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**CHARACTERIZATION AND ANALYSIS OF DEVONIAN SHALES AS
RELATED TO RELEASE OF GASEOUS HYDROCARBONS**

Quarterly Technical Progress Report for January—March 1979

By
R. S. Kalyoncu
J. P. Boyer
M. J. Snyder

MASTER

April 15, 1979
(Date Published)

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Battelle, Columbus Laboratories
Columbus, Ohio

U. S. DEPARTMENT OF ENERGY

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R. S. Kalyoncu, J. P. Boyer and M. J. Snyder

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

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LIST OF CONTRIBUTORS

M. J. Snyder, Program Manager
R. S. Kalyoncu, Principal Investigator
J. P. Boyer
C. A. Alexander
D. Chase
R. W. Coutant
J. W. Lennon
D. W. Pickett
M. Rausch
A. J. Roese
A. J. Walker
M. V. Weaver

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CHARACTERIZATION AND ANALYSIS
OF DEVONIAN SHALES AS RELATED TO
RELEASE OF GASEOUS HYDROCARBONS

Quarterly Technical Progress Report
January - March 1979

EXECUTIVE SUMMARY

This tenth Quarterly Technical Progress Report on the Characterization of Eastern Devonian Gas Shales as Related to Release of Gaseous Hydrocarbons, under U. S./DOE Contract No. EY-76-C-05-5205, describes the characterization data obtained during the period January through March, 1979.

This program was initiated in September, 1976, with the objective and scope of determining the relationships between the shale characteristics, hydrocarbon gas contents, and well location, and thereby provide a sound basis for (1) assessing the productive capacity of the Eastern Devonian Gas Shale deposits, and (2) guiding research, development, and demonstration projects to enhance the recovery of natural gas from the shale deposits. Included in the scope of the program are a number of elemental tasks as a part of the Resource Inventory and Shale Characterization subprojects of DOE's Eastern Gas Shales Project designed to provide large quantities of support data for current and possibly future needs of the Project.

The Y-1 well in Allegany County, New York was sampled in September 1978. A total of 412 samples were collected from the Allegany County, New York well (165 for Battelle and 247 for other DOE/MERC contractors).

Characterization data on Y-1 (EGSP New York No. 1), Allegany County, New York well is reported and discussed in this tenth Quarterly Technical Progress Report.

Analysis of the hydrocarbon gases in Y-1 samples indicates that the longer chain hydrocarbon gases (ethane, propane, butane) in these shales are significantly higher than in the previous wells studied. Because these hydrocarbons have significantly higher heats of combustion than methane, the methane equivalent of the hydrocarbon gas contents in New York shales is considerably higher.

The carbon contents of the Y-1 (Allegany County, New York) well, on the other hand, are somewhat lower than one would predict from the hydrocarbon gas contents. There is still a positive relationship between the carbon and hydrocarbon gas contents, however; that is, higher carbon contents are associated with increasing hydrocarbon-gas content in the shales. A similar relationship is also apparent between the sulfur and hydrocarbon gas contents.

No unusual trends are observed in the porosity values, and a reasonable agreement exists between the measured Hg-intrusion values and those calculated from the density data. Generally, the expected inverse relationship exists between the porosity and bulk density data, that is, higher porosity values are associated with low bulk densities.

From limited lithological observations New York shales exhibit variable clay, mineral, and quartz contents. Generally, low levels of pyrite and carbonate minerals are observed. The low pyrite and carbonate contents noted in the powder examination of the samples are supported by the EDAX results showing low Ca and S contents.

INTRODUCTION

The ninth Quarterly Technical Progress Report (January 15) was devoted to the presentation and discussion of the data from the I-2 (Clark County, Indiana) well. Also some partial data on the Y-1 (Allegany County, New York) well was reported. This tenth Quarterly Technical Progress Report is a comprehensive presentation of all the characterization data obtained on the Y-1 well along with the AID (Automatic Interaction Detection) analysis of both well log and laboratory characterization data.

Among the characterization data are free gas contents, gas release kinetics, chemical analysis (carbon, hydrogen, nitrogen and sulfur), physical characteristics (densities, porosities, permeabilities), and lithology of shales.

OBJECTIVE AND SCOPE

The objective of this program is to determine the relationships between shale characteristics, hydrocarbon gas content, and well location to provide a sound basis for defining the productive capacity of the Eastern Devonian Shale deposits and for guiding research, development, and demonstration projects to enhance the recovery of natural gas from the shale deposits. The program includes a number of elemental tasks as a part of the Resource Inventory and Shale Characterization subprojects of DOE's Eastern Gas Shales Project and is designed to provide a wide variety of support data for that project.

Approximately 1000 core samples of gas bearing Eastern Devonian Shale will have been examined by the end of the program. After the characterization data for individual wells have been compiled, a regression-type analysis for pattern recognition will be performed to establish the inter-relationships between the shale characteristics, the hydrocarbon gas content, and well locations from which the samples were obtained.

The following tasks comprise the total efforts in this research program:

<u>Task</u>	<u>Descriptive Title</u>
1	Core Sampling
2	Gas Content and Gas Release Kinetics
3	Chemical Characterization of Shale
4	Physical Characterization of Shale
5	Lithology of Shale
6	Data Interpretation and Correlation

A. ANALYSIS AND DISCUSSION OF THE CHARACTERIZATION DATA

The characterization data on the Y-1 (Allegany County, New York) well are reported and discussed in the ensuing pages.

Task No. 1 - Well Coring

Cored shale samples were obtained on the Y-1 well in Allegany County, New York in September 1978. The coring was made between depths of 370 and 2926 feet. A total of 412 core samples were taken from the well, 165 of which were for Battelle and the remaining 247 samples were delivered to other DOE contractors. Well and field sampling data on the Y-1 well are presented in Tables 1 and 2, respectively. Surface times are plotted in Figure 1.

Task No. 2 - Free Gas Contents and Gas Release Kinetics

The initial gas release rates are presented in Table 3 for the Y-1 well with statistical analysis depicted in Table 4. A wide variation in the total hydrocarbon gas contents in the shales is quite apparent from Table 3 and from the statistical parameters in Table 4. The mean value of hydrocarbon gas contents in the Y-1 well is approximately 28.7 percent with a standard deviation of 22 and a variance of 482.

Some of the shale specimens exhibit significant amounts of longer chain hydrocarbon gases (ethane, propane, butane). These long chain hydrocarbons have considerably higher heats of combustion than that of methane. For example, the heat of combustion for ethane (373 kCal/mol) is about 1.75 times that of methane (212 kCal/mol). The values for propane (531) and butane (688) are 2.5 and 3.2 times higher than that of methane, respectively. With the heat of combustion value in mind the total hydrocarbon content could be converted to methane equivalent by simply multiplying the high hydrocarbon gas values by the ratio of the heats of combustion. Table 5 summarizes the methane equivalent of the hydrocarbon gas contents obtained in this manner. High hydrocarbons to methane ratio $(2 + 3 + 4 + 5/1)$ is also given in Table 5. This ratio could be looked at as a measure of gas quality. The higher this ratio the higher would be the BTU content of the gas. As indicated in Table 5, the ratio varies between zero (no hydrocarbons other than methane) and 2.73 for direct ratio, and zero to 7.5 for the methane equivalents.

Gas release rates were determined for five shale samples from the Y-1 well. This work was performed by rapidly evacuating the shale containers, and then monitoring the pressure buildup over a period of about 65 days. Data for these samples are shown in Table 6.

These data were analyzed using the methods of Wilson (Phil. Mag. (7) 39, 48 (1948)). Accordingly, the following equation applies:

$$\frac{P}{P_{\infty}} = 1 - \sum \frac{4a(1+a)}{4 + 4a + a^2 q_n^2} e^{-D q_n^2 t / r^2} \quad (1)$$

where r is the sample radius (4.4 cm), a is the ratio of the capacity of the shale to that of the free space in the container, and q_n 's are the positive non-zero roots of the equation

$$a q_n J_0(q_n) + 2 J_1(q_n) = 0 \quad (2)$$

where the J 's are zero and first order Bessel functions. Solutions for the q_n 's are available in standard tabulations for various values of a , the capacity parameter. The latter parameter must be determined by fitting the data to Equation 1. For cases where there is little sorption of the gas by the shale, a is small and is determined by bulk volume of the shale and its porosity. However, when appreciable sorption occurs, the value of a can be quite large. At values of $a > 10$, Equation 1 becomes insensitive to this parameter. Within the range of a values of 0-10, the shape of the pressure response curve is fairly sensitive to the value of a , and a preliminary judgment of the appropriate value of a can be made by comparison of the pressure curve to curves given by Wilson (op. cit.).

Application of Equation (1) to the data cited above yields the results tabulated in Table 7.

Calculated curves for samples Y-1-1939, 2119, and 2538 are shown along with the experimental data in Figures 3, 4, and 5. Data for the other two samples are not plotted due to lack of sufficient data points.

In principle, it should be possible to assess the total gas content per unit volume of shale from knowledge of a . However, because of the insensitivity of the results when $a > 10$, only qualitative comparisons can

be made for the current samples. For these samples, the value of a , based solely on the physical dimensions of the shale and its container, is 0.25. Thus, all of these samples display at least some capacity for hydrocarbon gas sorption.

It is interesting to compare the derived values of P_{∞} with the hydrocarbon pressures initially present in the containers before the experiment was begun. This comparison is illustrated in Table 8.

Except for the case of sample 1939, values of P_{∞} are less than the initial hydrocarbon pressures. This is to be expected if any appreciable gas was lost during the pump-out procedure. Samples 1939 and 2538 have large " a " values indicating relatively large gas capacities. Sample 1939, however, has a very small diffusion coefficient and 2538 has a relatively large diffusion coefficient. Thus, most of the gas present in 1939 was retained during the handling and experimental procedures, but it appears that much of the gas originally present in 2538 could have been lost. This comparison is significant because it indicates possible errors in judgment of gas capacity by the usual procedure of measuring pressures after some period of time (usually 30 days). In the case of sample 1939, this time is obviously not long enough; for sample 2538, a significant portion of the gas could have been lost before it was sealed into the container. In any case, the variation of real capacities (as opposed to the physical dimensions of the sample) make the initial pressure measurement less meaningful. Although this measurement probably reflects the amount of gas readily available under the current sampling conditions, it does not reflect the fact that more efficient fracture of sample 1939 would result in release of much more gas than could be obtained from sample 2119. For example, if the sample radius for 1939 had been 2.2 cm, the pressure expected after 65 days would be 355 torr. Furthermore, the simple pressure measurement probably underestimates the true original gas content of sample 2538.

Long-term diffusion study was conducted with sample Y-1-2538 at temperatures of 25 and 80 C using the continuous flow total hydrocarbon technique. Data for the 80 C run are shown in Figure 6. These data are interesting in that they display a departure from expected behavior during the initial portion of the run, and suggest a modified approach that should enable us to extract additional information from similar samples.

Our customary analysis of the diffusion data is based on the assumption that only methane contributes significantly to the observed total hydrocarbon signal. Treating the core sample as a cylinder having "easy" diffusion in the radial direction, the average concentration of gas in the cylinder at any time is

$$\bar{C} = 4C_0 \sum_1 \frac{1}{\xi_1^2} \exp \left[-\frac{\xi_1^2 Dt}{r^2} \right] \quad (3)$$

where C_0 is the initial concentration, ξ_1 are zero-order Bessel function roots, D is the diffusion coefficient, and r is the radius of the cylinder. With the technique used, we do not measure the concentration in the sample, but rather determine the total hydrocarbon concentration in a stream of nitrogen flowing over the sample. Thus, the gas phase concentration, C_g , is given by

$$C_g = (V_s/F)(d\bar{C}/dt) \quad (4)$$

or

$$C_g = 4C_0DV_s/r^2F \sum_1 \exp \left[-\frac{\xi_1^2 Dt}{r^2} \right] \quad (5)$$

For values of $Dt/r^2 > 0.15$, only the first term of the series in equation 5 is significant, and a plot of $\ln C_g$ vs. t yields a straight line having a slope proportional to D and an intercept proportional to the initial concentration in the cylinder.

Figure 6 shows the data for the subject sample plotted in this manner, with an apparent D of 1.6×10^{-6} cm²/sec. and an apparent gas to shale ratio of 0.80 V/V. However, the early portion of the experimental curve does not conform to equation 5; (alternatively, it suggests a higher diffusion coefficient). The most probable reason for this behavior is the inclusion of higher molecular weight ($>C_1$) in the escaping gas early in the experiment. The initial gas analysis for this sample indicated an average of about 1.8 carbons per molecule, which agrees well with the

approximately 2:1 disparity between the observed and predicted response curves. A run made at room temperature with a second sample of the same shale showed the same type of behavior, but with a smaller difference between the apparent diffusion coefficients for the initial and final portions of the run ($D_F = 1.36 \times 10^{-6} \text{ cm}^2/\text{sec.}$). Thus the apparent temperature dependencies for the two branches of the response curve are different, with the early portion having the greater coefficient. This too would be expected if the excess signal is due to higher molecular weight hydrocarbons.

One way to resolve this question while simultaneously obtaining additional information about the gas release process is to analyse the effluent gas for individual hydrocarbons rather than measuring the total carbon content. This can be accomplished with only minor modification to the existing set-up, and it should be worthwhile in terms of helping to define the compositional dispersion for an operating well.

Task No. 3 - Chemical Characterization Data

Total carbon, hydrogen, nitrogen, and sulfur determinations have been made on all the Y-1 shales. The results are summarized in Table 9. The measured carbon contents are surprisingly low compared with the hydrocarbon gas contents reported in Table 3. This observation is somewhat contrary to the findings in the studies of the previous wells where the general trends have been the association of high carbon contents with high values of hydrocarbon gas contents. The positive relationship between carbon and hydrocarbon gas contents, however, is still apparent, as illustrated in Figure 11. The Y-1 well shows higher H/C atomic ratios than the previous wells, indicating that inorganic minerals (mostly clay minerals such as illite and kaolinite) are also sources of hydrogen (in the form of water) in addition to organic compounds (such as kerogen).

Figures 7 through 13 summarize one-to-one correlations between the chemical composition (e.g., carbon, hydrogen, sulfur contents) and hydrocarbon gas contents and depth. Figure 7, for example, is a plot of depth versus carbon content. Selective points in this plot fall nearly on an exponential curve indicating an exponential increase in carbon contents with sample depth. The Y-1 well is the only location which exhibits such a relationship between carbon contents with shale depth.

No apparent significant pattern is seen in hydrogen contents as a function of depth as illustrated in Figure 8. H/C atomic ratio versus depth exhibits even more scatter than either carbon or hydrogen values with depth (Figure 9). A general increase in sulfur content as a function of depth is apparent. The scatter of data does not allow a possible approximation of a quantitative correlation. The relationship could be anything between linear and exponential. Sulfur versus depth is shown in Figure 10.

Figure 11 is a plot of carbon versus hydrocarbon gas contents. Increasing hydrocarbon gas contents is apparent with increasing carbon contents. Hydrogen versus hydrocarbon gas in Figure 12 does not exhibit a readily recognizable relationship. The same is true for Figure 13, illustrating the hydrocarbon gas contents as a function of sulfur content in the shales.

Task No. 4 - Summary of Physical Characterizations

The physical characterization data determined on the Y-1 shales are depicted in Table 10 with the statistical analysis provided in Table 11. For the 165 samples characterized the bulk densities have a mean value of 2.618 and true density of 2.767 with standard deviations of 0.06 and 0.14, respectively. One-to-one relationships between the bulk densities and various other data (hydrocarbon gas, carbon, and hydrogen contents, etc.) are illustrated in Figures 14 through 16. Similar relationships between carbon, hydrogen, nitrogen, and porosities are shown in Figures 17 through 19. Figure 20 is a plot of bulk density versus porosity.

Mercury intrusion porosity values are tabulated in Table 12. These values compare reasonably well with porosities obtained from the density data. Total data on mercury intrusion porosities are presented in Appendix A.

Five Y-1 shale specimens were prepared for gas permeability measurements. No significant permeation of gas took place after 60 minutes of subjecting the samples (1-inch diameter and 1-1/4-inch thick) to 1 atmosphere pressure gradient.

Task No. 5 - Lithology of Shales

The Y-1 shale samples examined are characterized by variable clay mineral and quartz contents, and generally low pyrite, carbonate minerals, and organic material contents. Chemical and physical characterization data support the low organic content observed microscopically.

Based on examination of powders using the petrographic microscope the illite contents of the samples range from high to very low, the converse being true of the quartz contents. Quartz grain size varies from 10 to 20 μm in sample Y-1-1751 to coarser sizes in the other samples, the largest being in sample Y-1-1440 where the range is 15 to 80 μm . As usual, pyrite grain sizes, which are generally sparse, range mostly in the 5 to 10 μm size.

Sample, Y-1-1330, examined in the powder form but not by SEM, appeared to have a more abundant pyrite content, and coarser single crystal fragments of carbonate minerals, though in small amounts.

In Table 13 are presented EDAX results obtained using the SEM. With one exception these results are in good agreement with microscopic observations of powder samples. Samples Y-1-1440 and Y-1-1909 appeared to be very low in illite and very high in quartz contents. This is reflected in the low K and high Si contents, or low K/Si ratios, shown in Table 13. The exception is sample Y-1-1440 which appears to have a high quartz content in the powder sample examined, whereas the EDAX results using a fragment of the shale show a high K and low Si content, indicating a high illite, low quartz content. Additional examination will be made of the Y-1-1440 sample.

The low pyrite and carbonate mineral contents noted in the powder examinations are supported in the low contents of S and Ca in Table 13. Occasionally Cl is noticeable in small amounts in EDAX results and is thought to be attributable to contamination from handling the specimen. However, the contents detected in samples Y-1-1440 and particularly Y-1-1592 were listed in Table 13 because care is generally taken in handling the sample and the content of Y-1-1592 is relatively high.

Samples Y-7-6104, -6194, -6293, and -6448 were similar in their abundant clay-mineral content, moderate quartz content and generally low pyrite and carbonate mineral content. Sample Y-7-6104, when examined by petrographic microscope appeared to have a somewhat higher clay-mineral content than the other samples. As the K content, as shown by EDAX in Table 13, was comparable to that of the other samples, and the Al content higher, it is considered that the illite content is comparable to that of the other samples but this sample also contains kaolinite. As judged microscopically, the Sample Y-7-6293 contained a moderate amount of pyrite, the other samples containing very little. The EDAX results indicated Sample Y-7-6194 to contain the most, based on the Fe and S counts. Similarly, Sample Y-7-6194 was observed microscopically to contain more carbonate mineral than the other samples, which was not indicated by the Ca/Mg counts in Table 13. These discrepancies can be accounted for by the fact that different portions of the same sample were used for microscopic examination and for the energy dispersive analysis.

As mentioned previously, Sample Y-7-6544 was highly opaque to transmitted light making mineral identification nearly impossible. It is of interest that the Fe count of this sample was similar to that of the others indicating that the Fe was not responsible for the opacity.

Figures 21 through 25 are SEM views of typical areas of fractured surfaces of the sample. A number of SEM photographs on Y-1 shales were presented in the Ninth Quarterly Report.

AUTOMATIC INTERACTION DETECTION (AID) ANALYSIS

The physical, chemical, and wirelog data from well EGSP NY No. 1 have been analyzed utilizing the A.I.D. program described in previous reports. This program splits the data into binary groups in such a fashion that the variability of the new groups is less than the parent group. At each splitting point the program selects the most useful (greatest variability reducer) splitting variable. Because of the large number of samples taken from the Y-1 well (159 samples were used in most of this work) the data base should be adequate to detect any correlations or interactions which may exist in the data.

The primary emphasis in the current work has been to determine which, if any, of the wirelog data would prove useful in predicting gas contents. The log data available to us are shown in the following Table 14. All logs were from Schlumberger.

TABLE 14. WIRELOGS FROM EGSP NY NO. 1

1.	Compensated Neutron Porosity
2.	Bulk Density
3.	Gamma Ray
4.	Medium Induction - Resistivity
5.	Deep Induction - Resistivity
6.	Shallow Focused - Resistivity
7.	Interval Transit Time
8.	Coriband Porosity
9.	Coriband Shale Content
10.	Coriband Kerogen Content
11.	Coriband Water Saturation
12.	Coriband Bulk Density
13.	Amplitude
14.	Pressure Gradient
15.	Shear Modulus

Using these wirelogs and various laboratory data on chemistry, gas content, porosity, and density a number of A.I.D. analyses were made. The splitting trees generated by some of these analyses are presented in Figures 26 through 29.

In the course of our A.I.D. work several anomalous results have been encountered associated with wirelog data. The tree presented in Figure 26 is a typical example. The initial split was made on the basis of sample depth and it shows that the higher gas contents are found at the greater depths*. The next split is made on the low gas content group according to shale color (the A.I.D. program permits variables to be treated as "free"

* It should be noted that the A.I.D. program requires the raw data to be coded to range from 0 to 63.

that is, although the various color codes have been assigned numerical values the computer does not assume 3 is greater than 2, for instance. This means that the computer will try all of the possible arrangements of the various colors in order to determine if any order is a good predictor). In this case the program tells us that samples with shale colors N2, N3, 5Y2/1, and 5YR2/1 generally contain more gas than N4, N5, or 5GY4/1. At this point a few anomalies surface. The first is that in the splitting of the high gas content group on the basis of Coriband porosity, the higher gas contents are associated with low porosity. In the next two splits based on Coriband bulk density we see a similar result with high density being associated with high gas.

Very similar behavior occurred when the gas/unit volume of shale was compared with both wirelog and laboratory physical property data as shown in Figure 27. In this case the first split made on wirelog bulk density appears normal. However, the next three splits made on Coriband porosity, laboratory true density, and wirelog neutron porosity are apparently reversed. The next split on laboratory total porosity is apparently satisfactory but the final splits are not.

We do not, at present, have a good explanation for this behavior but we believe that these results are indicative of the present state-of-the-art of logging these tight shale formations. We believe that this illustrates why a good deal more work is necessary to determine how gas is held and transported in the shale. Apparently the porosity being detected by the Coriband techniques is not the principal location of gas in the shale. We are continuing to check and verify the results on other well data and exploring other explanations such as:

- (1) Results are a mathematical artifact caused by an unusual distribution of the collected data
- (2) Logging data influenced by the nature of fluid in the borehole
- (3) Logging results influenced by the nature of the gas or other materials in the pores
- (4) High porosity samples are losing a greater proportion of their gas prior to sealing in canisters.

Other results from the A.I.D. work are shown in Figures 35 and 36. The analysis of the total carbon data is interesting in that it indicates that lateral resistivity shows good potential as a predictor and the use of color as a predictor follows the results previously discussed. The second split on color in Figure 28 indicates that the 5Y2/1 and 5YR2/1 shales show more gas than the N2 and N3 shales. This figure does contain one other anomaly associated with Coriband data; the higher densities being associated with high carbon content.

Figure 29 illustrates the importance of depth and corrected pressure with splits occurring on both twice. The potential of resistivity as a good tool is also seen in this analysis.

In general, one can account for approximately 80 percent of the variation in the gas contents through the data analysis. This includes, however, the anomalous porosity results in some cases. In view of this, definite conclusions regarding the development of a predictive scheme cannot be made at this time. Further refinements of the systems will be made as the anomalies are resolved.

TABLE 1. WELL DATA FOR Y- 1

LOCATION: ALLEGANY COUNTY, NY

ALTITUDE: 1850 FEET

COORDINATES: 77.49 (DEGREES.MINUTES) LONGITUDE
42.21 (DEGREES.MINUTES) LATITUDE

CORING BEGAN AT 370 FEET AND STOPPED AT 2926 FEET. IT TOOK 29 BARRELS TO COMPLETE.

SAMPLES WERE RETURNED TO BATTELLE ON 9/21/78.

THERE WERE 165 SAMPLES COLLECTED FOR BATTELLE AND 247 SAMPLES COLLECTED FOR OTHERS.

RUN INFORMATION FROM WELL Y- 1

RUN NO. 1	CORING BEGAN AT 370 FEET AND CORING STOPPED AT 429 FEET. THE AVERAGE CORING RATE IS 7.66 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN .90 HOURS
RUN NO. 2	CORING BEGAN AT 429 FEET AND CORING STOPPED AT 488 FEET. THE AVERAGE CORING RATE IS 7.86 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.27 HOURS
RUN NO. 3	CORING BEGAN AT 488 FEET AND CORING STOPPED AT 546 FEET. THE AVERAGE CORING RATE IS 8.52 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.33 HOURS
RUN NO. 4	CORING BEGAN AT 963 FEET AND CORING STOPPED AT 1022 FEET. THE AVERAGE CORING RATE IS 8.54 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.50 HOURS
RUN NO. 5	CORING BEGAN AT 1328 FEET AND CORING STOPPED AT 1387 FEET. THE AVERAGE CORING RATE IS 8.71 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.93 HOURS
RUN NO. 6	CORING BEGAN AT 1378 FEET AND CORING STOPPED AT 1446 FEET. THE AVERAGE CORING RATE IS 7.59 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.23 HOURS

TABLE 1. (Continued)

RUN INFORMATION FROM WELL CONTINUED Y- 1

RUN NO. 7	CORING BEGAN AT 1446 FEET AND CORING STOPPED AT 1483 FEET. THE AVERAGE CORING RATE IS 7.30 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.98 HOURS
RUN NO. 8	CORING BEGAN AT 1433 FEET AND CORING STOPPED AT 1531 FEET. THE AVERAGE CORING RATE IS 6.77 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.10 HOURS
RUN NO. 9	CORING BEGAN AT 1531 FEET AND CORING STOPPED AT 1590 FEET. THE AVERAGE CORING RATE IS 8.42 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.40 HOURS
RUN NO. 10	CORING BEGAN AT 1590 FEET AND CORING STOPPED AT 1649 FEET. THE AVERAGE CORING RATE IS 7.70 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.00 HOURS
RUN NO. 11	CORING BEGAN AT 1649 FEET AND CORING STOPPED AT 1708 FEET. THE AVERAGE CORING RATE IS 7.41 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.38 HOURS
RUN NO. 12	CORING BEGAN AT 1708 FEET AND CORING STOPPED AT 1767 FEET. THE AVERAGE CORING RATE IS 8.58 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.55 HOURS
RUN NO. 13	CORING BEGAN AT 1767 FEET AND CORING STOPPED AT 1826 FEET. THE AVERAGE CORING RATE IS 8.78 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.53 HOURS
RUN NO. 14	CORING BEGAN AT 1826 FEET AND CORING STOPPED AT 1885 FEET. THE AVERAGE CORING RATE IS 8.95 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.45 HOURS
RUN NO. 15	CORING BEGAN AT 1885 FEET AND CORING STOPPED AT 1943 FEET. THE AVERAGE CORING RATE IS 8.83 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.67 HOURS
RUN NO. 16	CORING BEGAN AT 1944 FEET AND CORING STOPPED AT 2003 FEET. THE AVERAGE CORING RATE IS 8.19 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.28 HOURS
RUN NO. 17	CORING BEGAN AT 2003 FEET AND CORING STOPPED AT 2062 FEET. THE AVERAGE CORING RATE IS 8.83 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.52 HOURS
RUN NO. 18	CORING BEGAN AT 2062 FEET AND CORING STOPPED AT 2121 FEET. THE AVERAGE CORING RATE IS 9.44 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.43 HOURS

TABLE 1. (Continued)

RUN INFORMATION FROM WELL CONTINUED Y- 1

RUN NO. 19	CORING BEGAN AT 2122 FEET AND CORING STOPPED AT 2181 FEET. THE AVERAGE CORING RATE IS 7.93 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.55 HOURS
RUN NO. 20	CORING BEGAN AT 2181 FEET AND CORING STOPPED AT 2240 FEET. THE AVERAGE CORING RATE IS 11.41 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.48 HOURS
RUN NO. 21	CORING BEGAN AT 2240 FEET AND CORING STOPPED AT 2299 FEET. THE AVERAGE CORING RATE IS 7.66 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.68 HOURS
RUN NO. 22	CORING BEGAN AT 2299 FEET AND CORING STOPPED AT 2358 FEET. THE AVERAGE CORING RATE IS 8.63 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.55 HOURS
RUN NO. 23	CORING BEGAN AT 2486 FEET AND CORING STOPPED AT 2545 FEET. THE AVERAGE CORING RATE IS 7.39 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.73 HOURS
RUN NO. 24	CORING BEGAN AT 2545 FEET AND CORING STOPPED AT 2604 FEET. THE AVERAGE CORING RATE IS 6.95 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.52 HOURS
RUN NO. 25	CORING BEGAN AT 2606 FEET AND CORING STOPPED AT 2665 FEET. THE AVERAGE CORING RATE IS 7.71 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.73 HOURS
RUN NO. 26	CORING BEGAN AT 2723 FEET AND CORING STOPPED AT 2782 FEET. THE AVERAGE CORING RATE IS 7.32 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.70 HOURS
RUN NO. 27	CORING BEGAN AT 2782 FEET AND CORING STOPPED AT 2841 FEET. THE AVERAGE CORING RATE IS 7.32 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.45 HOURS
RUN NO. 28	CORING BEGAN AT 2841 FEET AND CORING STOPPED AT 2900 FEET. THE AVERAGE CORING RATE IS 7.17 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 1.87 HOURS
RUN NO. 29	CORING BEGAN AT 2900 FEET AND CORING STOPPED AT 2926 FEET. THE AVERAGE CORING RATE IS 7.89 MINUTES PER FOOT. THE SAMPLES WERE ON THE SURFACE IN 2.08 HOURS

TABLE 2. FIELD SAMPLING DATA FOR WELL Y 1

SAMPLE ID.	COLOR	ON SURFACE TIME	BARREL NO	SEQ NO.
Y 1- 372.	N4	1.62	1	1
Y 1- 382.	N4	1.68	1	2
Y 1- 392.	N4	2.03	1	3
Y 1- 402.	N5/5Y4	2.15	1	4
Y 1- 412.	N4	2.30	1	5
Y 1- 422.	N4	2.40	1	6
Y 1- 431.	N3	1.10	2	7
Y 1- 441.	N3	1.28	2	8
Y 1- 451.	N4	1.43	2	9
Y 1- 461.	N4	1.52	2	10
Y 1- 471.	N4	1.63	2	11
Y 1- 481.	N4	1.78	2	12
Y 1- 491.	5Y2/1	1.12	3	13
Y 1- 501.	N4	1.20	3	14
Y 1- 521.	5Y2/1	1.32	3	15
Y 1- 530.	5GY4/1	1.43	3	16
Y 1- 541.	N6	1.70	3	17
Y 1- 965.	N4	1.73	4	18
Y 1- 975.	N4	1.87	4	19
Y 1- 985.	N4	2.02	4	20
Y 1- 995.	N4	2.15	4	21
Y 1-1005.	N4	2.33	4	22
Y 1-1014.	N4	2.40	4	23
Y 1-1330.	N2	.77	5	24
Y 1-1340.	5Y2/1	.93	5	25
Y 1-1350.	N4/5Y2	1.03	5	26
Y 1-1360.	N4	1.20	5	27
Y 1-1370.	N4	1.30	5	28
Y 1-1380.	N3	1.53	5	29
Y 1-1390.	N4/W5	.70	6	30
Y 1-1400.	N5	.82	6	31
Y 1-1410.	N4	.97	6	32
Y 1-1420.	N3	1.13	6	33
Y 1-1430.	N4	1.25	6	34
Y 1-1440.	N5	1.37	6	35
Y 1-1449.	N4	.67	7	36
Y 1-1459.	N4	.88	7	37
Y 1-1469.	N4	1.03	7	38
Y 1-1479.	N4	1.18	7	39
Y 1-1484.	N4	.75	8	40
Y 1-1494.	N4	.92	8	41
Y 1-1504.	N4	1.05	8	42
Y 1-1514.	N4	1.22	8	43
Y 1-1524.	N5	1.37	8	44

TABLE 2. (Continued)
FIELD SAMPLING DATA FOR WELL Y 1

SAMPLE ID.	COLOR	ON SURFACE TIME	BARREL NO	SEQ NO.
Y 1-1533.	N4	.70	9	45
Y 1-1543.	N4	.87	9	46
Y 1-1553.	N4	.98	9	47
Y 1-1563.	N4	1.10	9	48
Y 1-1573.	N4	1.20	9	49
Y 1-1583.	N4	1.37	9	50
Y 1-1592.	N4	.85	10	51
Y 1-1602.	N4	1.05	10	52
Y 1-1612.	N4	1.17	10	53
Y 1-1622.	N4	1.30	10	54
Y 1-1632.	N4	1.45	10	55
Y 1-1642.	N4	1.53	10	56
Y 1-1652.	N4	.77	11	57
Y 1-1662.	N4	.90	11	58
Y 1-1672.	5YR2/1	1.07	11	59
Y 1-1682.	N4	1.30	11	60
Y 1-1692.	N4	1.47	11	61
Y 1-1703.	N4	1.68	11	62
Y 1-1711.	N5	.60	12	63
Y 1-1721.	N5	.75	12	64
Y 1-1731.	N5	.88	12	65
Y 1-1741.	N4/N3	1.30	12	66
Y 1-1751.	N4	1.45	12	67
Y 1-1761.	N4	1.55	12	68
Y 1-1770.	N4	.73	13	69
Y 1-1780.	N4	.90	13	70
Y 1-1790.	N4	1.02	13	71
Y 1-1800.	N4	1.22	13	72
Y 1-1810.	N4	1.35	13	73
Y 1-1820.	N4	1.48	13	74
Y 1-1830.	N3	.82	14	75
Y 1-1840.	N3	.93	14	76
Y 1-1850.	N4	1.12	14	77
Y 1-1860.	N3	1.23	14	78
Y 1-1870.	N4	1.35	14	79
Y 1-1880.	N4	1.43	14	80
Y 1-1889.	N4	.83	15	81
Y 1-1899.	N4	.97	15	82
Y 1-1909.	N4	1.08	15	83
Y 1-1919.	N4	1.18	15	84
Y 1-1929.	N4	1.25	15	85
Y 1-1939.	N3	1.37	15	86
Y 1-1947.	N4	.70	16	87
Y 1-1957.	5Y2/1	.83	16	88
Y 1-1967.	N4	.68	16	89

TABLE 2. (Continued)
FIELD SAMPLING DATA FOR WELL Y 1

SAMPLE ID.	COLOR	ON SURFACE TIME	BARREL NO	SEQ NO.
Y 1-1977.	N4	.95	16	90
Y 1-1987.	N3	1.03	16	91
Y 1-1997.	N4	1.13	16	92
Y 1-2006.	N4	.78	17	93
Y 1-2016.	N4	.85	17	94
Y 1-2026.	N3	.95	17	95
Y 1-2036.	N3	1.08	17	96
Y 1-2046.	N4	1.25	17	97
Y 1-2056.	N4	1.32	17	98
Y 1-2065.	5Y2/1	.52	18	99
Y 1-2075.	5Y2/1	.58	18	100
Y 1-2085.	N4	.72	18	101
Y 1-2095.	N4	.88	18	102
Y 1-2105.	N3	1.00	18	103
Y 1-2115.	N3	1.10	18	104
Y 1-2119.	5Y2/1	1.17	18	105
Y 1-2125.	N3	.80	19	106
Y 1-2135.	N4	.90	19	107
Y 1-2145.	N2	1.05	19	108
Y 1-2155.	N3	1.23	19	109
Y 1-2165.	N2	1.35	19	110
Y 1-2175.	N2	1.48	19	111
Y 1-2184.	N4/N2	.73	20	112
Y 1-2194.	N3	.93	20	113
Y 1-2204.	N4	1.07	20	114
Y 1-2214.	N4	1.18	20	115
Y 1-2224.	N4	1.28	20	116
Y 1-2234.	N5	1.40	20	117
Y 1-2243.	N4	.43	21	118
Y 1-2253.	N4	.60	21	119
Y 1-2263.	N4	.70	21	120
Y 1-2273.	N4	.82	21	121
Y 1-2283.	N4	.92	21	122
Y 1-2293.	N4	1.00	21	123
Y 1-2302.	N4	.75	22	124
Y 1-2312.	N2/N4	.83	22	125
Y 1-2322.	N3	.95	22	126
Y 1-2332.	5YR2/1	1.05	22	127
Y 1-2342.	N3	1.17	22	128
Y 1-2352.	N4	1.37	22	129
Y 1-2484.	N3	.67	23	130
Y 1-2495.	5YR2/1	.68	23	131
Y 1-2504.	5YR2/1	.98	23	132
Y 1-2514.	5YR2/1	1.06	23	133
Y 1-2524.	5YR2/1	1.20	23	134

TABLE 2. (Continued)
FIELD SAMPLING DATA FOR WELL Y 1

SAMPLE ID.	COLOR	ON SURFACE TIME	BARREL NO	SEQ NO.
Y 1-2538.	5YR2/1	1.38	23	135
Y 1-2548.	N4	1.02	24	136
Y 1-2558.	N3	1.10	24	137
Y 1-2568.	5YR2/1	1.18	24	138
Y 1-2578.	5YR2/1	1.28	24	139
Y 1-2588.	5YR2/1	1.37	24	140
Y 1-2598.	N2	1.53	24	141
Y 1-2607.	5YR2/1	.65	25	142
Y 1-2617.	5YR2/1	.77	25	143
Y 1-2627.	5YR2/1	.87	25	144
Y 1-2637.	N3	1.02	25	145
Y 1-2647.	N4	1.17	25	146
Y 1-2657.	N4	1.15	25	147
Y 1-2725.	5Y4/1	.80	26	148
Y 1-2735.	N3	.97	26	149
Y 1-2745.	5YR2/1	1.08	26	150
Y 1-2755.	5Y4/1	1.18	26	151
Y 1-2765.	N4	1.28	26	152
Y 1-2775.	5YR2/1	1.43	26	153
Y 1-2784.	N2	.88	27	154
Y 1-2794.	N3	1.02	27	155
Y 1-2804.	N3	1.12	27	156
Y 1-2814.	N2	1.17	27	157
Y 1-2824.	N3	1.27	27	158
Y 1-2832.	5YR2/1	1.57	27	159
Y 1-2844.	5YR2/1	.88	28	160
Y 1-2854.	5YR2/1	1.00	28	161
Y 1-2864.	5YR2/1	1.10	28	162
Y 1-2874.	5YR2/1	1.20	28	163
Y 1-2884.	5YR2/1	1.37	28	164
Y 1-2894.	5YR2/1	1.57	28	165

MEAN EXPOSURE TIME 1.16
STANDARD DEVIATION OF EXPOSURE TIME .37

TABLE 3. INITIAL GAS RELEASE DATA: WELL Y 1

02/05/79

SAMPLE ID	PRESSURE TORR	FREE	CORE	POROSITY PCI.	GAS COMPOSITION, VOLUME PERCENT							GAS RELEASED/			SEQ NO.
		VOLUME CC	VOLUME CC		METHANE	ETHANE	PROPANE	BUTANE	PENTANE	TOTAL HYDROC.	NITROGEN	OXYGEN	CARBON DIOXIDE	UNIT VOLUME OF SHALE	
Y 1- 372.	725.	624.	826.	16.53	.59	.13	.16	.01	0.00	.95	79.76	16.82	2.45	.01	1
Y 1- 382.	725.	754.	696.	0.00	.67	0.00	0.00	0.00	0.00	.57	78.63	20.34	.38	.01	2
Y 1- 392.	720.	546.	904.	10.77	.93	.09	.03	.01	0.00	1.06	80.13	18.14	.68	.01	3
Y 1- 402.	720.	568.	882.	6.51	.73	.06	0.00	0.00	0.00	.79	79.68	18.74	.82	.00	4
Y 1- 412.	730.	721.	729.	5.95	.58	.13	.18	.03	0.00	.92	79.23	19.41	.46	.01	5
Y 1- 422.	725.	817.	633.	3.37	.42	.11	.05	.01	0.00	.59	78.80	20.33	.26	.01	6
Y 1- 431.	740.	955.	495.	0.00	.60	.17	.13	.03	0.00	.73	71.87	20.72	.65	.01	7
Y 1- 441.	735.	807.	643.	0.00	1.29	.45	.14	.04	0.00	1.92	78.36	19.16	.53	.02	8
Y 1- 451.	735.	558.	892.	10.67	1.95	.56	.21	.05	0.00	2.71	78.12	18.17	.99	.02	9
Y 1- 461.	730.	731.	719.	5.06	.82	.17	.14	.02	0.00	1.15	78.38	19.93	.50	.01	10
Y 1- 471.	740.	663.	787.	1.52	1.61	.34	.23	.03	0.00	2.21	77.55	19.81	.39	.02	11
Y 1- 481.	745.	782.	668.	2.53	1.86	.44	.27	.04	0.00	2.61	76.54	20.56	.29	.03	12
Y 1- 491.	725.	905.	545.	1.21	1.09	.25	.15	.03	0.00	1.52	77.14	20.80	.56	.02	13
Y 1- 501.	725.	823.	627.	9.23	2.06	.40	.12	.04	0.00	2.62	76.29	18.75	2.33	.03	14
Y 1- 521.	730.	512.	938.	8.26	15.84	5.44	2.12	.69	.15	44.24	47.45	6.57	1.63	.23	15
Y 1- 530.	840.	2363.	717.	9.53	13.57	1.64	.73	.26	.05	16.25	66.60	16.78	.38	.59	16
Y 1- 965.	740.	802.	648.	1.74	3.10	.30	.16	.02	0.00	3.59	76.90	18.80	.69	.04	18
Y 1- 975.	740.	682.	768.	7.97	5.56	0.00	.39	.08	0.00	6.03	76.30	16.00	.99	.05	19
Y 1- 985.	745.	659.	791.	0.00	5.65	.30	.30	.05	0.00	6.30	75.20	17.50	.64	.05	20
Y 1- 995.	1100.	627.	823.	10.19	31.30	4.81	1.96	.52	.12	38.71	51.30	9.28	.73	.43	21
Y 1-1014.	950.	734.	716.	4.93	8.39	6.32	8.63	5.74	2.21	31.29	61.53	13.75	3.47	.40	23
Y 1-1330.	1200.	650.	800.	2.74	33.52	7.34	3.14	.93	.25	45.18	49.30	4.30	1.25	.58	24
Y 1-1340.	1225.	582.	868.	0.00	35.90	6.92	2.17	.59	.15	45.73	46.30	7.41	.66	.49	25
Y 1-1350.	1060.	474.	976.	.75	30.63	4.92	2.16	.70	.12	38.53	54.40	6.26	.87	.26	26
Y 1-1360.	750.	666.	784.	9.05	6.20	.13	.24	.03	0.00	6.60	74.10	18.05	.72	.06	27
Y 1-1370.	750.	616.	834.	.90	5.45	0.00	0.00	0.00	0.00	6.45	74.80	18.00	.74	.05	28
Y 1-1380.	900.	579.	871.	7.03	19.60	2.21	1.15	.27	.03	23.26	63.60	12.40	.65	.18	29
Y 1-1390.	700.	688.	762.	5.61	5.18	.25	.24	.03	0.00	5.62	76.10	17.40	.63	.05	30
Y 1-1400.	780.	711.	739.	2.89	12.00	2.30	.57	.05	.02	14.94	72.60	13.60	1.20	.15	31
Y 1-1410.	750.	716.	734.	4.90	5.07	.55	.15	.02	0.00	5.79	75.58	18.04	.62	.06	32
Y 1-1420.	1500.	426.	1024.	.30	29.67	5.63	1.05	.43	.11	37.69	50.78	11.24	.31	.31	33
Y 1-1430.	750.	695.	755.	5.27	5.18	.57	.21	.02	0.00	5.90	75.89	17.80	.45	.05	34
Y 1-1440.	750.	623.	827.	2.01	6.96	.92	.50	.21	.11	8.70	78.80	11.91	.57	.06	35
Y 1-1449.	350.	559.	891.	2.00	15.64	1.79	.77	.14	0.00	18.34	67.93	12.78	.95	.05	36
Y 1-1459.	900.	548.	902.	2.12	15.18	2.42	.74	.14	.39	22.87	64.23	12.24	.97	.16	37
Y 1-1469.	800.	495.	955.	0.00	10.63	.99	.37	.07	0.00	12.06	70.27	17.03	.64	.07	38
Y 1-1479.	750.	715.	735.	0.00	3.86	.39	.16	0.00	0.00	4.41	75.33	19.54	.67	.04	39
Y 1-1484.	750.	835.	615.	0.00	4.38	.57	.27	.02	0.00	5.24	76.53	17.59	.66	.07	40
Y 1-1494.	800.	600.	850.	3.48	8.58	1.02	.44	.09	.01	10.14	73.39	15.75	.75	.08	41
Y 1-1504.	900.	722.	728.	1.23	20.33	3.02	1.09	.27	.07	24.78	63.06	11.05	1.11	.29	42
Y 1-1514.	1100.	654.	796.	6.60	33.00	3.99	1.62	.37	.11	39.09	51.28	9.20	.44	.46	43
Y 1-1524.	800.	719.	731.	10.66	11.11	1.74	.79	1.82	.05	15.51	73.33	10.66	1.95	.16	44
Y 1-1533.	750.	602.	848.	11.83	8.19	.32	.39	.04	0.00	9.54	73.40	16.37	.68	.07	45
Y 1-1543.	800.	593.	857.	3.19	12.37	1.93	1.00	.20	.05	15.55	71.75	11.59	1.08	.11	46
Y 1-1553.	750.	597.	853.	2.72	6.57	.73	.33	.04	0.00	7.67	62.29	14.06	.42	.05	47

TABLE 3. (Continued)
INITIAL GAS RELEASE DATA: WELL Y 1

02/05/79

SAMPLE ID	PRESSURE 100K	FREE VOLUME CC	CORE VOLUME CC	POROSITY PCI.	GAS COMPOSITION, VOLUME PERCENT								CARBON DIOXIDE	GAS RELEASED/ UNIT VOLUME OF SHALE	SEQ NO.
					METHANE	ETHANE	PROPANE	BUTANE	PENTANE	HYDROC.	NITROGEN	OXYGEN			
Y 1-1563.	750.	721.	729.	0.00	4.90	.58	.20	.03	0.00	5.71	75.45	18.60	.27	.06	48
Y 1-1573.	650.	534.	916.	6.85	10.78	1.78	.42	.04	0.00	15.02	71.41	14.89	.79	.06	49
Y 1-1583.	750.	697.	753.	1.24	8.12	.94	.30	.06	0.00	9.42	74.54	15.14	.89	.09	50
Y 1-1592.	750.	656.	794.	3.44	5.77	.88	.60	.10	0.00	7.35	77.66	14.06	.89	.06	51
Y 1-1602.	750.	741.	709.	2.92	8.37	1.12	.86	.16	.04	10.57	74.51	14.13	.77	.11	52
Y 1-1612.	750.	632.	818.	1.72	9.12	1.17	.80	.15	.04	11.28	74.46	13.61	.63	.09	53
Y 1-1622.	750.	576.	874.	0.00	9.84	1.43	.95	.15	.04	12.41	72.87	14.36	.35	.08	54
Y 1-1632.	800.	484.	966.	2.61	8.01	1.13	.55	.10	.03	9.82	72.16	17.74	.28	.05	55
Y 1-1642.	850.	511.	939.	2.47	18.71	2.47	1.09	.25	.06	22.58	66.02	9.60	1.79	.14	56
Y 1-1652.	750.	849.	601.	8.90	7.23	1.53	.88	.26	.08	9.98	76.71	11.95	1.39	.14	57
Y 1-1662.	800.	676.	774.	5.05	16.49	3.30	1.74	.48	.15	22.16	69.60	6.70	1.54	.20	58
Y 1-1672.	1300.	611.	839.	2.43	40.92	6.64	3.90	.93	.25	52.64	45.01	1.53	.83	.66	59
Y 1-1682.	750.	614.	836.	8.08	6.40	1.64	1.03	.20	.06	9.33	77.19	12.04	1.41	.07	60
Y 1-1692.	750.	743.	707.	1.81	1.00	.16	.38	.02	0.00	1.56	76.96	21.37	.11	.02	61
Y 1-1703.	800.	673.	777.	3.45	9.64	1.47	1.07	.11	.02	12.31	71.61	15.55	.48	.11	62
Y 1-1711.	950.	485.	965.	0.00	4.65	.58	.41	.10	.03	5.77	73.83	20.21	.20	.04	63
Y 1-1721.	750.	764.	686.	8.21	7.93	1.12	.75	.07	0.00	9.87	73.58	15.70	.84	.11	64
Y 1-1731.	800.	763.	687.	4.68	13.63	1.60	.60	.11	.01	15.95	67.97	15.40	.68	.19	65
Y 1-1741.	1350.	513.	937.	3.29	43.97	7.31	2.76	.62	.16	54.82	39.72	4.19	1.26	.53	66
Y 1-1751.	750.	579.	871.	1.28	11.38	1.51	.66	.09	.01	13.65	70.70	15.23	.43	.09	67
Y 1-1761.	750.	733.	717.	0.00	3.85	.60	.44	.06	.01	4.96	75.73	18.80	.51	.05	68
Y 1-1770.	800.	682.	768.	0.00	22.97	3.67	2.43	.61	.19	29.87	63.36	4.52	2.27	.28	69
Y 1-1780.	800.	641.	809.	.60	22.75	2.67	2.39	.57	.18	28.56	64.64	4.74	2.03	.24	70
Y 1-1790.	750.	519.	931.	0.00	6.76	1.09	.74	.07	0.00	8.66	73.92	17.01	.40	.05	71
Y 1-1800.	800.	591.	859.	5.88	13.83	2.56	1.25	.34	.10	18.08	72.14	7.86	1.87	.13	72
Y 1-1810.	900.	638.	812.	2.57	19.22	3.71	1.54	.35	.09	24.91	63.53	10.67	.89	.23	73
Y 1-1820.	850.	711.	739.	9.72	13.92	2.76	1.56	.34	.11	18.69	68.91	10.64	1.57	.20	74
Y 1-1830.	900.	574.	876.	5.91	22.22	3.58	3.53	1.07	.29	30.63	65.33	1.30	2.74	.24	75
Y 1-1840.	800.	603.	847.	4.37	21.92	2.62	2.24	.58	.17	27.53	62.35	8.58	1.51	.21	76
Y 1-1850.	800.	781.	669.	10.23	12.10	2.36	.75	.18	0.00	15.39	70.09	13.87	.67	.19	77
Y 1-1860.	750.	573.	877.	.23	21.62	3.93	1.41	.34	.03	27.33	60.57	10.88	1.18	.18	78
Y 1-1870.	850.	633.	817.	6.96	18.59	3.83	2.14	.36	.10	25.02	63.76	10.29	.91	.22	79
Y 1-1880.	1300.	611.	839.	3.45	34.37	10.84	2.93	.67	.16	48.97	45.12	4.41	1.51	.61	80
Y 1-1889.	800.	538.	912.	2.57	14.39	3.00	1.18	.17	.03	18.77	72.29	7.56	1.34	.12	81
Y 1-1899.	800.	725.	725.	4.48	15.71	4.18	1.48	.36	.10	21.83	71.72	3.23	3.21	.23	82
Y 1-1909.	750.	552.	898.	0.00	4.12	.95	.43	.10	.01	5.61	75.04	18.86	.47	.03	83
Y 1-1919.	750.	660.	790.	1.97	23.48	4.95	2.01	.62	.18	31.24	61.33	5.09	2.36	.26	84
Y 1-1929.	750.	522.	928.	4.56	21.29	6.62	2.36	.67	.21	31.15	64.19	2.47	2.22	.17	85
Y 1-1939.	915.	2410.	670.	11.42	16.94	2.64	1.45	.38	.11	21.52	62.88	15.20	.39	.93	86
Y 1-1947.	850.	517.	933.	.46	24.26	4.85	1.75	.54	.19	31.59	62.05	5.40	.97	.20	87
Y 1-1957.	950.	666.	784.	1.07	39.71	10.15	4.18	1.05	.32	55.41	41.91	1.82	.87	.59	88
Y 1-1967.	850.	501.	949.	7.51	20.51	4.44	1.22	.30	.06	26.53	64.08	8.50	.92	.16	89
Y 1-1977.	800.	562.	888.	.68	16.53	3.23	.98	.24	.03	21.01	67.63	9.87	1.49	.14	90
Y 1-1987.	850.	642.	808.	6.70	19.65	3.74	1.09	.25	.03	24.76	64.96	8.20	2.09	.22	91
Y 1-1997.	750.	549.	901.	3.43	12.04	2.06	.58	.08	0.00	14.76	73.18	10.05	1.99	.09	92

TABLE 3. (Continued)
INITIAL GAS RELEASE DATA: WELL Y 1

02/05/79

SAMPLE ID	PRESSURE TORR	FREE VOLUME CC	CORE VOLUME CC	POROSITY PCI.	GAS COMPOSITION, VOLUME PERCENT								CARBON DIOXIDE	GAS RELEASED/ UNIT VOLUME OF SHALE	SEQ NO.
					METHANE	ETHANE	PROPANE	BUTANE	PENTANE	TOTAL HYDROC.	NITROGEN	OXYGEN			
Y 1-2006.	800.	566.	884.	4.85	14.68	3.00	.78	.14	.01	18.61	72.60	6.84	1.91	.13	93
Y 1-2016.	750.	643.	807.	1.62	12.49	3.04	1.06	.20	.05	16.84	71.18	10.56	1.03	.13	94
Y 1-2026.	800.	497.	953.	2.23	22.14	5.64	1.85	.52	.15	30.30	65.53	1.29	2.92	.17	95
Y 1-2036.	750.	584.	866.	0.00	14.48	3.61	1.10	.23	.05	19.47	72.20	7.69	.62	.13	96
Y 1-2046.	800.	611.	839.	5.69	9.79	1.40	.44	.03	0.00	11.66	71.65	16.12	.59	.09	97
Y 1-2056.	750.	629.	821.	0.00	18.19	4.29	1.21	.30	.09	24.08	65.08	9.73	1.12	.18	98
Y 1-2065.	900.	589.	861.	0.00	41.95	8.97	4.73	1.41	.38	51.44	40.52	.53	1.48	.47	99
Y 1-2075.	1250.	594.	856.	1.49	38.42	8.97	2.98	.80	.23	51.40	44.73	2.32	1.59	.59	100
Y 1-2085.	950.	541.	909.	.13	22.72	3.44	.94	.23	.03	27.36	59.85	11.92	.85	.20	101
Y 1-2095.	800.	749.	701.	3.36	10.82	1.54	.51	.06	0.00	12.23	71.57	13.77	1.40	.15	102
Y 1-2105.	1000.	782.	668.	7.64	30.59	6.98	2.04	.53	.15	40.29	51.20	7.89	.67	.62	103
Y 1-2115.	850.	690.	760.	4.32	19.18	4.10	1.23	.32	.10	24.93	65.47	7.94	1.65	.25	104
Y 1-2119.	750.	2543.	537.	16.29	18.92	6.43	2.71	.82	.13	28.01	57.56	13.37	.06	1.36	105
Y 1-2125.	750.	563.	887.	10.44	21.32	5.74	1.86	.49	.14	29.55	62.91	5.66	1.92	.18	106
Y 1-2135.	900.	601.	849.	4.20	33.45	9.56	3.06	.91	.28	47.26	50.12	.74	1.84	.40	107
Y 1-2145.	750.	588.	862.	5.62	25.62	8.49	3.09	.87	.25	38.32	57.44	3.10	1.12	.26	108
Y 1-2155.	1050.	608.	842.	3.48	46.55	14.90	6.28	1.77	.50	70.00	28.66	.64	.71	.70	109
Y 1-2165.	700.	725.	725.	13.49	18.27	6.57	4.17	1.40	.54	31.05	61.82	2.39	4.70	.29	110
Y 1-2175.	700.	553.	897.	1.81	24.83	6.13	1.85	.27	0.00	33.08	58.39	1.89	6.66	.19	111
Y 1-2184.	1250.	665.	785.	11.02	30.96	8.42	4.92	1.31	.19	45.80	52.38	.71	1.13	.64	112
Y 1-2194.	800.	788.	662.	3.59	15.60	4.58	2.03	.51	.07	22.79	68.76	7.44	.97	.29	113
Y 1-2204.	750.	621.	829.	7.37	12.98	3.39	1.35	.29	.03	18.04	69.86	11.34	.76	.13	114
Y 1-2214.	1250.	540.	910.	3.79	39.94	9.90	4.41	1.08	.15	54.48	43.98	.66	.90	.53	115
Y 1-2224.	750.	638.	812.	5.45	20.92	7.00	2.99	.82	.13	31.86	61.07	4.74	2.31	.25	116
Y 1-2234.	750.	623.	827.	4.97	20.21	4.44	1.97	.58	.20	27.40	61.29	8.36	2.92	.20	117
Y 1-2243.	850.	586.	864.	6.19	25.17	4.14	1.21	.20	0.00	30.72	64.24	2.82	2.18	.23	118
Y 1-2253.	750.	502.	948.	4.88	21.30	4.01	1.22	.15	0.00	26.68	66.13	.501	2.17	.14	119
Y 1-2263.	750.	691.	759.	14.49	14.01	1.67	.53	.33	0.00	16.54	68.32	14.29	.82	.15	120
Y 1-2273.	750.	725.	725.	5.89	8.26	1.37	.36	.04	0.00	10.03	74.93	13.62	1.48	.10	121
Y 1-2283.	850.	583.	867.	17.83	23.58	3.47	.87	.14	0.00	28.56	63.71	6.11	1.61	.21	122
Y 1-2293.	750.	829.	621.	10.33	4.51	.70	.16	0.00	0.00	5.37	76.54	17.38	.68	.07	123
Y 1-2302.	750.	584.	866.	0.00	8.57	1.57	.45	.07	0.00	10.66	72.60	15.96	.79	.07	124
Y 1-2312.	800.	696.	754.	18.30	15.42	4.42	8.00	0.00	0.00	19.84	68.57	10.22	1.33	.19	125
Y 1-2322.	1200.	505.	945.	4.86	30.71	12.40	4.03	.66	0.00	55.60	42.09	1.08	1.06	.47	126
Y 1-2332.	1500.	613.	937.	31.88	43.12	11.52	5.02	1.19	.37	61.22	28.66	9.56	.56	.68	127
Y 1-2342.	1050.	507.	943.	9.10	34.01	7.41	1.79	.37	.12	43.70	50.23	4.39	1.71	.32	128
Y 1-2352.	750.	742.	708.	12.77	2.18	.21	.05	0.00	0.00	2.44	76.25	21.15	.14	.03	129
Y 1-2488.	750.	497.	953.	8.54	29.13	13.09	5.62	1.69	.57	50.10	46.32	2.48	1.10	.26	130
Y 1-2498.	750.	742.	708.	5.32	27.80	13.24	4.08	1.04	.31	46.47	37.41	4.89	1.22	.48	131
Y 1-2508.	750.	583.	867.	5.93	25.23	15.71	6.34	1.64	.48	49.40	45.39	4.57	.63	.33	132
Y 1-2518.	950.	577.	873.	8.16	45.18	15.05	4.98	1.24	.39	66.85	31.49	.52	1.16	.55	133
Y 1-2528.	750.	496.	954.	8.56	37.07	15.13	6.70	1.61	.55	61.06	23.52	14.66	.78	.31	134
Y 1-2538.	1140.	2368.	712.	9.63	23.00	8.73	4.10	1.37	0.00	37.20	52.17	10.16	.01	1.85	135
Y 1-2548.	750.	523.	927.	12.02	28.48	14.55	5.96	1.73	.57	51.29	44.72	3.07	.90	.29	136
Y 1-2568.	1250.	557.	893.	0.00	43.70	18.20	8.55	2.54	.69	73.88	25.98	.34	.04	.76	138

TABLE 3. (Continued)
INITIAL GAS RELEASE DATA: WELL Y 1

02/05/79

SAMPLE ID	PRESSURE TORR	FREE	CORE	POROSITY PCI.	GAS COMPOSITION, VOLUME PERCENT									CARBON DIOXIDE	GAS RELEASED/ UNIT VOLUME OF SHALE	SEQ NO.
		VOLUME CC	VOLUME CC		TOTAL					HYDROC.	NITROGEN	OXYGEN				
					METHANE	ETHANE	PROPANE	BUTANE	PENTANE							
Y 1-2578.	750.	545.	905.	15.72	26.68	21.04	9.41	2.60	.83	60.56	37.21	1.76	.49	.36	139	
Y 1-2588.	750.	804.	646.	8.97	30.54	18.44	8.16	2.28	.74	60.16	37.51	2.09	.26	.74	140	
Y 1-2598.	850.	598.	852.	12.91	51.17	15.59	4.68	1.15	.39	72.98	25.78	.61	.67	.57	141	
Y 1-2607.	750.	762.	688.	10.88	36.96	22.25	11.53	3.54	1.11	75.39	23.75	.53	.37	.82	142	
Y 1-2617.	1500.	609.	841.	8.76	32.83	19.62	10.41	2.99	.74	66.59	32.27	.41	.69	.95	143	
Y 1-2627.	750.	671.	779.	13.41	28.97	18.13	11.93	4.16	1.21	64.40	33.98	.58	1.03	.55	144	
Y 1-2637.	850.	662.	788.	8.07	53.07	16.42	4.91	1.20	.46	76.06	21.96	.90	1.09	.71	145	
Y 1-2647.	1500.	640.	810.	12.47	45.22	16.31	6.74	1.73	.56	70.56	28.50	.74	.20	1.10	146	
Y 1-2657.	750.	577.	873.	8.09	40.53	14.46	4.75	1.08	.32	61.14	33.85	4.53	.49	.40	147	
Y 1-2725.	1250.	603.	847.	.67	43.50	16.70	6.29	1.57	.40	68.46	30.61	.55	.35	.80	148	
Y 1-2735.	1500.	520.	930.	0.00	54.94	13.45	4.54	1.22	.31	74.46	24.25	1.04	.21	.82	149	
Y 1-2745.	750.	624.	826.	10.59	17.79	16.80	9.64	2.81	.83	47.87	47.42	4.28	.43	.36	150	
Y 1-2755.	750.	646.	804.	7.25	41.33	24.77	11.59	3.22	.99	81.90	17.39	.45	.27	.65	151	
Y 1-2765.	1500.	478.	972.	8.64	57.00	11.19	3.66	.90	.24	72.99	24.52	2.22	.22	.71	152	
Y 1-2775.	750.	498.	952.	6.10	35.59	14.34	5.29	.92	.13	56.27	35.97	7.56	.20	.29	153	
Y 1-2784.	750.	892.	558.	9.35	6.77	7.02	5.42	1.64	.56	21.43	61.80	13.61	3.17	.34	154	
Y 1-2794.	750.	694.	756.	14.76	39.79	14.43	5.66	1.37	.37	61.62	34.61	3.50	.26	.56	155	
Y 1-2804.	750.	589.	861.	5.45	32.43	15.48	6.08	1.61	.45	56.55	37.85	5.38	.18	.38	156	
Y 1-2814.	1500.	651.	799.	0.00	53.64	11.87	4.79	1.34	.39	72.03	26.88	1.04	.03	1.16	157	
Y 1-2824.	750.	608.	842.	10.17	23.44	20.96	18.45	7.74	3.46	74.05	25.38	.47	.13	.53	158	
Y 1-2832.	775.	2435.	645.	8.25	2.28	2.23	5.13	3.10	1.18	13.92	75.90	10.03	.19	.54	159	
Y 1-2844.	750.	583.	867.	8.02	12.49	16.15	10.97	3.40	1.12	44.13	47.27	3.62	4.97	.24	160	
Y 1-2854.	800.	714.	736.	12.11	8.97	18.19	17.32	6.45	1.77	52.70	44.59	.74	1.95	.54	161	
Y 1-2864.	750.	626.	824.	5.93	32.09	11.18	3.65	.95	.34	48.21	42.36	8.78	.67	.36	162	
Y 1-2874.	750.	626.	824.	10.26	9.06	12.29	9.17	3.28	1.02	34.82	60.27	4.40	.52	.26	163	
Y 1-2884.	950.	505.	945.	7.51	5.96	12.46	15.72	6.35	1.84	42.33	56.42	1.24	0.00	.28	164	
Y 1-2894.	700.	654.	796.	6.79	10.39	9.56	11.53	5.82	2.08	39.38	58.31	2.27	.02	.30	165	

TABLE 4. STATISTICAL ANALYSES OF OFF GAS DATA

02/05/79

WELL Y 1

	MEAN	STANDARD DEVIATION	VARIANCE	COEFFICIENT OF DEVIATION	95 PCT. CONFIDENCE INTERVAL		NO OF SAMPLES
					LOWER LIMIT	UPPER LIMIT	
METHANE, PERCENT	19.105	14.02	196.55	.73	16.919	21.290	162
ETHANE, PERCENT	5.775	5.91	34.96	1.02	4.854	6.697	162
PROPANE, PERCENT	2.762	3.44	11.83	1.25	2.226	3.298	162
BUTANE, PERCENT	.832	1.36	1.870	1.57	.629	1.035	162
PENTANE, PERCENT	.243	.46	.21	1.89	.172	.315	162
TOTAL HYDROCARBONS, PCT	28.718	21.95	482.00	.76	25.295	32.140	162
NITROGEN, PERCENT	60.581	16.43	271.55	.27	57.812	62.949	162
OXYGEN, PERCENT	9.756	6.54	42.71	.67	8.737	10.775	162
CARBON DIOXIDE, PERCENT	1.063	.94	.88	.88	.917	1.210	162
GAS VOLUME/SHALE VOLUME	.286	.29	.08	1.01	.241	.331	162

*1 IS INSIGNIFICANT

TABLE 5. COMPARATIVE HYDROCARBON GAS ANALYSIS

WELL Y 1 01/09/79

SAMPLE NO.						MOLAR BASIS		METHANE EQUIVALENTS	
	METHANE (1)	ETHANE (2)	PROPANE (3)	BUTANE (4)	PENTANE (5)	TOTAL HYDROCARB	(2+3+4+5)/1	TOTAL HYDROCARB	(2+3+4+5)/1
372	.59	.19	.16	.01	0.00	.95	.61	1.35	1.30
382	.67	0.00	0.00	0.00	0.00	.67	0.00	.67	0.00
392	.93	.09	.03	.01	0.00	1.06	.14	1.19	.28
402	.73	.06	0.00	0.00	0.00	.79	.08	.84	.14
412	.58	.13	.18	.03	0.00	.92	.59	1.35	1.34
422	.42	.11	.05	.01	0.00	.59	.40	.77	.83
431	.40	.17	.13	.03	0.00	.73	.82	1.12	1.80
441	1.29	.45	.14	.04	0.00	1.92	.49	2.56	.98
451	1.95	.50	.21	.05	0.00	2.71	.39	3.51	.80
461	.82	.17	.14	.02	0.00	1.15	.40	1.53	.87
471	1.61	.34	.23	.03	0.00	2.21	.37	2.88	.79
481	1.86	.44	.27	.04	0.00	2.61	.40	3.43	.85
491	1.09	.25	.15	.03	0.00	1.52	.39	2.00	.83
501	2.06	.40	.12	.04	0.00	2.62	.27	3.19	.55
521	35.84	5.44	2.12	.69	.15	44.24	.23	53.70	.50
530	13.57	1.64	.73	.26	.05	16.25	.20	19.37	.43
541	41.60	6.58	5.31	3.30	1.33	58.12	.40	84.23	1.02
965	3.10	.30	.16	.02	0.00	3.58	.15	4.09	.32
975	5.56	0.00	.39	.08	0.00	6.03	.08	6.79	.22
985	5.65	.30	.30	.05	0.00	6.30	.12	7.09	.25
995	31.30	4.81	1.96	.52	.12	38.71	.24	46.95	.50
1005	35.46	7.14	2.49	.70	.17	45.96	.30	57.36	.62
1014	8.39	6.32	8.63	5.74	2.21	31.29	2.73	71.50	7.52
1330	33.52	7.34	3.14	.93	.25	45.18	.35	58.57	.75
1340	35.90	6.92	2.17	.59	.15	45.73	.27	56.15	.56
1350	30.63	4.92	2.16	.70	.12	38.53	.26	47.55	.55
1360	6.20	.13	.24	.03	0.00	6.60	.06	7.12	.15
1370	6.45	0.00	0.00	0.00	0.00	6.45	0.00	6.45	0.00
1380	19.60	2.21	1.15	.27	.03	23.26	.19	27.38	.40
1390	5.10	.25	.24	.03	0.00	5.62	.10	6.23	.22
1400	12.00	2.30	.57	.05	.02	14.94	.25	17.72	.48
1410	5.07	.55	.15	.02	0.00	5.79	.14	6.47	.28
1420	29.67	5.63	1.85	.43	.11	37.69	.27	46.13	.55
1430	5.10	.57	.21	.02	0.00	5.90	.16	6.69	.31
1440	6.96	.92	.50	.21	.11	8.70	.25	11.09	.59
1449	15.64	1.79	.77	.14	0.00	18.34	.17	21.15	.35
1459	19.18	2.42	.74	.14	.39	22.87	.19	27.82	.45
1469	10.63	.99	.37	.07	0.00	12.06	.13	13.51	.27
1479	3.86	.39	.16	0.00	0.00	4.41	.14	4.94	.28
1484	4.38	.57	.27	.02	0.00	5.24	.20	6.12	.40
1494	8.58	1.02	.44	.09	.01	10.14	.18	11.81	.38
1504	20.33	3.02	1.09	.27	.07	24.78	.22	29.59	.46
1514	33.00	3.99	1.62	.37	.11	39.09	.18	45.82	.39
1524	11.11	1.74	.79	1.82	.05	15.51	.40	22.28	1.01

TABLE 5. (Continued)
COMPARATIVE HYDROCARBON GAS ANALYSIS

WELL Y 1 01/03/79

SAMPLE NO.	MOLAR BASIS					METHANE EQUIVALENTS			
	METHANE (1)	ETHANE (2)	PROPANE (3)	BUTANE (4)	PENTANE (5)	TOTAL HYDROCARB (2+3+4+5)/1	TOTAL HYDROCARB (2+3+4+5)/1	TOTAL HYDROCARB (2+3+4+5)/1	TOTAL HYDROCARB (2+3+4+5)/1
1533	8.13	.92	.79	.04	0.00	9.54	.16	10.30	.33
1543	12.37	1.93	1.00	.20	.05	15.55	.26	19.16	.55
1553	6.57	.73	.33	.04	0.00	7.67	.17	8.60	.34
1563	4.90	.58	.20	.03	0.00	5.71	.17	6.51	.33
1573	10.78	1.78	.42	.04	0.00	13.02	.21	15.07	.40
1583	8.12	.94	.33	.06	0.00	9.42	.16	10.71	.32
1592	5.77	.88	.63	.10	0.00	7.35	.27	9.13	.58
1602	8.37	1.12	.83	.16	.04	10.57	.26	13.26	.58
1612	9.12	1.17	.88	.15	.04	11.28	.24	13.87	.52
1622	9.84	1.43	.95	.15	.04	12.41	.26	15.42	.57
1632	8.01	1.13	.55	.10	.03	9.82	.23	11.85	.48
1642	18.71	2.47	1.09	.25	.06	22.58	.21	26.99	.44
1652	7.23	1.53	.88	.26	.08	9.98	.38	13.38	.85
1662	16.49	3.30	1.74	.48	.15	22.16	.34	28.98	.76
1672	40.92	5.64	3.90	.93	.25	52.64	.29	66.64	.63
1682	6.40	1.64	1.03	.20	.06	9.33	.46	12.82	1.00
1692	1.00	.16	.38	.02	0.00	1.56	.56	2.29	1.29
1703	9.64	1.47	1.07	.11	.02	12.31	.28	15.35	.59
1711	4.65	.58	.41	.10	.03	5.77	.24	7.18	.54
1721	7.93	1.12	.75	.07	0.00	9.87	.24	11.99	.51
1731	13.63	1.60	.60	.11	.01	15.95	.17	18.34	.35
1741	43.97	7.31	2.76	.62	.16	54.82	.25	56.53	.51
1751	11.38	1.51	.66	.09	.01	13.65	.20	16.02	.41
1761	3.85	.60	.44	.06	.01	4.96	.29	6.25	.62
1770	22.97	3.67	2.43	.51	.19	29.87	.30	38.46	.67
1780	22.75	2.67	2.39	.57	.18	28.56	.26	36.21	.59
1790	6.76	1.09	.74	.37	0.00	8.66	.28	10.74	.59
1800	13.83	2.56	1.25	.34	.10	18.08	.31	23.07	.67
1810	19.22	3.71	1.54	.35	.09	24.91	.30	31.18	.62
1820	13.92	2.76	1.56	.34	.11	18.69	.34	24.34	.75
1830	22.22	3.58	3.53	1.01	.29	30.63	.38	42.14	.90
1840	21.92	2.62	2.24	.58	.17	27.53	.26	34.90	.59
1850	12.10	2.36	.75	.18	0.00	15.39	.27	18.69	.54
1860	21.62	3.93	1.41	.34	.03	27.33	.26	33.28	.54
1870	18.59	3.83	2.14	.36	.10	25.02	.35	32.35	.74
1880	34.37	10.84	2.93	.67	.16	48.97	.42	63.69	.85
1889	14.39	3.00	1.18	.17	.03	18.77	.30	23.30	.62
1899	15.71	4.18	1.48	.36	.10	21.83	.39	28.43	.81
1909	4.12	.95	.43	.10	.01	5.61	.36	7.23	.76
1919	23.48	4.95	2.01	.62	.18	31.24	.33	40.14	.71
1929	21.29	6.62	2.36	.67	.21	31.15	.46	42.07	.98
1939	16.94	2.64	1.45	.38	.11	21.52	.27	27.01	.59
1947	24.26	4.85	1.75	.54	.19	31.59	.30	33.89	.64
1957	39.71	10.15	4.18	1.05	.32	55.41	.40	71.04	.84

TABLE 5. (Continued)
COMPARATIVE HYDROCARBON GAS ANALYSIS

WELL Y 1 01/09/79

SAMPLE NO.	METHANE (1)	ETHANE (2)	PROPANE (3)	BUTANE (4)	PENTANE (5)	MOLAR BASIS		METHANE EQUIVALENTS	
						TOTAL HYDROCARB	(2+3+4+5)/1	TOTAL HYDROCARB	(2+3+4+5)/1
1967	20.51	4.44	1.22	.30	.06	26.53	.29	32.62	.59
1977	16.53	3.23	.98	.24	.03	21.01	.27	25.57	.55
1982	19.65	3.74	1.09	.25	.03	24.76	.26	29.29	.52
1997	12.04	2.06	.58	.08	0.00	14.76	.23	17.35	.44
2006	14.68	3.00	.78	.14	.01	18.61	.27	22.39	.52
2016	12.49	3.04	1.06	.20	.05	16.84	.35	21.38	.71
2026	22.14	5.64	1.85	.52	.15	30.30	.37	39.12	.77
2036	14.48	3.61	1.10	.23	.05	19.47	.34	24.56	.70
2046	9.79	1.40	.44	.03	0.00	11.66	.19	13.44	.37
2056	18.19	4.29	1.21	.30	.09	24.08	.32	30.18	.66
2066	41.95	8.97	4.73	1.41	.38	57.44	.37	76.08	.81
2075	38.42	8.97	2.98	.80	.23	51.40	.34	65.39	.70
2095	22.72	3.44	.94	.23	.03	27.36	.20	31.99	.41
2095	10.82	1.84	.51	.06	0.00	13.23	.22	15.51	.43
2105	30.59	6.98	2.04	.53	.15	40.29	.32	50.43	.65
2115	19.18	4.10	1.23	.32	.10	24.93	.30	31.00	.62
2113	18.92	6.43	2.71	.82	.13	29.01	.53	40.30	1.13
2125	21.32	5.74	1.96	.49	.14	29.55	.39	38.35	.80
2135	33.45	9.56	3.06	.91	.28	47.26	.41	62.28	.86
2145	25.62	8.49	3.09	.87	.25	38.32	.58	52.36	1.04
2155	46.55	14.90	6.28	1.77	.50	70.00	.50	96.74	1.08
2165	18.27	6.67	4.17	1.40	.54	31.05	.70	47.81	1.62
2175	24.83	6.13	1.85	.27	0.00	33.08	.33	41.05	.65
2184	30.96	8.42	4.92	1.31	.19	45.80	.48	63.25	1.04
2194	15.60	4.58	2.03	.51	.07	22.79	.46	30.72	.97
2204	12.99	3.39	1.35	.29	.03	18.04	.39	23.39	.80
2214	39.94	8.90	4.41	1.08	.15	54.48	.36	70.84	.77
2224	20.92	7.00	2.99	.82	.13	31.86	.52	44.00	1.10
2234	20.21	4.44	1.97	.58	.20	27.40	.36	35.86	.77
2243	25.17	4.14	1.21	.20	0.00	30.72	.22	36.09	.43
2253	21.30	4.01	1.22	.15	0.00	26.68	.25	31.95	.50
2263	14.01	1.67	.53	.33	0.00	16.54	.18	19.32	.38
2273	8.26	1.37	.36	.04	0.00	10.03	.21	11.59	.41
2283	23.58	3.97	.87	.14	0.00	28.56	.21	33.15	.41
2293	4.51	.70	.16	0.00	0.00	5.37	.19	6.14	.36
2302	8.57	1.57	.45	.07	0.00	10.66	.20	12.67	.48
2312	15.42	4.42	0.00	0.00	0.00	19.84	.29	23.16	.50
2322	38.71	12.40	4.03	.66	0.00	55.80	.44	72.62	.88
2332	43.12	11.52	5.02	1.19	.37	61.22	.42	81.67	.89
2342	34.01	7.41	1.79	.37	.12	43.70	.28	53.30	.57
2352	2.18	.21	.05	0.00	0.00	2.44	.12	2.67	.23
2488	29.13	13.09	5.62	1.69	.57	50.10	.72	74.62	1.56
2498	27.80	13.24	4.08	1.04	.31	46.47	.67	66.20	1.38
2509	25.23	15.71	6.34	1.64	.48	49.40	.96	76.46	2.03

TABLE 5. (Continued)
COMPARATIVE HYDROCARBON GAS ANALYSIS

WELL Y 1 01/09/79

SAMPLE NO.	METHANE (1)	ETHANE (2)	PROPANE (3)	BUTANE (4)	PENTANE (5)	MOLAR BASIS		METHANE EQUIVALENTS	
						TOTAL HYDROCARB	(2+3+4+5)/1	TOTAL HYDROCARB	(2+3+4+5)/1
2518	45.18	15.06	4.98	1.24	.39	66.85	.48	90.10	.99
2528	37.07	15.13	6.70	1.81	.55	61.06	.65	88.47	1.39
2538	23.00	8.73	4.10	1.37	0.00	37.20	.62	52.95	1.30
2548	28.48	14.55	5.95	1.73	.57	51.29	.80	77.51	1.72
2558	38.66	27.46	12.68	3.25	1.07	83.12	1.15	134.69	2.48
2568	43.70	18.20	8.55	2.54	.69	73.68	.69	108.86	1.49
2578	26.68	21.04	9.41	2.60	.83	60.56	1.27	99.90	2.74
2588	30.54	18.44	8.15	2.28	.74	60.16	.97	94.57	2.10
2598	51.17	15.59	4.63	1.15	.39	72.98	.43	95.97	.88
2607	36.96	22.25	11.53	3.54	1.11	75.39	1.04	122.15	2.30
2617	32.83	19.62	10.41	2.99	.74	66.59	1.03	106.94	2.25
2627	28.97	18.13	11.94	4.16	1.21	64.40	1.22	110.49	2.81
2637	53.07	16.42	4.91	1.20	.46	76.06	.43	100.44	.89
2647	45.22	16.31	6.74	1.73	.56	70.56	.56	99.22	1.19
2657	40.53	14.46	4.75	1.09	.32	61.14	.51	82.93	1.05
2725	43.50	16.70	6.29	1.57	.40	68.46	.57	95.68	1.20
2735	54.94	13.45	4.54	1.22	.31	74.46	.36	95.44	.74
2745	17.73	16.80	9.64	2.81	.83	47.87	1.69	84.85	3.77
2755	41.33	24.77	11.54	3.22	.99	81.90	.98	129.40	2.13
2765	57.00	11.19	3.66	.98	.24	72.99	.28	89.94	.58
2775	35.59	14.34	5.29	.92	.13	56.27	.58	77.58	1.18
2814	53.64	11.87	4.79	1.34	.39	72.03	.34	92.82	.73
2832	2.28	2.23	5.12	3.10	1.18	13.92	5.11	35.39	14.52

TABLE 6. GAS RELEASE RATES OF Y-1 SHALES
(GAS PRESSURES, TORR)

Time, days	Sample Identification (EGSP-NYL Series)				
	530	1939	2119	2538	2832
0	22	22	22	22	20
1	33	36	46	91	58
5	32	49	52	240	63
15	34	83	61	345	72
40	34	137	69	318	*
65	37	193	76	318	*

* Air accidentally admitted to container

TABLE 7. DIFFUSION COEFFICIENTS OF HYDROCARBON GASES
IN Y-1 SHALES (PARAMETERS FOR EQUATION 1)

Sample No.	P_{∞} , torr	D , cm^2/sec	a
530	34	2×10^{-6}	0.3
1939	1650	8.5×10^{-9}	large
2119	77	1×10^{-6}	0.43
2538	319	4×10^{-6}	large
2832	(120)	$(1 \times 10^{-6})^*$	$(2)^*$

* Insufficient data; values cited are rough estimates

TABLE 8. INITIAL AND ULTIMATE PRESSURES
IN THE SEALED CANISTERS

Sample No.	P_{∞} , torr	P_{HC} , torr
Y-1-530	34	150
Y-1-1939	1650	200
Y-1-2119	77	249
Y-1-2538	319	430
Y-1-2832	(120)	108

TABLE 9. CHEMICAL CHARACTERIZATION DATA, 02/02/79

SAMPLE ID	TOTAL CARBON PERCENT	TOTAL HYDROGEN PERCENT	TOTAL NITROGEN PERCENT	TOTAL SULFUR PERCENT	CARD CODE	SEQ NO.
Y 1- 372.	.6	.5	.1	.1	5	1
Y 1- 382.	.5	.4	.1	.1	5	2
Y 1- 392.	1.1	.5	.1	.2	5	3
Y 1- 402.	.2	.4	.1	.4	5	4
Y 1- 412.	.3	.4	.1	.3	5	5
Y 1- 422.	.3	.5	.1	.3	5	6
Y 1- 431.	.4	.4	.1	.5	5	7
Y 1- 441.	.3	.3	.1	.2	5	8
Y 1- 451.	.3	.4	.1	.6	5	9
Y 1- 461.	.1	.3	.1	.4	5	10
Y 1- 471.	.3	.3	.1	.4	5	11
Y 1- 481.	.6	.3	.1	.5	5	12
Y 1- 491.	.3	.3	.1	.5	5	13
Y 1- 501.	.4	.4	.1	.5	5	14
Y 1- 521.	.3	.4	.1	.7	5	15
Y 1- 530.	.1	.2	.1	.1	5	16
Y 1- 565.	.3	.3	.1	.1	5	18
Y 1- 575.	1.0	.4	.1	.4	5	19
Y 1- 585.	.5	.4	.1	.3	5	20
Y 1- 995.	1.4	.5	.1	1.3	5	21
Y 1-1014.	.6	.2	.1	1.1	5	23
Y 1-1330.	1.0	.5	.1	1.6	5	24
Y 1-1340.	1.1	.5	.1	1.6	5	25
Y 1-1350.	.4	.3	.1	1.6	5	26
Y 1-1360.	.3	.3	.1	.2	5	27
Y 1-1370.	.2	.5	.1	.1	5	28
Y 1-1380.	.2	.3	.1	1.3	5	29
Y 1-1390.	.4	.3	.1	.1	5	30
Y 1-1400.	.6	.4	.1	.1	5	31
Y 1-1410.	.3	.5	.1	.1	5	32
Y 1-1420.	1.2	.5	.1	1.3	5	33
Y 1-1430.	.1	.5	.1	.2	5	34
Y 1-1440.	.4	.2	.1	.1	5	35
Y 1-1449.	.1	.3	.1	.1	5	36
Y 1-1459.	.6	.5	.1	.3	5	37
Y 1-1469.	.5	.3	.1	.1	5	38
Y 1-1479.	.2	.4	.1	.1	5	39
Y 1-1484.	.1	.5	.1	.1	5	40
Y 1-1494.	.2	.4	.1	.2	5	41
Y 1-1504.	1.2	.5	.2	1.4	5	42
Y 1-1514.	.8	.5	.1	2.4	5	43
Y 1-1524.	.3	.5	.1	.6	5	44
Y 1-1533.	.3	.6	.1	.1	5	45
Y 1-1543.	.1	.5	.1	.2	5	46
Y 1-1553.	.3	.5	.1	.1	5	47

TABLE 9. (Continued)
CHEMICAL CHARACTERIZATION DATA, 02/02/79

SAMPLE ID	TOTAL CARBON PERCENT	TOTAL HYDROGEN PERCENT	TOTAL NITROGEN PERCENT	TOTAL SULFUR PERCENT	CARD CODE	SEQ NO.
Y 1-1563.	.2	.4	.1	.1	5	48
Y 1-1573.	.4	.6	.1	.1	5	49
Y 1-1583.	.3	.4	.1	.1	5	50
Y 1-1592.	.5	.3	.1	.2	5	51
Y 1-1602.	.2	.5	.1	.1	5	52
Y 1-1612.	.3	.4	.1	.2	5	53
Y 1-1622.	.1	.4	.1	.1	5	54
Y 1-1632.	.2	.5	.1	.4	5	55
Y 1-1642.	.7	.5	.1	.1	5	56
Y 1-1652.	.2	.4	.1	.2	5	57
Y 1-1662.	.3	.5	.1	.2	5	58
Y 1-1672.	.6	.5	.1	.2	5	59
Y 1-1682.	.3	.5	.1	.2	5	60
Y 1-1692.	.3	.5	.1	.3	5	61
Y 1-1703.	.5	.5	.1	.7	5	62
Y 1-1711.	.5	.3	.1	.1	5	63
Y 1-1721.	.6	.5	.1	.4	5	64
Y 1-1731.	.4	.5	.1	.2	5	65
Y 1-1741.	.5	.5	.1	1.2	5	66
Y 1-1751.	.4	.6	.1	.3	5	67
Y 1-1761.	.2	.3	.1	.5	5	68
Y 1-1770.	.3	.5	.1	.3	5	69
Y 1-1780.	.9	.6	.1	1.4	5	70
Y 1-1790.	.5	.5	.1	.4	5	71
Y 1-1800.	.5	.6	.1	1.3	5	72
Y 1-1810.	.9	.6	.1	1.9	5	73
Y 1-1820.	.8	.6	.1	2.9	5	74
Y 1-1830.	1.1	.6	.1	2.4	5	75
Y 1-1840.	.7	.5	.1	1.8	5	76
Y 1-1850.	3.5	.6	.1	.2	5	77
Y 1-1860.	.4	.3	.1	1.4	5	78
Y 1-1870.	.7	.5	.1	1.6	5	79
Y 1-1880.	1.1	.6	.3	1.6	5	80
Y 1-1889.	.8	.6	.1	.2	5	81
Y 1-1899.	.7	.6	.1	.5	5	82
Y 1-1909.	1.0	.2	.1	.9	5	83
Y 1-1919.	.5	.3	.1	.2	5	84
Y 1-1929.	.8	.6	.1	2.8	5	85
Y 1-1939.	1.2	.5	.2	1.8	5	86
Y 1-1947.	.3	.5	.1	.5	5	87
Y 1-1957.	1.0	.5	.1	1.5	5	88
Y 1-1967.	1.6	.5	.1	.1	5	89
Y 1-1977.	.4	.5	.1	1.8	5	90
Y 1-1987.	2.8	.6	.1	.3	5	91
Y 1-1997.	.4	.6	.1	.5	5	92

TABLE 9. (Continued)
CHEMICAL CHARACTERIZATION DATA, 02/02/79

SAMPLE ID	TOTAL CARBON PERCENT	TOTAL HYDROGEN PERCENT	TOTAL NITROGEN PERCENT	TOTAL SULFUR PERCENT	CARD CODE	SEQ NO.
Y 1-2006.	.4	.6	.1	.1	5	93
Y 1-2016.	.5	.4	.1	3.0	5	94
Y 1-2026.	.4	.5	.1	.4	5	95
Y 1-2036.	.3	.6	.1	.2	5	96
Y 1-2046.	.4	.6	.1	.1	5	97
Y 1-2056.	.3	.6	.1	.4	5	98
Y 1-2065.	1.1	.5	.1	1.9	5	99
Y 1-2075.	.4	.5	.1	1.1	5	100
Y 1-2085.	.5	.4	.1	.2	5	101
Y 1-2095.	.3	.5	.1	.3	5	102
Y 1-2105.	1.3	.5	.1	1.2	5	103
Y 1-2115.	.7	.5	.1	1.9	5	104
Y 1-2119.	2.0	.5	.2	1.8	5	105
Y 1-2125.	.7	.5	.1	.2	5	106
Y 1-2135.	.5	.4	.1	1.7	5	107
Y 1-2145.	.6	.5	.1	2.6	5	108
Y 1-2155.	1.9	.5	.1	1.9	5	109
Y 1-2165.	1.0	.4	.4	5.3	5	110
Y 1-2175.	.3	.5	.1	.3	5	111
Y 1-2184.	.5	.5	.2	.2	5	112
Y 1-2194.	.7	.4	.2	1.0	5	113
Y 1-2204.	.4	.5	.1	.3	5	114
Y 1-2214.	.5	.5	.2	.7	5	115
Y 1-2224.	.3	.4	.2	.7	5	116
Y 1-2234.	.6	.3	.2	.3	5	117
Y 1-2243.	.5	.6	.5	.3	5	118
Y 1-2253.	.6	.5	.6	.2	5	119
Y 1-2263.	.4	.5	.5	.2	5	120
Y 1-2273.	.4	.5	.5	.1	5	121
Y 1-2283.	.6	.6	.6	.7	5	122
Y 1-2293.	.4	.5	.4	.6	5	123
Y 1-2302.	.5	.5	.5	.1	5	124
Y 1-2312.	.7	.5	.1	1.2	5	125
Y 1-2322.	.4	.5	.1	.4	5	126
Y 1-2332.	1.0	.5	.1	1.5	5	127
Y 1-2342.	.4	.4	.2	1.9	5	128
Y 1-2352.	.9	.5	.1	.1	5	129
Y 1-2406.	.6	.5	.1	1.1	5	130
Y 1-2498.	.7	.5	.1	1.2	5	131
Y 1-2506.	.6	.5	.1	1.6	5	132
Y 1-2518.	.6	.5	.1	1.7	5	133
Y 1-2526.	.7	.4	.1	1.5	5	134
Y 1-2538.	2.0	.5	.1	1.5	5	135
Y 1-2548.	.6	.5	.1	1.2	5	136
Y 1-2568.	1.0	.6	.1	1.6	5	138

TABLE 9. (Continued)
CHEMICAL CHARACTERIZATION DATA, 02/02/79

SAMPLE ID	TOTAL CARBON PERCENT	TOTAL HYDROGEN PERCENT	TOTAL NITROGEN PERCENT	TOTAL SULFUR PERCENT	CARD CODE	SEQ NO.
Y 1-2570.	.7	.5	.1	1.7	5	139
Y 1-2580.	1.2	.5	.2	1.6	5	140
Y 1-2590.	.9	.5	.1	1.7	5	141
Y 1-2607.	1.0	.5	.1	2.1	5	142
Y 1-2617.	4.0	.6	.1	1.8	5	143
Y 1-2627.	2.0	.5	.1	2.6	5	144
Y 1-2637.	1.3	.5	.1	1.4	5	145
Y 1-2647.	.8	.4	.1	1.6	5	146
Y 1-2657.	1.3	.4	.1	.6	5	147
Y 1-2725.	2.0	.4	.1	.9	5	148
Y 1-2735.	2.1	.5	.1	.9	5	149
Y 1-2745.	2.1	.4	.1	.9	5	150
Y 1-2755.	3.1	.4	.1	1.0	5	151
Y 1-2765.	2.2	.4	.1	.9	5	152
Y 1-2775.	2.3	.4	.1	.5	5	153
Y 1-2784.	2.4	.5	.2	2.4	5	154
Y 1-2794.	1.9	.4	.1	.7	5	155
Y 1-2804.	2.6	.4	.2	.6	5	156
Y 1-2814.	1.0	.4	.1	.7	5	157
Y 1-2824.	1.0	.5	.1	1.0	5	158
Y 1-2832.	3.1	.5	.1	1.3	5	159
Y 1-2844.	1.6	.5	.1	1.4	5	160
Y 1-2854.	3.8	.5	.1	1.6	5	161
Y 1-2864.	6.5	.3	.1	.4	5	162
Y 1-2874.	6.6	.3	.1	.7	5	163
Y 1-2884.	4.6	.5	.1	1.0	5	164
Y 1-2894.	5.1	.6	.1	1.0	5	165

TABLE 10. SUMMARY OF PHYSICAL CHARACTERIZATION DATA
02/12/79

SAMPLE ID.	BULK DENSITY, G/CC	TRUE DENSITY, G/CC	POROSITY, PCT	SURFACE AREA, M2/G	SEQ NO.
Y 1- 372.	2.305	2.763	16.584	4.122	1
Y 1- 382.	2.676	2.603	0.000	3.649	2
Y 1- 392.	2.539	2.845	10.766	.903	3
Y 1- 402.	2.448	2.619	6.511	1.013	4
Y 1- 412.	2.609	2.774	5.945	1.746	5
Y 1- 422.	2.621	2.657	1.372	2.982	6
Y 1- 431.	2.643	2.567	0.000	3.605	7
Y 1- 441.	2.689	2.584	0.000	2.477	8
Y 1- 451.	2.388	2.573	10.670	4.052	9
Y 1- 461.	2.600	2.739	5.060	4.124	10
Y 1- 471.	2.508	2.547	1.517	3.372	11
Y 1- 481.	2.681	2.751	2.532	3.194	12
Y 1- 491.	2.633	2.665	1.206	1.747	13
Y 1- 501.	2.634	2.902	9.233	1.462	14
Y 1- 521.	2.538	2.767	8.264	2.363	15
Y 1- 530.	2.543	2.611	9.532	2.430	16
Y 1- 965.	2.543	2.588	1.740	1.521	18
Y 1- 975.	2.568	2.790	7.968	2.284	19
Y 1- 985.	2.684	2.038	0.000	1.188	20
Y 1- 995.	2.508	2.793	10.193	2.241	21
Y 1-1014.	2.548	2.680	4.927	1.145	23
Y 1-1110.	2.614	2.688	2.738	1.079	24
Y 1-1140.	2.642	2.634	0.000	1.542	25
Y 1-1150.	2.618	2.638	.751	1.563	26
Y 1-1150.	2.563	2.818	9.054	2.507	27
Y 1-1170.	2.645	2.659	.902	3.387	28
Y 1-1180.	2.612	2.809	7.029	1.003	29
Y 1-1190.	2.534	2.685	5.614	3.706	30
Y 1-1400.	2.586	2.663	2.893	1.090	31
Y 1-1410.	2.645	2.781	4.895	5.833	32
Y 1-1420.	2.621	2.629	.304	2.515	33
Y 1-1430.	2.628	2.774	5.265	3.934	34
Y 1-1440.	2.561	2.614	2.009	2.012	35
Y 1-1440.	2.655	2.709	1.995	4.291	36
Y 1-1450.	2.669	2.727	2.119	4.216	37
Y 1-1460.	2.635	2.578	0.000	1.022	38
Y 1-1470.	2.629	2.628	0.000	1.997	39
Y 1-1484.	2.659	2.652	0.000	5.197	40
Y 1-1494.	2.590	2.683	3.484	2.681	41
Y 1-1504.	2.614	2.646	1.226	3.322	42
Y 1-1514.	2.587	2.770	6.602	1.997	43
Y 1-1524.	2.472	2.749	10.057	5.069	44
Y 1-1531.	2.622	2.974	11.825	1.973	45
Y 1-1543.	2.630	2.717	3.189	2.179	46
Y 1-1553.	2.697	2.772	2.720	1.598	47

TABLE 10. (Continued)
SUMMARY OF PHYSICAL CHARACTERIZATION DATA
02/12/79

SAMPLE ID.	BULK DENSITY, G/CC	TRUE DENSITY, G/CC	POROSITY, PCT	SURFACE AREA, M2/G	SEQ NO.
Y 1-1563.	2.653	2.641	0.000	1.996	48
Y 1-1573.	2.656	2.851	6.849	1.109	49
Y 1-1583.	2.651	2.684	1.237	.932	50
Y 1-1592.	2.642	2.736	3.443	1.053	51
Y 1-1602.	2.607	2.685	2.918	4.265	52
Y 1-1612.	2.587	2.632	1.724	1.616	53
Y 1-1622.	2.685	2.676	0.000	2.581	54
Y 1-1632.	2.609	2.679	2.609	2.487	55
Y 1-1642.	2.652	2.719	2.473	3.749	56
Y 1-1652.	2.426	2.663	8.898	2.314	57
Y 1-1662.	2.681	2.824	5.053	2.303	58
Y 1-1672.	2.686	2.753	2.429	.934	59
Y 1-1682.	2.654	2.887	8.081	3.527	60
Y 1-1692.	2.608	2.656	1.810	2.716	61
Y 1-1703.	2.638	2.732	3.452	2.967	62
Y 1-1711.	2.667	2.591	0.000	1.659	63
Y 1-1721.	2.593	2.825	8.212	3.893	64
Y 1-1731.	2.521	2.645	4.678	3.542	65
Y 1-1741.	2.642	2.732	3.287	3.980	66
Y 1-1751.	2.646	2.680	1.276	2.641	67
Y 1-1761.	2.640	2.602	0.000	2.853	68
Y 1-1775.	2.628	2.594	0.000	2.490	69
Y 1-1780.	2.635	2.651	.602	3.126	70
Y 1-1790.	2.648	2.634	0.000	1.874	71
Y 1-1800.	2.638	2.803	5.882	4.459	72
Y 1-1810.	2.613	2.682	2.574	3.144	73
Y 1-1820.	2.615	2.896	9.716	1.336	74
Y 1-1830.	2.599	2.762	5.912	1.015	75
Y 1-1840.	2.583	2.761	4.374	3.779	76
Y 1-1850.	2.646	2.947	10.226	2.443	77
Y 1-1860.	2.623	2.629	.234	2.018	78
Y 1-1870.	2.563	2.755	6.956	.947	79
Y 1-1880.	2.570	2.662	3.453	1.198	80
Y 1-1889.	2.675	2.746	2.573	2.635	81
Y 1-1899.	2.594	2.716	4.484	2.858	82
Y 1-1909.	2.650	2.646	0.000	1.027	83
Y 1-1919.	2.624	2.677	1.974	2.295	84
Y 1-1929.	2.594	2.718	4.559	1.717	85
Y 1-1939.	2.624	2.962	11.423	1.628	86
Y 1-1947.	2.698	2.710	.458	2.065	87
Y 1-1957.	2.633	2.661	1.067	2.338	88
Y 1-1967.	2.671	2.888	7.514	1.230	89
Y 1-1977.	2.672	2.690	.679	4.319	90
Y 1-1987.	2.689	2.882	6.703	2.531	91
Y 1-1997.	2.555	2.646	3.431	4.733	92

TABLE 10. (Continued)
SUMMARY OF PHYSICAL CHARACTERIZATION DATA
02/12/79

SAMPLE ID.	BULK DENSITY, G/CC	TRUE DENSITY, G/CC	POROSITY, PCT	SURFACE AREA, M ² /G	SEQ NO.
Y 1-2006.	2.645	2.780	4.850	2.436	93
Y 1-2016.	2.626	2.669	1.617	2.876	94
Y 1-2026.	2.663	2.724	2.233	1.809	95
Y 1-2036.	2.700	2.580	0.000	.968	96
Y 1-2046.	2.633	2.792	5.693	1.502	97
Y 1-2056.	2.695	2.663	0.000	1.324	98
Y 1-2066.	2.681	2.633	0.000	2.306	99
Y 1-2075.	2.647	2.687	1.492	1.982	100
Y 1-2085.	2.661	2.664	.129	2.443	101
Y 1-2095.	2.603	2.696	3.456	2.004	102
Y 1-2105.	2.561	2.773	7.635	2.371	103
Y 1-2115.	2.620	2.738	4.324	2.351	104
Y 1-2119.	2.596	3.101	16.285	2.517	105
Y 1-2125.	2.610	2.914	10.439	4.043	106
Y 1-2135.	2.571	2.684	4.197	1.958	107
Y 1-2145.	2.603	2.770	5.823	3.554	108
Y 1-2155.	2.642	2.737	3.475	1.734	109
Y 1-2165.	2.677	3.112	13.986	2.036	110
Y 1-2175.	2.665	2.714	1.809	1.892	111
Y 1-2184.	2.668	2.998	11.020	2.823	112
Y 1-2194.	2.665	2.764	3.592	2.592	113
Y 1-2204.	2.676	2.889	7.368	2.885	114
Y 1-2214.	2.672	2.777	3.786	1.958	115
Y 1-2224.	2.647	2.880	5.450	2.284	116
Y 1-2234.	2.681	2.821	4.971	1.285	117
Y 1-2243.	2.672	2.848	6.186	2.631	118
Y 1-2253.	2.664	2.861	4.881	1.643	119
Y 1-2263.	2.537	2.967	14.492	2.433	120
Y 1-2273.	2.687	2.855	5.885	3.755	121
Y 1-2283.	2.588	3.148	17.799	2.207	122
Y 1-2293.	2.608	2.908	10.325	1.666	123
Y 1-2302.	2.669	2.593	0.000	2.759	124
Y 1-2312.	2.464	3.016	18.301	1.652	125
Y 1-2322.	2.665	2.801	4.863	3.622	126
Y 1-2332.	2.633	2.988	11.880	3.027	127
Y 1-2342.	2.640	2.904	9.099	2.005	128
Y 1-2352.	2.672	3.063	12.765	3.486	129
Y 1-2483.	2.636	2.882	8.542	3.516	130
Y 1-2493.	2.651	2.803	5.317	1.447	131
Y 1-2508.	2.655	2.822	5.928	2.966	132
Y 1-2518.	2.667	2.904	8.155	1.612	133
Y 1-2528.	2.636	2.884	8.584	2.804	134
Y 1-2538.	2.542	2.813	9.632	1.685	135
Y 1-2548.	2.622	2.988	12.017	.947	136
Y 1-2568.	2.624	2.622	0.000	1.685	138

TABLE 10. (Continued)
SUMMARY OF PHYSICAL CHARACTERIZATION DATA
02/12/79

SAMPLE ID.	BULK DENSITY, G/CC	TRUE DENSITY, G/CC	POROSITY, PCT	SURFACE AREA, M2/G	SEQ NO.
Y 1-2578.	2.668	3.166	15.724	3.523	139
Y 1-2588.	2.653	2.914	8.965	2.777	140
Y 1-2598.	2.581	2.964	12.914	3.004	141
Y 1-2607.	2.692	3.021	10.881	2.320	142
Y 1-2617.	2.524	2.766	8.762	2.812	143
Y 1-2627.	2.560	2.957	13.413	1.869	144
Y 1-2637.	2.651	2.884	8.074	2.568	145
Y 1-2647.	2.658	3.037	12.467	1.784	146
Y 1-2657.	2.642	2.875	8.094	1.864	147
Y 1-2725.	2.686	2.704	.668	2.569	149
Y 1-2735.	2.651	2.619	0.000	1.016	152
Y 1-2745.	2.636	2.948	10.594	2.658	148
Y 1-2755.	2.644	2.851	7.252	2.395	150
Y 1-2765.	2.650	2.901	8.637	.941	151
Y 1-2775.	2.661	2.834	6.100	1.945	153
Y 1-2784.	2.610	2.879	9.347	2.341	154
Y 1-2794.	2.630	3.086	14.764	3.851	155
Y 1-2804.	2.669	2.823	5.449	1.364	156
Y 1-2814.	2.641	2.637	0.000	3.170	157
Y 1-2824.	2.621	2.918	10.174	2.669	158
Y 1-2832.	2.613	2.848	8.253	1.758	159
Y 1-2844.	2.563	2.786	8.016	1.819	160
Y 1-2854.	2.522	2.870	12.125	1.132	161
Y 1-2864.	2.625	2.791	5.931	1.422	162
Y 1-2874.	2.541	2.832	10.284	1.075	163
Y 1-2884.	2.553	2.760	7.513	1.270	164
Y 1-2894.	2.533	2.718	6.792	2.483	165

TABLE 11. STATISTICAL ANALYSES OF PHYSICAL CHARACTERIZATION DATA
02/12/79

	WELL Y 1						
	MEAN	STANDARD DEVIATION	VARIANCE	COEFFICIENT OF DEVIATION	95 PCT. CONFIDENCE INTERVAL LOWER LIMIT	UPPER LIMIT	NO OF SAMPLES
BULK DENSITY, G/CC	2.618	.06	.00	.02	2.609	2.629	162
TRUE DENSITY, G/CC	2.767	.14	.02	.05	2.744	2.799	162
POROSITY, PCT	5.502	4.44	19.73	.81	4.310	6.195	162
SURFACE AREA, M2/G	2.405	1.02	1.03	.42	2.246	2.563	162

*I IS INSIGNIFICANT

TABLE 12. MERCURY INTRUSION POROSITY RESULTS
FOR WELL Y-1 SHALES

Sequence No.	Sample ID.	Porosity, percent
1	Y-1-372	4.73
3	-392	4.75
5	-412	4.62
9	-451	4.25
11	-471	3.94
13	-491	4.61
15	-521	5.00
19	-975	3.57
21	-995	3.79
23	-1014	8.31
27	-1360	6.64
29	-1380	4.39
31	-1400	4.50
33	-1420	4.14
35	-1440	5.25
37	-1459	6.70
41	-1494	2.59
43	-1514	4.86
45	-1533	5.87
47	-1553	2.23
49	-1573	9.93
51	-1592	5.76
53	-1612	9.52
55	-1632	5.40
57	-1652	2.28
59	-1672	6.88
61	-1692	5.63
65	-1731	4.56
67	-1751	5.66
73	-1810	7.19
75	-1830	8.08
77	-1850	10.32
79	-1870	9.41
81	-1889	9.55
85	-1929	3.35
87	-1947	5.37
89	-1967	9.19
91	-1987	6.78
93	-2006	8.20
95	-2026	9.40

TABLE 12. (Continued)

Sequence No.	Sample ID	Porosity, percent
97	Y-1-2046	5.19
101	-2085	6.39
103	-2105	4.79
105	-2119	3.87
107	-2135	2.44
109	-2155	2.85
111	-2175	6.69
113	-2194	6.08
115	-2214	4.41
117	-2234	5.82
119	-2253	11.59
121	-2273	5.97
123	-2293	5.06
125	-2312	7.37
127	-2332	7.58
129	-2352	8.50
131	-2498	5.91
133	-2518	8.29
135	-2538	4.37
139	-2578	11.50
141	-2598	9.63
143	-2617	2.68
145	-2637	7.66
147	-2657	3.06
149	-2725	4.92
151	2765	6.20
153	-2775	6.23
155	-2794	3.18
159	-2832	7.26
161	-2854	5.14
163	-2874	7.17
165	-2894	5.17

TABLE 13. ENERGY DISPERSIVE ANALYSIS OF Y-1 SHALES

Shale Sample	Element Count Per 100 Counts													
	Na	K	Ca	Mg	Al	Si	Fe	S	Cl	Ti	Fe/S	K/Al	K/Si	Al/Si
Y-1-372	-	8.9	1.6	2.0	21.3	55.6	9.4	-	-	1.2	∞	0.42	0.14	0.38
-975	-	11.8	-	-	24.5	54.2	8.0	0.2	-	1.3	40	0.48	0.22	0.45
-1440	-	3.9	3.5	-	11.5	73.7	6.1	-	0.5	0.8	∞	0.34	0.05	0.16
-1592	-	6.5	2.0	-	16.7	61.0	9.1	-	3.3	1.4	∞	0.39	0.11	0.27
-1751	-	8.7	-	-	18.9	59.0	9.6	2.4	-	1.4	4.0	0.46	0.15	0.32
-1909	-	3.7	7.1	1.7	9.8	71.1	5.3	0.4	-	0.9	14.0	0.37	0.05	0.14
-2085	-	8.1	-	2.8	25.1	58.4	4.4	-	1.2	-	∞	0.32	0.14	0.43
-2253	-	9.7	-	2.6	23.9	55.4	6.8	0.4	1.2	-	16.5	0.41	0.17	0.43
-2548	-	7.9	21.1	1.4	14.8	42.7	8.5	1.4	0.9	1.3	5.94	0.53	0.18	0.34
-2794	-	7.5	9.9	2.8	16.5	57.7	3.7	0.8	1.1	-	4.59	0.45	0.13	0.28
-2894	-	6.2	8.5	1.8	16.4	61.5	3.5	1.7	0.9	-	2.01	0.40	0.10	0.27
Y-7-6104	-	8.6	-	-	27.7	58.4	4.4	-	-	0.9	∞	0.31	0.15	0.47
-6194	-	8.7	-	2.4	20.3	56.2	7.7	3.5	-	1.2	2.2	0.43	0.15	0.36
-6293	-	8.3	1.9	2.4	20.5	58.3	6.4	1.4	-	0.8	4.5	0.40	0.14	0.35
-6448	-	10.0	2.3	-	22.8	58.0	5.5	-	-	1.4	∞	0.44	0.17	0.39
-6544	-	8.4	22.1	-	15.8	47.3	4.7	0.8	-	0.9	5.7	0.53	0.18	0.33
Illite grain	-	17.2	-	-	25.5	57.3	-	-	-	-	-	0.67	0.30	0.45
Pyrite grain	-	-	-	-	-	-	27.5	72.5	-	-	0.38	-	-	-
Quartz grain	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-

FIGURE 1. TIME ON SURFACE FOR WELL Y-1

WELL Y 1

FIGURE 2. HYDROCARBON GAS VERSUS DEPTH.

FIGURE 3. EXPERIMENTAL AND CALCULATED GAS RELEASE RATES

FIGURE 4. EXPERIMENTAL AND CALCULATED GAS RELEASE RATES

FIGURE 5. EXPERIMENTAL AND CALCULATED GAS RELEASE RATES

FIGURE 6. RELEASE KINETICS CURVE FOR Y-1-2558

WELL Y 1

FIGURE 7. CARBON VERSUS DEPTH

FIGURE 8. HYDROGEN VERSUS DEPTH

FIGURE 9. HYDROCARBON VERSUS DEPTH

WELL Y 1

FIGURE 10. SULFUR VERSUS DEPTH

WELL Y 1

FIGURE 11. CARBON VERSUS HYDROCARBON GAS

WELL Y 1

FIGURE 12. HYDROGEN VERSUS HYDROCARBON GAS

WELL Y 1

FIGURE 13. SULFUR VERSUS HYDROCARBON GAS

WELL Y 1

FIGURE 14. BULK DENSITY VERSUS GAS RELEASED

WELL Y 1

FIGURE 15. BULK DENSITY VERSUS CARBON

WELL Y 1

FIGURE 16. BULK DENSITY VERSUS HYDROGEN

WELL Y 1

FIGURE 17. CARBON VERSUS POROSITY

WELL -Y 1

FIGURE 18. HYDROGEN VERSUS POROSITY

WELL Y 1

WELL Y 1

FIGURE 20. BULK DENSITY VERSUS POROSITY

700 X

FIGURE 21. SEM MICROGRAPH OF SAMPLE Y-7-6194

700 X

FIGURE 22. SEM MICROGRAPH OF SAMPLE Y-7-6293

700 X

FIGURE 23. SEM MICROGRAPH OF SAMPLE Y-7-6448

700 X

FIGURE 24. SEM MICROGRAPH OF SAMPLE Y-7-6544

700 X

FIGURE 25. SEM MICROGRAPH OF SAMPLE Y-7-6104

FIGURE 26. HYDROCARBON GAS VERSUS WIRELOG DATA FOR EGSP NY NO. 1

FIGURE 27. GAS/UNIT VOLUME OF SHALE VERSUS WIRELOG AND LABORATORY PHYSICAL DATA FOR EGSP NY NO. 1

FIGURE 28. TOTAL CARBON CONTENT VERSUS WIRELOG DATA FOR EGSP NY NO. 1

FIGURE 29. HYDROCARBON GAS CONTENT VERSUS LOG AND LABORATORY DATA FOR EGSP NY NO. 1

APPENDIX A

MERCURY INTRUSION POROSITY DATA FOR WELL Y-1

Y 1 431.

Y 1 451.

Y 1 471.

Y 1 491.

Y 1 521.

Y 1 975.

Y 1 995.

Y 11014.

Y 11340.

Y 11360.

Y 11380.

Y 11400.

Y 11420.

Y 11440.

Y 11459.

Y 11479.

Y 11494.

Y 11514.

Y 11533.

Y 11553.

Y 11573.

Y 11592.

Y 11612.

Y 11632.

Y 11652.

Y 11672.

Y 11692.

Y 11711.

Y 11731.

Y 11770.

Y 11751.

Y 11790.

Y 11810.

Y 11830.

Y 11850.

Y 11870.

Y 11889.

Y 11909.

Y 11929.

Y 11947.

Y 11967.

Y 11987.

Y 12006.

Y 12046.

Y 12056.

Y 12065.

Y 12085.

Y 12105.

Y 12119.

Y 12135.

Y 12155.

Y 12175.

Y 12194.

Y 12214.

Y 12234.

Y 12253.

Y 12273.

Y 12293.

Y 12312.

Y 12332.

Y 12352.

Y 12498.

Y 12518.

Y 12538.

Y 12578.

Y 12598.

Y. 12617.

Y 12637.

Y 12657.

Y 12735.

Y 12755.

Y 12775.

Y 12794.

Y 12814.

Y 12832.

Y 12854.

Y 12874.

Y 12894.

Y 1 431.

Y 1 412.

Y 1 451.

Y 1 471.

Y 1 491.

Y 1 521.

Y 1 975.

Y 1 995.

Y 11014.

Y 11340.

Y 11360.

Y 11380.

Y 11400.

Y 11420.

Y 11440.

Y 11459.

Y 11479.

Y 11494.

Y 11514.

Y 11533.

Y 11553.

Y 11573.

Y 11592.

Y 11612.

Y 11612.

Y 11632.

Y 11652.

Y 11632.

Y 11692.

Y 11672.

Y 11731.

Y 11711.

Y 11770.

Y 11751.

Y 11810.

Y 11790.

Y 11850.

Y 11830.

Y 11889.

Y 11870.

Y 11929.

Y 11909.

Y 11967.

Y 11947.

Y 12006.

Y 11987.

Y 12046.

Y 12056.

Y 12065.

Y 12085.

Y 12105.

Y 12119.

Y 12135.

Y 12155.

Y 12175.

Y 12194.

Y 12214.

Y 12234.

Y 12253.

Y 12273.

Y 12293.

Y 12312.

Y 12332.

Y 12352.

Y 12498.

Y 12518.

Y 12538.

Y 12578.

Y 12598.

Y 12617.

Y 12637.

Y 12657.

Y 12735.

Y 12755.

Y 12775.

Y 12794.

Y 12814.

Y 12832.

Y 12854.

Y 12874.

Y 12894.