

ANALYSIS OF CHEROKEE GROUP CORE AND CUTTINGS SAMPLES FOR GAS  
CONTENT

-- DART CHEROKEE BASIN OPERATING COMPANY  
ORR #BC3-34; NW NE sec. 34-T.30S.-R.15E.; WILSON COUNTY, KANSAS

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## SUMMARY

Three coal core samples from the Pennsylvanian Cherokee Group were collected from the Dart Cherokee Basin #BC3-34 Orr well, NW NE sec. 34-T.30S.-R.15E. in Wilson County, KS. In addition, one cuttings sample was collected. The samples calculate as having the following gas contents:

- Weir-Pittsburg coal (core) at 1052.2' to 1053.8' depth (267.6 scf/ton)
- Weir-Pittsburg coal (core) at 1053.8' to 1055.0' depth (235.5 scf/ton)
- Wainright coal (core) at 1077.3' to 1078.3' depth (140.0 scf/ton)
- Bluejacket coal (cuttings) at 1098' to 1099' depth<sup>1</sup> (146 scf/ton)

<sup>1</sup>assuming accompanying dark shales in sample desorb 3 scf/ton

## BACKGROUND

The Dart Cherokee Basin #BC3-34 Orr well, NW NE sec. 34-T.30S.-R.15E. 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 May 20, 2003 by K.David Newell and Glen Gagnon of the Kansas Geological Survey, with assistance from Gary Lazwell of Dart. Samples were obtained with a conventional core taken to the surface. The cuttings sample was subsequently taken upon resumption of drilling. The well was drilled using an air rotary rig owned by McPherson Drilling.

Time for the core to reach the surface was determined by noting the time the core left the bottom of the hole, and when it arrived on the surface. The time interval for the cuttings sample to reach the surface was determined by a signal from the driller as to when the coal was penetrated and when it arrived at the surface.

Weights for the core and cuttings samples are as follows:

- Weir-Pittsburg coal (core) at 1052.2' to 1053.8' depth (1459 grams dry wt.)
- Weir-Pittsburg coal (core) at 1053.8' to 1055.0' depth (1108 grams dry wt.)
- Wainright coal (core) at 1077.3' to 1078.3' depth (973 grams dry wt.)
- Bluejacket coal (cuttings) at 1098' to 1099' depth (1126 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 a desorption canister.

Temperature baths for the desorption canisters were on site, with temperature kept at approximately 78 °F. The canistered samples at the end of the day were transported to the laboratory at the Kansas Geological Survey in Lawrence, KS and desorption measurements were continued at approximately 80 °F. Desorption measurements were periodically made until the canisters produced negligible gas with daily testing for at least two successive days for the cuttings, and two successive weeks for the core samples.



## 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 "Maggy" desorption canister, used for one of the core samples, was made in-house at the Kansas Geological Survey. This canister is 14.5 inches long (37.8 cm), 8 inches (20.3 cm) in diameter, and enclose a volume of approximately 182 cubic inches (2990 cm<sup>3</sup>). The rest of the samples were placed in commercial canisters from SSD, Inc. in Grand Junction, CO. These canisters are 12.5 inches high (32 cm), 8 inches (20.3 cm) in diameter, and enclose a volume of approximately 153 cubic inches (2510 cm<sup>3</sup>).

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:

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

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  $P_{\text{stp}}$ ,  $V_{\text{stp}}$ , and  $T_{\text{stp}}$ , respectively, are pressure, volume and temperature at standard temperature and pressure, where standard temperature is degrees Rankine ( $^{\circ}\text{R} = 460 + ^{\circ}\text{F}$ ).  $P_{\text{rig}}$ ,  $V_{\text{rig}}$ , and  $T_{\text{rig}}$ , 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  $V_{\text{stp}}$  becomes:

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

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 #BC3-34 Orr well, the time of desorption for the Bluejacket coal cuttings sample was 6 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 brought 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 four hours for core samples and about an hour for cuttings samples.

## LITHOLOGIC ANALYSIS

Upon removal from the canisters, the cores and cuttings were washed of drilling mud. The cores were air dried for at least a week. The cuttings were dried in an oven at 150 °F for 10 days. After drying, the samples were again weighed to obtain dry weight,

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) data tables for the desorption analyses, 2) lost-gas graphs, 3) "lithologic component sensitivity analyses" showing the interdependence of gas evolved from dark shale versus coal in the cuttings sample, 4) a desorption graph for all the samples, and 5) a percentage of gas desorbed-vs.-time graph for the cored samples.

### *Data Tables of the Desorption Analyses (Table 1)*

These are the basic data used for lost-gas analyses and determination of total gas desorbed from the cuttings and core 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 the sample. In the case of the cuttings sample, the weight is that of the 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 2-5)*

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 few hour after the samples leave the bottom of the hole, thus data are presented in the lost-gas graphs for only up to one hour for cuttings off bottom, and 9 hours after the cores are off bottom. Lost-gas volumes derived from this analysis are incorporated in the data tables described above.

### *"Lithologic Component Sensitivity Analyses" (Figure 6)*

The rapidity of penetration of an air-drilled well makes collection of pure lithologies from relatively thin-bedded strata rather difficult. Mixed lithologies are more the norm rather than the exception. Some of this mixing is due to cavings from strata farther up hole. The mixing may also be due to collection of two or more successively drilled lithologies caught 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:

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

A unique solution for *gas content<sub>coal</sub>* in this equation is not possible because *gas content<sub>dark shale</sub>* 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<sub>coal</sub>* 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 bivariate 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 than 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 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.

*Desorption Graph (Figure 7)*

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.

*Desorption Graph (Percentage of Total Gas Desorbed) (Figure 8)*

This is a desorption graph of the percentage of total gas evolved vs. square root of time for the core samples. The rate at which gas is evolved from the samples is thus normalized and compared at a common scale, thus the permeability or deliverability of gas for each zone can be compared in a relative sense.

## RESULTS and DISCUSSION

The Bluejacket cuttings sample contained 6% coal, which indicates that much of the coal was probably pulverized to dust by the air-drill percussion bit and not retained in the catching sieve. This lack of coal in the samples imparts some uncertainty to the desorption measurements, but an estimate for gas content for the coal in this sample can be made assuming the admixed dark shale in the sample desorb 3 scf/ton. This sample was dominated by a black shale (N1, N2). Assuming the shale in this sample desorbs 3 scf/ton, the coal contains 146 scf/ton of desorbable gas, with a maximum of 185 scf/ton (assuming shale associated with the coal desorbs 0 scf/ton), and a minimum of 13 scf/ton (assuming shale associated with the coal desorbs equal to that of the coal).

The Weir-Pittsburg coal (1052.2' to 1053.8'), Weir-Pittsburg coal (1053.8' to 1055.0'), and Wainright coal (1077.3' to 1078.3') core samples respectively desorbed 267.6, 235.5, and 140.0 scf/ton. When this gas is normalized on a percentage basis, the Weir-Pittsburg coal sample (1053.8' to 1055.0') appears to have the best permeability, followed by the Weir-Pittsburg coal sample (1052.2' to 1053.8') and then the Wainright coal sample (1077.3' to 1078.3') (see Figure 8).

## 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

FIGURE 1. Correlation of field barometer to Petrophysics Lab pressure transducer.

TABLE 1. Desorption measurements for samples.

FIGURE 2. Lost-gas graph for Weir-Pittsburg coal (core) at 1052.2' to 1053.8' depth.

FIGURE 3. Lost-gas graph for Weir-Pittsburg coal (core) at 1053.8' to 1055.0' depth.

FIGURE 4. Lost-gas graph for Wainright coal (core) at 1077.3' to 1078.3' depth.

FIGURE 5. Lost-gas graph for Bluejacket coal (cuttings) at 1098' to 1099' depth.

FIGURE 6. Sensitivity analysis for Bluejacket coal (cuttings) at 1098 to 1099 depth.

FIGURE 7. Desorption graph for all samples.

FIGURE 8. Desorption graph for all samples on a basis of percentage of total gas evolved with time.



## Correlation of Field Barometer to KGS Petrophysics Lab Barometer

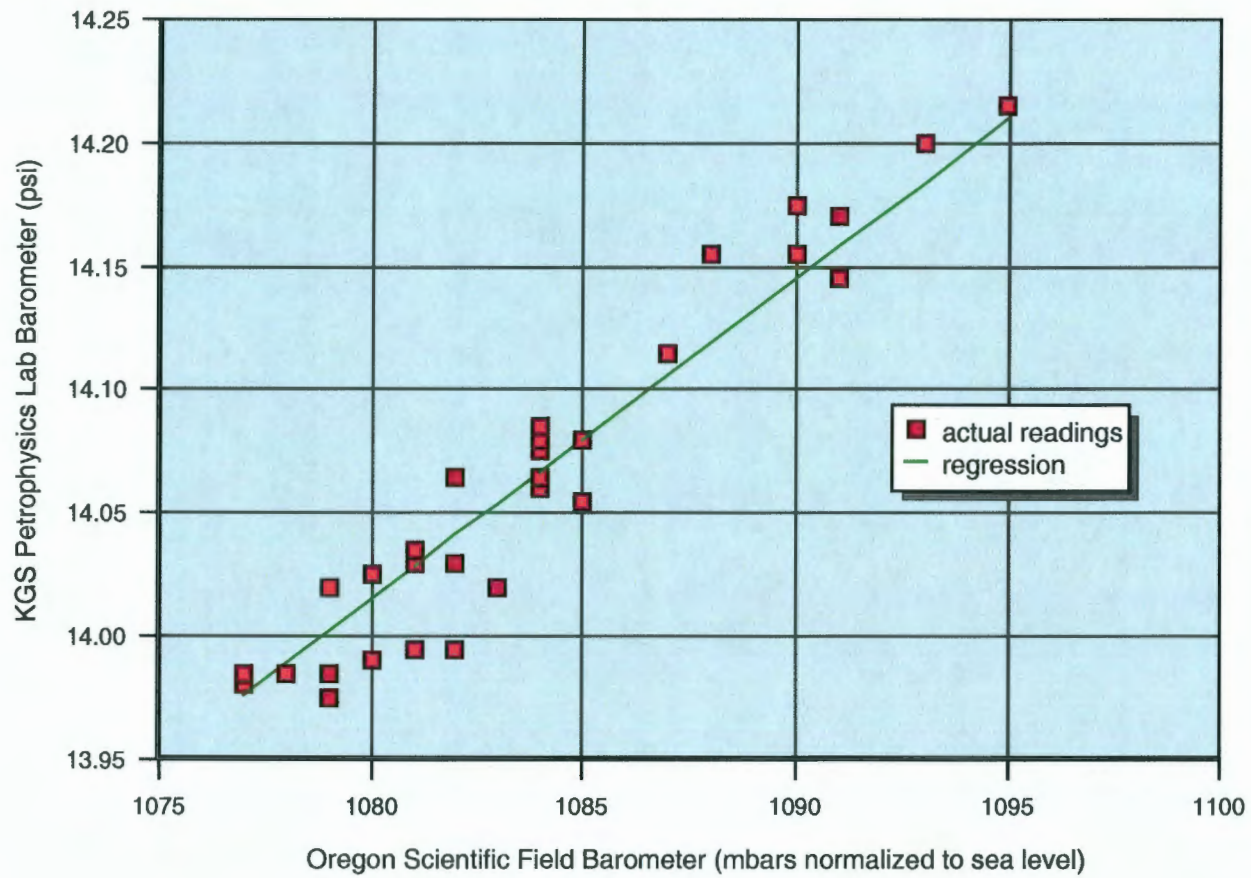


FIGURE 1.

Table 1 -- Description Table for Dart Orr #BC3-34; NW NE 34-T.30S.-R.15E.

SAMPLE: 1052.2' to 1053.6' (Weir-Pittsburg coal) in canister K (core sample)

dry sample weight:		lbs.	grams	wet sample weight:		moisture weight		est. lost gas (cc) =		TIME OF:			elapsed time (off bottom to canistering)		
		3.2183	1458.87			3.2498	1474.10	1.0%		1670			169.0 minutes		
										5/20/03 7:33			2.617 hours		
										5/20/03 10:22			1.678292783 SQRT (hrs)		
										TIME SINCE			SQRT hrs. (since off bottom)		
										off bottom			in canister		
RIGLAB MEASUREMENTS		CONVERSION OF RIGLAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)		CUMULATIVE VOLUMES		SCF/TON		SCF/TON		TIME OF MEASURE		TIME SINCE		SQRT	
measured cc	measured T (F)	measured P	cubic ft	absolute T (F) psia	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT	
30	78	1096	0.00108	538 14.226	0.000990952	28.06	0.62	37.29	0.62	5/20/03 10:25	2:52:00	0:03:00	1.693123347		
15	78	1096	0.00053	538 14.226	0.000495476	14.03	0.92	37.60	0.92	5/20/03 10:28	2:55:00	0:06:00	1.707825128		
16	78	1096	0.00057	538 14.226	0.000528508	14.97	1.25	37.93	1.25	5/20/03 10:31	2:58:00	0:09:00	1.722401424		
50	78	1096	0.00177	538 14.226	0.001851587	46.77	2.28	38.95	2.28	5/20/03 10:42	3:09:00	0:20:00	1.774823935		
26	78	1095	0.00092	538 14.213	0.000858042	24.30	2.81	39.49	2.81	5/20/03 10:47	3:14:00	0:25:00	1.798147195		
61	77	1095	0.00215	537 14.213	0.002016847	57.11	4.07	40.74	4.07	5/20/03 11:02	3:29:00	0:40:00	1.866389024		
34	77	1096	0.0012	537 14.226	0.001125171	31.86	4.77	41.44	4.77	5/20/03 11:10	3:37:00	0:48:00	1.901753577		
54	77	1096	0.00191	537 14.226	0.001787036	50.60	5.88	42.55	5.88	5/20/03 11:22	3:49:00	1:00:00	1.953629102		
64	77	1097	0.00226	537 14.239	0.002119901	60.03	7.20	43.87	7.20	5/20/03 11:37	4:04:00	1:15:00	2.016597795		
81	77	1097	0.00286	537 14.239	0.002682999	75.97	8.67	45.54	8.67	5/20/03 11:57	4:24:00	1:35:00	2.097617696		
250	77	1097	0.00883	537 14.239	0.008280862	234.49	14.01	50.69	14.01	5/20/03 13:00	5:27:00	2:38:00	2.334523506		
481	77	1091	0.01699	537 14.161	0.015845237	448.69	23.87	60.54	23.87	5/20/03 15:09	7:38:00	4:47:00	2.75680975		
368	77	1094	0.013	537 14.200	0.012156094	344.22	31.43	68.10	31.43	5/20/03 19:16	11:43:00	8:54:00	3.422961681		
558	77	1095	0.01971	537 14.213	0.018449187	522.42	42.90	79.57	42.90	5/21/03 0:06	16:33:00	13:44:00	4.068169121		
634	72	1093	0.02239	532 14.187	0.021120344	598.06	58.03	92.71	58.03	5/21/03 8:42	25:09:00	22:20:00	5.014977567		
582	80	1090	0.02055	540 14.148	0.019048419	539.39	67.88	104.55	67.88	5/21/03 16:27	32:54:00	30:05:00	5.73585216		
860	82	1091	0.03037	542 14.161	0.028069012	794.82	85.33	122.01	85.33	5/22/03 9:05	49:32:00	46:43:00	7.037992138		
407	72	1087	0.01437	532 14.109	0.0134839	381.82	93.72	130.39	93.72	5/22/03 21:45	62:12:00	59:23:00	7.886697661		
510	85	1088	0.01801	545 14.122	0.01650843	467.46	103.98	140.66	103.98	5/23/03 8:49	73:16:00	70:27:00	8.559595006		
313	70	1084	0.01105	530 14.070	0.010380086	293.93	110.44	147.11	110.44	5/24/03 1:33	90:00:00	87:11:00	9.486832981		
575	86	1083	0.02031	546 14.057	0.018492979	523.66	121.94	158.81	121.94	5/25/03 1:49	114:18:00	111:27:00	10.68955877		
398	80	1086	0.01406	540 14.096	0.012978436	367.51	130.01	166.68	130.01	5/26/03 0:10	136:37:00	133:48:00	11.68831325		
195	68	1088	0.00689	528 14.122	0.006515276	184.49	134.06	170.73	134.06	5/26/03 22:49	159:16:00	158:27:00	12.6200898		
520	85	1092	0.01838	545 14.174	0.016894008	478.38	144.56	181.24	144.56	5/28/03 10:55	195:22:00	192:33:00	13.97736265		
280	80	1087	0.00989	540 14.109	0.009138965	258.79	150.25	186.92	150.25	5/29/03 11:55	220:22:00	217:33:00	14.84475216		
325	85	1083	0.01148	545 14.057	0.010471732	298.53	158.76	193.43	158.76	5/30/03 16:23	248:50:00	246:01:00	15.77445190		
105	66	1085	0.00371	526 14.083	0.003511854	99.44	158.94	195.62	158.94	5/31/03 16:50	273:17:00	270:28:00	16.53128346		
328	87	1082	0.01158	547 14.044	0.01052003	297.89	165.49	202.16	165.49	6/1/03 14:49	295:16:00	292:27:00	17.18332525		
244	83	1081	0.00862	543 14.031	0.007876239	223.03	170.38	207.06	170.38	6/3/03 11:12	339:39:00	336:50:00	18.42959576		
314	85	1077	0.01109	545 13.979	0.010061253	284.90	178.84	213.31	178.84	6/6/03 18:48	419:15:00	416:26:00	20.47559523		
201	70	1078	0.0071	530 13.992	0.00662891	187.71	180.76	217.43	180.76	6/9/03 13:56	486:23:00	483:34:00	22.05410015		
275	88	1074	0.00971	548 13.940	0.008738957	247.48	186.20	222.87	186.20	6/12/03 13:52	558:19:00	555:30:00	23.62872546		
292	85	1087	0.01031	545 14.109	0.009443198	267.40	192.07	228.74	192.07	6/16/03 15:18	655:43:00	652:54:00	25.6069652		
38	73	1082	0.00134	533 14.044	0.001250797	35.42	192.85	229.52	192.85	6/19/03 13:44	726:11:00	723:22:00	26.94778902		
295	87	1079	0.01042	547 14.005	0.009435379	267.18	198.71	235.39	198.71	6/23/03 11:32	819:59:00	817:10:00	28.63535111		
74	73	1087	0.00281	533 14.109	0.002447019	69.29	200.23	236.91	200.23	6/26/03 14:25	894:52:00	892:03:00	29.9143221		
11	66	1088	0.00039	526 14.122	0.000368926	10.45	200.46	237.14	200.46	6/30/03 11:07	987:34:00	984:45:00	31.42557345		
155	80	1078	0.00547	540 13.992	0.005017183	142.07	203.58	240.26	203.58	7/3/03 9:43	1058:10:00	1055:21:00	32.52947381		
97	80	1078	0.00343	540 13.992	0.003139785	88.91	205.54	242.21	205.54	7/5/03 22:42	1119:09:00	1116:20:00	33.45369935 estimate		
47	80	1081	0.00186	540 14.031	0.001525573	43.20	206.49	243.16	206.49	7/7/03 14:01	1158:28:00	1155:39:00	34.03625518		
62	78	1082	0.00219	538 14.044	0.002021808	57.25	207.74	244.42	207.74	7/10/03 14:48	1231:15:00	1228:26:00	35.06917212		
85	80	1084	0.003	540 14.070	0.002766672	78.34	209.46	246.14	209.46	7/15/03 13:52	1350:19:00	1347:30:00	36.74665518		
101	78	1079	0.00357	538 14.005	0.003284458	93.01	211.51	248.18	211.51	7/21/03 16:25	1496:52:00	1494:03:00	38.68936116		
94	80	1081	0.00332	540 14.031	0.003051146	86.40	213.40	250.08	213.40	7/28/03 20:21	1668:48:00	1665:59:00	40.85094858		
80	79	1079	0.00283	539 14.005	0.002596724	73.53	215.02	251.69	215.02	8/4/03 13:44	1830:11:00	1827:22:00	42.78064204		
82	78	1086	0.0029	538 14.096	0.002883889	76.00	216.69	253.36	216.69	8/11/03 13:58	1998:25:00	1995:36:00	44.70365384		
77	79	1082	0.00272	539 14.044	0.002508296	70.97	218.24	254.92	218.24	8/16/03 19:57	2172:24:00	2169:35:00	46.609012		
67	80	1083	0.00237	540 14.057	0.002178777	61.70	219.60	258.27	219.60	8/24/03 22:44	2319:11:00	2316:22:00	48.15790001		
51	80	1086	0.0018	540 14.096	0.001663086	47.09	220.63	257.31	220.63	9/1/03 14:47	2503:14:00	2500:25:00	50.03232289		
46	83	1084	0.00162	543 14.070	0.001488986	42.16	221.56	258.23	221.56	9/8/03 14:03	2670:30:00	2667:41:00	51.67688071		
42	80	1085	0.00148	540 14.083	0.001388323	38.75	222.41	259.08	222.41	9/15/03 15:11	2839:38:00	2836:49:00	53.28821008		
46	80	1084	0.00162	540 14.070	0.001497258	42.40	223.34	260.02	223.34	9/23/03 10:46	3027:13:00	3024:24:00	55.02014782		
17	80	1091	0.0006	540 14.161	0.000556908	15.77	223.69	260.36	223.69	9/26/03 18:51	3107:18:00	3104:29:00	55.74316102		
49	83	1085	0.00173	543 14.083	0.001587557	44.95	224.68	261.35	224.68	10/8/03 12:05	3340:32:00	3337:43:00	57.79734711		



44	81	1084	0.00155	541	14.070	0.001429512	40.48	0.362735968	10271.50	225.56	262.24	10/14/03	23:03	3543:30:00	3540:41:00	59.52730466
27	85	1081	0.00095	545	14.031	0.000868353	24.59	0.36360432	10298.09	226.10	262.78	10/20/03	15:31	3679:58:00	3677:09:00	60.66272881
22	82	1075	0.00078	542	13.953	0.000707514	20.03	0.364311834	10318.12	226.54	263.22	10/27/03	15:03	3847:30:00	3844:41:00	62.02821938
12	80	1080	0.00042	540	14.018	0.000389148	11.02	0.364700982	10327.14	226.79	263.46	11/3/03	22:11	4022:38:00	4019:49:00	63.42423301
13	81	1085	0.00046	541	14.083	0.000422746	11.97	0.385123727	10339.11	227.05	283.72	11/10/03	23:17	4191:44:00	4188:55:00	64.74359885
65	83	1069	0.0023	543	13.875	0.002074887	58.75	0.367198814	10397.87	228.34	265.01	11/17/03	18:26	4352:53:00	4350:04:00	65.97638466
8	61	1086	0.00028	541	14.096	0.000260391	7.37	0.367459005	10405.24	228.50	265.17	11/24/03	14:24	4518:51:00	4516:02:00	67.2223921
25	84	1090	0.00088	544	14.148	0.000812215	23.00	0.38827122	10428.24	229.01	265.68	12/4/03	19:55	4764:22:00	4761:33:00	69.02439182
20	83	1083	0.00071	543	14.057	0.000546788	18.31	0.368918008	10446.56	229.41	266.08	12/10/03	14:59	4903:26:00	4900:37:00	70.02451952
33	88	1087	0.00117	548	14.109	0.001061368	30.05	0.369979376	10478.81	230.07	266.74	12/16/03	14:23	5046:50:00	5044:01:00	71.04106793
27	85	1081	0.00095	545	14.031	0.000868353	24.59	0.370847729	10501.20	230.61	267.28	12/22/03	16:08	5192:35:00	5189:46:00	72.05958183
14	83	1082	0.00049	543	14.044	0.000452333	12.81	0.371300062	10514.01	230.89	267.56	12/29/03	14:29	5358:56:00	5356:07:00	73.20473573
-11	86	1103	-0.0004	546	14.316	-0.000360312	-10.20	0.37093975	10503.80	230.67	267.34	1/8/04	15:11	5551:38:00	5548:49:00	74.50928354
-8	81	1093	-0.0003	541	14.187	-0.000262069	-7.42	0.370877861	10496.38	230.50	267.18	1/12/04	11:45	5892:12:00	5889:23:00	75.44666991
12	80	1089	0.00042	540	14.135	0.000392391	11.11	0.371070072	10507.49	230.75	267.42	1/21/04	10:35	5907:02:00	5904:13:00	76.85722694
-7	80	1091	-0.0002	540	14.161	-0.000229315	-6.49	0.370840757	10501.00	230.60	267.28	1/27/04	10:11	8050:38:00	8047:49:00	77.78581704

DESORPTION TERMINATED 01/27/04 DUE TO NO MORE GAS BEING EVOLVED; sample air dried 8 days

SAMPLE: 1053.8' to 1055.0' (Weir-Pittsburg coal) in Maggy 2 (core sample)

dry sample weight:	lbs.	grams	wet sample weight:	lbs.	grams	moisture weight	est. lost gas (cc) =	TIME OF:	elapsed time (off bottom to canistering)
	2.4419	1107.64		2.8174	1187.24	8.7%	1080	off bottom 5/20/03 7:34	144.0 minutes
								in canister 5/20/03 9:58	2.400 hours

RIGLAB MEASUREMENTS			CONVERSION OF RIGLAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)				CUMULATIVE VOLUMES		SCF/TON	SCF/TON	TIME OF MEASURE	TIME SINCE	TIME SINCE	SQRT	
measured cc	measured T (F)	measured P	cubic ft	absolute T (F)	pela	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas		off bottom	in canister	hrs. (since off bottom)		
60	75	1096	0.00212	535	14.226	0.001993018	56.44	0.001993018	56.44	1.63	32.87	5/20/03 10:14	2:40:00	0:16:00	1.632993162
7	75	1096	0.00025	535	14.228	0.000225537	6.58	0.002225537	63.02	1.82	33.06	5/20/03 10:15	2:41:00	0:17:00	1.638088317
39	77	1096	0.00138	537	14.226	0.001290637	36.55	0.003516174	99.57	2.88	34.12	5/20/03 10:23	2:49:00	0:25:00	1.678292783
14	78	1096	0.00049	538	14.226	0.000462444	13.09	0.003978618	112.66	3.26	34.50	5/20/03 10:29	2:55:00	0:31:00	1.707825128
10	78	1096	0.00035	538	14.226	0.000330317	9.35	0.004308936	122.02	3.53	34.77	5/20/03 10:32	2:58:00	0:34:00	1.722401424
25	78	1096	0.00088	538	14.226	0.000825794	23.38	0.005134729	145.40	4.21	35.44	5/20/03 10:41	3:07:00	0:43:00	1.765408357
24	78	1095	0.00085	538	14.213	0.000792038	22.43	0.005926768	167.83	4.85	36.09	5/20/03 10:48	3:14:00	0:50:00	1.798147195
46	77	1095	0.00162	537	14.213	0.001520901	43.07	0.007447868	210.89	8.10	37.34	5/20/03 11:02	3:28:00	1:04:00	1.861898672
30	77	1096	0.00108	537	14.226	0.000992798	28.11	0.008440488	239.01	6.91	38.15	5/20/03 11:11	3:37:00	1:13:00	1.901753577
31	77	1096	0.00109	537	14.226	0.001025891	29.05	0.009466357	268.06	7.75	38.99	5/20/03 11:23	3:49:00	1:25:00	1.953629102
39	77	1097	0.00138	537	14.239	0.001291815	36.58	0.010758171	304.84	8.81	40.05	5/20/03 11:38	4:02:00	1:38:00	2.008316044
64	77	1097	0.00226	537	14.239	0.002119901	60.03	0.012878072	364.87	10.55	41.79	5/20/03 11:58	4:24:00	2:00:00	2.097617696
170	77	1097	0.006	537	14.239	0.005630986	159.45	0.018509058	524.12	15.16	46.40	5/20/03 13:01	5:27:00	3:03:00	2.334523506
331	77	1091	0.01169	537	14.161	0.010903895	308.76	0.029412953	832.88	24.09	55.33	5/20/03 15:01	7:27:00	5:03:00	2.729468813
242	77	1094	0.00855	537	14.200	0.007993953	226.36	0.037408907	1059.24	30.64	61.87	5/20/03 19:22	11:48:00	9:24:00	3.435112807
436	77	1095	0.0154	537	14.213	0.014415494	408.20	0.051822401	1487.44	42.44	73.68	5/21/03 0:10	16:36:00	14:12:00	4.074309757
445	72	1093	0.01572	532	14.187	0.014824216	419.77	0.086646617	1887.21	54.59	85.82	5/21/03 8:35	25:01:00	22:37:00	5.001666389
475	80	1090	0.01677	540	14.148	0.01554639	440.22	0.082193007	2327.44	67.32	98.56	5/21/03 16:33	32:59:00	30:35:00	5.743111818
626	82	1091	0.02211	542	14.181	0.020431629	578.56	0.102824637	2906.00	84.05	115.29	5/22/03 8:59	49:25:00	47:01:00	7.029698903
224	72	1087	0.00791	532	14.109	0.007421115	210.14	0.110045751	3116.14	90.13	121.37	5/22/03 21:47	62:13:00	59:49:00	7.887754222
403	85	1088	0.01423	545	14.122	0.013044897	389.39	0.123090648	3485.53	100.81	132.05	5/23/03 8:51	73:17:00	70:53:00	8.560568517
150	70	1084	0.0053	530	14.070	0.004974482	140.86	0.12806513	3828.39	104.89	136.13	5/24/03 1:38	90:02:00	87:38:00	9.488589839
463	86	1083	0.01635	548	14.057	0.014890868	421.66	0.142955998	4048.05	117.08	148.32	5/25/03 1:58	114:22:00	111:58:00	10.69423521
253	80	1086	0.00893	540	14.096	0.008250111	233.82	0.151206109	4281.66	123.84	155.08	5/26/03 0:13	136:39:00	134:15:00	11.68973909
67	68	1088	0.00237	528	14.122	0.002238582	63.39	0.153444691	4345.05	125.68	158.91	5/28/03 22:50	159:16:00	158:52:00	12.6200898
410	85	1092	0.01448	545	14.174	0.013320275	377.19	0.166764966	4722.24	136.58	167.82	5/28/03 11:05	195:31:00	193:07:00	13.98272744
195	80	1087	0.00689	540	14.109	0.006364636	180.23	0.173129603	4902.47	141.80	173.04	5/29/03 11:55	220:21:00	217:57:00	14.84419078
260	85	1083	0.00918	545	14.057	0.008377386	237.22	0.181505988	5139.69	148.66	179.90	5/30/03 16:25	248:51:00	246:27:00	15.77498019
-10	61	1085	-0.0004	521	14.083	-0.000337672	-9.56	0.181189318	5130.12	148.38	179.62	5/31/03 16:49	273:15:00	270:51:00	16.53027525
213	86	1082	0.00752	546	14.044	0.006844117	193.80	0.188013433	5323.93	153.99	185.23	6/1/03 14:52	295:18:00	292:54:00	17.18429516
158	83	1081	0.00556	543	14.031	0.005100188	144.42	0.193113821	5468.35	158.16	189.40	6/3/03 11:13	339:39:00	337:15:00	18.42959576
212	85	1077	0.00749	545	13.979	0.006792948	192.35	0.199905669	5880.70	183.73	194.97	6/6/03 18:57	419:23:00	415:59:00	20.47885088
170	70	1078	0.006	530	13.992	0.005606541	158.76	0.20551311	5819.46	188.32	199.56	6/9/03 13:59	486:25:00	484:01:00	22.05485585
205	88	1074	0.00724	548	13.940	0.006514498	184.47	0.212027605	6003.93	173.86	204.89	6/12/03 13:53	558:19:00	555:55:00	23.62872546
164	85	1087	0.00579	545	14.109	0.005303714	150.18	0.217331319	6154.11	178.00	209.24	6/16/03 15:22	655:48:00	653:24:00	25.60859231
-4	73	1082	-0.0001	533	14.044	-0.000131863	-3.73	0.217199656	6150.39	177.89	209.13	6/19/03 13:45	728:11:00	723:47:00	26.94778902
187	87	1079	0.0066	547	14.005	0.005981071	169.36	0.223180727	6319.75	182.79	214.03	6/23/03 11:34	820:00:00	817:36:00	28.63564213
3	73	1087	0.00011	533	14.109	9.92035E-05	2.81	0.223279931	6322.56	182.87	214.11	6/26/03 14:28	894:52:00	892:28:00	29.9143221



-30	66	1088	-0.0011	528	14.122	-0.001006161	-28.49	0.222273769	8294.07	182.05	213.29	6/30/03	11:08	987:34:00	985:10:00	31.42557345
193	80	1078	0.00682	540	13.992	0.006247202	176.90	0.228520971	6470.97	187.16	218.40	7/3/03	9:45	1058:11:00	1055:47:00	32.52972999
55	81	1081	0.00194	541	14.031	0.001761945	50.46	0.230302918	6521.43	188.62	219.86	7/7/03	14:02	1158:28:00	1156:04:00	34.03625518
51	83	1082	0.0018	543	14.044	0.001647786	46.66	0.231950702	6568.09	189.97	221.21	7/10/03	14:47	1231:13:00	1228:49:00	35.08869714
70	85	1084	0.00247	545	14.070	0.002257533	63.93	0.234208234	6632.01	191.82	223.06	7/15/03	13:53	1350:19:00	1347:55:00	36.74685518
68	80	1079	0.0024	540	14.005	0.002203128	62.39	0.238411363	6894.40	193.63	224.86	7/21/03	16:28	1496:52:00	1494:28:00	38.68936116
59	83	1081	0.00208	543	14.031	0.0019045	53.93	0.238315863	6748.33	195.19	226.42	7/26/03	20:22	1668:48:00	1666:24:00	40.85094858
27	80	1079	0.00095	540	14.005	0.000874772	24.77	0.239190835	6773.10	195.90	227.14	8/4/03	13:45	1830:11:00	1827:47:00	42.78064204
34	81	1086	0.0012	541	14.098	0.001106661	31.34	0.240297296	6804.44	198.81	228.05	8/11/03	13:59	1998:25:00	1996:01:00	44.70365384
60	84	1082	0.00212	544	14.044	0.001935008	54.79	0.242232304	6859.23	198.39	229.63	8/16/03	20:00	2172:26:00	2170:02:00	46.60936959
47	84	1083	0.00166	544	14.057	0.001517157	42.96	0.243749462	6902.19	199.64	230.87	8/24/03	22:46	2319:12:00	2318:48:00	48.15807305
11	82	1086	0.00039	542	14.096	0.000357377	10.12	0.244106839	6912.31	199.93	231.17	9/1/03	14:47	2503:13:00	2500:49:00	50.03215633
0	80	1084	0	540	14.070	0	0.00	0.244106839	6912.31	199.93	231.17	9/6/03	14:03	2670:29:00	2668:05:00	51.67671945
36	83	1085	0.00127	543	14.083	0.001166368	33.03	0.245273207	6945.34	200.88	232.12	9/15/03	15:12	2839:38:00	2837:14:00	53.28821008
40	85	1084	0.00141	545	14.070	0.001290019	36.53	0.248583225	6981.87	201.94	233.18	9/23/03	10:48	3027:14:00	3024:50:00	55.02029928
-7	80	1091	-0.0002	540	14.161	-0.000229315	-6.49	0.24833391	6975.37	201.75	232.99	9/26/03	18:52	3107:18:00	3104:54:00	55.74316102
68	86	1085	0.0024	546	14.083	0.002191034	62.04	0.248524945	7037.42	203.55	234.79	10/6/03	12:08	3340:32:00	3338:08:00	57.79734711
15	84	1084	0.00053	544	14.070	0.000484646	13.72	0.249009591	7051.14	203.95	235.18	10/14/03	23:05	3543:31:00	3541:07:00	59.52744465
11	81	1081	0.00039	541	14.031	0.000356389	10.09	0.24938598	7061.23	204.24	235.47	10/20/03	15:22	3679:48:00	3677:24:00	60.66135508
1	80	1075	3.5E-05	540	13.953	3.22788E-05	0.91	0.249398259	7082.15	204.26	235.50	10/27/03	15:04	3847:30:00	3845:06:00	62.02821938
-10	81	1080	-0.0004	541	14.018	-0.00032369	-9.17	0.249074569	7052.98	204.00	235.24	11/3/03	10:12	4010:38:00	4008:14:00	63.32956129

DESORPTION TERMINATED 11/03/03 DUE TO NO MORE GAS BEING EVOLVED; sample air dried 12 days

SAMPLE: 1077.3' to 1078.3' (Wainright coal) in canister 4 (core sample)

dry sample weight: 2.1456 lbs. 973.22 grams wet sample weight: 2.1549 lbs. 977.46 grams moisture weight 0.4% est. lost gas (cc) = 585 TIME OF: 5/20/03 7:55 in canister 5/20/03 10:00 elapsed time (off bottom to canistering) 125.0 minutes 2.083 hours

RIG/LAB MEASUREMENTS		CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)				CUMULATIVE VOLUMES		SCF/TON	SCF/TON	TIME OF MEASURE	TIME SINCE		1.443375673 SQRT (hrs)		
measured cc	measured T (F)	measured P	cubic ft	absolute T (F)	psia	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	off bottom	in canister	SQRT hrs. (since off bottom)			
43	75	1096	0.00152	535	14.226	0.00142833	40.45	0.00142833	40.45	1.33	20.59	5/20/03 10:18	2:21:00	0:16:00	1.532970972
19	77	1096	0.00067	537	14.226	0.000628772	17.80	0.002057101	58.25	1.92	21.17	5/20/03 10:25	2:30:00	0:25:00	1.58113883 estimate
8	78	1096	0.00028	538	14.226	0.000264254	7.48	0.002321355	65.73	2.16	21.42	5/20/03 10:29	2:34:00	0:29:00	1.602081979
5	78	1096	0.00018	538	14.226	0.000165159	4.68	0.002486514	70.41	2.32	21.58	5/20/03 10:32	2:37:00	0:32:00	1.617811408
10	78	1096	0.00035	538	14.226	0.000330317	9.35	0.002618832	79.78	2.63	21.88	5/20/03 10:40	2:45:00	0:40:00	1.658312395
12	78	1095	0.00042	538	14.213	0.000396019	11.21	0.003212851	90.98	2.99	22.25	5/20/03 10:49	2:54:00	0:49:00	1.702938637
15	77	1095	0.00053	537	14.213	0.000495946	14.04	0.003708797	105.02	3.46	22.71	5/20/03 11:01	3:06:00	1:01:00	1.780681686
10	77	1096	0.00035	537	14.226	0.000330933	9.37	0.004039729	114.39	3.77	23.02	5/20/03 11:12	3:17:00	1:12:00	1.811997057
14	77	1096	0.00049	537	14.226	0.000463306	13.12	0.004503035	127.51	4.20	23.45	5/20/03 11:24	3:29:00	1:24:00	1.866369024
11	77	1097	0.00039	537	14.239	0.000364358	10.32	0.004867393	137.83	4.54	23.79	5/20/03 11:35	3:40:00	1:35:00	1.914854216
26	77	1097	0.00092	537	14.239	0.00086121	24.39	0.005728602	182.22	5.34	24.60	5/20/03 11:59	4:04:00	1:59:00	2.016597795
68	77	1097	0.0024	537	14.239	0.002252395	83.78	0.007980997	226.00	7.44	26.70	5/20/03 12:59	5:04:00	2:59:00	2.250925736
118	77	1091	0.00417	537	14.181	0.003887189	110.07	0.011868186	336.07	11.06	30.32	5/20/03 15:06	7:11:00	5:06:00	2.680174124
93	77	1094	0.00328	537	14.200	0.003072056	86.99	0.014940243	423.06	13.93	33.18	5/20/03 18:12	11:17:00	9:12:00	3.359067331
137	77	1095	0.00484	537	14.213	0.004529639	128.26	0.019469882	551.32	18.15	37.41	5/21/03 0:13	16:18:00	14:13:00	4.037325848
172	72	1093	0.00607	532	14.187	0.00572981	162.25	0.025199691	713.57	23.49	42.75	5/21/03 8:48	24:53:00	22:48:00	4.98831969
189	80	1090	0.00867	540	14.148	0.006185827	175.16	0.031385518	888.74	29.26	48.51	5/21/03 16:36	32:41:00	30:36:00	5.71893391
283	82	1091	0.00999	542	14.161	0.009236663	261.55	0.040622181	1150.29	37.87	57.12	5/22/03 9:13	49:18:00	47:13:00	7.021395873
89	72	1087	0.00314	532	14.109	0.002948568	83.49	0.043570749	1233.78	40.81	59.87	5/22/03 21:48	61:53:00	59:48:00	7.866596045
192	85	1088	0.00678	545	14.122	0.006214938	175.99	0.049785687	1409.77	48.41	65.67	5/23/03 8:54	72:59:00	70:54:00	8.543028347
62	70	1084	0.00219	530	14.070	0.002056119	58.22	0.051841807	1487.99	48.32	67.58	5/24/03 1:36	89:41:00	87:36:00	9.470128475
241	86	1083	0.00851	546	14.057	0.00775097	219.48	0.059592777	1687.47	55.55	74.81	5/25/03 1:59	114:04:00	111:59:00	10.68019975
119	80	1086	0.0042	540	14.098	0.003880487	109.88	0.063473264	1797.36	59.17	78.42	5/26/03 0:15	138:20:00	134:15:00	11.67618659
32	68	1088	0.00113	528	14.122	0.001069173	30.28	0.064542437	1827.63	60.16	79.42	5/26/03 22:52	158:57:00	156:52:00	12.60753743 estimate
203	85	1092	0.00717	545	14.174	0.006595161	188.75	0.071137598	2014.38	88.31	85.57	5/28/03 11:08	195:13:00	193:08:00	13.9719958
98	80	1087	0.00346	540	14.109	0.003198638	90.57	0.074336236	2104.96	69.29	88.55	5/29/03 11:54	219:59:00	217:54:00	14.83183513
135	85	1073	0.00477	545	13.927	0.004309632	122.03	0.078845868	2226.99	73.31	92.57	5/30/03 16:22	248:27:00	246:22:00	15.78229679
14	66	1085	0.00049	526	14.083	0.000468247	13.26	0.079114115	2240.25	73.75	93.00	5/31/03 16:51	272:56:00	270:51:00	16.52089409
125	86	1082	0.00441	546	14.044	0.004016501	113.73	0.083130616	2353.99	77.49	96.75	8/1/03 14:53	294:58:00	292:53:00	17.17459364
106	83	1081	0.00374	543	14.031	0.003421645	96.89	0.08855226	2450.88	80.68	99.94	6/3/03 11:14	339:19:00	337:14:00	18.42055012
136	85	1077	0.0048	545	13.979	0.00435774	123.40	0.09091	2574.27	84.74	104.00	6/6/03 18:58	419:03:00	416:58:00	20.47071078
73	70	1078	0.00258	530	13.992	0.002407515	88.17	0.093317515	2842.45	86.99	106.24	6/9/03 14:00	486:05:00	484:00:00	22.04729764
151	88	1074	0.00533	548	13.940	0.004798482	135.88	0.098115997	2778.33	91.48	110.72	8/12/03 13:54	557:59:00	555:54:00	23.82167084



119	85	1087	0.0042	545	14.109	0.003848427	108.97	0.101984424	2887.30	95.05	114.30	6/16/03	15:23	655:28:00	853:23:00	25.60208325
15	73	1082	0.00053	533	14.044	0.000493736	13.98	0.10245816	2901.28	95.51	114.78	6/19/03	13:48	725:51:00	723:46:00	26.94160352
152	87	1079	0.00537	547	14.005	0.004861819	137.67	0.107319779	3038.95	100.04	119.30	6/23/03	11:38	819:41:00	817:36:00	28.63011235
8	73	1087	0.00028	533	14.109	0.000264543	7.49	0.107584321	3046.44	100.28	119.54	6/26/03	14:27	894:32:00	892:27:00	29.90875011
-6	66	1088	-0.0002	526	14.122	-0.000201232	-5.70	0.107383089	3040.74	100.10	119.35	6/30/03	11:09	987:14:00	985:09:00	31.42026947
80	80	1078	0.00283	540	13.992	0.002589514	73.33	0.109972602	3114.07	102.51	121.77	7/3/03	9:45	1057:50:00	1055:45:00	32.52434985
55	80	1084	0.00194	540	14.070	0.001790199	50.69	0.111762802	3164.76	104.18	123.44	7/7/03	14:03	1158:08:00	1158:03:00	34.03135809
39	78	1082	0.00138	538	14.044	0.001271782	36.01	0.113034584	3200.77	105.36	124.62	7/10/03	14:50	1230:55:00	1228:50:00	35.08442199
45	80	1084	0.00159	540	14.070	0.001464709	41.48	0.114499293	3242.25	106.73	125.99	7/15/03	13:54	1349:59:00	1347:54:00	36.74211934
52	78	1079	0.00184	538	14.005	0.001691008	47.88	0.118190301	3290.13	108.31	127.56	7/21/03	18:27	1498:32:00	1494:27:00	38.6850531
46	80	1081	0.00162	540	14.031	0.001493114	42.28	0.117683415	3332.41	109.70	128.96	7/28/03	20:24	1868:29:00	1866:24:00	40.84707252
36	79	1079	0.00127	539	14.005	0.001168526	33.09	0.118851941	3385.50	110.79	130.04	8/4/03	13:46	1829:51:00	1827:46:00	42.77674602
34	81	1086	0.0012	541	14.096	0.001106661	31.34	0.119958602	3396.84	111.82	131.08	8/11/03	13:59	1998:04:00	1995:59:00	44.699739
42	79	1082	0.00148	539	14.044	0.001387071	38.71	0.121325673	3435.55	113.09	132.35	8/18/03	20:01	2172:06:00	2170:01:00	46.80579363
32	80	1083	0.00113	540	14.057	0.00104061	29.47	0.122386283	3465.01	114.06	133.32	8/24/03	22:46	2318:51:00	2316:46:00	48.15443905
11	80	1086	0.00039	540	14.096	0.0003587	10.18	0.122724983	3475.17	114.40	133.66	9/1/03	14:48	2502:53:00	2500:48:00	50.02882502
18	83	1084	0.00064	543	14.070	0.000582647	16.50	0.12330763	3491.67	114.94	134.20	9/8/03	14:04	2670:09:00	2668:04:00	51.67349417
20	80	1085	0.00071	540	14.083	0.000651582	18.45	0.123959212	3510.12	115.55	134.81	9/15/03	15:12	2839:17:00	2837:12:00	53.28492595
33	80	1084	0.00117	540	14.070	0.00107412	30.42	0.125033332	3540.54	116.55	135.81	9/23/03	10:49	3026:54:00	3024:49:00	55.01727002
-7	80	1091	-0.0002	540	14.161	-0.000229315	-6.49	0.124804017	3534.04	116.34	135.59	9/26/03	18:52	3108:57:00	3104:52:00	55.74002153
36	83	1085	0.00127	543	14.083	0.001166368	33.03	0.125970385	3567.07	117.42	136.68	10/6/03	12:08	3340:13:00	3338:08:00	57.79460759
16	81	1084	0.00057	541	14.070	0.000519823	14.72	0.126490207	3581.79	117.91	137.16	10/14/03	23:07	3543:12:00	3541:07:00	59.52478475
20	85	1081	0.00071	545	14.031	0.000643224	18.21	0.127133432	3600.00	118.51	137.76	10/20/03	15:34	3679:39:00	3677:34:00	60.68011869
5	82	1075	0.00018	542	13.953	0.000160799	4.55	0.12729423	3604.56	118.66	137.91	10/27/03	15:04	3847:09:00	3845:04:00	62.02539802
-1	80	1080	-4E-05	540	14.018	-3.2429E-05	-0.92	0.127261801	3603.64	118.83	137.88	11/3/03	10:13	4010:18:00	4008:13:00	63.3269295
11	81	1085	0.00039	541	14.083	0.000357708	10.13	0.127619509	3613.77	118.96	138.22	11/10/03	11:19	4179:24:00	4177:19:00	64.64827917
60	83	1089	0.00212	543	13.875	0.00191528	54.23	0.129534789	3668.00	120.75	140.00	11/17/03	18:27	4352:32:00	4350:27:00	65.97373215
-15	81	1086	-0.0005	541	14.096	-0.000488233	-13.83	0.129046557	3654.18	120.29	139.55	11/24/03	14:24	4518:29:00	4516:24:00	67.21966478
-7	84	1090	-0.0002	544	14.148	-0.00022742	-6.44	0.128819136	3847.74	120.08	139.34	12/4/03	19:57	4784:02:00	4761:57:00	69.02197718

DESCRIPTION TERMINATED 12/05/03 DUE TO NO MORE GAS BEING EVOLVED; sample air dried 20 days

SAMPLE: 1098.0' to 1099.0' Bluejacket coal in canister G (cuttings sample)

dry sample weight: lbs. 2.0224 grams 917.324

est. lost gas (cc) = 48

TIME OF:

off bottom

in canister

elapsed time (off bottom to canistering)

4.7 minutes

0.079 hours

RIG/LAB MEASUREMENTS

CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)

CUMULATIVE VOLUMES

SCF/TON

SCF/TON

TIME OF MEASURE

TIME SINCE

0.281365717 SQRT (hrs)

measured cc	measured T (F)	measured P	cubic ft	absolute T (F)	psia	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)		
22	77	1097	0.00078	537	14.239	0.000728716	20.63	0.000728716	20.83	0.72	2.40	5/20/03 12:00	0:10:15	0:05:30	0.413319892
5	77	1097	0.00018	537	14.239	0.000165617	4.89	0.000894333	25.32	0.88	2.56	5/20/03 12:02	0:11:30	0:08:45	0.437797516
4	77	1097	0.00014	537	14.239	0.000132494	3.75	0.001026827	29.08	1.02	2.69	5/20/03 12:03	0:12:30	0:07:45	0.456435465
4	77	1097	0.00014	537	14.239	0.000132494	3.75	0.001159321	32.83	1.15	2.82	5/20/03 12:04	0:13:30	0:08:45	0.474341649
3	77	1097	0.00011	537	14.239	9.93703E-05	2.81	0.001258691	35.64	1.24	2.92	5/20/03 12:05	0:14:30	0:09:45	0.49159604
7	77	1097	0.00025	537	14.239	0.000231884	6.57	0.001490555	42.21	1.47	3.15	5/20/03 12:07	0:16:30	0:11:45	0.524404424
5	77	1097	0.00018	537	14.239	0.000165617	4.69	0.001856172	46.90	1.64	3.31	5/20/03 12:09	0:18:30	0:13:45	0.555277706
4	77	1097	0.00014	537	14.239	0.000132494	3.75	0.001788688	50.85	1.77	3.45	5/20/03 12:11	0:20:30	0:15:45	0.584522597
5	77	1097	0.00018	537	14.239	0.000165617	4.69	0.001954283	55.34	1.93	3.61	5/20/03 12:14	0:23:30	0:18:45	0.625832779
6	77	1097	0.00021	537	14.239	0.000198741	5.83	0.002153024	60.97	2.13	3.81	5/20/03 12:17	0:26:30	0:21:45	0.684580068
11	77	1097	0.00039	537	14.239	0.000364358	10.32	0.002517382	71.28	2.49	4.17	5/20/03 12:23	0:32:30	0:27:45	0.735980072
4	77	1097	0.00014	537	14.239	0.000132494	3.75	0.002849878	75.04	2.62	4.30	5/20/03 12:28	0:37:30	0:32:45	0.790569415
7	76	1097	0.00025	536	14.239	0.000232297	6.58	0.002882173	81.61	2.85	4.53	5/20/03 12:33	0:42:30	0:37:45	0.841625412
6	76	1097	0.00021	536	14.239	0.000199111	5.64	0.003081284	87.25	3.05	4.72	5/20/03 12:38	0:47:30	0:42:45	0.889756521
7	76	1097	0.00025	536	14.239	0.000232297	6.58	0.003313581	93.83	3.28	4.95	5/20/03 12:44	0:53:30	0:48:45	0.944281032
6	77	1097	0.00021	537	14.239	0.000198741	5.63	0.003512322	99.46	3.47	5.15	5/20/03 12:51	1:00:30	0:55:45	1.004158022
7	77	1097	0.00025	537	14.239	0.000231884	6.57	0.003744188	108.02	3.70	5.38	5/20/03 12:58	1:07:30	1:02:45	1.060860172
41	77	1091	0.00145	537	14.161	0.001350634	38.25	0.005094819	144.27	5.04	8.71	5/20/03 15:03	3:12:30	3:07:45	1.791182105
20	77	1094	0.00071	537	14.200	0.000660657	18.71	0.005755478	162.98	5.69	7.37	5/20/03 19:21	7:30:30	7:25:45	2.740133817
58	77	1095	0.00205	537	14.213	0.001917657	54.30	0.007673134	217.28	7.59	9.26	5/21/03 0:13	12:22:30	12:17:45	3.51781182
11	72	1093	0.00039	532	14.187	0.000366441	10.38	0.008039575	227.85	7.95	9.83	5/21/03 8:48	20:57:30	20:52:45	4.578027232
51	80	1090	0.0018	540	14.148	0.001869191	47.27	0.009708787	274.92	9.80	11.28	5/21/03 16:37	28:48:30	28:41:45	5.364233403
17	82	1091	0.0006	542	14.181	0.000554853	15.71	0.010283819	290.63	10.15	11.83	5/22/03 9:15	45:24:30	45:19:45	6.73857057
-32	72	1087	-0.0011	532	14.109	-0.001060159	-30.02	0.00920348	260.81	9.10	10.78	5/22/03 21:49	57:58:30	57:53:45	7.614131599
67	85	1088	0.00237	545	14.122	0.002168755	61.41	0.011372214	322.02	11.25	12.92	5/23/03 8:55	69:04:30	68:59:45	8.311137106

-60	70	1084	-0.0021	530	14.070	-0.001989793	-56.34	0.009382422	265.66	9.28	10.96	5/24/03	1:38	85:47:30	85:42:45	9.262379104
72	86	1083	0.00254	546	14.057	0.002315843	65.57	0.011698064	331.25	11.57	13.25	5/25/03	2:01	110:10:30	110:05:45	10.49842796
-17	80	1086	-0.0008	540	14.096	-0.000554355	-15.70	0.011143709	315.55	11.02	12.70	5/26/03	0:15	132:24:30	132:19:45	11.506882

DESORPTION TERMINATED 5/26/03 DUE TO NO MORE GAS BEING EVOLVED; sample oven dried 10 days @ 150 degrees F



1052.2' to 1053.8' (Weir-Pittsburg coal core) in canister K  
Dart Orr #B3C-34; NW NE 34-T.30S.-R.15E., Wilson County, KS

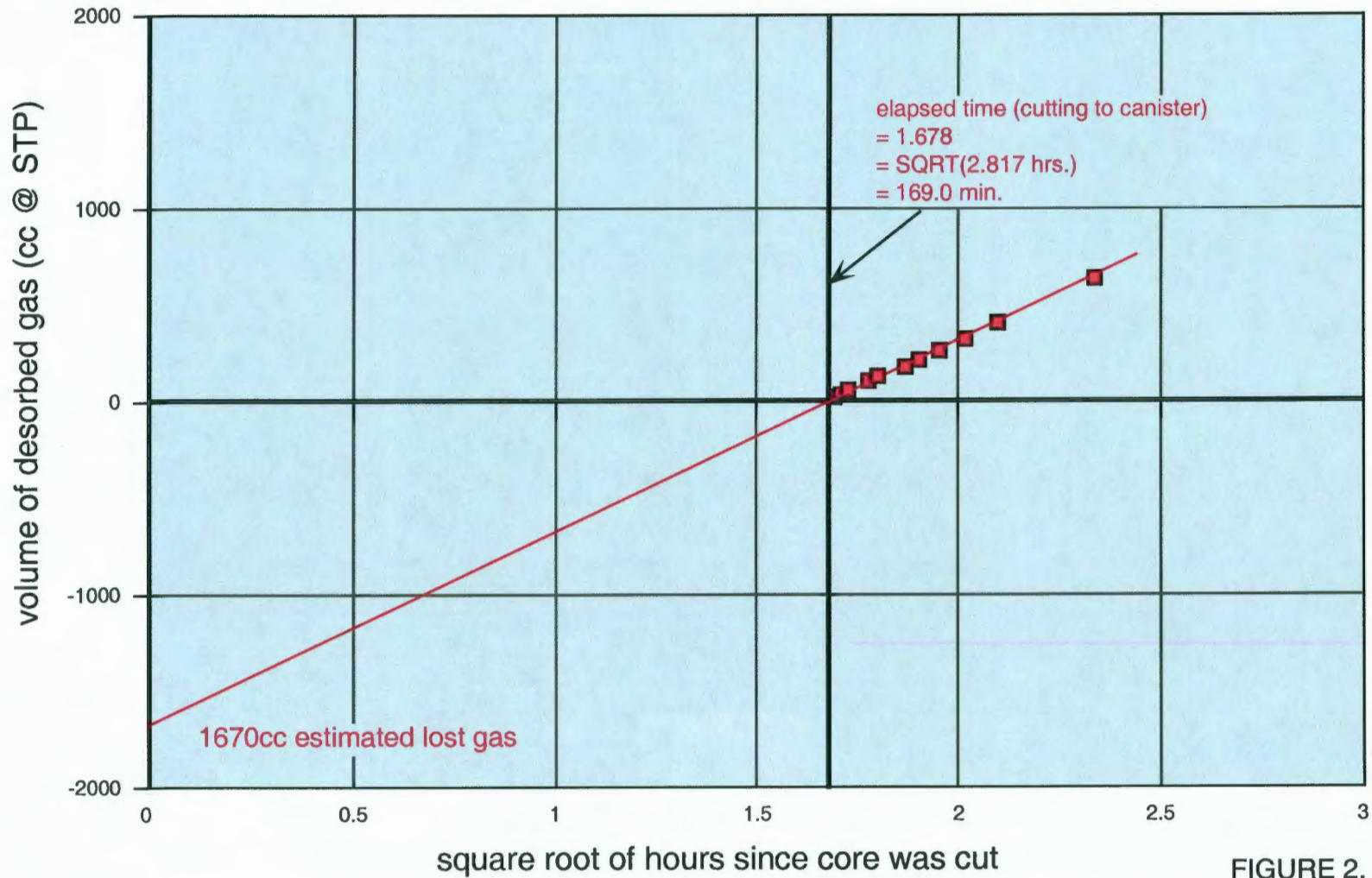


FIGURE 2.

1053.8' to 1055.0' (Weir-Pittsburg coal core) in canister Maggy 2  
Dart Orr #B3C-34; NW NE 34-T.30S.-R.15E., Wilson County, KS

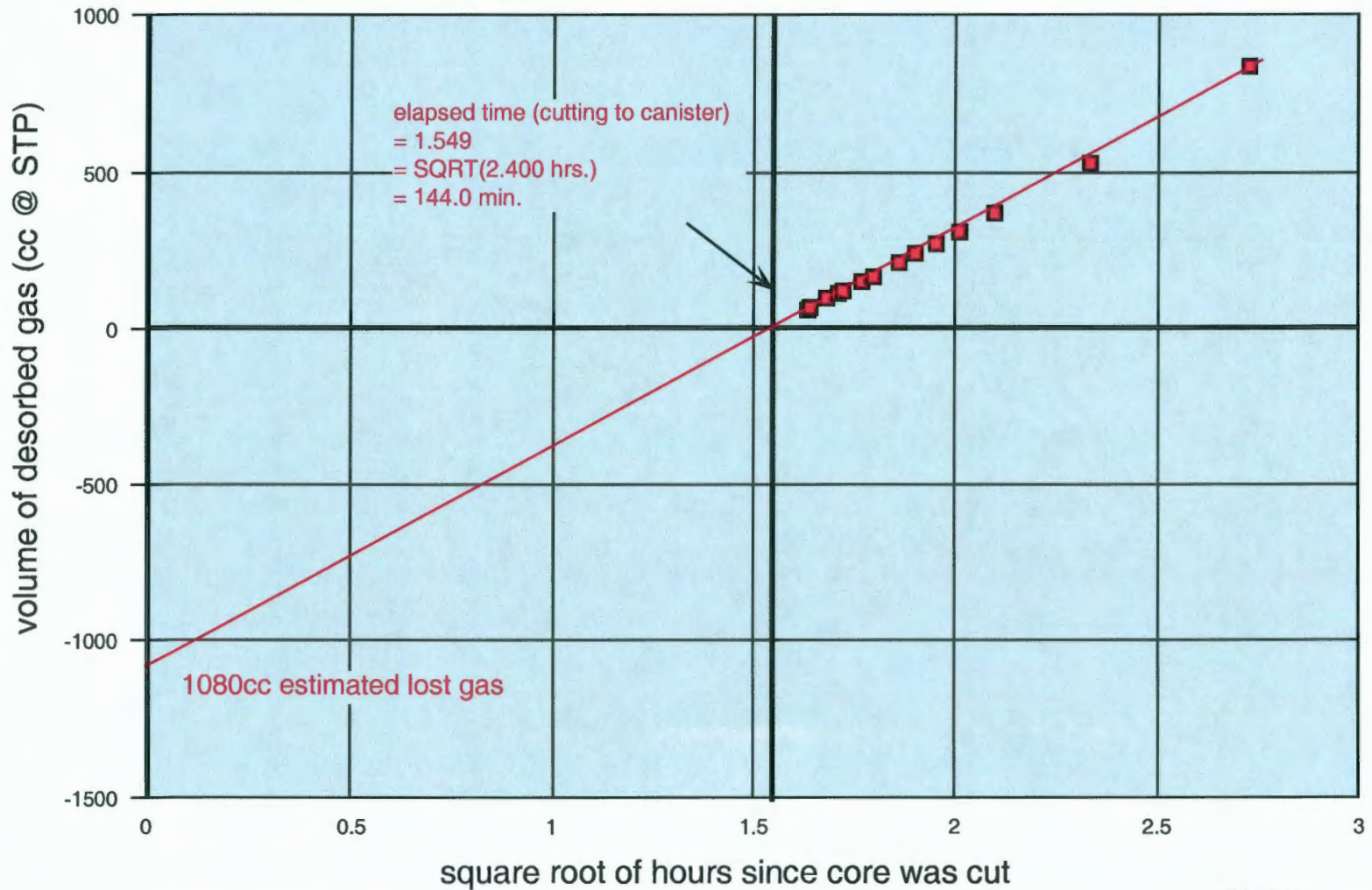


FIGURE 3.



1077.3' to 1078.3' (Wainright coal core) in canister 4  
Dart Orr #B3C-34; NW NE 34-T.30S.-R.15E., Wilson County, KS

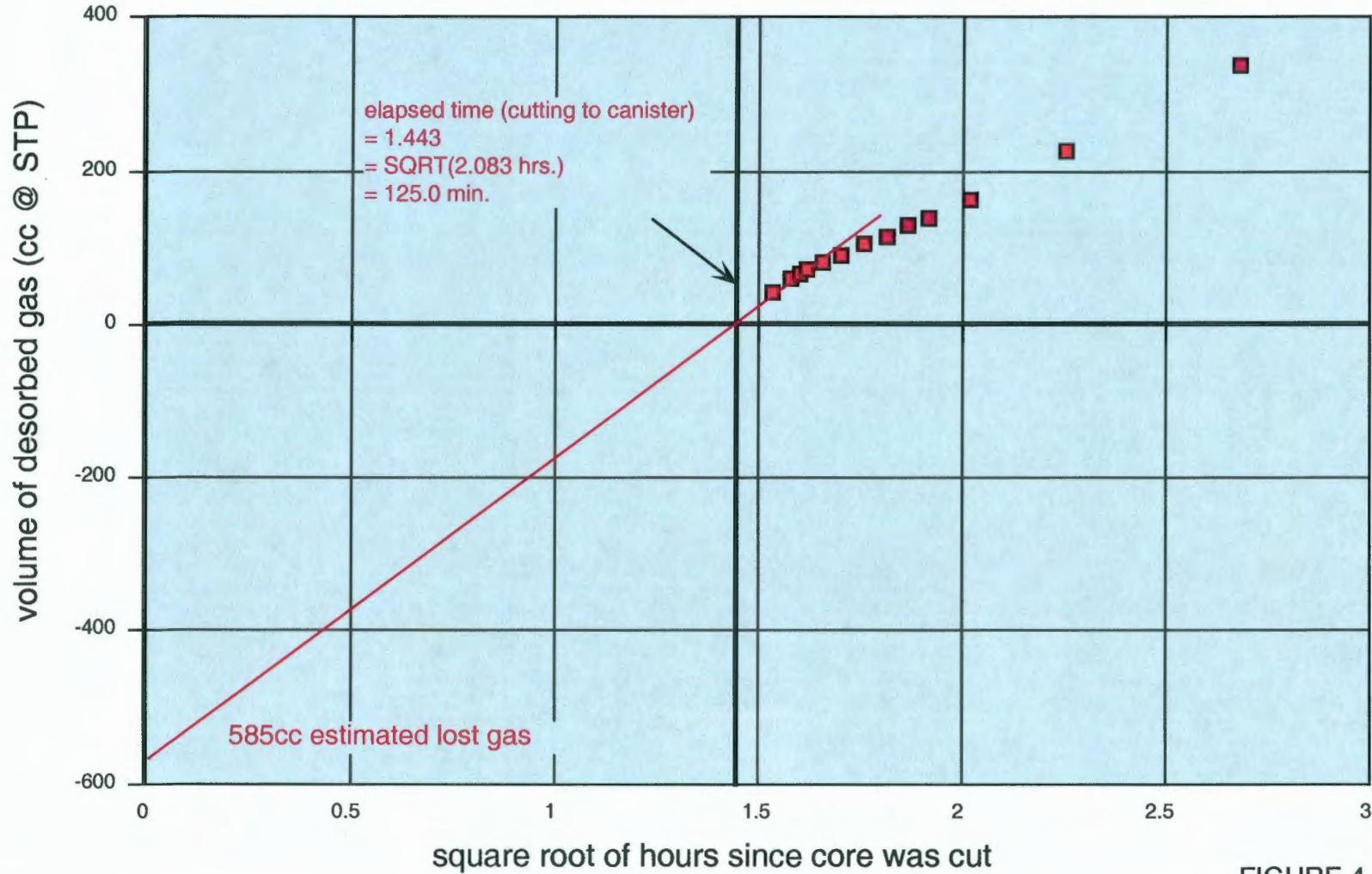


FIGURE 4.

1098' to 1099' (Bluejacket coal cuttings) in canister 4  
Dart Orr #B3C-34; NW NE 34-T.30S.-R.15E., Wilson County, KS

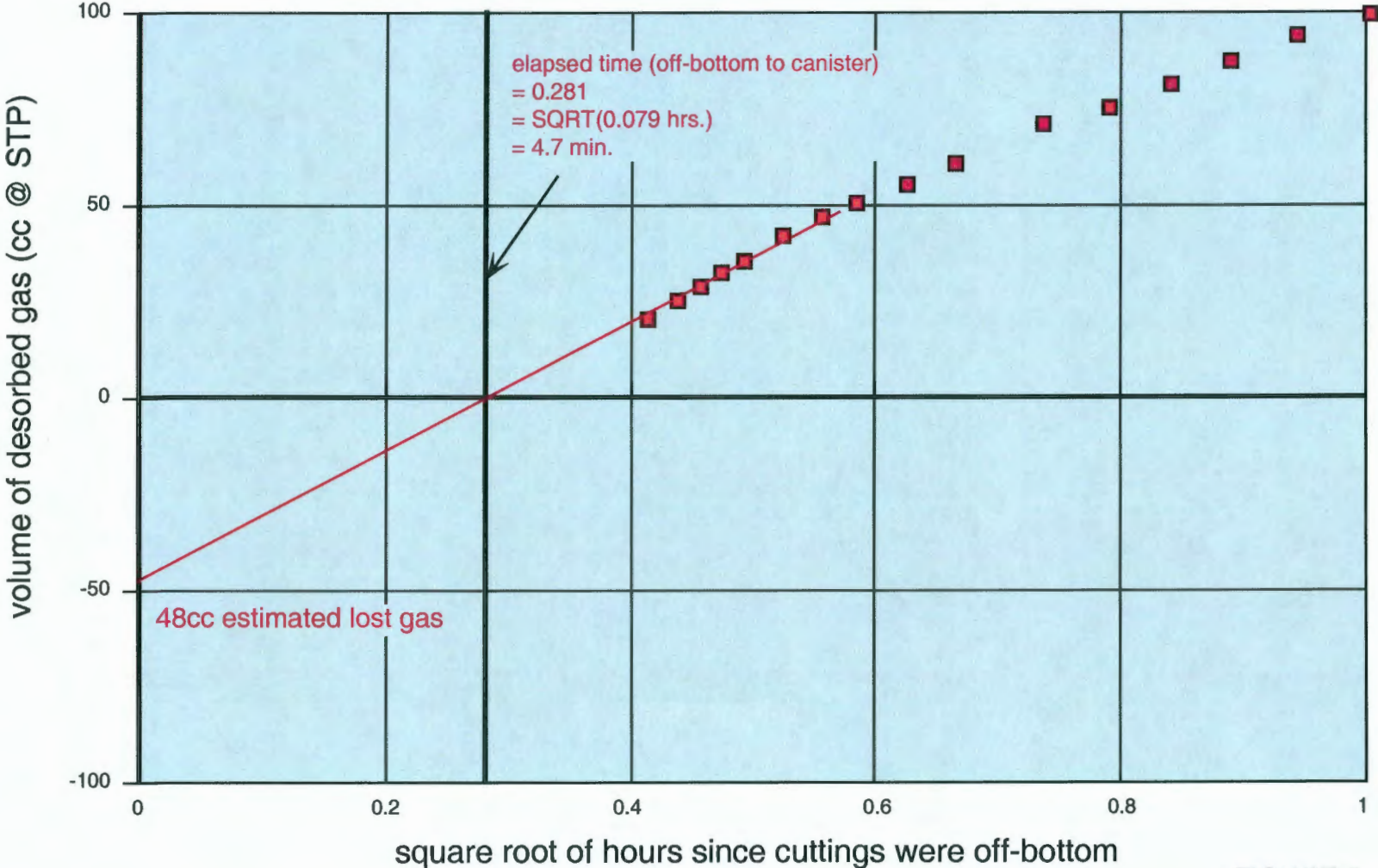


FIGURE 5.



# Desorption Characteristics of Cuttings Sample

Dart Cherokee Basin #B3C-34 Orr; NW NE sec. 34-T.30S.-R.15E., Wilson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Bluejacket coal at 1098-1099'

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

total gas desorbed = 379 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1125.90 grams

weight<sub>light-colored lithologies</sub> = 208.58 grams (18.5%)

weight<sub>dark shale</sub> = 851.52 grams (75.6%)

weight<sub>coal</sub> = 65.81 grams (5.8%)

sieve size	grams	% coal / % dark shale / % light-colored liths
>0.0930"	727.55	3.83% / 76.31% / 19.86%
>0.0661"	212.50	10.91% / 74.74% / 14.35%
>0.0460"	120.54	7.82% / 74.24% / 17.94%
>0.0331"	40.87	8.39% / 72.90% / 18.71%
<0.0331"	24.43	7.74% / 74.55% / 17.71%

**1125.90 TOTAL**

UNIT	coal in sample	scf/ton w/ shale @ 3 scf/ton	maximum scf/ton	minimum scf/ton
Bluejacket	6%	145.8	184.6	13.3

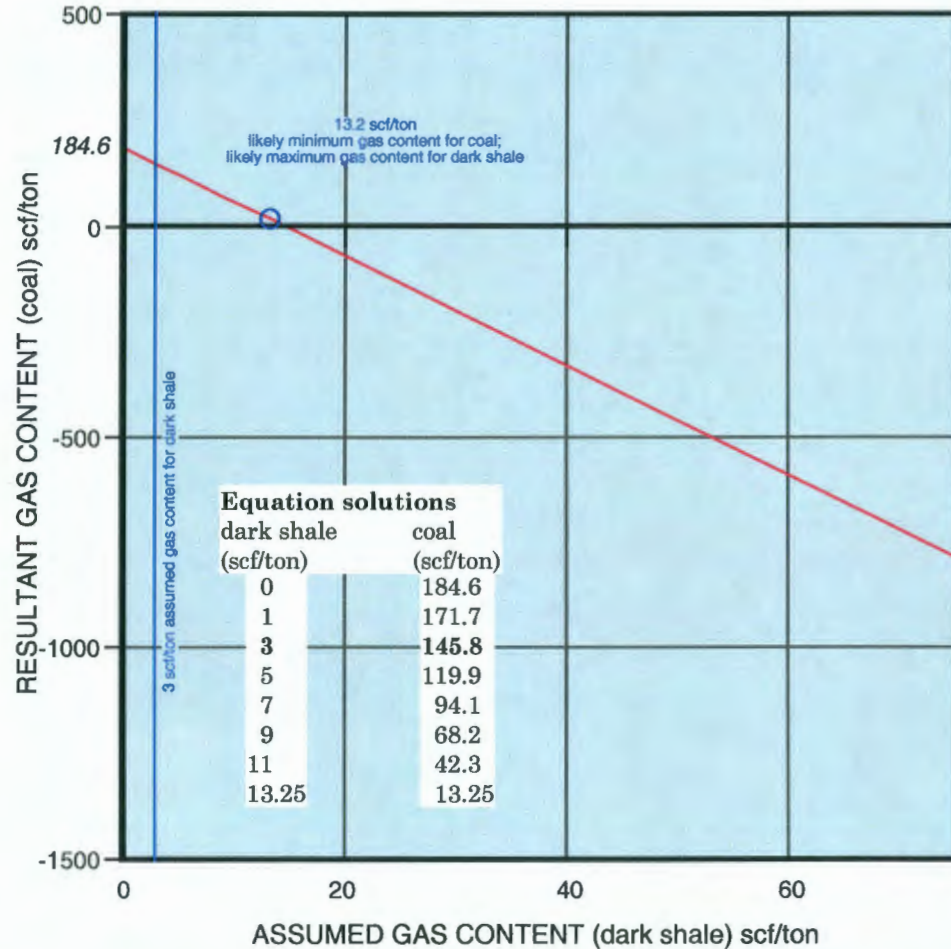


FIGURE 6.

# Desorption Characteristics of Dart Cherokee Basin Orr #BC3-34; NW NE sec. 34-T.30S.-R.15E.; Wilson Co., KS

surface

100'  
200'  
300'  
400'  
500'  
600'  
700'  
800'  
900'  
1000'  
1200'

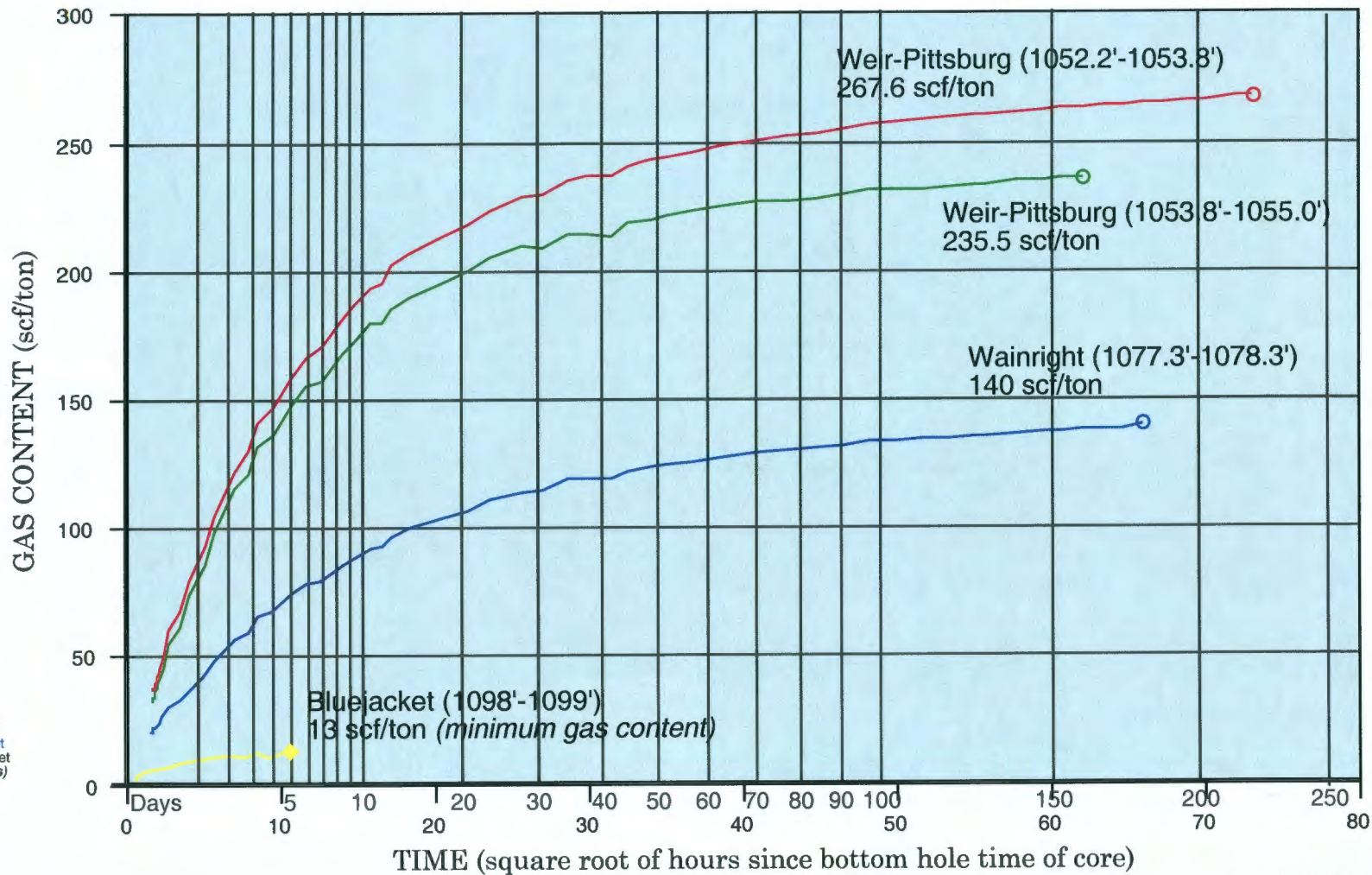


FIGURE 7.



Desorption Characteristics of Dart Cherokee Basin Orr #BC3-34;  
 NW NE sec. 34-T.30S.-R.15E.; Wilson Co., KS  
 Percentage of Total Gas Desorbed vs. Time

surface

100'

200'

300'

400'

500'

600'

700'

800'

900'

1000'

1200'

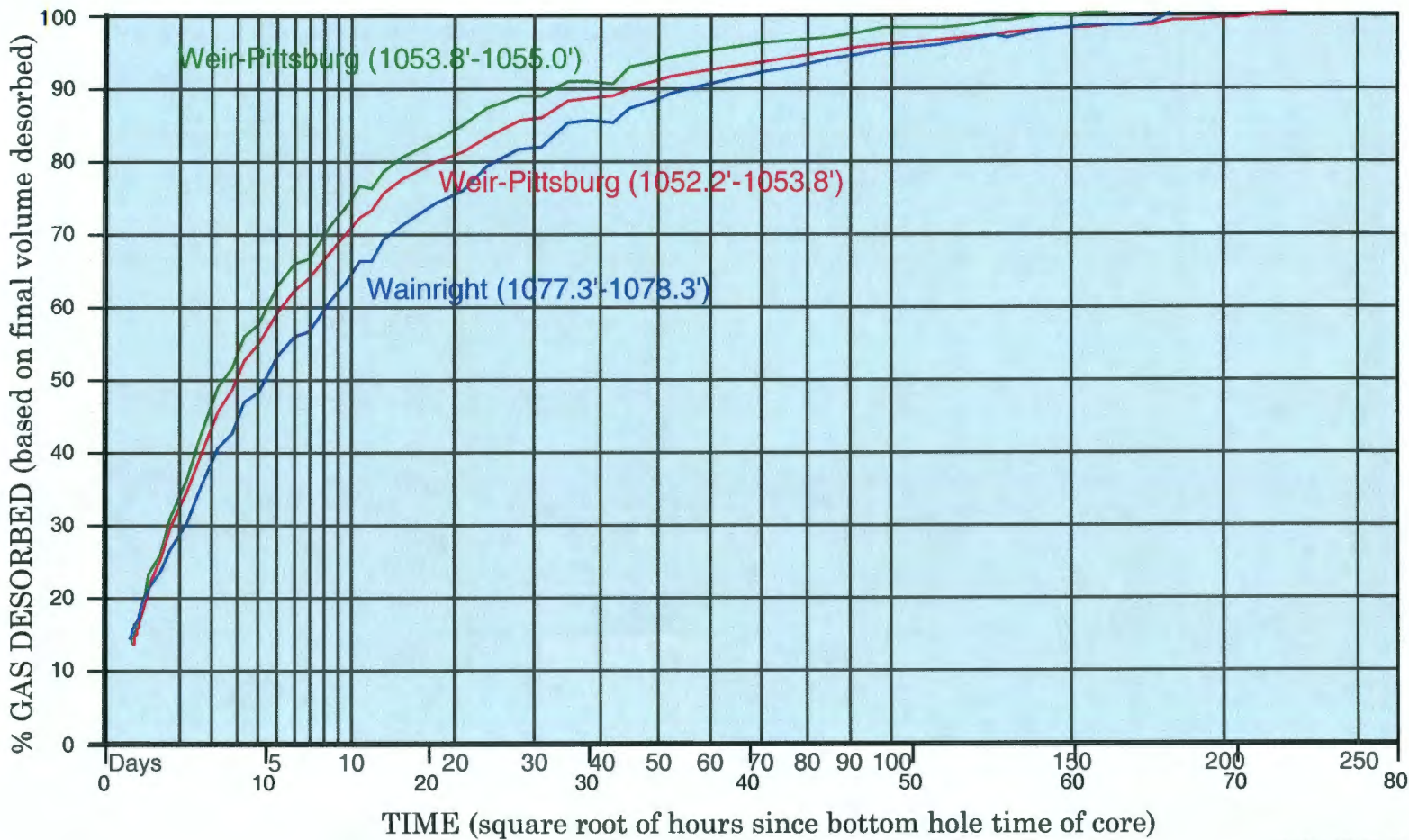


FIGURE 8.