ANALYSIS OF KANSAS CITY GROUP CUTTINGS SAMPLES FOR GAS CONTENT
-- MERITAGE KCM
#34-41 LANKARD WELL; NE NE sec. 34-T.19S.-R.19E.; ANDERSON COUNTY, KANSAS

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SUMMARY

Two cuttings samples from the Pennsylvanian Kansas City Group were collected from the Meritage KCM #34-41 Lankard well, NE NE sec. 34-T.19S.-R.19E., in Anderson County, KS. The samples calculate as having the following gas contents:

- Stark Shale at 386' to 391' depth (14.2 scf/ton)
- Hushpuckney Shale at 427' to 432' depth (19.2 scf/ton)

BACKGROUND

The Meritage KCM #34-41 Lankard well, NE NE sec. 34-T.19S.-R.19E., in Anderson 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 October 8, 2003 by K.D. Newell and T.A. Johnson of the Kansas Geological Survey with well site collection aided by Lawrence A. Weis (consultant for Meritage KCM). Samples were obtained during normal drilling of the well, with no cessation of drilling before zones of interest (i.e., shales in the Kansas City Group) were penetrated. The well was drilled using an air rotary rig owned by MOKAT Drilling.

Lag times for samples to reach the surface (important for assessing lost gas) were determined by periodically noting the time it took for cuttings to reach the surface following resumption of drilling after new pipe was added to the drill string.

Two cuttings samples from the Pennsylvanian Kansas City Group were collected

- Stark Shale at 386' to 391' depth (1534 grams dry wt.)
- Hushpuckney Shale at 427' to 432' depth (2243 grams dry wt.)

The cuttings were caught in kitchen strainers as they exited the air-stream pipe emptying to the mud pit. The samples were then washed in water while in the kitchen strainers to rid them of as much drilling mud as possible before the cuttings were placed in desorption canisters.

Temperature baths for the desorption canisters were on site, with temperature kept at 70 °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 the same temperature. Desorption measurements were periodically made until the canisters produced negligible gas with daily testing for at least two successive days.

DESORPTION MEASUREMENTS

The equipment and method for measuring desorption gas is that prescribed by McLennan and others (1995). The volumetric displacement apparatus is a set of connected dispensing burettes, one of which measures the gas evolved from the desorption canister.

The other burette compensates for the compression that occurs when the desorbed gas displaces the water in the measuring burette. This compensation is performed by adjusting the cylinders so that their water levels are identical, then figuring the amount of gas that evolved by reading the difference in water level using the volumetric scale on the side of the burette.

The desorption canisters used were commercial canisters from SSD, Inc. in Grand Junction, CO were also used. These canisters are 12.5 inches high (32 cm), 3 1/2 inches (9 cm) in diameter, and enclose a volume of approximately 150 cubic inches (2450 cm^3).

The desorbed gas that collected in the desorption canisters was periodically released into the volumetric displacement apparatus and measured as a function of time, temperature and atmospheric pressure.

The time and atmospheric pressure were measured in the field using a portable weather station (model BA928) marketed by Oregon Scientific (Tualatin, OR). The atmospheric pressure was displayed in millibars on this instrument, however, this measurement was not the actual barometric pressure, but rather an altitude-compensated barometric pressure automatically converted to a sea-level-equivalent pressure. In order to translate this measurement to actual atmospheric pressure, a regression correlation was determined over several weeks by comparing readings from the Oregon Scientific instrument to that from a pressure transducer in the Petrophysics Laboratory in the Kansas Geological Survey in Lawrence, Kansas (Figure 1). The regression equation shown graphically in Figure 1 was entered into a spreadsheet and was used to automatically convert the millibar measurement to barometric pressure in pounds per square inch (psi).

A spreadsheet program written by K.D. Newell (Kansas Geological Survey) was used to convert all gas volumes at standard temperature and pressure. Conversion of gas volumes to standard temperature and pressure was by application of the perfect-gas equation, obtainable from basic college chemistry texts:

$$n = PV/RT$$

where n is moles of gas, T is degrees Kelvin (i.e., absolute temperature), V is in liters, and R is the universal gas constant, which has a numerical value depending on the units in which it is measured (for example, in the metric system R = 0.0820 liter atmosphere per degree mole). The number of moles of gas (i.e., the value n) is constant in a volumetric conversion, therefore the conversion equation, derived from the ideal gas equation, is:

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

Customarily, standard temperature and pressure for gas volumetric measurements in the oil industry are 60 °F and 14.7 psi (see Dake, 1978, p. 13), therefore P_{stp}, V_{stp}, and T_{stp}, respectively, are pressure, volume and temperature at standard temperature and pressure, where standard temperature is degrees Rankine (°R = 460 + °F). P_{rig}, V_{rig}, and T_{rig},

respectively, are ambient pressure, volume and temperature measurements taken at the rig site or in the desorption laboratory.

The universal gas constant R drops out as this equation is simplified and the determination of V_{stp} becomes:

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

The conversion calculations in the spreadsheet were carried out in the English metric system, as this is the customary measure system used in American coal and oil industry. V is therefore converted to cubic feet; P is psia; T is °R.

The desorbed gas was summed over the time period for which the coal samples evolved all of their gas. In the case of well cuttings from Meritage KCM #34-41 Lankard well, the maximum time of desorption was 16 days.

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

LITHOLOGIC ANALYSIS

Upon removal from the canisters, the cuttings were washed of drilling mud, and dried in an oven at 150 °F for 1 to 3 days. After drying, the cuttings were weighed and then dry sieved into 5 size fractions: >0.0930", >0.0661", >0.0460", >0.0331", and <0.0331". For large sample sizes, the cuttings were ran through a sample splitter and a lesser portion (approximately 75 grams) were sieved and weighed, and the derived size-fraction ratios were applied to the entire sample.

The size fractions were then inspected and sorted by hand under a dissecting microscope. Three major lithologic categories were differentiated: coal, dark shales (generally Munsell rock colors N3 (dark gray), N2 (grayish black), and N1 (black) on dry surface), and lighter-colored lithologies and/or dark and light-colored carbonates. The lighter-colored lithologies are considered to be incapable of generating significant amounts of gas. After sorting, and for every size class, each of these three lithologic categories was weighed and the proportion of coal dark shale and light-colored lithologies were determined for the entire cuttings sample based on the weight percentages.

DATA PRESENTATION

Data and analyses accompanying this report are presented in the following order: 1) lag time to surface for the well cuttings, 2) data tables for the desorption analyses, 3) lost-gas graphs, 4) "lithologic component sensitivity analyses" showing the interdependence of gas evolved from dark shale versus coal in each sample, and 5) a desorption graph for all the samples.

Graph of Lag-time to Surface for Well Cuttings (Figure 2)
Lag time of cuttings to surface varied, but there is a general trend of longer lag times for greater depth. The lag times accepted for cuttings were taken to be a visual average of the trend (defined by the scatter of data points on this graph) at the depth at which the samples were taken.

Data Tables of the Desorption Analyses (Table 1)
These are the basic data used for lost-gas analysis and determination of total gas desorbed from the cuttings samples. Basic temperature, volume, and barometric measurements are listed at left. Farther to the right, these are converted to standard temperature, pressure and volumes. The volumes are cumulatively summed, and converted to scf/ton based on the total weight of coal *and* dark shale in the sample. At the right of the table, the time of the measurements are listed and converted to hours (and square root of hours) since the sample was drilled.

Lost-Gas Graphs (Figures 3-4)
Gas lost prior to the canistering of the sample was estimated by extrapolation of the first few data points after the sample was canistered. The linear characteristic of the initial desorption measurements is usually lost within the first hour after the cuttings leave the bottom of the hole, thus data are presented in the lost-gas graphs for only up to one hour after cuttings are off bottom. Lost-gas volumes derived from this analysis are incorporated in the data tables described above.

"Lithologic Component Sensitivity Analyses" (Figures 5-6)
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 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. In the "lithologic component sensitivity analysis" diagrams, each sample is described in terms of its admixed lithologies for both the entire sample and its sieved fractions.

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.

RESULTS and DISCUSSION

Both the Stark Shale and Hushpuckney are very similar in that they are dark gray and grayish black shales. Rarely, conodonts can be observed in the cuttings. Admixed non-gas-generating lithologies (light-colored shale and limestones) were not present in significant quantity in either sample due to these Stark and Hushpuckney Shales being relatively near the surface, at depths of less than 450 feet. Sample quantity was good with both shales, and thus desorption canisters were filled to near capacity by these cuttings.

Two deeper samples (Little Osage Shale/Summit coal at 746' to 751' and Excello Shale at 774' to 779') were attempted to be obtained for cuttings analyses, but excessive water entering the hole caused erratic sample return. Coals, in particular, could possibly be milled to powder by the coal not being effectively lifted from the vicinity of the percussion bit. Judging by the poor desorption results for the Little Osage Shale/Summit coal and Excello samples (see Table 1), no gas generating lithologies were obtained.

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 7. Desorption graph for all samples.

Correlation of Field Barometer to KGS Petrophysics Lab Barometer

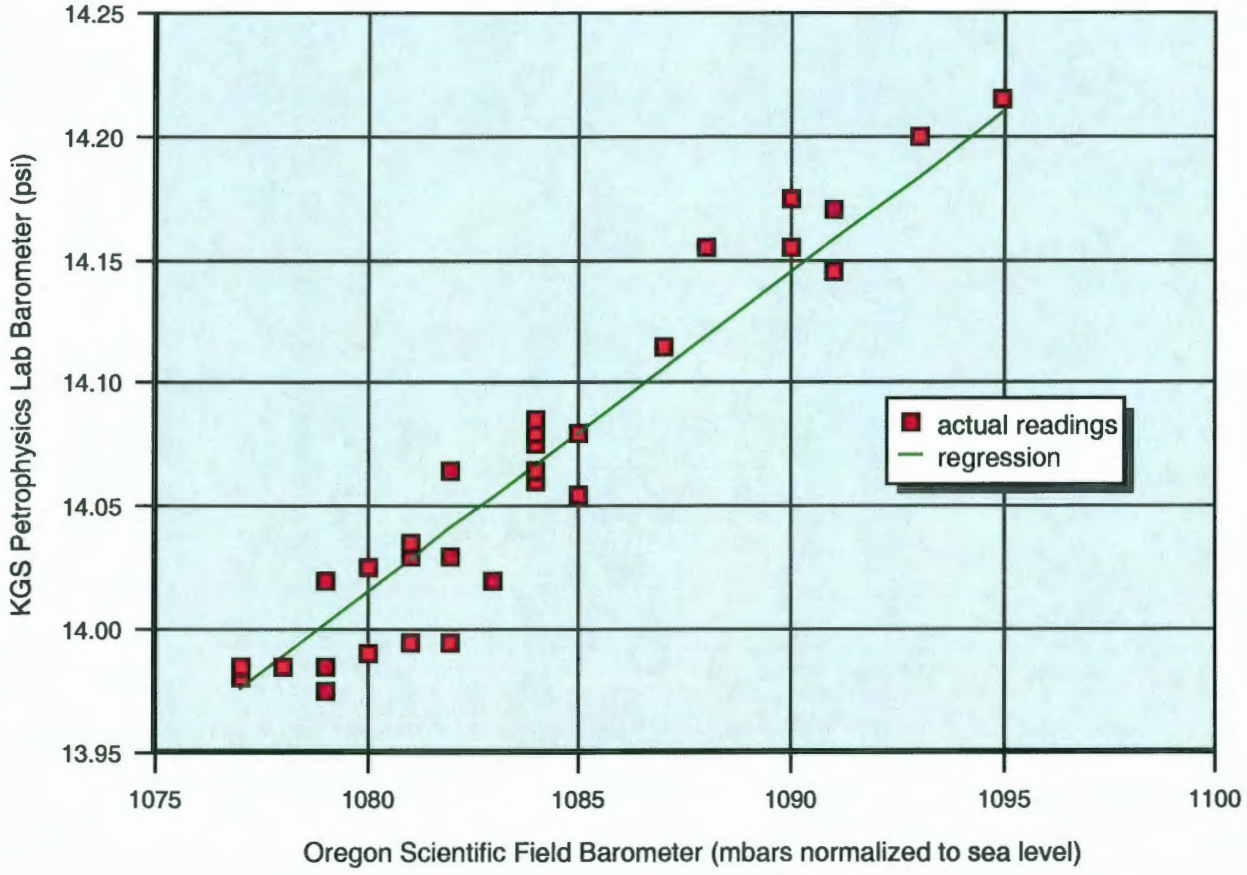

FIGURE 1.

Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS
lag-time to surface for well cuttings

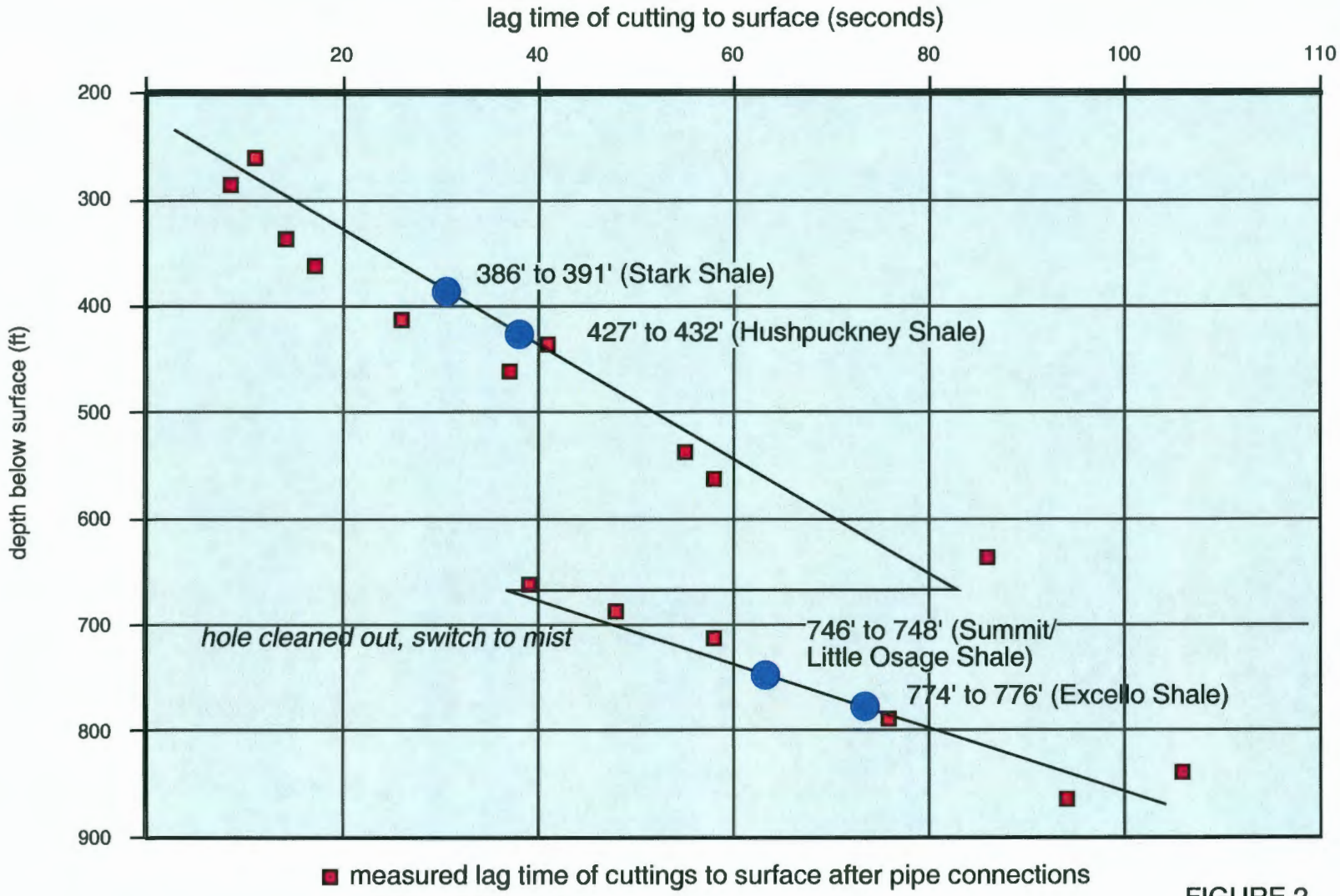

FIGURE 2.

TABLE 1 -- Desorption Measurements for Meritage KCM Lankard #34-41, NE NE 34-T.19S.-R.19E.

SAMPLE: 386' to 391' (Stark Shale) in canister E

DRY WEIGHT lbs. grams
sample weight: 3.2840 1489.56

est. lost gas (cc) = 53

TIME OF: off bottom 10/8/03 9:27; at surface 10/8/03 9:26; in canister 10/8/03 9:32

elapsed time (off bottom to canistering) 4.3 minutes; 0.071 hours; 0.266666666 SQRT (hrs)

CONVERSION OF VOLUMES TO STP

RIG MEASUREMENTS			CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
9	75	1083	0.000317833	535	14.057	0.000295407	8.364956	0.000295407	8.364956	0.179908763	1.319802975	10/8/03 9:33	0:05:46	0:01:30	0.310017921
4	75	1083	0.000141259	535	14.057	0.000131292	3.717758	0.000426699	12.08271	0.259868214	1.399762425	10/8/03 9:34	0:06:31	0:02:15	0.329561999
8	75	1083	0.000282518	535	14.057	0.000262584	7.435516	0.000689282	19.51823	0.419787115	1.559681326	10/8/03 9:36	0:08:16	0:04:00	0.371184291
38	75	1083	0.001341962	535	14.057	0.001247273	35.3187	0.001936555	54.83693	1.179401893	2.319296105	10/8/03 9:46	0:18:46	0:14:30	0.559265391
25	75	1083	0.00088287	535	14.057	0.000820574	23.23599	0.00275713	78.07292	1.679146456	2.81904267	10/8/03 9:56	0:28:31	0:24:15	0.689403929
11	75	1083	0.000388463	535	14.057	0.000361053	10.22383	0.003118182	88.29675	1.899036947	3.038931158	10/8/03 10:00	0:32:31	0:28:15	0.738168761
16	75	1083	0.000565037	535	14.057	0.000525168	14.87103	0.00364335	103.1678	2.218674746	3.35876896	10/8/03 10:09	0:41:01	0:36:45	0.826807784
4	75	1083	0.000141259	535	14.057	0.000131292	3.717758	0.003774642	106.8855	2.298834199	3.43872841	10/8/03 10:11	0:43:01	0:38:45	0.84672572
6	75	1083	0.000211889	535	14.057	0.000196938	5.576637	0.003971579	112.4622	2.418773374	3.558667586	10/8/03 10:14	0:46:31	0:42:15	0.880498596
20	75	1083	0.000706296	535	14.057	0.000656459	18.58879	0.004628039	131.051	2.818570626	3.958464838	10/8/03 10:26	0:58:31	0:54:15	0.987581531
11	75	1083	0.000388463	535	14.057	0.000361053	10.22383	0.004989092	141.2748	3.038459115	4.178353326	10/8/03 10:30	1:02:01	0:57:45	1.016666667
22	75	1083	0.000776926	535	14.057	0.000722105	20.44767	0.005711197	161.7225	3.478236092	4.618130303	10/8/03 10:45	1:17:01	1:12:45	1.132965627
12	75	1083	0.000423778	535	14.057	0.000393876	11.15327	0.006105072	172.8757	3.718114443	4.858008655	10/8/03 10:53	1:25:01	1:20:45	1.190354756
24	75	1083	0.000847555	535	14.057	0.000787751	22.30655	0.006892824	195.1823	4.197671145	5.337765357	10/8/03 11:14	1:46:01	1:41:45	1.329264625
26	75	1083	0.000918185	535	14.057	0.000853397	24.16543	0.007746221	219.3477	4.717607573	5.857501765	10/8/03 11:39	2:11:01	2:06:45	1.477704677
24	75	1083	0.000847555	535	14.057	0.000787751	22.30655	0.008533972	241.6543	5.197364275	6.337258487	10/8/03 12:14	2:46:01	2:41:45	1.663413492
50	76	1082	0.00176574	536	14.044	0.001638574	46.34244	0.010170546	287.9967	6.194071508	7.33396572	10/8/03 13:07	3:39:01	3:34:45	1.910570014
8	76	1082	0.000282518	536	14.044	0.000261852	7.414791	0.010432398	295.4115	6.353544665	7.493438677	10/8/03 13:18	3:50:01	3:45:45	1.957960958
54	76	1082	0.001906999	536	14.044	0.0017675	50.04984	0.012199898	345.4613	7.429988477	8.569882686	10/8/03 15:33	6:05:01	6:00:45	2.466497742
34	75	1082	0.001200703	535	14.044	0.001114951	31.57176	0.013314849	377.0331	8.109016238	9.248910449	10/8/03 20:24	10:56:01	10:51:45	3.306601142
25	76	1082	0.00088287	536	14.044	0.000818287	23.17122	0.014133136	400.2043	8.607369654	9.747264066	10/9/03 11:20	25:52:01	25:47:45	5.085955608
36	78	1082	0.001271333	538	14.044	0.001173953	33.24252	0.015307089	433.4469	9.322331295	10.46222551	10/10/03 11:07	49:39:01	49:34:45	7.046295323
52	82	1079	0.00183837	542	14.005	0.001678528	47.53045	0.016985617	480.9773	10.34456957	11.48448378	10/11/03 11:31	74:03:01	73:58:45	8.605247107
17	80	1087	0.000600352	540	14.109	0.000554866	15.71199	0.017540483	496.6893	10.6825142	11.82240841	10/12/03 13:22	99:54:01	99:49:45	9.995012645
53	80	1084	0.001871684	540	14.070	0.001725101	48.84924	0.019265584	545.5385	11.73313628	12.8730305	10/14/03 22:54	157:26:01	157:21:45	12.54725512
21	77	1083	0.000741611	537	14.057	0.000686715	19.44554	0.0199523	564.9841	12.15135995	13.29125416	10/16/03 10:02	192:34:01	192:29:45	13.87684923
-13	75	1091	-0.00045909	535	14.161	-0.000429651	-12.172	0.019522449	552.8121	11.88957211	13.02946633	10/17/03 12:49	219:21:01	219:16:45	14.81047865
28	75	1085	0.000988814	535	14.083	0.00092074	26.07237	0.020443189	578.8845	12.45032191	13.59021612	10/19/03 2:31	257:03:01	256:58:45	16.03278759
18	73	1084	0.000635666	533	14.070	0.000593578	16.80819	0.021036767	595.6927	12.81162308	13.95171729	10/19/03 21:10	275:42:01	275:37:45	16.6042247
12	78	1081	0.000423778	538	14.031	0.000390956	11.0706	0.021427723	606.7633	13.0499233	14.16981751	10/20/03 16:01	294:33:01	294:28:45	17.16246712
0	76	1085	0	536	14.083	0	0	0.021427723	606.7633	13.0499233	14.16981751	10/21/03 11:52	314:24:01	314:19:45	17.73133604
-4	75	1081	-0.00014126	535	14.031	-0.000131049	-3.71069	0.021296674	603.0524	12.97011152	14.11000573	10/23/03 11:07	361:39:01	361:34:45	19.01710487

DECANISTERED 10/23/03

SAMPLE: 427' to 432' (Hushpuckney Shale) in canister 6

DRY WEIGHT lbs. grams
sample weight: 4.7924 2173.76

est. lost gas (cc) = 91

TIME OF: off bottom 10/8/03 9:41; at surface 10/8/03 9:42; in canister 10/8/03 9:46

elapsed time (off bottom to canistering) 4.6 minutes; 0.077 hours; 0.277888867 SQRT (hrs)

CONVERSION OF VOLUMES TO STP

RIG MEASUREMENTS			CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)					CUMULATIVE VOLUMES		SCF/TON	SCF/TON		TIME SINCE		
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE	off bottom	in canister	SQRT hrs. (since off bottom)
36	75	1083	0.001271333	535	14.057	0.001181627	33.45982	0.001181627	33.45982	0.493129012	1.834281979	10/8/03 9:49	0:08:23	0:03:45	0.373794358
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.001411388	39.9659	0.589015208	1.930168176	10/8/03 9:50	0:09:23	0:04:45	0.395460351
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.001641149	46.47196	0.684901405	2.026054373	10/8/03 9:51	0:10:23	0:05:45	0.415999466
8	75	1083	0.000282518	535	14.057	0.000262584	7.435516	0.001903732	53.90749	0.79446563	2.135638597	10/8/03 9:52	0:11:23	0:06:45	0.435571145
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.002133493	60.41357	0.890371627	2.231524794	10/8/03 9:54	0:12:36	0:08:00	0.45866333
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.002363254	66.91964	0.986258023	2.327410991	10/8/03 9:55	0:13:53	0:09:15	0.48102899
38	75	1083	0.001341962	535	14.057	0.001247273	35.3187	0.003610527	102.2383	1.506783091	2.847936059	10/8/03 10:02	0:20:53	0:16:15	0.589962334
9	75	1083	0.000317833	535	14.057	0.000295407	8.364956	0.003905933	110.6033	1.630065344	2.971216312	10/8/03 10:04	0:22:53	0:18:15	0.617566911
8	75	1083	0.000282518	535	14.057	0.000262584	7.435516	0.004168517	118.0388	1.739649569	3.080802537	10/8/03 10:06	0:24:53	0:20:15	0.643989303
44	75	1083	0.001553851	535	14.057	0.001444211	40.89534	0.005612728	158.9342	2.342362605	3.683515773	10/8/03 10:17	0:36:08	0:31:30	0.776029782
6	75	1083	0.000211889	535	14.057	0.000196938	5.576637	0.005809666	164.5108	2.424550974	3.765703942	10/8/03 10:19	0:38:08	0:33:30	0.797217383
11	75	1083	0.000388463	535	14.057	0.000361053	10.22383	0.006170718	174.7346	2.575229283	3.916382251	10/8/03 10:22	0:41:23	0:36:45	0.830495167
5	75	1083	0.000176574	535	14.057	0.000164115	4.647198	0.006334833	179.3818	2.643719424	3.984672391	10/8/03 10:24	0:43:08	0:38:30	0.847873156
23	75	1083	0.00081224	535	14.057	0.000754928	21.37711	0.007089762	200.7589	2.95677407	4.299927038	10/8/03 10:32	0:50:38	0:46:00	0.918634252
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.007319522	207.265	3.054660267	4.395813234	10/8/03 10:34	0:53:23	0:48:45	0.94325088
7	75	1083	0.000247204	535	14.057	0.000229761	6.506077	0.007549283	213.7711	3.150546463	4.491699431	10/8/03 10:37	0:55:38	0:51:00	0.962923788
5	75	1083	0.000176574	535	14.057	0.000164115	4.647198	0.007713398	218.4163	3.219036604	4.560189572	10/8/03 10:39	0:57:53	0:53:15	0.98220274

4	75	1083	0.000141259	535	14.057	0.000131292	3.717758	0.00784469	222.136	3.273828716	4.614981684	10/8/03	10:41	0:59:38	0:55:00	0.996939762
35	75	1083	0.001236018	535	14.057	0.001148804	32.53036	0.008993494	254.6664	3.7532597	5.094412666	10/8/03	10:58	1:14:38	1:10:00	1.115297668
33	75	1083	0.001165388	535	14.057	0.001083158	30.6715	0.010078652	285.3379	4.205294627	5.546447595	10/8/03	11:12	1:30:38	1:26:00	1.229046604
49	75	1083	0.001730425	535	14.057	0.001606326	45.54254	0.011684977	330.6805	4.676498004	6.217650972	10/8/03	11:41	1:59:38	1:55:00	1.412051305
41	75	1083	0.001447907	535	14.057	0.001345742	38.10702	0.013030719	368.9875	5.438117157	6.779270124	10/8/03	12:12	2:30:38	2:26:00	1.584473274
68	76	1082	0.002401406	536	14.044	0.002225741	63.02572	0.01525646	432.0132	6.366986783	7.708139751	10/8/03	13:05	3:23:38	3:19:00	1.842251039
18	76	1082	0.000635666	536	14.044	0.000589167	16.68326	0.015845627	448.6965	6.612664037	7.954017005	10/8/03	13:19	3:37:38	3:33:00	1.904526771
73	76	1082	0.00257798	536	14.044	0.002389398	67.65997	0.018235025	516.3565	7.610032901	8.951185869	10/8/03	15:38	5:54:38	5:50:00	2.431163416
116	75	1082	0.004096517	535	14.044	0.003803949	107.7154	0.022038974	624.0719	9.197536987	10.53868993	10/8/03	20:25	10:43:38	10:39:00	3.275243842
173	76	1082	0.00610948	536	14.044	0.005662548	160.3449	0.02770152	784.4167	11.56069058	12.90184354	10/9/03	11:21	25:39:38	25:35:00	5.065624893
156	78	1082	0.005509109	538	14.044	0.005087129	144.0509	0.03278865	928.4677	13.68370508	15.02485805	10/10/03	11:08	49:26:38	49:22:00	7.031634866
113	82	1079	0.003990572	542	14.005	0.003647571	103.2873	0.036436221	1031.755	15.20594806	16.54710103	10/11/03	11:31	73:49:38	73:45:00	8.592276894
50	80	1087	0.00176574	540	14.109	0.001631958	46.21173	0.038068179	1077.967	15.88701401	17.22818698	10/12/03	13:23	99:41:38	99:37:00	9.964682713
49	80	1084	0.001730425	540	14.070	0.001594905	45.16251	0.039663084	1123.129	16.55261657	17.89376953	10/15/03	6:41	164:59:38	164:55:00	12.8449947
35	77	1083	0.001236018	537	14.057	0.001144525	32.40923	0.04080761	1155.538	17.03026196	18.37141493	10/16/03	10:04	192:22:38	192:18:00	13.87001162
-3	75	1091	-0.00010594	535	14.161	-9.91963E-05	-2.80892	0.040708413	1152.73	16.98866432	16.33001729	10/17/03	12:50	219:08:38	219:04:00	14.80350934
26	75	1085	0.000988814	535	14.063	0.00092074	26.07237	0.041629154	1178.802	17.3731174	16.71427037	10/19/03	2:32	256:50:38	256:46:00	16.02634983
18	73	1084	0.000635666	533	14.070	0.000593578	16.80819	0.042222732	1195.61	17.62083563	16.9619686	10/19/03	21:12	275:30:38	275:26:00	16.59851064
13	78	1081	0.000459092	538	14.031	0.000423536	11.99315	0.042646267	1207.603	17.79758999	19.13874296	10/20/03	16:02	294:20:38	294:16:00	17.15645327
5	76	1085	0.000176574	536	14.063	0.000164111	4.647093	0.042810379	1212.25	17.8660786	19.20723157	10/21/03	11:52	314:10:38	314:06:00	17.72504506
-2	75	1081	-7.063E-05	535	14.031	-6.55247E-05	-1.85545	0.042744854	1210.395	17.83673314	19.1798661	10/23/03	11:07	361:25:38	361:21:00	19.01123937

DECANISTERED 10/23/03

SAMPLE: 746' to 751' (Little Osage Shale/Summit coal) in canister E

														at surface		
DRY WEIGHT	lbs.	grams								est. lost gas (cc) =		TIME 0F:		10/8/03	11:53	elapsed time (off bottom to canistering)
sample weight:	0.0000	0								0		off bottom		in canister		136.0 minutes
CONVERSION OF VOLUMES TO STP												10/8/03	9:42	10/8/03	11:58	2.267 hours
RIG MEASUREMENTS		CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)						CUMULATIVE VOLUMES		SCF/TON	SCF/TON			TIME SINCE		1.505545305 SQRT (hrs)
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE		off bottom	in canister	SQRT hrs. (since off bottom)
2	75	1083	7.06296E-05	535	14.057	6.56459E-05	1.858679	6.56459E-05	1.858679	#DIV/0!	#DIV/0!	10/8/03	11:58	2:16:30	0:00:30	1.508310313
1	75	1083	3.53148E-05	535	14.057	3.2823E-05	0.92944	9.84689E-05	2.788319	#DIV/0!	#DIV/0!	10/8/03	12:15	2:33:00	0:17:00	1.596871942
23	76	1082	0.00081224	536	14.044	0.000752824	21.31752	0.000851293	24.10584	#DIV/0!	#DIV/0!	10/8/03	13:03	3:21:00	1:05:00	1.830300522
2	76	1082	7.06296E-05	536	14.044	6.5463E-05	1.853698	0.000916758	25.95954	#DIV/0!	#DIV/0!	10/8/03	13:20	3:38:00	1:22:00	1.906130461
-23	76	1082	-0.00081224	536	14.044	-0.000752824	-21.3175	0.000163932	4.642016	#DIV/0!	#DIV/0!	10/8/03	15:38	5:56:00	3:40:00	2.435843454

DECANISTERED 10/08/03 due to no gas being evolved

SAMPLE: 774' to 779' (Excello Shale) in canister 1

														at surface		
DRY WEIGHT	lbs.	grams								est. lost gas (cc) =		TIME 0F:		10/8/03	12:05	elapsed time (off bottom to canistering)
sample weight:	0.0000	0								0		off bottom		in canister		6.2 minutes
CONVERSION OF VOLUMES TO STP												10/8/03	12:03	10/8/03	12:10	0.104 hours
RIG MEASUREMENTS		CONVERSION OF RIG MEASUREMENTS TO STP (cubic ft; @60 degrees; @14.7 psi)						CUMULATIVE VOLUMES		SCF/TON	SCF/TON			TIME SINCE		0.321886799 SQRT (hrs)
measured cc	measured T (F)	measured P	cubic ft (@rig)	ABSOLUTE T (F) (@rig)	psia (@rig)	cubic ft (@STP)	cc (@STP)	cubic ft (@STP)	cc (@STP)	without lost gas	with lost gas	TIME OF MEASURE		off bottom	in canister	SQRT hrs. (since off bottom)
3	75	1083	0.000105944	535	14.057	9.84689E-05	2.788319	9.84689E-05	2.788319	#DIV/0!	#DIV/0!	10/8/03	12:18	0:14:28	0:08:15	0.491030662
2	75	1083	7.06296E-05	535	14.057	6.56459E-05	1.858679	0.000164115	4.647198	#DIV/0!	#DIV/0!	10/8/03	12:22	0:18:43	0:12:30	0.556519869
3	75	1083	0.000105944	535	14.057	9.84689E-05	2.788319	0.000262584	7.435516	#DIV/0!	#DIV/0!	10/8/03	12:58	0:52:13	0:46:00	0.932886798
0	76	1082	0	536	14.044	0	0	0.000262584	7.435516	#DIV/0!	#DIV/0!	10/8/03	13:06	1:04:13	0:58:00	1.034542304
0	76	1082	0	536	14.044	0	0	0.000262584	7.435516	#DIV/0!	#DIV/0!	10/8/03	13:21	1:17:13	1:11:00	1.134435738
-15	76	1082	-0.00052972	536	14.044	-0.000490972	-13.9027	-0.000228388	-6.46722	#DIV/0!	#DIV/0!	10/8/03	15:40	3:36:13	3:30:00	1.898317969
-13	73	1082	-0.00045909	533	14.044	-0.000427904	-12.1169	-0.000656293	-18.5641	#DIV/0!	#DIV/0!	10/8/03	20:27	8:23:13	8:17:00	2.896022176
-24	72	1082	-0.00084758	532	14.044	-0.000791462	-22.4116	-0.001447755	-40.9957	#DIV/0!	#DIV/0!	10/9/03	11:25	23:21:13	23:15:00	4.832557409

DECANISTERED 10/09/03 due to no gas being evolved

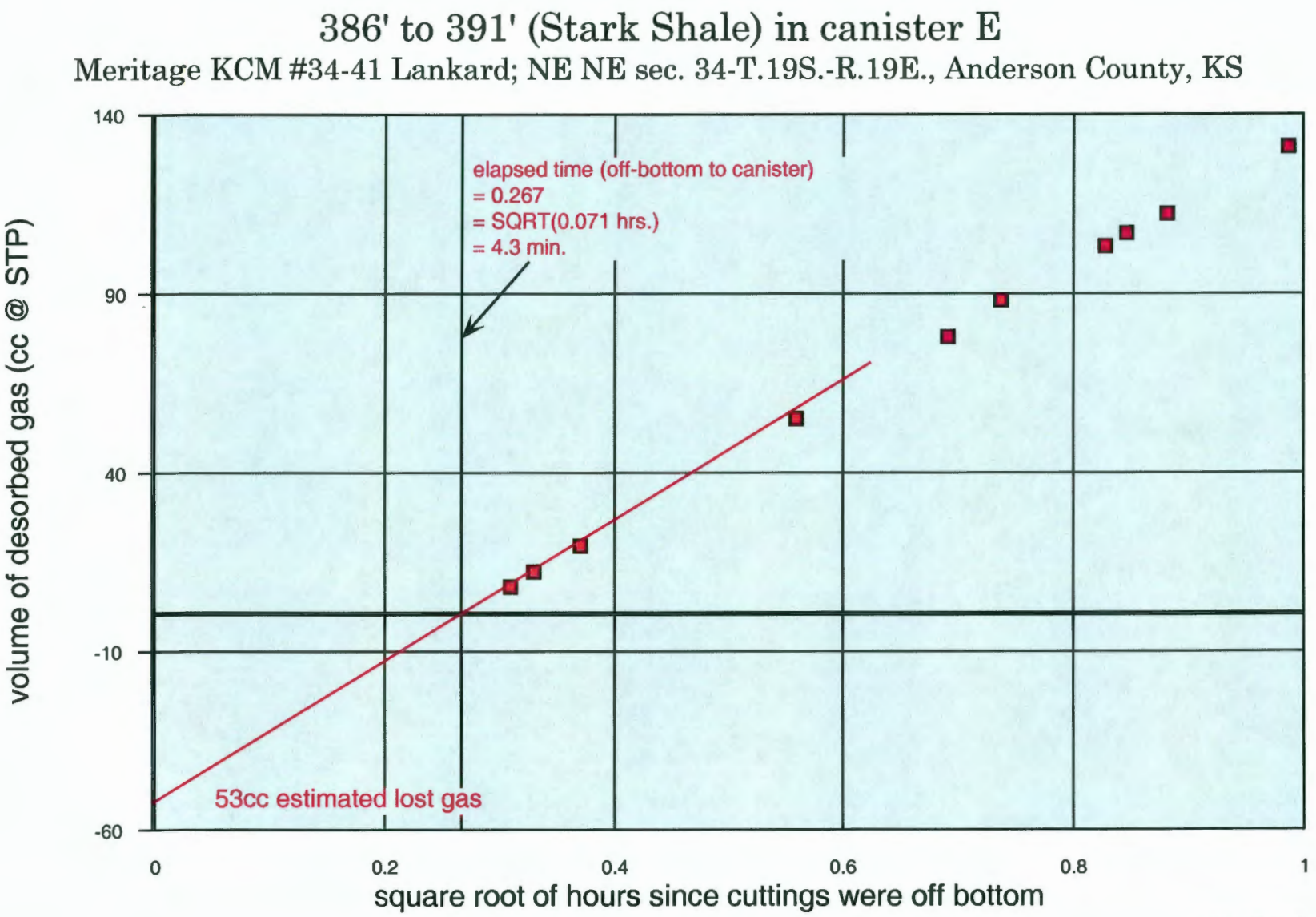
386' to 391' (Stark Shale) in canister E
Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS
volume of desorbed gas (cc @ STP)
140
90
40
-10
-60
elapsed time (off-bottom to canister)
= 0.267
= SQRT(0.071 hrs.)
= 4.3 min.
53cc estimated lost gas
0
0.2
0.4
0.6
0.8
1
square root of hours since cuttings were off bottom

FIGURE 3.

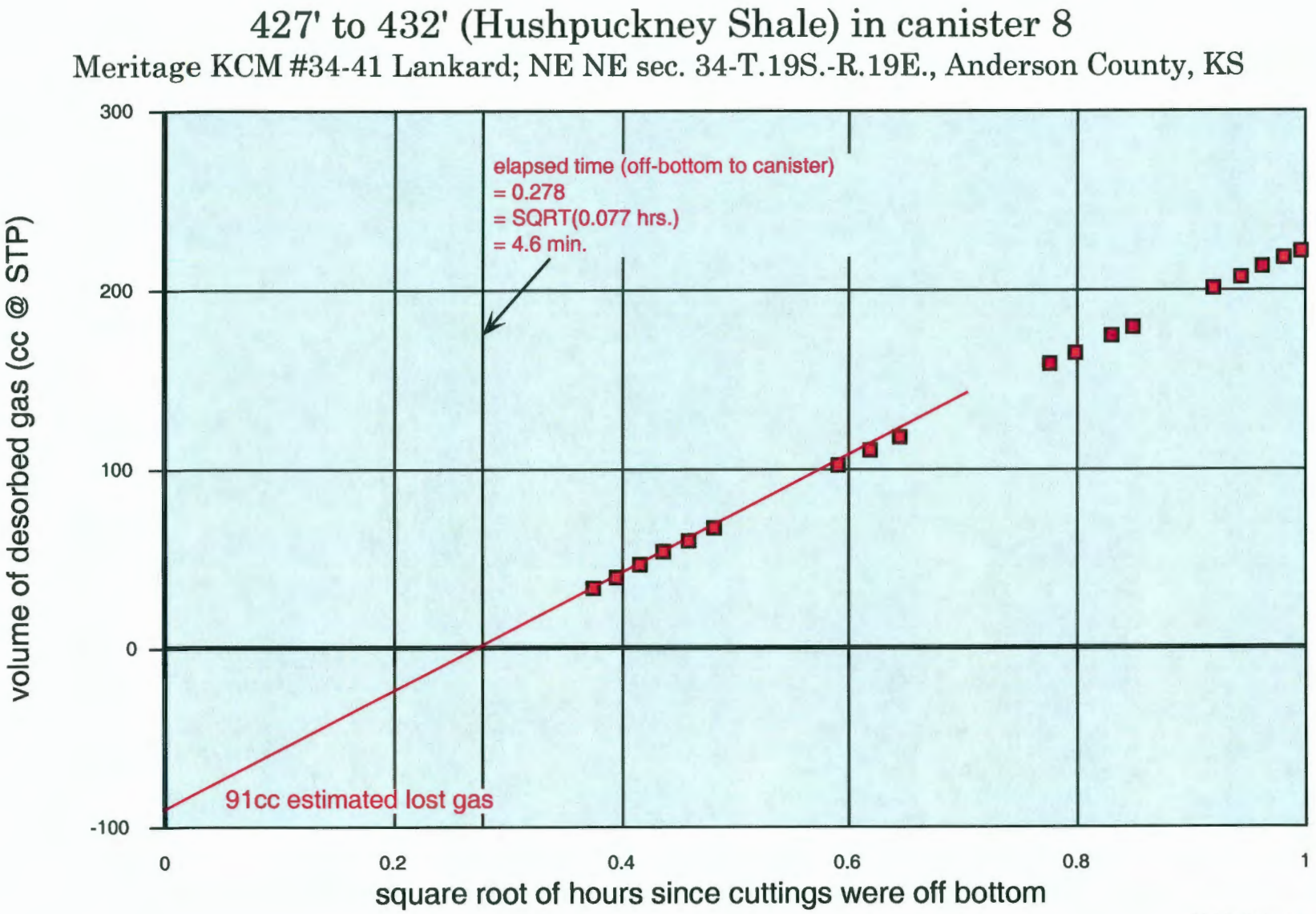
427' to 432' (Hushpuckney Shale) in canister 8
Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS
volume of desorbed gas (cc @ STP)
300
200
100
0
-100
elapsed time (off-bottom to canister)
= 0.278
= SQRT(0.077 hrs.)
= 4.6 min.
91cc estimated lost gas
0
0.2
0.4
0.6
0.8
1
square root of hours since cuttings were off bottom

FIGURE 4.

Desorption Characteristics of Cuttings Samples

Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Stark Shale from 386-391'

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

total gas desorbed = 660 ccs

TOTAL DRY WEIGHT OF SAMPLE = 1534.30 grams
$\text{weight}_{\text{light-colored lithologies}}$ = 44.72 grams (2.9%)
$\text{weight}_{\text{dark shale}}$ = 1489.58 grams (97.1%)
weight_{coal} = 00.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	1032.58	0.00% / 98.00% / 2.00%
>0.0661"	286.40	0.00% / 94.73% / 5.27%
>0.0460"	143.35	0.00% / 95.45% / 4.55%
>0.0331"	46.69	0.00% / 96.82% / 3.18%
<0.0331"	25.28	0.00% / 96.25% / 3.75%
	1534.30 TOTAL	

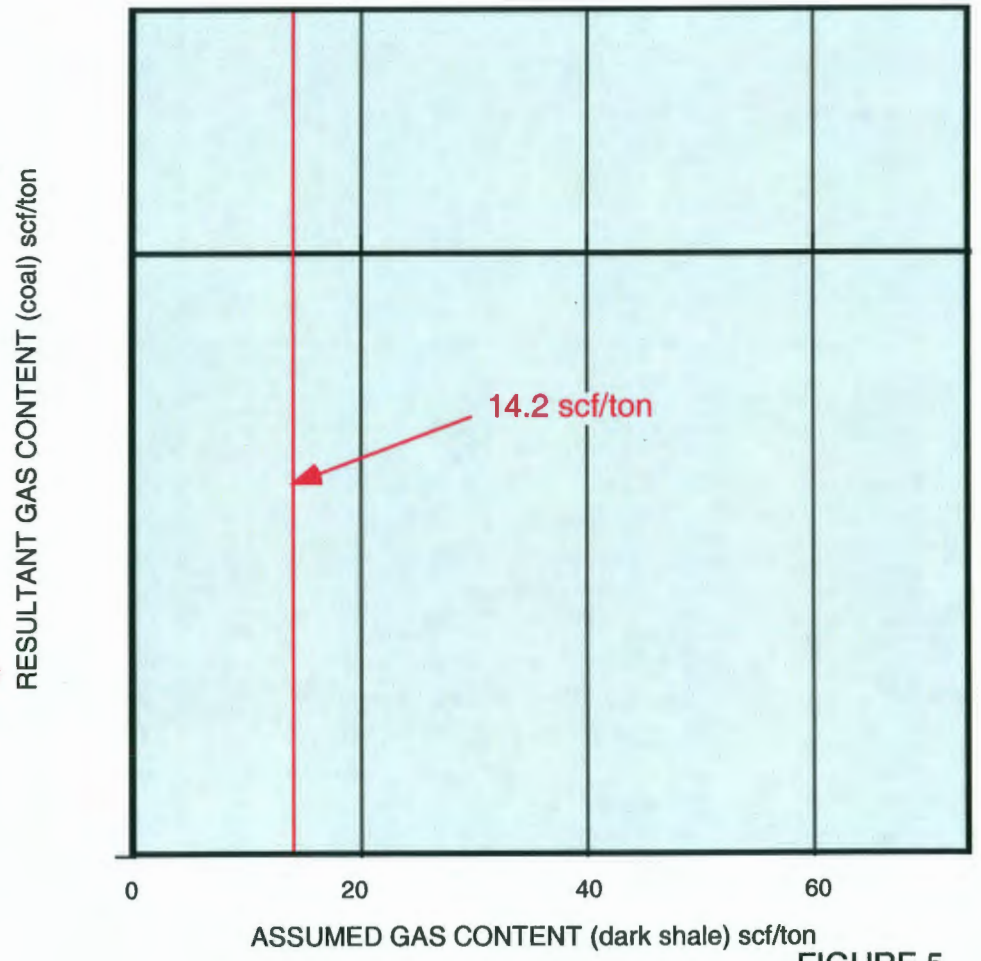

FIGURE 5.

Desorption Characteristics of Cuttings Samples

Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS

LITHOLOGIC COMPONENT SENSITIVITY ANALYSIS for calculation of gas content of Hushpuckney Shale from 427-432'

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

total gas desorbed = 1303 ccs

TOTAL DRY WEIGHT OF SAMPLE = 2243.04 grams
$\text{weight}_{\text{light-colored lithologies}}$ = 60.26 grams (3.1%)
$\text{weight}_{\text{dark shale}}$ = 2173.78 grams (96.9%)
weight_{coal} = 00.00 grams (0.0%)

sieve size	*grams*	*% coal / % dark shale / % light-colored liths*
>0.0930"	1540.56	0.00% / 97.38% / 2.62%
>0.0661"	330.01	0.00% / 94.88% / 5.12%
>0.0460"	235.31	0.00% / 96.57% / 3.43%
>0.0331"	89.03	0.00% / 97.52% / 2.47%
<0.0331"	48.13	0.00% / 95.59% / 3.41%
	2243.04 TOTAL	

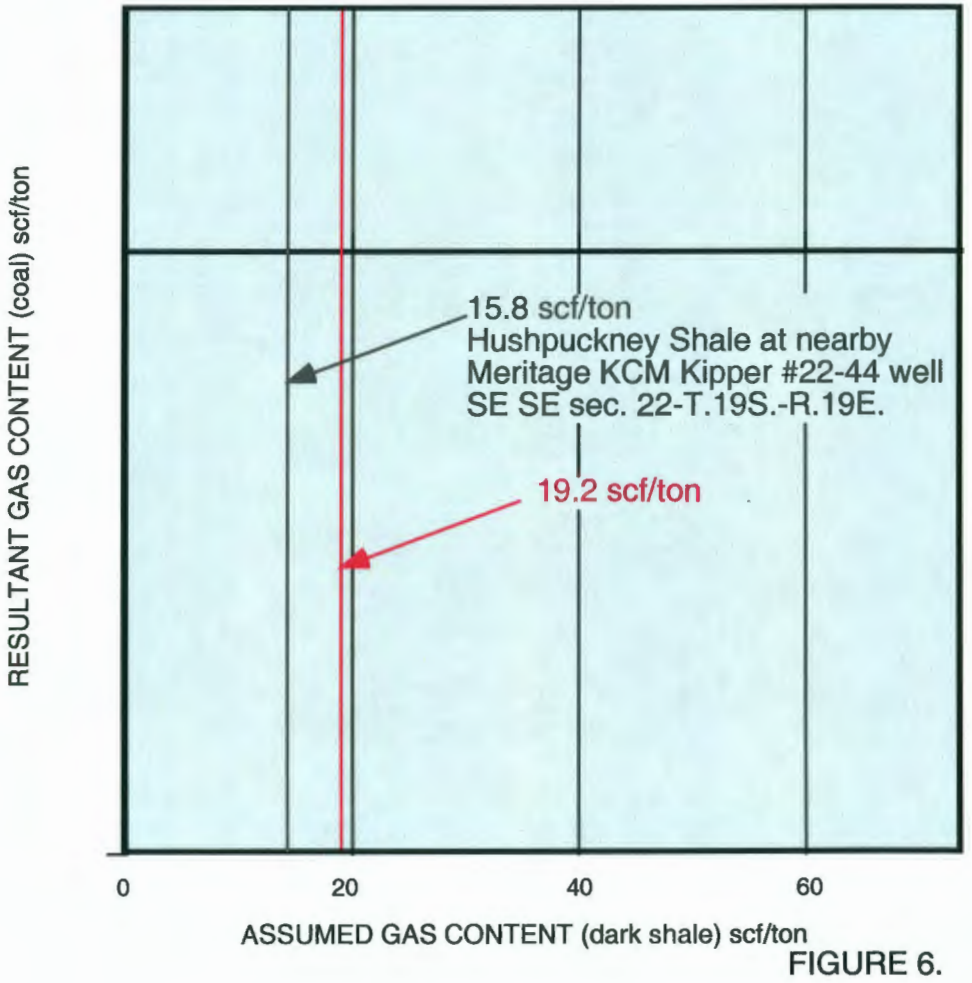

FIGURE 6.

Desorption Characteristics of Cuttings Samples

based on total weight of gas-generating lithologies (i.e., coal and dark shale) in sample
Meritage KCM #34-41 Lankard; NE NE sec. 34-T.19S.-R.19E., Anderson County, KS

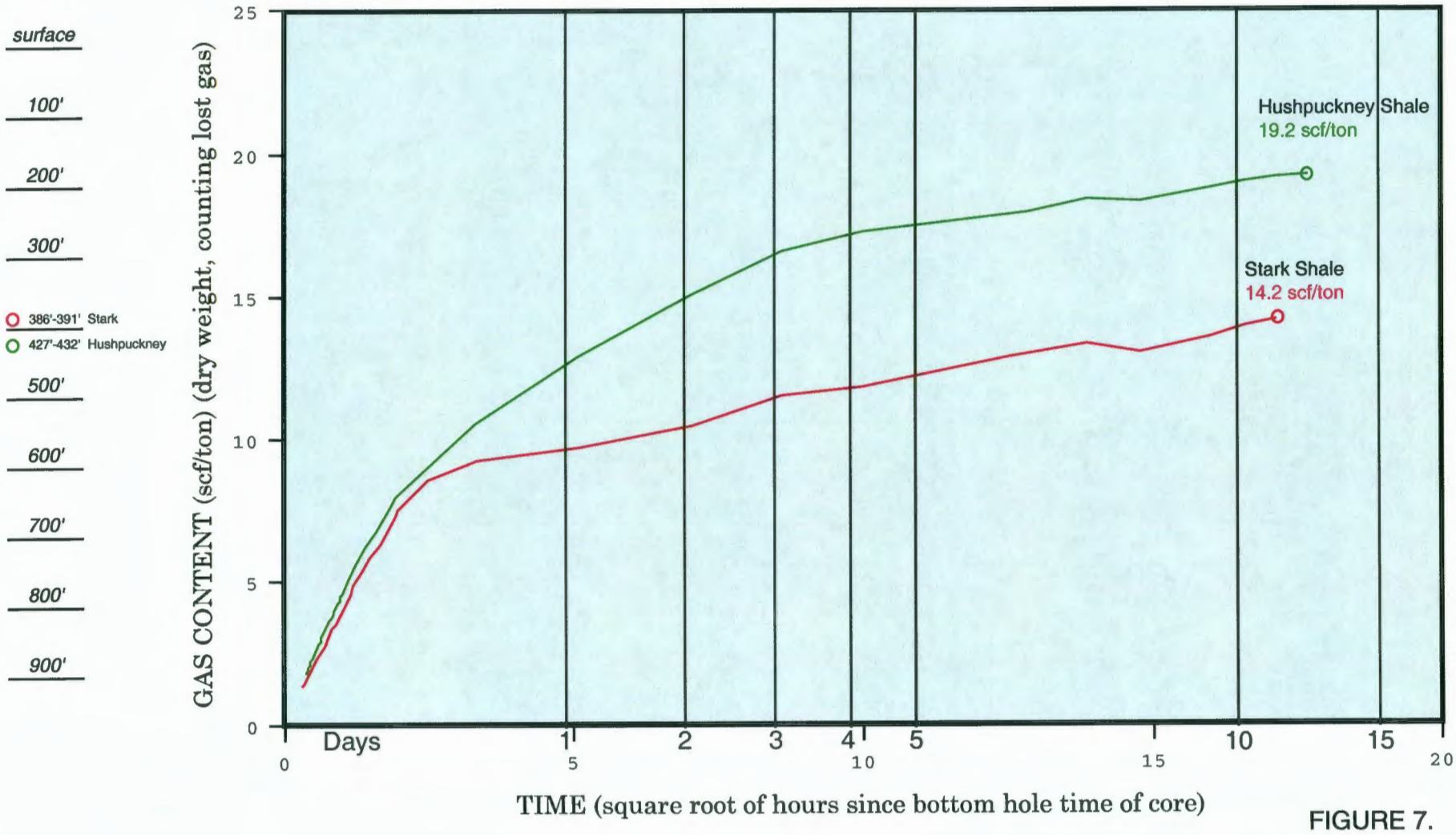

FIGURE 7.