	63	1086	0.0002	523	14.096	0.000235684	6.67	0.009955618	281.91	21.90	23.76	3/29/04 16:54	124:55:27	124:50:40	11.176948
-1	63	1088	-4E-05	523	14.122	-3.37311E-05	-0.96	0.009921887	280.96	21.82	23.89	3/30/04 20:02	152:03:27	151:58:40	12.33115972
2	64	1088	7E-05	524	14.122	6.73334E-05	1.91	0.00998922	282.86	21.97	23.84	3/31/04 2:14	158:15:27	158:10:40	12.58004372
9	69	1084	0.0003	529	14.070	0.000299033	8.47	0.010288254	291.33	22.63	24.49	4/1/04 9:46	189:47:27	189:42:40	13.77645939
0	65	1089	0	525	14.135	0	0.00	0.010288254	291.33	22.83	24.49	4/2/04 11:12	215:13:27	215:08:40	14.67052033
2	66	1088	7E-05	526	14.122	6.70774E-05	1.90	0.010355331	293.23	22.78	24.64	4/3/04 17:01	245:02:27	244:57:40	15.65378016
0	65	1087	0	525	14.109	0	0.00	0.010355331	293.23	22.78	24.64	4/4/04 15:22	287:23:27	267:18:40	16.35208957
2	65	1082	7E-05	525	14.044	6.68346E-05	1.89	0.010422166	295.12	22.92	24.79	4/5/04 21:09	297:10:27	297:05:40	17.23874029
4	67	1080	0.0001	527	14.018	0.000132916	3.76	0.010555081	298.89	23.22	25.08	4/6/04 14:22	314:23:27	314:18:40	17.73106972
6	68	1076	0.0002	528	13.966	0.000198259	5.81	0.01075334	304.50	23.65	25.52	4/7/04 14:00	338:01:27	337:56:40	18.38543355
-2	67	1082	-7E-05	527	14.044	-6.65809E-05	-1.89	0.010686759	302.61	23.51	25.37	4/8/04 14:09	362:10:27	362:05:40	19.03087404
0	66	1081	0	526	14.031	0	0.00	0.010686759	302.61	23.51	25.37	4/9/04 18:38	388:39:27	388:34:40	19.71439829
-4	62	1087	-0.0001	522	14.109	-0.000135059	-3.82	0.010551701	298.79	23.21	25.07	4/10/04 16:23	412:24:27	412:19:40	20.30781869
-1	63	1084	-4E-05	523	14.070	-3.36071E-05	-0.95	0.010518094	297.84	23.14	25.00	4/11/04 22:41	442:42:27	442:37:40	21.04061549
-4	62	1086	-0.0001	522	14.096	-0.000134934	-3.82	0.010383159	294.02	22.84	24.70	4/12/04 14:38	458:39:27	458:34:40	21.41629053

DESORPTION TERMINATED 4/12/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 20 days

SAMPLE: 1050' to 1051' (Iron Post coal) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	0.3304	149.86

NOTE: lost gas is estimated by time interval between at surface and canister times, and total gas evolved

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
19	off bottom	at surface	in canister	8.5 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:07	0.142 hours
				0.377491722 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
4	71	1087	0.0001	531	14.109	0.000132769	3.76	0.000132769	3.76	0.80	4.87	3/25/04 11:55	23:56:29	23:47:56	4.892993857
16	72	1084	0.0008	532	14.070	0.000528617	14.97	0.000661386	18.73	4.00	8.07	3/26/04 14:43	50:44:29	50:35:56	7.123299017
7	71	1076	0.0002	531	13.986	0.000229995	6.51	0.000891381	25.24	5.40	9.48	3/27/04 16:24	76:25:29	76:16:56	8.742123439
-3	70	1084	-0.0001	530	14.070	-9.94896E-05	-2.82	0.000791892	22.42	4.79	8.88	3/28/04 12:33	96:34:29	96:25:56	9.827243877
-3	63	1086	-0.0001	523	14.096	-0.000101007	-2.86	0.000690885	19.56	4.18	8.24	3/29/04 16:54	124:55:29	124:46:56	11.17697286

DESORPTION TERMINATED 3/29/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 33 days

SAMPLE: 1076' to 1078' (Croweburg coal) cuttings in Dart SSD canister

NOTE: lost gas is estimated by time interval between at surface and canister times, and total gas evolved

	lbs.	grams
dry sample weight:	0.3507	159.07

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
22	off bottom	at surface	in canister	8.5 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:07	0.142 hours
				0.377123817 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
55	71	1087	0.0019	531	14.109	0.00182558	51.89	0.00182558	51.69	10.41	14.84	3/25/04 11:58	23:59:32	23:51:00	4.898185605
19	72	1084	0.0007	532	14.070	0.000627732	17.78	0.002453312	69.47	13.99	18.42	3/26/04 14:54	50:55:32	50:47:00	7.136214371
8	71	1076	0.0003	531	13.966	0.000262852	7.44	0.002716164	76.91	15.49	19.92	3/27/04 16:30	76:31:32	78:23:00	8.747888634
-2	70	1084	-7E-05	530	14.070	-6.63264E-05	-1.88	0.002649838	75.03	15.11	19.54	3/28/04 12:35	96:36:32	96:28:00	9.828982088
-2	63	1086	-7E-05	523	14.096	-6.73382E-05	-1.91	0.0025825	73.13	14.73	19.18	3/29/04 16:54	124:55:32	124:47:00	11.17701013

DESORPTION TERMINATED 3/29/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 33 days

SAMPLE: 1192' to 1195' (Weir-Pittsburg coal) cuttings in Dart SSD canister DCB1

	lbs.	grams
dry sample weight:	0.0000	0

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
28	off bottom	at surface	in canister	7.2 minutes
	3/25/04 8:23	3/25/04 8:25	3/25/04 8:30	0.120 hours
				0.348410161 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
5	78	1088	0.0002	538	14.122	0.000163953	4.64	0.000163953	4.64	#DIV/0!	#DIV/0!	3/25/04 8:32	0:08:42	0:01:30	0.380788655
3	78	1088	0.0001	538	14.122	9.83719E-05	2.79	0.000262325	7.43	#DIV/0!	#DIV/0!	3/25/04 8:33	0:10:12	0:03:00	0.412310582
14	78	1088	0.0005	538	14.122	0.000459069	13.00	0.000721394	20.43	#DIV/0!	#DIV/0!	3/25/04 8:39	0:16:27	0:09:15	0.523609269
3	78	1088	0.0001	538	14.122	9.83719E-05	2.79	0.000819766	23.21	#DIV/0!	#DIV/0!	3/25/04 8:42	0:18:57	0:11:45	0.56199051
10	78	1088	0.0004	538	14.122	0.000327906	9.29	0.001147672	32.50	#DIV/0!	#DIV/0!	3/25/04 8:49	0:26:27	0:19:15	0.66395281
4	77	1088	0.0001	537	14.122	0.000131407	3.72	0.001279079	36.22	#DIV/0!	#DIV/0!	3/25/04 8:53	0:29:57	0:22:45	0.70651728
5	77	1088	0.0002	537	14.122	0.000164258	4.65	0.001443338	40.87	#DIV/0!	#DIV/0!	3/25/04 8:57	0:34:27	0:27:15	0.757737861
4	77	1088	0.0001	537	14.122	0.000131407	3.72	0.001574744	44.59	#DIV/0!	#DIV/0!	3/25/04 9:01	0:38:27	0:31:15	0.800520664
4	77	1088	0.0001	537	14.122	0.000131407	3.72	0.001706151	48.31	#DIV/0!	#DIV/0!	3/25/04 9:06	0:43:27	0:36:15	0.850979827
4	77	1088	0.0001	537	14.122	0.000131407	3.72	0.001837558	52.03	#DIV/0!	#DIV/0!	3/25/04 9:12	0:49:27	0:42:15	0.907836255
3	77	1088	0.0001	537	14.122	9.85551E-05	2.79	0.001936113	54.82	#DIV/0!	#DIV/0!	3/25/04 9:17	0:54:12	0:47:00	0.950438495
44	74	1088	0.0016	534	14.122	0.001453595	41.18	0.003389708	95.99	#DIV/0!	#DIV/0!	3/25/04 11:15	2:52:27	2:45:15	1.695336741
13	74	1087	0.0005	534	14.109	0.000429077	12.15	0.003818785	108.14	#DIV/0!	#DIV/0!	3/25/04 12:01	3:37:42	3:30:30	1.904818452
78	72	1084	0.0028	532	14.070	0.002577006	72.97	0.006395791	181.11	#DIV/0!	#DIV/0!	3/26/04 14:57	30:33:42	30:26:30	5.528260727
31	71	1076	0.0011	531	13.966	0.001018551	28.84	0.007414342	209.95	#DIV/0!	#DIV/0!	3/27/04 16:31	56:07:42	56:00:30	7.491884498
9	70	1089	0.0003	530	14.135	0.000299846	8.49	0.007714187	218.44	#DIV/0!	#DIV/0!	3/28/04 12:36	76:12:42	76:05:30	8.729929362
9	65	1086	0.0003	525	14.096	0.000301867	8.55	0.008016055	226.99	#DIV/0!	#DIV/0!	3/29/04 16:55	104:31:42	104:24:30	10.22390988
1	63	1088	4E-05	523	14.122	3.37311E-05	0.96	0.008049786	227.94	#DIV/0!	#DIV/0!	3/30/04 20:03	131:39:42	131:32:30	11.47439178
4	64	1088	0.0001	524	14.122	0.000134687	3.81	0.008184453	231.76	#DIV/0!	#DIV/0!	3/31/04 14:14	149:50:42	149:43:30	12.24111923
12	69	1084	0.0004	529	14.070	0.000398711	11.29	0.008583164	243.05	#DIV/0!	#DIV/0!	4/1/04 9:46	169:22:42	189:15:30	13.01454315
1	65	1089	4E-05	525	14.135	3.36335E-05	0.95	0.008616797	244.00	#DIV/0!	#DIV/0!	4/2/04 11:13	194:49:42	194:42:30	13.95809204
4	66	1088	0.0001	528	14.122	0.000134155	3.80	0.008750952	247.80	#DIV/0!	#DIV/0!	4/3/04 17:02	224:38:42	224:31:30	14.988162
1	65	1087	4E-05	525	14.109	3.35717E-05	0.95	0.008784524	248.75	#DIV/0!	#DIV/0!	4/4/04 15:22	246:58:42	246:51:30	15.71554432
3	65	1082	0.0001	525	14.044	0.000100252	2.84	0.008884776	251.59	#DIV/0!	#DIV/0!	4/5/04 21:10	276:46:42	276:39:30	16.63665631
7	67	1080	0.0002	527	14.018	0.000232603	6.59	0.009117378	258.17	#DIV/0!	#DIV/0!	4/6/04 14:23	293:59:42	293:52:30	17.1462824
7	68	1076	0.0002	528	13.966	0.000231302	6.55	0.00934868	264.72	#DIV/0!	#DIV/0!	4/7/04 14:00	317:38:42	317:29:30	17.82166285
0	67	1082	0	527	14.044	0	0.00	0.00934868	264.72	#DIV/0!	#DIV/0!	4/8/04 14:10	341:46:42	341:39:30	18.48724786
2	66	1081	7E-05	526	14.031	6.66459E-05	1.89	0.009415326	266.61	#DIV/0!	#DIV/0!	4/9/04 16:39	368:15:42	368:08:30	19.19014504
0	63	1084	0	523	14.070	0	0.00	0.009415326	266.61	#DIV/0!	#DIV/0!	4/11/04 22:42	422:18:42	422:11:30	20.55022303
-4	62	1086	-0.0001	522	14.096	-0.000134934	-3.82	0.009280392	262.79	#DIV/0!	#DIV/0!	4/12/04 14 28	438:04:42	437:57:30	20.93032091
-2	61	1088	-7E-05	521	14.122	-6.77212E-05	-1.92	0.009212671	260.87	#DIV/0!	#DIV/0!	4/13/04 14:08	461 44:42	461:37:30	21.4882526

DESORPTION TERMINATED 4/12/2004 DUE TO NO MORE GAS BEING EVOLVED (CANISTER HAS LEAK!); sample not saved

SAMPLE: 1324' to 1325' (Dry Wood coal) cuttings in Dart SSD canister DCB2

	lbs.	grams
dry sample weight:	2.1668	982.85

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
19	off bottom	at surface	in canister	8.7 minutes
	3/25/04 9:26	3/25/04 9:28	3/25/04 9:34	0.144 hours
				0.380058475 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	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)
0.5	75	1088	2E-05	535	14.122	1.64873E-05	0.47	1.64873E-05	0.47	0.02	0.83	3/25/04 9:39	0:13:10	0:04:30	0.468448977
2	75	1088	7E-05	535	14.122	6.5949E-05	1.87	8.24363E-05	2.33	0.08	0.70	3/25/04 9:41	0:15:40	0:07:00	0.510990324
1.5	75	1088	5E-05	535	14.122	4.94818E-05	1.40	0.000131898	3.73	0.12	0.74	3/25/04 9:46	0:20:40	0:12:00	0.586893895

1	75	1088	4E-05	535	14.122	3.29745E-05	0.93	0.000164873	4.67	0.15	0.77	3/25/04	9:51	0:24:55	0:18:15	0.644420498
4	74	1088	0.0001	534	14.122	0.000132145	3.74	0.000297018	8.41	0.27	0.89	3/25/04	10:03	0:36:55	0:28:15	0.784396442
4	74	1088	0.0001	534	14.122	0.000132145	3.74	0.000429163	12.15	0.40	1.02	3/25/04	10:18	0:52:10	0:43:30	0.932440049
6.5	74	1088	0.0002	534	14.122	0.000214736	6.08	0.000643898	18.23	0.59	1.21	3/25/04	11:14	1:47:55	1:39:15	1.341123078
5	74	1087	0.0002	534	14.109	0.000165029	4.67	0.000808928	22.91	0.75	1.37	3/25/04	12:03	2:36:55	2:28:15	1.617182048
-1	72	1084	-4E-05	532	14.070	-3.30385E-05	-0.94	0.000775889	21.97	0.72	1.34	3/26/04	14:58	29:31:55	29:23:15	5.434330174
-3	71	1076	-0.0001	531	13.966	-9.85694E-05	-2.79	0.00067732	19.18	0.63	1.24	3/27/04	16:31	55:04:55	54:56:15	7.421721124
-5	70	1084	-0.0002	530	14.070	-0.000165816	-4.70	0.000511504	14.48	0.47	1.09	3/28/04	12:37	75:10:55	75:02:15	8.670752242
-4	65	1086	-0.0001	525	14.098	-0.000134183	-3.80	0.00037734	10.69	0.35	0.97	3/29/04	16:55	103:28:55	103:20:15	10.17260755

DESORPTION TERMINATED 3/29/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 33 days

SAMPLE: 1404' to 1406' (Rowe coal) cuttings in Dart SSD canister DCB3

	lbs.	grams
dry sample weight:	2.2810	1034.7

est. lost gas (cc) = 115

TIME OF: off bottom 3/25/04 10:09; at surface 3/25/04 10:09; in canister 3/25/04 10:18

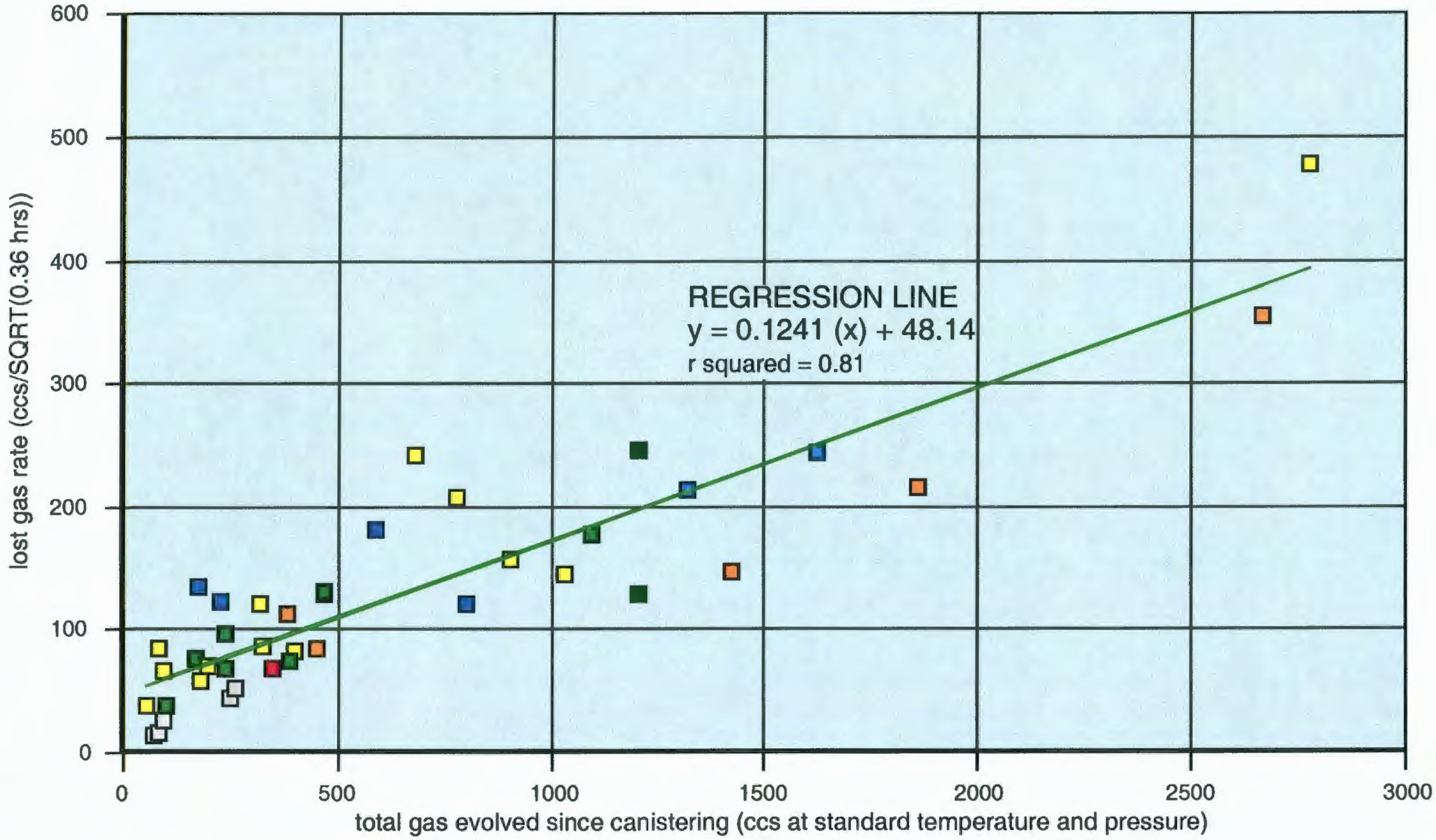
elapsed time (off bottom to canistering): 9.0 minutes; 0.150 hours; 0.387298335 SQRT (hrs)

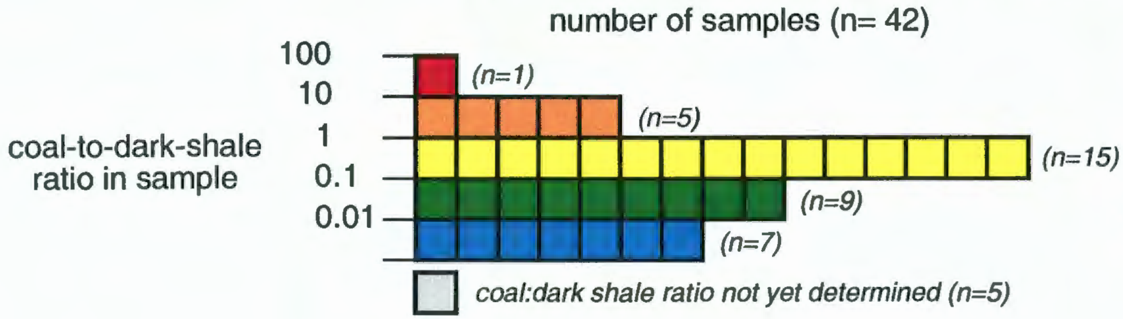
RIG/LAB MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi) cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON without lost gas	SCF/TON with lost gas	TIME OF MEASURE		TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
30	74	1088	0.0011	534	14.122	0.000991088	28.06	0.000991088	28.06	0.87	4.43	3/25/04	10:23	0:14:15	0:05:15	0.487339717
9	74	1088	0.0003	534	14.122	0.000297326	8.42	0.001288414	36.48	1.13	4.69	3/25/04	10:24	0:15:45	0:06:45	0.512347538
9	74	1088	0.0003	534	14.122	0.000297326	8.42	0.00158574	44.90	1.39	4.95	3/25/04	10:26	0:17:30	0:08:30	0.540061725
17	74	1088	0.0006	534	14.122	0.000561816	15.90	0.002147357	60.81	1.88	5.44	3/25/04	10:30	0:21:15	0:12:15	0.595119036
14	74	1088	0.0005	534	14.122	0.000462508	13.10	0.002609864	73.90	2.29	5.85	3/25/04	10:33	0:24:30	0:15:30	0.63900965
8	74	1088	0.0003	534	14.122	0.00028429	7.48	0.002874154	81.39	2.52	6.08	3/25/04	10:35	0:26:45	0:17:45	0.667707521
14	74	1088	0.0005	534	14.122	0.000462508	13.10	0.003336662	94.48	2.93	6.49	3/25/04	10:39	0:30:30	0:21:30	0.712974988
10	74	1088	0.0004	534	14.122	0.000330363	9.35	0.003667025	103.84	3.22	6.76	3/25/04	10:42	0:33:15	0:24:15	0.744423714
14	74	1088	0.0005	534	14.122	0.000462508	13.10	0.004129532	116.93	3.62	7.18	3/25/04	10:46	0:37:30	0:28:30	0.790569415
38	74	1088	0.0013	534	14.122	0.001255378	35.55	0.00538491	152.48	4.72	8.28	3/25/04	10:59	0:50:45	0:41:45	0.919691977
26	74	1088	0.0009	534	14.122	0.000858943	24.32	0.006243853	176.81	5.47	9.04	3/25/04	11:11	1:02:15	0:53:15	1.018577439
90	74	1087	0.0032	534	14.109	0.00297053	84.12	0.009214383	260.92	8.08	11.64	3/25/04	12:04	1:55:00	1:46:00	1.38443731
490	72	1088	0.0173	532	14.122	0.016248823	460.11	0.025463006	721.03	22.33	25.89	3/26/04	14:58	28:49:00	28:40:00	5.368115746
172	71	1076	0.0061	531	13.966	0.005651314	160.03	0.031114319	881.06	27.28	30.84	3/27/04	16:32	54:23:00	54:14:00	7.374505633
79	70	1084	0.0028	530	14.070	0.002619894	74.19	0.033734213	955.24	29.58	33.14	3/28/04	12:38	74:29:00	74:20:00	8.630372723
66	65	1086	0.0023	525	14.098	0.002213694	62.68	0.035947908	1017.93	31.52	35.08	3/29/04	16:56	102:47:00	102:38:00	10.13821155
41	63	1088	0.0014	523	14.122	0.001382975	39.16	0.037330882	1057.09	32.73	36.29	3/30/04	8:03	117:54:00	117:45:00	10.85817664
27	64	1088	0.001	524	14.122	0.000909001	25.74	0.038239884	1082.83	33.53	37.09	3/31/04	14:15	148:08:00	147:57:00	12.16963434
37	69	1084	0.0013	529	14.070	0.001229358	34.81	0.039469242	1117.64	34.61	38.17	4/1/04	9:47	167:38:00	167:29:00	12.9473292
28	65	1089	0.001	525	14.135	0.000941737	26.67	0.04041098	1144.31	35.43	38.99	4/2/04	11:14	193:05:00	192:56:00	13.8954429
26	66	1088	0.0009	526	14.122	0.000872006	24.69	0.041282986	1169.00	36.20	39.76	4/3/04	17:02	222:53:00	222:44:00	14.92927772
17	65	1087	0.0006	525	14.109	0.000570719	16.16	0.041853705	1185.16	36.70	40.26	4/4/04	15:23	245:14:00	245:05:00	15.65992763
22	65	1082	0.0008	525	14.044	0.00073518	20.82	0.042588885	1205.98	37.34	40.90	4/5/04	21:10	275:01:00	274:52:00	16.58362646
14	67	1080	0.0005	527	14.018	0.000465205	13.17	0.04305409	1219.15	37.75	41.31	4/6/04	14:23	292:14:00	292:05:00	17.09483353
20	68	1076	0.0007	528	13.966	0.000660863	18.71	0.043714954	1237.86	38.33	41.89	4/7/04	14:01	315:52:00	315:43:00	17.77263815
12	67	1082	0.0004	527	14.044	0.000399486	11.31	0.044114439	1249.18	38.68	42.24	4/8/04	14:10	340:01:00	339:52:00	18.43954085
13	66	1081	0.0005	526	14.031	0.000433198	12.27	0.044547637	1261.44	39.06	42.62	4/9/04	16:38	366:29:00	366:20:00	19.14375442
0	62	1087	0	522	14.109	0	0.00	0.044547637	1261.44	39.06	42.62	4/10/04	16:23	390:14:00	390:05:00	19.75432442
1	63	1084	4E-05	523	14.070	3.36071E-05	0.95	0.044581244	1262.40	39.09	42.65	4/11/04	22:41	420:32:00	420:23:00	20.5069094
5	62	1086	0.0002	522	14.096	0.000168666	4.78	0.044749912	1267.17	39.24	42.80	4/12/04	14:39	436:30:00	436:21:00	20.89258242
5	61	1088	0.0002	521	14.122	0.000169303	4.79	0.044919215	1271.97	39.39	42.95	4/13/04	14:09	460:00:00	459:51:00	21.44761059
11	62	1085	0.0004	522	14.083	0.000370728	10.50	0.045289943	1282.46	39.71	43.27	4/14/04	14:06	483:57:00	483:48:00	21.99886381
17	64	1076	0.0006	524	13.966	0.000566022	16.03	0.045855965	1298.49	40.21	43.77	4/15/04	14 26	508:17:00	508:08 00	22.5451399
15	68	1078	0.0005	528	13.992	0.000496569	14.06	0.046352533	1312.55	40.64	44.20	4/16/04	13 53	531:44:00	531:35 00	23.05934373
13	71	1081	0.0005	531	14.031	0.000429119	12.15	0.046781652	1324.70	41.02	44.58	4/17/04	19 30	561:21:00	561 12:00	23.69282592
10	71	1079	0.0004	531	14.005	0.000329481	9.33	0.047111133	1334.03	41.31	44.87	4/18/04	16:00	581 51 00	581 42 00	24.12156711
2	68	1088	7E-05	528	14.122	6.68233E-05	1.89	0.047177957	1335.93	41.37	44.93	4/19/04	14 01	603 52 00	603:43:00	24.57369868
18	71	1071	0.0006	531	13.901	0.000588668	16.67	0.047766625	1352.60	41.88	45.44	4/20/04	12:56	626 47 00	626:38:00	25.03564126
7	68	1075	0.0002	528	13.953	0.000231087	6.54	0.047997712	1359.14	42.08	45.65	4/21/04	13 12	651:03:00	650:54:00	25.51568145
4	68	1080	0.0001	528	14.018	0.000132664	3.76	0.048130376	1362.90	42.20	45.78	4/22/04	16:14	678:05:00	677:56:00	26.04003328
-2	66	1088	-7E-05	526	14.122	-6.70774E-05	-1.90	0.048063299	1361.00	42.14	45.70	4/23/04	14:20	700 11 00	700 02 00	26.46097756
11	69	1078	0.0004	529	13.992	0.000363482	10.29	0.048426761	1371.29	42.48	48.02	4/24/04	12:09	722:00:00	721:51:00	26.87005769
1	66	1090	4E-05	526	14.148	3.36004E-05	0.95	0.048460361	1372.24	42.49	46.05	4/26/04	11:17	769:08:00	768:59:00	27.73325321
6	65	1087	0.0002	525	14.109	0.00020143	5.70	0.048661791	1377.94	42.87	46.23	4/27/04	12:31	794:22:00	794:13:00	28.18451111
15	68	1072	0.0005	528	13.914	0.000493805	13.98	0 049155596	1391.93	43.10	46.66	4/28/04	15:28	821:19:00	821:10:00	28.6586229
4	68	1079	0.0001	528	14.005	0.000132541	3.76	0 049288137	1395.68	43.22	46.78	4/29/04	14:27	844:18:00	844:09:00	29.05684085

0	66	1086	0	526	14.096	0	0.00	0.049288137	1395.68	43.22	46.78	5/1/04 17:42	895:33:00	895:24:00	29.92574143
2	64	1083	7E-05	524	14.057	6.7024E-05	1.90	0.049355161	1397.58	43.27	46.84	5/3/04 18:38	944:29:00	944:20:00	30.73244756
8	66	1081	0.0003	528	14.031	0.000266583	7.55	0.049621745	1405.13	43.51	47.07	5/5/04 9:35	983:26:00	983:17:00	31.35974065
8	69	1079	0.0003	529	14.005	0.000264581	7.49	0.049886326	1412.62	43.74	47.30	5/6/04 10:52	1008:43:00	1008:34:00	31.76030017
6	71	1084	0.0002	531	14.070	0.000198605	5.62	0.05008493	1418.24	43.91	47.48	5/7/04 13:27	1035:18:00	1035:09:00	32.17607807
7	70	1080	0.0002	530	14.018	0.000231286	6.55	0.050316216	1424.79	44.12	47.68	5/8/04 14:25	1060:16:00	1060:07:00	32.56173624
7	71	1078	0.0002	531	13.992	0.000230423	6.52	0.050546639	1431.32	44.32	47.88	5/9/04 19:46	1089:37:00	1089:28:00	33.00934211
3	71	1081	0.0001	531	14.031	9.90275E-05	2.80	0.050645666	1434.12	44.41	47.97	5/10/04 13:50	1107:41:00	1107:32:00	33.28187695
7	71	1077	0.0002	531	13.979	0.000230209	6.52	0.050875876	1440.64	44.61	48.17	5/11/04 14:10	1132:01:00	1131:52:00	33.64545536
7	72	1076	0.0002	532	13.968	0.000229563	6.50	0.051105439	1447.14	44.81	48.37	5/12/04 10:35	1152:26:00	1152:17:00	33.9475085
0	72	1081	0	532	14.031	0	0.00	0.051105439	1447.14	44.81	48.37	5/13/04 14:19	1180:10:00	1180:01:00	34.35355392
-9	65	1088	-0.0003	525	14.122	-0.000302423	-8.56	0.050803015	1438.58	44.54	48.11	5/15/04 23:19	1237:10:00	1237:01:00	35.17338009
6	68	1082	0.0002	528	14.044	0.000199364	5.65	0.05100238	1444.22	44.72	48.28	5/17/04 9:34	1271:25:00	1271:16:00	35.65693014
4	70	1083	0.0001	530	14.057	0.00013253	3.75	0.05113491	1447.97	44.84	48.40	5/18/04 14:29	1300:20:00	1300:11:00	36.06013496
9	72	1081	0.0003	532	14.031	0.000296524	8.40	0.051431434	1456.37	45.10	48.68	5/20/04 13:48	1347:39:00	1347:30:00	36.71035276
8	73	1079	0.0003	533	14.005	0.000262596	7.44	0.05169403	1463.81	45.33	48.89	5/21/04 13:49	1371:40:00	1371:31:00	37.0360185
10	72	1074	0.0004	532	13.940	0.000327338	9.27	0.052021367	1473.08	45.61	49.17	5/23/04 14:57	1420:48:00	1420:39:00	37.69350077
3	73	1075	0.0001	533	13.953	9.81083E-05	2.78	0.052119476	1475.85	45.70	49.26	5/24/04 10:22	1440:13:00	1440:04:00	37.95018665
-2	71	1080	-7E-05	531	14.018	-6.59572E-05	-1.87	0.052053518	1473.99	45.64	49.20	5/25/04 11:48	1465:39:00	1485:30:00	38.28380859
3	70	1075	0.0001	530	13.953	9.86636E-05	2.79	0.052152182	1476.78	45.73	49.29	5/26/04 12:34	1490:25:00	1490:16:00	38.60591492
5	70	1070	0.0002	530	13.888	0.000163675	4.63	0.052315856	1481.41	45.87	49.43	5/27/04 11:09	1513:00:00	1512:51:00	38.89730068
-2	72	1078	-7E-05	532	13.992	-8.57113E-05	-1.86	0.052250145	1479.55	45.81	49.37	5/28/04 13:10	1539:01:00	1538:52:00	39.23030291
6	71	1069	0.0002	531	13.875	0.000195856	5.55	0.052446001	1485.10	45.98	49.55	5/29/04 14:18	1564:09:00	1564:00:00	39.54933628
5	71	1067	0.0002	531	13.849	0.000162908	4.81	0.05260891	1489.71	48.13	49.69	5/30/04 12:42	1586:33:00	1586:24:00	39.83152018
-3	70	1077	-0.0001	530	13.979	-9.88472E-05	-2.80	0.052510063	1486.91	46.04	49.60	6/1/04 10:47	1632:38:00	1632:29:00	40.40585766
-5	70	1085	-0.0002	530	14.083	-0.000165969	-4.70	0.052344093	1482.21	45.90	49.46	6/2/04 13:32	1659:23:00	1659:14:00	40.73552913
-2	70	1090	-7E-05	530	14.148	-6.66935E-05	-1.89	0.0522774	1480.33	45.84	49.40	6/3/04 11:07	1680:58:00	1880:49:00	40.99959349
3	71	1087	0.0001	531	14.109	9.95771E-05	2.82	0.052376977	1483.15	45.92	49.49	6/4/04 13:41	1707:32:00	1707:23:00	41.32231036

SAMPLE DECANISTERED 6/4/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 5 days

RELATIONSHIP of TOTAL GAS EVOLVED FROM a CUTTINGS SAMPLE to RATE of LOST-GAS
(from 42 cuttings samples from air-drilled wells, Cherokee basin, southeastern Kansas)





LOST-GAS ALGORITHM

$$\text{ccs lost gas} = \sqrt{X}\ (Y)$$

where X = bottom-hole to canister time (in hours)
where Y = ccs lost gas at 0.36 hours
(i.e., value Y from regression equation)

FIGURE 3.

1192' to 1195' (Weir-Pittsburg coal) cuttings in Dart SSD canister DCB1

Dart Cherokee Basin Southwinds Buffalo Ranch #B2-2; 2-T.34S.-R.14E.; Montgomery County, KS

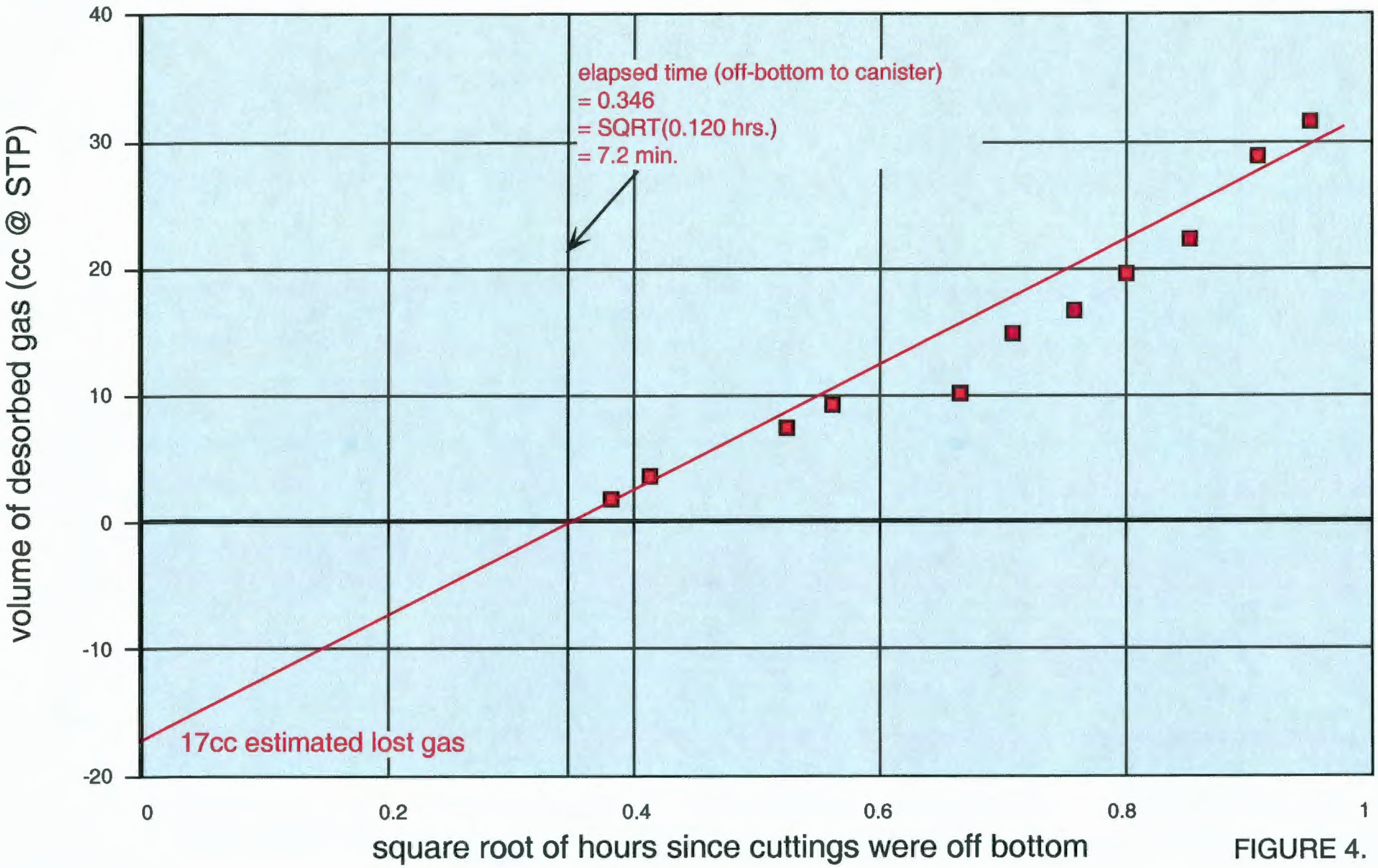


FIGURE 4.

1322' to 1323' (Dry Wood coal) cuttings in Dart SSD canister DCB2

Dart Cherokee Basin Southwinds Buffalo Ranch #B2-2; 2-T.34S.-R.14E.; Montgomery County, KS

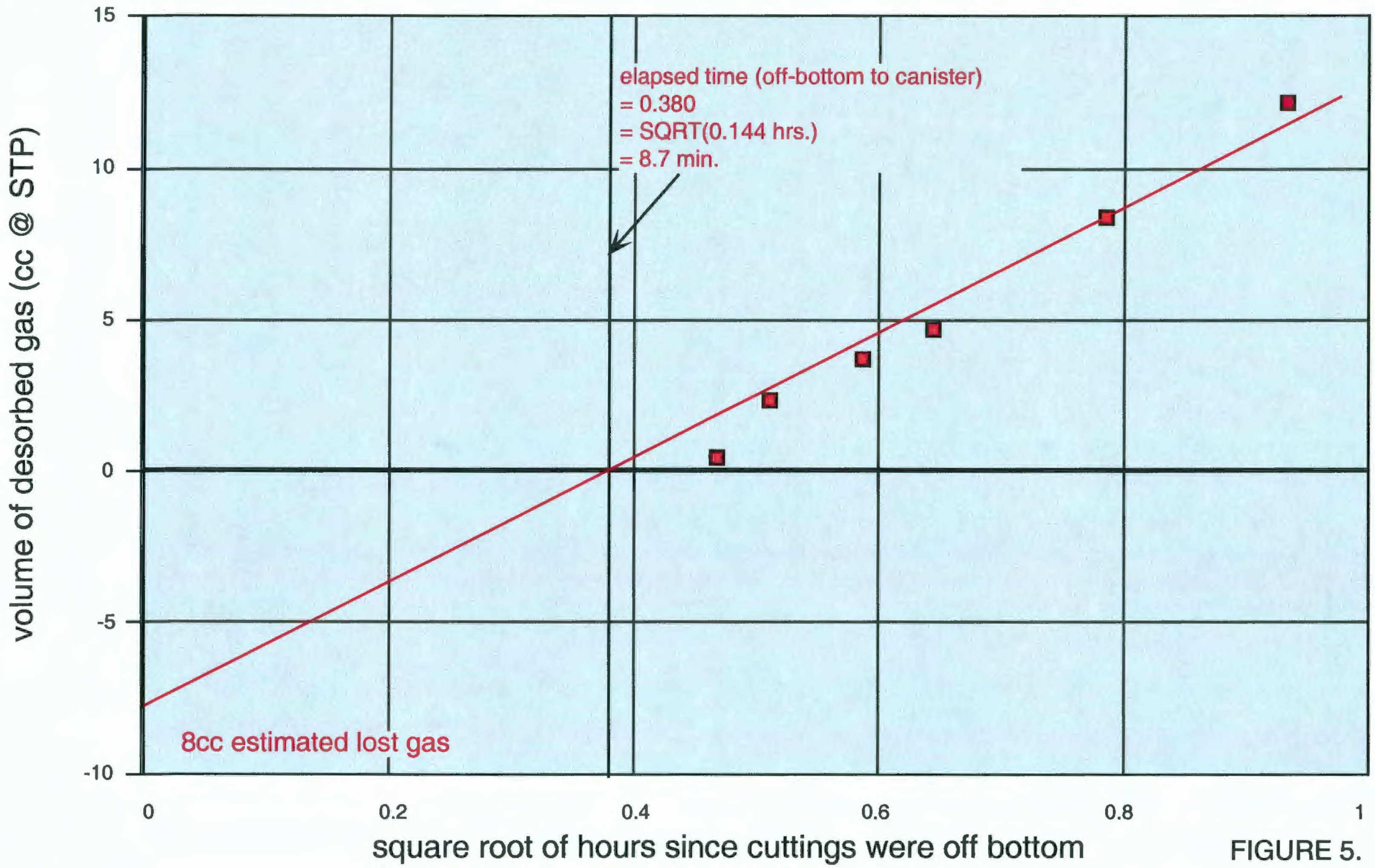


FIGURE 5.

1404' to 1406' (Rowe coal) cuttings in Dart SSD canister DCB3

Dart Cherokee Basin Southwinds Buffalo Ranch #B2-2; 2-T.34S.-R.14E.; Montgomery County, KS

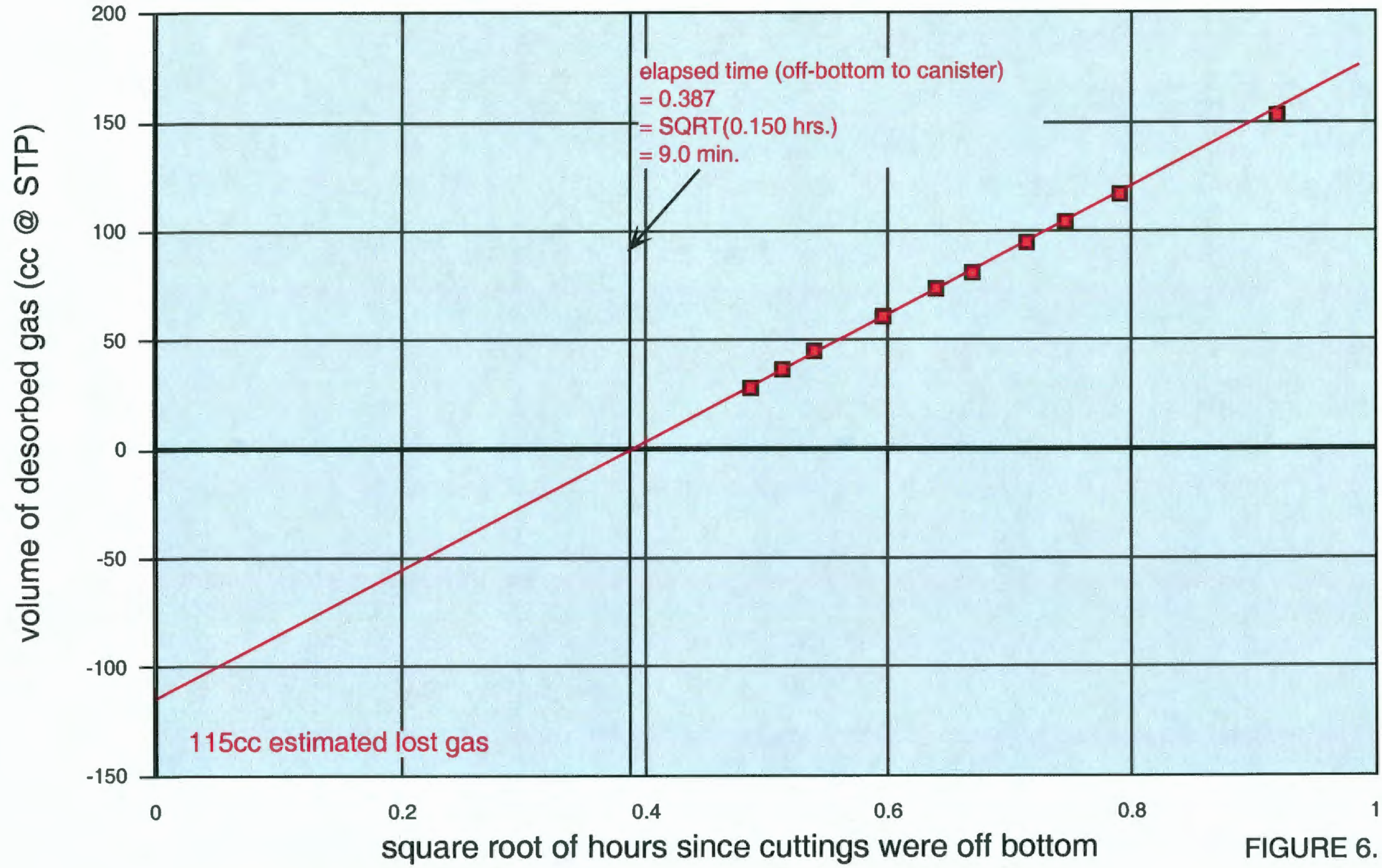


FIGURE 6.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

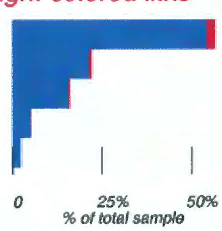
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Little Osage Shale from 994' to 998'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed
(including estimated lost gas) = 274.8 ccs

TOTAL DRY WEIGHT OF SAMPLE = 462.25 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 17.03 grams (3.7%)
$\text{weight}_{dark\ shale}$ = 444.16 grams (96.1%)
weight_{coal} = 1.06 grams (0.2%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	257.10	0.19% / 95.57% / 4.24%
>0.0661"	100.00	0.40% / 96.81% / 2.79%
>0.0460"	71.88	0.11% / 96.55% / 3.34%
>0.0331"	23.03	0.35% / 96.88% / 2.78%
<0.0331"	10.25	0.25% / 97.00% / 2.75%
	462.25 TOTAL	



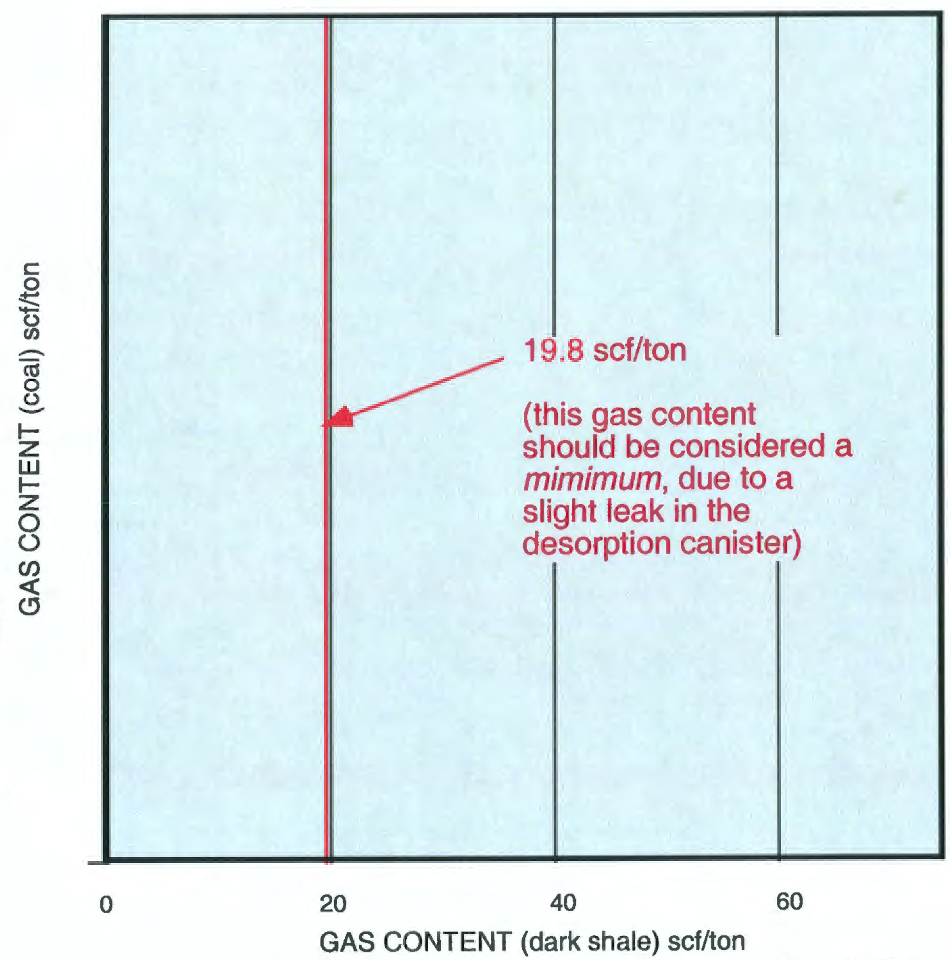


FIGURE 7.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

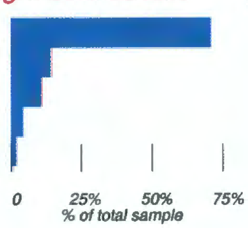
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Excello Shale from 1025' to 1030'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed
(including estimated lost gas) = 328.5 ccs

TOTAL DRY WEIGHT OF SAMPLE = 413.69 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 1.26 grams (0.3%)
$\text{weight}_{dark\ shale}$ = 412.43 grams (99.7%)
weight_{coal} = 00.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	289.61	0.00% / 99.92% / 0.08%
>0.0661"	56.66	0.00% / 99.35% / 0.65%
>0.0460"	43.31	0.00% / 98.80% / 1.20%
>0.0331"	16.69	0.00% / 99.56% / 0.44%
<0.0331"	7.42	0.00% / 99.00% / 1.00%
	413.69 TOTAL	



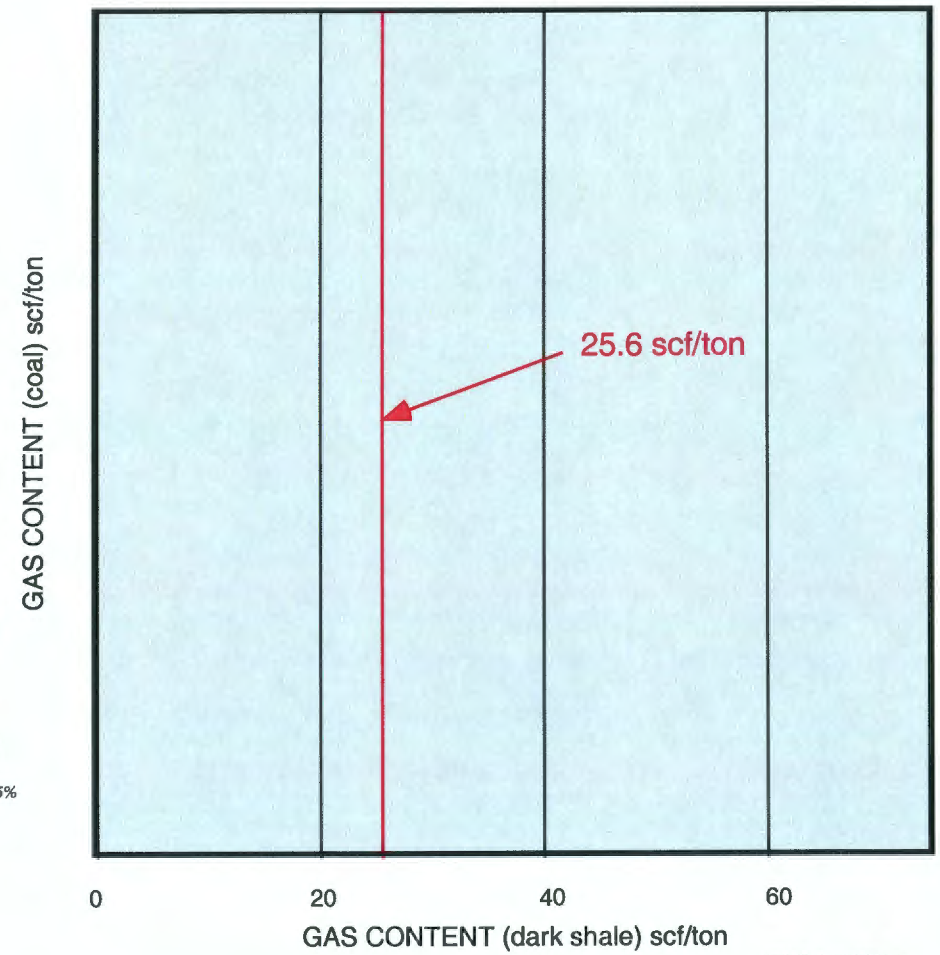


FIGURE 8.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

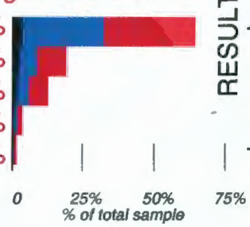
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Iron Post coal from 1050' to 1051'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed
(including estimated lost gas) = 44.2 ccs

TOTAL DRY WEIGHT OF SAMPLE = 308.17 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 158.31 grams (51.4%)
$\text{weight}_{dark\ shale}$ = 127.20 grams (41.3%)
weight_{coal} = 22.66 grams (7.4%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	196.63	5.03% / 44.89% / 50.08%
>0.0661"	58.26	10.89% / 35.28% / 53.83%
>0.0460"	38.44	10.85% / 34.91% / 54.24%
>0.0331"	10.48	15.22% / 34.78% / 50.00%
<0.0331"	4.37	15.00% / 30.00% / 55.00%
	308.17 TOTAL	



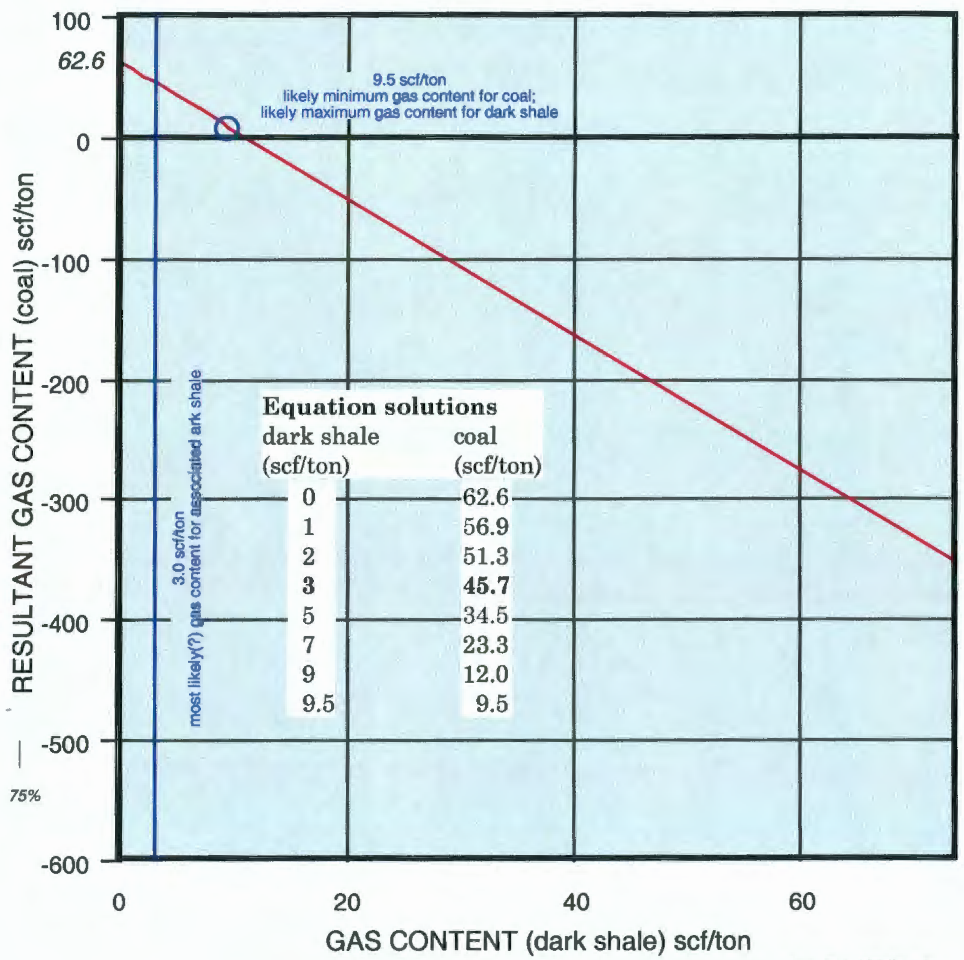


FIGURE 9.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

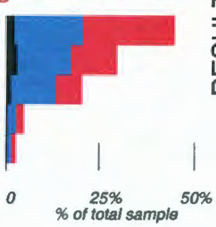
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Croweburg coal from 1076' to 1078'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed
(including estimated lost gas) = 98.9 ccs

TOTAL DRY WEIGHT OF SAMPLE = 292.19 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 133.12 grams (45.6%)
$\text{weight}_{dark\ shale}$ = 141.02 grams (48.3%)
weight_{coal} = 18.05 grams (6.2%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	128.69	4.59% / 41.56% / 53.85%
>0.0661"	85.06	9.23% / 49.79% / 40.98%
>0.0460"	58.04	5.59% / 60.53% / 33.88%
>0.0331"	13.49	5.15% / 51.55% / 43.30%
<0.0331"	6.91	5.00% / 45.00% / 50.00%
	292.19 TOTAL	



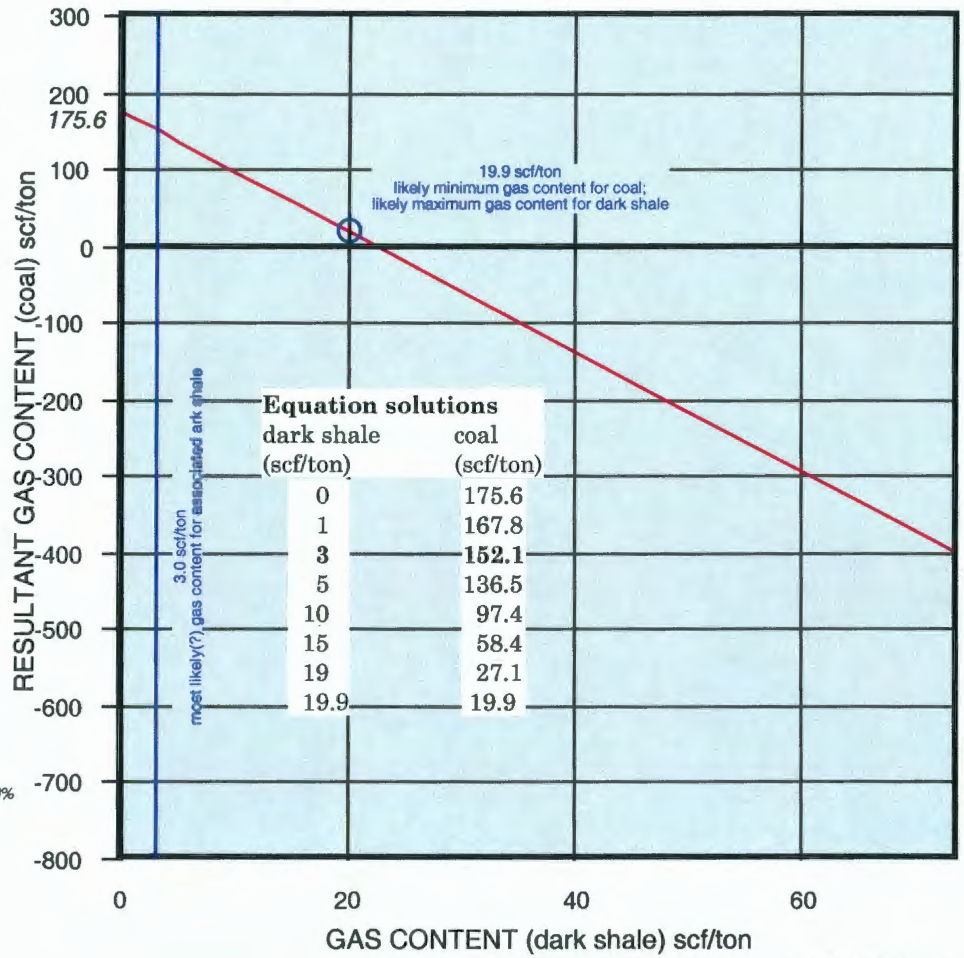


FIGURE 10.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

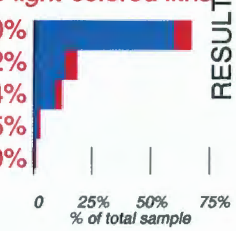
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Dry Wood coal from 1324' to 1325'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed = 41.9 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1170.41 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 187.56 grams (16.0%)
$\text{weight}_{dark\ shale}$ = 970.79 grams (82.9%)
weight_{coal} = 12.05 grams (1.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	776.47	0.87% / 88.83% / 10.30%
>0.0661"	211.34	1.47% / 71.11% / 27.42%
>0.0460"	138.82	1.31% / 74.34% / 24.34%
>0.0331"	32.12	0.82% / 63.93% / 35.25%
<0.0331"	11.65	1.00% / 60.00% / 39.00%
	1170.41 TOTAL	



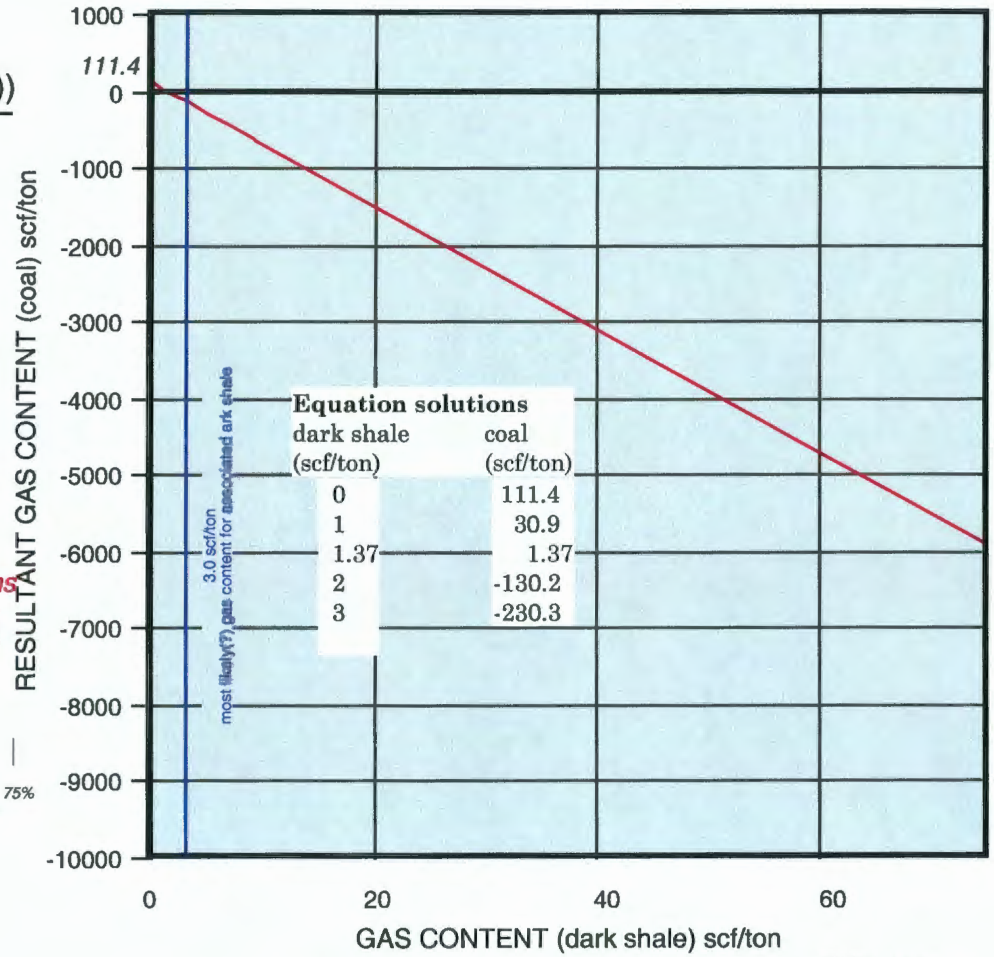


FIGURE 11.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Rowe coal from 1404' to 1406'

$$\text{GAS CONTENT}_{coal} = \frac{\text{total gas desorbed} - ((\text{gas content}_{dark\ shale}) * (\text{weight}_{dark\ shale}))}{\text{weight}_{coal}}$$

total gas desorbed = 1604.7 ccs

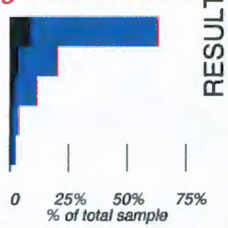
TOTAL DRY WEIGHT OF SAMPLE = 1053.29 grams

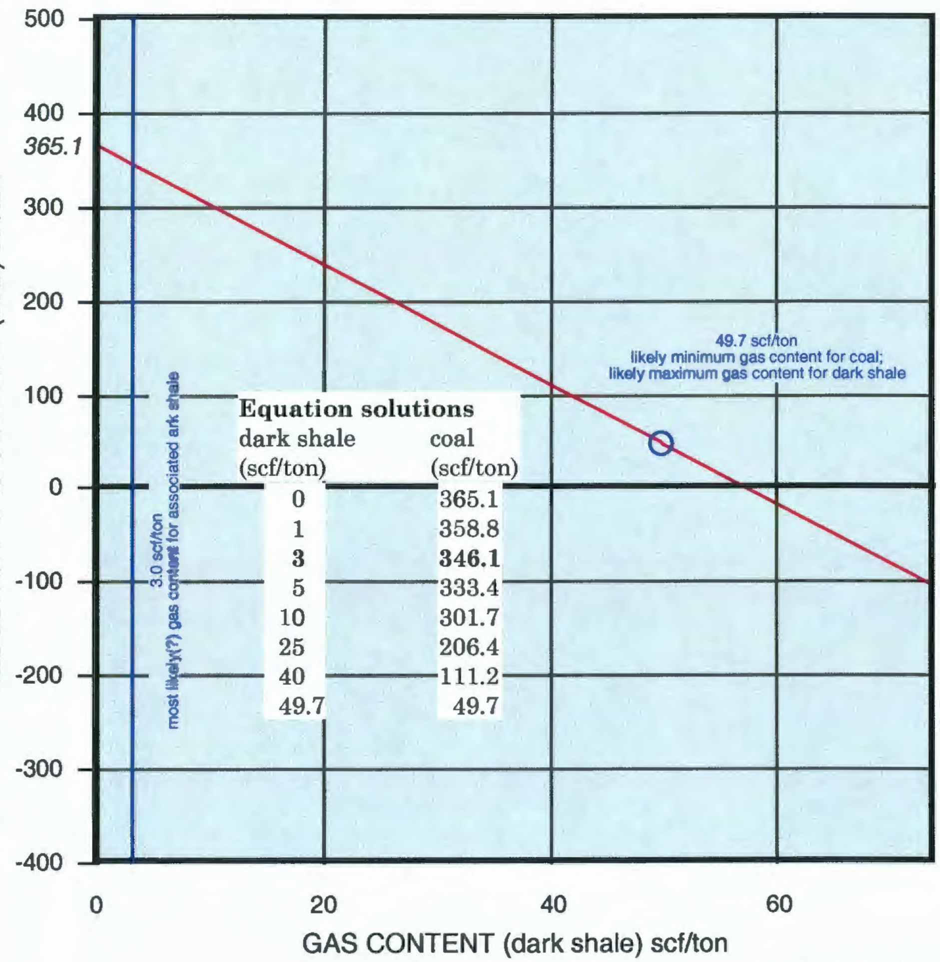
$\text{weight}_{light\text{-}colored\ lithologies}$ = 18.64 grams (1.8%)

$\text{weight}_{dark\ shale}$ = 893.85 grams (84.9%)

weight_{coal} = 140.80 grams (13.4%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	659.65	13.08% / 85.72% / 1.20%
>0.0661"	209.31	15.93% / 81.19% / 2.88%
>0.0460"	118.56	13.69% / 83.82% / 2.49%
>0.0331"	39.36	9.88% / 86.42% / 3.70%
<0.0331"	26.40	4.00% / 95.00% / 1.00%
	1053.29 TOTAL	

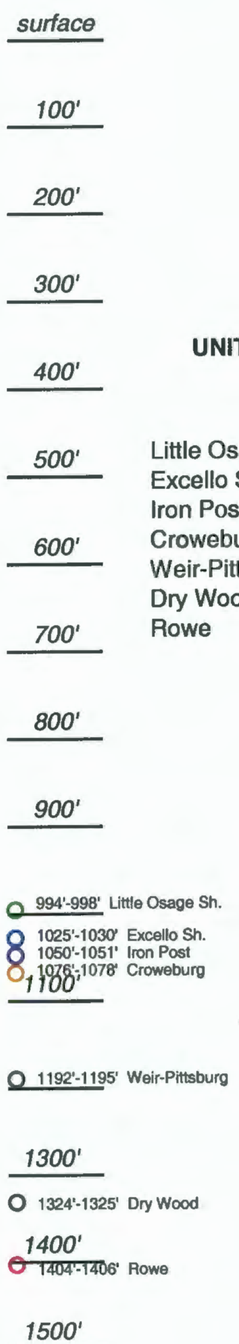




Equation solutions

dark shale (scf/ton)	coal (scf/ton)
0	365.1
1	358.8
3	**346.1**
5	333.4
10	301.7
25	206.4
40	111.2
49.7	49.7

FIGURE 12.



Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for all samples

UNIT	coal in sample	scf/ton w/ shale @ 3 scf/ton	maximum scf/ton	minimum scf/ton
Little Osage Sh.	0%	----	----	19.8
Excello Sh.	0%	----	----	25.6
Iron Post	7%	45.7	62.6	9.5
Croweburg	6%	152.1	175.6	19.9
Weir-Pittsburg	----		*no valid data*	
Dry Wood	1%		*no valid data*	
Rowe	13%	346.1	365.1	49.7

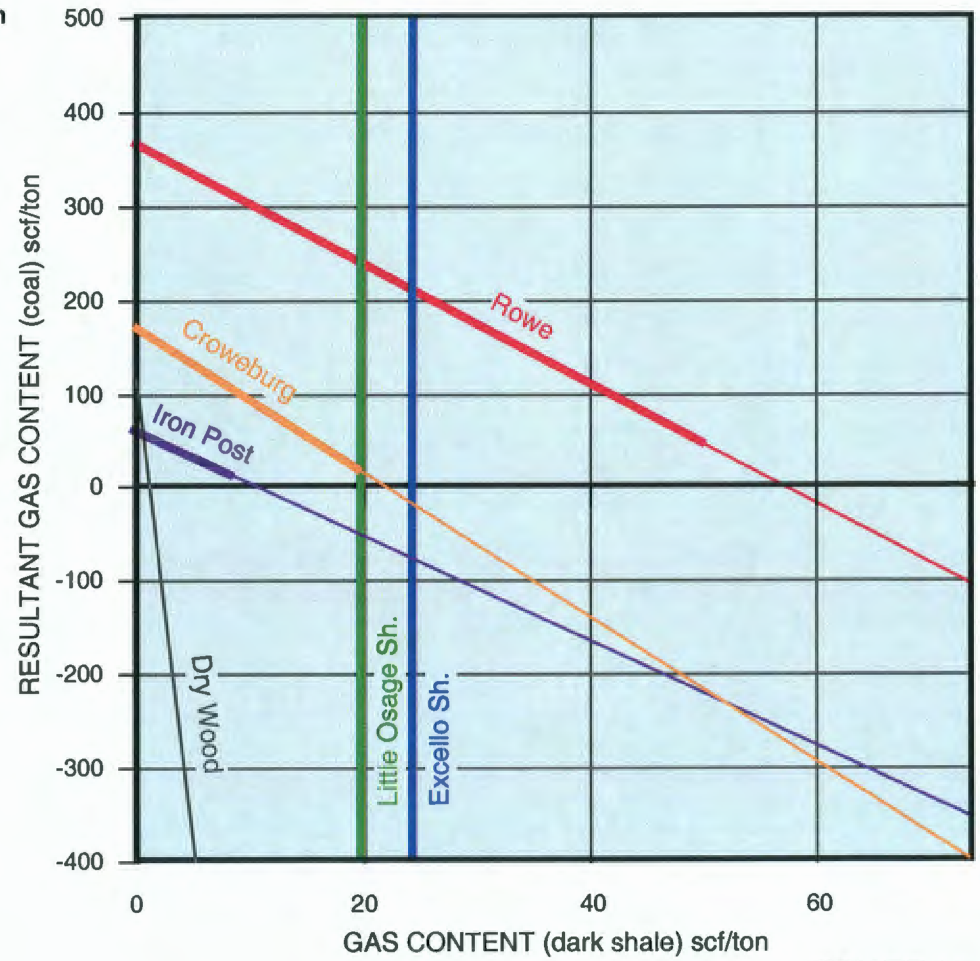


FIGURE 13.

Desorption Characteristics of Cuttings Samples

based on total weight of gas-generating lithologies (i.e., coal and dark shale) in sample
Dart Cherokee Basin #B2-2 Southwinds Buffalo Ranch, 2-T.34S.-R.14E., Montgomery County, KS

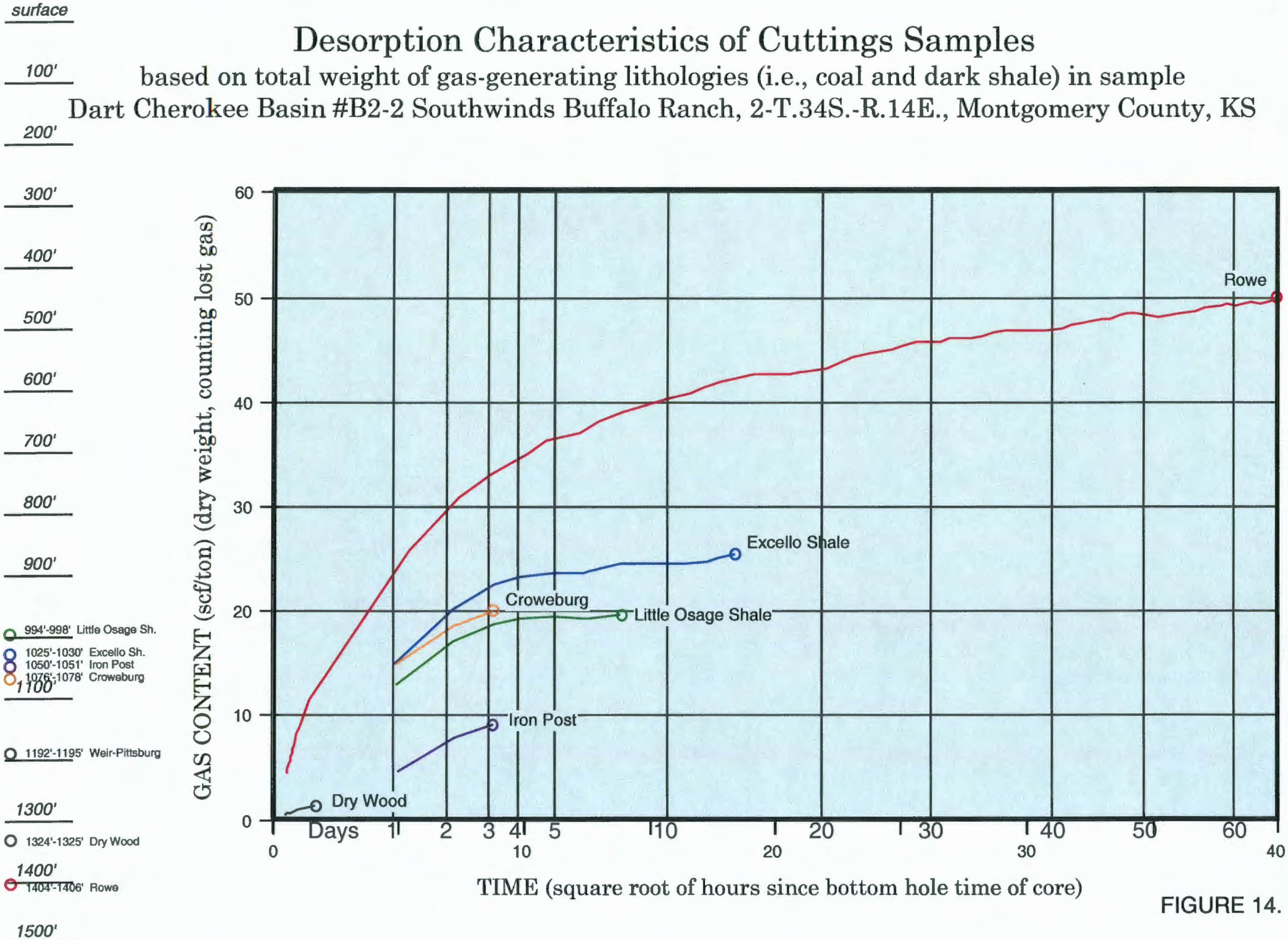


FIGURE 14.