ANALYSIS OF CHEROKEE GROUP CUTTINGS SAMPLES FOR GAS CONTENT -- EVERGREEN OPERATING CORP. EVERGREEN SHORT #41-32; NE NE 32-T.18S.-R.20E., FRANKLIN COUNTY, KANSAS

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September 15, 2004
Kansas Geological Survey Open-File Report 2006-46

SUMMARY

Six cuttings samples from the Pennsylvanian Kansas City Group and Cherokee Group were collected from the Evergreen Operating Corp. #41-32 Short well, NE NE 32-T.18S.-R.20E., Franklin County, KS. The samples calculate as having the following gas contents:

- Hushpuckney Shale at 417.0' to 420.0' depth[1] (10 scf/ton)
- Mulky coal at 760.0' to 761.5' depth[2, 3] (11 scf/ton)
- Bevier coal at 845.3' to 846.2' depth[2] (14 scf/ton)
- Croweburg coal at 860.5' to 861.3' depth[2] (27 scf/ton)
- Tebo coal at 932.0' to 933.0' depth[2] (23 scf/ton)
- Riverton coal at 1128.0' to 1130.0' depth[2] (54 scf/ton)

[1]no coal in sample
[2]assuming accompanying dark shales in sample desorb 3 scf/ton
[3]gas content should be considered a minimum due to a possible leak in the desorption canister

BACKGROUND

The Evergreen Operating Corp. #41-32 Short well, NE NE 32-T.18S.-R.20E., Franklin County, KS, was selected for cuttings desorption tests in association with an on-going coalbed gas research project at the Kansas Geological Survey. The samples were gathered March 28, 29, and 30, 2004, by K. David Newell and Galen A. Worthington of the Kansas Geological Survey, with assistance from Richard A. Robba (consultant to Evergreen). Samples were obtained during coring of the well. The well was drilled using a mud system, with a rig owned by Layne-Christensen, Canada, Ltd.

Lag times for samples to reach the surface (important for assessing lost gas) were determined with a rule-of-thumb rate of circulation of 100 feet per minute. A mud-logging trailer with a gas detector trailer was on site.

Six cuttings samples from the Pennsylvanian Cherokee Group were collected:

- Hushpuckney Shale at 417.0' to 420.0' depth (515 grams dry wt.)
- Mulky coal at 760.0' to 761.5' depth (391 grams dry wt.)
- Bevier coal at 845.3' to 846.2' depth (318 grams dry wt.)
- Croweburg coal at 860.5' to 861.3' depth (432 grams dry wt.)
- Tebo coal at 932.0' to 933.0' depth (386 grams dry wt.)
- Riverton coal at 1128.0' to 1130.0' depth (518 grams dry wt.)

The cuttings were caught in kitchen strainers as they exited the shale shaker emptying to the mud pit. The samples were then washed in water while in the kitchen strainers to rid them of as much drilling mud as possible before the cuttings were placed in desorption canisters. Water with biocide was poured into the canisters before the canisters were sealed.

Temperature baths for the desorption canisters were on site, with temperature kept at approximately 75°F. The canistered samples at the end of the job were transported to the laboratory at the Kansas Geological Survey in Lawrence, KS, and desorption measurements were continued at the same temperature. Desorption measurements were periodically made until the canisters produced negligible gas with daily testing for at least two successive days.

DESORPTION MEASUREMENTS

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

Most desorption canisters were made in-house at the Kansas Geological Survey. The "ST" canisters enclosed a volume of 38 cubic inches (620 cm^3). The "W" canisters enclosed a volume of 44 cubic inches (720 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 linear regression was determined over several weeks by comparing readings from the Oregon Scientific instrument to that from a pressure transducer in the Petrophysics Laboratory in the Kansas Geological Survey in Lawrence, KS. The regression equation was entered into the desorption 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, the customary measure system used in American coal and oil industry. V is therefore converted to cubic feet; P is psia; T is °R.

The desorbed gas was summed over the time period for which the coal samples evolved all of their gas. Lost gas (i.e., the gas lost from the sample from the time it was drilled, brought to the surface, to the time it was canistered) was determined using the direct method (Kissel and others, 1975; also see McLennan and others, 1995, p. 6.1-6.14) in which the cumulative gas evolved is plotted against the square root of elapsed time. Time zero is assumed to be the moment that the rock is cut and its cuttings circulated off bottom. Characteristically, the cumulative gas evolved from the sample, when plotted against the square root of time, is linear for a short time after the sample reaches ambient surface pressure conditions, therefore lost gas is determined by a line projected back to time zero. The period of linearity generally is about an hour for cuttings samples.

LITHOLOGIC ANALYSIS

Upon removal from the canisters, the cuttings were washed of drilling mud, and either air-dried for several days, or dried in an oven at 150 °F for 1 to 3 days. After drying, the cuttings were weighed and then dry sieved into 5 size fractions: >0.0930", >0.0661", >0.0460", >0.0331", and <0.0331". For large sample sizes, the cuttings were run through a sample splitter and a lesser portion (approximately 75 grams) was 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 each sample, 4) a summary component analysis for all samples showing relative reliability of the data from all the samples, and 5) a desorption graph for all the samples.

Data Tables of the Desorption Analyses (Table 1)

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

Lost-Gas Graphs (Figures 1-6)

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 hours after the cuttings leave the bottom of the hole, thus data are presented in the lost-gas graphs for only up to four hours 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 7-12)

Collection of pure lithologies using drill cuttings from relatively thin-bedded strata is 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:

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

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 vice versa. If there is little dark shale in a sample, a relatively well constrained answer for *gas content*$_{coal}$ can be obtained. Conversely, if considerable dark shale is in a sample, the gas content of a coal will be hard to precisely determine.

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

A value of 3 scf/ton for average dark shale is based on the assay of the gas content of cores of dark shales with normal gamma-ray readings in Kansas 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. For example, the Mulky coal is associated with a "hot shale" (Excello Shale).

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

Summary Component Analysis for all Samples (Figure 13)
This diagram is a summary of the individual "lithologic component sensitivity analyses" for each sample, all set at a common scale. The steeper the angle of the line for a sample, the more uncertainty is attached to the results (i.e., *gas content*$_{coal}$) for that sample. If the coal content is miniscule (i.e., < approximately 5%), the results are a better reflection of the *gas content*$_{dark\ shale}$.

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

RESULTS and DISCUSSION

One sample (Hushpuckney Shale at 417.0' to 420.0' depth) contained no coal. The gas analyses associated with these samples is therefore a gas content for shale.

The Mulky coal (902'-903' depth) and Croweburg coal (972'-973' depth) samples registered exceptionally high gas contents (respectively 2617 scf/ton and 1249 scf/ton, assuming accompanying black shales desorbed 3 scf/ton). These sample were dominated by very dark to black shales (N1, N2) that display a high gamma-ray values on wireline logs. These shales likely have a high gas content, perhaps close to that of the average gas content for the entire sample (i.e., 35 to 40 scf/ton).

The best constrained data are associated with the Bevier sample (845.3' to 846.2' depth), which contained 31% coal. This sample is followed closely by the Tebo coal (860.5' to 861.3' depth) and "upper Tebo" coal 1035' to 1036' depth), which, respectively, have 40% and 32% coal. The Riverton coal (1128.0' to 1130.0' depth), with 17% coal, also has acceptably constrained data, but the calculated gas content for the coal in this samples varies more with whatever value is assumed for the accompanying black shales. The subsidiary amount of coal in this sample imparts some uncertainty to the desorption measurements, but an approximation of its gas content is nevertheless obtained. 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.

A leak is suspected in the canister containing the Mulky coal (760.0' to 761.5' depth), thus any data collected for this sample is considered invalid. The peculiar lost-gas response, the overall low gas content (for a normally gas-rich zone), and a lack of variation in the quantity of gas emitted by the canister in response to day-to-day barometric and temperature changes all indicate a slight leak in the desorption canister.

REFERENCES

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

FIGURES and TABLES

TABLE 1. Desorption measurements for samples.

FIGURE 1. Lost-gas graph for Hushpuckney Shale at 417.0' to 420.0' depth.
FIGURE 2. Lost-gas graph for Mulky coal at 760.0' to 761.5' depth.
FIGURE 3. Lost-gas graph for Bevier coal at 845.3' to 846.2' depth.
FIGURE 4. Lost-gas graph for Croweburg coal at 860.5' to 861.3' depth.
FIGURE 5. Lost-gas graph for Tebo coal at 932.0' to 933.0' depth.
FIGURE 6. Lost-gas graph for Riverton coal at 1128.0' to 1130.0' depth.

FIGURE 7. Sensitivity analysis for Hushpuckney Shale at 417.0' to 420.0' depth.
FIGURE 8. Sensitivity analysis for Mulky coal at 760.0' to 761.5' depth.
FIGURE 9. Sensitivity analysis for Bevier coal at 845.3' to 846.2' depth.
FIGURE 10. Sensitivity analysis for Croweburg coal at 860.5' to 861.3' depth.
FIGURE 11. Sensitivity analysis for Tebo coal at 932.0' to 933.0' depth.
FIGURE 12. Sensitivity analysis for Riverton coal at 1128.0' to 1130.0' depth.

FIGURE 13. Lithologic component sensitivity analyses for all samples.

FIGURE 14. Desorption graph for all samples.

TABLE 1 -- Desorption data for EVERGREEN SHORT #41-32; NE NE 32-T.18S.-R.20E., Franklin County, KS

SAMPLE: 417' to 420' (Hushpuckney Shale) cuttings in canister ST1

	lbs.	grams
dry sample weight:	0.2714	123.09

est. lost gas (cc) = 6

TIME OF:	off bottom	at surface	in canister
	3/28/04 16:48	3/28/04 16:53	3/28/04 17:01

elapsed time (off bottom to canistering): 12.5 minutes; 0.208 hours; 0.456435465 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	measured T (F)	measured P	cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
1	76	1083	4E-05	536	14.057	3.27617E-05	0.93	3.27617E-05	0.93	0.24	1.80	3/28/04 17:06	0:17:30	0:05:00	0.540061725
1	76	1083	4E-05	536	14.057	3.27617E-05	0.93	6.55235E-05	1.86	0.48	2.04	3/28/04 17:10	0:21:15	0:08:45	0.595119036
2	76	1083	7E-05	536	14.057	6.55235E-05	1.86	0.000131047	3.71	0.97	2.53	3/28/04 17:22	0:33:15	0:20:45	0.744423714
2	76	1083	7E-05	536	14.057	6.55235E-05	1.86	0.00019657	5.57	1.45	3.01	3/28/04 17:37	0:48:15	0:35:45	0.896753403
1	76	1083	4E-05	536	14.057	3.27617E-05	0.93	0.000229332	6.49	1.69	3.25	3/28/04 18:27	1:38:15	1:25:45	1.279648389
0.5	76	1083	2E-05	536	14.057	1.63809E-05	0.46	0.000245713	6.96	1.81	3.37	3/28/04 18:52	2:03:15	1:50:45	1.433236431
16	75	1085	0.0006	535	14.083	0.000528137	14.90	0.00077185	21.86	5.69	7.25	3/29/04 19:32	26:43:15	26:30:45	5.169219799
2	73	1087	7E-05	533	14.109	6.81356E-05	1.87	0.000837986	23.73	6.18	7.74	3/30/04 7:11	38:22:15	38:09:45	6.194419532
-1	70	1088	-4E-05	530	14.122	-3.32856E-05	-0.94	0.0008047	22.79	5.93	7.49	3/30/04 20:05	51:16:15	51:03:45	7.160365447
6	75	1088	0.0002	535	14.122	0.000197847	5.60	0.001002547	28.39	7.39	8.95	3/31/04 14:16	69:27:15	69:14:45	8.333916646
3	80	1084	0.0001	540	14.070	9.76472E-05	2.77	0.001100195	31.15	8.11	9.67	4/1/04 9:48	88:59:15	88:46:45	9.43331861
-1	80	1089	-4E-05	540	14.135	-3.26992E-05	-0.93	0.001067495	30.23	7.87	9.43	4/2/04 11:15	114:26:15	114:13:45	10.69754645
0	80	1088	0	540	14.122	0	0.00	0.001067495	30.23	7.87	9.43	4/3/04 17:04	144:15:15	144:02:45	12.01058561
-1	80	1087	-4E-05	540	14.109	-3.26392E-05	-0.92	0.001034856	29.30	7.63	9.19	4/4/04 15:24	168:35:15	186:22:45	12.90667801
0	80	1082	0	540	14.044	0	0.00	0.001034856	29.30	7.63	9.19	4/5/04 21:12	196:23:15	196:10:45	14.01383245

DESORPTION TERMINATED 4/6/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 21 days

SAMPLE: 760' to 761.5' (Mulky coal) cuttings in canister ST4

	lbs.	grams
dry sample weight:	0.3701	167.86

est. lost gas (cc) = 7

TIME OF:	off bottom	at surface	in canister
	3/29/04 7:17	3/29/04 7:25	3/29/04 7:46

elapsed time (off bottom to canistering): 28.5 minutes; 0.475 hours; 0.689202438 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	measured T (F)	measured P	cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
3	75	1087	0.0001	535	14.109	9.88326E-05	2.80	9.88326E-05	2.80	0.53	1.87	3/29/04 7:47	0:29:30	0:01:00	0.701189466
0	75	1088	0	535	14.122	0	0.00	9.88326E-05	2.80	0.53	1.87	3/29/04 7:55	0:37:30	0:09:00	0.790569415
0	75	1088	0	535	14.122	0	0.00	9.88326E-05	2.80	0.53	1.87	3/29/04 8:00	0:42:30	0:14:00	0.841625412
0	75	1088	0	535	14.122	0	0.00	9.88326E-05	2.80	0.53	1.87	3/29/04 8:10	0:52:30	0:24:00	0.935414347
1	75	1086	4E-05	535	14.122	3.29745E-05	0.93	0.000131807	3.73	0.71	2.05	3/29/04 8:20	1:02:30	0:34:00	1.020620726
0	75	1088	0	535	14.122	0	0.00	0.000131807	3.73	0.71	2.05	3/29/04 8:35	1:17:30	0:49:00	1.136515141
1	75	1088	4E-05	535	14.122	3.29745E-05	0.93	0.000164782	4.87	0.89	2.23	3/29/04 9:00	1:42:30	1:14:00	1.307032262
1	75	1088	4E-05	535	14.122	3.29745E-05	0.93	0.000197756	5.80	1.07	2.40	3/29/04 9:30	2:12:30	1:44:00	1.486046208
5	75	1085	0.0002	535	14.083	0.000184418	4.86	0.000382174	10.26	1.98	3.29	3/29/04 19:31	12:13:30	11:45:00	3.496426747
1	73	1087	4E-05	533	14.109	3.30678E-05	0.94	0.000395242	11.19	2.14	3.47	3/30/04 7:13	23:55:30	23:27:00	4.891318841
-1	70	1088	-4E-05	530	14.122	-3.32856E-05	-0.94	0.000361958	10.25	1.96	3.29	3/30/04 20:05	36:47:30	36:19:00	6.065613462
5	75	1088	0.0002	535	14.122	0.000164873	4.67	0.000526829	14.92	2.85	4.18	3/31/04 14:16	54:58:30	54:30:00	7.414512796
3	80	1084	0.0001	540	14.070	9.76472E-05	2.77	0.000624476	17.68	3.37	4.71	4/1/04 9:48	74:30:30	74:02:00	8.631820974
-1	80	1089	-4E-05	540	14.135	-3.26992E-05	-0.93	0.000591777	16.78	3.20	4.53	4/2/04 11:15	99:57:30	99:29:00	9.99791645
0	80	1088	0	540	14.122	0	0.00	0.000591777	16.76	3.20	4.53	4/3/04 17:04	129:46:30	129:18:00	11.39188308
-1	80	1087	-4E-05	540	14.109	-3.28392E-05	-0.92	0.000559138	15.83	3.02	4.36	4/4/04 15:25	152:07:30	151:39:00	12.33389638
0	80	1082	0	540	14.044	0	0.00	0.000559138	15.83	3.02	4.36	4/5/04 21:13	181:55:30	181:27:00	13.48795759

DESORPTION TERMINATED 4/6/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 21 days

SAMPLE: 845.3' to 848.2' (Bevier coal) cuttings in canister W1

	lbs.	grams
dry sample weight:	0.2799	126.98

est. lost gas (cc) = 7

TIME OF:	off bottom	at surface	in canister
	3/29/04 11:21	3/29/04 11:30	3/29/04 11:41

elapsed time (off bottom to canistering): 19.5 minutes; 0.325 hours; 0.570087713 SQRT (hrs)

RIG/LAB MEASUREMENTS			CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	measured T (F)	measured P	cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
2	72	1087	7E-05	532	14.109	6.626E-05	1.88	6.626E-05	1.88	0.47	2.24	3/29/04 11:52	0:30:30	0:11:00	0.712974988
0	72	1087	0	532	14.109	0	0.00	6.626E-05	1.88	0.47	2.24	3/29/04 11:54	0:32:30	0:13:00	0.735980072
0	72	1087	0	532	14.109	0	0.00	6.626E-05	1.88	0.47	2.24	3/29/04 11:56	0:34:30	0:15:00	0.758287544
0.5	72	1087	2E-05	532	14.109	1.6565E-05	0.47	8.28249E-05	2.35	0.59	2.36	3/29/04 12:00	0:38:30	0:19:00	0.801040989
3.5	74	1086	0.0001	534	14.096	0.000115414	3.27	0.000198239	5.61	1.42	3.18	3/29/04 12:19	0:57:30	0:38:00	0.97894501
0	74	1086	0	534	14.096	0	0.00	0.000198239	5.61	1.42	3.18	3/29/04 12:30	1:08:30	0:49:00	1.068488028

1.5	74	1086	5E-05	534	14.096	4.94633E-05	1.40	0.000247703	7.01	1.77	3.54	3/29/04	12:46	1:24:30	1:05:00	1.186732208
1.5	75	1086	5E-05	535	14.096	4.93706E-05	1.40	0.000297073	8.41	2.12	3.89	3/29/04	13:00	1:38:30	1:19:00	1.281275408
1	75	1086	4E-05	535	14.096	3.29139E-05	0.93	0.000329987	9.34	2.36	4.12	3/29/04	13:15	1:53:30	1:34:00	1.375378736
1	75	1086	4E-05	535	14.096	3.29139E-05	0.93	0.000362901	10.28	2.59	4.36	3/29/04	13:30	2:08:30	1:49:00	1.463443428
1	75	1086	4E-05	535	14.096	3.29139E-05	0.93	0.000395615	11.21	2.83	4.59	3/29/04	13:45	2:23:30	2:04:00	1.546501428
1	74	1086	4E-05	534	14.096	3.29755E-05	0.93	0.000428791	12.14	3.06	4.83	3/29/04	14:00	2:38:30	2:19:00	1.625320481
0 5	75	1086	2E-05	535	14.096	1.64569E-05	0.47	0.000445248	12.61	3.18	4.95	3/29/04	14:20	2:58:30	2:39:00	1.724818831
7	75	1085	0.0002	535	14.083	0.000230165	6.52	0.000675433	19.13	4.83	6.59	3/29/04	19:29	8:07:30	7:48:00	2.850438563
7	73	1087	0.0002	533	14.109	0.000231475	6.55	0.000906907	25.68	6.48	8.25	3/30/04	7:14	19:52:30	19:33:00	4.458138625
0	70	1088	0	530	14.122	0	0.00	0.000906907	25.68	6.48	8.25	3/30/04	20:06	32:44:30	32:25:00	5.722033438
7	75	1088	0.0002	535	14.122	0.000230622	6.54	0.001137729	32.22	8.13	9.89	3/31/04	14:17	50:55:30	50:36:00	7.136175446
3	80	1084	0.0001	540	14.070	9.76472E-05	2.77	0.001235376	34.98	8.83	10.59	4/1/04	9:49	70:27:30	70:08:00	8.393946231
-1	80	1089	-4E-05	540	14.135	-3.26992E-05	-0.93	0.001202677	34.06	8.59	10.36	4/2/04	11:15	95:53:30	95:34:00	9.792429048
-1	80	1088	-4E-05	540	14.122	-3.26692E-05	-0.93	0.001170008	33.13	8.36	10.13	4/3/04	17:05	125:43:30	125:24:00	11.212716
0	80	1087	0	540	14.109	0	0.00	0.001170008	33.13	8.36	10.13	4/4/04	15:25	148:03:30	147:44:00	12.16792231
2	80	1082	7E-05	540	14.044	6.49761E-05	1.84	0.001234986	34.97	8.82	10.59	4/5/04	21:14	177:52:30	177:33:00	13.33697867
2	79	1080	7E-05	539	14.016	6.49763E-05	1.84	0.001299964	36.81	9.29	11.05	4/6/04	14:24	195:02:30	194:43:00	13.96573187
3	80	1076	0.0001	540	13.966	9.69266E-05	2.74	0.001396891	39.56	9.98	11.75	4/7/04	14:01	218:39:30	218:20:00	14.78710023
-1	78	1082	-4E-05	536	14.044	-3.26098E-05	-0.92	0.001364281	38.83	9.75	11.51	4/8/04	14:11	242:49:30	242:30:00	15.58284313
1	77	1081	4E-05	537	14.031	3.26403E-05	0.92	0.001396921	39.56	9.98	11.75	4/9/04	16:40	269:16:30	268:59:00	16.41061648
-1	75	1087	-4E-05	535	14.109	-3.29442E-05	-0.93	0.001383977	38.62	9.74	11.51	4/10/04	18:26	293:04:30	292:45:00	17.1194334
-4	75	1086	-0.0001	535	14.096	-0.000131656	-3.73	0.001232321	34.90	8.80	10.57	4/12/04	14:42	339:20:30	339:01:00	18.4212287

DESORPTION TERMINATED 4/12/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 21 days

SAMPLE: 860.5' to 861.3' (V-shale/Croweburg coal) cuttings in canister W2

	lbs.	grams
dry sample weight:	0.6814	309.06

est. lost gas (cc) = 12

TIME OF:	off bottom	at surface	in canister
	3/29/04 12:04	3/29/04 12:13	3/29/04 12:23

elapsed time (off bottom to canistering): 18.8 minutes; 0.313 hours; 0.559016994 SQRT (hrs)

RIG/LAB MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi) cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON without lost gas	SCF/TON with lost gas	TIME OF MEASURE		TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
16	75	1085	0.0006	535	14.083	0.000526137	14.90	0.000526137	14.90	1.54	2.79	3/29/04	14:28	2:23:15	2:04:30	1.545153714
3	75	1085	0.0001	535	14.083	9.86506E-05	2.79	0.000624788	17.69	1.83	3.08	3/29/04	14:32	2:27:15	2:08:30	1.568578012
2	75	1085	7E-05	535	14.083	6.57672E-05	1.86	0.000890555	19.55	2.03	3.27	3/29/04	14:36	2:31:15	2:12:30	1.58771324
1	75	1085	4E-05	535	14.083	3.28836E-05	0.93	0.000723439	20.49	2.12	3.37	3/29/04	14:40	2:35:15	2:16:30	1.608570794
1	75	1085	4E-05	535	14.083	3.28838E-05	0.93	0.000756322	21.42	2.22	3.46	3/29/04	14:45	2:40:15	2:21:30	1.63426844
2	75	1085	7E-05	535	14.083	6.57672E-05	1.86	0.00082209	23.28	2.41	3.68	3/29/04	14:52	2:47:15	2:28:30	1.669580786
0	76	1085	0	536	14.083	0	0.00	0.00082209	23.28	2.41	3.86	3/29/04	15:00	2:55:15	2:38:30	1.709044567
4	75	1085	0.0001	535	14.083	0.000131534	3.72	0.000953824	27.00	2.80	4.04	3/29/04	15:22	3:17:15	2:58:30	1.813146436
2	75	1085	7E-05	535	14.083	6.57672E-05	1.88	0.001019391	28.87	2.99	4.24	3/29/04	15:40	3:35:15	3:16:30	1.894069693
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.001085098	30.73	3.19	4.43	3/29/04	16:00	3:55:15	3:38:30	1.980109425
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.001150804	32.59	3.38	4.62	3/29/04	16:16	4:11:15	3:52:30	2.046338193
0	76	1084	0	536	14.070	0	0.00	0.001150804	32.59	3.38	4.62	3/29/04	16:33	4:28:15	4:09:30	2.114434519
7	75	1085	0.0002	535	14.083	0.000230165	6.52	0.001380989	39.11	4.05	5.30	3/29/04	19:29	7:24:15	7:05:30	2.721059843
6	73	1085	0.0002	533	14.083	0.000196042	5.61	0.001579031	44.71	4.63	5.88	3/29/04	22:34	10:29:15	10:10:30	3.238440983
10	73	1087	0.0004	533	14.109	0.000330676	9.36	0.001909709	54.08	5.81	8.65	3/30/04	7:15	19:10:15	18:51:30	4.37845102
8	70	1088	0.0003	530	14.122	0.000266285	7.54	0.002175994	61.62	6.39	7.63	3/30/04	20:07	32:02:15	31:43:30	5.660167842
14	75	1088	0.0005	535	14.122	0.000461643	13.07	0.002637637	74.69	7.74	8.99	3/31/04	14:17	50:12:15	49:53:30	7.085489868
11	80	1084	0.0004	540	14.070	0.00035804	10.14	0.002995677	84.83	8.79	10.04	4/1/04	9:49	69:44:15	69:25:30	8.350898155
9	80	1089	0.0003	540	14.135	0.000294293	8.33	0.00328997	93.16	9.66	10.90	4/2/04	11:18	95:13:15	94:54:30	9.75811628
6	80	1088	0.0002	540	14.122	0.000196015	5.55	0.003485985	98.71	10.23	11.48	4/3/04	17:53	125:48:15	125:29:30	11.21624566
4	80	1087	0.0001	540	14.109	0.000130557	3.70	0.003616542	102.41	10.62	11.86	4/4/04	15:26	147:21:15	147:02:30	12.13895245
5	80	1082	0.0002	540	14.044	0.000162445	4.60	0.003778987	107.01	11.09	12.34	4/5/04	21:14	177:09:15	176:50:30	13.30992737
3	79	1080	0.0001	539	14.016	9.74674E-05	2.76	0.003876454	109.77	11.38	12.82	4/6/04	14:24	194:19:15	194:00:30	13.93990076
3	80	1076	0.0001	540	13.966	9.69266E-05	2.74	0.003973381	112.51	11.66	12.91	4/7/04	14:01	217:56:15	217:37:30	14.78270639
2	78	1082	7E-05	538	14.044	6.52196E-05	1.85	0.004038601	114.38	11.85	13.10	4/8/04	14:11	242:06:15	241:47:30	15.55969687
3	77	1081	0.0001	537	14.031	9.7921E-05	2.77	0.004136522	117.13	12.14	13.39	4/9/04	16:41	268:36:15	268:17:30	16.38914783
2	75	1087	7E-05	535	14.109	6.56864E-05	1.87	0.00420241	119.00	12.34	13.58	4/10/04	16:27	292:22:15	292:03:30	17.09885474
-1	75	1086	-4E-05	535	14.096	-3.29139E-05	-0.93	0.004169496	118.07	12.24	13.48	4/12/04	14:42	338:37:15	338:18:30	18.40165301
-1	73	1086	-4E-05	533	14.096	-3.30374E-05	-0.94	0.004138459	117.13	12.14	13.39	4/13/04	14:07	362:02:15	361:43:30	19.02728304
0	73	1085	0	533	14.083	0	0.00	0.004136459	117.13	12.14	13.39	4/14/04	14:04	385:59:15	385:40:30	19.64658459

DESORPTION TERMINATED 4/14/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 21 days

SAMPLE: 932' to 933' (Tebo coal) cuttings in canister W3

	lbs.	grams
dry sample weight:	0.7070	320.69

est. lost gas (cc) = 18

TIME OF: off bottom 3/29/04 15:20; at surface 3/29/04 15:30; in canister 3/29/04 15:30

elapsed time (off bottom to canistering): 9.5 minutes; 0.158 hours; 0.397911213 SQRT (hrs)

RIG/LAB MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi) cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON without lost gas	SCF/TON with lost gas	TIME OF MEASURE	TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
15	75	1084	0.0005	535	14.070	0.000492799	13.95	0.000492799	13.95	1.39	3.19	3/29/04 16:38	1:18:00	1:08:30	1.140175425
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.000558506	15.82	1.58	3.38	3/29/04 16:41	1:21:00	1:11:30	1.161895004
1	75	1084	4E-05	535	14.070	3.28533E-05	0.93	0.000591359	16.75	1.67	3.47	3/29/04 16:44	1:24:00	1:14:30	1.183215957
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.000657066	18.61	1.86	3.66	3/29/04 16:52	1:31:30	1:22:00	1.234908903
2.5	75	1084	9E-05	535	14.070	8.21332E-05	2.33	0.000739199	20.93	2.09	3.89	3/29/04 17:00	1:39:30	1:30:00	1.287762918
2.5	75	1084	9E-05	535	14.070	8.21332E-05	2.33	0.000821332	23.26	2.32	4.12	3/29/04 17:13	1:52:30	1:43:00	1.369306394
2.5	75	1084	9E-05	535	14.070	8.21332E-05	2.33	0.000903465	25.58	2.56	4.35	3/29/04 17:27	2:06:30	1:57:00	1.452010101
2.5	75	1084	9E-05	535	14.070	8.21332E-05	2.33	0.000985598	27.91	2.79	4.59	3/29/04 17:42	2:21:30	2:12:00	1.5356866
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.001051305	29.77	2.97	4.77	3/29/04 18:00	2:39:30	2:30:00	1.630439613
3	75	1084	0.0001	535	14.070	9.85598E-05	2.79	0.001149865	32.56	3.25	5.05	3/29/04 18:25	3:05:00	2:55:30	1.755942292
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.001215571	34.42	3.44	5.24	3/29/04 18:45	3:24:30	3:15:00	1.848167201
2	75	1084	7E-05	535	14.070	6.57066E-05	1.86	0.001281278	36.28	3.62	5.42	3/29/04 19:18	3:57:30	3:48:00	1.989556064
9	73	1085	0.0003	533	14.083	0.000297063	8.41	0.001578341	44.69	4.46	6.26	3/29/04 22:37	7:16:30	7:07:00	2.697220792
8	73	1087	0.0003	533	14.109	0.000264543	7.49	0.001842883	52.18	5.21	7.01	3/30/04 7:17	15:56:30	15:47:00	3.992701675
9	70	1088	0.0003	530	14.122	0.00029957	8.48	0.002142453	60.67	6.06	7.86	3/30/04 20:08	28:47:30	28:38:00	5.365786677
15	75	1088	0.0005	535	14.122	0.000494618	14.01	0.002637071	74.67	7.46	9.26	3/31/04 14:18	46:57:30	46:48:00	6.852615073
11	80	1084	0.0004	540	14.070	0.00035804	10.14	0.002995111	84.81	8.47	10.27	4/1/04 9:51	66:30:30	66:21:00	8.155284149
7	80	1089	0.0002	540	14.135	0.000228895	6.48	0.003224005	91.29	9.12	10.92	4/2/04 11:18	91:57:30	91:48:00	9.589490775
6	80	1088	0.0002	540	14.122	0.000196015	5.55	0.003420021	96.84	9.67	11.47	4/3/04 17:10	121:49:30	121:40:00	11.0374363
4	80	1087	0.0001	540	14.109	0.000130557	3.70	0.003550577	100.54	10.04	11.84	4/4/04 15:27	144:06:30	143:57:00	12.00451304
4	80	1088	0.0001	540	14.122	0.000130677	3.70	0.003681254	104.24	10.41	12.21	4/5/04 21:16	173:55:30	173:46:00	13.18806278
2	79	1082	7E-05	539	14.044	6.50986E-05	1.84	0.003746353	106.08	10.60	12.40	4/6/04 14:25	191:04:30	190:55:00	13.8229881
3	80	1076	0.0001	540	13.966	9.69266E-05	2.74	0.003843279	108.83	10.87	12.67	4/7/04 14:02	214:41:30	214:32:00	14.65236045
0	78	1082	0	538	14.044	0	0.00	0.003843279	108.83	10.87	12.67	4/8/04 14:11	238:50:30	238:41:00	15.45450312
1	77	1081	4E-05	537	14.031	3.26403E-05	0.92	0.00387592	109.75	10.96	12.76	4/9/04 16:42	265:21:30	265:12:00	16.289823
0	75	1087	0	535	14.109	0	0.00	0.00387592	109.75	10.96	12.76	4/10/04 16:27	289:06:30	288:57:00	17.00318598
-3	75	1086	-0.0001	535	14.096	-9.87417E-05	-2.80	0.003777178	106.96	10.69	12.48	4/12/04 14:43	335:22:30	335:13:00	18.31324657
-2	73	1088	-7E-05	533	14.122	-6.61965E-05	-1.87	0.003710981	105.08	10.50	12.30	4/13/04 14:07	358:46:30	358:37:00	18.94135687
0	75	1085	0	535	14.083	0	0.00	0.003710981	105.08	10.50	12.30	4/14/04 14:04	382:43:30	382:34:00	19.56335861

DESORPTION TERMINATED 4/14/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 14 days

SAMPLE: 1128' to 1130' (Riverton coal) cuttings in canister W4

	lbs.	grams
dry sample weight:	0.8657	401.77

est. lost gas (cc) = 20

TIME OF: off bottom 3/30/04 6:49; at surface 3/30/04 7:01; in canister 3/30/04 7:07

elapsed time (off bottom to canistering): 17.8 minutes; 0.298 hours; 0.543905629 SQRT (hrs)

RIG/LAB MEASUREMENTS measured cc	measured T (F)	measured P	CONVERSION OF RIG/LAB MEASUREMENTS TO STP (@60 deg F; 14.7 psi) cubic ft	absolute T (R)	psia	cubic ft (@STP)	cc (@STP)	CUMULATIVE VOLUMES cubic ft (@STP)	cc (@STP)	SCF/TON without lost gas	SCF/TON with lost gas	TIME OF MEASURE	TIME SINCE off bottom	in canister	SQRT hrs. (since off bottom)
5	73	1087	0.0002	533	14.109	0.000165339	4.68	0.000165339	4.68	0.37	1.97	3/30/04 7:19	0:29:45	0:12:00	0.704154339
2	73	1087	7E-05	533	14.109	6.61356E-05	1.87	0.000231475	6.55	0.52	2.12	3/30/04 7:21	0:32:00	0:14:15	0.730296743
2	73	1087	7E-05	533	14.109	6.61356E-05	1.87	0.00029761	8.43	0.67	2.27	3/30/04 7:26	0:37:00	0:19:15	0.785281266
1	73	1087	4E-05	533	14.109	3.30678E-05	0.94	0.000330678	9.36	0.75	2.34	3/30/04 7:30	0:40:15	0:22:30	0.819044158
2	73	1087	7E-05	533	14.109	6.61356E-05	1.87	0.000396814	11.24	0.90	2.49	3/30/04 7:38	0:48:30	0:28:45	0.880340843
2	73	1087	7E-05	533	14.109	6.61356E-05	1.87	0.000462949	13.11	1.05	2.64	3/30/04 7:42	0:52:15	0:34:30	0.933184512
6	73	1087	0.0002	533	14.109	0.000198407	5.62	0.000661356	18.73	1.49	3.09	3/30/04 8:02	1:12:15	0:54:30	1.097345281
7	73	1087	0.0002	533	14.109	0.000231475	6.55	0.000892831	25.28	2.02	3.61	3/30/04 8:30	1:40:15	1:22:30	1.292607184
9	73	1087	0.0003	533	14.109	0.00029761	8.43	0.001190441	33.71	2.69	4.28	3/30/04 9:29	2:39:15	2:21:30	1.629181338
4	73	1087	0.0001	533	14.109	0.000132271	3.75	0.001322713	37.45	2.99	4.58	3/30/04 10:04	3:14:15	2:56:30	1.799305422
24	70	1088	0.0008	530	14.122	0.000798854	22.62	0.002121567	60.08	4.79	6.39	3/30/04 20:08	13:18:15	13:00:30	3.64748772
35	75	1088	0.0012	535	14.122	0.001154108	32.68	0.003275675	92.76	7.40	8.99	3/31/04 14:18	31:28:15	31:10:30	5.609887105
21	80	1084	0.0007	540	14.070	0.000683531	19.36	0.003959205	112.11	8.94	10.53	4/1/04 9:51	51:01:15	50:43:30	7.142886905
14	80	1089	0.0005	540	14.135	0.000457789	12.96	0.004416994	125.07	9.97	11.57	4/2/04 11:19	76:29:15	76:11:30	8.745713236
10	80	1088	0.0004	540	14.122	0.000326692	9.25	0.004743686	134.33	10.71	12.31	4/3/04 17:10	106:20:15	106:02:30	10.31200756
6	80	1087	0.0002	540	14.109	0.000195835	5.55	0.004939521	139.87	11.15	12.75	4/4/04 15:28	128:38:15	128:20:30	11.34184729
6	80	1082	0.0002	540	14.044	0.000194934	5.52	0.005134455	145.39	11.59	13.19	4/5/04 21:17	158:27:15	158:09:30	12.58785791
3	79	1080	0.0001	539	14.018	9.74674E-05	2.76	0.005231923	148.15	11.81	13.41	4/6/04 14:25	175:35:15	175:17:30	13.25094338
4	80	1076	0.0001	540	13.966	0.000129235	3.66	0.005361158	151.81	12.11	13.70	4/7/04 14:02	199:12:15	198:54:30	14.11397062
2	78	1082	7E-05	538	14.044	6.52196E-05	1.85	0.005426378	153.66	12.25	13.85	4/8/04 14:11	223:21:15	223:03:30	14.9450382

2	77	1081	7E-05	537	14.031	6.52607E-05	1.85	0.005491656	155.51	12.40	13.99	4/9/04	16:42	249:52:15	249:34:30	15.80730316
0	75	1087	0	535	14.109	0	0.00	0.005491658	155.51	12.40	13.99	4/10/04	16:28	273:38:15	273:20:30	16.54199202
-1	75	1086	-4E-05	535	14.096	-3.29139E-05	-0.93	0.005456745	154.57	12.33	13.92	4/12/04	14:43	319:53:15	319:35:30	17.88539907
1	75	1085	4E-05	535	14.083	3.28836E-05	0.93	0.005491628	155.51	12.40	13.99	4/13/04	14:25	343:35:15	343:17:30	18.5381134
2	74	1076	7E-05	534	13.966	6.53436E-05	1.85	0.005556972	157.36	12.55	14.14	4/14/04	14:25	367:35:15	367:17:30	19.17257155
2	74	1078	7E-05	534	13.992	6.54652E-05	1.85	0.005622437	159.21	12.70	14.29	4/16/04	13:52	415:02:15	414:44:30	20.37246917
-1	70	1079	-4E-05	530	14.005	-3.30102E-05	-0.93	0.005589427	158.27	12.62	14.22	4/17/04	19:29	444:39:15	444:21:30	21.08682448
-1	68	1088	-4E-05	526	14.122	-3.34117E-05	-0.95	0.005556015	157.33	12.55	14.14	4/18/04	14:52	464:02:15	463:44:30	21.54152966
-2	69	1071	-7E-05	529	13.901	-6.56549E-05	-1.86	0.00549036	155.47	12.40	13.99	4/19/04	14:00	487:10:15	486:52:30	22.07194675

DESORPTION TERMINATED 4/22/2004 DUE TO NO MORE GAS BEING EVOLVED; sampled air dried for 14 days

417' to 420' (Hushpuckney Shale) cuttings in canister ST1

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

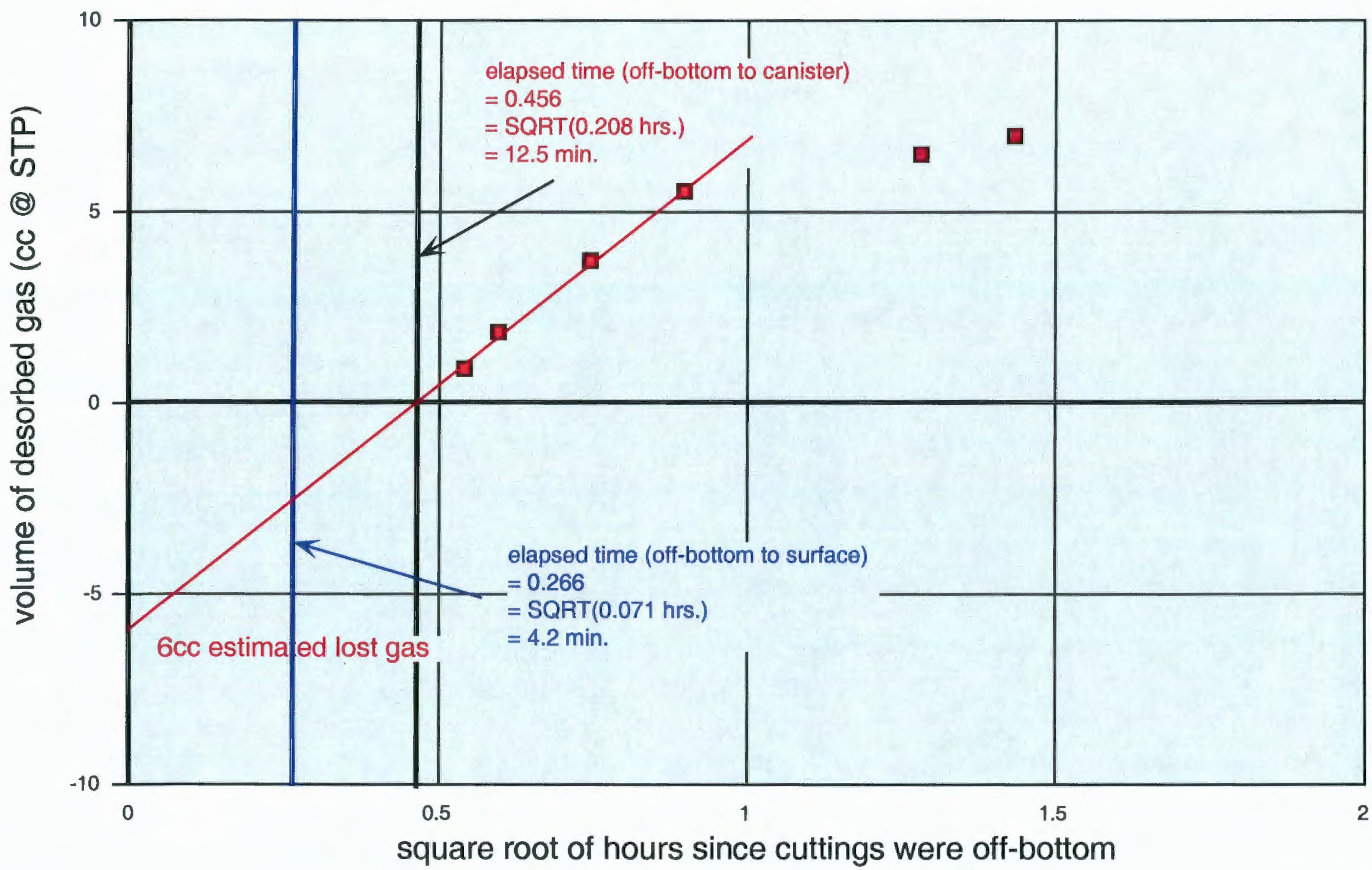


FIGURE 1.

760' to 761.5' (Mulky coal) cuttings in canister ST4

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

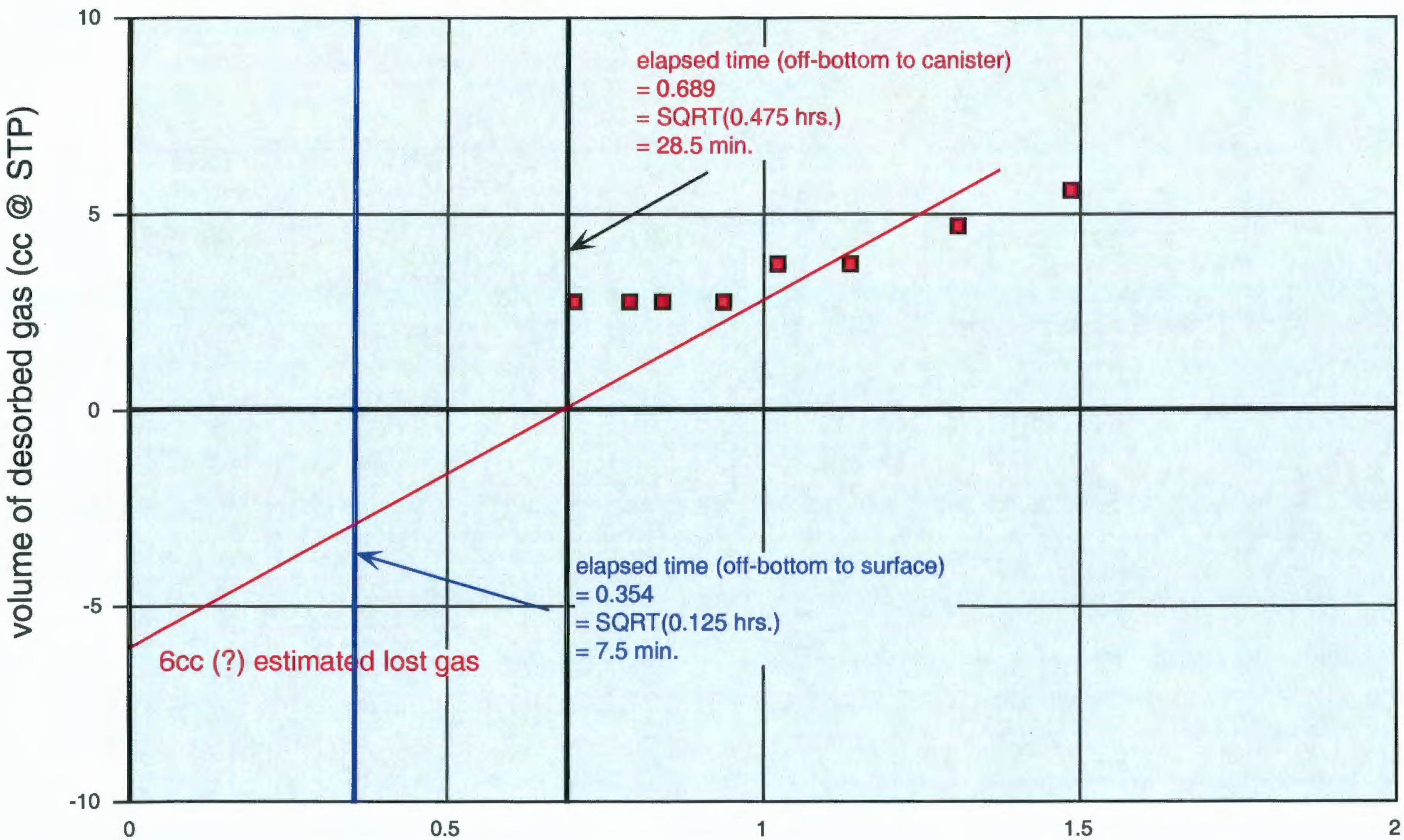


FIGURE 2.

845.3' to 846.2' (Bevier coal) cuttings in canister W1

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

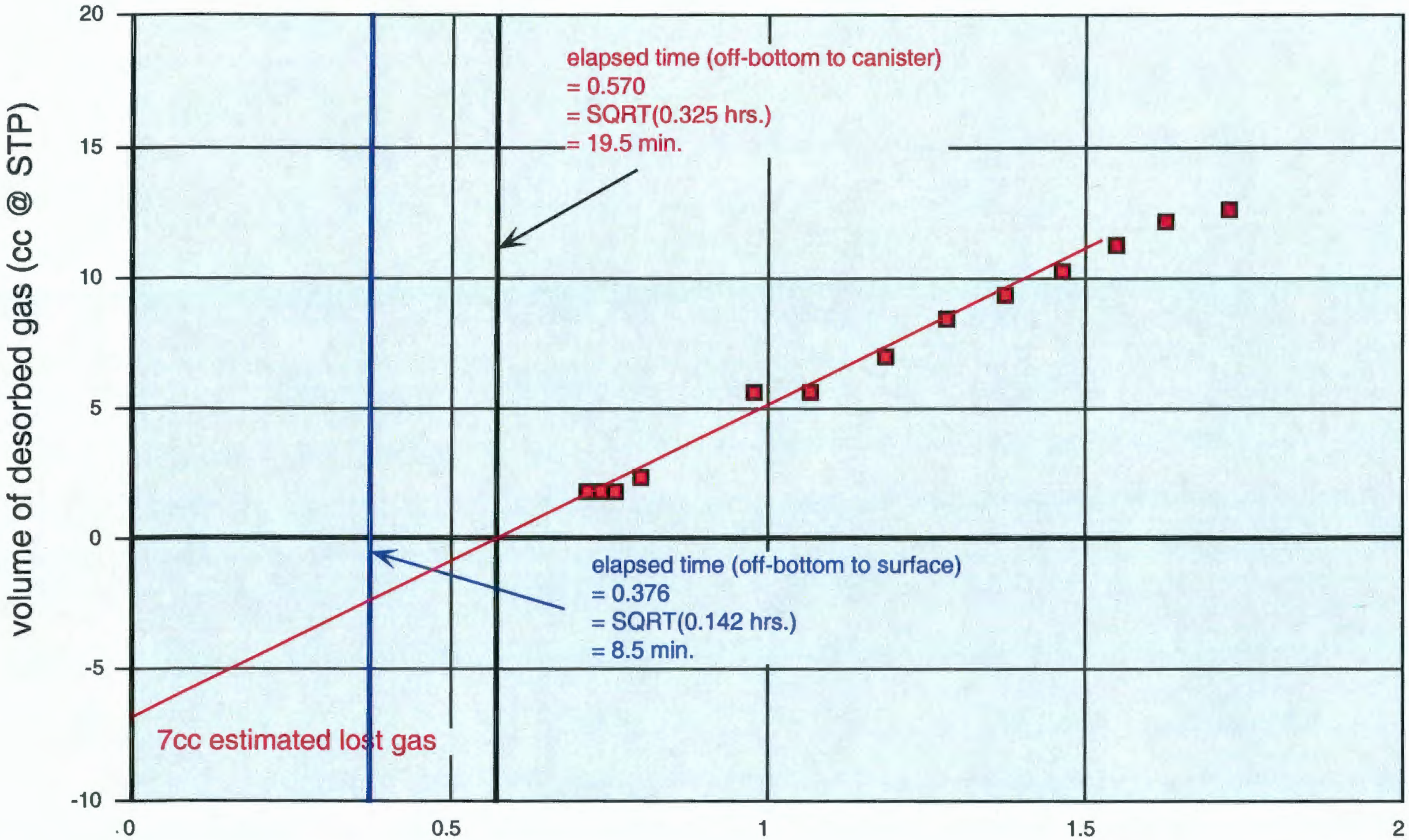


FIGURE 3.

860.5' to 861.3' (V-shale/Croweburg coal) cuttings in canister W2

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

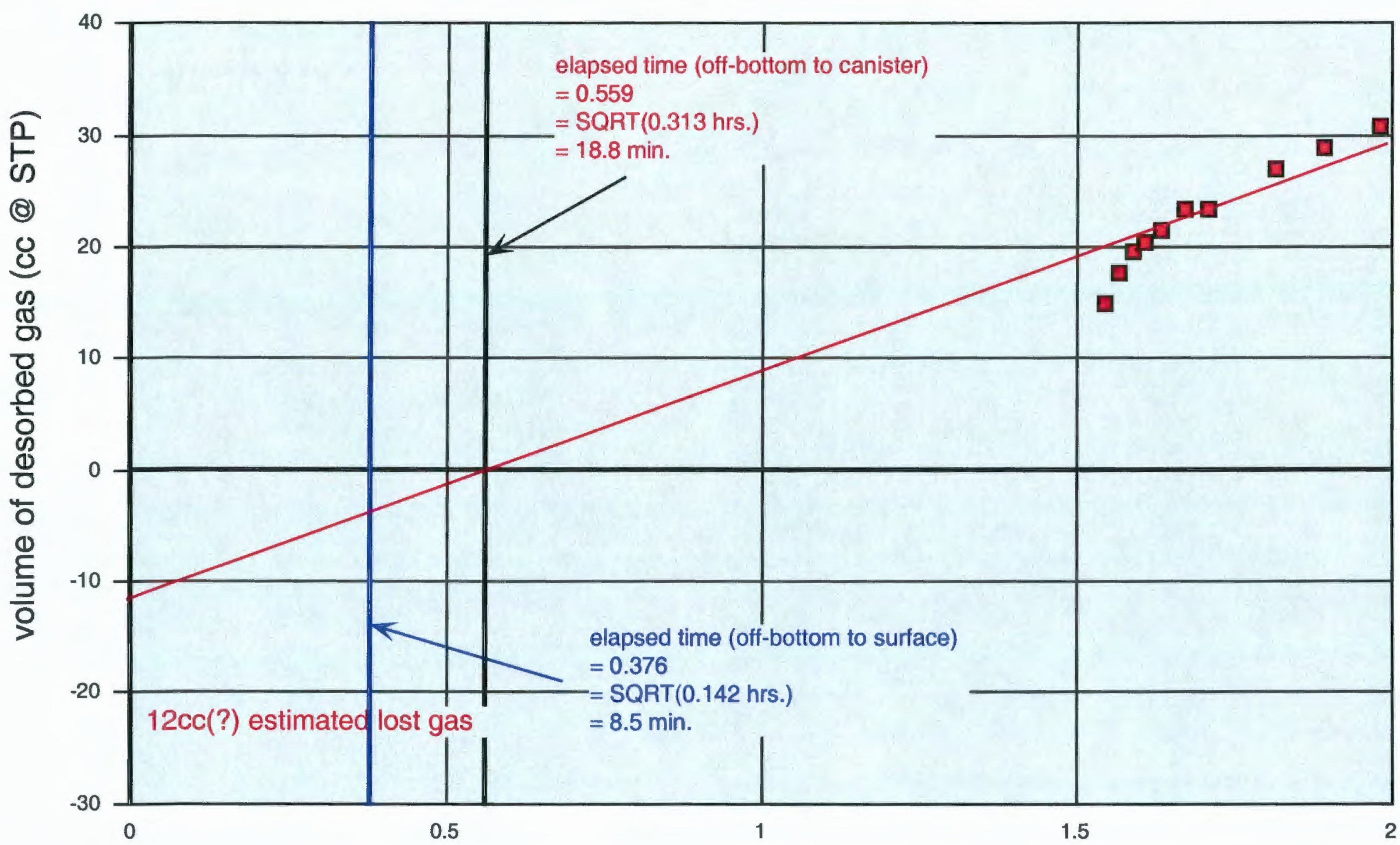
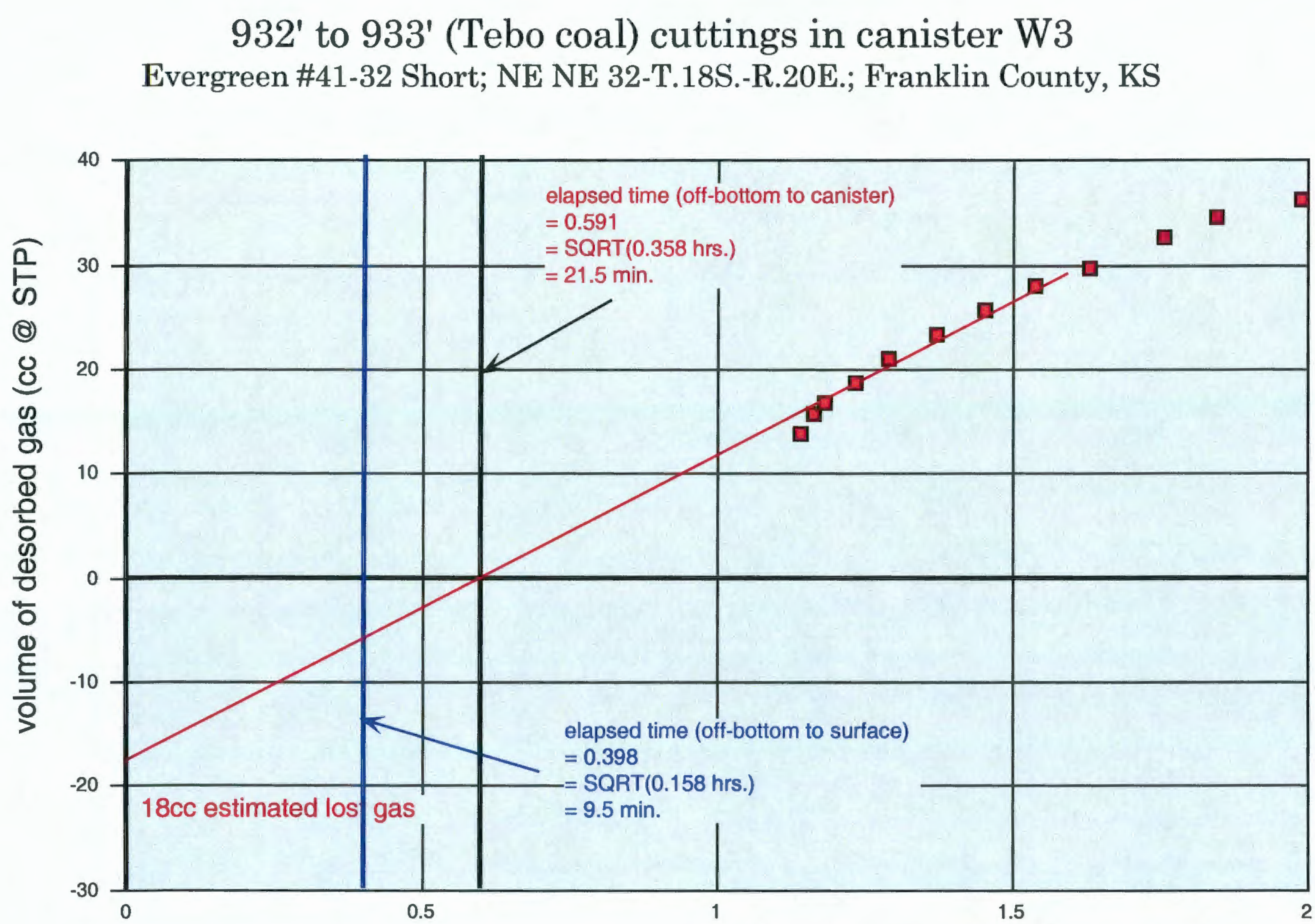


FIGURE 4.



932' to 933' (Tebo coal) cuttings in canister W3
Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS
volume of desorbed gas (cc @ STP)
40
30
20
10
0
-10
-20
-30
0
0.5
1
1.5
2
elapsed time (off-bottom to canister)
= 0.591
= SQRT(0.358 hrs.)
= 21.5 min.
elapsed time (off-bottom to surface)
= 0.398
= SQRT(0.158 hrs.)
= 9.5 min.
18cc estimated lost gas

FIGURE 5.

1128' to 1130' (Riverton coal) cuttings in canister W4

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

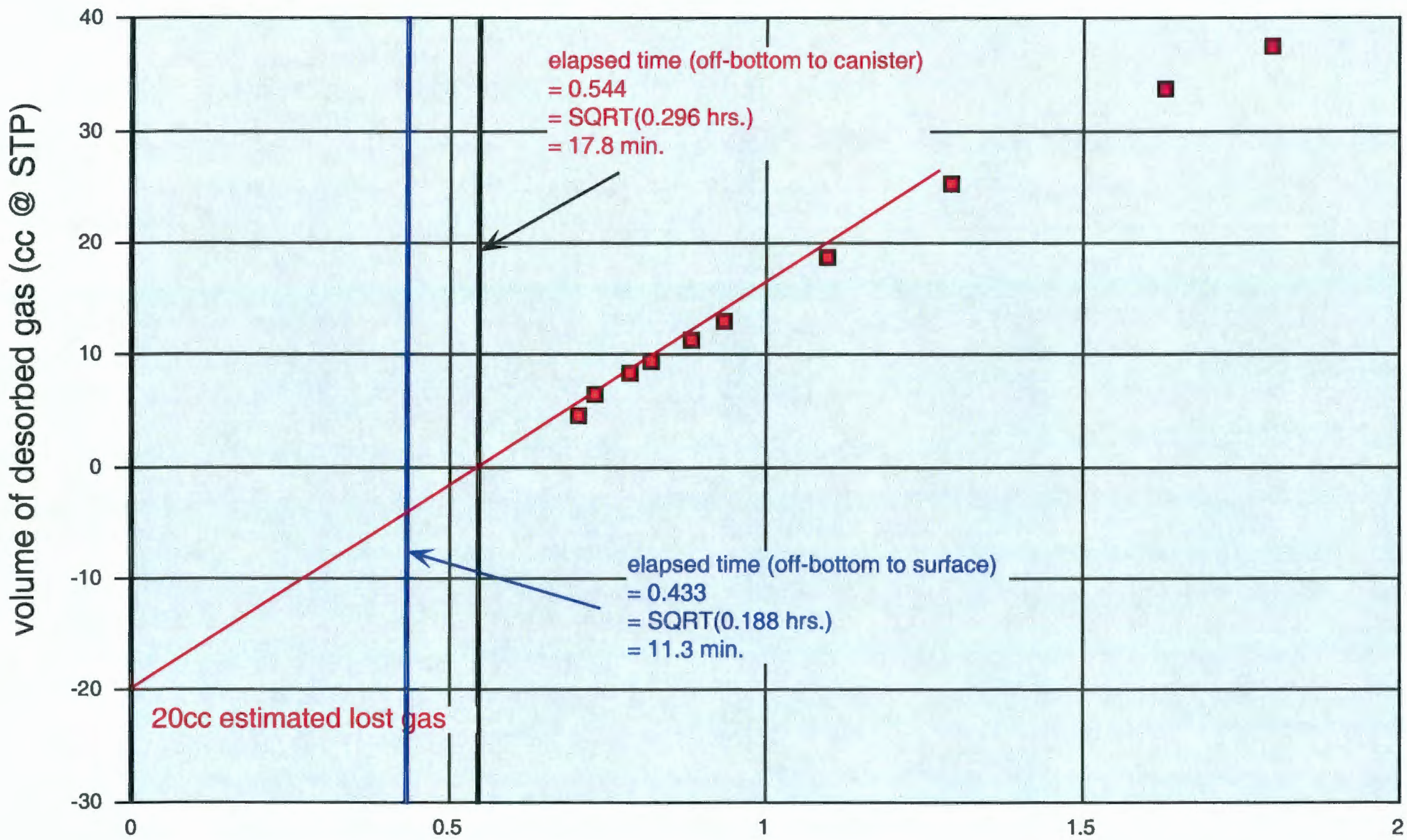


FIGURE 6.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

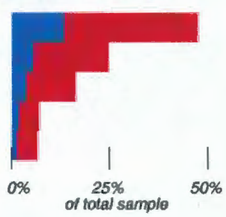
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Hushpuckney Shale from 417'-420'

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

total gas desorbed = 37.2 ccs

TOTAL DRY WEIGHT OF SAMPLE = 514.79 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 391.70 grams (76.1%)
$\text{weight}_{dark\ shale}$ = 123.09 grams (23.9%)
weight_{coal} = 0.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	241.33	0.00% / 27.71% / 72.29%
>0.0661"	124.90	0.00% / 20.98% / 79.02%
>0.0460"	81.80	0.00% / 21.26% / 78.74%
>0.0331"	34.32	0.00% / 22.94% / 77.06%
<0.0331"	32.44	0.00% / 14.63% / 85.37%
	514.79 TOTAL	



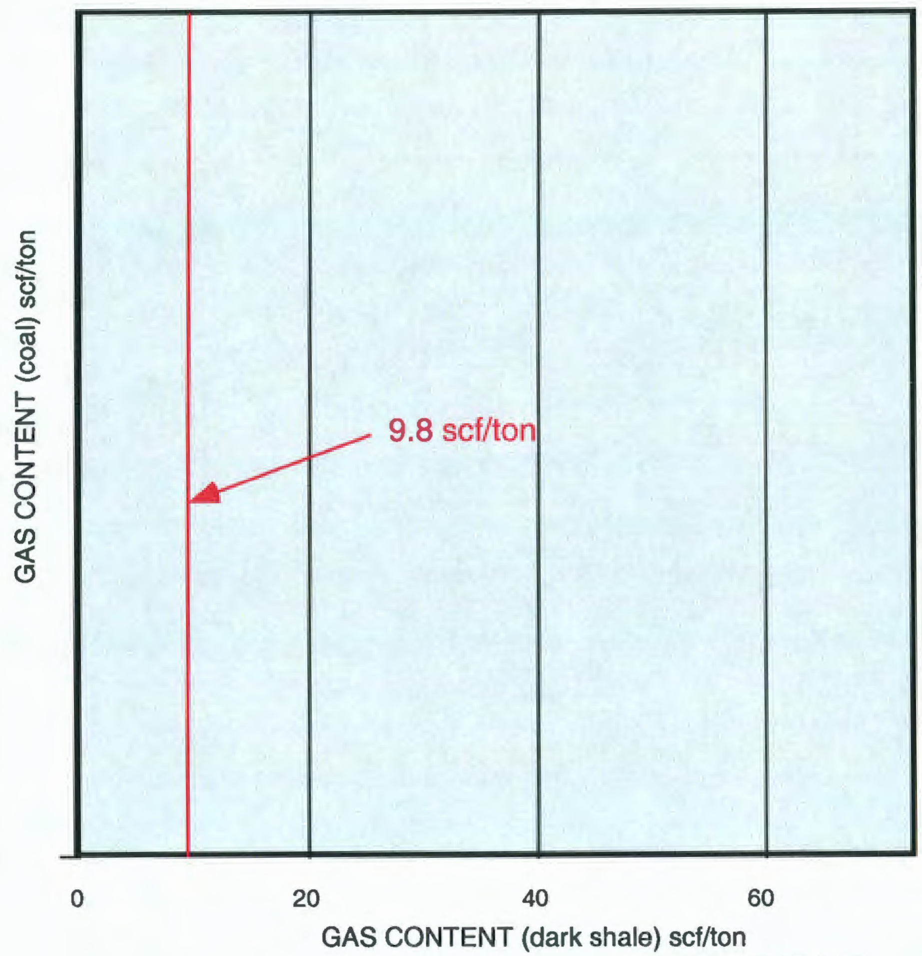


FIGURE 7.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

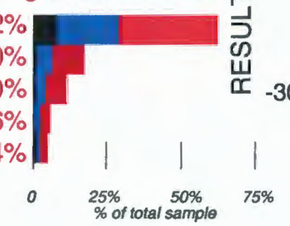
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Mulky coal from 760.0'-761.5'

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

total gas desorbed
(including estimated lost gas) = 24.7 ccs

TOTAL DRY WEIGHT OF SAMPLE = 391.22 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 223.36 grams (57.1%)
$\text{weight}_{dark\ shale}$ = 130.16 grams (33.3%)
weight_{coal} = 37.70 grams (9.6%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	240.54	12.42% / 33.96% / 53.62%
>0.0661"	66.37	3.95% / 32.06% / 64.00%
>0.0460"	43.42	3.66% / 32.33% / 64.10%
>0.0331"	22.31	4.29% / 35.36% / 60.36%
<0.0331"	18.58	14.29% / 28.57% / 57.14%
	391.22 TOTAL	



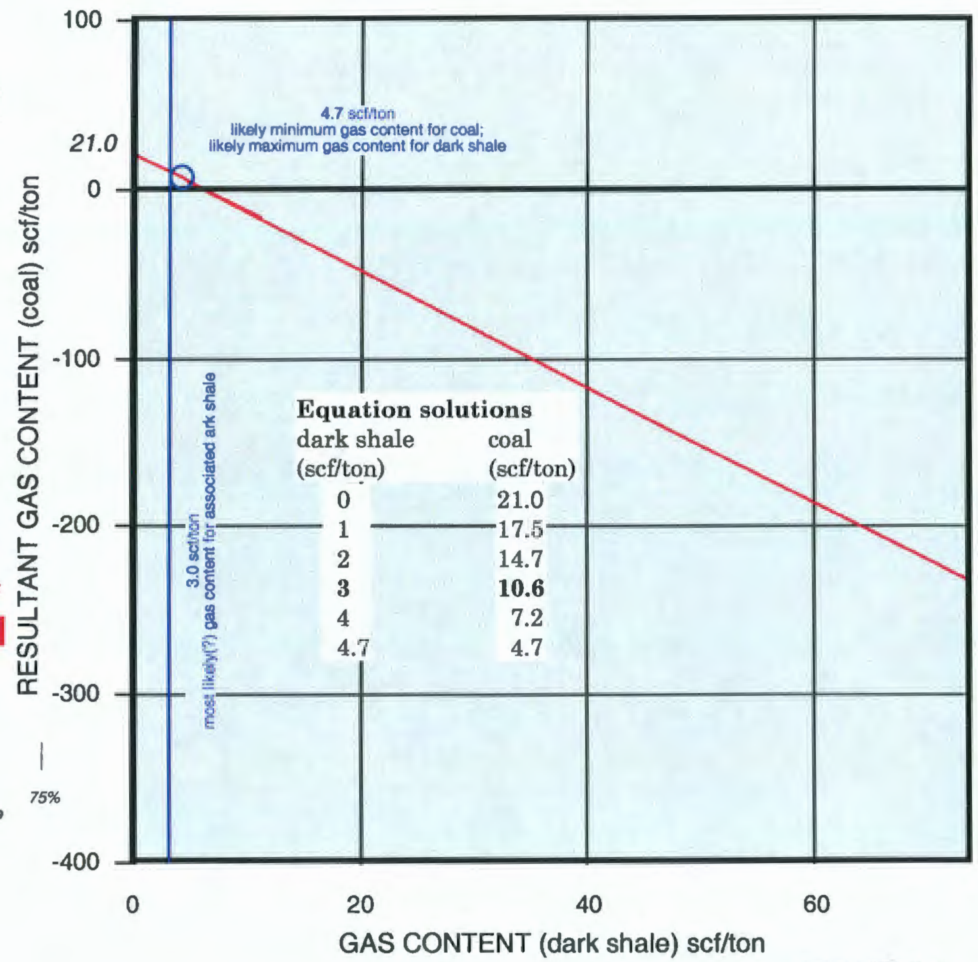


FIGURE 8.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

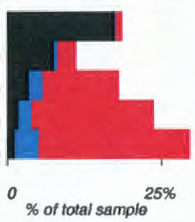
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Bevier coal from 845.3'-846.2'

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

total gas desorbed
(including estimated lost gas) = 46.6 ccs

TOTAL DRY WEIGHT OF SAMPLE = 318.18 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 191.20 grams (60.1%)
$\text{weight}_{dark\ shale}$ = 29.34 grams (9.2%)
weight_{coal} = 97.64 grams (30.7%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	58.44	93.44% / 1.31% / 5.25%
>0.0661"	34.91	67.04% / 5.97% / 26.99%
>0.0460"	56.98	18.67% / 12.86% / 68.46%
>0.0331"	74.66	7.34% / 9.17% / 83.49%
<0.0331"	93.19	3.77% / 13.21% / 83.02%
	318.18 TOTAL	



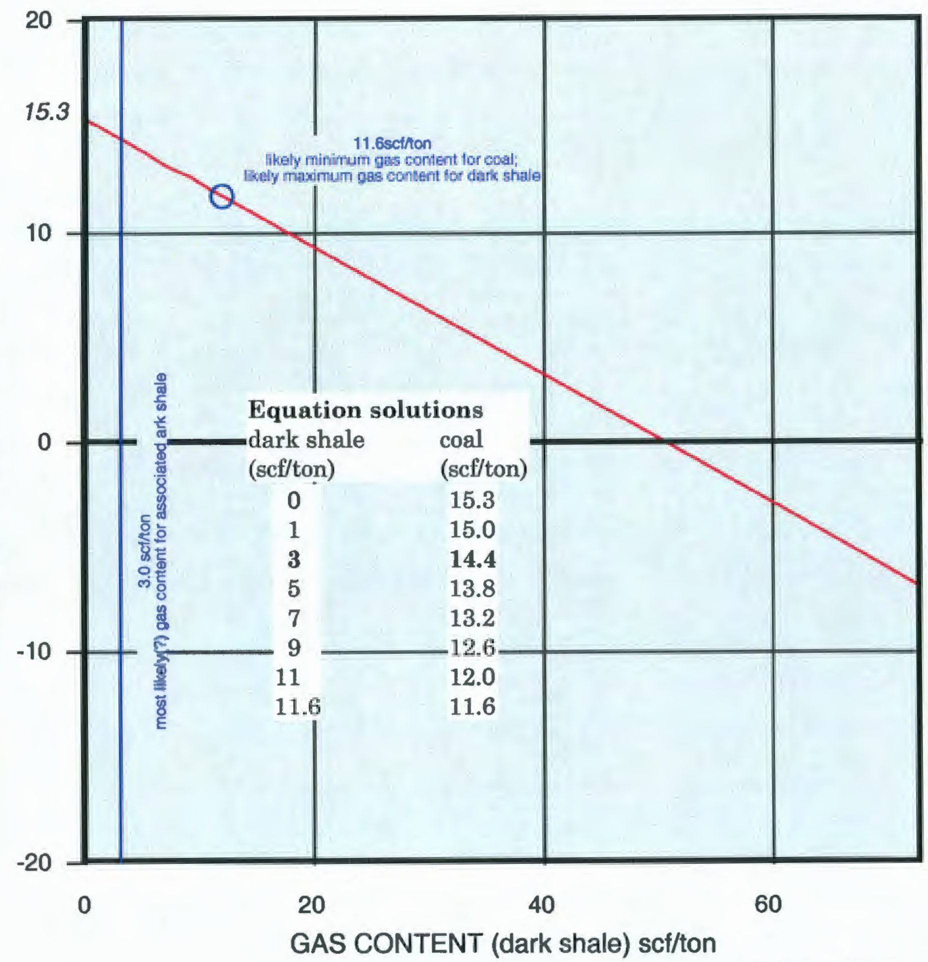


FIGURE 9.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

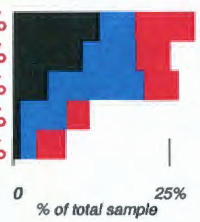
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Croweburg coal from 860.5'-861.3'

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

total gas desorbed
(including estimated lost gas) = 131.0 ccs

TOTAL DRY WEIGHT OF SAMPLE = 432.37 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 123.31 grams (28.5%)
$\text{weight}_{dark\ shale}$ = 171.67 grams (39.7%)
weight_{coal} = 137.39 grams (31.8%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	124.15	47.32% / 19.80% / 32.88%
>0.0661"	107.28	43.93% / 34.25% / 21.82%
>0.0460"	113.47	20.38% / 58.77% / 20.85%
>0.0331"	51.86	7.80% / 62.41% / 29.79%
<0.0331"	35.61	12.20% / 31.71% / 56.10%
	432.37 TOTAL	



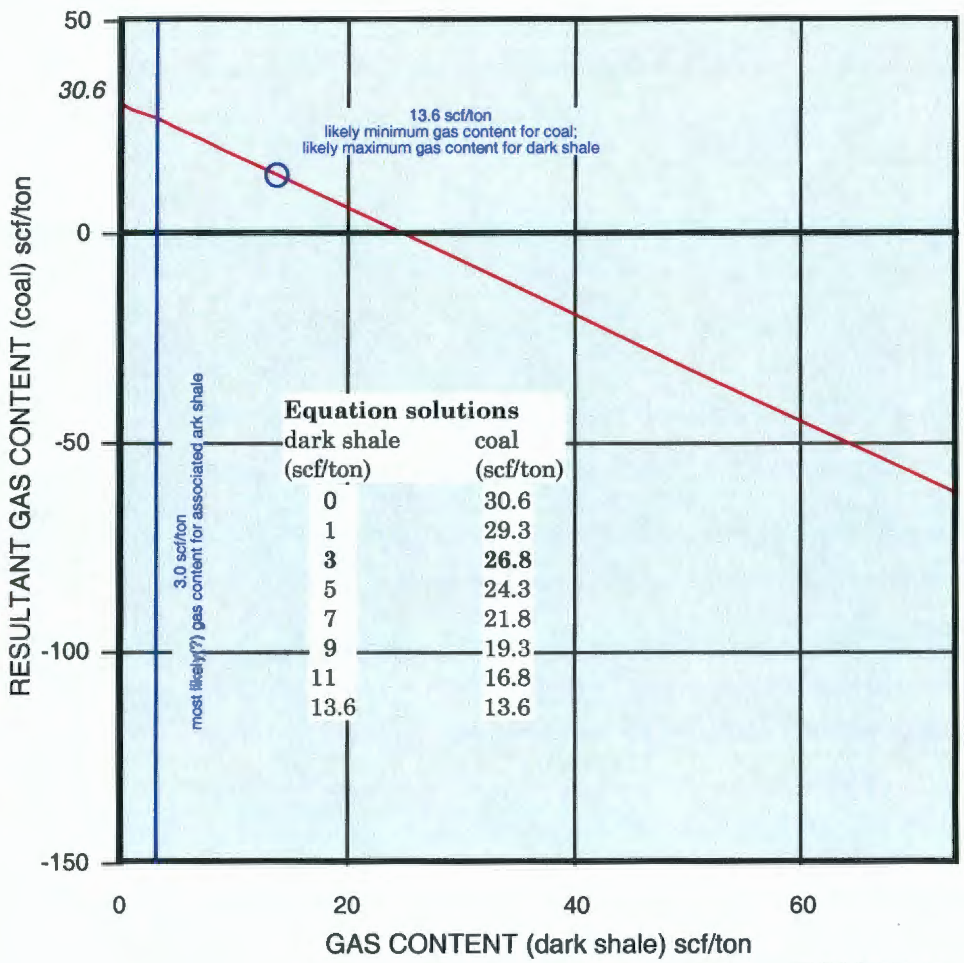


FIGURE 10.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

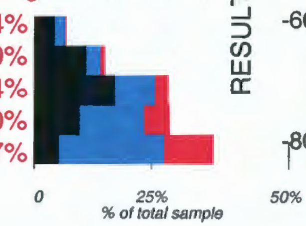
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Tebo coal from 932'-933'

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

total gas desorbed
(including estimated lost gas) = 127.8 ccs

TOTAL DRY WEIGHT OF SAMPLE = 385.90 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 65.21 grams (16.9%)
$\text{weight}_{dark\ shale}$ = 165.70 grams (42.9%)
weight_{coal} = 154.99 grams (40.2%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	21.87	62.03% / 34.04% / 2.84%
>0.0661"	49.25	73.27% / 20.44% / 6.29%
>0.0460"	94.07	60.11% / 30.05% / 9.84%
>0.0331"	94.98	33.07% / 48.03% / 18.90%
<0.0331"	125.73	13.64% / 59.09% / 27.27%
	385.90 TOTAL	



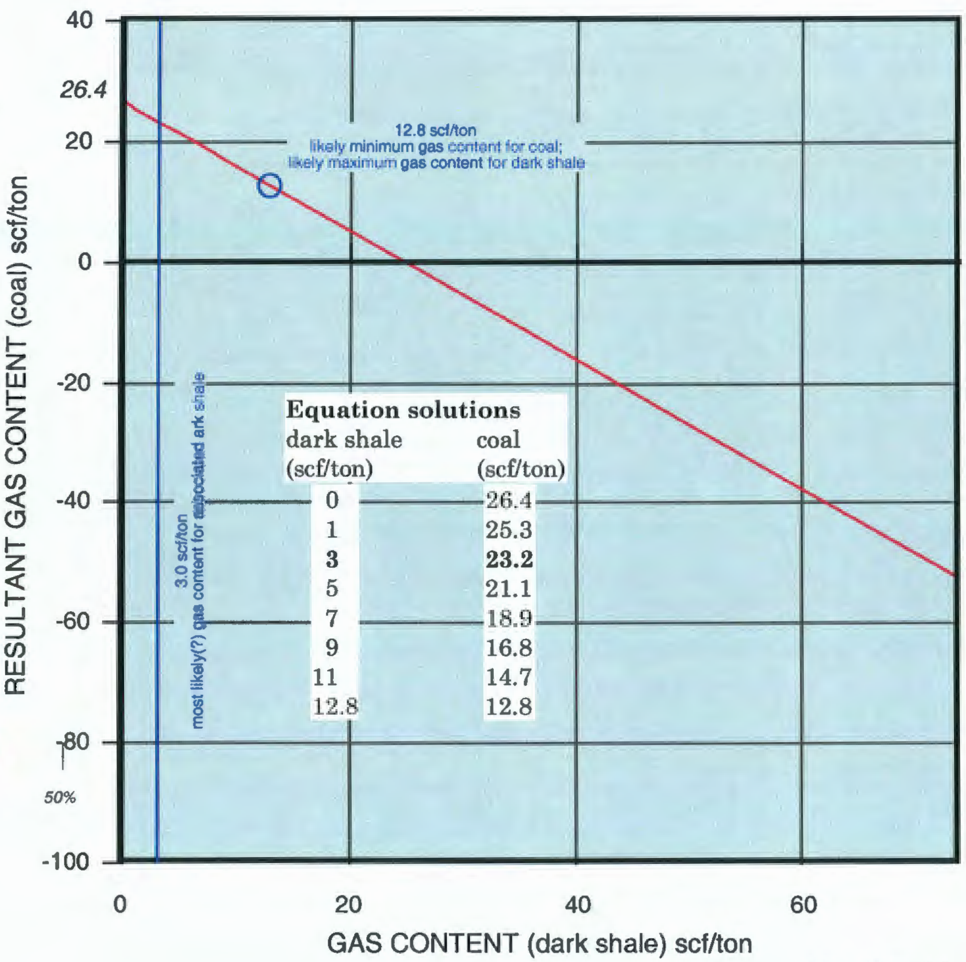


FIGURE 11.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

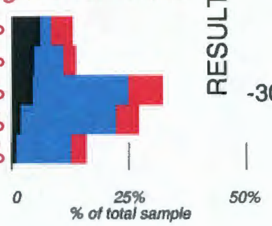
LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Riverton coal from 1128'-1130'

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

total gas desorbed
(including estimated lost gas) = 179.2 ccs

TOTAL DRY WEIGHT OF SAMPLE = 517.75 grams
$\text{weight}_{light\text{-}colored\ lithologies}$ = 115.98 grams (22.4%)
$\text{weight}_{dark\ shale}$ = 313.29 grams (60.5%)
weight_{coal} = 88.48 grams (17.1%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	65.64	46.03% / 18.22% / 35.75%
>0.0661"	69.17	34.00% / 46.44% / 19.56%
>0.0460"	164.71	13.52% / 63.35% / 23.13%
>0.0331"	137.72	6.40% / 75.86% / 17.73%
<0.0331"	80.52	4.55% / 75.00% / 20.45%
	517.75 TOTAL	



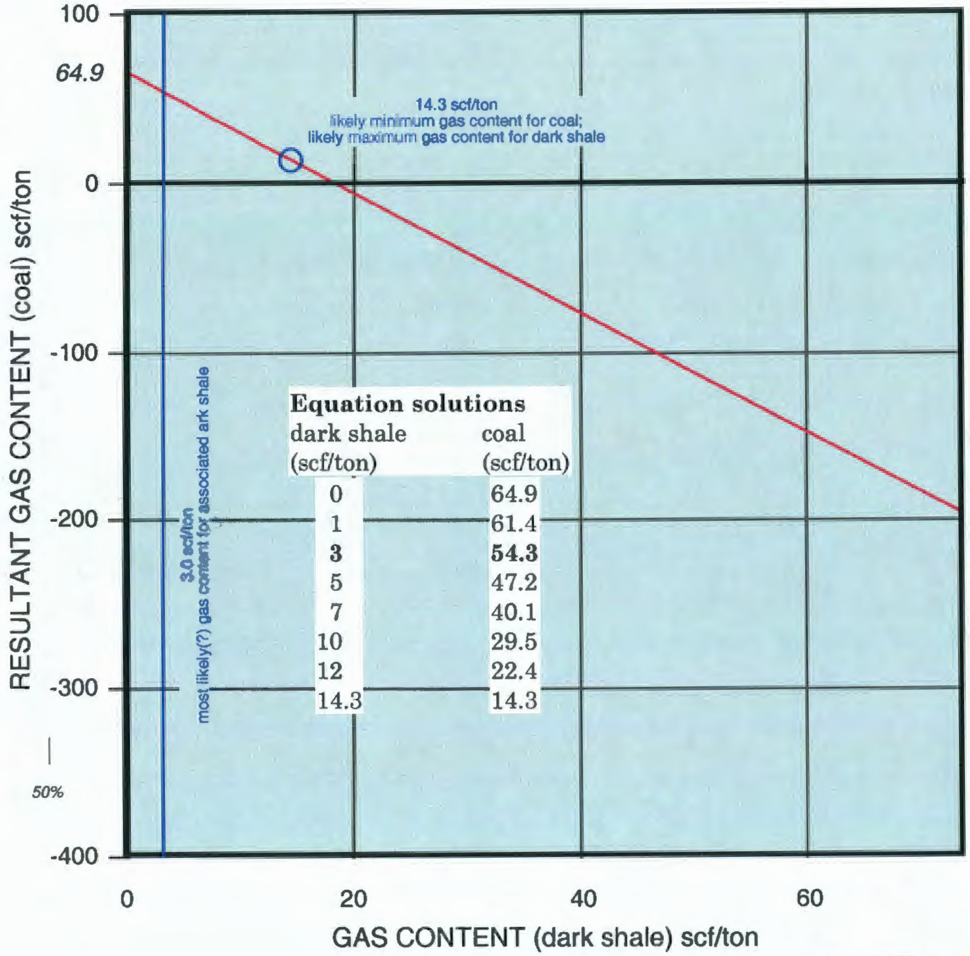


FIGURE 12.

Desorption Characteristics of Cuttings Samples

Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin 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
Hushpuckney Sh.	0%	----	----	9.8
Mulky	10%	10.6	21.0	4.7
Bevier	31%	14.4	15.3	11.6
Croweburg	32%	26.8	30.6	13.6
Tebo	40%	23.2	26.4	12.8
Riverton	17%	54.3	64.9	14.3

surface
100'
200'
300'
400'
417'-420' Hushpuckney Sh.
500'
600'
700'
760'-762' Mulky
800'
845'-846' Bevier
860-861' Croweburg
900'
932'-922' Tebo
1000'
1100'
1128'-1130' Riverton
1200'

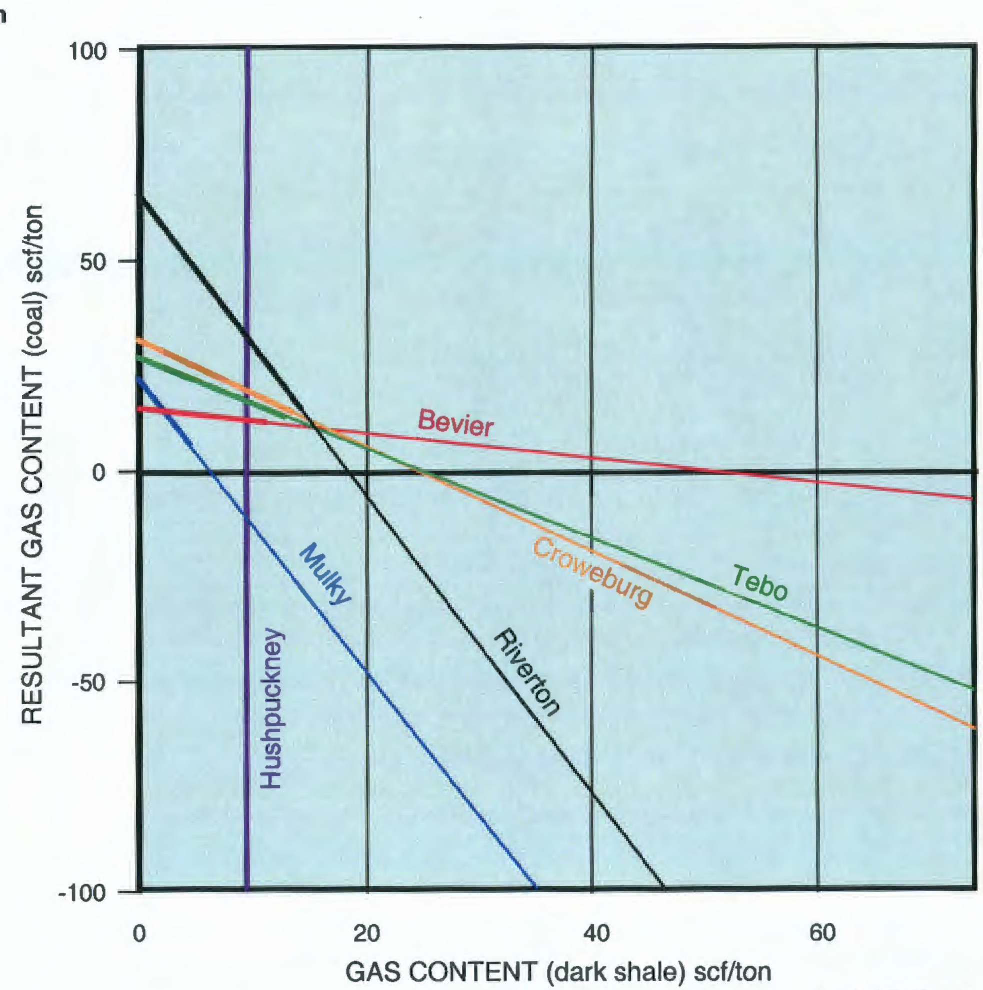


FIGURE 13.

Desorption Characteristics of Cuttings Samples

based on total weight of gas-generating lithologies (i.e., coal and dark shale) in sample
Evergreen #41-32 Short; NE NE 32-T.18S.-R.20E.; Franklin County, KS

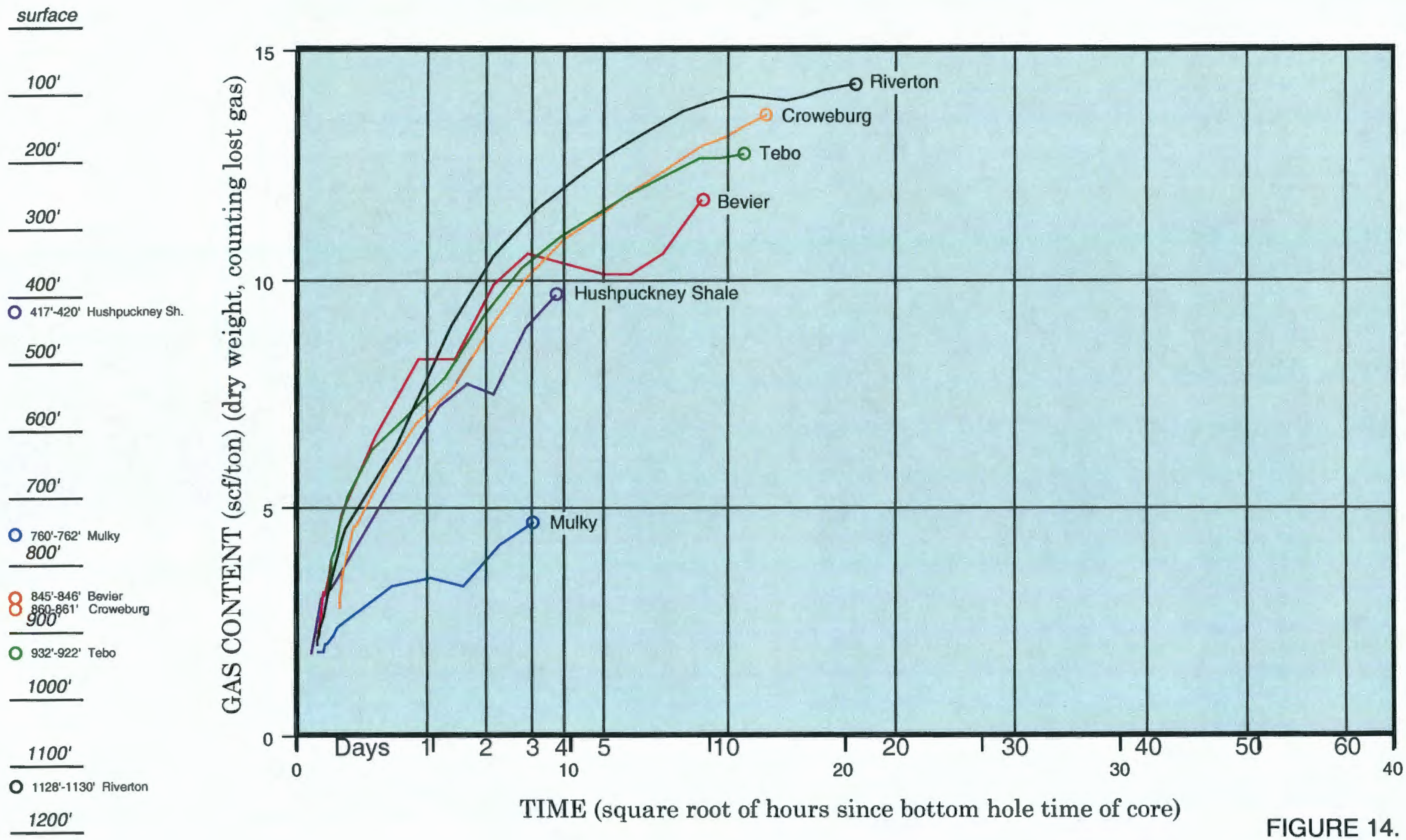


FIGURE 14.