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STUDY OF HYDROCARBON - SHALE INTERACTION

ANNUAL REPORT #2

October 1, 1977 - September 30, 1978

MASTER

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Abstract

This report is the second annual report for contract EY-76-S-05-5197 on the Hydrocarbon-Shale Interaction at Juniata College covering the period from October 1, 1977 through September 30, 1978. The work accomplished is reported in detail in progress reports #7,8,9,10 (ORO-5197-7,8,9,10).

Table I and Table II summarize the data determined for each sample measured during the year. Table III is a statistical summary of the averages, maximum, minimum values of each parameter along with their % variation from sample to sample. Included also are brief summaries of two papers presented during the year.

Details regarding methods of measurement, uncertainty of measurement, along with the text of the full papers, is included in the four quarterly reports presented over the time period of the contract.

The Concept of Specific Degasibility and Its Application to Gas Bearing Tight Formations as Represented by the Devonian Shales of Appalachia.

This report examines the various possible parameters for reporting the ability of shales to hold gas and the rate of travel of gas through shale. Permeabilities and porosities are the standard parameters utilized in this regard but these parameters have shortcomings that limit their application to shale. It is suggested that porosity be replaced by the "model free" concept of an isotherm wherein the reported quantity is the amount of gas sorbed per unit volume of shale per unit change in pressure. The reason for the suggestion is that the amount of void space in the shale is not a measure of the capacity of the shale for methane.

The rate that bulk shale degasses upon undergoing a pressure change is a function both of its permeability and the capacity of the shale for gas according to the following equation for a step change.

$$\frac{1}{A} \frac{dM_T}{dt} = \frac{2SD}{\pi^{\frac{1}{2}}} (p_2 - p_0) t^{-\frac{1}{2}}$$

where A is the area of the rock, p_2 is the initial equilibrium pressure, p_0 is the final pressure, t is time, D is the diffusion constant, S is the solubility of methane in rock, and $\frac{dM_T}{dt}$ is the rate of production. The suggestion is to compile $G = \frac{2SD}{\pi^{\frac{1}{2}}} t^{\frac{1}{2}}$ as the quantity and give it a separate name. Various implications of these suggestions are explored. For example, the permeability (K) is related to G by $K = \frac{\pi G^2 \eta}{4S}$ where η is the viscosity.

The Estimation of Reserves In Tight Shales

The isotherm and degassing properties of shale as measured in a laboratory environment are used to make two estimates of the expected reserves/square mile/1,000 feet thickness of shale. The first estimate is to use the isotherm properties of methane in shale in conjunction with estimates of the equilibrium pressure of methane in shale to obtain an estimate of the total gas in place of about 100×10^8 MCF/square mile/1,000 feet thickness. The second step was a kinetic calculation which estimated the amount of this gas that would, in fact, be accessible. Assuming an average fracture spacing of 100 feet, the amount of recoverable gas would be about 2% of the above value over a 100 year period based on this calculation.

Data Summary

Table I

Explanation of headings

Well I D - EGSP# when possible. Others as follows:

Brown - Belmont County, Ohio

Dawson - Richland County, Ohio

Egner - Richland County, Ohio

Romig - Richland County, Ohio

Warn - Chatauqua County, New York

Density Bulk - density measured using toluene as displacing fluid.

Isotherm Slope - volume of gas sorbed into rock (STP) per unit volume rock per torr pressure.

BET Area - volume of nitrogen (STP) calculated from BET equation required

G - Specific degasibility. Volume of gas (STP) released from a sq cm of rock surface per $(\text{sec})^{\frac{1}{2}}$ per torr of discontinuous pressure drop.

WELL ID	DENSITY BULK G/CM ³	ISO SLOPE HELIUM TORR ⁻¹ *E4	ISO SLOPE METHANE TORR ⁻¹ *E4	BET AREA	G METHANE CM/TORR *E7	G NITROGEN CM/TORR *E7
BROWN:4400	2.735	0.211	2.132	4.4	2.68	47.44
BROWN:5541	2.661	0.580	2.724	5.0	1.66	106.02
BROWN:5561	2.611	0.314	1.678	2.2	0.72	6.30
BROWN:5586	2.623	0.573	2.109	2.7	1.10	13.29
CH-11940:3481.5	2.500	*****	2.180	*****	*****	*****
CH-11940:3636.4	2.678	0.195	1.570	*****	*****	*****
CH-11940:3778.9	2.504	0.551	4.009	*****	*****	*****
CH-11940:3787.9	2.554	0.137	1.579	*****	*****	*****
DAWSON:676	2.370	0.461	10.327	4.0	8.76	61.24
DAWSON:686	2.684	0.039	0.896	3.2	0.01	69.31
EGNER:340	2.605	1.204	6.477	12.5	0.31	188.49
EGNER:345	2.656	1.289	6.150	11.2	0.29	155.78
EGNER:510	2.560	2.638	10.580	5.8	11.44	113.73
EGNER:520	2.424	0.685	8.297	6.7	9.61	150.39
IL#1-EGSP:3010	2.568	0.862	4.834	*****	0.16	*****
IL#1-EGSP:3038	2.346	1.322	7.504	*****	1.16	*****
IL#1-EGSP:3052	2.480	0.659	3.093	2.2	0.94	8.95
IL#1-EGSP:3070	2.410	1.426	5.124	*****	0.89	*****
IL#1-EGSP:3094	2.379	0.936	4.938	*****	1.09	*****
IL#1-EGSP:3106	2.628	0.434	0.503	2.5	0.02	0.01
IL#2-EGSP:321.3	2.520	1.684	7.678	16.7	0.08	111.74
IL#2-EGSP:418.33	2.560	1.432	4.715	18.6	0.12	185.78
IL#2-EGSP:465.65	2.483	1.175	5.838	11.6	0.24	588.52
IL#2-EGSP:513.1	2.502	0.939	6.361	*****	0.34	*****
IL#3-EGSP:926.5	2.592	0.908	5.011	13.3	0.06	92.96
IL#3-EGSP:976.2	2.560	*****	4.498	12.2	0.06	85.06
IL#3-EGSP:1026	2.539	1.446	8.839	18.4	0.16	170.93

WELL ID	DENSITY BULK G/CM^3	ISO SLOPE HELIUM TORR^-1 *E4	ISO SLOPE METHANE TORR^-1 *E4	BET AREA	G METHANE CM/TORR *E7	G NITROGEN CM/TORR *E7
IL#3-EGSP:1076.0	2.524	1.400	7.189	13.8	0.17	164.37
IL#3-EGSP:1126	2.788	1.158	3.631	7.7	0.10	92.96
OH#2-EGSP:3544	2.694	0.020	0.930	*****	*****	*****
ROMIG:570	2.682	0.540	2.465	11.9	0.13	263.26
ROMIG:571	2.748	0.936	4.662	8.5	0.50	197.42
ROMIG:684	2.400	0.959	10.111	26.5	100.24	2383.86
ROMIG:704	2.777	*****	10.934	5.5	15.22	112.47
WARN:1517	2.673	0.785	2.706	5.2	0.58	106.05
WARN:2630	2.517	0.051	1.099	2.2	0.66	13.29
WARN:2660	2.419	0.941	3.098	2.1	0.89	11.09
WARN:2675	2.677	0.294	1.729	3.7	2.72	73.55
WU#5-EGSP:2723	2.488	0.383	2.066	1.9	0.59	0.30
WU#5-EGSP:2823	2.704	0.837	3.209	5.7	2.02	81.37
WU#5-EGSP:2935	2.471	0.547	3.426	1.7	0.97	0.78
WU#5-EGSP:3030	2.429	0.253	2.105	1.2	1.26	1.05
WU#5-EGSP:3035	2.658	0.855	3.144	4.7	3.17	70.64
WU#5-EGSP:3135	2.661	1.357	4.200	7.0	2.05	145.14
WU#5-EGSP:3235	2.676	0.443	3.580	4.2	4.38	88.46
WU#5-EGSP:3305	2.648	0.704	2.564	0.6	0.94	110.72
WU#5-EGSP:3335	2.428	0.568	2.120	1.4	0.49	1.02
WU#5-EGSP:3355	2.359	0.381	4.508	1.2	0.90	0.86
WU#6-MERC-1X:7215	2.592	0.916	3.205	3.7	1.77	54.78
WU#6-MERC-1X:7267	2.671	0.494	8.015	7.5	4.95	85.92
WU#6-MERC-1X:7316	2.639	1.033	6.233	6.2	3.93	77.72
WU#6-MERC-1X:7369	2.572	0.951	16.118	13.0	13.46	142.04
WU#6-MERC-1X:7421	2.522	0.647	29.439	15.5	19.53	86.72
WU#6-MERC-1X:7474	2.509	1.040	10.815	13.3	4.53	123.10

WELL ID	DENSITY BULK G/CM ³	ISO SLOPE HELIUM TORR^-1 *E4	ISO SLOPE METHANE TORR^-1 *E4	BET AREA	G METHANE CM/TORR *E7	G NITROGEN CM/TORR *E7
20336:2449	2.424	0.374	1.853	1.6	0.70	0.53
20336:2459	2.454	0.648	2.268	1.6	0.82	0.74
20336:2539	2.657	1.161	4.105	7.7	0.89	147.15
20336:2579	2.644	0.590	4.606	9.0	1.92	158.08
20336:2629	2.660	1.132	4.004	5.3	3120.00	*****
20336:2873	2.642	0.752	2.554	3.1	1.22	25.98
20336:3029	2.492	0.285	1.366	1.9	0.57	0.64
20336:3129	2.648	0.703	2.461	5.6	0.37	145.09
20336:3139	2.642	1.330	3.232	5.8	0.13	142.11
20336:3349	2.554	0.569	3.029	*****	1.84	*****
20338:4921	2.566	0.514	6.334	5.7	4.24	44.82
20338:4971	2.695	0.453	3.486	6.1	3.29	*****
20338:5221	2.692	0.557	1.804	*****	0.38	*****
20338:5451	2.542	0.563	18.634	14.6	8.89	62.00
20403:2836.2	2.721	0.309	3.707	5.6	4.48	67.74
20403:2846.1	2.658	1.824	3.154	3.3	0.69	39.98
20403:2866.3	2.699	0.612	3.733	5.4	3.61	64.25
20403:2876.1	2.698	0.337	3.303	*****	4.02	64.04
20403:2876.3	2.740	0.352	4.133	6.1	5.40	65.33
20403:2886.1	2.668	0.629	3.301	3.6	1.75	*****
20403:2896.1	2.683	0.365	0.974	2.3	0.57	5.19
20403:2906.1	2.708	0.377	2.681	2.8	1.36	28.62
20403:2916.1	2.690	0.060	1.093	2.8	0.30	18.01
20403:2916.3	2.697	0.528	2.092	3.4	1.84	28.40
20403:2926.1	2.737	0.325	2.941	8.8	2.00	37.25
20403:2936.1	2.708	*****	2.911	3.2	1.97	15.58
20403:2946.1	2.744	0.412	2.649	3.0	2.25	23.65
20403:2946.3	2.732	0.839	3.432	4.2	2.54	38.76
20403:2976.1	2.679	0.814	3.656	20.5	3.27	94.43
20403:2996.1	2.624	0.138	1.727	1.4	0.68	3.30
20403:3006.1	2.666	*****	1.633	0.8	2.32	59.88

WELL ID	DENSITY BULK G/CM ³	ISO SLOPE HELIUM TORR^-1 #E4	ISO SLOPE METHANE TORR^-1 #E4	BET AREA	G METHANE CM/TORR #E7	G NITROGEN CM/TORR #E7
20403:3016.1	2.745	*****	0.776	15.0	0.86	70.72
20403:3016.3	2.620	0.932	2.659	3.7	2.08	37.31
20403:3026.1	2.669	0.096	1.197	0.3	0.73	2.10
20403:3026.3	2.654	0.618	2.196	2.0	0.83	5.92
20403:3036.1	2.744	0.669	2.615	2.5	13.60	244.00
20403:3046.1	2.726	0.369	2.564	2.9	1.73	*****
20403:3046.3	2.670	0.334	2.521	4.3	2.78	35.85
20403:3056.1	2.742	0.241	2.541	3.8	2.64	25.43
20403:3066.1	2.674	0.579	2.470	2.9	1.95	28.62
20403:3066.3	2.582	0.840	2.966	2.3	1.46	14.60
20403:3076.1	2.678	0.496	1.854	2.8	1.76	27.53
20403:3086.1	2.703	0.733	2.964	2.8	1.50	14.34
20403:3116.3	2.597	0.815	3.579	2.4	1.36	11.93
20403:3126.3	2.588	1.372	4.416	6.0	4.01	46.19
20403:3186.3	2.647	0.326	1.246	2.1	0.42	2.06
20403:3201.3	3.178	*****	1.837	6.0	5.65	67.11
20403:3211.3	2.681	0.724	3.220	3.4	1.87	23.92
20403:3241.3	2.704	0.232	3.643	31.3	3.35	170.96
20403:3251.3	2.648	0.408	2.738	3.7	2.55	39.89
20403:3291.3	2.716	1.023	3.769	6.8	3.60	62.51
20403:3311.3	2.646	0.583	1.543	1.7	0.39	2.09
20403:3321.3	2.653	0.174	1.196	14.7	0.63	14.46
20403:3476.3	2.570	0.531	1.206	1.7	0.30	2.30
20403:3506.3	2.628	0.863	2.092	3.3	2.28	55.39
20403:3556.3	2.677	0.863	2.852	4.8	2.16	86.12
20403:3616.3	2.684	0.775	1.832	2.4	1.17	16.87
20403:3656.3	2.670	0.693	2.415	5.0	0.14	120.54
20403:3666.3	2.714	0.554	2.380	5.3	0.16	119.67
20403:3796.3	2.672	0.617	2.858	6.0	0.10	130.23
20403:3816.3	2.870	0.222	1.930	5.9	0.16	144.59
20403:3876.3	2.715	0.490	2.060	5.4	0.23	134.83
20403:3946.1	2.512	1.098	2.320	2.0	0.67	6.93
20403:3976.3	2.506	0.212	0.791	2.2	0.26	1.48

Data Summary

Table II

Explanation of headings

Well I D

Brown - Belmont County, Ohio

Dawson - Richland County, Ohio

Egner - Richland County, Ohio

Romig - Richland County, Ohio

Warn - Chataqua County, New York

Diffusion Constant - calculated from degassing data. Expressed in cm^2/sec .

Density, Helium - density found using helium as the displacing fluid.

Net Methane Sorption - The amount of methane that must be in solution in kerogen, or adsorbed onto surfaces expressed in volume sorbed/volume rock/torr pressure.

Permeability - Expressed in darcies.

Apparent Porosity - Calculated in the standard manner from helium and methane isotherms. These numbers do not, however, reflect actual void spaces in the shale.

WELL ID	DIF CONST METHANE CM^2/S #E7	DENSITY HELIUM G/CM^3	NET CH4 SORPTION TORR^-1 #E4	PERM DARCIES #E9	APP POROSITY HELIUM %	APP POROSITY METHANE %
BROWN:4400	49.70	2.78	1.921	8.262	1.6	16.2
BROWN:5541	11.62	2.78	2.144	2.469	4.4	20.7
BROWN:5561	5.79	2.67	1.364	0.758	2.4	12.8
BROWN:5586	8.54	2.74	1.536	1.405	4.4	16.0
CH-11940:3481.5	*****	****	2.180	*****	****	16.6
CH-11940:3636.4	*****	2.72	1.375	*****	1.5	11.9
CH-11940:3778.9	*****	2.61	3.458	*****	4.2	30.5
CH-11940:3787.9	*****	2.58	1.443	*****	1.0	12.0
DAWSON:676	22.63	2.46	9.865	18.219	3.5	78.5
DAWSON:686	0.01	2.69	0.857	0.000	0.3	6.8
EGNER:340	0.07	2.87	5.274	0.037	9.1	49.2
EGNER:345	0.07	2.94	4.861	0.033	9.8	46.7
EGNER:510	36.72	3.20	7.942	30.291	20.0	80.4
EGNER:520	42.18	2.56	7.612	27.288	5.2	63.1
IL#1-EGSP:3010	0.03	2.75	3.972	0.013	6.5	36.7
IL#1-EGSP:3038	0.76	2.61	6.183	0.442	10.0	57.0
IL#1-EGSP:3052	2.87	2.61	2.434	0.693	5.0	23.5
IL#1-EGSP:3070	0.95	2.70	3.697	0.378	10.8	38.9
IL#1-EGSP:3094	1.53	2.56	4.002	0.589	7.1	37.5
IL#1-EGSP:3106	0.06	2.72	0.069	0.002	3.3	3.8
IL#2-EGSP:321.3	0.00	2.89	5.994	0.002	12.8	58.4
IL#2-EGSP:418.33	0.02	2.87	3.283	0.007	10.9	35.8
IL#2-EGSP:465.65	0.05	2.73	4.663	0.025	8.9	44.4
IL#2-EGSP:513.1	0.09	2.69	5.423	0.044	7.1	48.3
IL#3-EGSP:926.5	0.00	2.78	4.103	0.002	6.9	38.1
IL#3-EGSP:976.2	0.01	****	4.498	0.002	*****	34.2
IL#3-EGSP:1026	0.01	2.85	7.392	0.007	-11-0	67.2

WELL ID	DIF CONST METHANE CM^2/S #E7	DENSITY HELIUM G/CM^3	NET CH4 SORPTION TORR^-1 #E4	PERM DARCIES #E9	APP POROSITY HELIUM %	APP POROSITY METHANE %
IL#3-EGSP:1076.0	0.02	2.82	5.789	0.010	10.6	54.6
IL#3-EGSP:1126	0.02	3.06	2.473	0.007	8.8	27.6
QH#2-EGSP:3544	*****	2.70	0.910	*****	0.2	7.1
ROMIG:570	0.09	2.80	1.926	0.018	4.1	18.7
ROMIG:571	0.36	2.96	3.727	0.129	7.1	35.4
ROMIG:684	3087.93	2.59	9.152	2434.340	7.3	76.8
ROMIG:704	60.85	****	10.934	51.876	*****	83.1
WARN:1517	1.47	2.84	1.921	0.309	6.0	20.6
WARN:2630	11.38	2.53	1.048	0.975	0.4	8.4
WARN:2660	2.56	2.61	2.157	0.619	7.2	23.5
WARN:2675	77.48	2.74	1.436	10.448	2.2	13.1
WU#5-EGSP:2723	2.60	2.56	1.684	0.419	2.9	15.7
WU#5-EGSP:2823	12.45	2.89	2.372	3.114	6.4	24.4
WU#5-EGSP:2935	2.51	2.58	2.879	0.672	4.2	26.0
WU#5-EGSP:3030	11.17	2.48	1.852	1.834	1.9	16.0
WU#5-EGSP:3035	32.04	2.84	2.289	7.854	6.5	23.9
WU#5-EGSP:3135	7.50	2.97	2.843	2.457	10.3	31.9
WU#5-EGSP:3235	46.94	2.77	3.137	13.103	3.4	27.2
WU#5-EGSP:3305	4.26	2.80	1.860	0.851	5.3	19.5
WU#5-EGSP:3335	1.66	2.54	1.552	0.274	4.3	16.1
WU#5-EGSP:3355	1.26	2.43	4.127	0.444	2.9	34.3
WU#6-MERC-1X:7215	9.63	2.79	2.289	2.407	7.0	24.4
WU#6-MERC-1X:7267	12.00	2.78	7.522	7.501	3.8	60.9
WU#6-MERC-1X:7316	12.50	2.86	5.199	6.076	7.9	47.4
WU#6-MERC-1X:7369	21.91	2.77	15.166	27.539	7.2	122.5
WU#6-MERC-1X:7421	13.82	2.65	28.792	31.731	4.9	223.7
WU#6-MERC-1X:7474	5.51	2.72	9.775	4.644	7.9	82.2

WELL ID	DIF CONST METHANE CM^2/S *E7	DENSITY HELIUM G/CM^3	NET CH4 SORPTION TORR^-1 *E4	PERM DARCIES *E9	APP POROSITY HELIUM %	APP POROSITY METHANE %
20336:2449	4.51	2.49	1.480	0.651	2.8	14.1
20336:2459	4.13	2.58	1.619	0.731	4.9	17.2
20336:2539	1.49	2.91	2.944	0.476	8.8	31.2
20336:2579	5.44	2.77	4.015	1.952	4.5	35.0
20336:2629	19.08	2.91	2.872	5.955	8.6	30.4
20336:2873	7.17	2.80	1.802	1.427	5.7	19.4
20336:3029	5.39	2.55	1.081	0.573	2.2	10.4
20336:3129	0.69	2.80	1.759	0.133	5.3	18.7
20336:3139	0.05	2.94	1.902	0.014	10.1	24.6
20336:3349	11.60	2.67	2.460	2.740	4.3	23.0
20338:4921	14.07	2.67	5.820	6.949	3.9	48.1
20338:4971	28.04	2.79	3.033	7.621	3.4	26.5
20338:5221	1.38	2.81	1.247	0.194	4.2	13.7
20338:5451	7.15	2.66	18.071	10.394	4.3	141.6
20403:2836.2	45.79	2.79	3.398	13.238	2.3	28.2
20403:2846.1	1.49	3.09	1.330	0.366	13.9	24.0
20403:2866.3	29.34	2.83	3.120	8.539	4.7	28.4
20403:2876.1	46.47	2.77	2.966	11.967	2.6	25.1
20403:2876.3	53.55	2.82	3.781	17.254	2.7	31.4
20403:2886.1	8.83	2.80	2.673	2.273	4.8	25.1
20403:2896.1	10.83	2.76	0.609	0.822	2.8	7.4
20403:2906.1	8.08	2.79	2.304	1.689	2.9	20.4
20403:2916.1	2.35	2.70	1.033	0.200	0.5	8.3
20403:2916.3	24.40	2.81	1.564	3.980	4.0	15.9
20403:2926.1	14.47	2.81	2.616	3.318	2.5	22.4
20403:2936.1	14.46	****	2.911	3.281	*****	22.1
20403:2946.1	22.75	2.83	2.237	4.700	3.1	20.1
20403:2946.3	17.22	2.92	2.593	4.607	6.4	26.1
20403:2976.1	25.17	2.86	2.842	7.175	6.2	27.8
20403:2996.1	4.93	2.65	1.590	0.664	1.0	13.1
20403:3006.1	63.42	****	1.633	8.060	*****	12.4

WELL 10

	DIF CONST METHANE CM^2/S *E7	DENSITY HELIUM G/CM^3	NET CH4 SORPTION TORR^-1 *E4	PERM DARCIES *E9	APP POROSITY HELIUM %	APP POROSITY METHANE %
20403:3016.1	38.42	****	0.776	2.324	*****	5.9
20403:3016.3	19.29	2.82	1.727	3.998	7.1	20.2
20403:3026.1	11.73	2.69	1.102	1.095	0.7	9.1
20403:3026.3	4.50	2.78	1.578	0.770	4.7	16.7
20403:3036.1	84.97	2.89	1.946	173.300	5.1	19.9
20403:3046.1	14.35	2.80	2.195	2.869	2.8	19.5
20403:3046.3	38.09	2.74	2.187	7.486	2.5	19.2
20403:3056.1	33.97	2.79	2.300	6.730	1.8	19.3
20403:3066.1	19.51	2.80	1.890	3.758	4.4	18.8
20403:3066.3	7.63	2.76	2.126	1.765	6.4	22.5
20403:3076.1	28.45	2.78	1.359	4.113	3.8	14.1
20403:3086.1	8.04	2.86	2.231	1.858	5.6	22.5
20403:3116.3	4.54	2.77	2.764	1.266	6.2	27.2
20403:3126.3	25.93	2.89	3.044	8.928	10.4	33.6
20403:3186.3	3.51	2.71	0.920	0.341	2.5	9.5
20403:3201.3	296.77	****	1.837	42.517	*****	14.0
20403:3211.3	10.61	2.84	2.496	2.664	5.5	24.5
20403:3241.3	26.59	2.75	3.412	7.554	1.8	27.7
20403:3251.3	27.20	2.73	2.330	5.807	3.1	20.8
20403:3291.3	28.60	2.94	2.746	8.403	7.8	28.6
20403:3311.3	1.99	2.77	0.960	0.240	4.4	11.7
20403:3321.3	0.81	2.69	1.022	0.822	1.3	9.1
20403:3476.3	1.92	2.68	0.674	0.180	4.0	9.2
20403:3506.3	37.27	2.81	1.229	6.077	6.6	15.9
20403:3556.3	18.03	2.87	1.989	4.010	6.6	21.7
20403:3616.3	12.87	2.85	1.057	1.838	5.9	13.9
20403:3656.3	0.10	2.82	1.722	0.019	5.3	18.4
20403:3666.3	0.14	2.83	1.826	0.027	4.2	18.1
20403:3796.3	0.04	2.80	2.241	0.009	4.7	21.7
20403:3816.3	0.20	2.92	1.708	0.031	1.7	14.7
20403:3876.3	0.39	2.82	1.570	0.063	3.7	15.7
20403:3946.1	2.64	2.74	1.222	0.477	8.3	17.6
20403:3976.3	3.37	2.55	0.578	0.208	1.6	6.0

TABLE III. SUMMARY STATISTICAL INFORMATION OF TABLE II

Parameter	Minimum Value	Maximum Value	Average Value	Sigma (% of Average)
Bulk Density	2.35	3.18	2.62	4.44
Isotherm Slope (Helium)	1.98E-06	2.64E-04	6.90E-05	61.2
Isotherm Slope (Methane)	5.03E-05	2.94E-03	3.96E-04	93.9
BET	.306	31.3	6.11	89.4
G (Methane)	1.21E-09	3.12E-04	3.08E-06	950.
G (Nitrogen)	1.40E-09	2.38E-04	9.60E-06	251.
Diffusion Constant (Methane)	3.51E-10	3.09E-04	4.38E-06	661.
Density (Helium)	2.43	3.20	2.76	4.73
Net Methane Sorption	6.91E-06	2.88E-03	3.31E-04	109.
Permeability (Darcies)	4.00E-13	2.43E-06	2.77E-08	822.
Apparent Porosity (Helium)	.151	20.0	5.25	61.2
Apparent Porosity (Methane)	3.83	223.	30.1	93.9