ANALYSIS OF MARMATON AND CHEROKEE GROUP CUTTINGS SAMPLES FOR GAS CONTENT -- DART CHEROKEE BASIN OPERATING COMPANY #A3-20 SISSON; NW NE sec. 20-T.33S.-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 #A3-20 Sisson well; NW NE sec. 20-T.33S.-R.14E.; Montgomery County, KS. The samples calculate as having the following gas contents:

- Little Osage Shale at 1021' to 1025' depth[1] (11 scf/ton)
- Excello Shale at 1051'-1056' depth[1] (24 scf/ton)
- Bevier coal at 1072'-1074' depth[2] (127 scf/ton)
- Croweburg coal at 1096'-1097' depth[2] (245 scf/ton)
- "Weir-Pittsburg equivalent" at 1200' to 1201' depth[2, 3] (150 scf/ton)
- "Dry Wood equivalent" at 1235' to 1238' depth[2, 3] (91 scf/ton)
- Rowe coal at 1373' to 1374' depth[2, 3] (98 scf/ton)

[1]no coal in sample
[2]assuming accompanying dark shales in sample desorb 3 scf/ton
[3]reliability of result is unclear due to small amount of coal in the sample

BACKGROUND

The Dart Cherokee Basin #A3-20 Sisson well, NW NE sec. 20-T.33S.-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 turned over to K. David Newell of the Kansas Geological Survey on March 25, 2004. 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 by Gary Bogue 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. 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 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 1021' to 1025' depth (798 grams dry wt.)
- Excello Shale at 1051'-1056' depth (1704 grams dry wt.)
- Bevier coal at 1072'-1074' depth (415 grams dry wt.)
- Croweburg coal at 1096'-1097' depth (539 grams dry wt.)

- "Weir-Pittsburg equivalent" at 1200'-1201' depth (531 grams dry wt.)
- "Dry Wood equivalent" at 1235' to 1238' depth (891 grams dry wt.)
- Rowe coal at 1373' to 1374' depth (1870 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.

All samples were transported on March 25 to the laboratory at the Kansas Geological Survey in Lawrence, KS, and desorption measurements 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 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, the customary measuring 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 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 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 (Figure 3)
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 3). The rate of lost gas used in this correlation was that amount of gas lost by 0.6 (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 3), therefore further refinement of the relationship of the rate of lost gas to the total gas desorbed after canistering is not possible.

"Lithologic Component Sensitivity Analyses" (Figures 4-10)
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 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 $\text{content}_{\text{coal}}$ 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 "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 11)
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., $\textit{gas content}_{coal}$) for that sample. If the coal content is miniscule (i.e., < approximately 5%), the results are a better reflection of the $\textit{gas content}_{dark\ shale}$.

Desorption Graph (Figure 12)
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

Little Osage Shale at 1021' to 10256' depth and Excello Shale at 1051'-1056' depth contained no coal, thus these samples are organic-rich shales that give up adsorbed gas.

The best constrained data are those associated with the Bevier sample (1072'-1074'), which contained 8% coal. The Croweburg coal sample (1096'-1097') contained 4% coal and its result is nearly as well constrained as the Bevier sample.

However, the next three samples ("Weir-Pittsburg equivalent" at 1200'-1201' depth; "Dry Wood equivalent" at 1322' to 1324' depth; Rowe coal at 1373' to 1374' depth) contained only 1% to 2% coal, thus the calculated gas content for the coal in these samples varies greatly with whatever value is assumed for the accompanying black shales. The subsidiary amount 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.

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.

FIGURE 2. Lag-time to surface for well cuttings.

TABLE 1. Desorption measurements for samples.

FIGURE 3. Correlation of the rate of lost gas to the total gas desorbed after canistering.

FIGURE 4. Sensitivity analysis for Little Osage Shale at 1021' to 1025' depth.
FIGURE 5. Sensitivity analysis for Excello Shale at 1051'-1056' depth.
FIGURE 6. Sensitivity analysis for Bevier coal at 1072'-1074' depth.
FIGURE 7. Sensitivity analysis for Croweburg coal at 1096'-1097' depth.
FIGURE 8. Sensitivity analysis for "Weir-Pittsburg equivalent" at 1200'-1201' depth.
FIGURE 9. Sensitivity analysis for "Dry Wood equivalent" at 1235' to 1238' depth.
FIGURE 10. Sensitivity analysis for Rowe coal at 1373' to 1374' depth.

FIGURE 11. Lithologic component sensitivity analyses for all samples.

FIGURE 12. Desorption graph for all samples.

Correlation of Field Barometer to KGS Petrophysics Lab Barometer

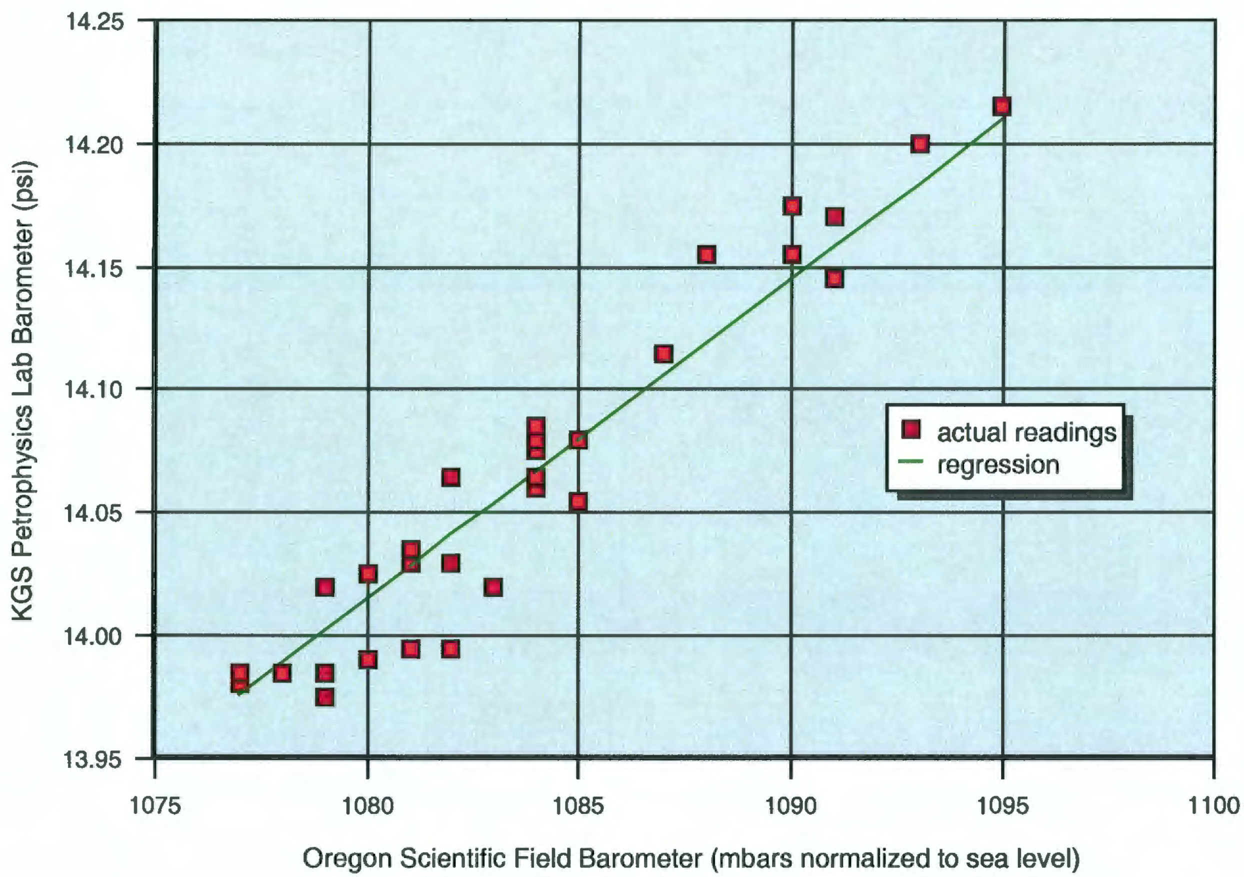
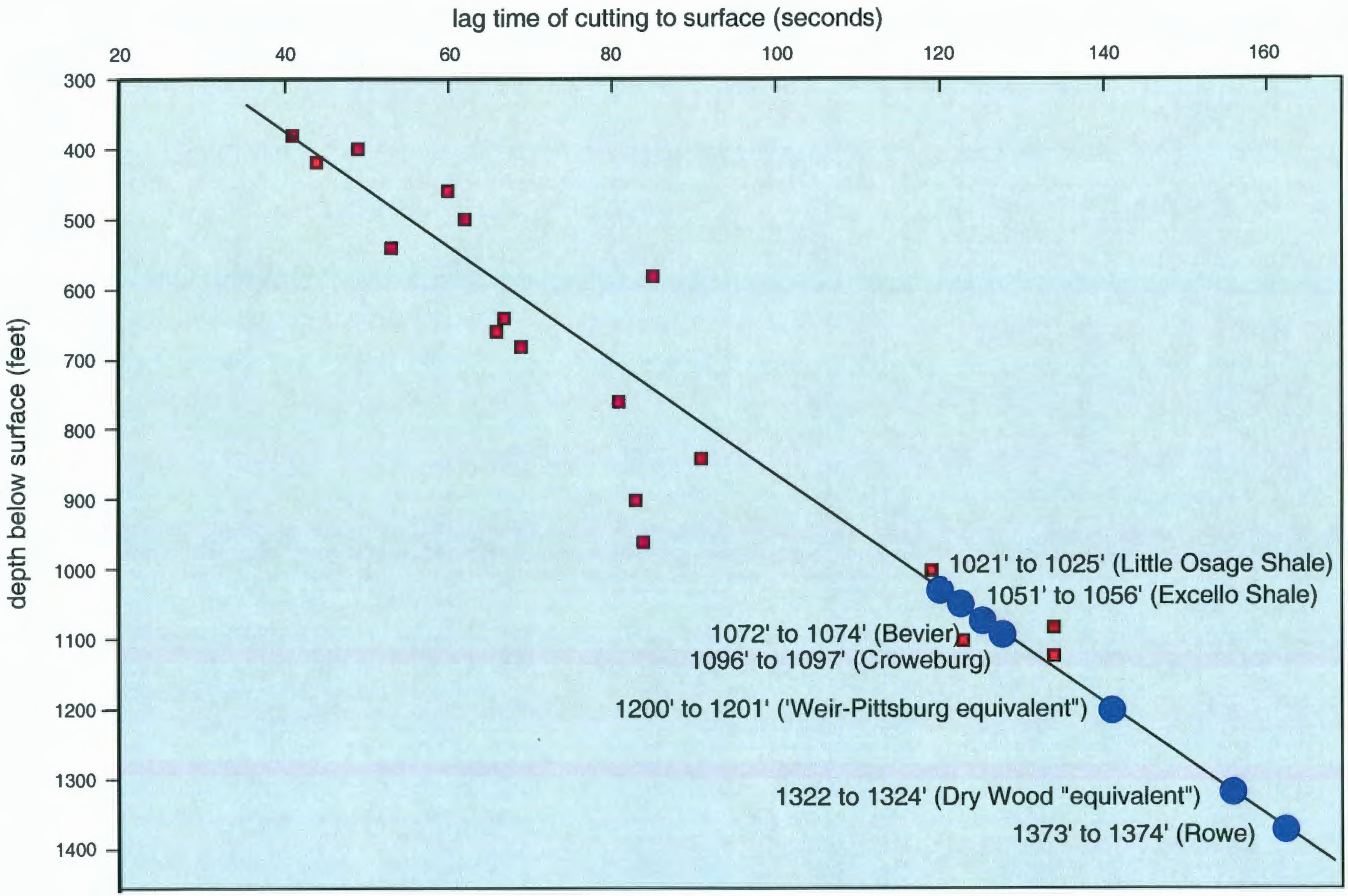


FIGURE 1.

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-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



■ measured lag time of cuttings to surface after pipe connections

FIGURE 2.

TABLE 1 -- Desorption data for DART CHEROKEE BASIN SISSON #A3-20; NW NE 20-T.33S.-R.14E.

SAMPLE: 1021' to 1025' (Little Osage Shale) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	1.5986	724.21

NOTE: los 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)
26	off bottom	at surface	in canister	8.8 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:05	0.114 hours
				0.337885582 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)
180	66	1088	0.0064	528	14.122	0.006036968	170.95	0.006036968	170.95	7.58	8.71	3/25/04	9:19	21:20:26	21:13:35	4.619583916
44	72	1084	0.0016	532	14.070	0.001453698	41.16	0.007490864	212.11	9.38	10.53	3/26/04	14:37	50:38:26	50:31:35	7.116217784
16	71	1076	0.0008	531	13.966	0.000525704	14.89	0.008016367	227.00	10.04	11.19	3/27/04	18:23	76:24:26	78:17:35	8.741122481
4	70	1084	0.0001	530	14.070	0.000132653	3.76	0.00814902	230.75	10.21	11.36	3/28/04	12:24	98:25:26	96:18:35	9.819566634
1	63	1086	4E-05	523	14.096	3.36691E-05	0.95	0.008182689	231.71	10.25	11.40	3/29/04	16:50	124:51:28	124:44:35	11.17395285
-3	63	1088	-0.0001	523	14.122	-0.000101193	-2.87	0.008081496	228.84	10.12	11.27	3/30/04	19:58	151:59:28	151:52:35	12.32844498
-1	64	1088	-4E-05	524	14.122	-3.36667E-05	-0.95	0.008047829	227.89	10.08	11.23	3/31/04	2:05	158:06:26	157:59:35	12.57406944

DESORPTION TERMINATED 3/31/2004 DUE TO NO MORE GAS BEING EVOLVED; sample air dried for 28 days

SAMPLE: 1051' to 1056' (Excello Shale) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	3.6216	1642.8

NOTE: los 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)
60	off bottom	at surface	in canister	5.8 minutes
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:04	0.097 hours
				0.310912635 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)
633	65	1088	0.0224	525	14.122	0.021270442	602.31	0.021270442	602.31	11.75	12.92	3/25/04	8:18	20:17:29	20:11:41	4.504596418
219	72	1084	0.0077	532	14.070	0.00723544	204.88	0.028505882	807.19	15.74	16.91	3/26/04	14:39	50:40:29	50:34:41	7.118617999
88	71	1076	0.0031	531	13.968	0.00289137	81.87	0.031397252	889.07	17.34	18.51	3/27/04	16:24	76:25:29	78:19:41	8.742123439
47	70	1084	0.0017	530	14.070	0.001558671	44.14	0.032955923	933.20	18.20	19.37	3/28/04	12:26	98:27:29	98:21:41	9.821306204
37	63	1086	0.0013	523	14.098	0.001245756	35.28	0.034201679	968.48	18.89	20.08	3/29/04	18:50	124:51:29	124:45:41	11.17399014
21	63	1088	0.0007	523	14.122	0.000708353	20.06	0.034910032	988.54	19.28	20.45	3/30/04	19:58	151:59:29	151:53:41	12.32847877
19	64	1088	0.0007	524	14.122	0.000639688	18.11	0.0355497	1006.65	19.63	20.80	3/31/04	14:05	170:06:29	170:00:41	13.04254789
22	69	1084	0.0008	529	14.070	0.00073097	20.70	0.03628067	1027.35	20.04	21.21	4/1/04	9:45	189:46:29	189:40:41	13.77587464
14	65	1089	0.0005	525	14.135	0.000470869	13.33	0.036751538	1040.88	20.30	21.47	4/2/04	11:10	215:11:29	215:05:41	14.66940315
16	66	1088	0.0006	526	14.122	0.000536619	15.20	0.037288158	1055.88	20.59	21.78	4/3/04	16:58	244:59:29	244:53:41	15.65220077
7	65	1087	0.0002	525	14.109	0.000235002	6.65	0.03752318	1082.53	20.72	21.89	4/4/04	15:19	267:20:29	267:14:41	18.35057763
12	65	1082	0.0004	525	14.044	0.000401007	11.36	0.037924187	1073.89	20.94	22.11	4/5/04	21:05	297:06:29	297:00:41	17.23682266
9	67	1087	0.0003	527	14.109	0.000300999	8.52	0.038225186	1082.41	21.11	22.28	4/6/04	14:21	314:22:29	314:18:41	17.73061539
13	68	1076	0.0005	528	13.968	0.000429561	12.16	0.038654727	1094.58	21.35	22.52	4/7/04	13:59	338:00:29	337:54:41	18.38499539
6	67	1082	0.0002	527	14.044	0.000199743	5.66	0.03885447	1100.23	21.46	22.63	4/8/04	14:08	362:09:29	382:03:41	19.03045074
7	66	1081	0.0002	526	14.031	0.00023326	6.61	0.03908773	1108.84	21.59	22.78	4/9/04	16:37	388:38:29	388:32:41	19.71398967
-1	62	1087	-4E-05	522	14.109	-3.37646E-05	-0.96	0.039053966	1105.88	21.57	22.74	4/10/04	16:22	412:23:29	412:17:41	20.30742201
0	63	1084	0	523	14.070	0	0.00	0.039053966	1105.88	21.57	22.74	4/11/04	22:39	442:40:29	442:34:41	21.03983855
3	62	1086	0.0001	522	14.096	0.000101201	2.87	0.039155166	1108.75	21.62	22.79	4/12/04	14:34	458:35:29	458:29:41	21.414747
1	61	1088	4E-05	521	14.122	3.38606E-05	0.96	0.039189027	1109.71	21.64	22.81	4/13/04	14:08	482:09:29	482:03:41	21.95809772
5	62	1085	0.0002	522	14.083	0.000168513	4.77	0.03935754	1114.48	21.73	22.90	4/14/04	14:05	508:06:29	506:00:41	22.49684546
11	64	1076	0.0004	524	13.966	0.000366249	10.37	0.039723789	1124.85	21.94	23.11	4/15/04	14:25	530:26:29	530:20:41	23.03131323
9	68	1078	0.0003	528	13.992	0.000297941	8.44	0.04002173	1133.28	22.10	23.27	4/16/04	13:53	553:54:29	553:48:41	23.53525134
8	71	1081	0.0003	531	14.031	0.000264073	7.48	0.040285803	1140.76	22.25	23.42	4/17/04	19:29	583:30:29	583:24:41	24.1559114
7	71	1079	0.0002	531	14.005	0.000230637	6.53	0.04051844	1147.29	22.37	23.54	4/18/04	16:00	804:01:29	603:55:41	24.57691442
0	68	1088	0	528	14.122	0	0.00	0.04051844	1147.29	22.37	23.54	4/19/04	14:01	828:02:29	625:58:41	25.02081911
12	71	1071	0.0004	531	13.901	0.000392446	11.11	0.040908885	1158.41	22.59	23.76	4/20/04	12:56	848:57:29	648:51:41	25.47465518
4	68	1075	0.0001	528	13.953	0.00013205	3.74	0.041040935	1162.15	22.66	23.83	4/21/04	13:11	673:12:29	673:06:41	25.94625321
1	68	1080	4E-05	528	14.018	3.3166E-05	0.94	0.041074101	1163.08	22.68	23.85	4/22/04	16:14	700:15:29	700:09:41	26.46238945
-3	66	1088	-0.0001	528	14.122	-0.000100616	-2.85	0.040973485	1160.24	22.63	23.80	4/23/04	14:20	722:21:29	722:15:41	26.87671958
6	69	1078	0.0002	529	13.992	0.000198252	5.61	0.041171737	1165.85	22.74	23.91	4/24/04	12:09	744:10:29	744:04:41	27.27958602
-2	66	1090	-7E-05	528	14.148	-6.72007E-05	-1.90	0.041104538	1183.95	22.70	23.87	4/26/04	11:16	791:17:29	791:11:41	28.12990204
2	65	1087	7E-05	525	14.109	6.71434E-05	1.90	0.04117168	1185.85	22.74	23.91	4/27/04	12:31	818:32:29	816:28:41	28.57518834
10	68	1072	0.0004	528	13.914	0.000329203	9.32	0.041500883	1175.17	22.92	24.09	4/28/04	15:28	843:29:29	843:23:41	29.04292322
2	68	1079	7E-05	528	14.005	6.62706E-05	1.88	0.041587154	1177.05	22.95	24.12	4/29/04	14:26	868:27:29	866:21:41	29.43565959
-1	66	1086	-4E-05	526	14.096	-3.34771E-05	-0.95	0.041533878	1178.10	22.94	24.11	5/1/04	17:41	917:42:29	917:36:41	30.29369683
-1	64	1083	-4E-05	524	14.057	-3.3512E-05	-0.95	0.041500164	1175.15	22.92	24.09	5/3/04	18:35	966:36:29	986:30:41	31.09032093

DESORPTION TERMINATED 5/3/2004 DUE TO NO MORE GAS BEING EVOLVED; sample air dried for 30 days

SAMPLE: 1072' to 1074' (Bevier coal) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	0.6911	313.5

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

est. lost gas (cc) = 23

TIME OF:	off bottom	at surface	in canister	elapsed time (off bottom to canistering)
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:05	7.3 minutes
				0.121 hours
				0.348010217 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)
110	71	1088	0.0039	531	14.122	0.003654519	103.48	0.003654519	103.48	10.58	12.93	3/25/04 11:55	23:56:32	23:49:16	4.893079012
27	72	1084	0.001	532	14.070	0.000892041	25.26	0.00454656	128.74	13.16	15.51	3/26/04 14:43	50:44:32	50:37:16	7.12335751
10	71	1076	0.0004	531	13.966	0.000328565	9.30	0.004875125	138.05	14.11	16.46	3/27/04 16:24	76:25:32	76:18:16	8.742171101
-1	70	1084	-4E-05	530	14.070	-3.31632E-05	-0.94	0.004841961	137.11	14.01	16.36	3/28/04 12:27	96:28:32	96:21:16	9.822197084
-1	63	1086	-4E-05	523	14.096	-3.36691E-05	-0.95	0.004808292	136.16	13.91	16.26	3/29/04 16:51	124:52:32	124:45:16	11.17477318
-4	63	1088	-0.0001	523	14.122	-0.000134924	-3.82	0.004673368	132.33	13.52	15.87	3/30/04 19:59	152:00:32	151:53:16	12.32918849
-1	64	1088	-4E-05	524	14.122	-3.36667E-05	-0.95	0.004639701	131.36	13.43	15.78	3/31/04 14:06	170:07:32	170:00:16	13.04321876

DESORPTION TERMINATED 3/31/2004 DUE TO NO MORE GAS BEING EVOLVED; sample air dried for 30 days

SAMPLE: 1096' to 1097' (Croweburg coal) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	0.7679	357.4

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

est. lost gas (cc) = 23

TIME OF:	off bottom	at surface	in canister	elapsed time (off bottom to canistering)
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:05	7.0 minutes
				0.117 hours
				0.342377310 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)
133	71	1088	0.0047	531	14.122	0.004418646	125.12	0.004418646	125.12	11.22	13.28	3/25/04 11:45	23:46:33	23:39:31	4.876046896
26	72	1084	0.0009	532	14.070	0.000859002	24.32	0.005277648	149.45	13.40	15.46	3/26/04 14:44	50:45:33	50:38:31	7.124546769
11	71	1076	0.0004	531	13.966	0.000361421	10.23	0.005639069	159.68	14.31	16.38	3/27/04 16:28	76:27:33	76:20:31	8.744093244
-1	70	1084	-4E-05	530	14.070	-3.31632E-05	-0.94	0.005605906	158.74	14.23	16.29	3/28/04 12:28	96:29:33	96:22:31	9.823059605
0	63	1086	0	523	14.096	0	0.00	0.005605906	158.74	14.23	16.29	3/29/04 16:51	124:52:33	124:45:31	11.17478561
-3	63	1088	-0.0001	523	14.122	-0.000101193	-2.87	0.005504713	155.88	13.97	16.03	3/30/04 19:59	152:00:33	151:53:31	12.32919976
0	64	1088	0	524	14.122	0	0.00	0.005504713	155.88	13.97	16.03	3/31/04 14:07	170:08:33	170:01:31	13.04386829

DESORPTION TERMINATED 3/31/2004 DUE TO NO MORE GAS BEING EVOLVED; sample air dried for 40 days

SAMPLE: 1200' to 1201' (Weir-Pittsburg "equivalent" interval) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	1.0492	475.9

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

est. lost gas (cc) = 17

TIME OF:	off bottom	at surface	in canister	elapsed time (off bottom to canistering)
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:04	6.1 minutes
				0.101 hours
				0.318418220 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)
37	71	1088	0.0013	531	14.122	0.001229247	34.81	0.001229247	34.81	2.34	3.49	3/25/04 11:53	23:54:43	23:48:38	4.889984095
14	72	1084	0.0005	532	14.070	0.00048254	13.10	0.001691787	47.91	3.23	4.37	3/26/04 14:44	50:45:43	50:39:38	7.124741711
5	71	1076	0.0002	531	13.966	0.000164282	4.65	0.001856069	52.56	3.54	4.68	3/27/04 16:27	76:28:43	76:22:38	8.745205035
-4	70	1084	-0.0001	530	14.070	-0.000132653	-3.76	0.001723417	48.80	3.29	4.43	3/28/04 12:29	96:30:43	96:24:38	9.82404929
-3	63	1086	-0.0001	523	14.096	-0.000101007	-2.86	0.001622409	45.94	3.09	4.24	3/29/04 16:52	124:53:43	124:47:38	11.17565559

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

SAMPLE: 1322' to 1324' (Dry Wood coal "equivalent" interval) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	1.3850	628.21

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

est. lost gas (cc) = 19

TIME OF:	off bottom	at surface	in canister	elapsed time (off bottom to canistering)
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:04	6.6 minutes
				0.110 hours
				0.331243449 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)
65	70	1088	0.0023	530	14.122	0.002163563	61.27	0.002163583	61.27	3.12	4.09	3/25/04 11:49	23:50:50	23:44:15	4.883361775
14	72	1084	0.0005	532	14.070	0.00048254	13.10	0.002626103	74.36	3.79	4.76	3/26/04 14:45	50:46:50	50:40:15	7.126047681
1	71	1076	4E-05	531	13.966	3.28565E-05	0.93	0.002658959	75.29	3.84	4.81	3/27/04 16:27	76:28:50	76:22:15	8.745316207
-7	70	1084	-0.0002	530	14.070	-0.000232143	-6.57	0.002426817	68.72	3.50	4.47	3/28/04 12:30	96:31:50	96:25:15	9.824996466
-4	63	1086	-0.0001	523	14.096	-0.000134678	-3.81	0.00229214	64.91	3.31	4.28	3/29/04 16:52	124:53:50	124:47:15	11.17574258

DESORPTION TERMINATED 3/29/2004 DUE TO NO MORE GAS BEING EVOLVED; sample air dried for 28 days

SAMPLE: 1373' to 1374' (Rowe coal) cuttings in Dart SSD canister

	lbs.	grams
dry sample weight:	3.3684	1527.9

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

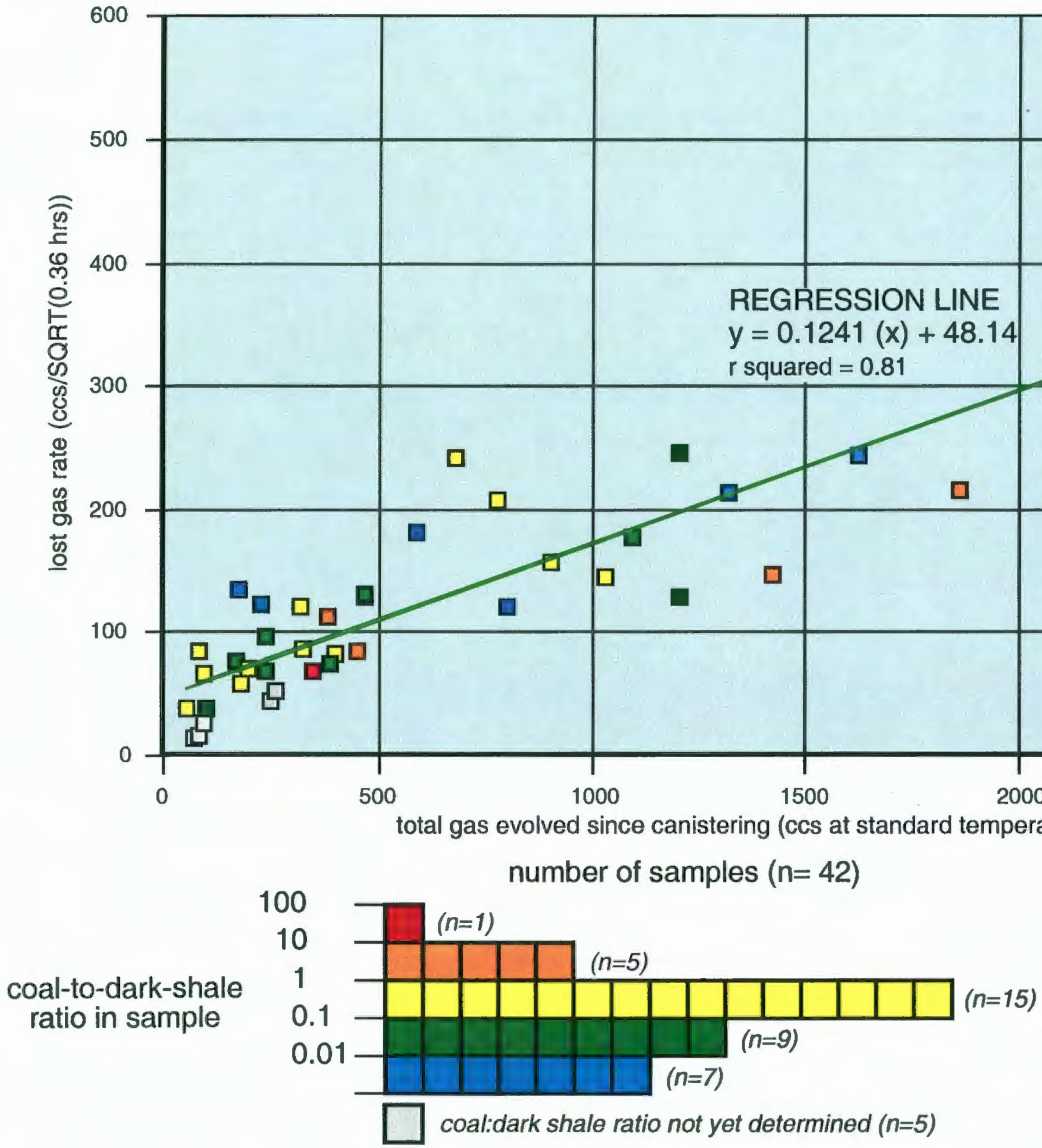
est. lost gas (cc) = 26

TIME OF:	off bottom	at surface	in canister	elapsed time (off bottom to canistering)
	3/24/04 11:58	3/24/04 12:00	3/24/04 12:04	6.7 minutes
				0.112 hours

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		0.334580998 SQRT (hrs)
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)
157	70	1088	0.0055	530	14.122	0.005225637	147.98	0.005225837	147.98	3.10	3.85	3/25/04 11:34	23:36:00	23:29:17	4.857983121
40	72	1084	0.0014	532	14.070	0.001321542	37.42	0.008547379	185.40	3.89	4.43	3/26/04 14:48	50:48:00	50:41:17	7.127411872
16	71	1076	0.0006	531	13.966	0.000525704	14.89	0.007073083	200.29	4.20	4.74	3/27/04 16:28	76:30:00	76:23:17	8.746427842
1	70	1084	4E-05	530	14.070	3.31632E-05	0.94	0.007108248	201.23	4.22	4.78	3/28/04 12:30	98:32:00	96:25:17	9.825137828
3	63	1086	0.0001	523	14.096	0.000101007	2.86	0.007207253	204.09	4.28	4.82	3/29/04 18:53	124:55:00	124:48:17	11.17661249
-3	63	1088	-0.0001	523	14.122	-0.000101193	-2.87	0.00710606	201.22	4.22	4.76	3/30/04 20:01	152:03:00	151:58:17	12.33085561
2	64	1088	7E-05	524	14.122	6.73334E-05	1.91	0.007173393	203.13	4.28	4.80	3/31/04 14:13	170:15:00	170:08:17	13.04798835
10	69	1084	0.0004	529	14.070	0.000332259	9.41	0.007505652	212.54	4.46	5.00	4/1/04 9:45	189:47:00	189:40:17	13.77618718
0	65	1089	0	525	14.135	0	0.00	0.007505652	212.54	4.46	5.00	4/2/04 11:11	215:13:00	215:06:17	14.67026471
2	66	1088	7E-05	526	14.122	6.70774E-05	1.90	0.00757273	214.44	4.50	5.04	4/3/04 17:00	245:02:00	244:55:17	15.6535406
2	65	1087	7E-05	525	14.109	6.71434E-05	1.90	0.007639873	216.34	4.54	5.08	4/4/04 15:20	267:22:00	267:15:17	18.35135081
3	65	1082	0.0001	525	14.044	0.000100252	2.84	0.007740125	219.18	4.60	5.14	4/5/04 21:07	297:09:00	297:02:17	17.23803933
5	67	1080	0.0002	527	14.018	0.000166145	4.70	0.00790627	223.88	4.69	5.24	4/6/04 14:21	314:23:00	314:18:17	17.73085822
7	68	1076	0.0002	528	13.966	0.000231302	6.55	0.008137572	230.43	4.83	5.38	4/7/04 13:59	338:01:00	337:54:17	18.38522958
-0.5	67	1082	-2E-05	527	14.044	-1.66452E-05	-0.47	0.008120926	229.96	4.82	5.37	4/8/04 14:09	362:11:00	382:04:17	19.03111487
2	66	1081	7E-05	526	14.031	6.66459E-05	1.89	0.008187572	231.85	4.86	5.41	4/9/04 16:38	388:40:00	388:33:17	19.71463078
-3	62	1087	-0.0001	522	14.109	-0.000101294	-2.87	0.008086278	228.98	4.80	5.35	4/10/04 16:23	412:25:00	412:18:17	20.30804438
0	63	1084	0	523	14.070	0	0.00	0.008086278	228.98	4.80	5.35	4/11/04 22:40	442:42:00	442:35:17	21.04043726
-2	62	1086	-7E-05	522	14.096	-6.74672E-05	-1.91	0.008018811	227.07	4.76	5.31	4/12/04 14:37	458:39:00	458:32:17	21.41611543

SAMPLE DECANISTERED 4/12/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 18 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

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.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

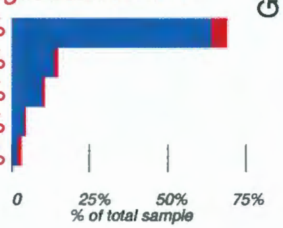
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of Little Osage Shale from 1021' to 1025'

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

total gas desorbed
(including estimated lost gas) = 257.7 ccs

TOTAL DRY WEIGHT OF SAMPLE = 798.20 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 73.99 grams (9.3%)
$\text{weight}_{dark\ shale}$ = 724.21 grams (90.7%)
weight_{coal} = 0.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	544.71	0.00% / 92.42% / 7.58%
>0.0661"	115.86	0.00% / 90.70% / 9.30%
>0.0460"	81.71	0.00% / 92.28% / 7.72%
>0.0331"	34.00	0.00% / 83.06% / 16.94%
<0.0331"	21.92	0.00% / 55.00% / 45.00%
	798.20 TOTAL	



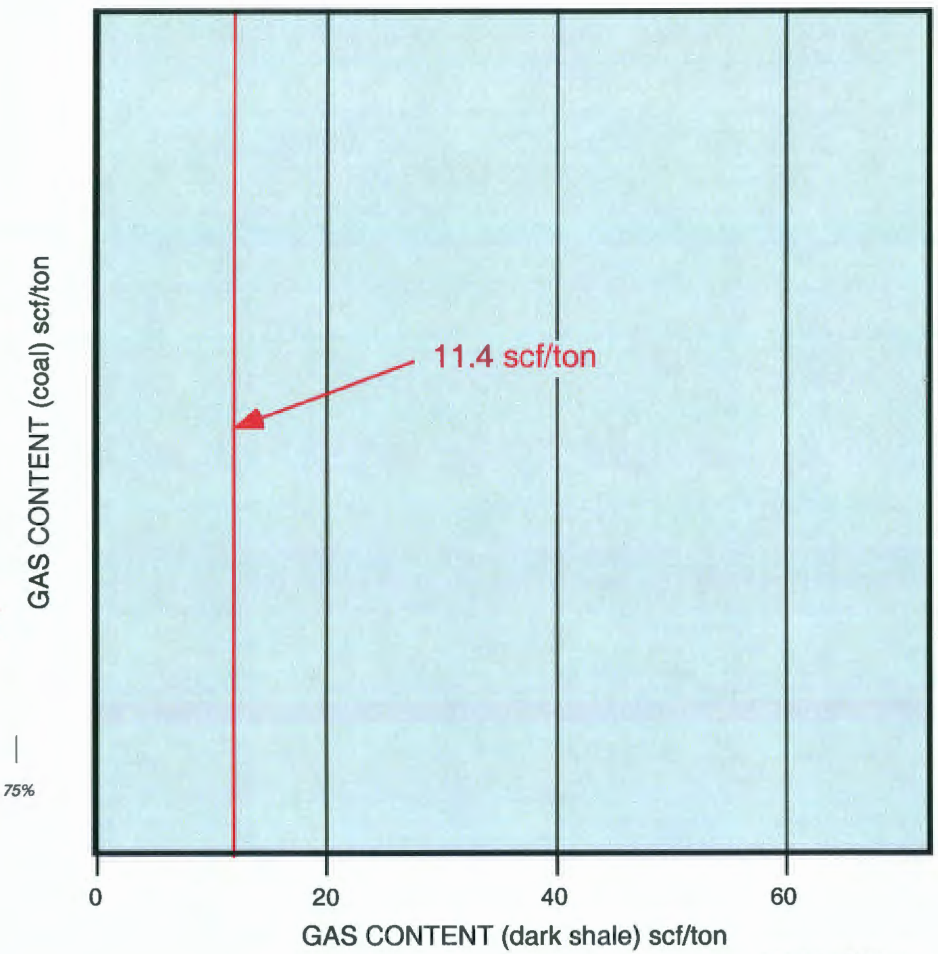


FIGURE 4.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

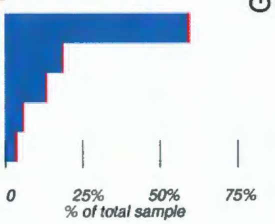
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of Excello Shale from 1051' to 1056'

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

total gas desorbed
(including estimated lost gas) = 1237.1 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1703.88 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 61.13 grams (3.6%)
$\text{weight}_{dark\ shale}$ = 1642.75 grams (96.4%)
weight_{coal} = 0.00 grams (0.0%)

sieve size	grams	% coal / % dark shale / % light-colored liths
>0.0930"	1004.84	0.00% / 98.16% / 1.84%
>0.0661"	313.29	0.00% / 97.61% / 2.39%
>0.0460"	225.35	0.00% / 94.68% / 5.32%
>0.0331"	99.43	0.00% / 88.94% / 11.06%
<0.0331"	60.96	0.00% / 80.00% / 20.00%
	1703.88 TOTAL	



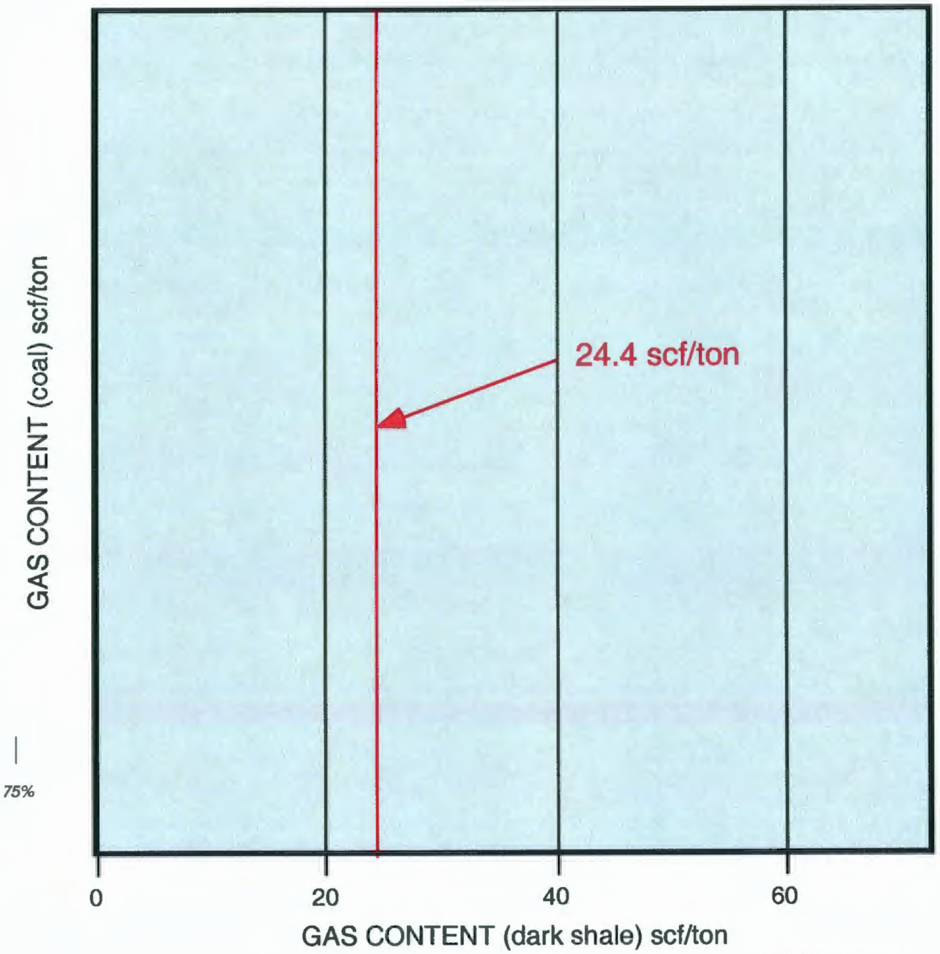


FIGURE 5.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

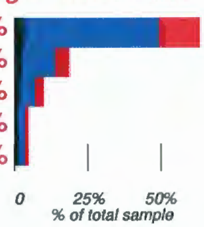
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Bevier coal from 1072' to 1074'

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

total gas desorbed
(including estimated lost gas) = 161.1 ccs

TOTAL DRY WEIGHT OF SAMPLE = 415.18 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 101.68 grams (24.5%)
$\text{weight}_{dark\ shale}$ = 90.29 grams (67.3%)
weight_{coal} = 33.99 grams (8.2%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	260.34	4.42% / 73.30% / 22.28%
>0.0661"	75.90	10.91% / 62.58% / 26.50%
>0.0460"	40.87	15.28% / 53.28% / 31.44%
>0.0331"	19.16	16.84% / 56.84% / 26.32%
<0.0331"	18.91	25.00% / 45.00% / 30.00%
	415.18 TOTAL	



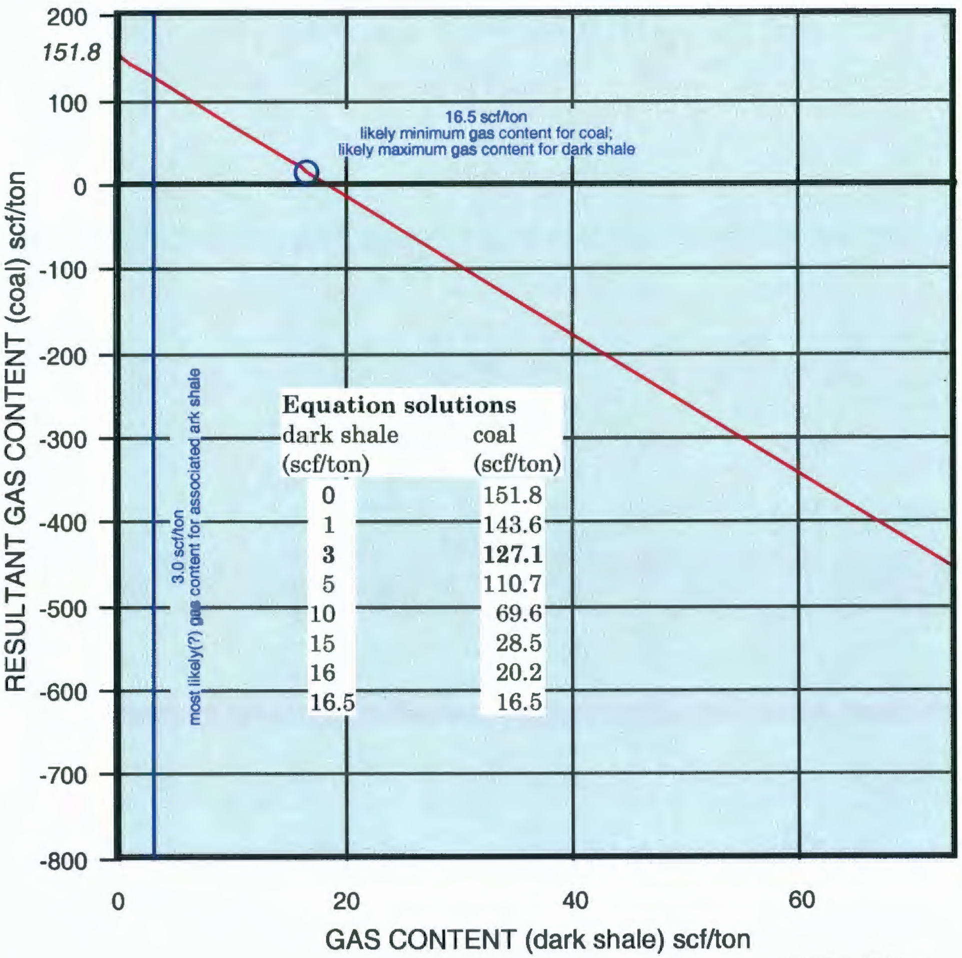


FIGURE 6.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

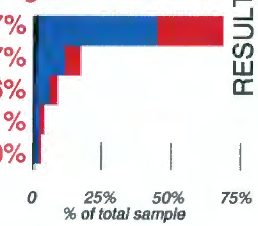
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Croweburg coal from 1096' to 1097'

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

total gas desorbed
(including estimated lost gas) = 182.7 ccs

TOTAL DRY WEIGHT OF SAMPLE = 538.98 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 181.58 grams (33.7%)
$\text{weight}_{dark\ shale}$ = 337.65 grams (62.7%)
weight_{coal} = 19.75 grams (3.7%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	365.62	2.55% / 63.09% / 34.37%
>0.0661"	91.34	5.25% / 62.17% / 32.57%
>0.0460"	46.48	4.51% / 63.93% / 31.56%
>0.0331"	20.77	6.42% / 55.96% / 37.61%
<0.0331"	14.76	15.00% / 60.00% / 25.00%
	538.98 TOTAL	



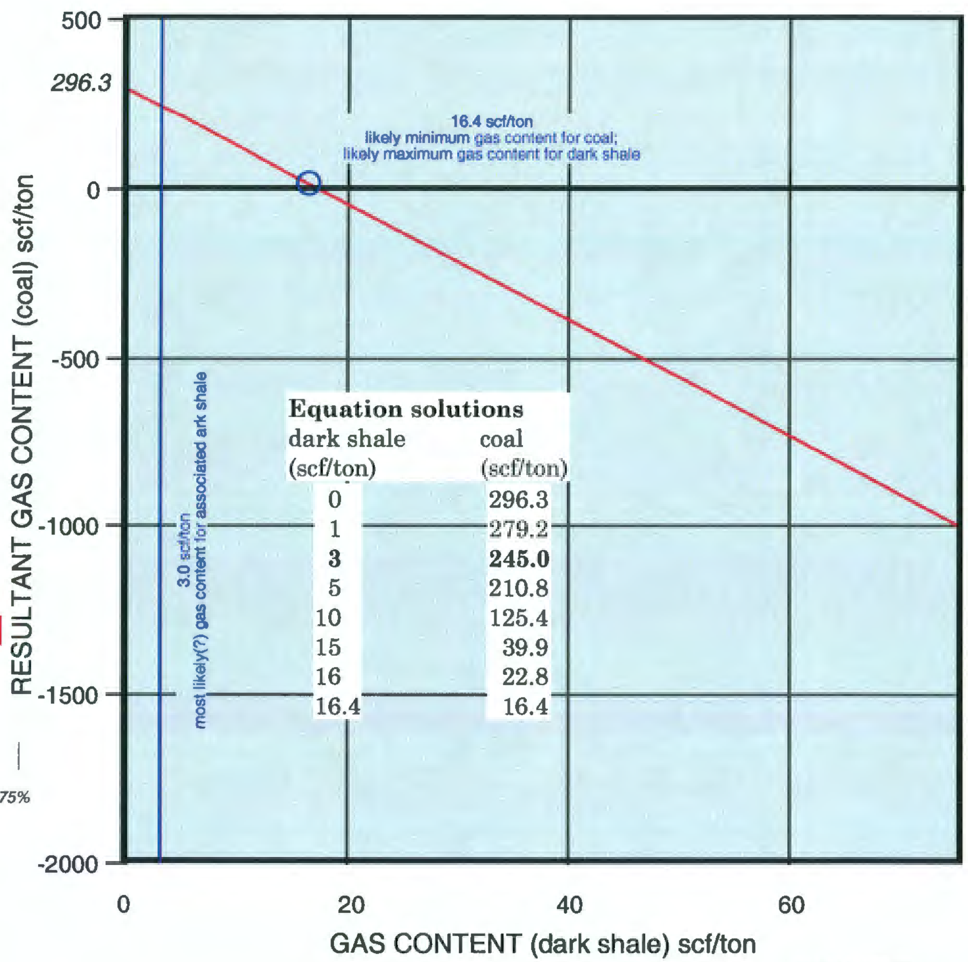


FIGURE 7.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

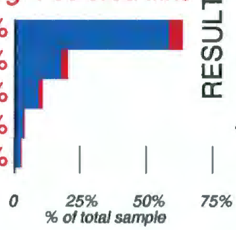
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Weir-Pittsburg "equivalent" interval from 1200' to 1201'

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

total gas desorbed
(including estimated lost gas) = 69.6 ccs

TOTAL DRY WEIGHT OF SAMPLE = 530.94 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 55.04 grams (10.4%)
$\text{weight}_{dark\ shale}$ = 470.46 grams (88.6%)
weight_{coal} = 5.44 grams (1.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	305.64	0.53% / 91.03% / 8.34%
>0.0661"	90.99	1.07% / 85.45% / 13.48%
>0.0460"	45.76	2.60% / 82.29% / 15.10%
>0.0331"	16.03	4.69% / 81.25% / 14.06%
<0.0331"	12.03	1.00% / 90.00% / 9.00%
	530.94 TOTAL	



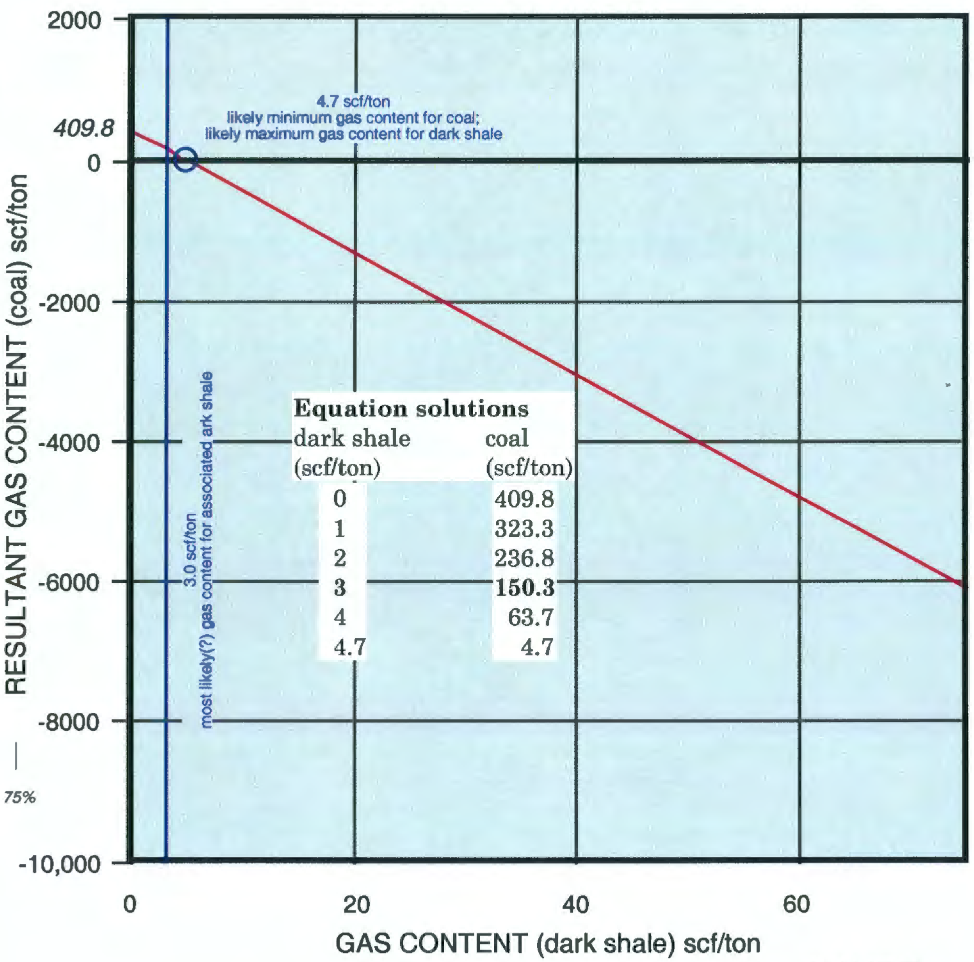


FIGURE 8.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

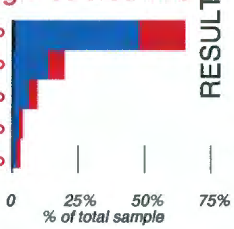
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Dry Wood coal from 1322' to 1324'

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

total gas desorbed
(including estimated lost gas) = 94.3 ccs

TOTAL DRY WEIGHT OF SAMPLE = 890.71 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 262.50 grams (29.5%)
$\text{weight}_{dark\ shale}$ = 615.31 grams (69.1%)
weight_{coal} = 12.90 grams (1.5%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	575.25	1.21% / 71.92% / 26.87%
>0.0661"	171.93	1.43% / 67.08% / 31.48%
>0.0460"	82.97	2.96% / 61.58% / 35.47%
>0.0331"	34.70	2.27% / 64.77% / 32.95%
<0.0331"	25.87	1.00% / 49.00% / 50.00%
	890.71 TOTAL	



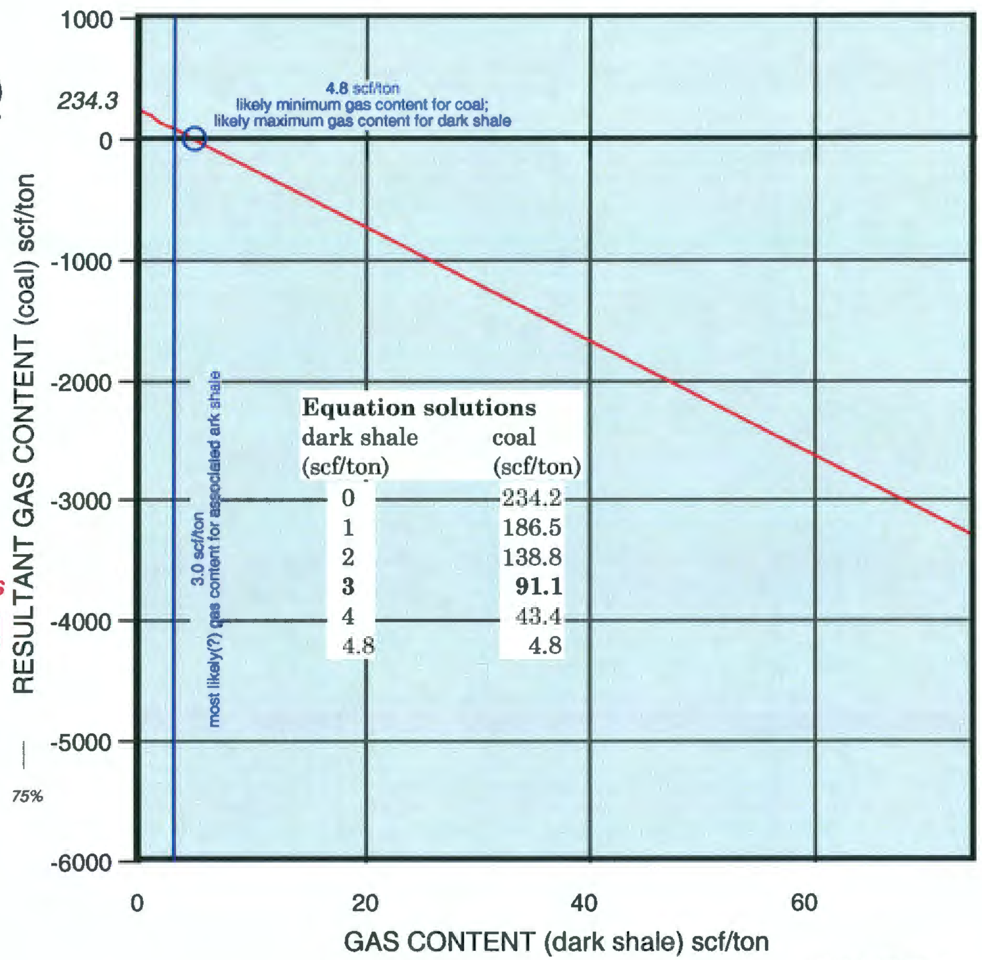


FIGURE 9.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

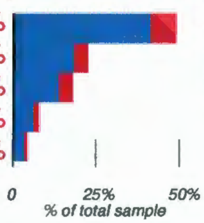
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Rowe coal from 1373' to 1374'

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

total gas desorbed
(including estimated lost gas) = 257.9 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1870.46 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 342.60 grams (18.3%)
$\text{weight}_{dark\ shale}$ = 1488.96 grams (79.6%)
weight_{coal} = 38.90 grams (2.1%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	907.48	1.43% / 82.89% / 15.68%
>0.0661"	416.50	3.54% / 77.81% / 18.65%
>0.0460"	331.45	1.49% / 75.62% / 22.89%
>0.0331"	134.21	2.88% / 75.54% / 21.58%
<0.0331"	80.83	3.00% / 60.00% / 22.00%
	1870.46 TOTAL	



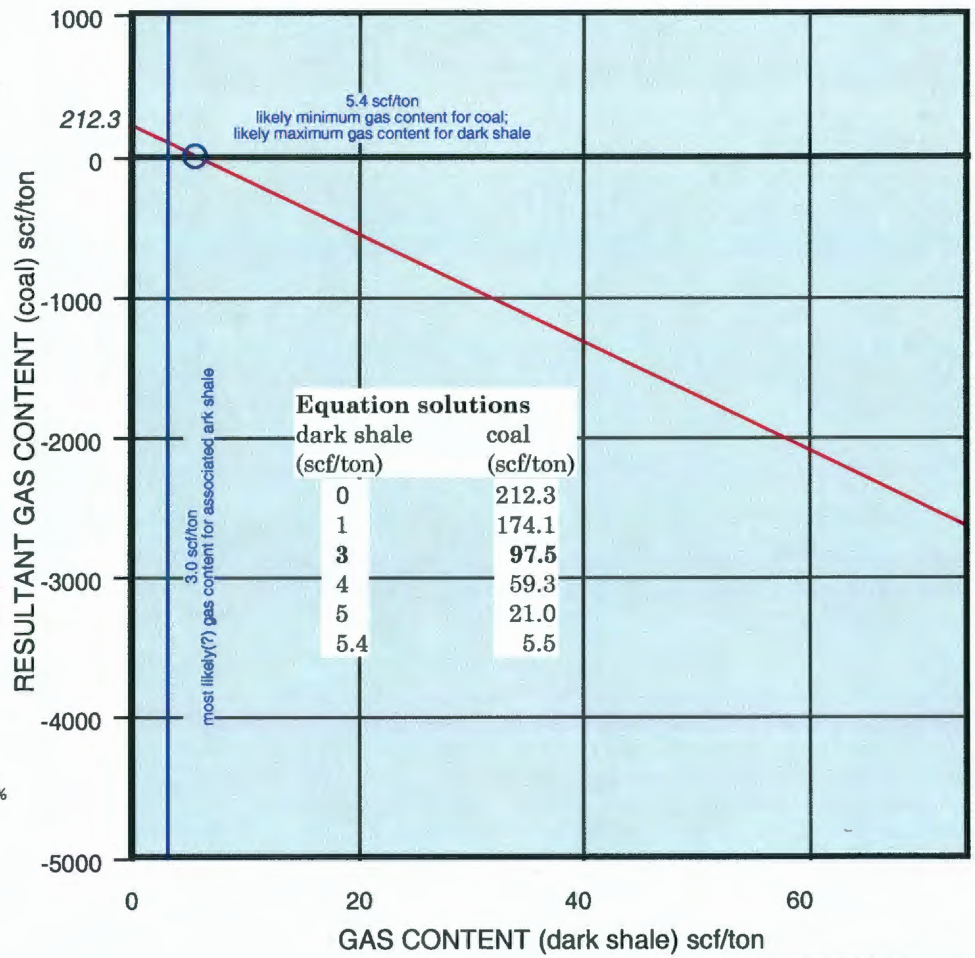


FIGURE 10.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin #A3-20 Sisson, 20-T.33S.-R.14E., Montgomery County, KS

surface
100'
200'
300'
400'
500'
600'
700'
800'
900'
1000'
1021'-1025' Little Osage Shale
1051'-1056' Excello Shale
1072'-1074' Bevier
1096'-1097' Croweburg
1200'
1200'-1201' "Weir-Pittsburg equiv."
1300'
1322'-1324' "Dry Wood equiv."
1373'-1374' Rowe

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%	----	----	11.4
Excello Shale	0%	----	----	24.4
Bevier coal	8%	127.1	151.8	16.5
Croweburg coal	4%	245.0	296.3	16.4
"Weir-Pitt. equiv."	1%	150.3	409.8	4.7
"Dry Wood equiv."	2%	91.1	234.2	4.8
Rowe coal	2%	97.5	212.3	5.5

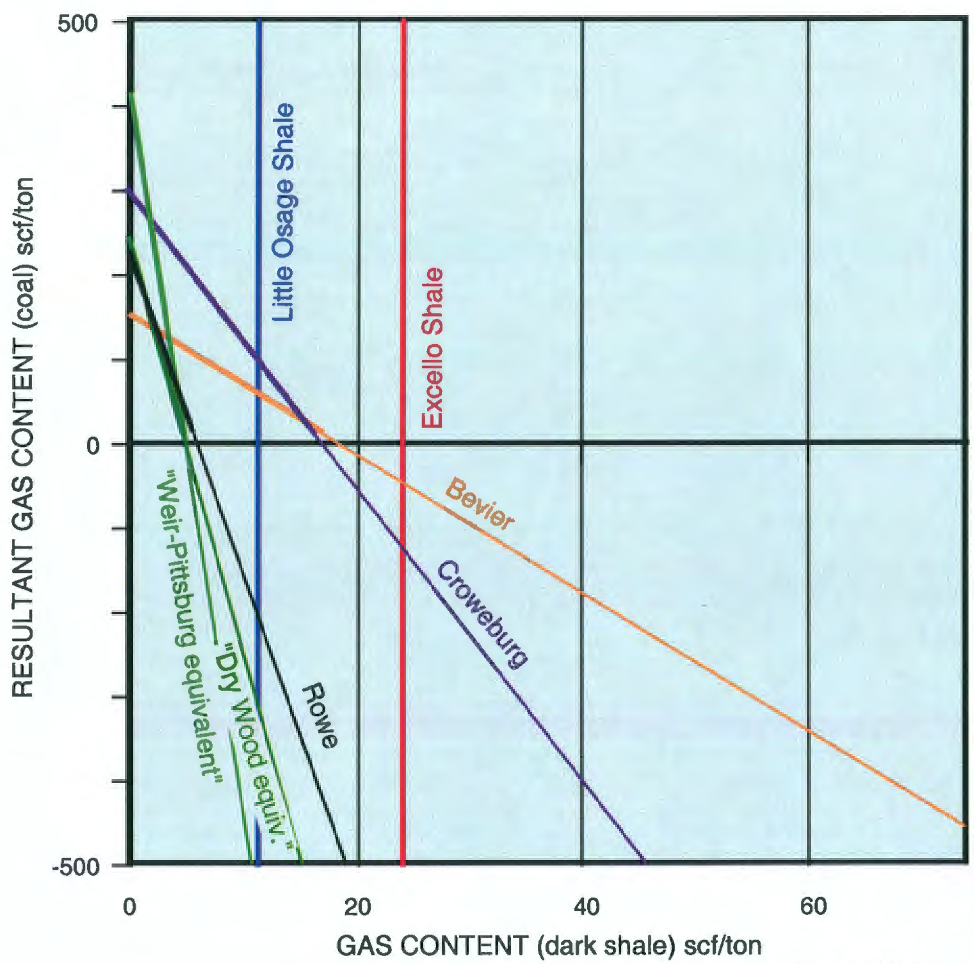


FIGURE 11.

Desorption Characteristics of Cuttings Samples

based on total weight of gas-generating lithologies (i.e., coal and dark shale) in sample
Dart Cherokee Basin #A1-22 Huser, 22-T.30S.-R.14E., Wilson County, KS

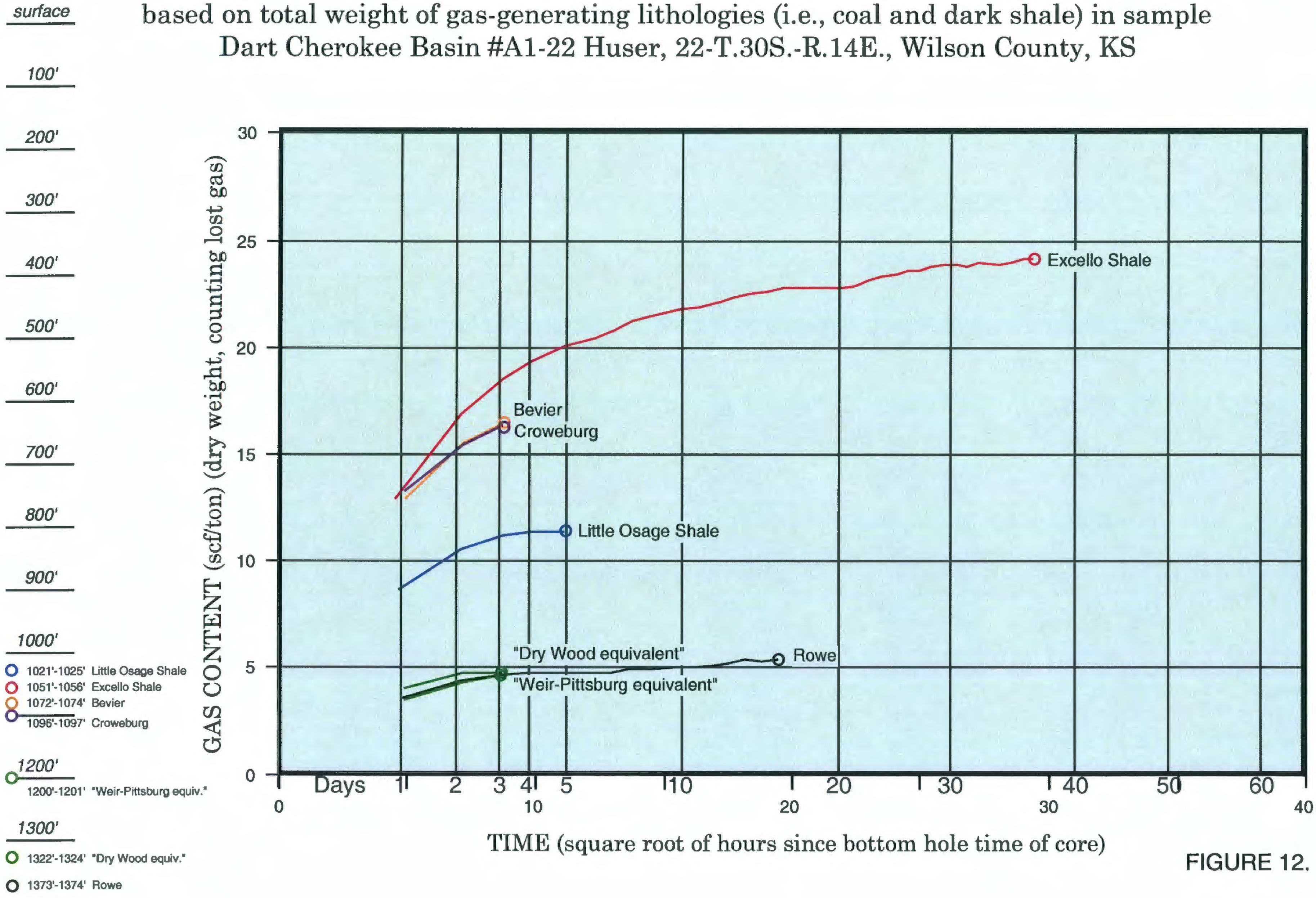


FIGURE 12.