ANALYSIS OF MARMATON AND CHEROKEE GROUP CUTTINGS SAMPLES FOR GAS CONTENT -- DART CHEROKEE BASIN OPERATING COMPANY #CH-1 HOLDER; SE NE sec. 1-T.30S.-R.14E.; WILSON COUNTY, KANSAS

By
K. David Newell, Troy A. Johnson, and W. Matthew Brown

Kansas Geological Survey
The University of Kansas
1930 Constant Avenue
Lawrence, KS 66047-3726

OCTOBER 30, 2003
(to be held proprietary to August 9, 2005)

Kansas Geological Survey
Open-file Report no. 2005-44

SUMMARY

Four cuttings samples from the Pennsylvanian Marmaton Group and Cherokee Group were collected from the Dart Cherokee Basin #CH-1 Holder; SE NE sec. 1-T.30S.-R.14E. in Wilson County, KS. One sample (Little Osage Shale) did not have any coal present. The samples calculate as having the following gas contents:

- Mulberry coal at 718' to 720' depth[1] (149.2 scf/ton)
- Little Osage Shale at 808' to 810' depth[2] (18.4 scf/ton)
- Mulky coal/Excello Shale at 820' to 824' depth[3] (70.7 scf/ton)
- Weir-Pittsburg coal at 1012' to 1014' depth[1] (251.4 scf/ton)

[1]assuming accompanying dark shales in sample desorb 3 scf/ton
[2]no coal in sample
[3]reliability of result is unclear due to small amount of coal in the sample; desorption value should be considered a minimum value for the Mulky coal and a maximum value for the accompanying dark shale

BACKGROUND

The Dart Cherokee Basin #CH-1 Holder well (SE NE sec. 1-T.30S.-R.14E.) in Wilson County, KS was selected for cuttings desorption tests in association with an on-going coalbed gas research project at the Kansas Geological Survey. The samples were gathered August 9, 2003 by K.D. Newell, T.A. Johnson, and W.M. Brown of the Kansas Geological Survey. Samples were obtained during normal drilling of the well, with no cessation of drilling before zones of interest (i.e., coals and dark shales in the Marmaton Group and Cherokee Group) were penetrated. The well was drilled using an air rotary rig owned by McPherson Drilling.

Lag times for samples to reach the surface (important for assessing lost gas) 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.

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

- Mulberry coal at 718' to 720' depth (1899 grams dry wt.)
- Little Osage Shale at 808' to 810' depth (1936 grams dry wt.)
- Mulky coal/Excello Shale at 820' to 824' depth (1609 grams dry wt.)
- Weir-Pittsburg coal at 1012' to 1014' depth (1806 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 drilling mud as possible before the cuttings were placed in desorption canisters. Temperature baths for the desorption canisters were on site, with temperature kept at approximately 75 °F for the Mulky/Excello sample and shallower samples, and 80 °F for the Weir-Pittsburg sample. The canistered samples were later that day transported to the laboratory at the Kansas Geological Survey in Lawrence, KS and desorption measurements were continued at approximately these respective temperatures. 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 made in-house at the Kansas Geological Survey. On average, the canisters were approximately 15 inches long (38.1 cm), 3 inches (7.6 cm) in diameter, and enclosed a volume of approximately 106 cubic inches (1740 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, Kansas (Figure 1). The regression equation shown graphically in Figure 1 was entered into a spreadsheet and was used to automatically convert the millibar measurement to barometric pressure in pounds per square inch (psi).

A spreadsheet program written by K.D. Newell (Kansas Geological Survey) was used to convert all gas volumes at standard temperature and pressure. Conversion of gas volumes to standard temperature and pressure was by application of the perfect-gas 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 V_{stp} 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. In the case of well cuttings from Dart Cherokee Basin #CH-1 Holder well, the maximum time of desorption was 58 days.

Lost gas (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 period 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.

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 ran through a sample splitter and a lesser portion (approximately 75 grams) were sieved and weighed, and the derived size-fraction ratios were applied to the entire sample.

The size fractions were then inspected and sorted by hand under a dissecting microscope. Three major lithologic categories were differentiated: coal, dark shales (generally Munsell rock colors N3 (dark gray), N2 (grayish black), and N1 (black) on dry surface), and lighter-colored lithologies and/or dark and light-colored carbonates. The 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)
Gas lost prior to the canistering of the sample was estimated by 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. Lost-gas volumes derived from this analysis are incorporated in the data tables described above.

"Lithologic Component Sensitivity Analyses" (Figures 7-10)
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

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

The lithologic-component-sensitivity-analysis diagram therefore expresses the bivariant nature inherent in the determination of gas content in mixed cuttings. The gas content of dark shales in Kansas can vary greatly. Proprietary desorption analyses of dark shales in cores from southeastern Kansas have registered as much as 50 scf/ton, but can be as low as 2-4 scf/ton. For a general understanding of the lithologic-component-sensitivity-analyses diagrams, the calculated *gas content*$_{coal}$ is given for assumed *gas content*$_{dark\ shale}$ at 30 scf/ton and 50 scf/ton. For most samples gathered in east-central and northeastern Kansas, the resultant *gas content*$_{coal}$ is a negative number for 30 scf/ton and 50 scf/ton *gas content*$_{dark\ shale}$. The only conclusion is that the *gas content*$_{dark\ shale}$ or most samples taken from this region has to be lower than 30-50 scf/ton. Conversely though, to assume that all the gas evolved from a cuttings sample is derived solely from the coal would result in an erroneously high gas content for the coal.

In all the lithologic-component-sensitivity-analysis diagrams, a "break-even" point is 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.

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., *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 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

The Little Osage Shale sample did not contain any Summit coal. Colors of the shale were gradational between very dark gray (N1) and light gray (N7), thus it was impossible to pick out any single, distinct shale in this sample that could have been representative of the Summit interval. Nearby cores of the Summit 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.

The Mulky/Excello sample contained very little (1.8%) coal. These samples were dominated by a very dark to black shale (N1, N2), which is identified as Excello Shale. Due to the small amount of coal in the sample, the calculated gas content of the coal varies greatly with any slight variation in gas content assumed for the accompanying shale in the sample. The Excello, however, is very rich in organic matter, and it may have a gas content close to that of the average gas content for the entire sample (i.e., 70.7 scf/ton).

Maximum gas content (gas content calculated assuming no gas contribution by admixed dark shale), minimum gas content (gas content calculated assuming equal gas content for coal and admixed dark shale) and "most likely" gas content (gas content calculated with admixed dark shales desorbing 3 scf/ton) for all the coal samples are presented on Figure 11. According to this diagram, the Mulberry sample has the most tightly constrained results, which corresponds to the highest ratio of coal to dark shale in this sample. The least constrained results are for the Mulky/Excello sample, which contained only 1.8% coal.

The value of 3 scf/ton for average dark shales is based on the assay of the gas content of the dark shales in nearby wells. High-gamma-ray shales (such as the Excello Shale), also colloquially known as "hot shales", however, typically have more organic matter and associated gas content than a normal shale, and thus determination of gas content for a coal associated with a "hot" shale carries more uncertainty than if the coal were associated with a shale without a high gamma-ray value.

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

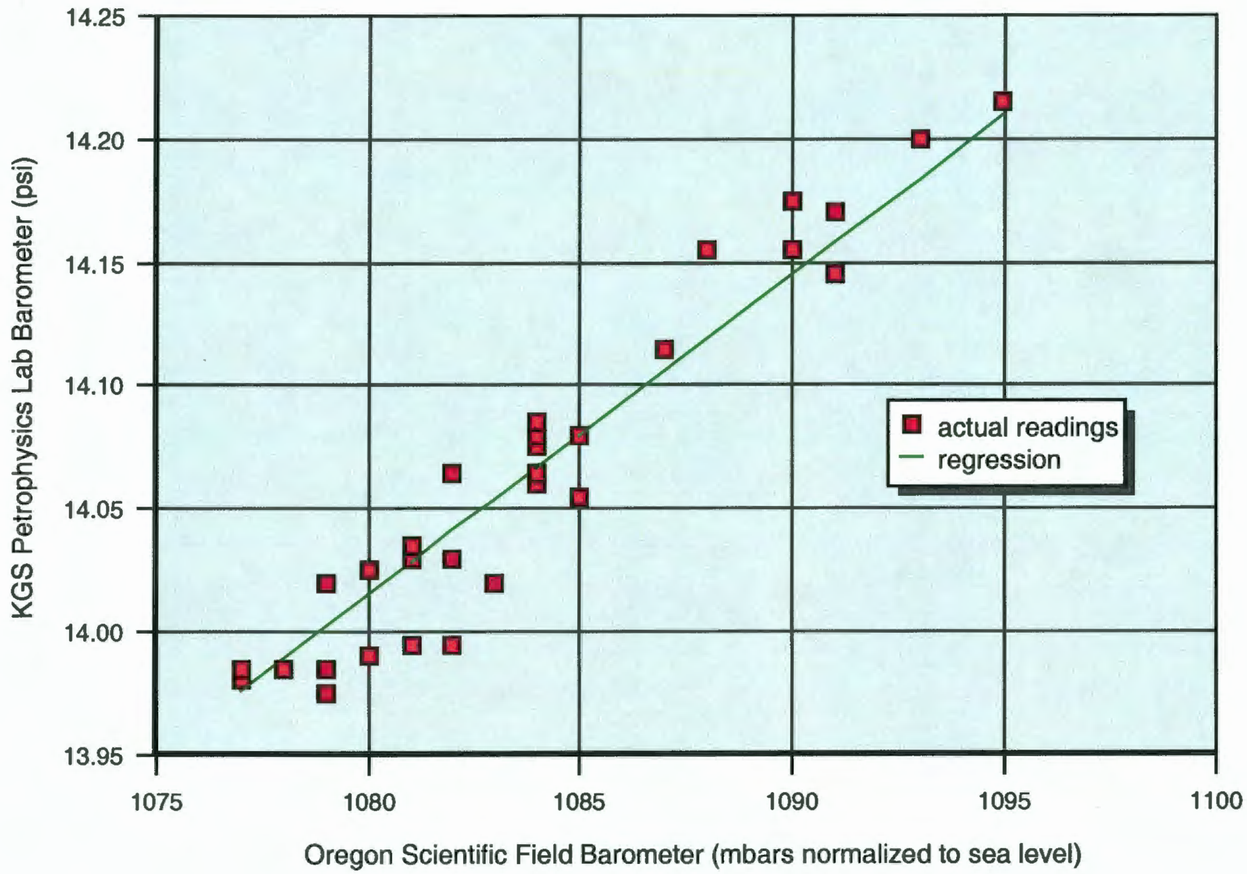

FIGURE 1.

Dart Cherokee Basin #CH-1 Holder; SE NE sec. 1-T.30S.-R.14E., Wilson County, KS
lag-time to surface for well cuttings

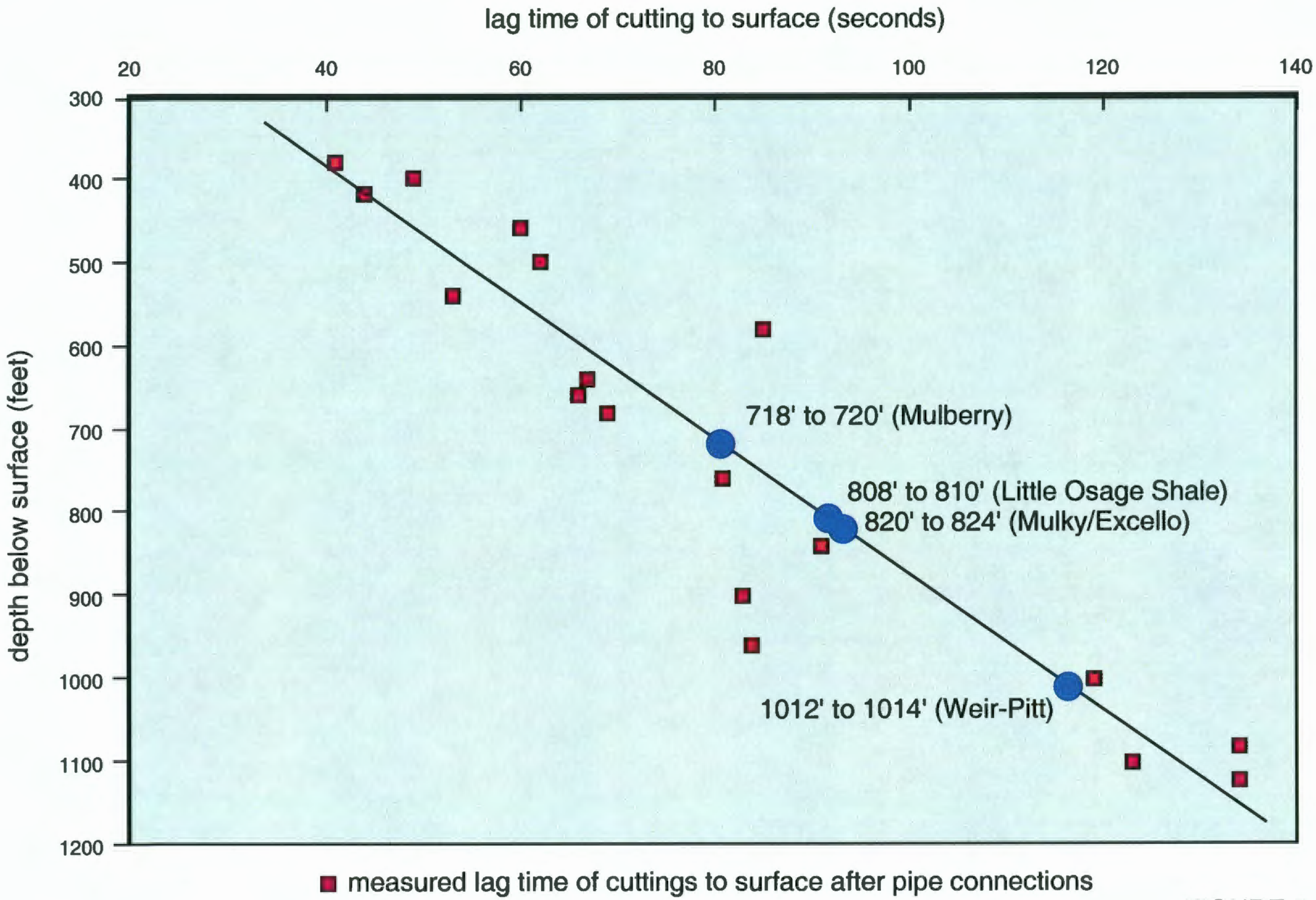

FIGURE 2.

TABLE 1 -- Desorption data for DART HOLDER #CH-1; SE NE 1-T.30S.-R.14E.

SAMPLE: 718' to 720' (Mulberry coal) in canister Brady 24

	lbs.	grams		est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
dry sample weight:	0.3652	165.636		58	off bottom	at surface	in canister	10.1 minutes
CONVERSION OF VOLUMES TO STP					8/9/03 9:48	8/9/03 9:50	8/9/03 9:58	0.166 hours
								0.410284454 SQRT (hrs)

RIG MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi) cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON (approx) without lost gas	SCF/TON (approx) with lost gas	TIME OF MEASURE		TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
6	75	1088	0.000211889	535	14.122	0.000197847	5.602363	0.000197847	5.602363	1.063603993	12.30187096	8/9/03	10:01	0:12:36	0:02:30	0.458257569
4	75	1088	0.000141259	535	14.122	0.000131898	3.734922	0.000329745	9.337306	1.806006655	13.02427382	8/9/03	10:02	0:14:06	0:04:00	0.484767986
4	75	1088	0.000141259	535	14.122	0.000131898	3.734922	0.000461643	13.07223	2.528409317	13.74667828	8/9/03	10:04	0:15:36	0:05:30	0.509901951
6	75	1088	0.000211889	535	14.122	0.000197847	5.602363	0.00065949	18.67461	3.612013309	14.83026027	8/9/03	10:06	0:18:06	0:08:00	0.549241902
3	75	1088	0.000105944	535	14.122	9.89235E-05	2.801192	0.000758414	21.4758	4.153815308	15.37208227	8/9/03	10:08	0:19:36	0:09:30	0.571547607
8	75	1088	0.000282518	535	14.122	0.000263796	7.469844	0.00102221	28.94565	5.598820829	16.81688759	8/9/03	10:11	0:23:06	0:13:00	0.620483682
4	75	1088	0.000141259	535	14.122	0.000131898	3.734922	0.001154108	32.68057	6.321023291	17.53929025	8/9/03	10:15	0:26:21	0:16:15	0.662696512
3	75	1088	0.000105944	535	14.122	9.89235E-05	2.801192	0.001253031	35.48176	6.862825288	18.08109225	8/9/03	10:17	0:29:06	0:19:00	0.698419414
4	75	1088	0.000141259	535	14.122	0.000131898	3.734922	0.001384929	39.21668	7.58522795	18.80349491	8/9/03	10:21	0:32:36	0:22:30	0.73711148
3	75	1088	0.000105944	535	14.122	9.89235E-05	2.801192	0.001483853	42.01787	8.127029946	19.34529691	8/9/03	10:23	0:34:51	0:24:45	0.762124224
2	75	1088	7.06296E-05	535	14.122	6.5949E-05	1.867461	0.001549802	43.88534	8.488231277	19.70649824	8/9/03	10:25	0:36:36	0:26:30	0.781024968
14	75	1088	0.000494407	535	14.122	0.000461643	13.07223	0.002011445	56.95756	11.01664059	22.23490758	8/9/03	10:39	0:50:51	0:40:45	0.920597632
2	75	1088	7.06296E-05	535	14.122	6.5949E-05	1.867461	0.002077394	58.82502	11.37784192	22.59610689	8/9/03	10:42	0:53:21	0:43:15	0.942956344
10	75	1089	0.000353148	535	14.135	0.000330048	9.345888	0.002407442	68.17091	13.18550651	24.40377547	8/9/03	10:55	1:07:06	0:57:00	1.057512805
7	75	1089	0.000247204	535	14.135	0.000231034	6.542121	0.002638476	74.71303	14.45087512	25.66914209	8/9/03	11:08	1:20:06	1:10:00	1.155422001
6	75	1088	0.000211889	535	14.122	0.000197847	5.602363	0.002836323	80.31542	15.53447912	26.75274606	8/9/03	11:18	1:29:51	1:19:45	1.223723825
7	75	1088	0.000247204	535	14.122	0.000230822	6.536114	0.003067144	86.85153	16.79868377	28.01695074	8/9/03	11:37	1:46:21	1:36:15	1.343812963
4	75	1088	0.000141259	535	14.122	0.000131898	3.734922	0.003199042	90.58645	17.52108644	28.7393534	8/9/03	11:47	1:56:21	1:46:15	1.40445719
7	75	1088	0.000247204	535	14.122	0.000230822	6.536114	0.003429864	97.12257	18.78529109	30.00355806	8/9/03	12:05	2:16:21	2:06:15	1.507481343
9	75	1088	0.000317833	535	14.122	0.000296771	8.403575	0.003726635	105.5261	20.41069706	31.62896405	8/9/03	12:35	2:46:21	2:36:15	1.665082581
13	74	1088	0.000459092	534	14.122	0.000429471	12.16123	0.004156106	117.6874	22.76290236	33.98116934	8/9/03	13:22	3:33:21	3:23:15	1.885691739
9	75	1088	0.000317833	535	14.122	0.000296771	8.403575	0.004452877	126.0909	24.38830837	35.60657533	8/9/03	14:02	4:13:21	4:03:15	2.054872259
15	78	1074	0.000529722	538	13.940	0.00048553	13.74864	0.004938407	139.8396	27.04754614	38.2658151	8/9/03	16:05	6:16:21	6:06:15	2.504495957
3	75	1084	0.000105944	535	14.070	9.85596E-05	2.790893	0.005036967	142.6305	27.58735622	38.80562518	8/9/03	17:30	7:41:21	7:31:15	2.772934667
33	75	1085	0.001165388	535	14.083	0.001085158	30.72815	0.006122125	173.3586	33.53074685	44.74901381	8/9/03	23:17	13:26:21	13:18:15	3.67049043
44	75	1086	0.001553851	535	14.096	0.001448211	41.00882	0.007570336	214.3672	41.46256872	52.68083568	8/10/03	12:43	26:54:21	26:44:15	5.187063317
45	75	1086	0.001589168	535	14.096	0.001481125	41.94084	0.009051462	256.3079	49.57465927	60.79292824	8/11/03	9:42	47:53:21	47:43:15	6.920199901
33	75	1089	0.001165388	535	14.135	0.001089159	30.84143	0.01014062	287.1493	55.53995901	66.75822597	8/12/03	11:31	73:42:21	73:32:15	8.585210151
24	75	1091	0.000847555	535	14.161	0.00079357	22.47132	0.010934191	309.6206	59.8863265	71.10459346	8/13/03	13:49	100:00:21	99:50:15	10.00029166
20	75	1093	0.000706296	535	14.187	0.000662521	18.76043	0.011596712	328.3811	63.51493913	74.73320809	8/14/03	11:20	121:31:21	121:21:15	11.02372442
18	75	1091	0.000635666	535	14.161	0.000595178	16.85349	0.01219189	345.2346	66.77471475	77.99298171	8/15/03	15:39	149:50:21	149:40:15	12.24088096
15	75	1083	0.000529722	535	14.057	0.000492345	13.94159	0.012684234	359.1762	69.47127523	80.6895422	8/16/03	16:09	174:20:21	174:10:15	13.20375578
10	75	1081	0.000353148	535	14.031	0.000327624	9.277231	0.013011858	368.4534	71.26566236	82.48392932	8/17/03	12:38	194:49:21	194:39:15	13.95788308
14	76	1082	0.000494407	536	14.044	0.000458241	12.97588	0.013470098	381.4293	73.77543707	84.99370404	8/18/03	20:26	226:37:21	226:27:15	15.05398618
14	76	1082	0.000494407	536	14.044	0.000458241	12.97588	0.013928339	394.4052	76.28521179	87.50347875	8/20/03	10:01	264:12:21	264:02:15	16.25440966
13	78	1081	0.000459092	538	14.031	0.000423536	11.99315	0.014351875	406.3983	78.60490742	89.82317438	8/21/03	20:32	298:43:21	298:33:15	17.28359048
9	78	1083	0.000317833	538	14.057	0.000294856	8.349349	0.01464673	414.7476	80.21982517	91.43809213	8/24/03	22:37	372:48:21	372:38:15	19.30816048
11	78	1079	0.000388463	538	14.005	0.000359048	10.16707	0.015005778	424.9147	82.18632346	93.40459042	8/26/03	16:32	414:43:21	414:33:15	20.36473668
3	80	1082	0.000105944	540	14.044	9.74671E-05	2.75995	0.015103245	427.6747	82.72014856	93.93841552	8/27/03	14:06	436:17:21	436:07:15	20.88753616
6	80	1079	0.000211889	540	14.005	0.000194394	5.504595	0.015297639	433.1793	83.78483854	95.0031055	8/28/03	16:33	462:44:21	462:34:15	21.51137296
-1	79	1084	-3.5315E-05	539	14.070	-3.26095E-05	-0.92339	0.01526503	432.2559	83.60623719	94.82450415	8/29/03	14:06	484:17:21	484:07:15	22.00657099
0	78	1086	0	538	14.096	0	0	0.01526503	432.2559	83.60623719	94.82450415	9/1/03	14:35	556:46:21	556:36:15	23.59602721
2	77	1084	7.06296E-05	537	14.070	6.54618E-05	1.853666	0.015330491	434.1095	83.96477026	95.18303722	9/2/03	18:37	584:48:21	584:38:15	24.18275901
2	77	1084	7.06296E-05	537	14.070	6.54618E-05	1.853666	0.015395953	435.9632	84.32330333	95.5415703	9/3/03	17:34	607:45:21	607:35:15	24.65270438
0	77	1087	0	537	14.109	0	0	0.015395953	435.9632	84.32330333	95.5415703	9/4/03	17:48	631:59:21	631:49:15	25.13939472
4	75	1084	0.000141259	535	14.070	0.000131413	3.721191	0.015527366	439.6844	85.0430501	96.26131707	9/7/03	17:35	703:46:21	703:36:15	26.52871086
1	75	1084	3.53148E-05	535	14.070	3.28533E-05	0.930298	0.01556022	440.6147	85.2229866	96.44125376	9/8/03	14:16	724:27:21	724:17:15	26.91571722
2	75	1082	7.06296E-05	535	14.044	6.55853E-05	1.857163	0.015625805	442.4719	85.58219621	96.80046317	9/9/03	17:34	751:45:21	751:35:15	27.41616612
3	78	1079	0.000105944	538	14.005	9.79222E-05	2.772837	0.015723727	445.2447	86.11651392	97.33878089	9/10/03	19:06	777:17:21	777:07:15	27.87990615
6	78	1079	0.000211889	538	14.005	0.000195844	5.545674	0.015919572	450.7904	87.19114935	98.40941632	9/12/03	14:06	820:17:21	820:07:15	28.64069075
-1	77	1083	-3.5315E-05	537	14.057	-3.27007E-05	-0.92598	0.015886871	449.8644	87.01204619	98.23031516	9/13/03	18:06	848:17:21	848:07:15	29.12540415
-3	78	1086	-0.00010594	538	14.122	-9.83719E-05	-2.78557	0.015788499	447.0788	86.4732674	97.69153438	9/14/03	19:33	873:44:21	873:34:15	29.55907926
0	75	1085	0	535	14.083	0	0	0.015788499	447.0788	86.4732674	97.69153438	9/15/03	15:25	893:36:21	893:26:15	29.8932406

DESORPTION TERMINATED 9/15/03 DUE TO NO MORE GAS BEING EVOLVED

SAMPLE: 808' to 810' (Little Osage Shale) in canister Brady 27

	lbs.	grams		est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
dry sample weight:	3.3670	1527.24		77	off bottom	at surface	in canister	8.8 minutes
CONVERSION OF VOLUMES TO STP					8/9/03 10:30	8/9/03 10:31	8/9/03 10:39	0.146 hours

RIG MEASUREMENTS			CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)					CUMULATIVE VOLUMES		SCF/TON (approx)	SCF/TON (approx)		TIME SINCE		0.382608009 SQRT (hrs)	
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	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)	
20	75	1088	0.000706296	535	14.122	0.00065949	16.67461	0.00065949	16.67461	0.391736976	2.006974832	8/9/03 10:44	0:14:02	0:05:15	0.483620604	
10	75	1089	0.000353146	535	14.135	0.000330046	9.345686	0.000969538	26.0205	0.587766494	2.203024346	8/9/03 10:47	0:16:47	0:08:00	0.526867722	
9	75	1089	0.000317633	535	14.135	0.000297043	8.411299	0.001286562	36.4316	0.764233058	2.379468912	8/9/03 10:49	0:19:32	0:10:45	0.570574759	
7	75	1089	0.000247204	535	14.135	0.000231034	6.542121	0.001517615	42.97392	0.901467719	2.516703574	8/9/03 10:51	0:21:32	0:12:45	0.599073359	
3	75	1089	0.000105944	535	14.135	9.90144E-05	2.803766	0.00161663	45.77769	0.960262574	2.575518426	8/9/03 10:53	0:22:47	0:14:00	0.616216052	
31	75	1089	0.001094759	535	14.135	0.001023149	26.97225	0.002639779	74.74994	1.568036074	3.183271928	8/9/03 11:07	0:37:17	0:26:30	0.768282239	
7	75	1089	0.000247204	535	14.135	0.000231034	6.542121	0.002670813	81.29206	1.705270735	3.320506589	8/9/03 11:12	0:41:47	0:33:00	0.834499184	
10	75	1089	0.000353148	535	14.135	0.000330048	9.345886	0.003200661	90.63795	1.901320251	3.516556105	8/9/03 11:16	0:45:47	0:37:00	0.673530512	
6	75	1066	0.000211869	535	14.122	0.000197847	5.602383	0.003398708	96.24033	2.018641945	3.634077799	8/9/03 11:19	0:49:32	0:40:45	0.906600678	
4	75	1066	0.000141259	535	14.122	0.000131898	3.734922	0.003530606	99.97525	2.09716974	3.712425594	8/9/03 11:22	0:52:32	0:43:45	0.935711257	
5	75	1086	0.000176574	535	14.122	0.000164673	4.668653	0.003695479	104.6439	2.195124485	3.810360339	8/9/03 11:26	0:56:32	0:49:45	0.987702159	
10	75	1086	0.000353148	535	14.122	0.000329745	9.337306	0.004025224	113.9812	2.390993973	4.006229628	8/9/03 11:35	1:05:32	0:56:45	1.04509436	
11	75	1066	0.000368463	535	14.122	0.00036272	10.27104	0.004367943	124.2522	2.606450411	4.221686265	8/9/03 11:45	1:15:02	1:06:15	1.116282413	
27	75	1068	0.0009535	535	14.122	0.000690312	25.21072	0.005276255	149.463	3.135298031	4.750533885	8/9/03 12:09	1:36:47	1:30:00	1.263116865	
16	75	1068	0.000635666	535	14.122	0.000593541	16.80715	0.005671796	166.2701	3.467863111	5.103096966	8/9/03 12:34	2:03:47	1:55:00	1.436334066	
36	75	1068	0.001271333	535	14.122	0.001187082	33.6143	0.007056678	199.6644	4.192993271	5.808229126	8/9/03 13:20	2:49:47	2:41:00	1.662177621	
26	75	1068	0.000988614	535	14.122	0.000923286	26.14446	0.007982165	226.0269	4.74142784	6.356663695	8/9/03 14:00	3:29:47	3:21:00	1.869863334	
43	75	1074	0.001516536	535	13.940	0.001399659	39.63377	0.009381623	265.6626	5.572829011	7.166084865	8/9/03 15:56	5:25:47	5:17:00	2.330176436	estimate
19	75	1064	0.000670961	535	14.070	0.000624212	17.67566	0.010006036	263.3383	5.943612834	7.558846688	8/9/03 17:34	7:03:47	6:55:00	2.657640976	
70	75	1065	0.002472036	535	14.083	0.002301651	65.18091	0.012307667	346.5192	7.310916667	6.926154541	8/9/03 23:18	12:47:47	12:39:00	3.57720406	
95	75	1066	0.003354906	535	14.096	0.00312662	68.54134	0.015434706	437.0606	9.168256317	10.76349417	8/10/03 12:44	26:13:47	26:05:00	5.121496092	
86	75	1066	0.003037073	535	14.096	0.002830595	80.15322	0.018265301	517.2136	10.64963946	12.46487531	8/11/03 9:44	47:13:47	47:05:00	6.872386393	
64	75	1089	0.002260147	535	14.135	0.002112308	59.81368	0.020377609	577.0275	12.10435636	13.71959221	8/12/03 11:32	73:01:47	72:53:00	8.54574293	
45	75	1091	0.001569166	535	14.161	0.001487944	42.13373	0.021665554	619.1612	12.98819942	14.60343528	8/13/03 13:50	99:19:47	99:11:00	9.966429763	
27	75	1093	0.0009535	535	14.167	0.000694403	25.32658	0.022759957	644.4676	13.51947741	15.13471326	8/14/03 11:21	120:50:47	120:42:00	10.99301546	
31	75	1091	0.001094759	535	14.161	0.001025026	29.02546	0.023784965	673.5132	14.12634708	15.74358293	8/15/03 15:40	149:09:47	149:01:00	12.21323261	
25	75	1063	0.00068267	535	14.057	0.000820574	23.23599	0.024605559	696.7492	14.61577046	16.23100632	8/16/03 16:10	173:39:47	173:31:00	13.17612792	
16	75	1081	0.000565037	535	14.031	0.000524196	14.84357	0.025129757	711.5926	14.92714534	16.54236119	8/17/03 12:36	194:07:47	193:59:00	13.93304426	
21	76	1082	0.000741611	536	14.044	0.000687361	19.46363	0.025817116	731.0566	15.33543976	16.95067561	8/18/03 20:26	225:55:47	225:47:00	15.03095679	
22	76	1082	0.000776926	536	14.044	0.000720093	20.39066	0.026537211	751.4473	15.76317677	17.37841262	8/20/03 10:03	263:32:47	263:24:00	16.23411189	
19	76	1061	0.000670981	538	14.031	0.000619014	17.52645	0.027156225	766.9757	16.13067259	17.74610844	8/21/03 20:34	298:03:47	297:55:00	17.26450276	
16	76	1063	0.000565037	538	14.057	0.000524166	14.84329	0.027680412	763.619	16.44224156	18.05747741	8/24/03 22:36	372:07:47	371:59:00	19.29066412	
15	76	1079	0.000529722	536	14.005	0.000489611	13.86419	0.028170023	797.6832	16.73307182	18.34830767	8/26/03 16:34	414:03:47	413:55:00	20.3485394	
1	80	1082	3.53148E-05	540	14.044	3.2469E-05	0.919983	0.028202512	798.6032	16.75237039	18.36760624	8/27/03 14:07	435:36:47	435:28:00	20.87134532	
3	80	1079	0.000105944	540	14.005	9.71968E-05	2.752298	0.028299709	801.3555	16.61010558	18.42534144	8/28/03 16:35	462:04:47	461:56:00	21.49603969	
-3	79	1084	-0.00010594	539	14.070	-9.76264E-05	-2.77018	0.028201681	796.5653	16.75199524	16.36723109	8/29/03 14:07	483:36:47	463:28:00	21.99120405	
-4	76	1086	-0.00014126	538	14.096	-0.000130921	-3.70727	0.028070959	794.676	16.67422754	16.2894634	9/1/03 14:36	556:05:47	555:57:00	23.58169606	
-1	77	1064	-3.5315E-05	537	14.070	-3.27309E-05	-0.92663	0.028038226	793.9512	16.65476529	16.27002114	9/2/03 16:39	584:06:47	584:00:00	24.16912057	
0	77	1084	0	537	14.070	0	0	0.028038228	793.9512	16.65478529	18.27002114	9/3/03 17:32	607:01:47	606:53:00	24.63797316	

SAMPLE DECANISTERED 09/05/03 DUE TO NO MORE GAS BEING EVOLVED

SAMPLE: 820' to 824' (Excello Shale) in canister Brady 28

DRY WEIGHT	lbs.	grams
sample weight:	1.1757	533.3

est. lost gas (cc) =	TIME OF:			elapsed time (off bottom to canistering)
85	off bottom	at surface	in canister	5.0 minutes
	8/9/03 10:46	8/9/03 10:46	8/9/03 10:52	0.084 hours

CONVERSION OF VOLUMES TO STP

RIG MEASUREMENTS			CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)					CUMULATIVE VOLUMES		SCF/TON (approx)	SCF/TON (approx)		TIME SINCE		0.290114920 SQRT (hrs)	
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	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)	
48	75	1089	0.00169511	535	14.135	0.001584231	44.86026	0.001584231	44.86026	2.694900397	7.801124286	8/9/03 10:56	0:11:16	0:06:15	0.433973886	
8	75	1089	0.000282516	535	14.135	0.000264039	7.47671	0.00184827	52.33697	3.144050463	8.250274354	8/9/03 10:59	0:12:46	0:07:45	0.461680215	
16	75	1089	0.000565037	535	14.135	0.000528077	14.95342	0.002376347	67.29039	4.042350595	9.148574487	8/9/03 11:03	0:16:03	0:11:00	0.517204022	estimate
18	75	1089	0.000635666	535	14.135	0.000594087	16.8228	0.002970433	84.11299	5.052938244	10.15916214	8/9/03 11:06	0:19:16	0:14:15	0.567156851	
12	75	1089	0.000423778	535	14.135	0.000396058	11.21507	0.003366491	95.32805	5.726683343	10.83288723	8/9/03 11:09	0:22:46	0:17:45	0.6184414	
15	75	1089	0.000529722	535	14.135	0.000495072	14.01883	0.003861563	109.3469	6.568619717	11.67504361	8/9/03 11:14	0:27:16	0:22:15	0.674536878	
10	75	1089	0.000353148	535	14.135	0.000330048	9.345886	0.004191612	118.6928	7.1302573	12.23846119	8/9/03 11:17	0:30:03	0:25:00	0.707695791	
12	75	1089	0.000423778	535	14.135	0.000396058	11.21507	0.004587669	129.9078	7.803962399	12.91020829	8/9/03 11:20	0:33:48	0:28:45	0.75055535	
10	75	1088	0.000353148	535	14.122	0.000329745	9.337306	0.004917414	139.2451	8.364904429	13.47112832	8/9/03 11:24	0:37:33	0:32:30	0.791096286	
5	75	1088	0.000176574	535	14.122	0.000164673	4.668653	0.005082287	143.9138	8.645365443	13.75158933	8/9/03 11:27	0:40:03	0:35:00	0.817006732	
15	75	1088	0.000529722	535	14.122	0.000494618	14.00596	0.005576905	157.9198	9.486748467	14.59297236	8/9/03 11:32	0:45:33	0:40:30	0.871301708	
2	75	1088	7.06296E-05	535	14.122	6.5949E-05	1.867461	0.005642854	159.7872	9.598932893	14.70515678	8/9/03 11:34	0:47:48	0:42:45	0.892581856	
18	75	1088	0.000635668	535	14.122	0.000593541	16.80715	0.006236395	176.5944	10.60859255	15.71481644	8/9/03 11:44	0:57:18	0:52:15	0.977241014	
14	75	1088	0.000494407	535	14.122	0.000461643	13.07223	0.006698038	189.6666	11.39388339	16.50010728	8/9/03 11:51	1:04:48	0:59:45	1.039230485	
11	75	1088	0.000388463	535	14.122	0.00036272	10.27104	0.007060757	199.9376	12.01069762	17.11712151	8/9/03 11:58	1:11:48	1:06:45	1.093922605	
14	75	1088	0.000494407	535	14.122	0.000461643	13.07223	0.0075224	213.0099	12.79616846	17.90241235	8/9/03 12:11	1:24:03	1:19:00	1.183568052	
27	75	1088	0.0009535	535	14.122	0.000890312	25.21072	0.008412712	238.2206	14.31087794	19.41690183	8/9/03 12:33	1:46:03	1:41:00	1.32947358	
54	74	1088	0.001906999	534	14.122	0.001783958	50.51587	0.01019667	288.7365	17.34532914	22.45155303	8/9/03 13:17	2:30:03	2:25:00	1.581402331	

42	76	1088	0.001483222	536	14.122	0.001377207	36.998	0.011573677	327.7345	19.68806483	24.79428872	8/9/03	13:59	3:12:03	3:07:00	1.789087291
42	75	1074	0.001483222	535	13.940	0.001367109	36.71206	0.012940985	366.4465	22.01362262	27.11964671	8/9/03	15:59	5:12:03	5:07:00	2.280533563
21	76	1064	0.000741611	535	14.070	0.000689919	19.53625	0.013630904	365.9626	23.16722843	28.29345232	8/9/03	17:33	6:46:03	6:41:00	2.601441908
92	75	1065	0.003246962	535	14.083	0.00302529	65.66635	0.016656194	471.6491	28.33346183	33.43970572	8/9/03	23:19	12:32:03	12:27:00	3.540362505
128	75	1068	0.004520294	535	14.122	0.004220737	119.5175	0.020676931	591.1666	35.51326361	40.6195077	8/10/03	12:45	25:56:03	25:53:00	5.09583163
112	75	1066	0.003955256	535	14.096	0.003686356	104.3656	0.024563267	695.5522	41.78406214	46.89028603	8/11/03	9:45	46:56:03	46:53:00	6.853283884
84	75	1069	0.002966443	535	14.135	0.002772404	78.50546	0.027335691	774.0577	46.50013783	51.60636172	8/12/03	11:33	72:46:03	72:41:00	8.530366861
58	75	1091	0.002046258	535	14.161	0.001917795	54.3057	0.029253466	828.3634	49.76245623	54.66868012	8/13/03	13:52	99:05:03	99:00:00	9.954103007
35	75	1093	0.001236016	535	14.167	0.001159412	32.83076	0.030412898	861.1941	51.73470552	56.84092941	8/14/03	11:22	120:35:03	120:30:00	10.96106222
43	75	1091	0.001516536	535	14.161	0.001421613	40.26112	0.031834711	901.4552	54.15332088	59.25954477	8/15/03	15:41	146:54:03	148:49:00	12.20249291
35	75	1063	0.001236018	535	14.057	0.001148804	32.53038	0.032983515	933.9856	56.1075258	61.21374969	8/16/03	16:11	173:24:03	173:19:00	13.16817502
20	75	1061	0.000706296	535	14.031	0.000655247	18.55446	0.033638763	952.5401	57.22215211	62.326376	8/17/03	12:40	193:53:03	193:48:00	13.92422948
29	76	1062	0.001024129	536	14.044	0.000949213	26.87862	0.034587976	979.4167	58.83663727	63.94306116	8/18/03	20:27	225:40:03	225:35:00	15.02223352
32	76	1061	0.001130074	536	14.031	0.001046439	29.63175	0.035634415	1009.05	60.61691212	65.72313602	8/20/03	10:04	263:17:03	263:12:00	16.22603361
28	78	1063	0.000988814	538	14.057	0.000913918	25.87919	0.036548333	1034.93	62.17155642	67.27776231	8/21/03	20:35	297:46:03	297:43:00	17.25690683
22	76	1063	0.000776926	536	14.057	0.000720758	20.40952	0.037269091	1055.339	63.39762408	68.50364797	8/24/03	22:38	371:51:03	371:46:00	19.28343417
25	76	1079	0.00088287	536	14.005	0.000616018	23.10698	0.03808511	1078.446	64.76573461	69.8919585	8/26/03	16:35	413:46:03	413:43:00	20.34209511
5	80	1082	0.000176574	540	14.044	0.000162445	4.599917	0.036247555	1083.046	65.06206642	70.16829031	8/27/03	14:08	435:21:03	435:16:00	20.8650625
10	80	1079	0.000353148	540	14.005	0.000323989	9.174325	0.036571544	1092.22	65.61319771	70.7194216	8/28/03	16:35	461:46:03	461:43:00	21.48955172
-2	79	1064	-7.063E-05	539	14.070	-6.52169E-05	-1.84679	0.036506325	1090.374	65.50225522	70.60847912	8/29/03	14:06	483:21:03	463:16:00	21.98524126
-2	78	1066	-7.083E-05	538	14.096	-6.54607E-05	-1.65363	0.038440665	1088.52	65.39090145	70.49712534	9/1/03	14:36	555:49:03	555:44:00	23.57578207
-1	77	1064	-3.5315E-05	537	14.070	-3.27309E-05	-0.92663	0.038408134	1067.593	65.33522361	70.4414475	9/2/03	18:40	563:53:03	583:48:00	24.16369522
-1	77	1064	-3.5315E-05	537	14.070	-3.27309E-05	-0.92663	0.038375403	1086.666	65.27954577	70.38576966	9/3/03	17:32	608:45:03	606:40:00	24.63231279

SAMPLE DECANISTERED 09/05/03 DUE TO NO MORE GAS BEING EVOLVED

SAMPLE: 1012' to 1014' (Weir-Pittsburg coal) in canister Brady 31

	lbs.	grams
dry sample weight:	2.0557	932.455

est. lost gas (cc) = 95

TIME OF: off bottom 8/9/03 12:23

TIME OF: at surface 8/9/03 12:25; in canister 8/9/03 12:31

elapsed time (off bottom to canistering): 7.9 minutes; 0.132 hours; 0.364005494 SQRT (hrs)

CONVERSION OF VOLUMES TO STP

RIG MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi) cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON (approx) without lost gas	SCF/TON (approx) with lost gas	TIME OF MEASURE		TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
32	80	1088	0.001130074	540	14.122	0.001045414	29.60272	0.001045414	29.60272	1.017082539	4.281066143	8/9/03	12:36	0:13:12	0:05:15	0.469041576
6	80	1088	0.000211889	540	14.122	0.000196015	5.550509	0.001241429	35.15323	1.207785516	4.471771119	8/9/03	12:37	0:14:27	0:06:30	0.490747729
12	80	1086	0.000423778	540	14.122	0.00039203	11.10102	0.001633459	46.25424	1.569191468	4.653177071	8/9/03	12:40	0:17:12	0:09:15	0.535412613
7	80	1088	0.000247204	540	14.122	0.000226664	6.475594	0.001862144	52.72984	1.611678273	5.075663677	8/9/03	12:42	0:19:12	0:11:15	0.565685425
6	80	1088	0.000211889	540	14.122	0.000196015	5.550509	0.002058159	56.28035	2.00236125	5.266366853	8/9/03	12:44	0:21:12	0:13:15	0.594418483
25	80	1086	0.00088287	540	14.122	0.00061673	23.12712	0.002874889	81.40747	2.796976964	6.060962587	8/9/03	12:51	0:26:42	0:20:45	0.691616464
7	80	1066	0.000247204	540	14.122	0.000226664	6.475594	0.003103573	67.88307	3.019463769	6.283449392	8/9/03	12:54	0:31:27	0:23:30	0.723993554
10	60	1068	0.000353148	540	14.122	0.000326692	9.250649	0.003430265	97.13391	3.337302083	6.601267686	8/9/03	12:58	0:34:57	0:27:00	0.763216876
25	80	1068	0.00088287	540	14.122	0.00061673	23.12712	0.004246994	120.261	4.131697617	7.39566342	8/9/03	13:11	0:46:42	0:40:45	0.90092545
10	80	1068	0.000353148	540	14.122	0.000326692	9.250849	0.004573686	129.5119	4.44973611	7.713721713	8/9/03	13:16	0:53:12	0:45:15	0.941629793
12	80	1088	0.000423778	540	14.122	0.00039203	11.10102	0.004965717	140.6129	4.831142062	8.095127666	8/9/03	13:24	1:00:57	0:53:00	1.007885576
16	80	1068	0.000635666	540	14.122	0.000566045	16.65153	0.005553762	157.2644	5.403250991	8.667236594	8/9/03	13:34	1:11:12	1:03:15	1.089342309
13	80	1088	0.000459092	540	14.122	0.000424699	12.0261	0.005978461	169.2905	5.816440773	9.080426376	8/9/03	13:42	1:19:12	1:11:15	1.148912529
16	80	1088	0.000565037	540	14.122	0.000522707	14.80136	0.006501168	184.0919	6.324962042	9.586967645	8/9/03	13:56	1:32:57	1:25:00	1.24465524
86	84	1074	0.003037073	544	13.940	0.002753005	77.95613	0.009254174	262.048	9.003378844	12.26736445	8/9/03	15:56	3:32:57	3:25:00	1.883923211
30	81	1064	0.001059444	541	14.070	0.000974667	27.59941	0.010226641	289.6474	9.951632131	13.21561773	8/9/03	17:26	5:04:57	4:57:00	2.254440064
90	81	1065	0.003178332	541	14.083	0.0029267	82.6746	0.013155541	372.522	12.79901631	16.06300191	8/9/03	23:21	10:57:57	10:50:00	3.311469966
109	81	1066	0.003849313	541	14.096	0.003547826	100.4629	0.016703367	472.9849	16.25069326	19.51467887	8/10/03	12:46	24:22:57	24:15:00	4.937663911
86	80	1086	0.003107702	540	14.096	0.002869604	81.25762	0.019572971	554.2427	19.04252874	22.30651435	8/11/03	9:47	45:23:57	45:16:00	6.737890372
63	80	1089	0.002224832	540	14.135	0.002060051	58.33392	0.021633021	612.5766	21.04675042	24.31073602	8/12/03	11:34	71:10:57	71:03:00	8.436972206
44	80	1091	0.001553851	540	14.161	0.001441406	40.81597	0.023074429	653.3926	22.44909504	25.71306064	8/13/03	13:53	97:29:57	97:22:00	9.874166632
27	80	1093	0.0009535	540	14.167	0.000886122	25.09208	0.023960551	678.4847	23.31120219	26.5751878	8/14/03	11:23	118:59:57	118:52:00	10.90867392
30	60	1091	0.001059444	540	14.161	0.000982778	27.82907	0.024943329	706.3137	24.26734625	27.53133186	8/15/03	15:42	147:18:57	147:11:00	12.13737341
24	80	1083	0.000847555	540	14.057	0.000760457	22.10001	0.025723786	728.4136	25.02665259	28.29063819	8/18/03	16:12	171:48:57	171:41:00	13.10765388
15	80	1061	0.000529722	540	14.031	0.000486665	13.787	0.026210671	742.2007	25.50034265	28.76432826	8/17/03	12:41	192:17:57	192:10:00	13.86719751
14	79	1062	0.000494407	539	14.044	0.00045569	12.90366	0.026666361	755.1044	25.94368337	29.20766897	8/18/03	20:27	224:03:57	223:56:00	14.96882872
24	79	1082	0.000847555	539	14.044	0.000761183	22.12056	0.027447544	777.225	26.70369602	29.96766162	8/20/03	10:05	261:41:57	261:34:00	16.17711861
20	79	1081	0.000706296	539	14.031	0.000650384	18.41677	0.028097929	795.6417	27.33645455	30.60044016	8/21/03	20:35	296:11:57	296:04:00	17.21043772
18	80	1083	0.000635666	540	14.057	0.000585343	16.575	0.028683272	812.2167	27.9059343	31.16991991	8/24/03	22:39	370:15:57	370:08:00	19.24229283
18	80	1079	0.000635666	540	14.005	0.000583181	16.51379	0.029266453	828.7305	28.47331071	31.73729632	8/28/03	16:36	412:12:57	412:05:00	20.30309911
6	83	1082	0.000211689	543	14.044	0.000193857	5.469403	0.02946031	834.2199	28.66191422	31.92569982	8/27/03	14:09	433:45:57	433:38:00	20.82704572
7	85	1079	0.000247204	545	14.005	0.000224712	6.36311	0.029685022	840.583	28.88053632	32.14452193	8/28/03	16:36	460:14:57	460:07:00	21.45341853
0	83	1084	0	543	14.070	0	0	0.029685022	840.583	28.88053632	32.14452193	8/29/03	14:09	481:45:57	481:38:00	21.94916475
5	80	1086	0.000176574	540	14.096	0.000163046	4.616922	0.029846068	845.2	29.03916334	32.30314894	9/1/03	14:37	554:13:57	554:06:00	23.54214306
6	81	1084	0.000211869	541	14.070	0.000194933	5.519881	0.030043001	850.7198	29.228814	32.4927996	9/2/03	18:41	582:17:57	582:10:00	24.1306758
3	82	1084	0.000105944	542	14.070	9.72869E-05	2.754848	0.030140288	853.4747	29.32346437	32.56744997	9/3/03	17:34	605:10:57	605:03:00	24.60045731

2	81	1087	7.06296E-05	541	14.109	8.51577E-05	1.845053	0.030205448	855.3197	29.38665821	32.65084181	9/4/03	17:49	629:25:57	829:18:00	25.08849338
8	82	1084	0.000282518	542	14.070	0.000259432	7.346262	0.030464878	882.886	29.63925721	32.90324281	9/7/03	17:38	701:14:57	701:07:00	26.46110962
2	83	1084	7.06296E-05	543	14.070	6.47385E-05	1.833183	0.030529618	884.4992	29.70224125	32.96622686	9/8/03	14:17	721:53:57	721:46:00	26.86816131
4	82	1082	0.000141259	542	14.044	0.000129477	3.866354	0.030859093	868.1855	29.82820891	33.09219451	9/9/03	17:35	749:11:57	749:04:00	27.37150262
5	81	1079	0.000176574	541	14.005	0.000181895	4.578684	0.030820788	872.7442	29.98552215	33.24950775	9/10/03	19:07	774:43:57	774:36:00	27.83401696
8	81	1079	0.000282518	541	14.005	0.000258712	7.325894	0.0310795	880.0701	30.23722333	33.50120893	9/12/03	14:07	817:43:57	817:36:00	28.59602245
1	83	1083	3.53148E-05	543	14.057	3.23394E-05	0.915748	0.03111184	880.9859	30.2686863	33.5326719	9/13/03	18:07	845:43:57	845:36:00	29.08146036
-3	80	1088	-0.00010594	540	14.122	-9.80078E-05	-2.77525	0.031013832	878.2106	30.17333481	33.43732041	9/14/03	19:35	871:11:57	871:04:00	29.51808319
2	80	1085	7.06296E-05	540	14.083	8.51582E-05	1.845068	0.03107899	880.0557	30.23872719	33.50071279	9/15/03	15:26	891:02:57	890:55:00	29.85044667
3	80	1079	0.000105944	540	14.005	9.71968E-05	2.752298	0.031178187	882.808	30.33128992	33.59527553	9/17/03	12:10	935:46:57	935:39:00	30.59056227
1	80	1088	3.53148E-05	540	14.096	3.26091E-05	0.923384	0.031208796	883.7314	30.36301533	33.82700093	9/18/03	16:29	964:05:57	963:56:00	31.04994632
-1	83	1087	-3.5315E-05	543	14.109	-3.24588E-05	-0.91913	0.031176338	882.8122	30.33143615	33.59542175	9/17/03	17:19	940:55:57	940:48:00	30.67462306
1	81	1082	3.53148E-05	541	14.044	3.2429E-05	0.918283	0.031208767	883.7305	30.38298827	33.62697188	9/21/03	13:51	1033:27:57	1033:20:00	32.14756341
9	80	1084	0.000317833	540	14.070	0.000292942	8.295155	0.031501708	892.0257	30.64798907	33.91197467	9/23/03	11:02	1078:38:57	1078:31:00	32.84279475
3	82	1081	0.000105944	542	14.031	9.70177E-05	2.747224	0.031598726	894.7729	30.74237749	34.0083631	9/25/03	19:25	1135:01:57	1134:54:00	33.69024339
0	82	1081	0	542	14.031	0	0	0.031598726	894.7729	30.74237749	34.0063631	9/27/03	14:16	1177:52:57	1177:45:00	34.32029283
-4	82	1089	-0.00014126	542	14.135	-0.000130314	-3.89007	0.031468412	891.0828	30.61559489	33.87958049	9/28/03	19:21	1206:57:57	1206:50:00	34.74141381
4	82	1091	0.000141259	542	14.181	0.000130554	3.696851	0.031598965	894.7797	30.74261034	34.00859594	9/29/03	18:38	1230:14:57	1230:07:00	35.07490794
0	80	1096	0	540	14.228	0	0	0.031598985	894.7797	30.74261034	34.00859594	9/30/03	20:13	1255:49:57	1255:42:00	35.43772707
12	83	1085	0.000423778	543	14.083	0.000388789	11.00925	0.031987755	905.7889	31.12086321	34.38484882	10/6/03	12:39	1392:15:57	1392:08:00	37.31307858
-20	83	1084	-0.0007063	543	14.070	-0.000647385	-18.3318	0.03134037	887.4571	30.49102279	33.75500839	10/14/03	20:13	1591:49:57	1591:42:00	39.89777563

SAMPLE DECANISTERED 10/14/03 DUE TO NO MORE GAS BEING EVOLVED

718' to 720' (Mulberry coal) in canister Brady 24

Dart Cherokee Basin Holder #CH-1; SE NE sec. 1-T.30S.-R.14E., Wilson County, KS

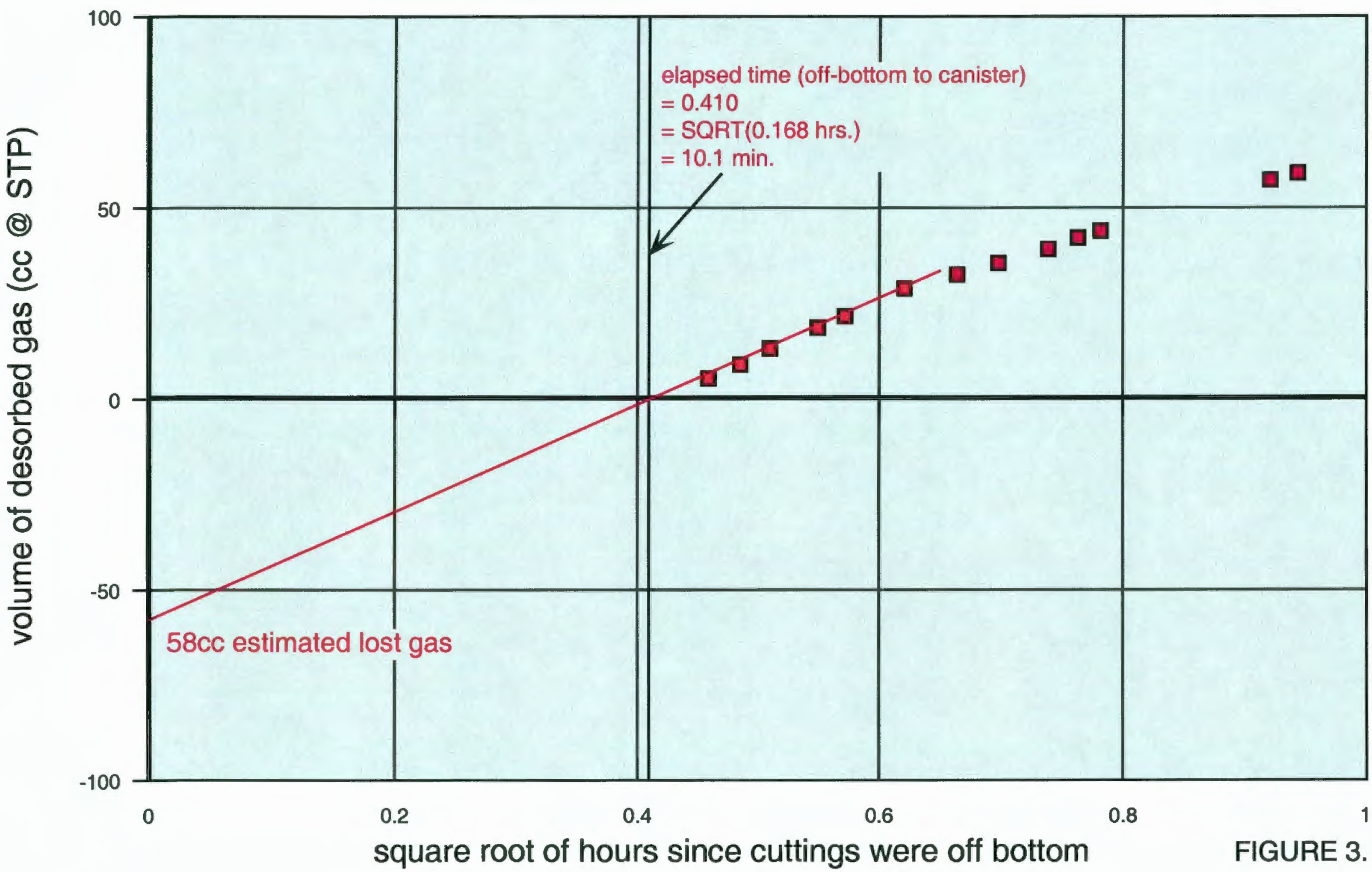

FIGURE 3.

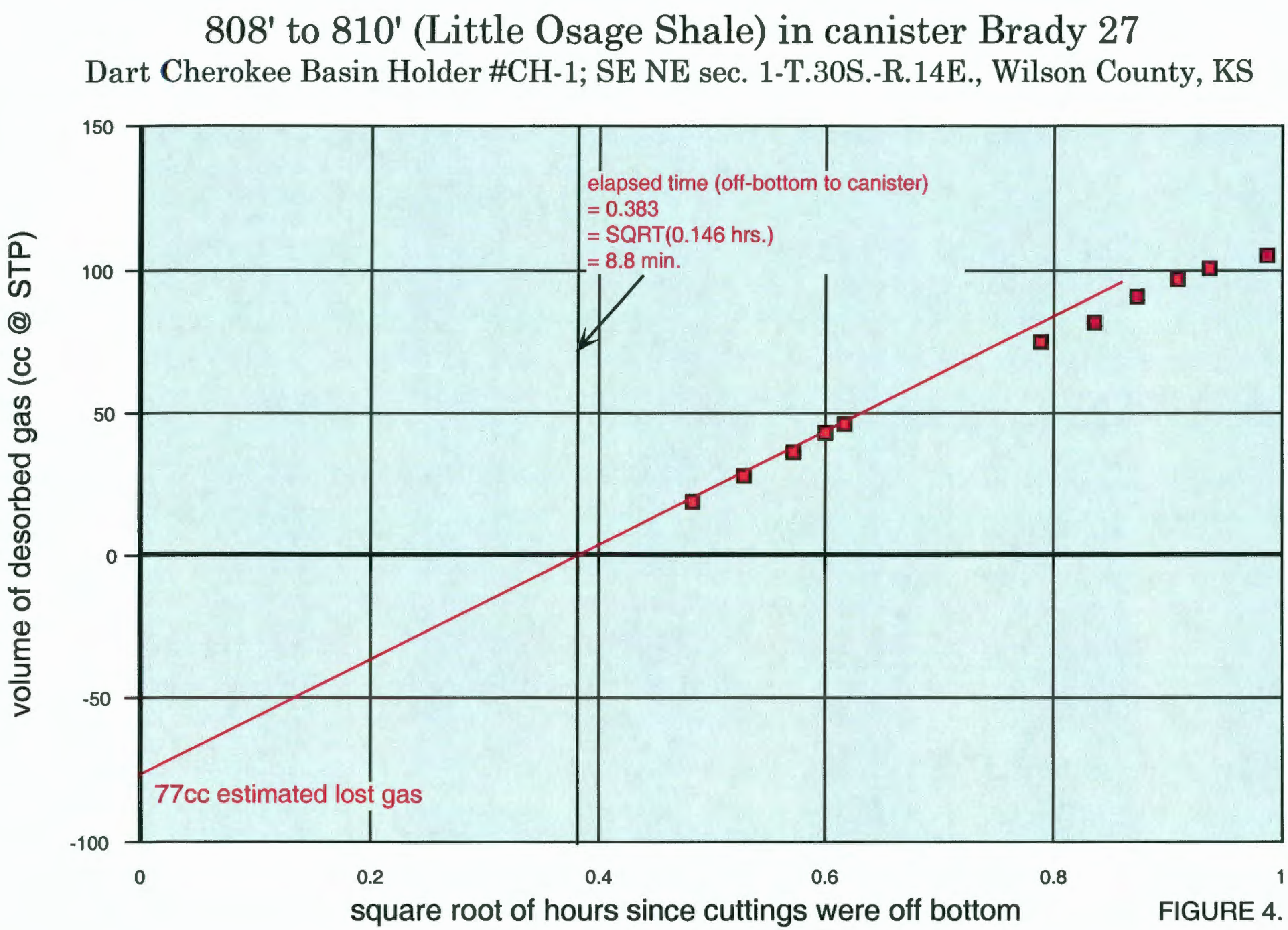
808' to 810' (Little Osage Shale) in canister Brady 27
Dart Cherokee Basin Holder #CH-1; SE NE sec. 1-T.30S.-R.14E., Wilson County, KS
elapsed time (off-bottom to canister)
= 0.383
= SQRT(0.146 hrs.)
= 8.8 min.
77cc estimated lost gas
volume of desorbed gas (cc @ STP)
150
100
50
0
-50
-100
0
0.2
0.4
0.6
0.8
1
square root of hours since cuttings were off bottom

FIGURE 4.

820' to 824' (Mulky coal/Excello Shale) in canister Brady 28

Dart Cherokee Basin Holder #CH-1; SE NE sec. 1-T.30S.-R.14E., Wilson County, KS

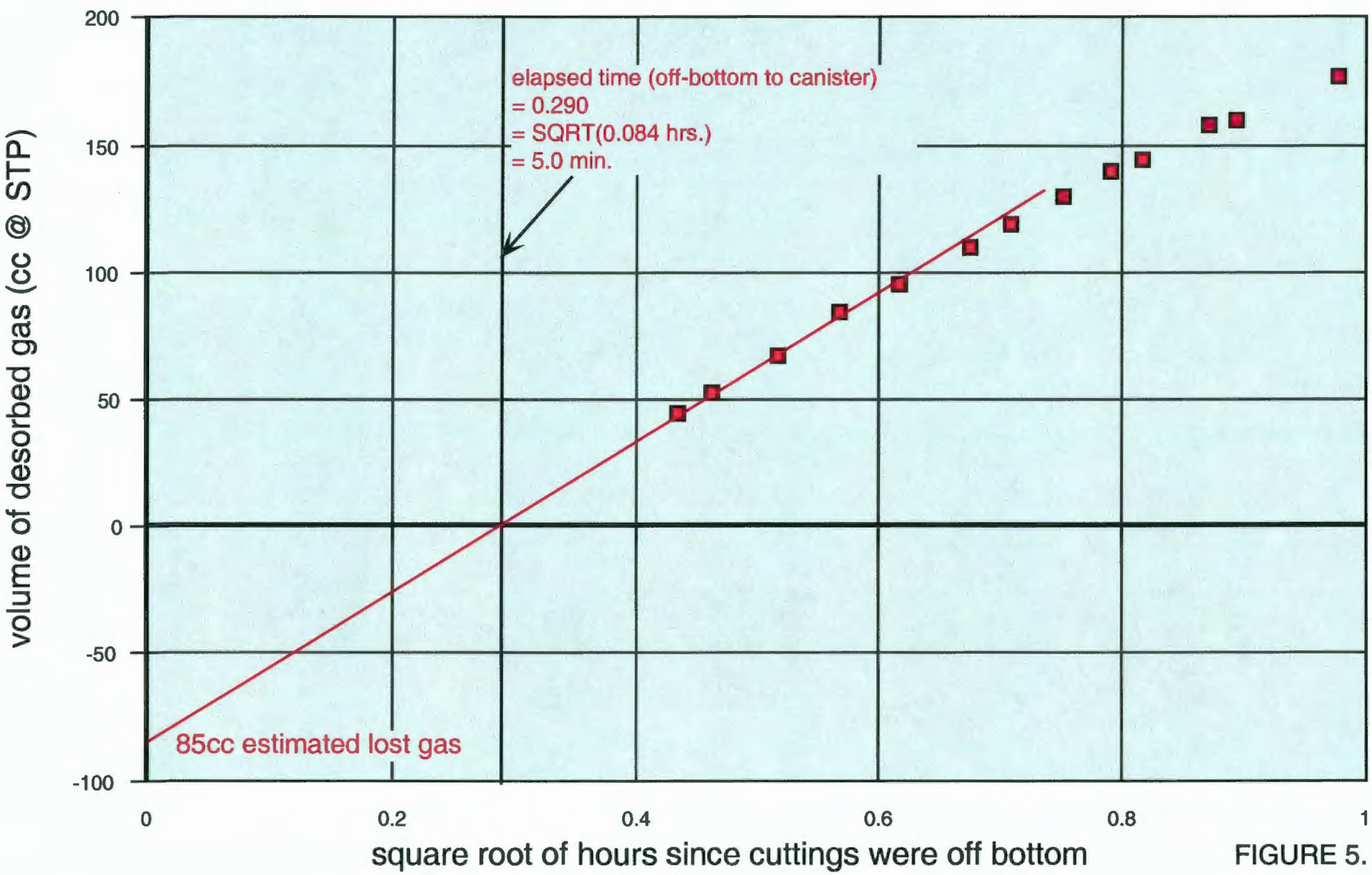

FIGURE 5.

1012' to 1014' (Weir-Pittsburg coal) in canister Brady 31

Dart Cherokee Basin Holder #CH-1; SE NE sec. 1-T.30S.-R.14E., Wilson County, KS

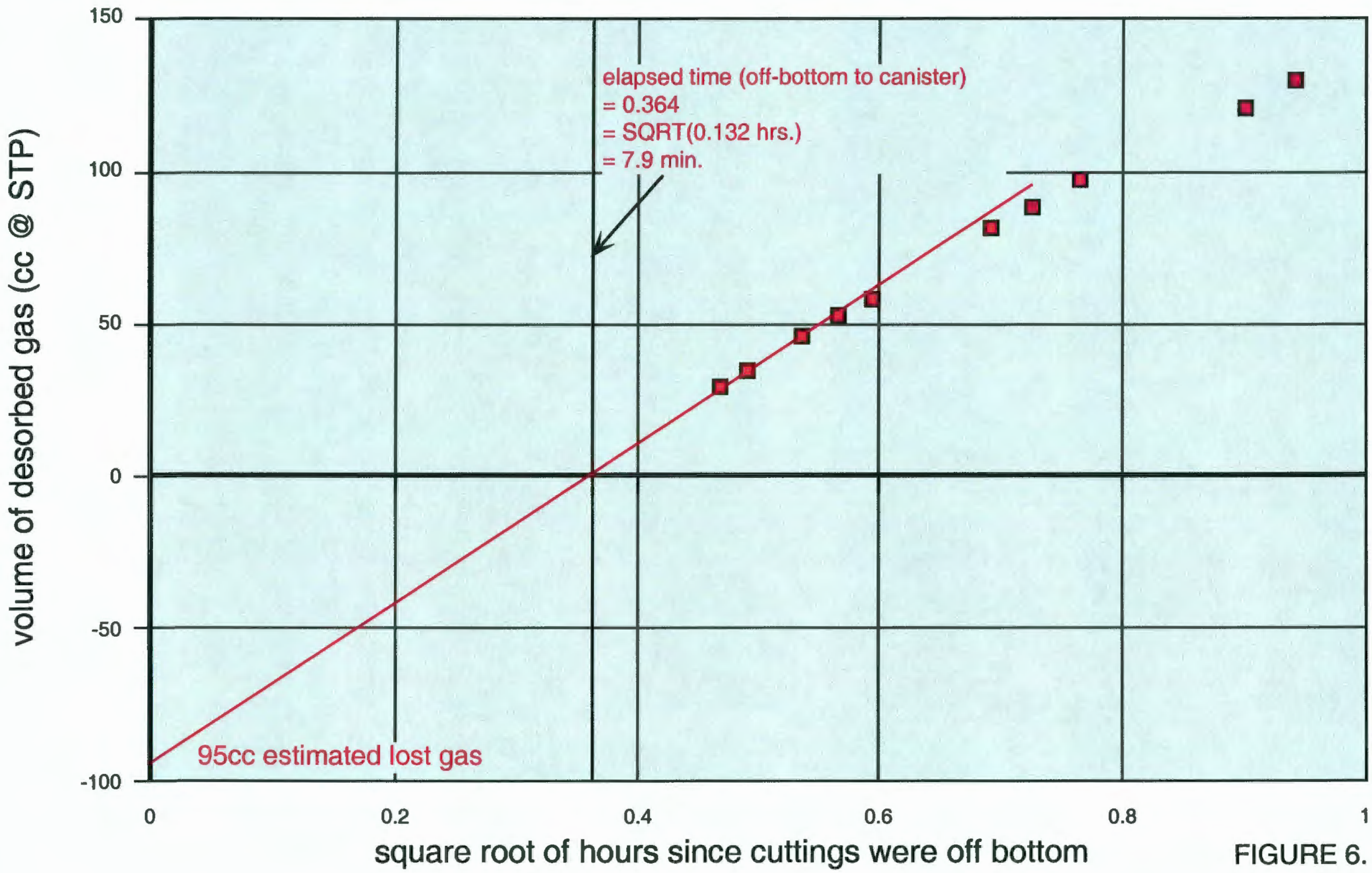

FIGURE 6.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Mulberry coal from 718-720'

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

total gas desorbed = 509 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1899.40 grams

$\text{weight}_{light\text{-}colored\ lithologies}$ = 1733.76 grams (91.3%)

$\text{weight}_{dark\ shale}$ = 57.55 grams (3.0%)

weight_{coal} = 108.09 grams (5.7%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	860.65	1.48% / 1.45% / 97.07%
>0.0661"	411.97	7.09% / 4.41% / 88.50%
>0.0460"	409.41	11.04% / 4.79% / 84.18%
>0.0331"	163.88	10.33% / 3.33% / 86.33%
<0.0331"	53.49	7.49% / 3.49% / 89.02%
	1899.40 TOTAL	

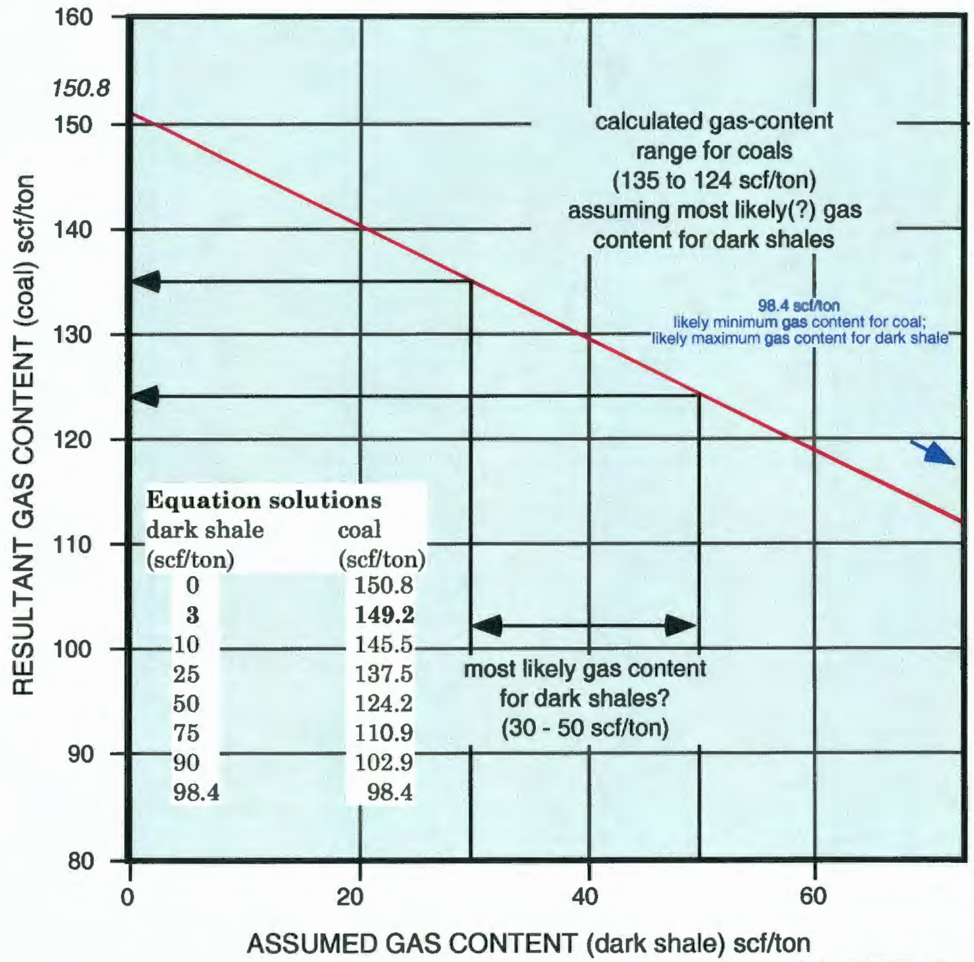

FIGURE 7.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Little Osage Shale from 808-810'

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

total gas desorbed = 878 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1935.81 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 408.57 grams (21.1%)
$\text{weight}_{dark\ shale}$ = 1527.24 grams (78.9%)
weight_{coal} = 0.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	1610.26	0.00% / 84.91% / 15.09%
>0.0661"	158.04	0.00% / 53.44% / 46.56%
>0.0460"	72.85	0.00% / 44.88% / 55.12%
>0.0331"	33.27	0.00% / 30.17% / 69.83%
<0.0331"	28.63	0.00% / 53.35% / 46.65%
	1935.81 TOTAL	

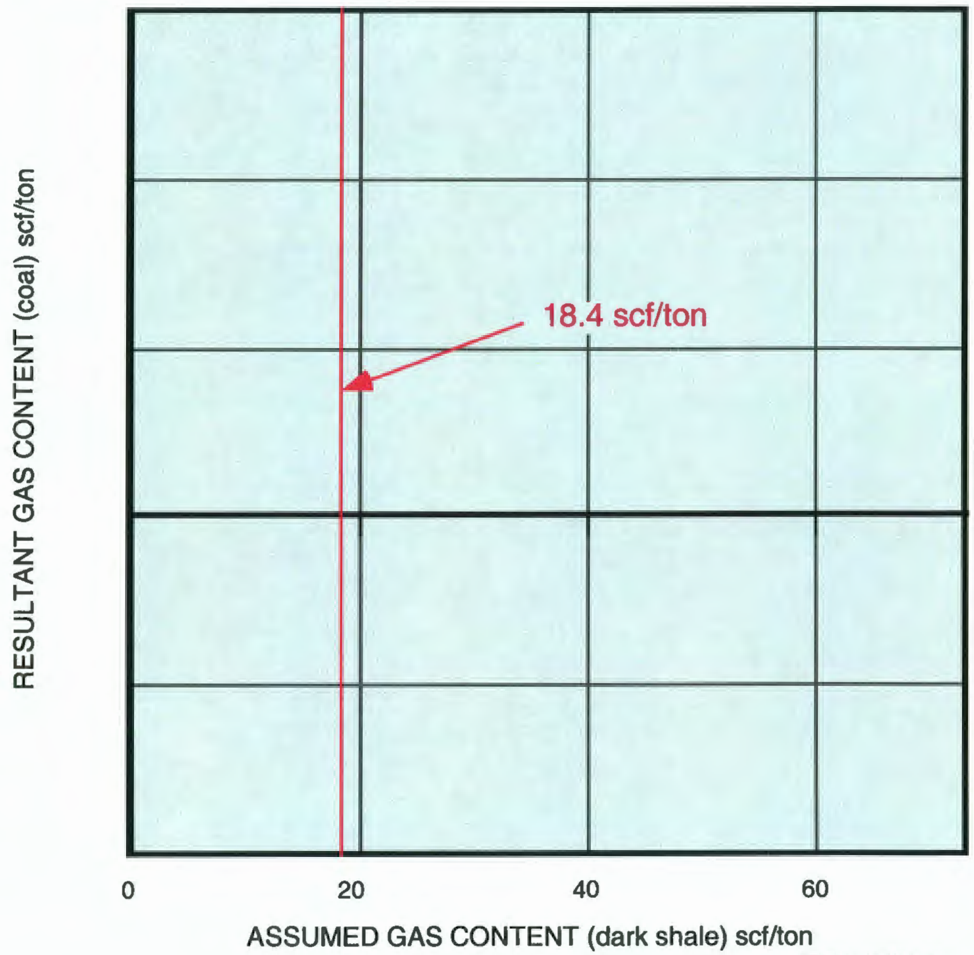

FIGURE 8.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Mulky coal/ Excello Shale from 820-824'

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

total gas desorbed = 1177 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1608.54 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 1075.24 grams (66.9%)
$\text{weight}_{dark\ shale}$ = 504.59 grams (31.4%)
weight_{coal} = 28.71 grams (1.8%)

sieve size	grams	% coal / % dark shale / % light-colored liths
>0.0930"	1328.44	1.46% / 31.72% / 66.82%
>0.0661"	144.58	4.28% / 23.13% / 72.59%
>0.0460"	45.94	2.80% / 38.00% / 59.20%
>0.0331"	17.93	1.06% / 37.23% / 61.70%
<0.0331"	19.11	2.40% / 32.52% / 65.08%
	1608.54 TOTAL	

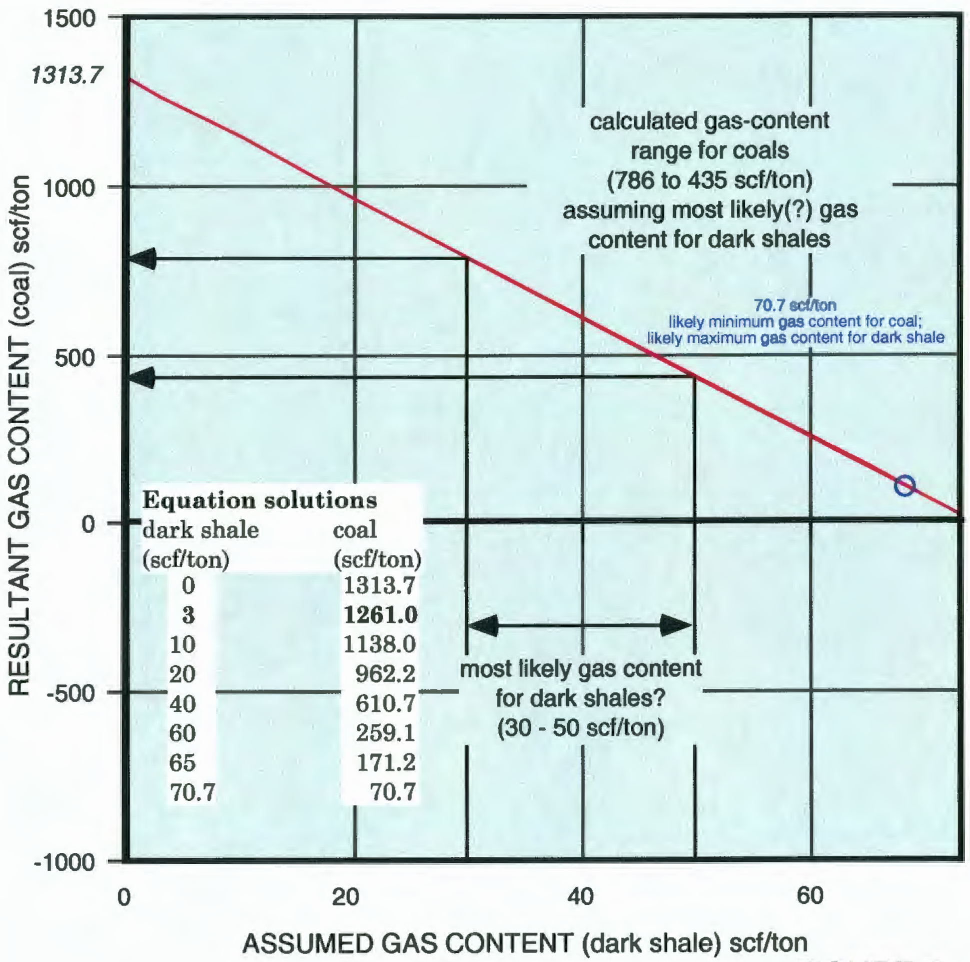

FIGURE 9.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Weir-Pittsburg coal from 1012-1014'

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

total gas desorbed = 1001 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1806.39 grams

$\text{weight}_{light\text{-}colored\ lithologies}$ = 873.93 grams (48.4%)

$\text{weight}_{dark\ shale}$ = 814.62 grams (45.1%)

weight_{coal} = 117.83 grams (6.5%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	1387.06	6.86% / 44.53% / 48.61%
>0.0661"	211.24	5.65% / 47.10% / 47.25%
>0.0460"	134.11	5.39% / 45.90% / 48.71%
>0.0331"	50.37	4.32% / 49.38% / 46.30%
<0.0331"	23.61	5.55% / 46.73% / 47.72%
	1806.39 TOTAL	

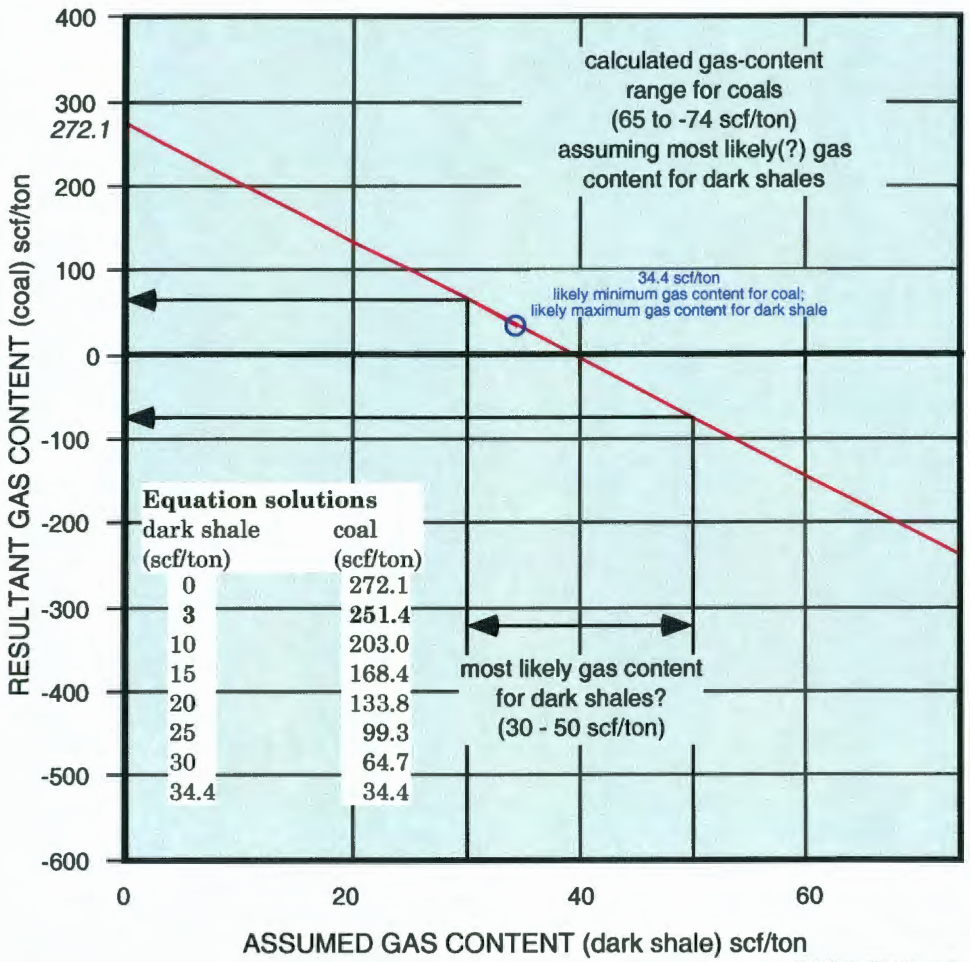

FIGURE 10.

Desorption Characteristics of Cuttings Samples

Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson 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
Mulberry	6%	149.2	150.8	98.4
Little Osage Sh.	0%	------	18.4	18.4
Mulky/Excello*	2%	------	70.7	70.7
Weir-Pittsburg	7%	251.4	272.1	34.4

*gas content should be considered a *maximum* for shale in the sample and a *miminum* for the coal in the sample

surface
100'
200'
300'
400'
500'
600'
700'
718'-720' Mulberry
800'
808'-810' Little Osage Shale
820'-824' Mulky/Excello
900'
1000'
1012'-1014' Weir-Pittsburg
1100'

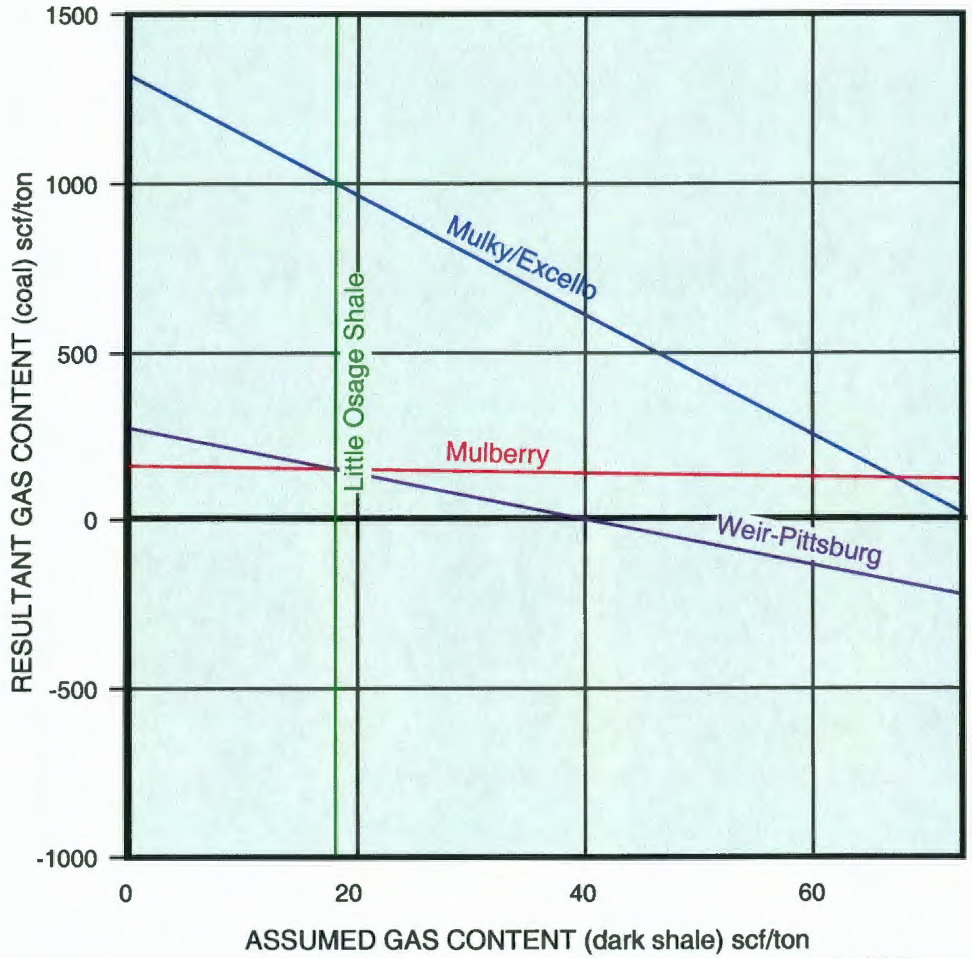

FIGURE 11.

Desorption Characteristics of Cuttings Samples

based on total weight of gas-generating lithologies (i.e., coal and dark shale) in sample
Dart Cherokee Basin Holder #CH-1, SE NE 1-T.30S.-R.14E., Wilson County, KS

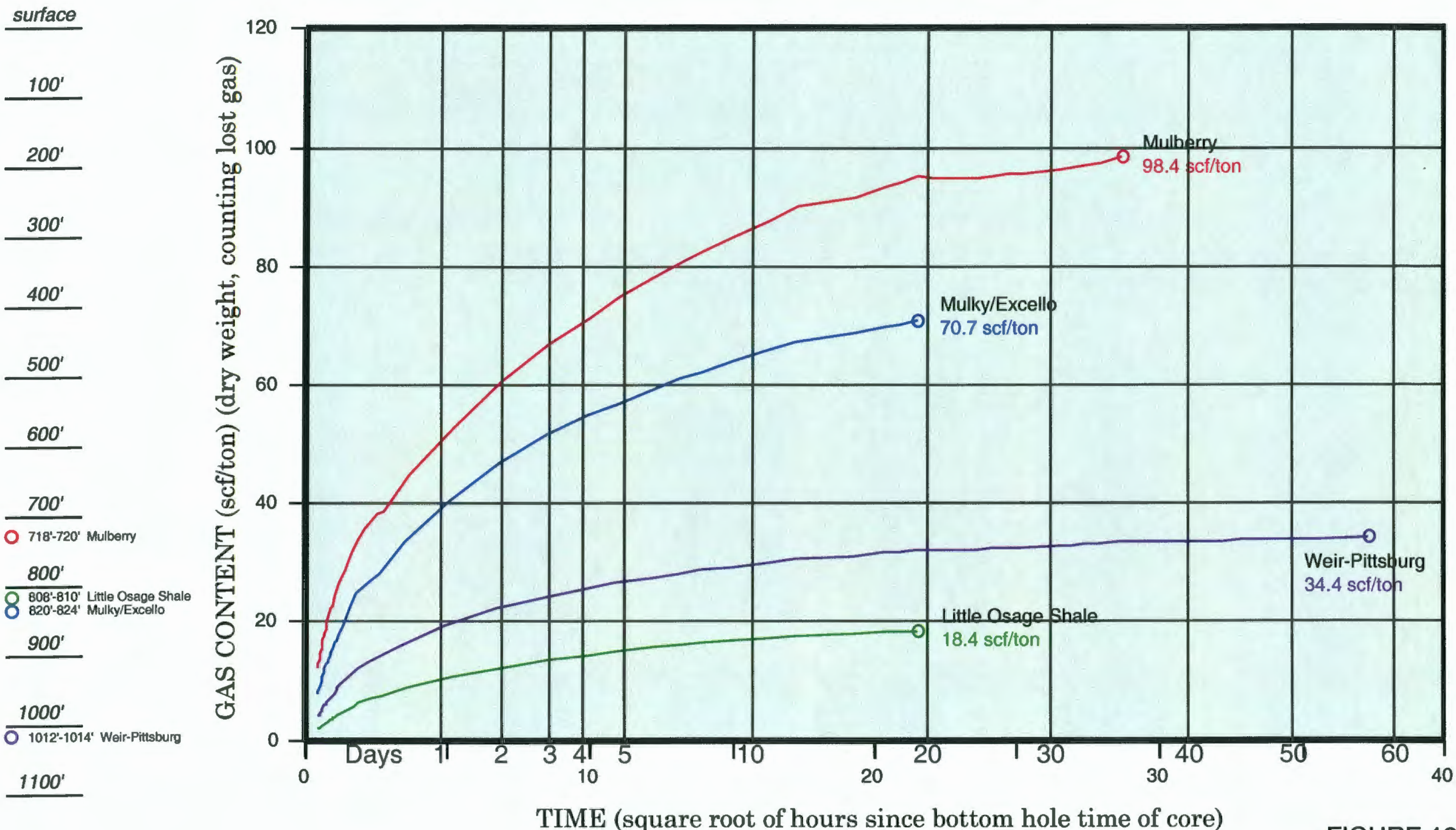

FIGURE 12.