17-8-21E

SEP 7 1990

17-8-21E

Crook 3

Edmiston Oil

CORE ANALYSIS REPORT

FOR

EDMISTON OIL COMPANY

CROOK NO.3
N.E. EASTON FIELD
LEAVENWORTH CO., KANSAS

On-Site Desorption Testing

Two full diameter coal seams were taken in the Cherokee coal group, Leavenworth County, Kansas, Sec. 17-8S-21E for on-site desorption (methane) measurements.

Recordings of core penetration times, trip to surface time and canister sealed time were taken to calculate lost gas time. Once sealed the canisters were connected to 500 cc cylinders to measure desorbed gas volumes by displacement of water.

On-site gas volume are taken to insure desorption rates for incremental data evaluation.

After initial desorption measurements, the canisters were shut in and transported to Core Laboratories Tulsa facility for further and complete desorption measurements.

Laboratory Procedures

Upon arrival the canister were put on line at reservoir temperature (90°) to continue methane desorption. Full desorption was completed in 3-4 weeks. Tabulated results show intervals 1038 and 1374.5 to be high in normalized ash-free gas and therefore, appear to be high methane productive intervals. This productive assumption is based on total gas content SCF/Ton and lithological evaluations.

Vitrinite Reflectance

Vitrinite reflectance data assesses the thermal maturity relative to petroleum generation and is one of the most reliable thermal maturity parameters available. Data provide the percentage of carbon in dry mineral-free coal, otherwise called the "rank". A measurement is taken of the fraction of incident light that is reflected coherently off a vitrinite particle. A total of 100 measurements are taken.

Vitrinite Reflectance (% Ro) on the coal samples measured .50 and .53 percent. Based on the data presented, samples tested may be classified as high volatile C bituminous coal. Drill cutting intervals 900 and 1313.1 ft. were predominately quartz and shale.

Mineralog™

The Mineralog™ analytical technique is based on absorption of a finely ground sample dispersed in potassium bromide matrix and provides rapid quantification of specific rock forming minerals. Coals have distinct infrared absorption signatures that reflect their composition and thermal history.

Drill cutting samples 900 ft. and 1313.1 ft. were high in quartz and clays and therefore would not be classified as coal.

Adsorption Isotherm

To prepare the samples for adsorption isotherm testing, a sequential process involving wet-crushing and wet-sieving was utilized so that the particle sizes tested were between 35 and 170 mesh. Extraneous water was removed from the desegregated coal, then the prepared sample was placed in an airtight container, purged with methane and allowed to set until the time of testing. The prepared coal was placed in a pressure vessel and the system temperature was equilibrated at 90 degrees Fahrenheit. Methane was then introduced at pressures ranging from approximately 0 psia to 1000 psia.

The amount of methane adsorbed onto the coal was determined by a Boyle's Law technique allowing for the variable compressibility of methane at the various pressures. Ash data derived from the Mineralog™ analyses were used to correct the adsorption isotherm results for the amount of ash present.

Discussion

A factor which may have caused the difference in the sample desorption data to be different than the adsorption isotherm is the inclusion of the gas in fractures which makes up at least part of the calculated lost gas. This gas which is not determined by adsorption isotherms causes the desorption data to indicate a greater gas content at a given depth than the adsorption isotherms indicate.[1]

---

[1]Greg E. Eddy and Craig T. Rightmire, TRW Energy Development Group, and Charles W. Byrer, U.S. Dept. of Energy "Relationship of Methane Content of Coal Rank and Depth: Theoretical vs. Observed", SPE/DOE 10800, 1982.

CORE LABORATORIES

Company : EDMISTON OIL COMPANY
Well : CROOK NO.3
Location : NE NE SW SEC.17-8S-21E
Co,State : LEAVENWORTH CO., KANSAS

Field : N.E. EASTON FIELD
Formation : Cherokee
Coring Fluid : Mud
Elevation : 1050 GL

File No.: CA57183-90091
Date : 17-AUG-1990
API No. :
Analysts: MCH/DW/DS

CORE ANALYSIS RESULTS

SAMPLE NUMBER	DEPTH ft	BULK DENSITY gm/cc	COAL WEIGHT g	CANNISTER DESORBED GAS VOLUME cc	ESTIMATED LOST GAS VOLUME cc	CANNISTER TOTAL GAS VOLUME cc	LOST GAS %	TOTAL GAS CONTENT scf/ton	ASH CONTENT %	NORMALIZED ASH-FREE GAS CONTENT scf/ton	DESCRIPTION
1	1037.0- 38.0	1.28	281.05	2811.90	1124.80	3936.70	28.60	448.20	6.00	476.80	COAL VITRAIN CLEATED FRAC'D
2	1374.5- 75.5	1.49	525.90	4469.80	625.80	5095.60	12.30	310.10	26.00	419.00	COAL VITRAIN CLEATED FRAC'D

SUMMARY OF COAL DESORPTION DATA

LOST GAS DETERMINATION BY SMITH AND WILLIAMS METHOD

Western Atlas International
A Litton/Dresser Company

CORE LABORATORIES

MINERALOG™ ANALYSIS
(Weight Percent)

Company: Edmiston Oil Company
Formation: Cherokee Formation
County, State: Leavenworth, Kansas

Well: Crook No. 3
Field: N.E. Easton

Sample I.D.:	4	1	2B	2
Sample Depth, ft:	900.0	1038.0	1313.1	1375.5
Grain Density:	2.79	1.15	2.40	1.37
Quartz	13	1	50	0
Plagioclase Feldspar	0	0	0	0
Potassium Feldspar	4	0	0	0
Calcite	11	0	0	0
Dolomite	1	0	0	0
Pyrite	10	4	0	23
Apatite	6	0	0	0
Percent Coal (by difference)	0	94	7	74
Ash Content (percent)	0	6	0	26

Clay Minerals Present

Kaolinite	4	1	19	3
Chlorite	0	0	0	0

TABLE

Total Volume of Gas in Coal Beds, Assuming Various Gas Concentration (in Cubic Feet per Ton) and Thicknesses of Coal (in Feet per Acre and Feet per Square Mile)

Gas Content in Cubic Feet Per Ton of Coal	Volume → Acre-foot Coal, tons → 1,800	1 ft/sq mi 1.15 x 10^6	3 ft/sq mi 3.45 x 10^6	6 ft/sq mi 6.9 x 10^6	50 ft/sq mi 57.5 x 10^6
50	90 x 10^3	58 x 10^6	173 x 10^6	345 x 10^6	2.9 x 10^9
75	135 x 10^3	87 x 10^6	255 x 10^6	515 x 10^6	4.3 x 10^9
100	180 x 10^3	115 x 10^6	345 x 10^6	690 x 10^6	5.8 x 10^9
200	360 x 10^3	230 x 10^6	690 x 10^6	1.4 x 10^9	11.6 x 10^9
300	540 x 10^3	345 x 10^6	1 x 10^9	2 x 10^9	-
400	720 x 10^3	460 x 10^6	1.4 x 10^9	2.7 x 10^9	-
500	900 x 10^3	575 x 10^6	1.7 x 10^9	3.4 x 10^9	-
600	1.1 x 10^6	690 x 10^6	2 x 10^9	4.1 x 10^9	-
650	1.2 x 10^6	748 x 10^6	2.2 x 10^9	4.5 x 10^9	-

(National Academy of Sciences Natural Gas from Unconventional Geologic Sources Board on Mineral Resources, 1976)

Western Atlas International
A Litton/Dresser Company

CORE LABORATORIES

File RFL 900335

Well Crook No. 3
1374.5-1375.5 ft

GAS COMPOSITION

Component	Mole Percent With Air*	Mole Percent Air Free**	Molecular Weight(1)	Density,gm/cc at 60°F(1)
Hydrogen	0.00	0.00	2.016	0.01710
Carbon Monoxide	0.00	0.00	28.100	0.78940
Oxygen	22.28	0.00	31.999	1.14097
Hydrogen Sulfide	0.00	0.00	34.080	0.80064
Carbon Dioxide	0.03	100.00	44.010	0.81720
Nitrogen	77.69	0.00	28.013	0.80860
Methane	0.00	0.00	16.043	0.29970
Ethane	0.00	0.00	30.070	0.35584
Propane	0.00	0.00	44.097	0.50648
iso-Butane	0.00	0.00	58.123	0.56231
n-Butane	0.00	0.00	58.123	0.58343
iso-Pentane	0.00	0.00	72.150	0.62408
n-Pentane	0.00	0.00	72.150	0.63049
Hexanes	0.00	0.00	84	0.685
Heptanes plus	0.00	0.00	103(2)	0.737(2)
	100.00	100.00		

Calculated Properties of Gas

* Gas gravity (air = 1.000) = 0.998 (with air)
** Gas gravity (air = 1.000) = 1.519 (air free)

Standard conditions = 14.65 psia and 60°F

(1) Assigned properties taken from literature.
(2) Assumed.

Figure 1
COAL RANK BASED ON MEAN RANDOM VITRINITE REFLECTANCE

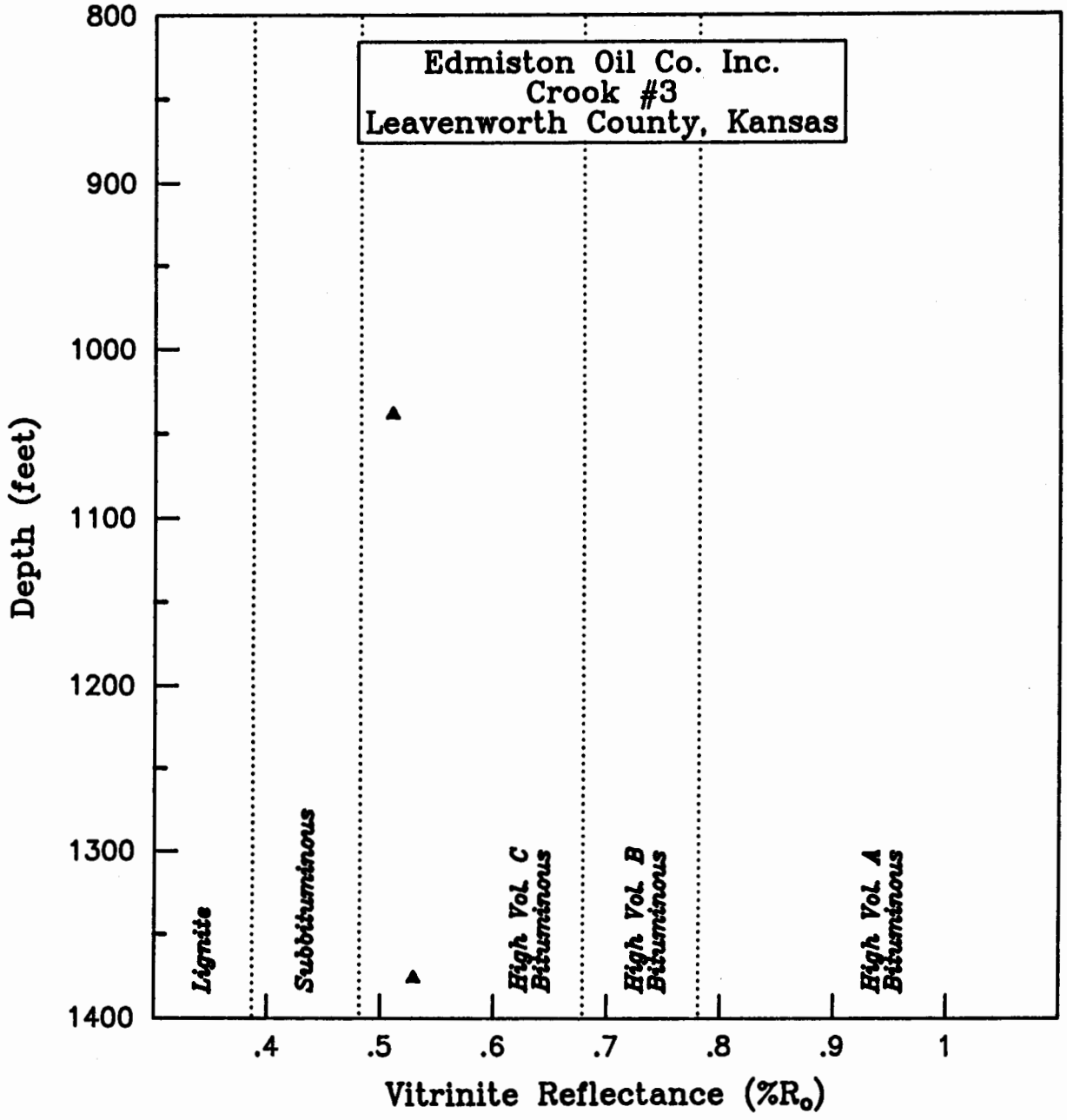
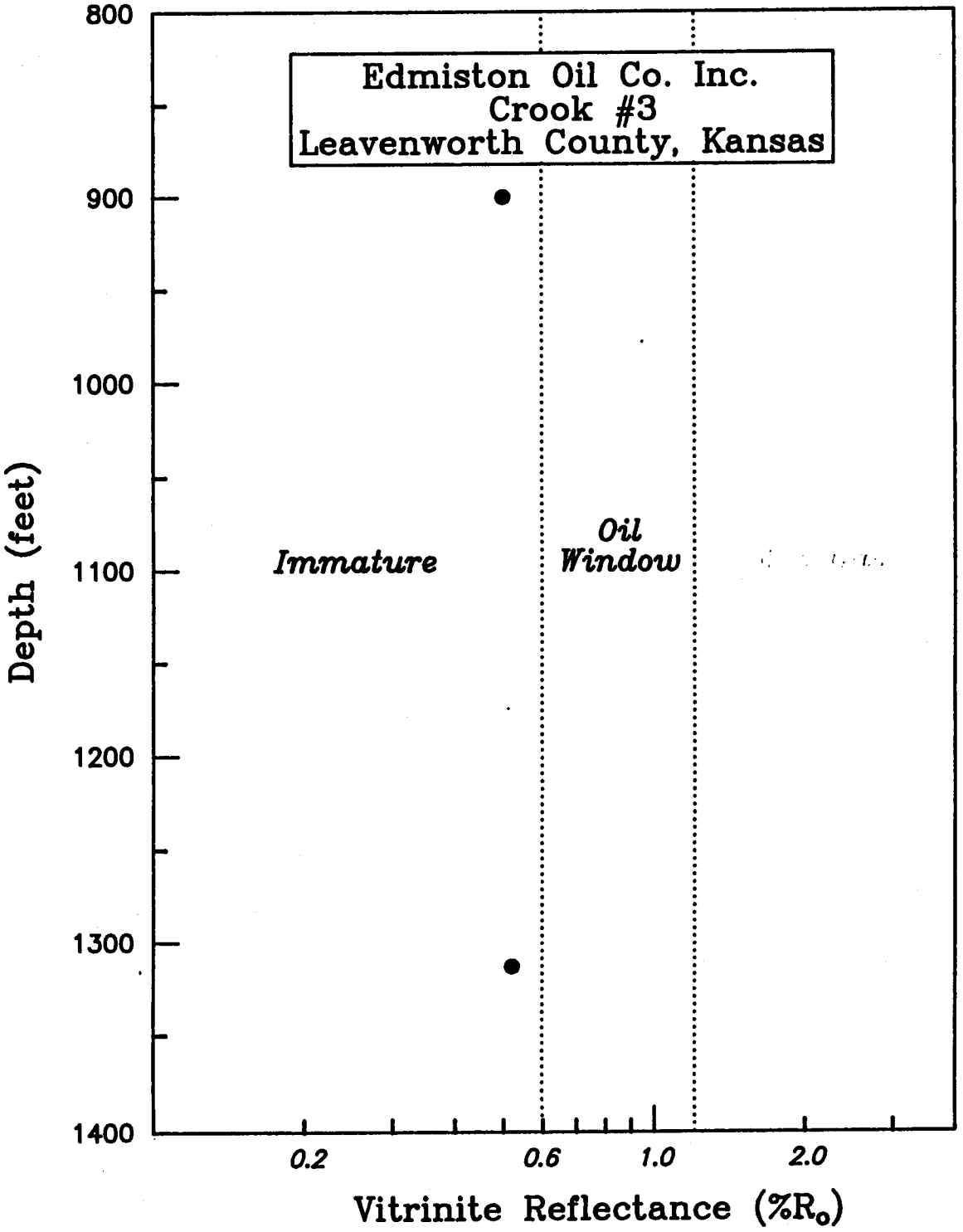


Figure 2
VITRINITE REFLECTANCE vs. DEPTH



File No. 90298

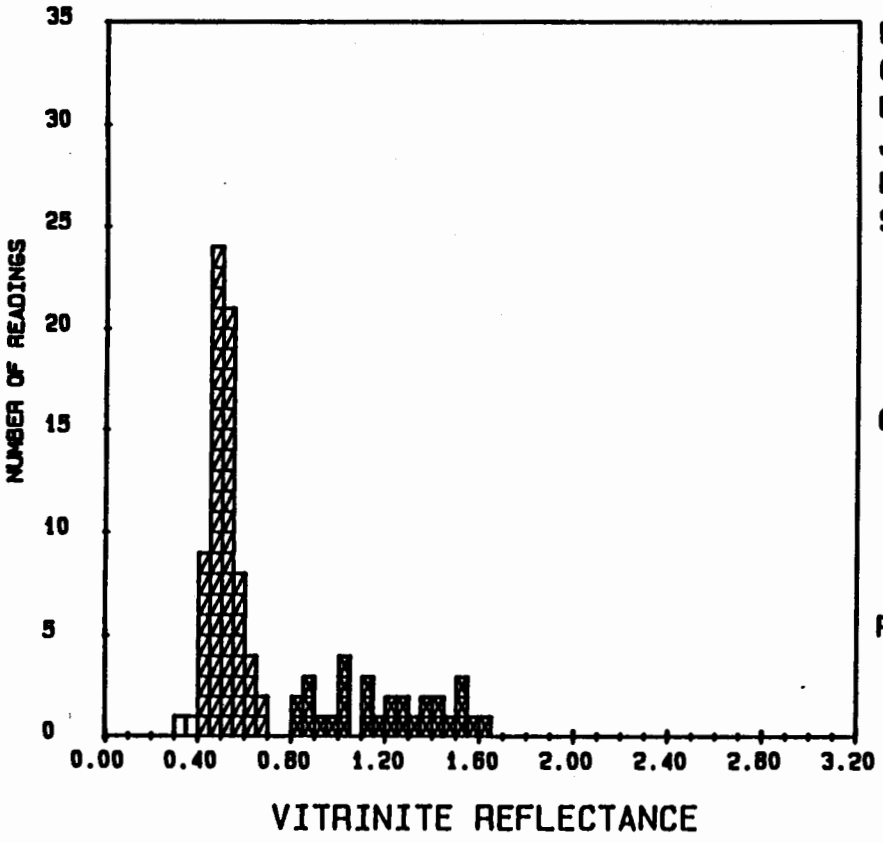
TABLE 1

VITRINITE REFLECTANCE DATA

EDMISTON OIL Co. INC.
CROOK #3
LEAVENWORTH COUNTY, KANSAS

SAMPLE DEPTH (feet)	VITRINITE REFLECTANCE (%Ro)
900	0.50
1038	0.51
1313	0.52
1375.5	0.53

TOTAL VITRINITE REFLECTANCE HISTOGRAM



Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas
JOB # : 90298
DEPTH : 900 FEET
SAMPLE: CUTTINGS

☐ CAVE OR CONTAMINANT

☒ INDIGENOUS

⊠ RECYCLED - OXIDIZED

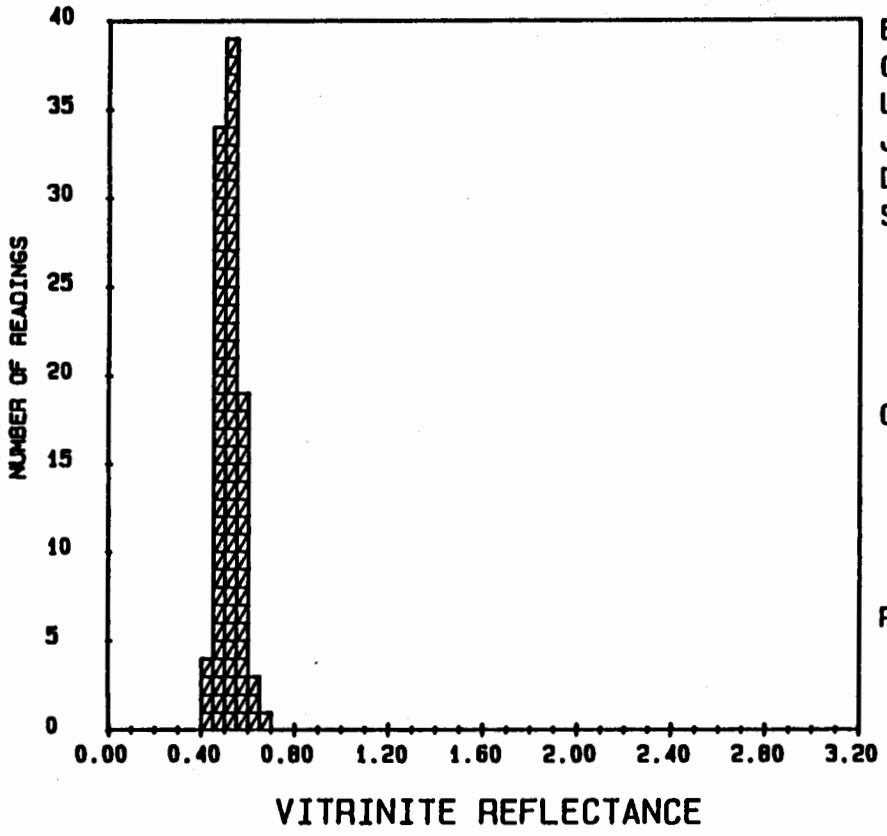
STATISTICS FOR THE INDIGENOUS POPULATION

NUMBER OF READINGS	68	STANDARD DEVIATION	0.06
MEAN REF.	0.50 %	MEDIAN	0.49
MIN. REF.	0.40 %	MODE	0.48
MAX. REF.	0.69 %	SKEWNESS	0.49

STATISTICS FOR THE TOTAL POPULATION

	READINGS		PERCENT OF POPULATION
CAVE OR CONTAMINANT	2	CAVE OR CONTAMINANT	2.0 %
INDIGENOUS	68	INDIGENOUS	68.0 %
RECYCLED - OXIDIZED	30	RECYCLED - OXIDIZED	30.0 %
TOTAL	100	TOTAL	100.0 %

TOTAL VITRINITE REFLECTANCE HISTOGRAM



Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas
JOB # : 90298
DEPTH : 1038 FEET
SAMPLE: CORE

☐ CAVE OR CONTAMINANT

☒ INDIGENOUS

⊠ RECYCLED - OXIDIZED

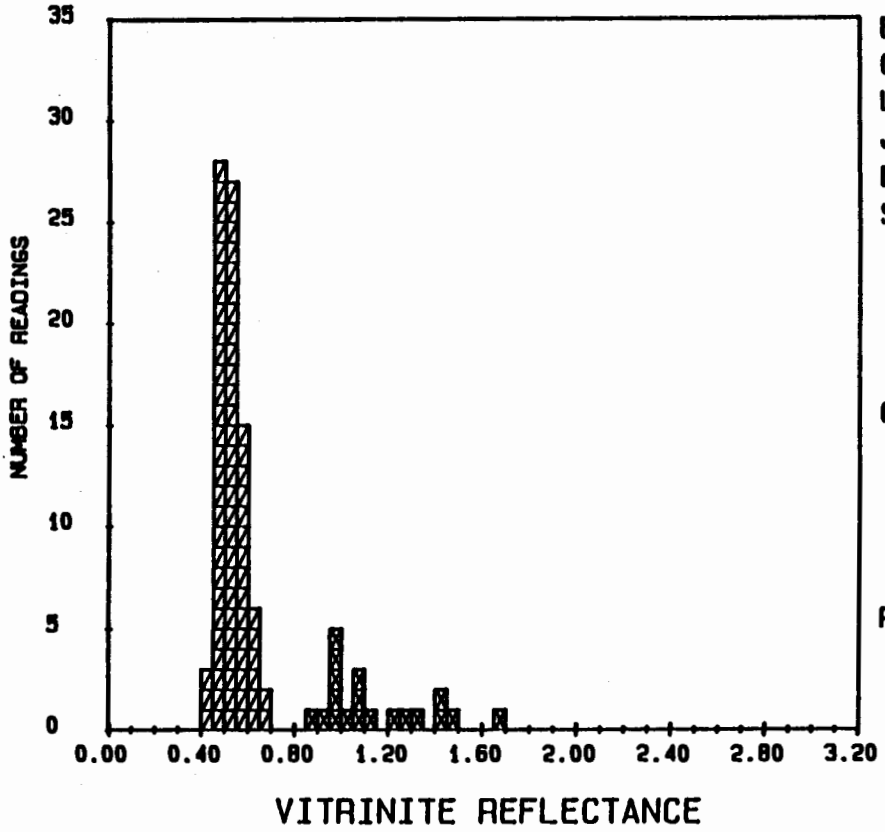
STATISTICS FOR THE INDIGENOUS POPULATION

NUMBER OF READINGS	100	STANDARD DEVIATION	0.05
MEAN REF.	0.51 %	MEDIAN	0.50
MIN. REF.	0.40 %	MODE	0.52
MAX. REF.	0.68 %	SKEWNESS	0.65

STATISTICS FOR THE TOTAL POPULATION

	READINGS		PERCENT OF POPULATION
CAVE OR CONTAMINANT	0	CAVE OR CONTAMINANT	0.0 %
INDIGENOUS	100	INDIGENOUS	100.0 %
RECYCLED - OXIDIZED	0	RECYCLED - OXIDIZED	0.0 %
TOTAL	100	TOTAL	100.0 %

TOTAL VITRINITE REFLECTANCE HISTOGRAM



Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas
JOB # : 90298
DEPTH : 1313 FEET
SAMPLE: CUTTINGS

☐ CAVE OR CONTAMINANT

▨ INDIGENOUS

☒ RECYCLED - OXIDIZED

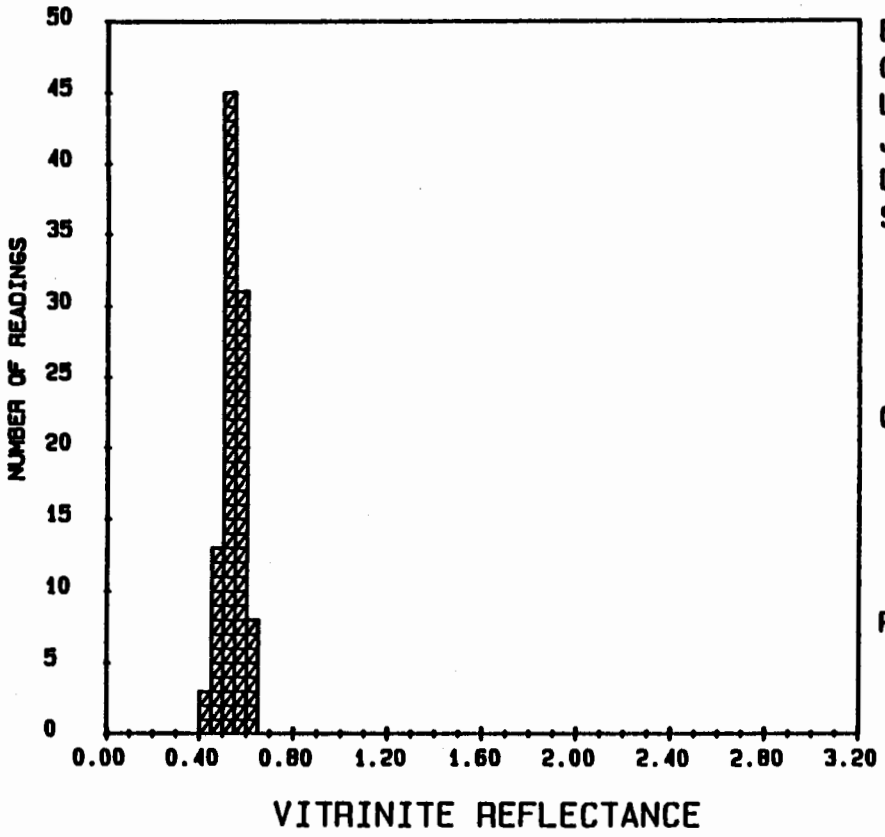
STATISTICS FOR THE INDIGENOUS POPULATION

NUMBER OF READINGS	81	STANDARD DEVIATION	0.06
MEAN REF.	0.52 %	MEDIAN	0.51
MIN. REF.	0.41 %	MODE	0.48
MAX. REF.	0.68 %	SKEWNESS	0.55

STATISTICS FOR THE TOTAL POPULATION

	READINGS		PERCENT OF POPULATION
CAVE OR CONTAMINANT	0	CAVE OR CONTAMINANT	0.0 %
INDIGENOUS	81	INDIGENOUS	81.0 %
RECYCLED - OXIDIZED	19	RECYCLED - OXIDIZED	19.0 %
TOTAL	100	TOTAL	100.0 %

TOTAL VITRINITE REFLECTANCE HISTOGRAM



Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas
JOB # : 90298
DEPTH : 1375.5 FEET
SAMPLE: CORE

☐ CAVE OR CONTAMINANT

☒ INDIGENOUS

⊠ RECYCLED - OXIDIZED

STATISTICS FOR THE INDIGENOUS POPULATION

NUMBER OF READINGS	100	STANDARD DEVIATION	0.04
MEAN REF.	0.53 %	MEDIAN	0.52
MIN. REF.	0.43 %	MODE	0.52
MAX. REF.	0.64 %	SKEWNESS	0.68

STATISTICS FOR THE TOTAL POPULATION

READINGS		PERCENT OF POPULATION	
CAVE OR CONTAMINANT	0	CAVE OR CONTAMINANT	0.0 %
INDIGENOUS	100	INDIGENOUS	100.0 %
RECYCLED - OXIDIZED	0	RECYCLED - OXIDIZED	0.0 %
TOTAL	100	TOTAL	100.0 %

Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas

DEPTH RANGE 900 FEET

SAMPLE TYPE CUTTINGS

RO VALUE	COUNT	RO VALUE	COUNT	RO VALUE	COUNT
.31	1	.57	1	1.10	1
.39	1	.58	1	1.11	2
.40	2	.59	1	1.16	1
.41	1	.61	2	1.20	1
.42	3	.63	1	1.23	1
.43	1	.64	1	1.26	1
.44	2	.66	1	1.27	1
.45	4	.69	1	1.34	1
.46	5	.81	1	1.35	1
.47	2	.84	1	1.36	1
.48	7	.87	1	1.40	1
.49	6	.88	1	1.44	1
.50	5	.89	1	1.48	1
.51	2	.90	1	1.51	1
.52	4	.97	1	1.53	1
.53	5	1.01	1	1.54	1
.54	5	1.02	1	1.58	1
.55	2	1.03	1	1.63	1
.56	3	1.04	1		

DEPTH RANGE 1038 FEET

SAMPLE TYPE CORE

RO VALUE	COUNT	RO VALUE	COUNT	RO VALUE	COUNT
.40	1	.48	9	.55	3
.41	1	.49	13	.56	3
.42	1	.50	8	.57	4
.44	1	.51	6	.58	7
.45	1	.52	14	.59	2
.46	6	.53	5	.60	3
.47	5	.54	6	.68	1

Edmiston Oil Co. Inc.
Crook #3
Leavenworth Co. Kansas

DEPTH RANGE 1313 FEET

SAMPLE TYPE CUTTINGS

RO VALUE	COUNT	RO VALUE	COUNT	RO VALUE	COUNT
.41	2	.56	4	.97	1
.43	1	.57	1	1.00	1
.45	5	.58	3	1.05	1
.46	5	.59	4	1.06	1
.47	3	.60	1	1.09	1
.48	8	.61	3	1.13	1
.49	7	.62	2	1.21	1
.50	3	.65	1	1.25	1
.51	5	.68	1	1.32	1
.52	5	.88	1	1.42	1
.53	6	.91	1	1.44	1
.54	8	.95	3	1.49	1
.55	3	.96	1	1.65	1

DEPTH RANGE 1375.5 FEET

SAMPLE TYPE CORE

RO VALUE	COUNT	RO VALUE	COUNT	RO VALUE	COUNT
.43	2	.51	10	.58	6
.44	1	.52	11	.59	4
.45	1	.53	5	.60	4
.46	3	.54	9	.61	1
.47	3	.55	8	.63	2
.49	6	.56	3	.64	1
.50	10	.57	10		

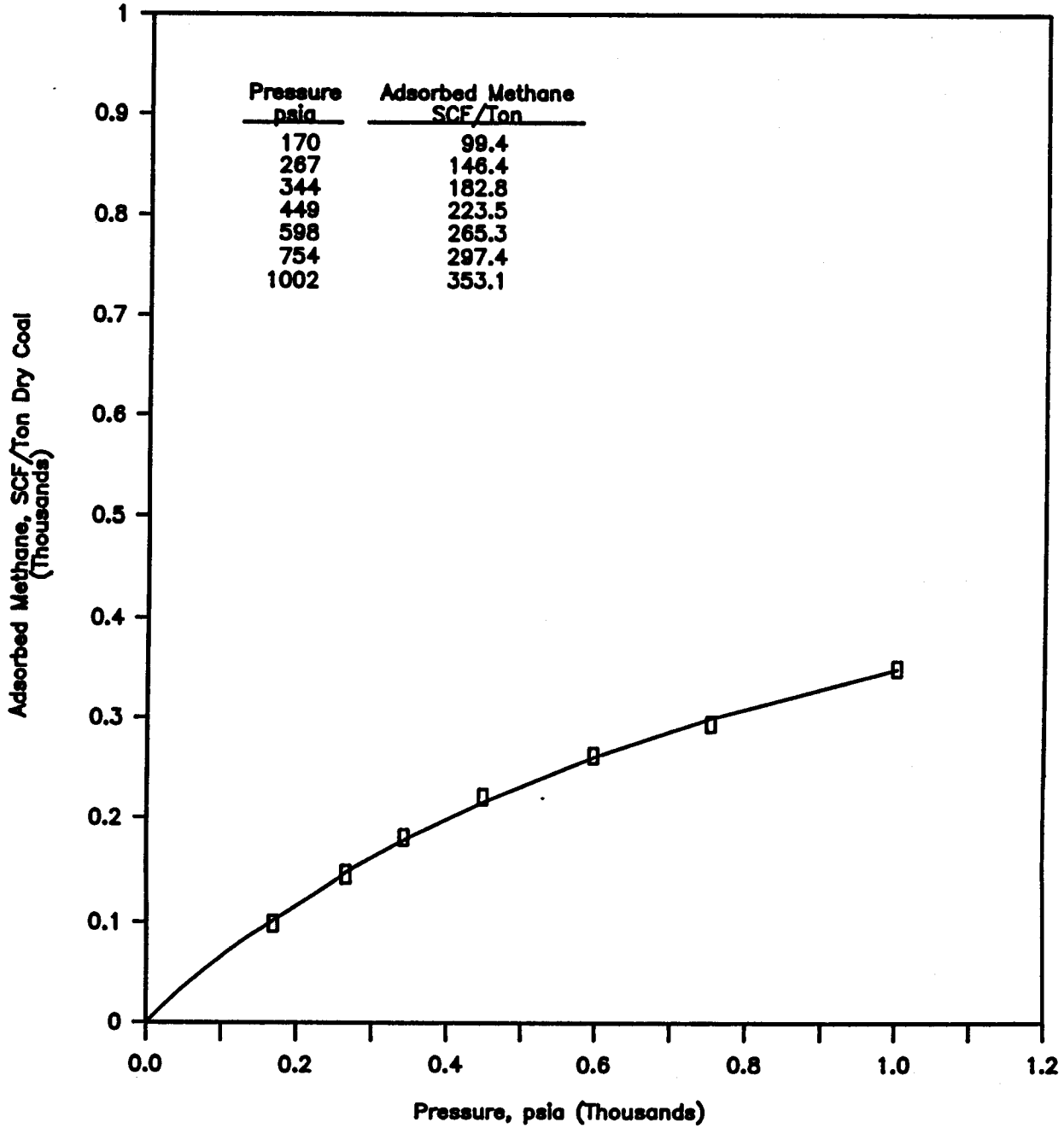
Methane Adsorption vs. Pressure

Normalized for Ash Content

EDMISTON OIL COMPANY
CROOK NO. 3 WELL
Croweburg Coal
N.E. EASTON FIELD
LEAVENWORTH COUNTY, KANSAS

SAMPLE ID:	1
SAMPLE DEPTH, ft:	1037–38
TEMP, Degrees F:	90
ASH CONTENT, %:	6.0
MOISTURE CONTENT, %:	9.56

Pressure psia	Adsorbed Methane SCF/Ton
170	99.4
267	146.4
344	182.8
449	223.5
598	265.3
754	297.4
1002	353.1

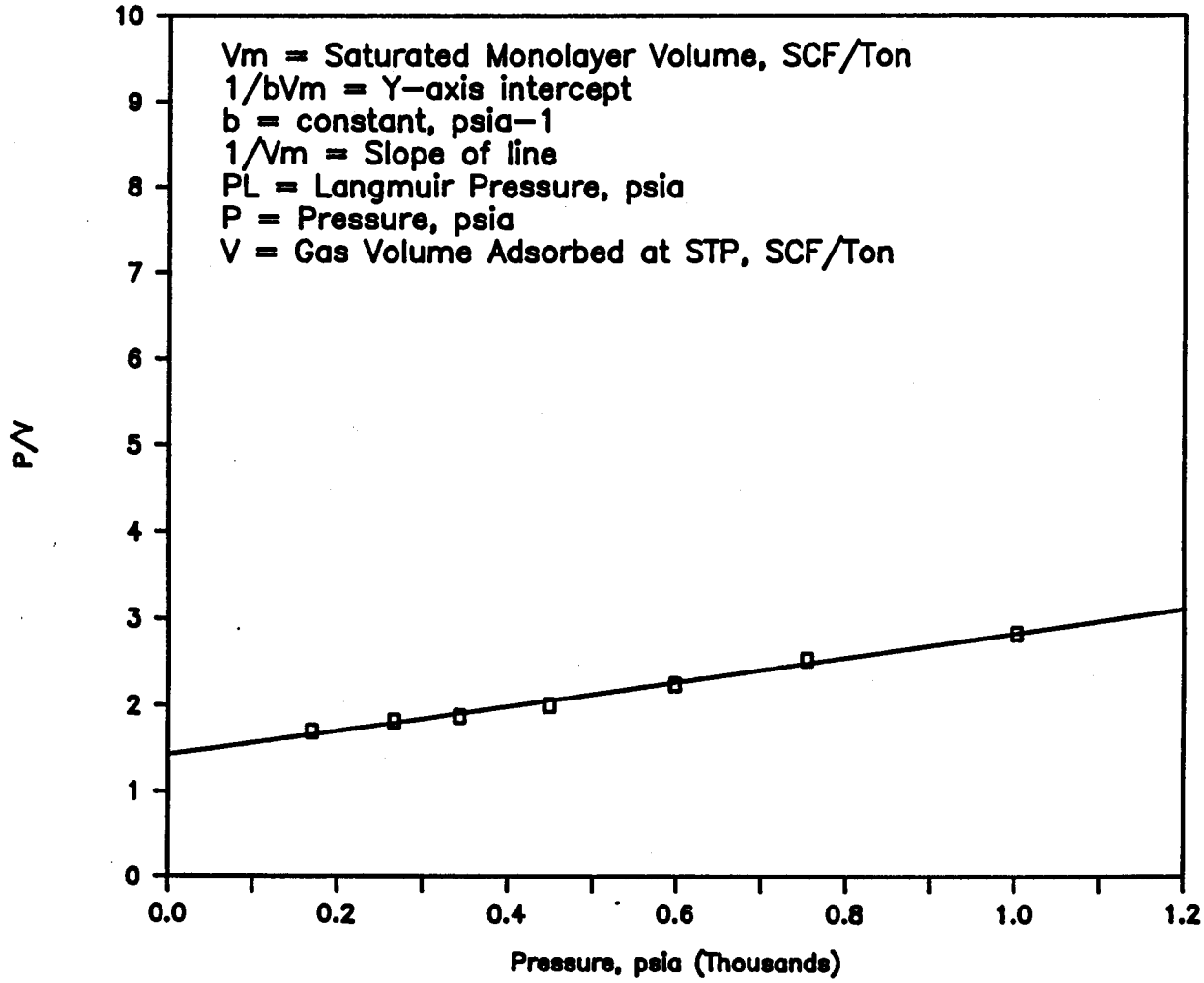


Core Laboratories

P/V vs. P Correlation

Normalized for Ash Content

EDMISTON OIL COMPANY	SAMPLE ID:	1
CROOK NO. 3 WELL	SAMPLE DEPTH, ft:	1037–38
Croweburg Coal	TEMP, Degrees F:	90
N.E. EASTON FIELD	ASH CONTENT, %:	6.0
LEAVENWORTH COUNTY, KANSAS	MOISTURE CONTENT, %:	9.56



Vm = 712.3 SCF/ton

1/Vm = 1.404E-03

1/bVm = 1.431

P_L = 1019.5 PSIA

b = 9.809E-04 $PSIA^{-1}$

Langmuir Correlation

Core Laboratories

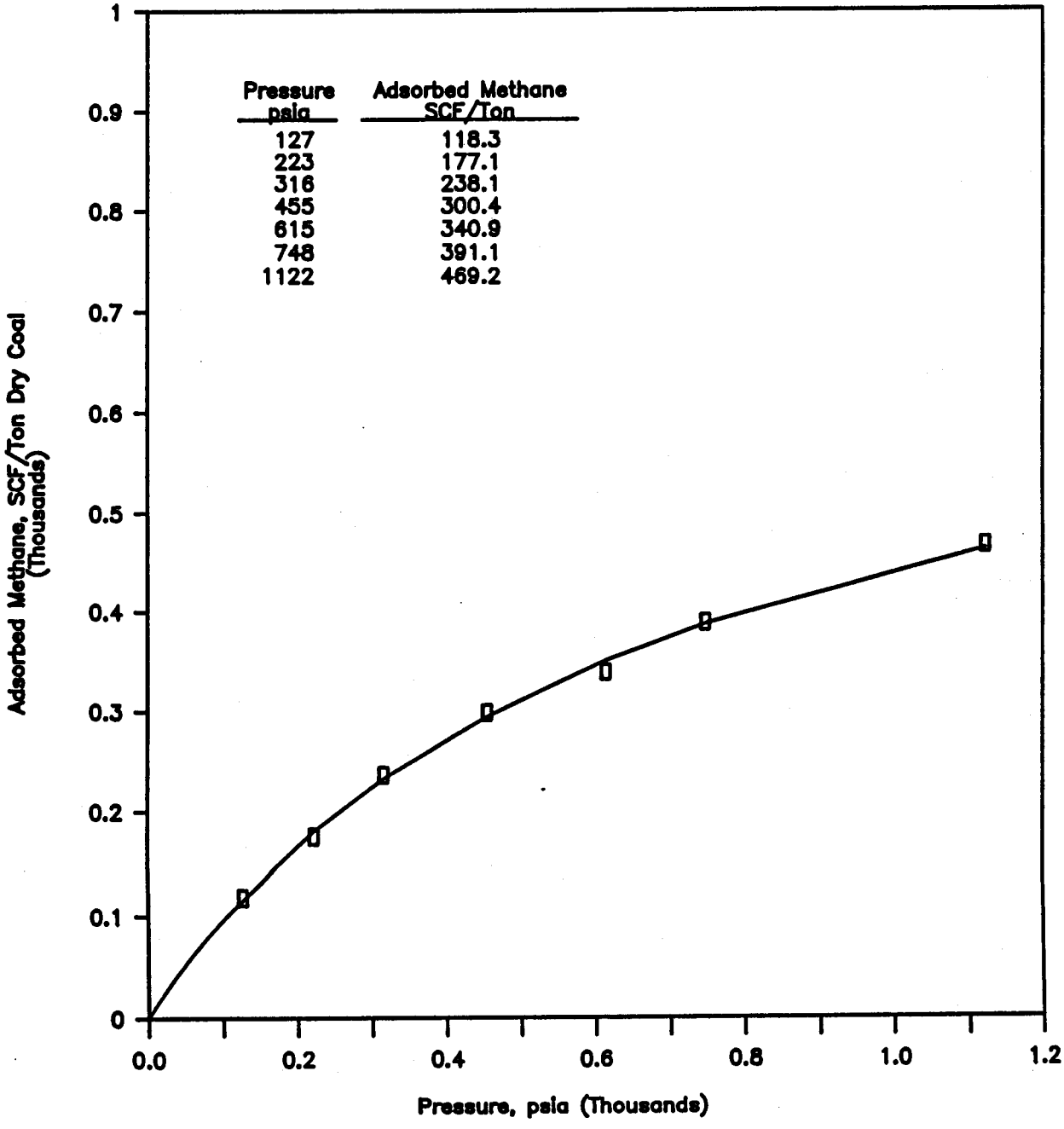
Methane Adsorption vs. Pressure

Normalized for Ash Content

EDMISTON OIL COMPANY
CROOK NO. 3 WELL
Drywood Coal
N.E. EASTON FIELD
LEAVENWORTH COUNTY, KANSAS

SAMPLE ID:	2
SAMPLE DEPTH, ft:	1374.5–75.5
TEMP, Degrees F:	90
ASH CONTENT, %:	26.0
MOISTURE CONTENT, %:	9.54

Pressure psia	Adsorbed Methane SCF/Ton
127	118.3
223	177.1
316	238.1
455	300.4
615	340.9
748	391.1
1122	469.2

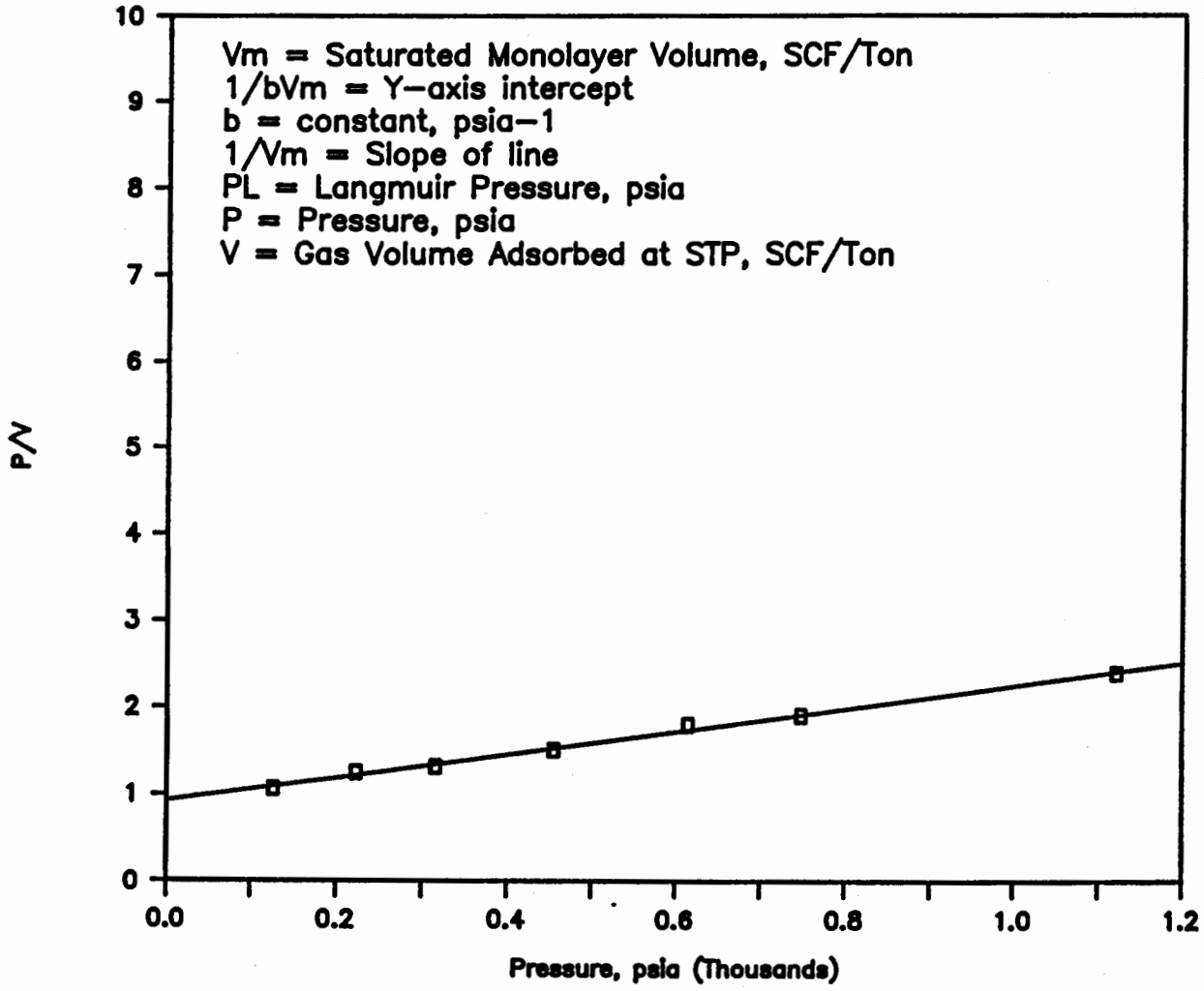


Core Laboratories

P/V vs. P Correlation

Normalized for Ash Content

EDMISTON OIL COMPANY	SAMPLE ID:	2
CROOK NO. 3 WELL	SAMPLE DEPTH, ft:	1374.5–75.5
Drywood Coal	TEMP, Degrees F:	90
N.E. EASTON FIELD	ASH CONTENT, %:	26.0
LEAVENWORTH COUNTY, KANSAS	MOISTURE CONTENT, %:	9.54



Vm = 760.0 SCF/ton

1/Vm = 1.316E–03

1/bVm = 0.934

P_L = 709.9 PSIA

b = 1.409E–03 $PSIA^{-1}$

Langmuir Correlation

Core Laboratories