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Clay mineralogy of Devonian shales in the Appalachian basin

by

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Abstract

A study of the clay mineralogy of the Devonian black shales of the Appalachian basin was undertaken to help predict areas for potential gas resources. More than 2,100 samples from 84 drill holes representing 11 shale units were analyzed for clay mineralogy or whole-rock mineralogy or both. Approximately 1,300 samples were from drill cores and about 800 samples were from drill cuttings. Illite (2M) recrystallized during diagenesis is more or less uniformly present throughout all shale units. Chlorite formed during low grade metamorphism is least abundant in the younger units and more abundant in the older units. Illite-smectite mixed-layer clay, which supplied the material for the formation of chlorite, is most abundant in the younger units and least abundant in the older units. Illite-chlorite mixed-layer clay occurs as a trace in all shale units. Kaolinite, the only unaltered detrital clay mineral, occurs in about 25 to 30 percent of the samples. The source of the kaolinite appears to have been to the east and northeast of the basin of deposition. The color of the shale units is primarily due to the organic content; however, those shales that contain calcite are darker than those that do not for equal amounts of organic carbon.

Introduction

This report contains mineralogical analyses of the Devonian black shale units of the Appalachian basin. More than 2,100 samples from 84 drill holes (fig. 1) were collected and analyzed. Two types of samples

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Figure 1 in pocket.

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were collected. One type is drill core from holes shown as a solid dot (fig. 1) and a second type is a split of drill cuttings from holes shown as an open circle (fig. 1). The samples from drill core were taken at 5, 10, 15, or 20-foot intervals depending upon lithology. The samples from drill cutting represent intervals from 20 to 100 feet. The number of samples per drill hole range from 3 to 77 depending upon the length of core or cuttings and the sampling interval. Most samples were taken of the dark gray to black shale units and a few samples were taken of the light gray silty shale units. Limestone beds were not sampled.

Appreciation is expressed to the following individuals for their cooperation in supplying or making the samples available: A. M. Van Tyne, New York State Geological Survey; R. A. Carlton, Ohio Division of Geological Survey; R. G. Piotrowski and J. A. Harper, Pennsylvania Bureau of Topographic and Geologic Survey; R. C. Milici, Tennessee Division of Geology; R. C. Milici and D. C. Le Van, Virginia Division of Mineral Resources; D. G. Patchen, West Virginia Geologic and Economic Survey; Alan Pyrah and W. A. Shelly, Cliff Minerals Inc., and R. C. Kepferle, U.S. Geological Survey.

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Sample Preparation

Each sample was ground with alcohol, in a tungsten-carbide ball mill for 15-20 minutes. A 0.5 g portion of the ground material was pressed, with 1.5 g of backing material, into a 2 mm-thick wafer 29 mm in diameter. The wafer was used to determine the whole-rock mineralogy by X-ray diffraction on a unit which has an automatic sample changer. The remainder of the ground material was dispersed in deionized water. An ultrasonic horn was placed in the clay-water mixture for 15-20 minutes. Usually this treatment dispersed the sample and flocculation did not occur. If the sample did flocculate, it was washed with deionized water 3 or 4 times using a centrifuge. If the sample continued to flocculate after this treatment, a few drops of sodium metaphosphate solution (0.05 g of the $NaPO_3$ dissolved in 1 ml of H_2O) were added to assure dispersal of the sample. The <2μm clay fraction, obtained by settling for a given time and depth, was siphoned off and placed on a porous ceramic tile using the vacuum technique described by Kinter and Diamond (1956).

The samples were analyzed for clay mineralogy on a standard X-ray unit using copper (CuK_{α_1}) radiation in conjunction with the following optical arrangements; a 1° beam slit, a medium resolution soller slit, a 0.1° detector slit, a graphite crystal for monochromatic radiation, and a 5° take-off angle. The goniometer was run at a speed of 1°2θ per minute

and the chart recorder was driven at a speed of 12 inches per hour, so that the X-ray diffraction trace was recorded at a rate of 5°2θ per inch. The detector was set on a linear scale of 1000 counts per second (cps) for full scale deflection and a 2.5 second time constant was used. The X-ray diffraction trace was used to identify and determine the relative abundances of the clay mineral following the method of Schultz (1960). An electronic planimeter was used to carefully measure selected basal peak areas on the X-ray diffraction traces to obtain the proportions of the individual clay minerals.

The samples were analyzed for whole-rock or bulk mineralogy on an automatic X-ray unit using copper radiation and the following optical arrangements; a theta compensating slit, a medium resolution soller slit, a 0.2 mm receiving slit, a graphite crystal for monochromatic radiation, and a 6° take off angle. The goniometer was run at a step-scan speed of 0.5° 2θ per minute with a one second time count made every 0.02° 2θ . The counts per second were recorded, in digital form, on cassette tapes. The digitized data were transmitted to a computer which compared the data against mineral standards. The minerals were identified and their amounts determined by a computer program using a least-squares method.

Three methods of preparing the clay fraction for X-ray diffraction analysis were tested because it was found that small amounts of kaolinite are difficult to recognize when chlorite is also present. One method consisted of (A) settling the clay fraction onto a glass slide using a centrifuge. The second method consisted of (B) settling the clay fraction onto a glass slide by allowing the water to evaporate from the clay-water mixture under room conditions. The third method consisted of (C) placing

the clay–water mixture onto a porous ceramic tile and removing the water through the tile by the vacuum method Kinter and Diamond (1956). X-ray diffraction traces were made of the top surface of all three preparations and X-ray diffraction traces were made of the bottom surface (the surface in contact with the support medium) of the first two preparations (methods A and B). An X-ray diffraction trace of the bottom surface of the sample on the porous tile (method C) could not be made because the sample could not be removed from the tile. However, the following discussion will show that the inability to analyze the bottom surface of the sample by method C doesn't matter.

The three methods result in different mineralogical interpretations. (fig. 2). The X-ray diffraction traces of the top surface of the sample

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Figure 2 near here.

---

prepared by method A and method B (figs. 2 A and B) show a single peak at 25° 2θ and the intensity of the 9° 2θ peak is much larger than the 12.5° 2θ peak. The 20.8° 2θ quartz peak has a low intensity peak indicating that quartz is present in a very minute amount. The X-ray diffraction traces of the bottom surface of the sample prepared by method A and B (fig. 2 D and E) and the top surface of the sample prepared by method C (fig. 2 C) show a double peak at 25° 2θ and the intensities of the 9° 2θ peak and the 12.5° 2θ peak are nearly equal on all three traces. Comparison of the 20.8° 2θ peak intensities indicate that the quartz is more abundant on the bottom surface than on the top surface – a result of differential settling. Another obvious effect of settling in the use of methods A and B is the double peak at 25° 2θ which indicates the presence of the (002) peak for kaolinite and the (004) peak for chlorite. Kaolinite, which is

Figure 2. X-ray diffraction traces of one sample prepared by three different methods. The sample is from drill hole (API 47-035-21369) Jackson Co., WV, at a depth of 3489.0 feet. The vertical scale is 300 counts per second except A, which is 500 counts per second.

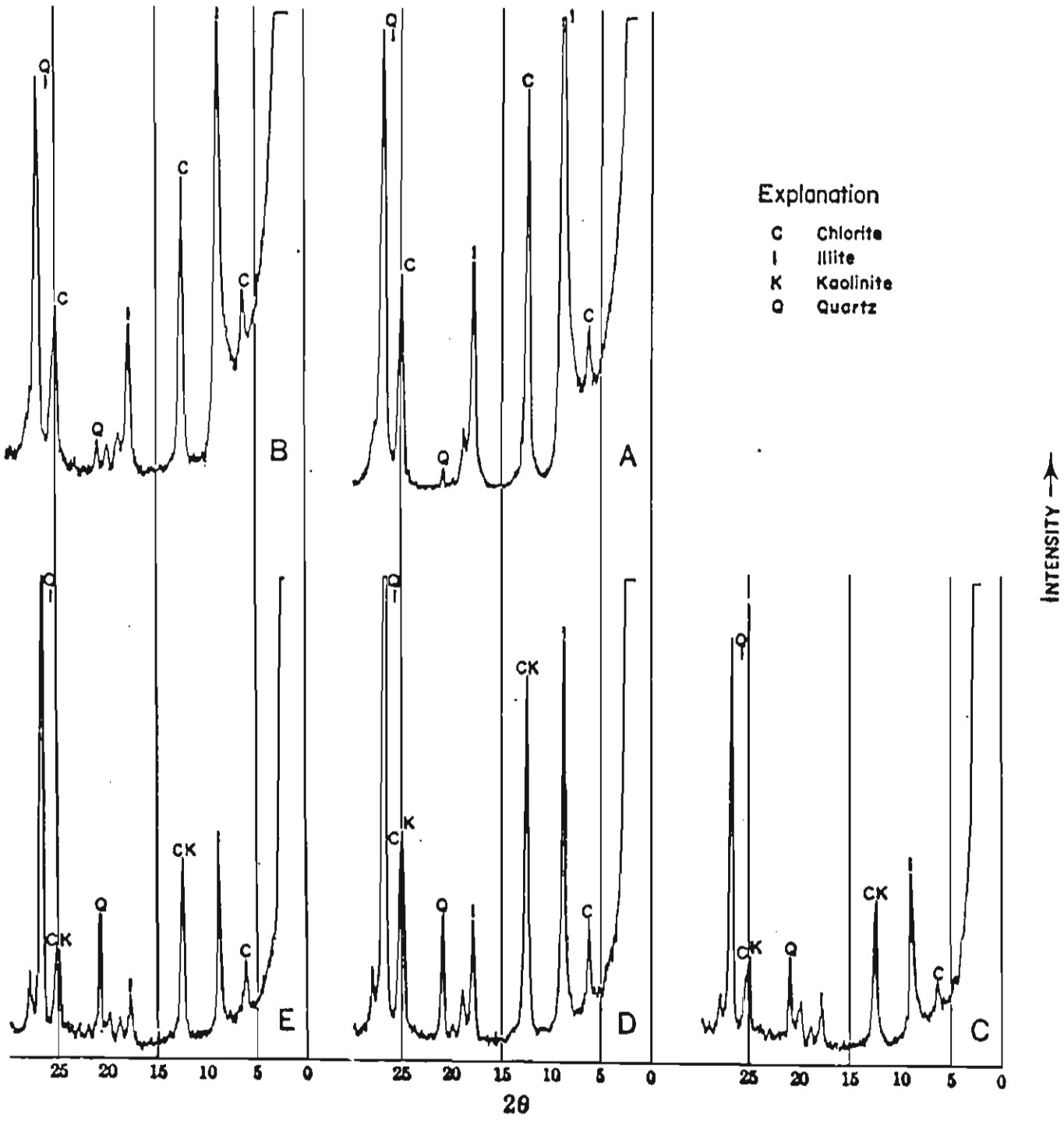
A. X-ray diffraction trace of the top surface of settled sample, water removed by centrifuge.

B. X-ray diffraction trace of the top surface of settled sample, water removed by evaporation.

C. X-ray diffraction trace of the top surface of sample on porous ceramic tile, water removed by vacuum.

D. X-ray diffraction trace of bottom surface of A.

E. X-ray diffraction trace of bottom surface of B.


Explanation
C Chlorite
I Illite
K Kaolinite
Q Quartz
INTENSITY
B
A
E
D
C
25 20 15 10 5 0
2θ

in the presence of chlorite, the (002) peak of kaolinite is not seen on the top surface. The vacuum method (c) of Kinter and Diamond (1956, p. 111) minimizes or eliminates this differential settling effect.

Clay mineralogy

The clay minerals in the Devonian-age shales of the Appalachian basin are illite, chlorite, kaolinite, and two types of mixed-layer clay. X-ray studies by Bates and Strahl (1957) identified illite, kaolinite, and chlorite as the clay minerals in the Chattanooga Shale in Tennessee. All samples analyzed contained considerable illite, some chlorite, and small amounts of mixed-layer clay. Kaolinite is present in about 25 to 30 percent of the samples. Relative amounts of the clay minerals for each sample were calculated using the following techniques. The areas beneath the peaks on the X-ray diffraction traces at 10 A (8.8°2θ), 7A (12.6° 2θ), and 3.5A (25°2θ) were measured with a planimeter. Proportions of illite and mixed-layer clays are calculated from the area changes of the 10 A peak. The proportions of chlorite and kaolinite are calculated from a ratio obtained by measuring the areas of the double peak at about 3.5 A and applying this ratio to the area of 7 A.

Illite in this report is applied to a dioctahedral 2M polytype muscovite $(OH)_4\ K_2\ (Si_6Al_2)(Mg\ Fe)_6\ O_{20}$. It contains approximately 12 percent K_2O, 39 percent Al_2O_3, 45 percent SiO_2, and 5 percent H_2O. Illite is the most abundant clay mineral with relative proportions ranging from 40 to 90 percent. It is recognized on X-ray diffraction traces by its strong first-order basal (001) peak at 10 A, a weak second-order basal (002) peak at 5 A, and a strong third-order basal (003) peak at 3.3 A. The 2M polymorph is identified by the position of the prism reflections that

occur between 4.5 A and 2.5 A. Only the material at the 10 A position that does not expand when treated with ethylene glycol ($HOCH_2CH_2OH$) is considered illite. The material that expands with ethylene glycol and/or collapses when heated to 350°C is mixed-layer clay.

The mixed-layer clay minerals are the random interlayering of two or more clay minerals. Illite is one of the major constituents. Two types of mixed-layer clay minerals are present in the Devonian black shales. One type is composed of random interlayering of illite and an expandable mineral such as smectite. This type is called illite-smectite mixed-layer clay throughout this report. The second type is composed of a random mixture of illite and either a degraded chlorite or vermiculite. This second type is called illite-chlorite mixed-layer clay throughout this report. The mixed-layer clay minerals are identified by comparing the 10 A peak area measurements on the X-ray diffraction traces of the clay fraction that have been run untreated, after ethylene glycol saturation, and after heating to 350°C for a minimum of 30 minutes. Ethylene glycol saturation expands the smectite layers leaving illite as the only mineral represented by the 10 A peak area. Therefore, the 10 A peak area of the untreated sample represents illite plus illite-smectite mixed-layer clay. Heating to 350°C collapses the expandable layers plus the vermiculite-type layers to the 10 A position; therefore, the 10 A peak area, after heating, represents illite plus both types of mixed-layer clay minerals. An estimate can be made, based on the area measurement, of the relative proportions of illite, illite-smectite mixed-layer clay and illite-chlorite mixed-layer clay minerals.

Chlorite $(OH)_8(SiAl)_4(MgFe_3)(MgAl)_3\ O_{10}$ is present in almost all of the Devonian shale samples analyzed for this report. Its average chemical

content is: 14 percent MgO, 27 percent Fe_2O_3, 17 percent Al_2O_3, 30 percent SiO_2, and 12 percent H_2O. Chlorites in the Devonian shales range from a magnesium variety to a iron variety. Chlorite is recognized on the X-ray diffraction trace by its moderate, for the magnesium variety, to weak, for the iron variety, first-order basal (001) peak at 14 A, its strong second-order basal (002) peak at 7 A, its moderate, for the Mg variety, to weak, for the Fe variety, third-order basal (003) peak at 4.7 A, and its weak, Mg variety, to moderate, Fe variety, fourth-order basal (004) peak at approximately 3.5 A. Chlorite is not affected by ethylene glycol saturation or heating to 350°C. Heating to 550°C, however, produces an increase in the first-order basal (001) peak at 14 A and a decrease in the second, third, and fourth-order basal peaks. Fine-grained chlorite decomposes in warm hydrochloric acid (Brindley, 1961, p. 264) but it may be necessary to keep the temperature at about 80°C for 16 to 20 hours to achieve complete decomposition, especially if the chlorite is well ordered. The relative chlorite composition in Devonian shales range from 0 to 30 percent with the average between 10 and 15 percent.

Kaolinite $(OH)_8Si_4Al_4O_{10}$ is the least abundant clay mineral in the Devonian shale samples analyzed. It contains approximately 40 percent Al_2O_3, 46 percent SiO_2, and 14 percent H_2O. Kaolinite is recognized on the X-ray diffraction trace by its strong basal (001) peak at 7 A and its moderate basal (002) peak at 3.5 A. Kaolinite is not effected by ethylene glycol saturation or heating to 350°C for a minimum of 30 minutes. Heating kaolinite to about 550°C destroys its crystalline form; however, the exact temperature at which this takes place is dependent upon the grain size and degree of crystallinity of the kaolinite. Kaolinite is more immune to attack by warm dilute acids than most other clay minerals

including chlorite; however, dissolution rates also vary considerably with grain size and degree of crystallinity. Kaolinite occurs in about 30 percent of the Devonian shale samples analyzed in relative proportions to a maximum of 20 percent.

The presence of kaolinite in small amounts is extremely difficult to determine when chlorite is present. A slight difference in the c-axis dimension of the two minerals is expressed as a doublet at 3.50 A for the second-order basal (002) peak of kaolinite and the 3.57 A for the fourth-order (004) peak of chlorite. We depended upon this doublet (at about 25° 2θ) for recognizing the existence of kaolinite because neither heating or acid treatment can remove one mineral without effecting the other.

Nonclay mineralogy

The minerals, other than clay minerals, include allogenic minerals that were introduced during deposition of the clay, authigenic minerals that were formed at the time or shortly after deposition of the clay, and fossil material. The allogenic minerals are quartz, K-feldspar, plagioclase, and biotite. The authigenic minerals are calcite, dolomite, siderite, gypsum, pyrite, marcasite, barite and traces of galena and chalcopyrite. Minerals derived from fossil material are calcite, dolomite, and apatite. Quartz is present in all shale samples analyzed and pyrite is present in most samples, especially those high in organic matter. Calcite is present in almost all shales sampled from Pennsylvania and New York. All of the other non-clay minerals, both allogenic and authigenic, occur in very minor amounts throughout the Appalachian basin.

Color value as related to organic content

We determined the color of each whole sample to investigate the possibility of a relationship between color and organic carbon content by visually comparing the Munsell soil color charts (1954) to dry pressed-powder wafers. The Munsell color designation is composed of the hue (color), value (lightness), and chroma (saturation). A neutral (N) color has no hue or chroma but does have value. The value ranges from 0 (black) to 10 (white) for neutral colors and from 1 to 9 for colors with hue and saturation. Values from both the neutral and other colors were plotted against the organic carbon content to determine if there is any relationship.

All color determinations were made under similar lighting conditions. The chroma was estimated to the nearest 0.25 and the value was estimated to the nearest 0.1. The color value did not change more than 0.1 when a comparison was made between the whole-rock color of a shale sample before and after laboratory preparation. The color value for a moist whole-rock sample was consistently about 2.0 lower than for the dry whole rock sample. Any human error in determining the color value could be eliminated by using a colorimeter.

Organic carbon refers to the disseminated carbonaceous material derived from both plant and animal organisms. Organic carbon was determined by one of two methods. In the first method, the organic carbon is the difference between total carbon, measured by high-temperature combustion, and carbonate carbon, measured by titration (Leventhal, 1979). In the second method, the organic carbon is measured directly by a wet oxidation technique (Claypool and Threkeld, written commun., 1979). The results of both methods are reported in percent by weight.

We compared color value to organic carbon in approximately 880 samples from 50 drill holes throughout New York, Pennsylvania, Ohio, West Virginia, Virginia, Kentucky, and Tennessee. In samples from all but two drill holes, where data are incomplete, an excellent relationship represented by a power curve regression exists between the color value and the organic carbon content. A color value 3.0 to 3.5 or lower does indicate that organic carbon is present in concentrations greater than 7 percent but it is meaningless in determining organic carbon content accurately because a large increase in the amount of organic carbon results in only a small increase in the color value. The correlation coefficients (r) for 48 drill holes ranged from 0.81 to 1.00. However, the spread of color value between drill holes was greater than expected from the excellent individual correlations. This large spread in the color value indicated that there is probably another control in addition to the organic C content.

The mineralogy of all 880 samples was carefully studied and we determined that calcite was the only mineral to have any effect on the color value. Calcite is present in trace amounts throughout most of the Appalachian basin except New York and Pennsylvania where it occurs in amounts up to 40 percent. The color value at 1.0 percent organic carbon ranges from 4.0 to 5.5 for the shales deposited in a high calcium environment and from 4.8 to 6.1 for the shales deposited in a low- or no-calcium environment. Figure 3 shows the best power curve fit for (A)

Figure 3 near here.

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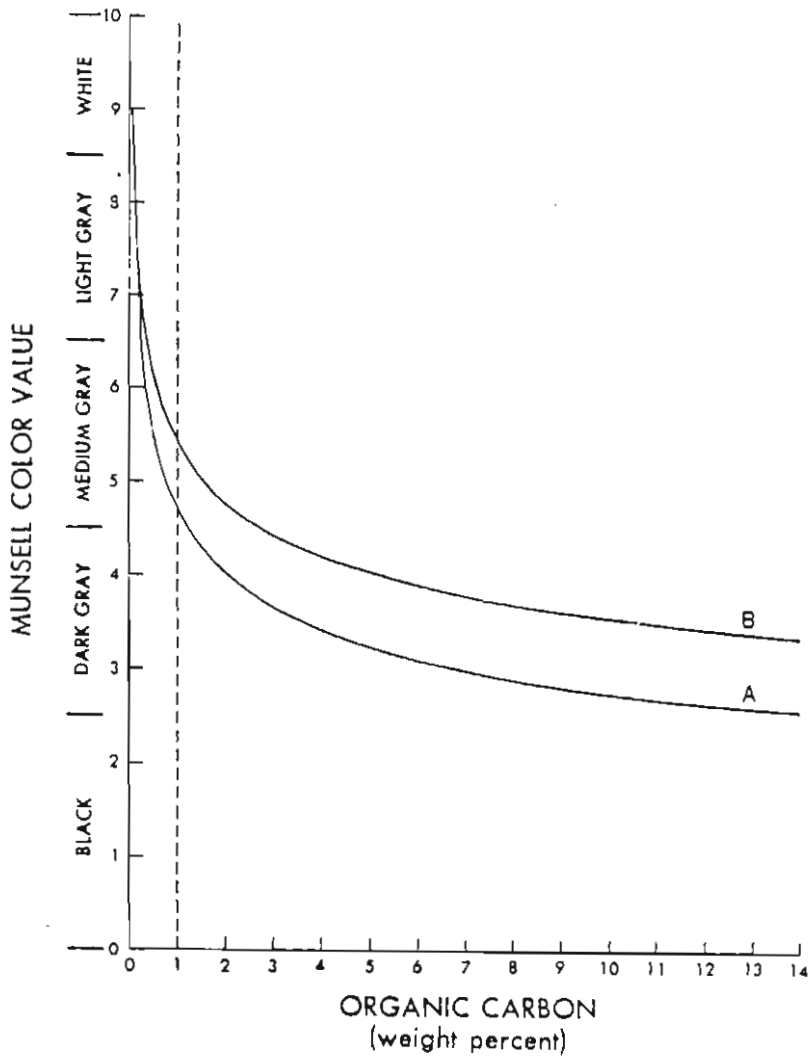
757 samples that contain calcite and (B) for 123 samples that contain

Figure 3. Munsell color value versus organic carbon in Devonian-age shale of the Appalachian basin, (A) shale containing more than 5 percent calcite, (B) shale containing no more than a trace of calcite.


MUNSELL COLOR VALUE
BLACK
DARK GRAY
MEDIUM GRAY
LIGHT GRAY
WHITE
0
1
2
3
4
5
6
7
8
9
10
B
A
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
ORGANIC CARBON
(weight percent)

only a trace of calcite. The two curves indicate that the average black shales, without calcite, contain more than 1.0 percent organic carbon when the color value is 5.4 or less. The average calcareous black shale, with more than 5 percent calcite, contains more than 1.0 percent organic carbon when the color value is 4.7 or less.

We assume that the influence of the calcium on the clay minerals during deposition causes the difference in color value between shale containing calcite and shale not containing calcite. All clay minerals have the property of sorbing and retaining anions and cations in an exchangeable state. In a calcium-rich environment, the clay mineral adsorbs the calcium ions easily and they also flocculate readily (Grim, 1968, p. 358). Because calcium ions have strong bonds, a larger than stoichiometric amount of organic carbon is needed for the calcium ions to be replaced by organic carbon. Flocculation of the clay minerals, causing rapid deposition, also prevents interaction with the organic carbon. These two factors leave the organic material free to settle as discrete grains. Conversely, in a calcium-free environment, the clay minerals will adsorb the organic material in lieu of calcium ions and there is no tendency for the clay minerals to flocculate. In shales with equal amounts of organic carbon, if the organic matter is adsorbed by the clay minerals, the color is light because of dilution and if the organic material is free, the color is dark.

Mineralogy of the Devonian shales

We determined the clay mineralogy and whole-rock mineralogy of about 1,900 samples from more than 80 drill holes throughout the Appalachian basin. The following shale units were analyzed and will be discussed

together in groups because they can be correlated (table 1 as modified from Oliver and others, 1969).

Cleveland Member of Ohio Shale
Upper unit Gassaway Member of Chattanooga Shale

Chagrin Shale
Three Lick Bed of Ohio Shale
Middle Gassaway Member of Chattanooga Shale

Upper part of the Huron Member of Ohio Shale

Middle part of the Huron Member of Ohio Shale

Lower part of the Huron Member of Ohio Shale
Dunkirk Shale Member of Perrysburg Formation
Lower unit Gassaway Member of Chattanooga Shale

Hanover Shale Member of Java Formation
Pipe Creek Shale Member of Java Formation
Upper unit Dowelltown Member of Chattanooga Shale

Rhinestreet Shale Member of West Falls Formation
Lower unit Dowelltown Member of Chattanooga Shale

Middlesex Shale Member of Sonyea Formation

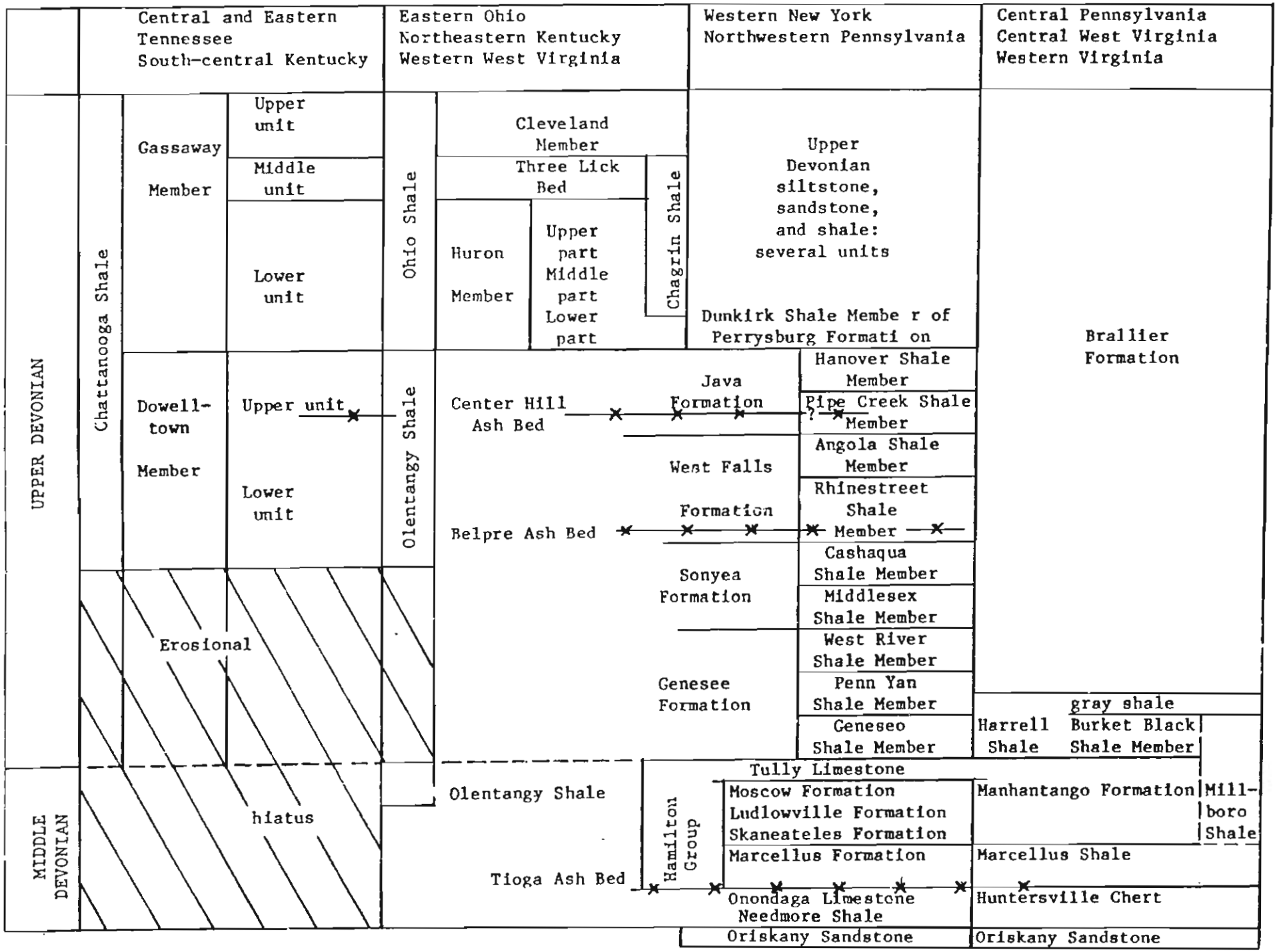
Penn Yan Shale Member of Genesee Formation
Geneseo Shale Member of Genesee Formation
Burket Black Shale Member of Harrell Shale

Mahantango Formation of Hamilton Group
Millboro Shale (excluding Marcellus Member)

Marcellus Shale of Hamilton Group
Marcellus Member of Millboro Shale

The regional subsurface correlations are based on gamma-ray log interpretations by Roen (1980). These units contain the black shale beds that have proven to be the best sources of natural gas in the Appalachian basin (Bagnall and Ryan, 1976; Patchen, 1977).

Table 1. Generalized correlation of Devonian shale units studied for clay mineralogy
[Modified from Oliver and others, 1969]



Cleveland Member of Ohio Shale

The Cleveland Member of the Ohio Shale and the upper unit of the Gassaway Member of Chattanooga Shale are correlative (Conant and Swanson, 1961, p. 20; Roen, 1980, fig. 6). We analyzed 73 samples from 20 drill holes in Alabama, Tennessee, Kentucky, Virginia, and Ohio (fig. 4). The

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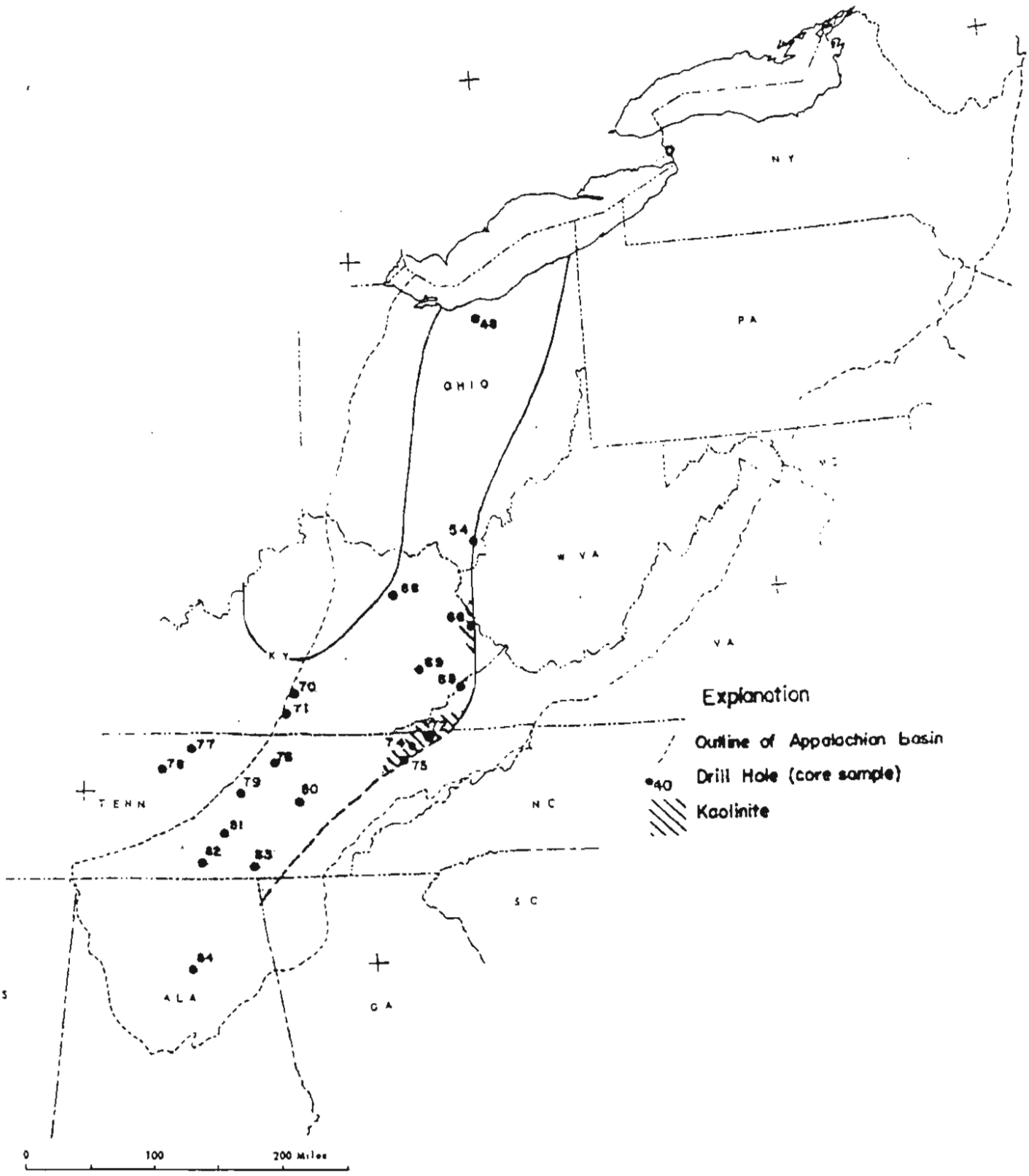
Figure 4 near here

Cleveland Member and its equivalent have an average composition of a dark gray (10YR 4.1/2) silty shale with 30 percent quartz silt, 65 percent clay, and 5 percent pyrite. Illite is the most abundant clay mineral at 60 percent with 30 percent illite-smectite mixed-layer clay and 10 percent chlorite (table 2). The illite-chlorite mixed-layer clay mineral averages about a trace and is found in samples from drill holes 66, 69, 76, 80, and 83. A trace of kaolinite occurs in samples from drill holes 66, 72, 74, and 75 in the eastern part of the basin.

Figure 4. Map showing areal extent (shaded area) of the Cleveland Member of the Ohio Shale and the upper unit of the Gassaway Member of the Chattanooga Shale.



N Y
P A
OHIO
W VA
V A
K Y
TENN
N C
S C
ALA
G A
48
54
68
66
69
68
70
71
77
78
76
79
80
81
82
83
74
75
84
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
40
Kaolinite
0
100
200 Miles

Chagrin Shale

The Chagrin Shale and its equivalents, the middle unit of the Gassaway Member of Chattanooga Shale (Roen, 1980) was sampled from 10 drill holes in Tennessee, West Virginia, and Ohio (fig. 5). The average composition

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Figure 5 near here.

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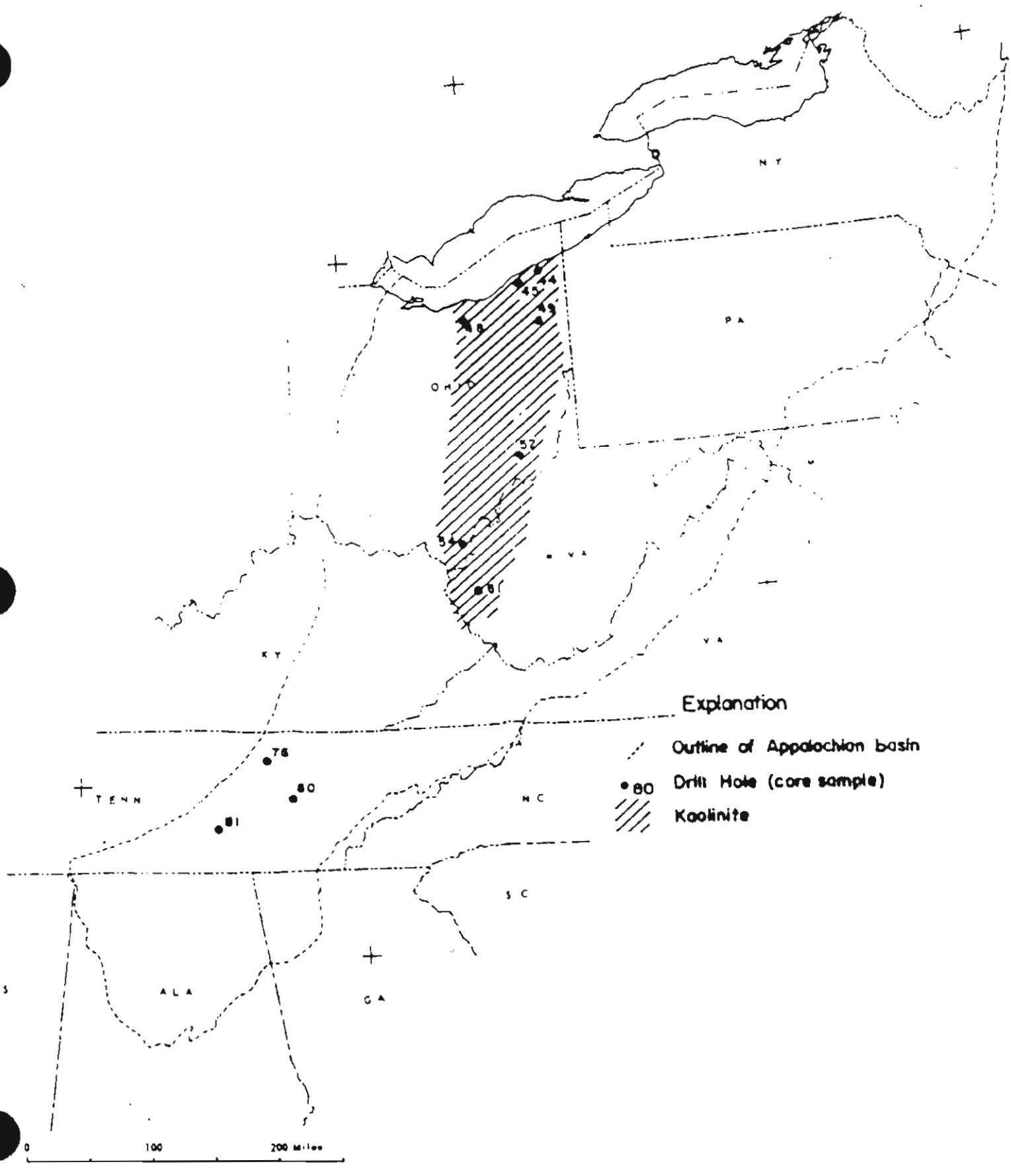
from 131 samples of the shale is 25 percent quartz silt, 75 percent clay, and a trace of pyrite. The average color of the shale is medium gray (N 6.1) with a few light brownish gray (10 YR 6/.5) and bluish gray (5 B 6/.5) beds. The average ratio of clay minerals is: 15 percent chlorite, 55 percent illite, 25 percent illite-smectite mixed layer clay, 5 percent kaolinite, and a trace of illite-chlorite mixed-layer (table 2). Kaolinite was found in samples from the northern drill holes (Nos. 44, 45, 48, 49, 52, and 54 in Ohio and No. 61 in West Virignia). The illite-chlorite mixed-layer clay is limited to samples from drill holes Nos. 80 and 81 in Tennessee and No. 61 in West Virginia.

Figure 5. Map showing the drill holes from which samples were taken of the Chagrin Shale and the middle unit of the Gassaway Member of the Chattanooga Shale.


NY
PA
OHIO
WVA
KY
VA
TENN
NC
SC
SS
ALA
GA
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Kaolinite
0
100
200 Miles

Upper part of the Huron Member of Ohio Shale

A total of 66 samples from the upper part of the Huron Member of the Ohio Shale from 12 drill holes in Tennessee, Kentucky, Virginia, and Ohio (fig. 6) were analyzed. The medium gray (10 YR 5.2/.5) shale in the

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Figure 6 near here.

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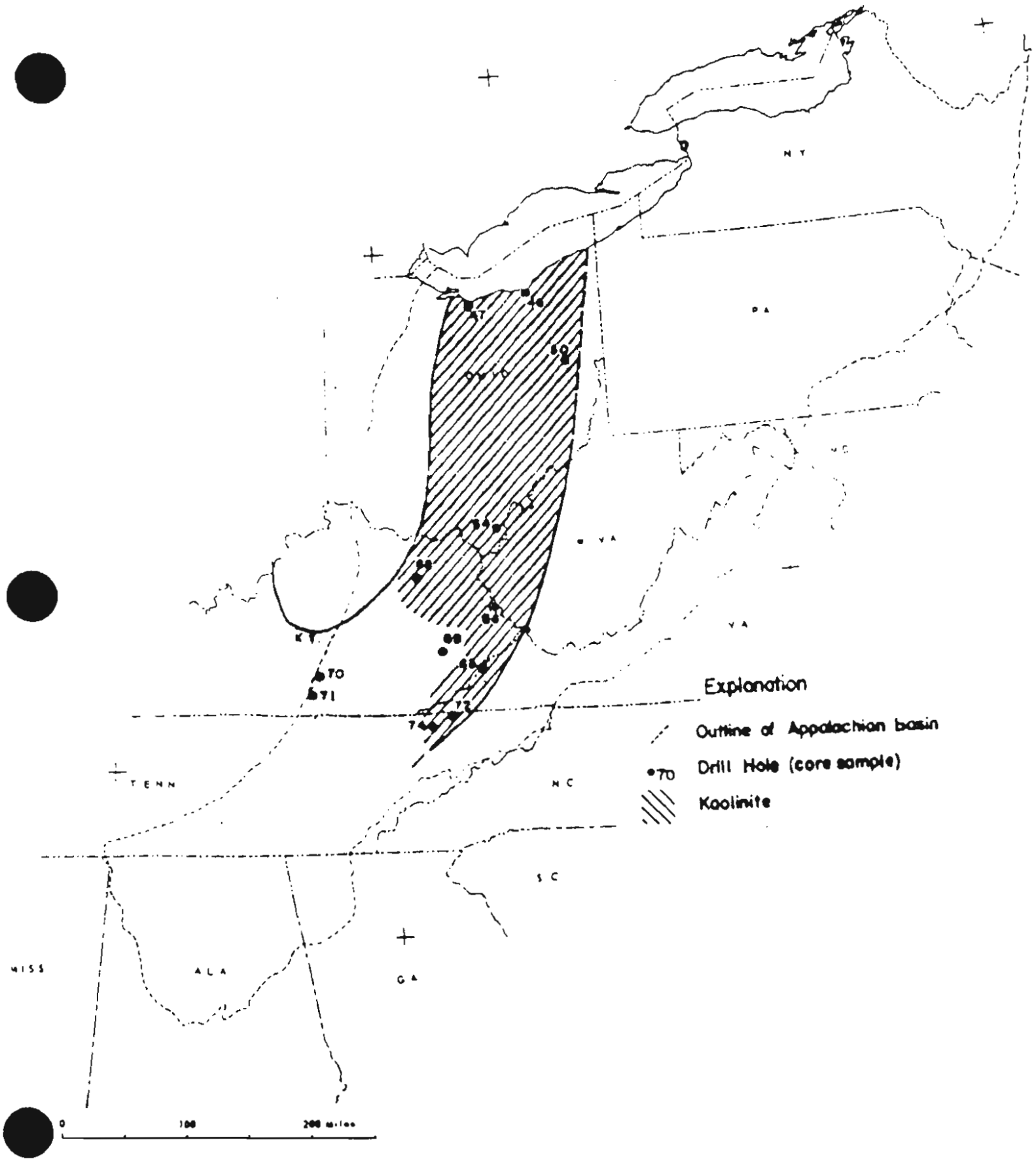
upper part of the Huron Member has an average composition of 25 percent quartz silt, 70 percent clay, and 5 percent pyrite. The clay minerals have an average ratio of 10 percent chlorite, 55 percent illite, 30 percent illite-smectite mixed-layer clay, 5 percent kaolinite, and a trace of illite-chlorite mixed-layer clay (table 2). Kaolinite is widespread throughout the upper part of the Huron Member. It was identified in samples from all drill holes except Nos. 69, 70, and 71 (fig. 6). A trace of illite-chlorite mixed-layer clay was identified in samples from drill hole Nos. 46, 50, 66, and 69.

Figure 6. Map showing the areal extent (shaded area) of the upper part of the Huron Member of the Ohio Shale.


NY
PA
VA
KY
TENN
NC
SC
GA
ALA
MISS
70
71
72
74
Explanation
Outline of Appalachian basin
•70 Drill Hole (core sample)
Kaolinite
0
100
200 miles

Middle part of the Huron Member of the Ohio Shale

A total of 178 samples from the middle part of the Huron Member of the Ohio Shale were analyzed from 18 drill holes in Tennessee, Kentucky, Virginia, West Virginia, and Ohio (fig. 7). The shale in the middle

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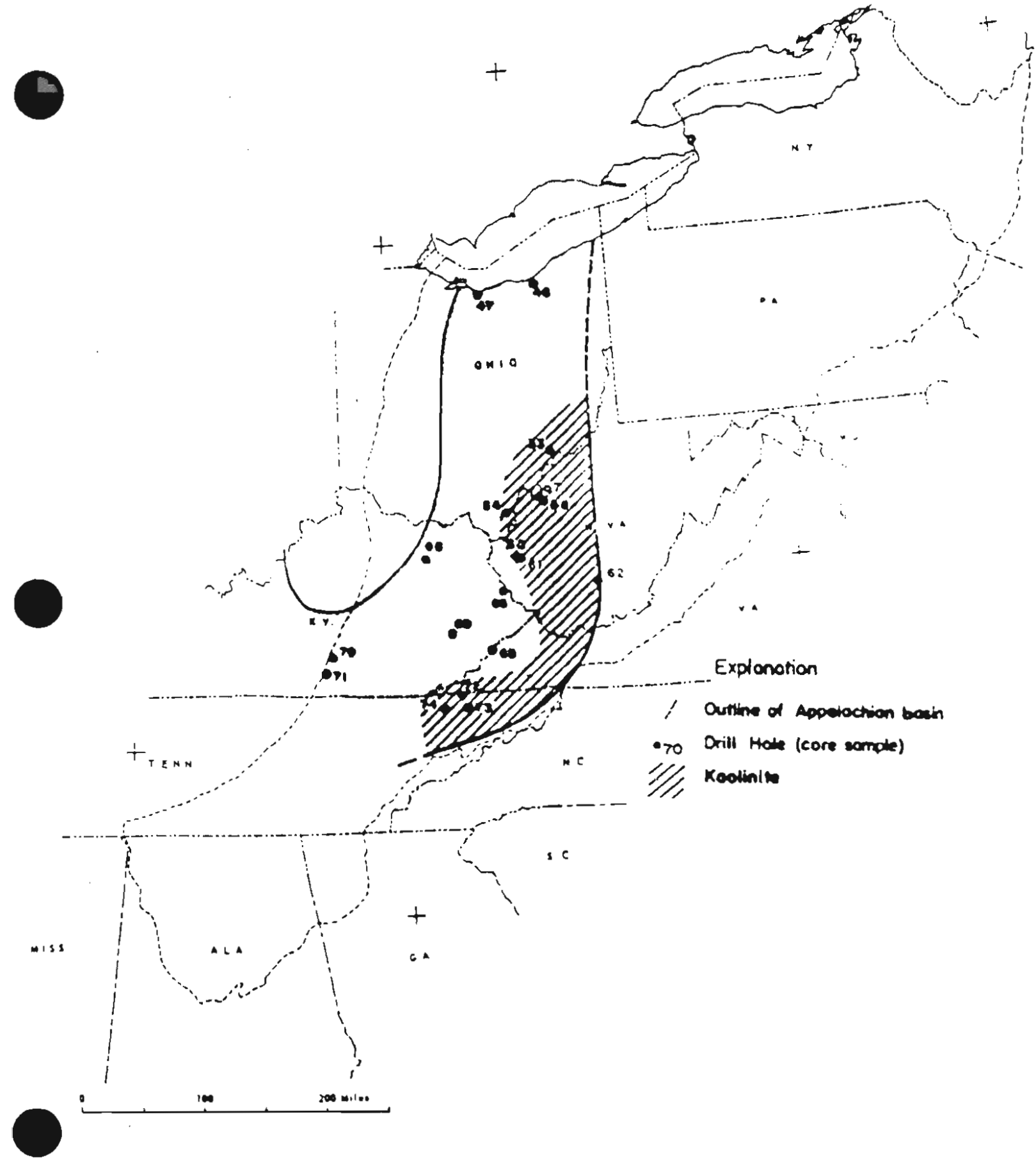
Figure 7 near here.

---

part of the Huron Member has an average composition of 25 percent quartz-silt, 75 percent clay, and a trace of pyrite. The color is medium gray (N5.5) which makes it distinguishable from the slightly darker upper and lower parts. The clay minerals have a ratio of: 10 percent chlorite, 60 percent illite, 5 percent kaolinite, 25 percent illite-smectite mixed-layer clay, and a trace of illite-chlorite mixed-layer clay. Kaolinite is found in samples from 10 holes (Nos. 53, 54, 57, 58, 60, 61, 62, 72, 73, and 74) in the eastern and southeastern part of the area. The illite-chlorite mixed-layer clay is concentrated in samples from 7 drill holes (Nos. 53, 57, 58, 60, 61, 66, and 69) that are located in the central part of the areal extent.

Figure 7. Map showing the areal extent (shaded area) of the middle part of the Huron Member of the Ohio Shale.


NY
PA
OHIO
WV
VA
KY.
TENN
NC
SC
GA
MISS
ALA
62
70
71
Explanation
Outline of Appalachian basin
70 Drill Hole (core sample)
Kaolinite
0
100
200 Miles

Lower part of the Huron Member of the Ohio Shale

The lower part of the Huron Member of the Ohio Shale is correlated with the Dunkirk Shale Member of the Perrysburg Formation and the lower unit of the Gassaway Member of the Chattanooga Shale (Roen, 1980, fig. 5; Conant and Swanson, 1961, p. 20). The lower part of the Huron Member and its equivalents consist of medium gray (10 YR 4.9/.5) shale beds having the darkest color of the Huron Member. About 358 samples from 38 drill holes in New York, Ohio, West Virginia, Virginia, Kentucky, and Tennessee (fig. 8) have an average composition of 25 percent quartz silt,

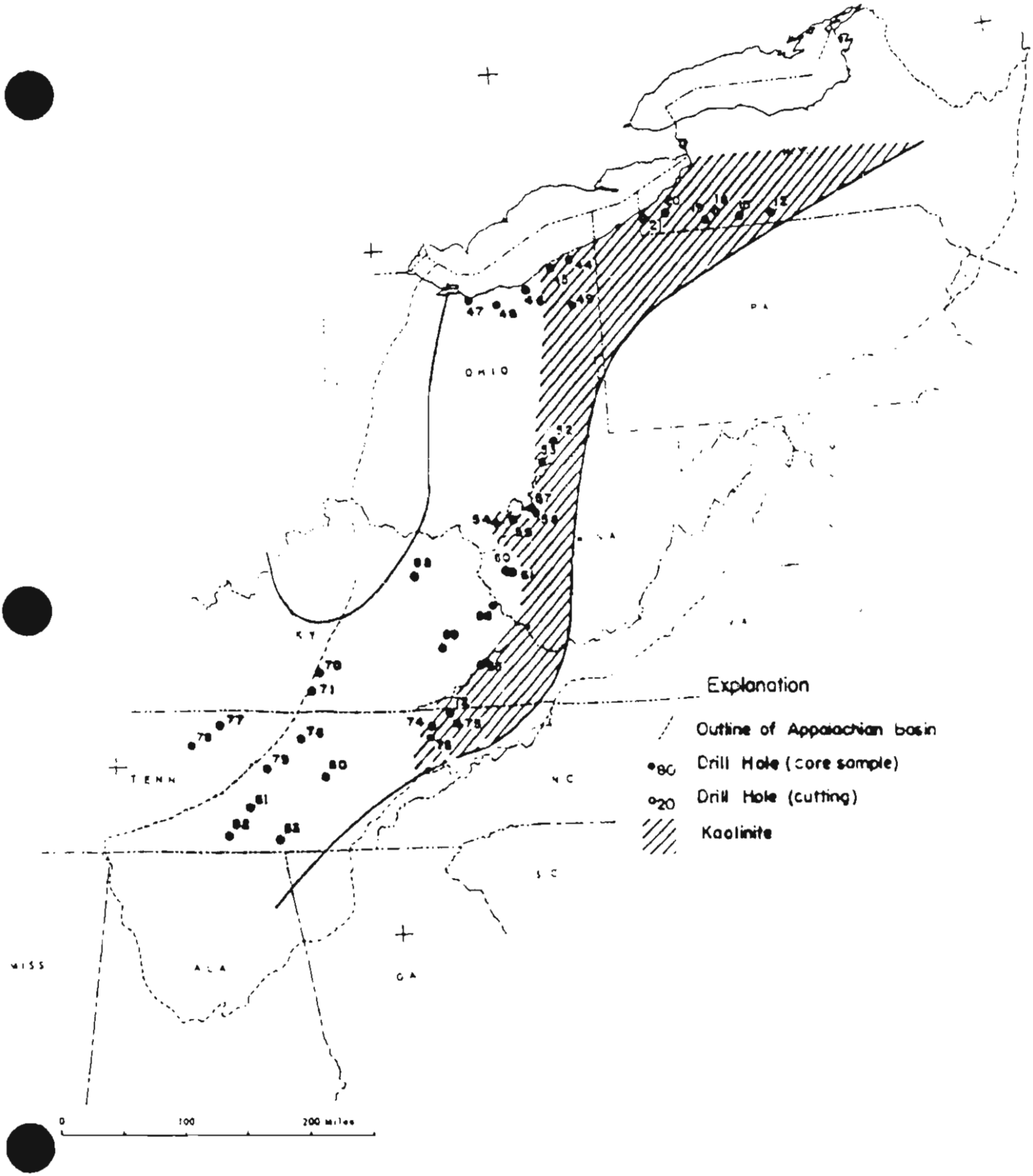
---

Figure 8 near here.

---

70 percent clay, and 5 percent pyrite. The clay minerals occur in a ratio of; 15 percent chlorite, 60 percent illite, 20 percent illite-smectite mixed-layer clay, 5 percent kaolinite, and a trace of illite-chlorite mixed-layer clay (table 2). The illite-chlorite mixed-layer clay is found in samples from 12 drill holes (Nos. 53, 57, 58, 59, 60, 61, 66, 69, 76, 80, 81, and 83) located near the central portion of the basin near the southern end. Kaolinite was identified in samples from 14 drill holes located on the east and northeast of the areal extent (fig. 8).

Figure 8. Map showing the areal extent (shaded area) of the lower part of the Huron Member of the Ohio Shale, the Dunkirk Shale Member of the Perrysburg Formation, and the lower unit of the Gassaway Member of the Chattanooga Shale.


Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
Kaolinite
OHIO
PA
KY
TENN
NC
SC
GA
ALA
MISS
0
100
200 miles

Java Formation

The shale units in the Java Formation, the Hanover Shale Member and the Pipe Creek Shale Member, are correlated with the upper unit of the Dowelltown Member of the Chattanooga Shale (Roen, 1980, fig. 5). A total of 77 samples of the Java Formation or its equivalent in 26 drill holes from New York, Ohio, West Virginia, Kentucky, and Tennessee (fig. 9) were analyzed. These medium gray (N 6.0) shale units have an average

---

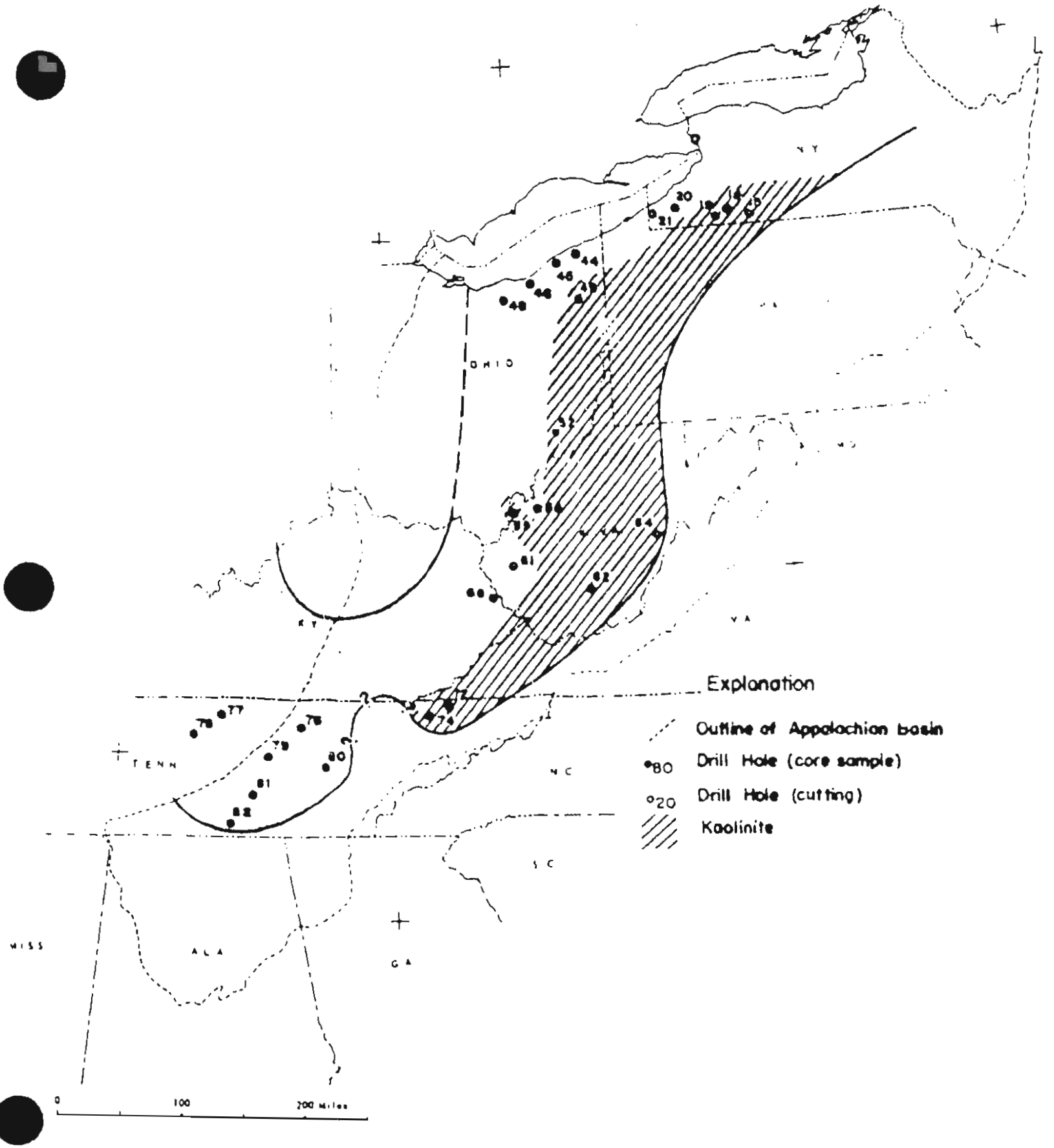
Figure 9 near here.

---

composition of 25 percent quartz silt, 70 percent clay, and 5 percent pyrite. There is a trace of calcite in the Java Formation of New York and northern Ohio and a trace of dolomite in the upper unit of the Dowelltown Member of Tennessee. The clay minerals have the following ratio: 20 percent chlorite, 55 percent illite, 25 percent illite-smectite mixed-layer clay, a trace of illite-chlorite mixed-layer clay, and a trace of kaolinite (table 2). The illite-chlorite mixed-layer clay was found in samples from 5 drill holes (Nos. 58, 59, 61, 66, and 76) near the central part of the basin in the southern portion of the basin. Kaolinite was identified in samples from 10 drill holes (Nos. 15, 18, 19, 49, 52, 59, 62, 64, 72, and 74) in the eastern edge of the areal extent.

At the base of the Java Formation is the Pipe Creek Shale Member. This dark gray (10YR 3/.5) unit is darker in color than most beds in the Java Formation. The Pipe Creek Shale Member is generally less than 20 feet thick and is an excellent marker between the Java Formation and the underlying West Falls Formation.

Figure 9. Map showing the areal extent (shaded area) of the Hanover Shale and Pipe Creek Shale Members of the Java Formation and the upper unit of the Dowelltown Member of the Chattanooga Shale.


Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
Kaolinite
OHIO
KY
TENN
VA
NC
SC
GA
ALA
MISS
NY
0
100
200 Miles

Rhinestreet Shale Member of the West Falls Formation

A total of 189 samples from the Rhinestreet Shale Member of the West Falls Formation and its stratigraphic equivalent, the lower unit of the Dowelltown Member of the Chattanooga Shale (Roen, 1980, fig. 5) from 37 drill holes in New York, Pennsylvania, Ohio, West Virginia, Kentucky, and Tennessee (fig. 10) were analyzed. The Rhinestreet Shale Member is

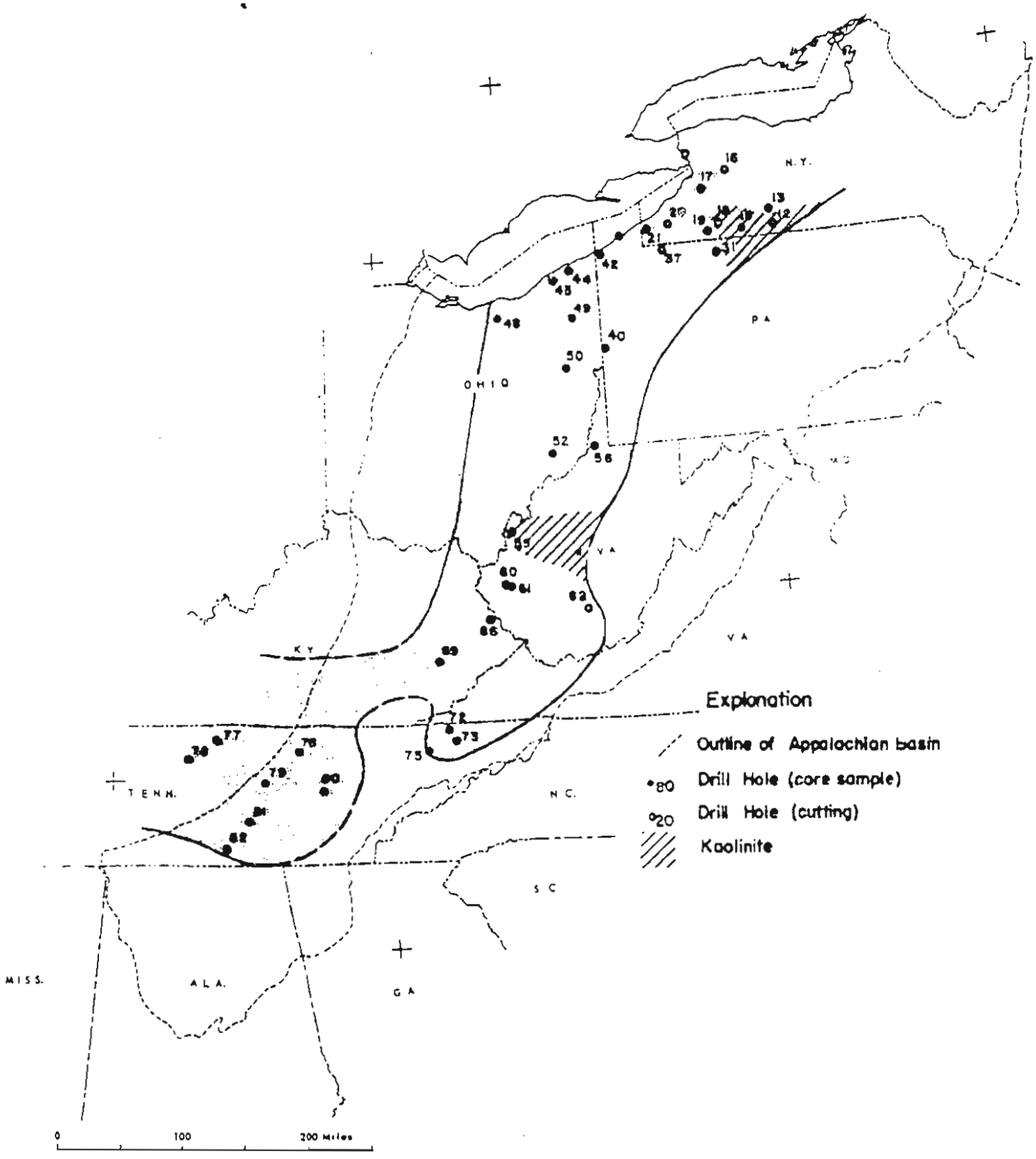
---

Figure 10 near here.

---

a medium gray (10 YR 5.3/.5) shale. It has an average composition of 25 percent quartz silt, 75 percent clay, and a trace of pyrite. The lower unit of the Dowelltown Member contains 5 percent dolomite in central Tennessee. The Rhinestreet Shale Member has a trace of calcite in Kentucky, West Virginia, Ohio, Pennsylvania, and New York. The clay minerals have an average ratio of 20 percent chlorite, 60 percent illite, and 20 percent illite-smectite mixed layer, a trace of illite-chlorite mixed-layer, and a trace of kaolinite (table 2). The illite-chlorite mixed-layer clay was found in samples from 10 drill holes (Nos. 13, 50, 59, 60, 61, 66, 69, 72, 76, and 81) located throughout the central part of the basin. Kaolinite has been identified in samples from 4 drill holes (Nos. 12, 15, 16 and 59) located on the eastern edge of the areal extent (fig. 10).

Figure 10. Map showing the areal extent (shaded area) of the Rhinestreet Shale Member of the West Falls Formation and the lower unit of the Dowelltown Member of the Chattanooga Shale.


N.Y.
PA
OHIO
KY
VA
W. VA
TENN.
N.C.
S.C.
GA
ALA.
MISS.
Explanation
Outline of Appalachian basin
•80 Drill Hole (core sample)
°20 Drill Hole (cutting)
Kaolinite
0
100
200 Miles

Middlesex Shale Member of Sonyea Formation

The Middlesex Shale Member of the Sonyea Formation was analyzed in 26 samples from 17 drill holes in New York, Pennsylvania, and West Virginia (fig. 11). The Middlesex Shale Member is a dark gray (10 YR 4.4/.5) shale

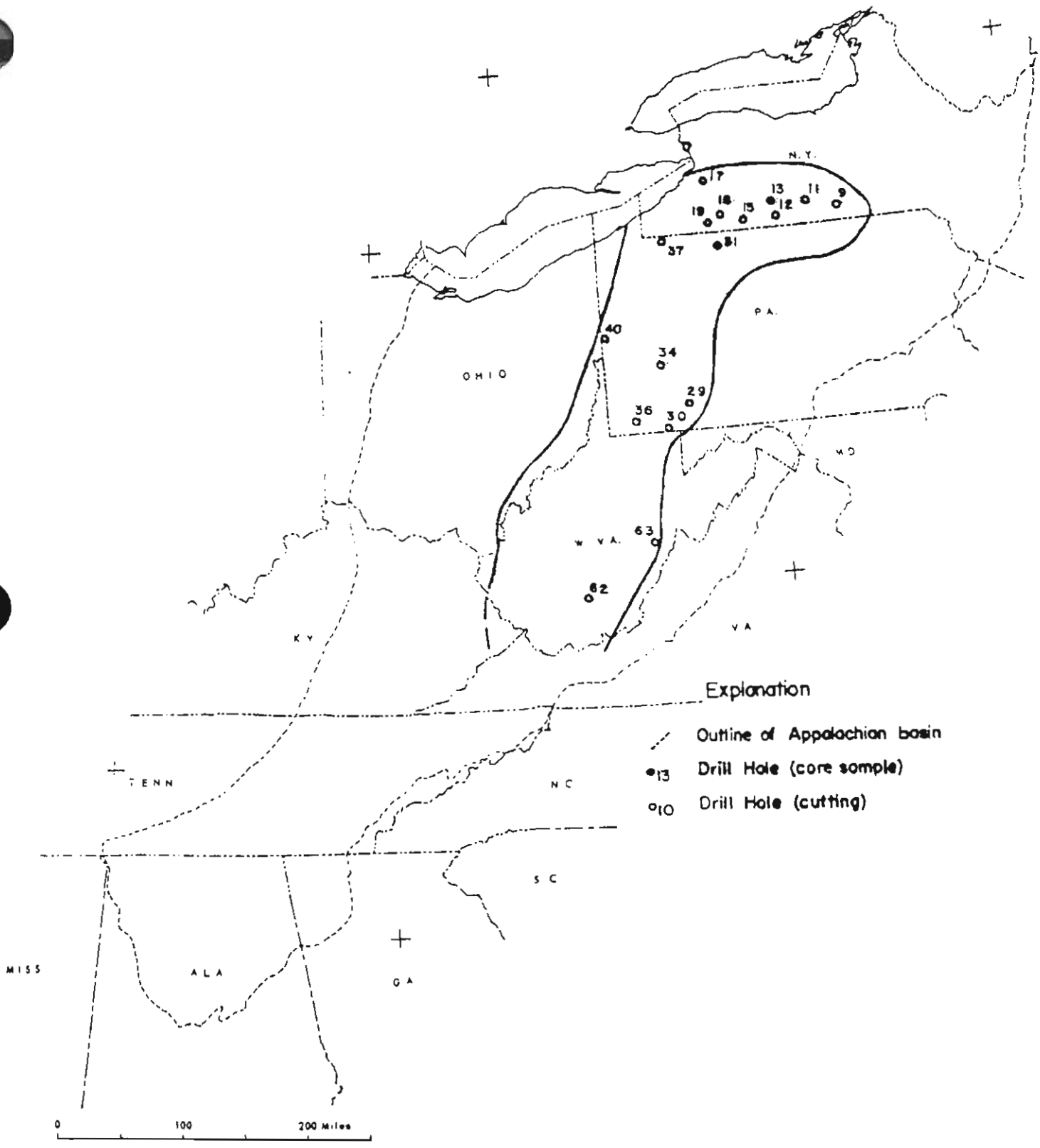
---

Figure 11 near here.

---

with an average composition of 25 percent quartz silt, 65 percent clay, 5 percent pyrite, and 5 percent calcite. The clay minerals have an average ratio of 25 percent chlorite, 55 percent illite, 20 percent illite-smectite mixed-layer clay, and a trace of illite-chlorite mixed-layer clay (table 2). The illite-chlorite mixed-layer clay occurs in samples from 3 drill holes (Nos. 11, 31, and 37) in the north-central part of the basin. Kaolinite was not identified in any samples from the Middlesex Shale Member. Calcite was found in samples from 7 drill holes (Nos. 11, 15, 18, 19, 31, 37, 23, and 40) which are in the center of the basin.

Figure 11. Map showing the areal extent (shaded area) of the Middlesex Shale Member of the Sonyea Formation.


N.Y.
PA.
OHIO
W VA.
MD
KY
VA
TENN
NC
SC
GA
ALA
MISS
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
0
100
200 Miles

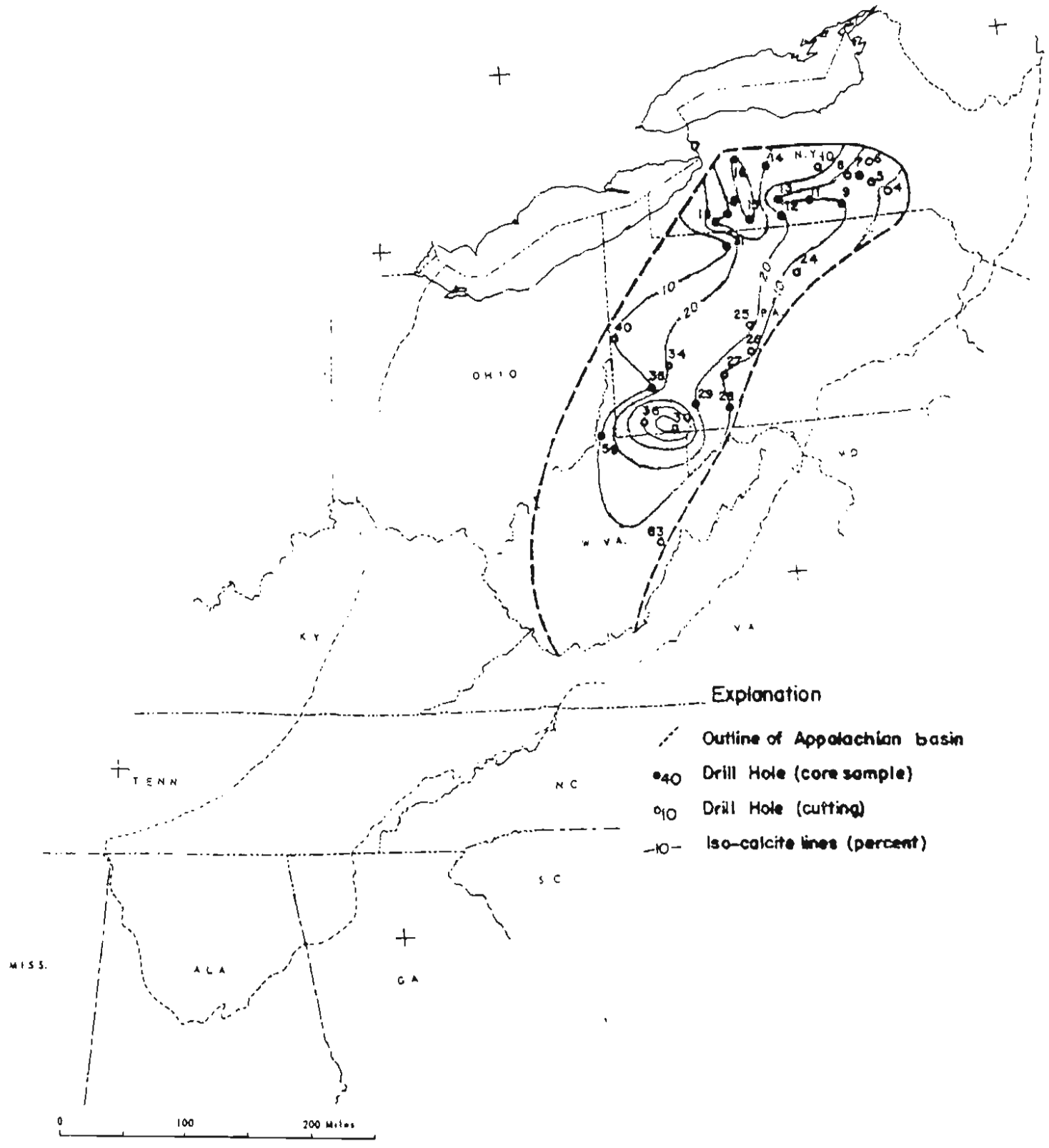
Geneseo Shale Member of the Genesee Formation

Included with the Geneseo Shale Member of the Genesee Formation are the Penn Yan Shale Member of the Genesee Formation and the Burket Member of the Harrell Shale (Oliver and others, 1969). These units are dark gray (10 YR 4.5/.5) and are composed of slightly limy shale that averages 20 percent quartz silt, 60 percent clay, 5 percent pyrite, and 15 percent calcite. Based on 64 samples from 29 drill holes in New York, Pennsylvania, and West Virginia (fig. 12), the clay minerals in the Geneseo Shale Member

Figure 12 near here.

and its equivalent have an average ratio of 25 percent chlorite, 60 percent illite, 15 percent illite-smectite mixed-layer clay, and a trace of illite-smectite mixed-layer clay (table 1). The illite-smectite mixed-layer clay was found in samples from 4 drill holes (Nos. 12, 16, 18 and 36).

Figure 12. Map showing the areal extent (shaded area) of the Geneseo Shale Member of the Genesee Formation, the Penn Yan Shale Member of the Genesee Formation and the Burket Member of the Harrell Shale.


N.Y.
OHIO
PA.
W VA.
VA
MD
KY
TENN
NC
SC
GA
ALA
MISS.
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
Iso-calcite lines (percent)
0
100
200 Miles

Mahantango Formation of the Hamilton Group

The Mahantango Formation correlates with all formations in the Hamilton Group exclusive of the Marcellus Formation. It also includes the Millboro Shale exclusive of the Marcellus Member. The Mahantango is a medium gray (N 5.2) limy shale. The average composition based on 444 samples of the Mahantango Formation from 50 drill holes in New York, Pennsylvania, Ohio, West Virginia, and Virginia (fig. 13) is 20 percent quartz silt,

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Figure 13 near here.

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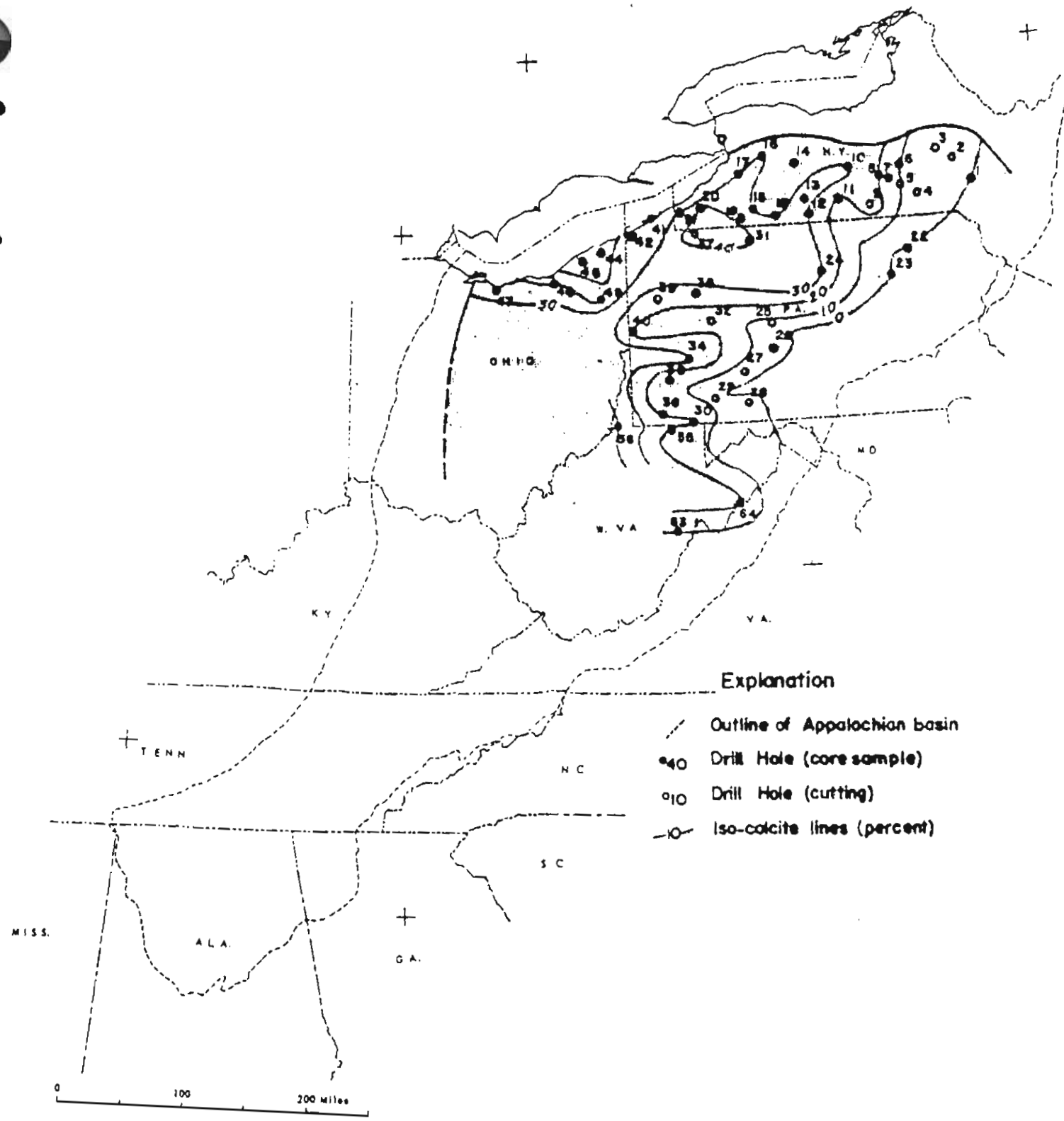
60 percent illite, a trace of pyrite, and 20 percent calcite. The clay minerals have a ratio of 25 percent chlorite, 60 percent illite, 15 percent illite-smectite mixed-layer clay, and a trace of illite-chlorite mixed-layer clay (table 2). The illite-chlorite mixed-layer clay is found in samples from 7 drill holes (Nos. 16, 18, 22, 24, 31, 37, and 39) distributed randomly in New York and Pennsylvania. Calcite is absent in eastern Pennsylvania and eastern New York but increases to 40 percent in western New York, northwestern Pennsylvania, and in the panhandle of West Virginia (fig. 13). Calcite data for most of Ohio are not available.

Figure 13. Map showing the areal extent (shaded area) of the Mahantango Formation of the Hamilton Group and the Millboro Shale, exclusive of the Marcellus Member.


N.Y.
OHIO
PA.
W. VA
MD
KY
VA.
TENN
N C
S C
MISS.
ALA.
GA.
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
Iso-calcite lines (percent)
0
100
200 Miles

Marcellus Shale of the Hamilton Group

The Marcellus Shale of the Hamilton Group and its equivalent beds in the Millboro Shale is a dark gray (N3.4) limy shale. The average composition is 20 percent quartz silt, 50 percent clay, 5 percent pyrite, and 25 percent calcite. This is based on 183 samples of the Marcellus Shale from 45 drill holes in New York, Pennsylvania, Ohio, West Virginia, and Virginia (fig. 14). The clay mineral ratio is: 15 percent chlorite,

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Figure 14 near here.

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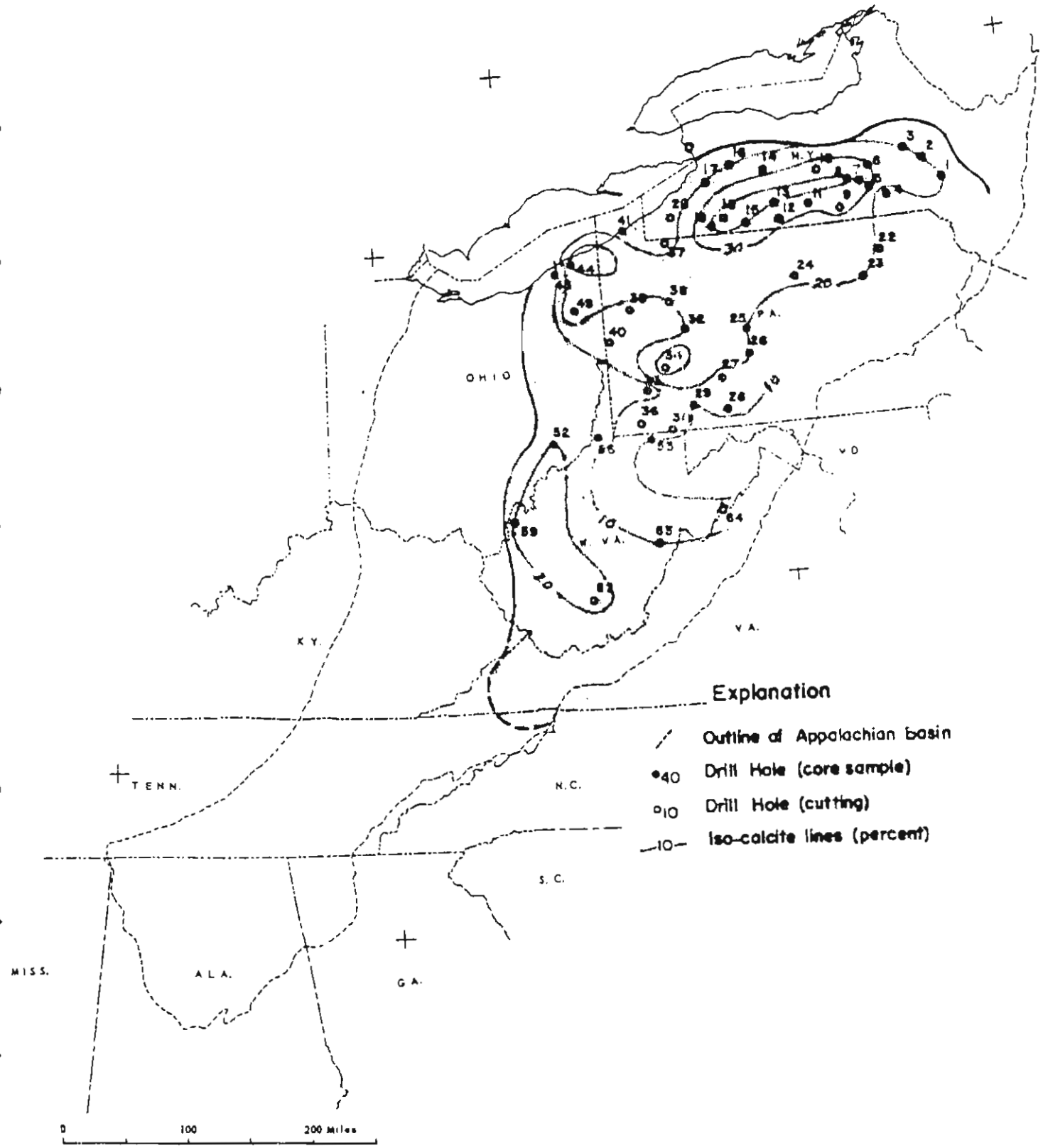
70 prcent illite, 15 percent illite-smectite mixed-layer clay, and a trace of illite-chlorite mixed-layer clay. All samples of Marcellus Shale contained some calcite. The highest amount of calcite is in western New York, northeastern Ohio, and southwestern Pennsylvania (fig. 14).

Figure 14. Map showing the areal extent (shaded area) of the Marcellus Shale of the Hamilton Group and equivalent beds in the Millboro Shale.

Table 2. Average color and mineralogy of the Devonian shale units in the Appalachian basin

	Number of Drill Holes	Number of Samples	Total Footage Sampled	Average Munsell Color	Average Lithology	Average Mineral Content (in percent)				Clay Mineral Ratio				
						Quartz Silt	Clay	Pyrite	Calcite	Chlorite	Illite	Mixed-layer		Kaolinite
												Illite-smectite	Illite-chlorite	
Cleveland Member of Ohio Shale and equivalent units	20	73	574	10YR4.1/.2	silty shale	30	65	5	-	10	60	30	tr	tr
Chagrin Shale Member of Ohio Shale and equivalent units	10	131	2984	N6.1	shale	25	75	tr	-	15	55	25	tr	5
Upper part of the Huron Member of Ohio Shale	12	66	764	10YR5.2/.5	shale	25	70	5	-	10	55	30	tr	5
Middle part of the Huron Member of Ohio Shale	18	178	4602	N5.5	shale	25	75	tr	-	10	60	25	tr	5
Lower part of the Huron Member of Ohio Shale and equivalent units	38	358	5254	10YR4.9/.5	shale	25	70	5	-	15	60	20	tr	5
Java Formation and equivalent units	26	77	1264	N6.0	shale	25	70	5	tr	20	55	25	tr	tr
Rhinestreet Shale Member of West Falls Formation and equivalent units	37	189	6292	10YR5.3/.5	shale	25	75	tr	tr	20	60	20	tr	tr
Middlesex Shale Member of Sonyea Formation	17	26	1180	10YR4.4/.5	shale	25	65	5	5	25	55	20	tr	-
Genesee Formation and equivalent units	29	64	2290	10YR4.5/.5	slightly limy shale	20	60	5	15	25	60	15	tr	-
Mahantango Formation of Hamilton Group and equivalent units	50	444	14,527	N5.2	limy shale	20	60	tr	20	25	60	15	tr	-
Marcellus Shale of Hamilton Group and equivalent units	48	189	4,952	N3.4	limy shale	20	50	5	25	15	70	15	tr	-


OHIO
KY.
TENN.
MISS.
ALA.
GA.
S. C.
N.C.
VA.
W. VA.
PA.
N.Y.
Explanation
Outline of Appalachian basin
Drill Hole (core sample)
Drill Hole (cutting)
Iso-calcite lines (percent)
0
100
200 Miles

Ash Beds

Three ash beds are definitely recognized in the Middle and Upper Devonian rocks (table 1) of the Appalachian basin. In ascending order they are the Tioga Bentonite Bed named by Fettke (Ebright, Fettke, and Ingham, 1949), the Belpre Bentonite Bed of Collins (1979), and an ash bed discovered by W. H. Hass (1948) and later designated the Center Hill Bentonite Bed by Conant and Swanson (1961). Roen and Hosterman (in press) have suggested that the terms "bentonite," "metabentonite," and "K-bentonite" be replaced by "ash" for these beds in the Paleozoic rocks of the Appalachian basin. This recommendation is based on the fact that these beds do not conform with the accepted definition of bentonite (Grim and Guven, 1978) with respect to the physical, chemical and mineralogical properties of bentonite.

The Center Hill Ash Bed occurs predominantly in the western portion of the Appalachian basin from northwestern Pennsylvania to Tennessee. The bed is in the Pipe Creek Shale Member of the Java Formation and near the top of the Dowelltown Member of the Chattanooga Shale. The Belpre Ash Bed is near the base of the Rhinestreet Shale Member of the West Fall Formation. It has an areal distribution very similar to the Center Hill Ash Bed. The Tioga Ash Bed is probably more widely distributed than the other ash beds. It occurs in the eastern portion of the Appalachian basin from northern New York to southern West Virginia and from eastern Pennsylvania to central Ohio. The Tioga Ash Bed is near the contact between the Onondaga Limestone and Marcellus Shale of the Hamilton Group. In a few places it occurs in the Marcellus, but generally it is found in the Onondaga.

The ash beds are difficult to recognize, even though their lithology is different from the enclosing rocks, because they are usually very thin and are readily altered by weathering. The beds range in thickness from 1 mm to 75 mm. In the fresh unweathered or drill core sample, conspicuous dark brown to black biotite make the ash beds recognizable. The biotite occurs in flakes to 1 to 2 mm in diameter and range in abundance from several percent up to as much as 45 percent. The biotite is also found as scattered flakes in the adjacent enclosing rocks. In a weathered outcrop, the biotite may be recognized by its light bronze color.

The mineralogy of the ash beds is somewhat different than the enclosing rocks but may be contaminated by the enclosing rocks. The Md illite, like biotite, is another mineral that is unique in the ash beds. However, it may be difficult to recognize if there is any contamination by 2M illite from the enclosing shales, especially where the ash bed is thin. Both the Center Hill Ash Bed (fig. 15A) and the Belpre Ash Bed (fig. 15B) do occur in shale beds. There is no contamination of Md illite by 2M illite in the Tioga Ash Bed where it occurs in limestone (fig. 15C). Normally the ash beds do not contain

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Figure 15 near here.

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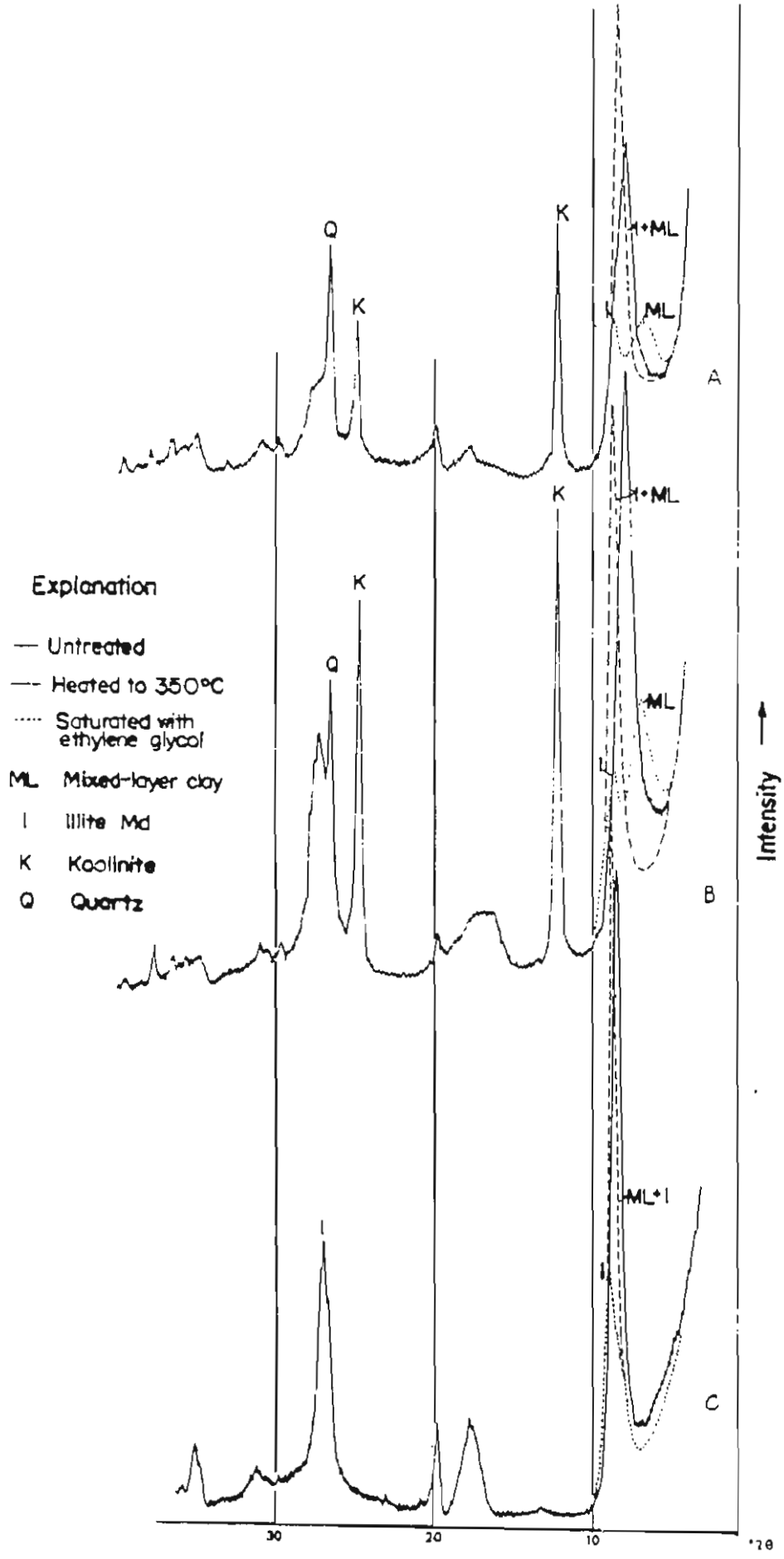
chlorite, but chlorite may be present as a contaminant from the adjacent shale beds. Quartz and kaolinite are present in the Center Hill and Belpre Ash Beds but neither is present in the Tioga Ash Bed (Table 3 and fig. 15). Since the enclosing shales of the Center Hill and the Belpre do not contain kaolinite, the kaolinite is an alteration product of the volcanic ash and is not a contaminant. The lack of kaolinite

Table 3. Mineralogy of the Center Hill, Belpre, and Tioga Ash Beds

Location	Map No.	Depth	Color	Mineral Composition (percent)						Clay Mineral Ratio				Enclosing rock
				Quartz	Clay	Biotite	Pyrite	Plagioclose	Calcite	Chlorite	Illite	Mixed layer illite-smectite	Kaol-inite	
Center Hill														
Erie Co., PA	41	1027.9	10YR4.8/.5	15	80	5	-	tr	-	-	Md 25	55	20	shale
Mason Co., WV	59	3140.0	N4.5	20	80	tr	-	-	-	5	Md 30	40	25	shale
Hancock Co., TN	72	675.8	N6.5	15	40	45	-	-	-	tr	Md 20	10	70	shale
Belpre														
Ashtabula Co, OH	43	1192.3	N5.3	5	80	tr	15	tr	-	-	Md 15	55	30	shale
Trumbull Co., OH	49	2551.9	N5.1	10	75	tr	10	5	-	-	Md 25	60	15	shale
Noble Co., OH	52	4080.4	10YR 4/.5	10	85	tr	5	-	-	-	Md 50	25	25	shale
Mason Co., WV	59	3363.	N5.5	15	70	tr	5	-	10	-	Md 20	65	15	shale
Tioga														
Tompkins Co., NY	7	1452.0	N5.8	-	90	tr	-	10	-	-	Md 55	45	-	limestone
Allegheny Co., PA	35	7485.4	N5.5	-	90	10	-	-	-	-	Md 70	30	-	limestone

Figure 15. X-ray diffraction traces of the Center Hill (A), Belpre (B), and Tioga (C) Ash Beds.


Explanation
— Untreated
-- Heated to 350°C
····· Saturated with ethylene glycol
ML Mixed-layer clay
I Illite Md
K Kaolinite
Q Quartz
Q
K
K
K+ML
ML
A
K
K+ML
Q
K
ML
B
ML+I
I
C
Intensity
30
20
10
°2θ

in the Tioga Ash Bed is due to the calcic environment which prevented the formation of kaolinite.

Depositional pattern

Shale is a rather loosely used term applied to a fine-grained, indurated, detrital sedimentary rock. It is formed by the consolidation of clay or mud, and it is characterized, more or less, by laminated stratification. Shale, as defined in this report, is composed predominantly of clay minerals (hydrous aluminous layered silicates). Quartz and calcite may be present in amounts as much as 25 percent each and pyrite is usually, but not always, present in amounts rarely as much as 15 percent. It is impossible to accurately tell what the original mineral suite of most shale was because all them have been subjected to diagenesis and low-grade metamorphism. Probably the only unaltered original major detrital minerals are quartz and kaolinite. Quartz, which occurs in the silt- and clay-size fraction, is ubiquitous and does not reveal any depositional pattern.

Calcite, a mineral precipitated from sea water, was found only in the oldest four units (table 2) which also do not contain any kaolinite. It increases from about 5 percent in the Middlesex Shale Member of the Sonyea Formation to 25 percent in the Marcellus Shale of the Hamilton Group. The carbonate indicates that these older units were deposited in the relatively shallow water of a shelf area and the rate of deposition of clastic material was slow enough to allow the concentration of calcium carbonate.

The occurrence of kaolinite in minor amounts, however, does indicate a probable depositional pattern for 7 of the 11 formations discussed in this report. Kaolinite is coarser grained than the other clay minerals; therefore, when transported by water, it does not remain in suspension long, and it is deposited closer to the source area. Kaolinite has been

found to be most abundant near the shoreline in both modern sediments and ancient sedimentary rocks (Parham, 1966). Kaolinite was not observed in the 4 older shale units (figs. 11 to 14)—Marcellus Shale of the Hamilton Group, the Mahantango Formation of the Hamilton Group, the Geneseo Shale Member of the Genesee Formation, and the Middlesex Shale Member of the Sonyea Formation. The Rhinestreet Shale Member of the West Falls Formation contains two small areas of kaolinite in northern Pennsylvania and adjacent New York and in West Virginia (fig. 10). Kaolinite is much more widespread in the younger units (figs. 5 to 9) the Chagrin Shale, all three parts of the Huron Member of the Ohio Shale, and the Java Formation. The kaolinite occurrence in the Cleveland Member of the Ohio Shale is limited to small areas in eastern Kentucky and eastern Tennessee (fig. 4).

Based on the distribution of kaolinite in the 7 youngest shale units studied, the source area for kaolinite and the other detrital material was to the east or northeast. As no kaolinite is present in the 4 oldest units, the location of the source area is speculative at best. However, based on the kaolinite distribution in the younger units and the calcite distribution in the older units, the source area was probably also to the east or northeast of the basin. The distance from the source area to the Appalachian basin is problematical. However, it seems that the distance between the source area and the basin of deposition was probably greatest during Marcellus time and least during deposition of the Java, and the lower part of the Huron, and the Dunkirk as suggested by the presence of kaolinite in the Huron and the Dunkirk and the absence of kaolinite in the Marcellus Shale. In all probability, the same source

supplied sediment to the basin throughout Devonian time. The size of the accumulation basin, the distance from center of accumulation to the shoreline, and the depositional energy are all factors that probably brought more kaolinite into the younger black shales.

Possibly, some of the material deposited during Devonian time was derived from volcanic ash. The widespread Tioga, Belpre, and Center Hill Ash Beds (table 1) (Roen and Hosterman, in press) and the occurrence of scattered biotite flakes indicate the possibility of partial volcanic ash origin. Also the present clay-mineral suite was probably derived from smectite, a very common clay mineral in volcanic ash.

Diagenesis and metamorphism

The major shale components of 2M illite, chlorite, and mixed-layer clay minerals are the result of diagenesis and green-schist (low-grade) metamorphism. The 2M illite was derived from degraded and disordered (Md) illite and smectite; chlorite was also derived from smectite; and the illite-smectite mixed-layer clay was formed from a mixture of Md illite and smectite; the illite-chlorite mixed-layer clay was formed from Md illite and smectite. Non-detrital quartz resulted from the formation of the above minerals in the reaction--

$$\text{smectite} + Al^{+3} + K^{+} = \text{illite} + \text{chlorite} + \text{quartz}$$

(Hower and others, 1976). The potassium was made available from the felspars and/or free ions in the water.

The distribution pattern of the clay minerals due to the low-grade metamorphism have become quite evident in the Devonian black shales studied. Excluding the Marcellus Shale of the Hamilton Group, chlorite increases from a ratio of 10 in the youngest units to a ratio of 25 in the oldest units (table 1). Conversely the illite-smectite mixed-layer clay mineral generally decrease from a ratio of 30 in the youngest units to a ratio of 15 in the oldest units. The amount of illite remains more or less constant in all shale units.

It was found that the sharpness of the 001 X-ray diffraction peak for illite had a slight variation. Using this sharpness of peak area to peak height as a measure of crystallinity, the following formula was used.

$$x = \frac{h}{A}$$

where: A is the area of the 001 illite peak on the X-ray diffraction trace;

h is the height of the same illite peak; and

x is the crystallinity factor.

For the 2M illite, the relative crystallinity factor ranged from about 0.10 for the poorest crystalline to 0.14 for the best crystalline. There is considerable variation in the crystallinity in the 2M illite, but, in general, the crystallinity increases with depth in almost every core sampled and it increases regionally in an eastward to southeastward direction (fig. 16). This regional change in crystallinity corresponds very

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Figure 16 near here.

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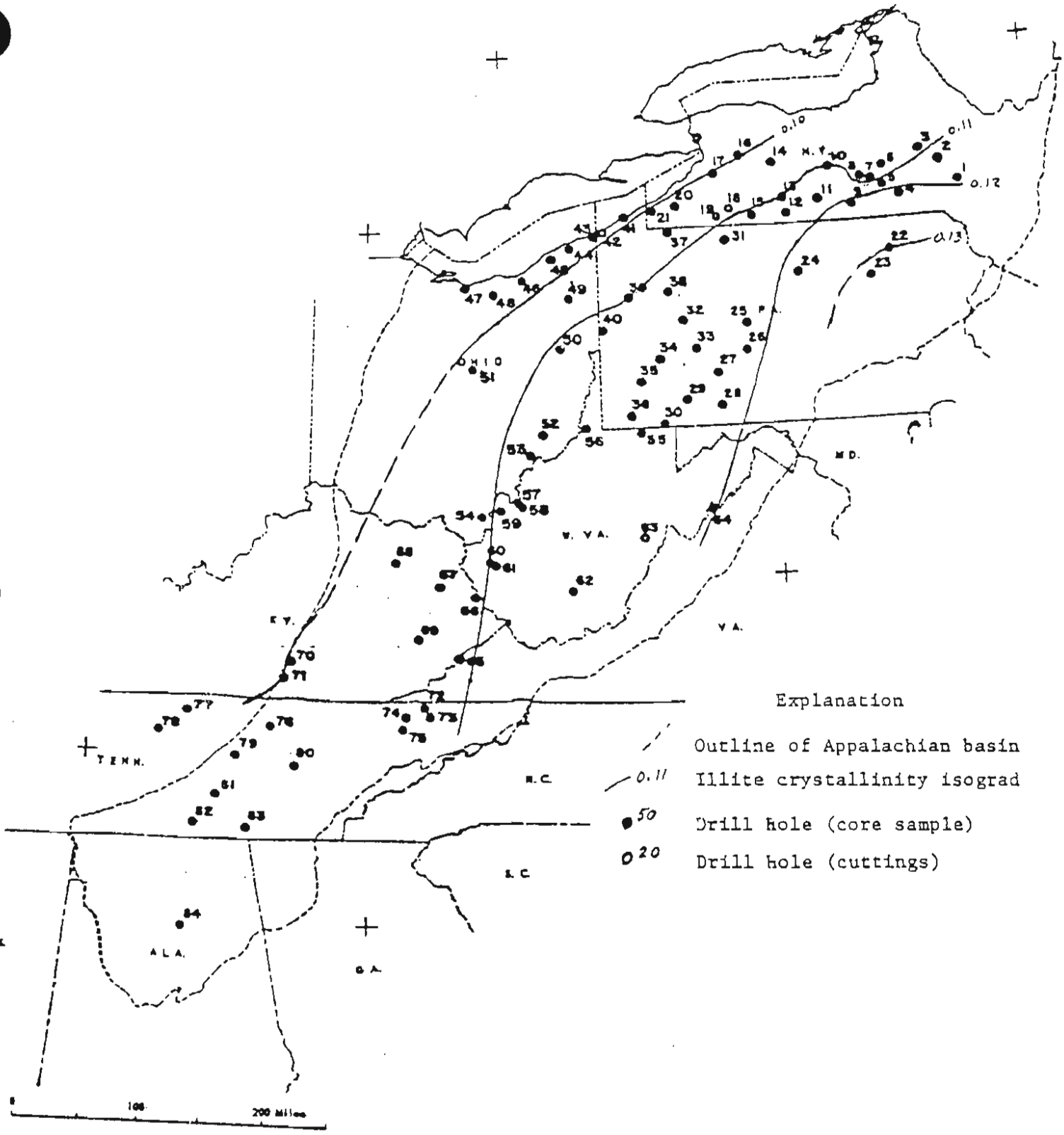
closely to the regional increase in thickness of the Devonian rocks and to the conodont color alteration index (CAI) (Epstein and others, 1977). A crystallinity factor of 0.11 closely matches the conodont (CAI) of 2.5-3 which has a temperature range of 110-200°C, and a crystallinity factor of 0.10 closely matches a CAI of 1.5-2 which has a temperature range of 50-140°C.

As mentioned above the Marcellus does not fit the pattern of increasing abundance of chlorite in older units (table 1). An explanation for this may be the fact that the Marcellus contains more calcite than any of the other units studied. Such concentration of calcite may prevent the temperature and pressure increases required for the formation of chlorite. The calcite, however, does not prevent the formation of 2M illite during diagenesis.


0.10
0.11
0.12
0.13
N.Y.
OHIO
PA.
MD.
W. VA.
VA.
KY.
TENN.
N.C.
S.C.
GA.
ALA.
MISS.
100
200 Miles
Explanation
Outline of Appalachian basin
Illite crystallinity isograd
Drill hole (core sample)
Drill hole (cuttings)

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Appendix

Map No.	Sample No.	Drill Hole Name	API No.
1	JWH1155-JWH1157	Leslie #1, Delaware Co., NY	31-025-04455
2	JWH1219-JWH1230	Lobdell #1, Chenango Co., NY	31-017-01160
3	JWH1212-JWH1218	Branagan #1, Madison Co., NY	31-053-03970
4	JWH1060-JWH1078	Richards #1, Broome Co., NY	31-007-05087
5	JWH988-JWH1003	Overbaugh #1, Cortland Co., NY	31-023-02308
6	JWH1231-JWH1245	Butler #1, Cortland Co., NY	31-023-00644
7	JWH1276-JWH1310	Cargill #17, Tompkins Co., NY	31-109-13173
8	JWH1103-JWH1116	Agard #1, Tompkins Co., NY	31-109-05017
9	JWH1079-JWH1093	Treat #118, Chemumg Co., NY	31-015-00509
10	JWH1094-JWH1102	Borglum #1, Yates Co., NY	31-123-04796
11	JWH1198-JWH1211	Blair Well #1, Steuben Co., NY	31-101-02679
12	JWH1246-JWH1264	Rogers #1, Steuben Co. NY	31-101-00053
13	JWH1550-JWH1588	6213(JO), Allegany Co., NY	31-003-13549
14	JWH1311-JWH1345	Stewart #6701, Livingston Co., NY	31-051-14100
15	JWH1031-JWH1059	Ames #1, Allegany Co., NY	31-003-04654
16	JWH1265-JWH1275	Hall #1, Wyoming Co., NY	31-121-04542
17	JWH1139-JWH1154	Well 796, Erie Co., NY	31-029-03269
18	JWH1117-JWH1138	Ackerly #1, Cattaraugus Co., NY	31-009-05106
19	JWH1013-JWH1030	Seneca Nations #1, Cattaraugus Co., NY	31-009-04088
20	JWH972-JWH987	Bates #1, Chautauqua Co., NY	31-013-01457
21	JWH1004-JWH1012	Carnoban #1, Chautauqua Co., NY	31-013-04152
22	JWH862-JWH881	Blemle #1, Bradford Co., PA	37-015-00001
23	JWH473-JWH483	Bennett #1, Sullivan Co., PA	37-113-00005
24	JWH699-JWH727	PA Tract 101 #1, Lycoming Co., PA	37-081-20004
25	JWH801-JWH828	General Refractories #1, Clearfield Co. PA	37-033-20537
26	JWH934-JWH953	Weldon #1, Blair Co., PA	37-013-20006
27	JWH562-JWH616	Heidingsfelder #1, Cambria Co., PA	37-021-20013
28	JWH663-JWH698	Mowry #1, Somerset Co., PA	37-111-20029
29	JWH617-JWH662	Dupre #1, Somerset Co., PA	37-111-20034
30	JWH882-JWH912	Ryan #2, Fayette Co, PA	37-051-20094
31	JWH1817-JWH1826	MREX #1, McKean Co., PA	37-083-36382
32	JWH913-JWH922	Martin #4, Armstrong Co., PA	37-005-00005
33	JWH2040-JWH2050	McCall #5, Indiana Co., PA	37-063-25073
34	JWH954-JWH971	Sloan #1, Westmoreland Co., PA	37-129-00080
35	JWH1739-JWH1766	C.E. #1, Allegheny Co., PA	37-003-20980
36	JWH762-JWH780	Gordon #4, Greene Co., PA	37-059-20038
37	JWH728-JWH745	Christensen #1, Warren Co., PA	37-123-24704
38	JWH923-JWH933	Mays #1, Clarion Co., PA	37-031-20168
39	JWH746-JHW761	Minnis #1, Mercer Co., PA	37-085-00018
40	JWH829-JWH861	Metropolitian Brick #1, Beaver Co., PA	37-007-20054
41	JWH2051-JWH2060	Presque Isle #1, Erie Co., PA	37-049-20846
42	JWH781-JWH800	Blickenderfer #22, Erie Co., PA	37-049-00412
43	JWH1767-JWH1789	B & L E RR #1, Astabula Co., OH	34-007-21087
44	JWH1589-JWH1660	Gerald #1, Astabula Co., OH	37-007-06002
45	JWH1685-JWH1738	DA-201, Lake Co., OH	34-085-06002
46	JWH1346-JWH1383	Cleveland #1, Cuyahoga Co., OH	34-035-01001
47	JWH1384-JWH1415	ENP B-19, Erie Co., OH	34-043-20057
48	JHW-1946-JWH1990	McGuire, Lorain Co., OH	34-093-21100
49	JWH2061-JWH2100	A. A. Meleski, Trumbull Co., OH	34-155-21238
50	JWH389-JWH413	S-745, Carroll Co., OH	34-019-20835

51		L. B. #1, Knox Co., OH	34-083-22599
52	JWH1991-JWH2037	Schockling #1, Noble Co., OH	34-121-22255
53	JWH414-JWH438	R-109, Washington Co., OH	34-167-23521
54	JWH1849-JWH1895	Mitchell Enegy, Gallia Co., OH	43-053-20477
55	JWH1158-JWH1197	Merc #1, Monongalia Co., WV	47-061-20370
56	JWH1790-JWH1816	E-P #1, Wetzel Co., WV	47-103-20645
57	JWH79-JWH104	11940, Jackson Co., WV	47-035-21369
58	JWH105-JWH151	12041, Jackson Co., WV	47-035-21371
59	JWH484-JWH561	D/K Farm #3, Mason Co., WV	47-053-20146
60	JWH152-JWH211	20402, Lincoln Co., WV	47-043-21636
61	JWH212-JWH264	20403, Lincoln Co., WV	47-043-21637
62	JWH1916-JWH1945	C. E. Guinn #1115, Raleigh Co., WV	47-081-00036
63	JWH1895-JWH1915	USAI-3, Pocahontas Co., WY	47-075-00015
64	JWH1834-JWH1848	R. J. Wetzel, Rockingham Co., VA	45-165-20007
65	JWH2-JWH78	20338, Wise Co., VA	45-195-20253
66	JWH333-JWH388	20336, Martin Co., KY	16-159-31020
67	JWH1827-JWH1833	Skaggs-Kelley, Johnson Co., KY	16-115-33985
68	JWH1673-JWH1684	NECO #5E, Fleming Co., KY	16-069-06001
69	JWH439-JWH472	7239, Perry Co., KY	16-193-28982
70	JWH1668-JWH1672	Redman, Russell Co., KY	16-207-90003
71	JWH1661-JWH1667	Jeff Story #1, Russell Co., KY	16-207-32515
72	JWH1436-JWH1471	TDG-DOE #3, Hancock Co., TN	41-067-01001
73	JWH1472-JWH1549	TDG-DOE #4, Hawkins Co., TN	41-073-01001
74	JWH1416-JWH1430	TDG-DOE #1, Claiborne Co., TN	41-025-06001
74	JWH1431-JWH1435	TDG-DOE #2, Claiborne Co., TN	41-025-06002
75	JWH2101-JWH2115	Industrial Park, Grainger Co., TN	41-057-01003
76	JWH319-JWH332	Dresser Industries, Overton Co., TN	41-133-90001
77	JWH310-JWH314	NV-56, Sumner Co., TN	41-165-06001
78	JWH305-JWH309	NV-54, Davidson Co., TN	41-037-01001
79	JWH270-JWH278	YB-39, Dekalb Co., TN	41-041-01001
80	JWH297-JWH304	WR-50, Cumberland Co., TN	41-035-06001
81	JWH280-JWH286	YB-43, Coffee Co., TN	41-031-01001
82	JWH287-JWH290	YB-45, Moore Co., Tn	41-127-01001
83	JWH291-JWH293	WR-47, Marion Co., TN	41-115-01001
84	JHW265-JHW269	AL-65, Blount Co., AL	01-009-01001

Leslie #1, Delaware Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1155	2640	2700	N5.7	55	45									30	55	10	5		Shale	Mahantango
1156	3100	3200	10YR4/.5	60	30	5		5						20	55	15	10		Shale	Marcellus
1157	3200	3310	10YR3/.5	50	15	5		30						15	70	10	5		Shale	Marcellus

Lobdell #1, Chenango Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1219	244	343	N5.7	60	30	tr		10						35	55	10			shale	Mahantango
1220	343	445	N5.7	50	35			15						45	50	5			sltshale	Mahantango
1221	445	548	N5.9	45	40			15						35	55	10			sltshale	Mahantango
1222	548	645	N5.9	50	40			10						30	55	10			sltshale	Mahantango
1223	645	744	N5.7	60	35	tr		5						30	60	10			sltshale	Mahantango
1224	744	845	N5.7	55	45			tr						30	60	10			sltshale	Mahantango
1225	845	941	N5.7	50	45			5						35	60	5			sltshale	Mahantango
1226	941	1044	N5.3	75	25	tr		tr						25	60	15			shale	Mahantango
1227	1044	1144	10YR6/.5	70	25	5		tr						25	55	20			shale	Mahantango
1228	1144	1247	10YR6/.5	75	20	tr		5						25	55	20			shale	Mahantango
1229	1247	1332	10YR6/.5	70	25	5		tr						30	60	10			shale	Mahantango
1230	1332	1464	10YR4/1	60	15	5		20						15	65	15	5		shale	Marcellus

Branagan #1, Madison Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1212	600	700	N5.8	60	30			10						30	60	10		tr	shale	Mahantango
1213	700	807	N5.6	70	25			5						20	50	20		10	shale	Mahantango
1214	807	916	N5.6	70	30	tr								20	55	15		10	shale	Mahantango
1215	916	997	N5.5	70	25	tr		5						20	60	10		10	shale	Mahantango
1216	997	1087	N5.5	70	25			5						20	60	10		10	shale	Mahantango
1217	1087	1178	N4.0	65	25	5		5						20	60	10	10		shale	Marcellus
1218	1178	1266	10YR3/.5	45	15	5		35						15	75	10			limshale	Marcellus

Richards #1, Broome Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1060	1320	1380	N5.6	75	25	tr	-							30	55	15		tr	shale	
1061	1380	1410	N5.3	75	25	tr	-							25	65	10			"	Geneseo
1062	1470	1570	N5.6	70	20	tr	-	10						20	65	15			"	Mahantango
1063	1570	1670	N5.6	65	25		-	10						30	50	20			shale	"
1064	1670	1770	N5.7	55	35		-	10						30	55	15			Sltshale	"
1065	1770	1870	N6.2	70	30		-							35	55	10			shale	"
1066	1870	1970	N6.0	55	35		-	10						30	55	15			Sltshale	"
1067	1970	2070	N5.7	55	35		-	10						30	55	15			"	"
1068	2070	2170	N5.7	60	40		-	tr						30	50	20			"	"
1069	2170	2270	N5.6	60	35		-	5						30	50	20			Sltshale	"
1070	2270	2370	N5.3	65	30	tr	-	5						30	50	20			shale	"
1071	2370	2470	N5.6	60	35	tr	-	5	tr					30	55	15			Sltshale	"
1072	2470	2570	N5.6	60	40	tr	-							30	55	15			Sltshale	"
1073	2570	2670	N5.3	70	30	tr	-							30	55	15		tr	shale	"
1074	2670	2770	N5.3	70	30		-							25	60	15			"	"
1075	2770	2870	N5.3	70	30		-							30	50	20			"	Mahantango
1076	2870	2970	10YR3/.5	70	25	5	-							20	55	25			"	Marcellus
1077	2970	3070	10YR3/ 1	75	20	5	-							15	65	20			shale	Marcellus
1078	3070	3110	10YR3/ 1	75	20	5	-					tr		5	70	25			shale	Marcellus

Overbaugh #1, Cortland Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0988	930	1036	10YR5/.5	65	25	5		5						20	65	25			shale	Geneseo
0989	1073	1175	N5.8	65	25			10						25	65	20			"	Mahantango
0990	1175	1278	N6.3	70	25			5						35	50	15			"	"
0991	1278	1371	N6.3	65	30			5						40	50	10			"	"
0992	1371	1472	N6.3	60	35			5						35	50	15			"	"
0993	1472	1575	N6.3	65	30			5						35	50	15			"	"
0994	1575	1672	N6.3	55	40	tr		5						30	55	15			"	"
0995	1672	1771	N6.3	60	35	tr		5						35	55	10			"	"
0996	1771	1875	N5.5	70	25	tr		5						30	55	15			"	"
0997	1875	1974	N5.8	70	25			5						35	45	20			"	"
0998	1974	2078	N6.0	70	25			5						35	50	15			"	"
0999	2078	2180	N5.8	65	20			15						35	50	15			"	"
1000	2180	2287	N5.8	65	20			15		tr				35	50	15			"	"
1001	2287	2370	N5.8	65	20			15						25	55	20			"	Mahantango
1002	2370	2437	10YR4/.5	60	20	5		15						15	55	30			"	Marcellus
1003	2437	2503	10YR4/.5	40	15	5		40						05	75	20			limshale	Marcellus

Butler #1, Cortland Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1231	498	579	10YR5/.5	70	25	tr		5						20	50	20		10	shale	Geneseo
1232	579	648	10YR4/.5	70	25	tr		5						20	60	15		5	"	Geneseo
1233	669	769	N5.6	70	25			5						25	55	10		10	"	Mahantango
1234	769	868	N5.6	65	25			10						30	60	10			"	"
1235	868	970	N5.6	65	25			10						35	45	20			"	"
1236	970	1066	N5.6	60	30	tr		10						35	55	10			"	"
1237	1066	1160	N6.0	50	30	tr		20						30	55	15			"	"
1238	1166	1271	N5.5	65	30	tr		5						30	40	30			"	"
1239	1275	1365	N5.5	65	30			5						30	65	5			"	"
1240	1365	1472	N5.5	65	25	tr		10						40	40	10	10		"	"
1241	1472	1577	N5.5	70	25			5						45	50		5		"	"
1242	1577	1677	N5.4	65	20			15						30	50	20			"	"
1243	1677	1783	N5.5	55	20	tr		25						30	55	15			"	Mahantango
1244	1783	1869	10YR4/.5	70	20	5		10						30	55	15			shale	Marcellus
1245	1869	1932	N3.1	35	15	5		50						5	75	10	10		limshale	Marcellus

Cargill #17, Tompkins Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1276	77.1		N6.1	85	15									20	60	5		15	shale	
1277	93.0		10YR5/.5	65	25	tr		10						30	45	20		5	"	
1278	113.0		N6.1	85	15									20	50	20		10	"	
1279	149.8		10YR4/.7	70	25	5								20	55	15	5	5	"	Geneseo
1280	180.2		10YR4/1	70	20	5		5						15	55	15		15	"	"
1281	210.0		10YR4/1	70	20	5		5						20	60	10		10	"	"
1282	240.0		10YR4/1	70	20	5		5						15	55	20		10	"	Geneseo
1283	299.8		N5.8	75	15	tr		10						15	60	15		10	"	Mahantango
1284	350.1		N5.8	80	15			5						25	55	10		10	"	"
1285	400.1		N5.8	75	20	tr		5						25	60	10		5	"	"
1286	449.1		N5.8	75	20			5						30	55	10		5	"	"
1287	510.3		N5.8	70	20	tr		10						25	50	15		10	"	"
1288	550.3		N5.8	70	25			5						25	50	15		10	"	"
1289	600.0		N5.7	70	25			5						25	45	20		10	"	"
1290	650.2		N5.7	70	30	tr								25	50	20		5	"	"
1291	701.5		N5.8	55	30			15						20	50	25		5	"	"
1292	750.0		N5.5	70	20	tr		5						30	50	20		tr	"	"
1293	800.0		N5.5	70	15	tr		15						30	45	25		tr	"	"
1294	850.2		N5.0	70	20	tr		5						25	50	25			"	"
1295	900.0		N4.5	70	25	5		5						30	50	20			"	"
1296	950.1		N4.5	35	10	5		50						30	50	20			limshale	"
1297	1000.3		N4.5	50	15	5		30						30	45	25			shale	"
1298	1050.0		N5.8	65	15	tr		20						30	50	20			shale	"
1299	1100.0		N5.8	70	20			10						30	45	25			shale	"

Cargill #17, Tompkins Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1300	1150.0		N5.9	70	20			10						30	40	30			shale	Mahantango
1301	1200.1		N5.9	70	15			15						30	40	30			"	"
1302	1250.1		N5.0	60	20	5		15						30	60	10			"	"
1303	1300.5		N5.3	35	15	5		45						20	65	15			limshale	"
1304	1339.3		10YR2/1	65	25	5		5						20	60	20			shale	Marcellus
1305	1360.0		10YR2/1	75	20	5					tr			15	65	10	5		"	"
1306	1380.1		10YR2/.5	65	30	5								10	75	10	5		"	"
1307	1403.8		10YR2/.5	40	15	5		40							80	20			limshale	"
1308	1420.0		10YR2/.5	45	15	10		30							85	15			shale	"
1309	1429.8		10YR2/1	30	15	05		50							85	15			limshale	"
1310	1452		N5.8	90		10													ash bed	Tioga

Agard #1, Tompkins Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1103	55	105	N5.2	70	30	tr								30	50	10		10	shale	Geneseo
1104	229	302	10YR6/.3	60	25	tr		15						30	55	15			"	Geneseo
1105	302	360	10YR4/.5	70	20	5		5						25	55	20			"	"
1106	385	495	N5.7	60	15	tr		25						30	55	15			"	Mahantango
1107	495	603	N5.9	55	20	tr		25						35	50	15			"	"
1108	603	698	N5.9	65	25	tr		10						35	50	15			"	"
1109	698	802	N5.7	65	25	tr		10						35	50	15			"	"
1110	802	899	N5.7	55	20	tr		25						30	55	15			"	"
1111	899	1004	10YR5/.5	65	20	tr		15						30	60	10			"	"
1112	1004	1108	10YR5/.5	65	20	tr		15						30	60	10			"	"
1113	1108	1203	N5.7	60	20	tr		20						30	55	15			"	"
1114	1203	1300	N5.7	60	20	tr		20						30	60	10			"	"
1115	1300	1401	10YR5/.5	45	15	5		35						25	50	25			limshale	"
1116	1401	1482	10YR3/1	40	15	5		40						10	65	25			"	Marcellus

Treat #118, Chemung Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1079	1103	1145	10YR6/.3	75	20	5								30	50	20			shale	Middlesex
1080	1980	2049	10YR4/.5	70	25	tr		5						25	45	30			"	Geneseo
1081	2049	2119	10YR4/.5	65	25	tr		10						25	60	15			"	Geneseo
1082	2187	2290	N5.7	50	25			25						35	50	15			"	Mahantango
1083	2290	2390	N5.7	55	15			30						35	50	15			"	"
1084	2390	2500	N5.5	65	25	tr		10						35	55	10			"	"
1085	2500	2603	N5.5	65	25	tr		10						35	45	20			"	"
1086	2603	2703	10YR5/.5	55	20	tr		25						35	45	20			"	"
1087	2703	2824	10YR5/.5	65	20	tr		15						30	45	15	10		"	"
1088	2824	2902	N5.5	55	20			25						30	55	15			shale	"
1089	2902	2997	10YR4/.5	50	15	tr		35						25	55	10	10		limshale	"
1090	2997	3101	10YR4/.5	50	15	tr		35						30	60	10			imshale	"
1091	3101	3203	10YR4/.5	50	15	tr		35						30	60	10			limshale	"
1092	3203	3303	10YR4/.5	55	20	5		20						25	65	10			shale	Mahantango
1093	3303	3387	10YR3/.5	40	20	5		35						15	75	10			limshale	Marcellus

Borglum #1, Yates Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1094	243	316	10YR4/.5	60	15	tr		25						25	60	15			shale	Geneseo
1095	336	401	N5.7	70	20	5		05						30	55	15			"	Mahantango
1096	401	497	N5.7	60	15			25						30	50	15			"	"
1097	497	626	N5.7	55	15			30						30	60	10			"	"
1098	626	700	10YR4/.5	70	15	tr		15						30	55	15			shale	"
1099	700	799	10YR5/.5	45	15	tr		40						30	55	15			limshale	"
1100	799	896	10YR5/.5	45	15	tr		40						30	60	10			"	"
1101	896	996	10YR5/.5	45	15	5		40						25	60	15			"	Mahantango
1102	996	1095	10YR3/.5	45	15	5		35						25	55	20			limshale	Marcellus

Blair Well #1, Steuben Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1198	1068	1134	N4.8	75	20	5								25	50	15	10		shale	Middlesex
1199	1134	1204	N4.8	75	20	5								25	55		20		"	Middlesex
1200	1204	1285	N5.3	80	20	tr								25	50	25			"	Middlesex
1201	1577	1677	N5.0	75	25	tr								30	60	10			"	Geneseo
1202	1677	1751	10YR4/1	65	20	5		10						20	55	25			"	Geneseo
1203	1751	1815	10YR4/1	65	25	5		10						15	70	15			"	Geneseo
1204	1855	1947	N5.3	75	15	tr		10						25	65	10			"	Mahantango
1205	1947	2049	N5.5	60	20	tr		20						30	60	10			"	"
1206	2049	2145	N4.8	65	20	tr		15						30	60	10			"	"
1207	2145	2246	N4.8	65	20	tr		15						25	60	15			"	"
1208	2246	2341	N4.8	60	15	tr		25						30	60	10			shale	"
1209	2341	2442	10YR6/.5	50	15	tr		35						25	60	15			limshale	"
1210	2442	2530	10YR6/.5	50	15	5		35						25	60	15			limshale	Mahantango
1211	2530	2616	10YR4/.5	50	15			35						20	60	20			limshale	Marcellus

Rogers #1, Steuben Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1246	1395	1415	10YR6/.5	75	15	5		5						25	60	10		5	shale	Dunkirk
1247	2435	2458	10YR6/.5	75	25									20	55	15		10	"	Rhinestreet
1248	3146	3252	N5.9	80	20									30	45	15		10	"	Rhinestreet
1249	3269	3348	10YR5/.5	75	25	tr								20	50	25		5	"	Rhinestreet
1250	3348	3453	N5.9	70	25			5						25	45	20		10	"	
1251	3453	3567	10YR6/.5	75	25									20	45	25		10	"	
1252	3567	3656	10YR4/1	70	25	5								25	50	25			"	Middlesex
1253	3656	3732	10YR4/1	70	25	5								25	50	25			"	Middlesex
1254	3732	3803	10YR6/.5	75	20	tr		5						20	45	30		5	"	Geneseo
1255	3803	3892	10YR5/.5	60	25	tr		15						25	60	5	5	5	"	"
1256	3892	3986	10YR5/1	60	15	tr		25						20	60		15	5	"	"
1257	3986	4077	10YR4/1	65	20	tr		15						20	55	20		5	shale	
1258	4077	4122	10YR3/1	40	15	5		40						20	65	15			limshale	Geneseo
1259	4170	4272	N5.0	65	15	tr		20						30	50	20			shale	Mahantango
1260	4272	4377	10YR6/1	55	20			25						30	50	10	10		"	"
1261	4377	4481	10YR4/1	60	20	tr		20						30	55	15				"
1262	4481	4584	10YR4/1	60	15	tr		25						25	50	25			shale	"
1263	4584	4690	10YR4/1	45	10			45						25	65	10			limshale	Mahantango
1264	4690	4787	10YR2/1	45	15	5		35						20	75	5			limshale	Marcellus

#6213(JO), Allegany Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1550	430.3		N6.5	70	30	tr								15	60	15		10	shale	
1551	490.5		N6.5	75	25									15	60	20		5	shale	
1552	1002.3		N5.0	75	20	5								15	60	20		5	shale	
1553	1338.5		N6.7	80	20									20	55	15		10	shale	Rhinestreet
1554	1392.6		N7.0	70	30									25	45	10	5	15	shale	"
1555	1442.6		N6.7	80	15	5								20	50	20		10	shale	"
1556	1490		N5.0	85	15									20	55	15		10	shale	"
1557	1542.6		N6.4	80	20	tr								20	45	25		10	shale	"
1558	1593.7		N6.7	85	15									25	40	25		10	shale	"
1559	1654.5		N5.9	80	15	5								15	55	15		15	shale	"
1560	1694.5		N6.9	80	20		tr							20	50	20		10	shale	"
1561	1744.3		N6.5	85	15									20	55	15		10	shale	"
1562	1794.5		N6.9	75	25									20	50	20		10	shale	"
1563	1830		N6.2	85	15									15	50	25		10	shale	"
1564	1897.2		N6.4	75	25									20	60	10		10	shale	"
1565	1970		N6.2	80	20	tr								25	50	15		10	shale	"
1566	1999.5		N7.0	50	40								10	40	35	10		15	sltshale	"
1567	2049.3		N6.7	80	15								5	15	55	20		10	shale	"
1568	2099.3		N6.7	75	25									20	60	10		10	shale	"
1569	2150		N4.2	75	20	5						tr		20	55	25			shale	"
1570	2201.4		N6.7	60	35								5	20	60	10		10	sltshale	"

#6213 (JO), Allegany Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1571	2251.3		N6.5	85	15									20	50	20		10	shale	Rhinestreet
1572	2301.5		N6.5	80	20									20	45	20		15	shale	Rhinestreet
1573	2351.4		N6.5	70	20			10						25	50	15		10	shale	Rhinestreet
1574	2495		N6.0	85	15	tr								25	50	25			shale	Middlesex
1575	2496.4		N5.1	75	20	5								15	55	25		5	shale	Middlesex
1576	2546.6		N5.1	75	20	5								20	60	20			shale	Middlesex
1577	2596.4		N5.0	75	20	5								20	55	25			shale	Middlesex
1578	2646.4		N6.0	80	15	tr		5						15	65	15		5	shale	
1579	2743.5		10YR5/.8	60	20	tr		20						20	65	10		5	shale	
1580	2793.5		10YR6/.5	65	20			15						20	65	15			shale	Geneseo
1581	2850		10YR4/.3	75	25	5								20	65	15			shale	Geneseo
1582	2910		10YR3/.8	45	30	5		20						20	75	5			shale	Geneseo
1583	2975	3070	10YR6/.5	70	15	tr		15						30	60	10			shale	Mahantango
1584	3070	3180	10YR6/.5	50	15	[illegible]		35						25	55	20			limshale	"
1585	3180	3280	10YR6/.5	50	15	[illegible]		35						25	55	20			limshale	"
1586	3280	3380	10YR6/.5	40	15	tr		45						20	65	15			limshale	"
1587	3380	3480	10YR5/.5	45	10	tr		45						15	55	20	10	10	limshale	Mahantango
1588	3480	3510	10YR3/.3	40	15	5		40						10	75	15			limshale	Marcellus

Stewart 6701, Livingston Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1311	77.7		N6.1	65	20	tr		15						25	65	10			shale	
1312	80.0		N6.5	75	20			5						20	65	10		5	"	
1313	92		N6.5	70	20	5		5						20	60	15		5	"	
1314	108		N6.1	70	20			10						20	60	15		5	"	
1315	120.3		N6.1	70	20			10						30	55	15			"	
1316	139.7		N6.1	70	15	tr		15						30	60	10			"	Geneseo
1317	155.9		N6.9	30	10	5		55						25	60	15			limshale	"
1318	168		N6.9	35	15	5		45						25	60	15			limshale	"
1319	179.8		N6.5	60	20	tr		20						25	55	20			shale	"
1320	201.4		N5.5	70	15	tr		15						25	55	20			shale	"
1321	215.8		N6.0	45	10	5		40						25	60	15			limshale	"
1322	229		N6.0	60	15	tr		25						25	55	20			shale	"
1323	235.8		N5.0	70	15			15			5			25	60	15			"	"
1324	260.7		N5.5	70	20	5		5						25	60	15			"	Mahantango
1325	269.8		N5.5	75	20	tr		5						25	60	15			"	"
1326	288		N5.9	50	15	5		30						25	60	15			"	"
1327	300		10YR5/.5	55	10	5		30						25	55	20			"	"
1328	318.1		10YR5/.5	50	15	5		30						25	55	20			"	"
1329	333.6		10YR5/.5	55	15	5		25						25	60	15			"	"
1330	348		10YR5/.5	55	20	5		20						20	60	20			"	"
1331	368		10YR5/.5	55	15	5		25						25	55	20			"	"
1332	384		10YR6/.5	50	15			35						20	55	25			limshale	"
1333	398		10YR5/.5	50	20	tr		30						25	60	15			shale	"
1334	403		N6.5	45	15	5		35						25	55	20			limshale	"
1335	425.5		10YR6/.5	40	15	5		40						20	55	25			limshale	"

Stewart 6701, Livingston Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1336	442		10YR5/.5	45	15	5		35						20	60	20			limshale	Mahantango
1337	455.2		10YR5/.5	50	15	.5		30						20	60	20			shale	"
1338	469.3		10YR5/.7	45	15			40						15	60	25			limshale	"
1339	491.5		10YR5/.7	30	10			60						20	55	25			"	"
1340	506.8		10YR5/.7	40	10			50											"	"
1341	511.5		10YR5/.7	45	15	tr		40						15	65	20			"	"
1342	530.5		10YR4/.5	40	10	.5		45						15	65	20			"	Marcellus
1343	543,4		10YR3/.5	55	15	5		25						15	70	15			shale	"
1344	564.5		10YR3/.5	70	20	10								10	75	15			"	"
1345	576.5		10YR2/.5	50	15	15		20						tr	80	20			"	"

Ames #1, Allegany Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1031	1813	1847	N6.2	75	20	tr							5	20	50	20		10	shale	Dunkirk
1032	1847	1880	N5.7	75	25	tr								20	50	20		10	"	"
1033	1880	1915	10YR6/.3	75	25	tr								20	55	20		5	"	"
1034	1915	1952	10YR6/.3	80	20	tr								15	50	25		10	"	Dunkirk
1035	1952	2120	N5.8	75	20	tr		5						20	50	20		10	"	"
1036	2120	2300	N6.7	65	30			5						25	40	25		10	"	"
1037	2300	2320	10YR6/.3	75	20	5								20	50	20		10	"	Java
1038	2320	2511	N6.7	70	25			5						35	40	15		10	"	"
1039	2511	2710	N6.1	75	25	tr								30	45	20		5	"	"
1040	2710	2804	N6.1	70	30									25	45	20		10	"	Rhinestreet
1041	2804	2900	N6.1	70	30									35	45	15		5	"	"
1042	2900	2993	N6.1	75	25									25	50	15		10	"	"
1043	2993	3092	N6.1	75	20								5	20	45	25		10	"	"
1044	3092	3193	10YR5/.3	75	20	tr							5	20	50	20		10	"	"
1045	3193	3290	N5.7	75	20	tr							5	20	50	25		5	"	"
1046	3290	3392	10YR6/.3	75	20	tr							5	20	55	20		5	"	"
1047	3392	3500	10YR6/.3	75	25	tr								25	55	20		tr	"	"
1048	3500	3596	10YR6/.3	80	20	tr								25	55	20		tr	"	Rhinestreet
1049	3596	3745	N5.9	70	20	tr		10						30	50	20			"	"
1050	3745	3872	10YR4/1	65	25	5		5						20	60	20			"	Middlesex
1051	3872	3967	10YR5/.5	55	25	tr		20						20	65	15			"	"
1052	3967	4081	10YR4/1	55	20	tr		25						25	65	10			shale	Geneseo
1053	4081	4111	10YR3/1	30	15	5		50						10	85	5			limshale	Geneseo
1054	4143	4225	10YR5/.5	55	15	tr		30						20	70	10			shale	Mahantango
1055	4225	4310	10YR6/.5	50	20	tr		30						30	60	10			shale	Mahantango
1056	4310	4393	10YR5/.5	60	15	tr		25						30	60	10			shale	Mahantango
1057	4393	4480	10YR5/.5	50	15			35						30	65	5			limshale	Mahantango
1058	4480	4568	10YR4/1	40	15	5		40						20	65	15			limshale	Marcellus
1059	4568	4621	10YR2/1	35	15	5		45						10	85	5			limshale	Marcellus

Hall #1, Wyoming Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1265	219	271	10YR6/.5	70	25	tr		5						20	60	20			shale	West Falls
1266	271	340	10YR5/.7	75	20	5								20	50	30			shale	West Falls
1267	340	428	10YR5/.7	70	25	5								15	60	20		5	shale	Rhinestreet
1268	428	498	N5.7	65	20	tr		10				5		15	50	25		10	shale	
1269	498	583	N5.7	75	20	tr		5						15	55	20			shale	
1270	583	657	10YR5/.7	35	10	5		50						15	60	10	15	5	limshale	Geneseo
1271	657	721	N6.0	60	15	tr		25						25	50	25			shale	Mahantango
1272	721	801	N5.8	70	15			15						25	55	20			shale	"
1273	811	905	10YR6/.5	45	10	5		40						20	50	15	15		limshale	"
1274	905	974	10YR5/1	40	10	5		45						20	60	10	10		limshale	Mahantango
1275	994	1003	10YR5/1	55	20	5		20						15	70	15			shale	Marcellus

Well #796, Erie Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1139	607	677	10YR5/1	70	25	tr		5						15	60	15		10	shale	Dunkirk
1140	677	730	10YR5/1	70	25	5								20	55	15		10	"	Dunkirk
1141	730	816	N6.0	65	25	tr		10						15	60	15		10	"	Java
1142	816	846	10YR4/1	70	25	5								15	65	15		5	"	Java
1143	846	969	N6.4	70	20			10						20	45	25		10	"	Angola
1144	969	1111	N6.0	75	20	tr		5						20	50	25		5	"	Angola
1145	1111	1211	10YR4/1	70	25	5		tr						15	60	25			"	Rhinestreet
1146	1211	1314	10YR4/1	70	25	5								15	60	25			"	Rhinestreet
1147	1314	1419	N6.0	75	15	tr		10						20	55	25			"	
1148	1419	1454	10YR4/1	65	30	5								20	70	10			"	Middlesex
1149	1469	1495	N6.0	55	15	5		25						25	50	25			"	Mahantango
1150	1508	1605	N6.0	60	15	tr		25						20	60	15		5	"	"
1151	1605	1698	N5.3	55	20	tr		25						20	55	20		5	shale	"
1152	1705	1738	10YR4/1	40	15	5		40						20	65	15			limshale	"
1153	1738	1787	10YR5/1	40	10	5		45						15	70	15			limshale	Mahantango
1154	1787	1810	10YR/1	60	15	5		20						20	65	15			shale	Marcellus

Ackerly #1, Cattaraugus Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1117	1765	1844	5Y6/.5	70	25	tr		5						20	55	15		10	shale	Dunkirk
1118	1844	1936	5Y6/.5	75	20	tr		5						20	55	15		10	"	Dunkirk
1119	1936	2085	N5.8	75	20	tr		5						25	50	15		10	"	Dunkirk
1120	2085	2115	N6.1	70	25			5						25	50	15		10	"	Java
1121	2115	2255	N6.7	70	25			5						35	45	15		5	"	Angola
1122	2255	2418	N6.1	75	25									30	45	15		10	"	Angola
1123	2418	2525	10YR6/.5	75	25	tr								25	50	20		5	"	Rhinestreet
1124	2525	2651	10YR6/.5	75	25	tr								20	50	20		10	"	"
1125	2651	2749	10YR5/.5	75	20	5								15	60	15		10	"	"
1126	2749	2850	10YR4/1	75	20	5								15	60	20		5	"	"
1127	2850	2950	10YR4/1	70	25	5								15	55	20		10	"	"
1128	2950	3060	10YR4/1	75	20	5								15	55	25		5	"	"
1129	3060	3160	N5.7	75	20			5						30	55	15			"	
1130	3160	3265	10YR5/.5	80	25	tr		5						25	60	15			"	Middlesex
1131	3265	3326	10YR4/1	60	20	5		15						20	65	15			"	
1132	3326	3372	10YR4/1	50	20	5		25						20	80	tr			"	Geneseo
1133	3372	3391	10YR5/.5	60	15	tr		25						15	65	10	10		"	Geneseo
1134	3391	3497	10YR6/.5	60	15	tr		25						25	60	10	5		"	Mahantango
1135	3497	3594	10YR6/.5	55	15	tr		30						25	65	5	5		"	Mahantango
1136	3594	3699	10YR5/.5	55	15	tr		30						25	65	5	5		"	Mahantango
1137	3699	3778	10YR4/1	50	15	5		30						15	65	15	5		"	Marcellus
1138	3785	3797	10YR5/1	20	15	5		60						15	80		5		limshale	Marcellus

Seneca Nations #1, Cattaraugus Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1013	1711	1775	5Y6/.5	65	30			5						20	45	25		10	shale	Dunkirk
1014	1775	1852	5Y6/.5	65	30	tr	tr	5						20	50	20		10	"	Hanover
1015	1852	1946	5Y7/.5	75	25			tr						35	40	20		5	"	Hanover
1016	1946	1960	10YR4/1	75	25	tr		tr						20	65	10		5	"	Pipe Creek
1017	1960	2268	N6.8	70	25			5						25	50	20		5	"	Angola
1018	2268	2388	N6.5	70	25								5	25	55	15		5	"	Angola
1019	2388	2438	10YR4/.5	70	25	5								20	65	15			"	Rhinestreet
1020	2481	2562	10YR4/.5	65	25	5		5						20	65	15			"	"
1021	2562	2670	10YR4/1	65	30	5								20	60	20			"	"
1022	2670	2731	10YR4/.5	60	30	5		5						15	65	20			"	Rhinestreet
1023	2731	2815	N6.0	75	20	tr		5						25	70	5			"	
1024	2815	2868	10YR4/.5	55	35	5		5						25	65	10			"	Middlesex
1025	2868	2920	10YR4/1	50	25	5		20						15	65	20			"	
1026	2920	2980	5Y6/.5	50	15	5		30						20	65	15			shale	Geneseo
1027	3000	3103	N6.0	55	15	tr		35						25	60	15			limshale	Mahantango
1028	3103	3204	10YR6/.5	45	20	tr		35						20	65	15			limshale	Mahantango
1029	3204	3270	10YR4/1	40	15	5		40						15	70	15			limshale	Marcellus
1030	3270	3300	10YR3/.5	40	15	5		40						10	85	5			limshale	Marcellus

Bates #1, Chautauqua Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0972	1460	1500	N6.0	75	20	tr		5						15	60	15		10	shale	Dunkirk
0973	1500	1564	10YR5/.5	70	25	5								15	55	25		5	"	"
0974	1564	1671	N6.5	80	20			10						25	55	20			"	Hanover
0975	1671	1688	10YR4/1	60	30	5		5						15	60	25			"	Pipe Creek
0976	1688	1788	N5.6	70	20	5		5						25	55	20			"	Angola
0977	1788	1887	N6.0	70	20			10						25	55	20			"	Angola
0978	1887	1990	N5.5	75	25	tr								20	60	20			"	Angola
0979	1990	2092	N5.5	80	20	tr								15	60	25			"	Angola
0980	2092	2191	10YR5/.5	70	30	tr								15	70	15			"	Rhinestreet
0981	2191	2266	10YR5/.5	70	30	tr		5						10	75	15			"	"
0982	2266	2313	N5.5	75	20	tr		5						20	65	15			"	"
0983	2313	2352	10YR6/.5	50	25	5		20						20	60	20			"	"
0984	2352	2375	N6.0	50	15	tr		35						20	60	20			limshale	"
0985	2403	2500	N6.0	45	15	tr		40						25	70	5			limshale	Mahantango
0986	2500	2555	10YR5/.5	45	20	5		35						20	65	15			limshale	"
0987	2570	2618	10YR4/.5	60	20	5		15						20	65	15			shale	Marcellus

Carnoban #1, Chautauqua Co., NY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1004	1522	1585	10YR5/.5	65	30	5								20	65	15			shale	Dunkirk
1005	1585	1680	7.5YR6/.3	65	20	tr		15						20	60	20			"	Hanover
1006	1680	1778	N6.5	65	25			10						20	55	25			"	Pipe Creek
1007	1778	1875	7.5YR6/.3	70	20	tr		10						25	60	15			"	Angola
1008	1875	1975	10YR6/.5	75	20	tr		5						30	35	10	25		"	Angola
1009	1975	2059	10YR5/.5	65	30	5		5						20	45	35			"	Rhinestreet
1010	2059	2110	10YR5/.5	45	20	5		30						20	65	15			shale	Rhinestreet
1011	2190	2261	10YR6/.3	40	15	5		40						25	65	10			limshale	Mahantango
1012	2261	2337	10YR5/.3	65	15	tr		20						20	65	15			shale	Mahantango

Blemle #1, Bradford Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0862	7400	7430	N3.5	65	30	5								20	65	10	5		shale	Marcellus
0863	7431		N3.1	65	30	5								15	65	15	5		"	"
0864	7430	7440	N3.5	60	25	5		10						20	60	20			"	"
0865	7440	7450	N3.7	65	25	5		5						20	65	10	5		"	"
0866	7450	7460	N3.1	65	25	5		5						15	65	20			"	"
0867	7460	7470	N3.5	65	25	5		5						10	70	20			"	"
0868	7470	7480	N3.5	65	25	5		5						10	75	15			"	"
0869	7480	7490	N3.5	65	30	5								10	70	10	5		"	"
0870	7490	7500	N3.5	65	30	5								15	80	5			"	"
0871	7500	7520	N3.5	50	25	5		20						10	70	15	5		"	"
0872	7520	7540	N3.5	50	25	5		20						5	80	10	5		"	"
0873	7540	7560	N3.5	55	25	5		15						5	80	15			"	"
0874	7560	7580	N3.5	55	30	5		10						5	75	20			"	"
0875	7580	7600	N3.3	50	30	10		10						5	75	20			"	"
0876	7600	7620	N3.1	55	25	5		15						5	85	10			"	"
0877	7620	7640	N3.1	50	30	5		15						5	90	5			"	"
0878	7640	7660	N3.1	40	30	5		25						5	80	15			"	"
0879	7660	7680	N3.5	40	25	5		30						10	75	15			shale	"
0880	7680	7700	N3.5	35	20	5		40						15	65	20			limshale	"
0881	7700	7720	10YR4/.5	25	20	5		50						5	80	15			limshale	Marcellus

Bennett #1, Sullivan Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0473	7380		N6.5	70	20								10	35	45	20			shale	Mahantango
0474	8260		N3.0	60	30	5		5						20	55	25			"	Marcellus
0475	8270		N3.0	55	30	5		10						15	65	10	10		"	"
0476	8280		N3.0	60	25	5		10						15	75	15	tr		"	"
0477	8300		N3.0	70	15	10		5							90	10	tr		"	"
0478	8310		N3.0	55	25	5		15						15	80	5			"	"
0479	8320		N2.8	40	30	10		20							90	10			"	"
0480	8330		N2.9	50	25	10		15						5	75	20			"	"
0481	8340		N3.0	20	20	10		50							85	15			limshale	"
0482	8350		N2.7	35	40	5		20							90	10			shale	"
0483	8360		N2.8	30	25	5		40							90	10			limshale	Marcellus

Pa. Tract 101 #1, Lycoming Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0699	6700	6730	N4.0	60	30	5		5						15	55	30			shale	
0700	6730	6750	N4.0	65	25	5		5						20	50	30			"	
0701	6750	6770	N3.5	65	25	5		5						20	60	20			"	Geneseo
0702	6770	6790	N3.5	65	25	5		5						20	60	20			"	Geneseo
0703	6790	6810	N3.5	70	25	5								20	60	20			shale	Geneseo
0704	6810	6850	N6.0	25	15			60						15	65	20			limshale	
0705	6850	6900	N6.0	25	15			60						20	65	15			limshale	
0706	6900	6950	N5.5	25	10			65						20	70	10			limshale	
0707	6950	7010	N5.5	15	5			80						25	65	15			limstone	
0708	7010	7040	N6.0	45	15			40						40	50	10			limshale	
0709	7040	7070	N5.5	65	25			10						35	50	15			shale	
0710	7070	7100	N4.5	65	20			15						30	55	15			"	
0711	7100	7150	N4.0	75	20			5						30	50	20			"	
0712	7150	7200	N4.0	65	20	tr		15						30	60	10			"	
0713	7200	7250	N4.5	70	20	tr		10						30	55	15			"	
0714	7250	7300	N5.0	60	20	tr		20						30	60	10			"	
0715	7300	7350	N5.0	65	25	tr		10						30	60	10			"	
0716	7350	7400	N5.0	65	25	tr		10						35	60	5			"	
0717	7400	7450	N5.0	60	15	tr		25						25	55	5	15		"	
0718	7450	7500	N4.5	60	20	5		15						25	55	5	15		"	
0719	7500	7550	N5.0	60	20	tr		20						30	55	10	5		"	
0720	7550	7600	N4.0	60	20	tr		20						30	60	5	5		"	
0721	7600	7650	N4.5	55	15	5		25						20	60	15	5		"	
0722	7650	7680	N4.0	55	25	tr		20						20	60	15	5		"	Marcellus
0723	7680	7710	N4.0	60	20	5		15						15	60	15	10		"	"
0724	7710	7740	N3.5	65	15	5		15						15	65	15	5		"	"
0725	7740	7770	N4.0	50	20	5		25						15	65	15	5		"	"
0726	7770	7800	N3.0	50	25	5		20						10	75	15			shale	
0727	7800	7815	N4.0	15	10	5		70						15	65	20			limstone	Marcellus

General Refractories #1, Clearfield Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0801	7050	7070	N5.5	40	15	5		40						30	60	10			limshale	
0802	7070	7100	N5.8	50	15	tr		35						30	65	5			limshale	
0803	7100	7130	N5.8	45	15	5		25						30	60	10			shale	Geneseo
0804	7150	7200	10YR6/.5	65	30	tr		5						35	55	10			"	
0805	7200	7240	10YR6/.5	65	30	tr		5						30	60	10			"	
0806	7250	7280	10YR6/.5	75	25									35	45	20			"	
0807	7280	7300	10YR6/.5	75	25									30	55	15			"	
0808	7300	7350	10YR6/.5	75	25									35	50	15			"	
0809	7350	7400	10YR6/.5	75	25									35	55	10			"	
0810	7400	7450	10YR6/.5	70	20			5					5	35	50	15			"	
0811	7450	7500	7.5YR5/.5	60	25	5		5					5	30	60	10			"	
0812	7500	7550	7.5YR5/.5	55	25	5		10					5	25	55	20			"	
0813	7550	7600	7.5YR5/.5	70	25	5								25	60	15			"	
0814	7600	7650	7.5YR5/.5	75	20	5								20	55	25			"	
0815	7650	7700	7.5YR5/.5	65	20	5		10						25	60	15			"	
0816	7700	7750	7.5YR5/.5	70	20	5		5						25	60	15			"	
0817	7750	7780	8.5YR4/.5	70	15	5		10						15	55	30			"	
0818	7780	7800	8.5YR4/.5	65	20	5		10						20	55	25			"	
0819	7800	7820	8.5YR4/.5	65	20	5		10						15	65	20			"	
0820	7820	7860	8.5YR4/.5	55	25	5		15						15	65	20			"	
0821	7860	7880	8.5YR4/.5	55	25	5		15						10	65	25			"	
0822	7880	7900	8.5YR4/.5	55	25	5		15						15	70	15			"	Marcellus
0823	7900	7920	8.5YR4/.5	55	25	5		15						15	65	20			shale	"
0824	7920	7940	8.5YR4/.5	40	20	5		35						15	65	20			limshale	"
0825	7940	7960	7.5YR5/.5	40	20	5		35						20	65	15			limshale	"
0826	7960	7980	7.5YR5/.5	50	35	5		10						15	55	15	15		shale	"
0827	7980	8000	10YR6/.5	40	25	5		30						20	60	20			shale	"
0828	8000	8020	10YR6/.5	60	25	5		10						25	55	20			shale	Marcellus

Weldon #1, Blair Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0934	4600	4650	7.5YR5/.5	60	30	5		5						25	60	15			shale	
0935	4650	4690	7.5YR4/.5	55	25	5		15						20	70	10			shale	Geneseo
0936	4690	4790	N5.5	55	20			25						30	60	10			shale	
0937	4790	4900	N6.5	65	30			5						40	45	15			shale	
0938	4900	5000	N6.7	70	25			5					tr	40	45	15			shale	
0939	5000	5100	N6.7	75	25	tr							tr	35	50	15			ale	
0940	5100	5150	7.5YR6/.5	70	20	5		5						30	60	10			shale	
0941	5150	5200	7.5YR5/.5	65	25	5		5						25	45	30			shale	
0942	5200	5300	7.5YR5/.5	70	25	5								25	55	20			shale	
0943	5300	5400	7.5YR5/.5	65	25	5		5						25	55	20			shale	
0944	5400	5500	7.5YR4/.5	70	20	5		5						25	60	15			shale	
0945	5500	5530	7.5YR5/.5	60	20	5		15						20	55	25			shale	
0946	5530	5550	7.5YR4/.5	60	25	5		10						20	60	20			shale	Marcellus
0947	5550	5570	7.5YR4/.5	60	25	5		10						20	60	20			shale	Marcellus
0948	5570	5590	7.5YR4/.5	60	20	5		15						15	70	15			shale	Marcellus
0949	5590	5610	7.5YR4/.5	60	20	5		15						15	60	25			shale	Marcellus
0950	5610	5630	7.5YR4/.5	65	20	5		10						15	55	30			shale	Marcellus
0951	5630	5650	7.5YR4/.5	65	25	5		10						15	65	20			shale	Marcellus
0952	5650	5670	10YR4/.5	60	25	5		15						15	60	25			shale	Marcellus
0953	5670	5700	10YR4/.5	40	20	5		35						15	60	25			limshale	Marcellus

Heidingsfelder #1, Cambria Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0562	8340	8350	N4.0	55	30	5		10						20	55	25			shale	Geneseo
0563	8350	8360	N3.8	45	45	5		5						25	60	15			sltstone	Geneseo
0564	8360	8365	N5.0	55	25	5		15						25	55	20			shale	Geneseo
0565	8365	8380	N6.3	40	15			45						30	55	15			limstone	
0566	8380	8400	N6.0	65	20	5		10						25	55	20			shale	
0567	8400	8420	N6.3	60	25			15						30	50	20			shale	
0568	8420	8440	N6.3	55	30	5		10						25	55	20			shale	
0569	8440	8460	N6.5	55	35			10						40	45	15			sltstone	
0570	8460	8480	N6.2	60	35			5						35	50	15			sltstone	
0571	8480	8500	N6.3	65	30								5	40	45	15			shale	
0572	8500	8520	N5.7	70	30									30	55	15			shale	
0573	8520	8540	N6.0	70	25	5								30	55	15			shale	
0574	8540	8560	N6.0	75	25									30	55	15			shale	
0575	8560	8580	N6.0	70	30									30	55	15			shale	
0576	8580	8600	N6.3	75	25									30	55	15			shale	
0577	8600	8620	N6.0	75	25									30	50	20			shale	
0578	8620	8640	N6.0	70	25	5								25	55	20			shale	
0579	8640	8660	N6.3	65	25			10						25	55	20			shale	
0580	8660	8680	N6.2	60	30			5					5	25	55	20			shale	
0581	8680	8700	N6.2	75	25									30	50	20			shale	
0582	8700	8720	N6.2	70	25								5	30	50	20			shale	
0583	8720	8740	N6.2	70	25								5	25	55	20			shale	
0584	8740	8760	N6.0	70	30									25	55	20			shale	
0585	8760	8780	N6.0	65	20			15						25	60	15			shale	
0586	8780	8800	N6.0	75	15			10						25	60	15			shale	
0587	8800	8820	N5.0	70	15	5		10						25	60	15			shale	
0588	8820	8840	N5.0	75	20	5								25	60	15			shale	
0589	8840	8860	N5.0	65	30	5							5	25	60	15			shale	

Heidingsfelder #1, Cambria Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0590	8860	8880	N4.0	70	25	5								25	60	15			shale	
0591	8880	8900	N4.0	70	25	5							5	25	60	15			shale	
0592	8900	8920	N4.0	70	25	5							5	20	60	20			shale	
0593	8920	8940	N4.0	65	30	5							5	20	60	20			shale	
0594	8940	8960	N4.0	65	30	5							5	25	55	20			shale	
0595	8960	8980	N4.0	65	30	5								25	55	20			shale	
0596	8980	9000	N4.0	70	20	5		5						25	55	20			shale	
0597	9000	9020	N4.0	75	20	5								25	55	20			shale	
0598	9020	9040	N4.0	75	20	5								20	60	20			shale	
0599	9040	9060	N4.0	70	20	5		5						20	60	20			shale	
0600	9060	9080	N3.5	75	20	5								20	60	20			shale	
0601	9080	9100	N4.0	55	15	5		25						30	50	20			shale	
0602	9100	9120	N4.0	65	20	5		10						20	55	25			shale	
0603	9120	9140	N4.0	70	25	5								20	55	25			shale	
0604	9140	9150	N4.0	70	25	5								20	60	20			shale	
0605	9150	9160	N3.0	70	20	5		5						20	60	20			shale	Marcellus
0606	9160	9170	N3.0	70	25	5								15	70	15			shale	Marcellus
0607	9170	9180	N3.5	40	20	5		35						15	70	15			limstone	Marcellus
0608	9180	9190	N4.0	30	15	5		50						15	60	25			limstone	Marcellus
0609	9190	9200	N3.5	45	30	5		20						15	65	20			shale	Marcellus
0610	9200	9210	N3.5	55	25	5		15						15	65	20			shale	Marcellus
0611	9210	9220	N3.5	60	25	5		10						10	70	20			shale	Marcellus
0612	9220	9230	N3.5	60	25	5		10						10	70	20			shale	Marcellus
0613	9230	9240	N3.0	60	20	5		10						10	75	15			shale	Marcellus
0614	9240	9250	N3.0	55	25	5		10						15	65	20			shale	Marcellus
0615	9250	9260	N3.0	40	25	10		25						10	65	25			shale	Marcellus
0616	9260	9270	N3.0	20	20	5		55						10	65	25			limshale	Onondaga

Mowry #1, Somerset Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0663	2360	2380	N6	75	25									30	60	10			shale	Geneseo
0664	2380	2400	N6	70	25	tr		5						35	55	10			"	Geneseo
0665	2400	2420	N4	70	20	5		10						25	60	15			"	Geneseo
0666	2420	2440	N5	60	20	tr		20						30	50	20			"	Geneseo
0667	2440	2460	N5	70	20	tr		10						30	55	15			"	
0668	2460	2500	N5.5	70	20	tr		10						30	50	20			"	
0669	2500	2550	N6	65	25			10						35	50	15			"	
0670	2550	2600	N5.5	75	25									35	50	15			"	
0671	2600	2650	N6	70	25	tr		5						30	50	20			"	
0672	2650	2700	N6	65	25	tr		10						35	50	15			"	
0673	2700	2750	N6.5	60	30			10						40	50	10			"	
0674	2750	2800	N6.5	55	35	tr		10						35	55	10			"	
0675	2800	2850	N5.5	75	20	5								30	50	20			"	
0676	2850	2900	N5.5	75	20	5								25	55	20			"	
0677	2900	2950	N5.5	75	20	5								25	55	20			"	
0678	2950	3000	N5.5	75	25	tr								25	55	20			"	
0679	3000	3050	N5.5	65	30	5								30	50	20			"	
0680	3050	3100	N5.5	65	25	5		5						30	50	20			"	
0681	3100	3150	N5	70	25	5								20	60	20			"	
0682	3150	3200	10YR5/.5	75	20	5								20	55	25			"	
0683	3200	3250	10YR5/.5	70	20	5		5						20	55	25			"	
0684	3250	3300	2.5Y4/1	65	25	5		5						15	70	15			"	
0685	3300	3320	10YR4/1	70	25	5								15	60	25			"	
0686	3320	3340	10YR4/1	70	25	5								15	65	20			"	Marcellus
0687	3340	3360	N3.5	65	25	5		5						20	60	20			shale	Marcellus
0688	3360	3370	7.5YR4/.5	25	20	5		50						15	65	20			limshale	Marcellus
0689	3370	3380	N5.5	65	15	tr		20						15	60	25			shale	Marcellus
0690	3380	3390	N5	55	20	5		20						15	60	25			shale	Marcellus

Mowry #1, Somerset Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0691	3390	3400	7.5YR4/.5	50	20	5		25						15	60	25			shale	Marcellus
0692	3400	3420	7.5YR4/.5	55	20	5		20						15	60	25			shale	Marcellus
0693	3420	3440	7.5YR4/.5	55	30	5		10						15	60	25			shale	Marcellus
0694	3440	3460	7.5YR4/.5	55	25	5		15						10	60	30			shale	Marcellus
0695	3460	3470	7.5YR4/.5	55	25	5		15						10	65	25			shale	Marcellus
0696	3470	3480	7.5YR4/.5	45	25	5		25						10	55	35			shale	Marcellus
0697	3480	3490	7.5YR4/.5	45	25	5		25						10	65	25			shale	Marcellus
0698	3490	3500	7.5YR4/.5	45	25	5		25						10	80	10			shale	Marcellus

Dupre #1, Somerset Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0617	6850	6880	N5.0	75	20	5								25	50	25			shale	Middlesex
0618	6880	6910	N4.0	65	30	5						tr		20	60	20			"	Middlesex
0619	6910	6940	N5.5	70	25	tr							5	30	55	15			"	Middlesex
0620	6940	6960	N5.0	75	20	5								25	50	25			"	Middlesex
0621	6960	6990	N5.0	70	25	5								25	60	15			"	
0622	6990	7020	N5.0	65	25	5						5		30	60	10			"	
0623	7020	7040	N5.0	65	30	5								25	70	5			"	
0624	7040	7070	N5.0	65	30	5								25	60	15			"	
0625	7070	7100	N5.0	65	25	5		5						25	60	15			"	
0626	7100	7130	N5.0	65	25	5		5						25	60	15			"	
0627	7130	7160	N5.0	70	25	5								25	60	15			"	
0628	7160	7190	N4.0	50	25	5		20						20	65	15			"	Geneseo
0629	7190	7220	N4.0	45	25	5		25						25	60	15			"	Geneseo
0630	7260	7290	N5.0	75	20	5								25	60	15			"	
0631	7290	7300	N5.5	75	20	5								25	65	10			"	
0632	7300	7320	N5.3	65	25	5							5	25	55	20			"	
0633	7320	7340	N5.3	75	20	5								30	55	10	5		"	
0634	7360	7380	N5.7	70	25	5								30	50	10	10		"	
0635	7380	7400	N6.0	70	30									35	60	5			"	
0636	7400	7420	N6.0	70	30									35	55	10			"	
0637	7420	7440	N6.0	65	30	5								35	50	15			"	
0638	7440	7460	N6.0	65	30								5	35	55	10			"	
0639	7460	7480	N6.0	65	30								5	35	60	5			"	
0640	7480	7500	N5.8	65	25	5		5						30	55	15			"	
0641	7500	7520	N5.8	70	25								5	30	55	15			"	
0642	7520	7540	N6.0	70	25	5								30	55	15			"	
0643	7540	7560	N5.0	70	25	5								30	55	15			"	
0644	7560	7580	N5.0	70	25	5								25	65	10			shale	

Dupre #1, Somerset Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0645	7580	7600	N5.0	70	25	5								25	65	10			shale	
0646	7600	7620	N4.0	70	25	5						tr		20	60	20			"	
0647	7620	7640	N4.0	60	30	5						5		20	60	20			"	
0648	7640	7660	N4.0	60	30	5						5		15	60	25			"	
0649	7660	7680	N4.2	65	25	5		5						15	60	25			"	
0650	7680	7700	N5.0	65	25	5						5		25	55	20			"	
0651	7700	7720	N5.0	70	25	5								25	55	20			"	
0652	7720	7740	N5.0	70	25	5								25	60	15			"	
0653	7740	7760	N5.3	60	25	tr		10	5					25	60	15			"	
0654	7760	7780	N4.0	65	25	5		5						20	60	20			"	Marcellus
0655	7780	7800	N4.0	70	25	5								20	55	25			"	Marcellus
0656	7800	7820	N4.0	70	20	5		5						15	65	20			"	Marcellus
0657	7820	7840	N4.0	75	20	5								20	55	25			"	Marcellus
0658	7840	7860	N3.5	70	20	5		5						15	65	20			"	Marcellus
0659	7860	7880	N3.5	55	20	5		20						10	75	15			"	Marcellus
0660	7880	7900	N3.5	50	20	5		25						20	60	20			"	Marcellus
0661	7900	7920	N3.5	45	25	5		25						15	70	15			"	Marcellus
0662	7920	7940	N3.5	50	25	5		20						15	60	25			shale	Marcellus

Ryan #2, Fayette Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0882	6760	6790	N5	75	25	tr								25	55	20			shale	Middlesex
0883	6790	6820	10YR4/.5	75	25	tr								25	55	20			shale	Middlesex
0884	6820	6850	10YR4/.5	70	25	5								20	55	25			shale	
0885	6850	6880	10YR4/.5	65	25	5		5						20	65	15			shale	
0886	6880	6910	10YR4/.5	65	25	5		5						20	60	20			shale	
0887	6910	6940	10YR5/.5	65	25	5		5						20	55	25			shale	
0888	6940	6970	7.5YR5/.5	45	20	tr		35						20	60	20			limshale	
0889	6970	7000	7.5YR5/.5	65	30	tr		5						25	65	10			shale	
0890	7000	7020	7.5YR5/.5	60	30	tr		10						20	60	20			shale	
0891	7020	7040	10YR5/.5	70	25	tr		5						25	60	15			shale	
0892	7040	7060	10YR5/.5	55	20	tr		25						25	60	15			shale	
0893	7060	7080	10YR5/.5	60	25	tr		15						20	65	15			shale	
0894	7080	7100	10YR5/.5	50	30	5		20						20	60	20			shale	
0895	7100	7110	10YR4/.5	45	25	tr		30						20	70	10			limshale	
0896	7110	7120	7.5YR5/.5	30	10	tr		60						20	65	15			limshale	Geneseo
0897	7120	7130	7.5YR6/.5	25	10	tr		65						20	60	20			limshale	Geneseo
0898	7130	7140	7.5YR6/.5	15	10			75						20	60	20			limstone	Geneseo
0899	7140	7160	7.5YR6/.5	15	10			75						20	55	25			limstone	
0900	7160	7180	7.5YR6/.5	10	10			80						20	65	15			limstone	
0901	7180	7200	7.5YR6/.5	50	15	tr		35						20	50	30			limshale	
0902	7200	7250	7.5YR6/.5	65	20	tr		15						25	60	15			shale	
0903	7250	7300	7.5YR6/.5	65	20	tr		15						25	55	20			shale	
0904	7400	7450	10YR4/.5	65	30	5								20	65	15			shale	
0905	7450	7500	10YR4/.5	70	25	5								15	55	30			shale	
0906	7500	7520	10YR4/.5	70	25	5								20	65	15			shale	
0907	7520	7540	10YR4/.5	70	20	5		5						15	65	20			shale	Marcellus
0908	7540	7560	10YR4/.5	65	20	5		10						10	70	20			shale	Marcellus
0909	7560	7580	10YR3/.5	65	20	5		10						10	70	20			shale	Marcellus

Ryan #2, Fayette Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0910	7580	7600	10YR3/.5	50	25	5		20			tr			5	75	20			shale	Marcellus
0911	7600	7620	10YR3/.5	50	20	5		25			tr			5	65	30			shale	Marcellus
0912	7620	7640	10YR3/.5	45	20	5		30			tr			5	75	20			shale	Marcellus

MREX #1, McKean Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1817	3517.46	3517.66	N6.8	60	35	5		tr						30	50	20			shale	Rhinestreet
1818	4577.28	4577.54	10YR4/.5	65	30	tr		5						15	65	10	10		shale	Middlesex
1819	4627.31	4627.56	10YR5/.5	80	20								tr	20	65	5	10		shale	
1820	4679.26	4679.52	10YR5/.5	65	20	tr		15						15	70	15			shale	
1821	4729.23	4729.60	10YR4/.5	60	20	tr		20						20	60	20			shale	Geneseo
1822	4829.25	4829.47	10YR5/.5	40	15	tr		45						20	70	10			limshale	Mahantango
1823	4879.15	4879.38	N5.1	65	20	tr		15						30	55	5	10		shale	Mahantango
1824	4929.57	4929.81	N4.5	50	20	tr		30						25	60	15			shale	Mahantango
1825	4979.40	4979.60	N6.0	35	10	tr		55						25	55	10	10		limshale	Mahantango
1826	5033.30	5033.55	N5.1	35	15	tr		50						25	60	15			limshale	Mahantango

Martin #4, Armstrong Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0913	6200	6220	N5.5	45	15	10		30						30	50	20			shale	
0914	6220	6240	N5.8	65	25			10						30	60	10			shale	
0915	6240	6260	10YR6/.5	75	20	tr		5						30	55	15			shale	
0916	6260	6280	10YR4/.5	65	20	5		10						20	60	20			shale	Marcellus
0917	6280	6300	10YR4/.5	60	25	5		10						15	65	20			shale	Marcellus
0918	6300	6320	10YR4/.5	65	20	5		10						15	55	30			shale	Marcellus
0919	6320	6340	10YR4/.5	65	20	5		10						10	60	30			shale	Marcellus
0920	6340	6360	10YR4/.5	65	20	5		10						5	65	30			shale	Marcellus
0921	6360	6380	10YR4/.5	40	15	5		40						5	75	20			limshale	Marcellus
0922	6380	6390	10YR4/.5	10	15	5		70						5	70	25			limshale	Marcellus

McCall #5, Indiana Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2040	7175.4		N6.6	80	20								tr						shale	
2041	7226.2		N6.5	80	20								tr						shale	
2042	7274.5		N5.9	75	20	5							tr						shale	
2043	7375.3		N5.2	70	25	5							tr						shale	
2044	7525.7		N3.9	55	20	tr		25					tr						shale	
2045	7576.4		N6.8	20	10			70											limshale	
2046	7627.6		N4.9	80	20	tr					tr		tr						shale	Mahantango
2047	7676.2		N5.5	80	20	tr							tr						shale	"
2048	7726.3		N5.5	80	20	tr							tr						shale	"
2049	7775.3		N5.2	80	20	tr						tr	tr						shale	"
2050	7874.6		N4.5	80	20	5							tr						shale	"

Sloan #1, Westmoreland Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0954	6460	6500	10YR4/.5	65	25	5		5						20	70	10			shale	Middlesex
0955	6500	6550	10YR4/.5	60	35	5								20	65	15			sltstone	
0956	6550	6600	10YR5/.5	55	35	5		5						25	70	5			sltstone	
0957	6600	6650	10YR5/.5	50	25	5		20						20	65	15			shale	
0958	6650	6700	10YR4/.5	50	25	5		20						20	60	20			shale	Geneseo
0959	6700	6750	N5.8	15	10	5		70						15	75	10			limstone	
0960	6750	6800	N5.7	15	10	5		70						20	70	10			limstone	
0961	6800	6850	10YR5/.5	50	20	tr		30						20	65	15			limshale	
0962	6850	6900	10YR5/.5	70	25	tr		5						25	60	15			shale	
0963	6900	6950	N4.4	55	25	tr		20						25	65	10			shale	
0964	6950	7010	10YR5/.5	65	25	tr		10						40	60				shale	
0965	7020	7050	10YR3/.5	60	25	5		10						20	70	10			shale	
0966	7050	7100	10YR3/.5	45	25	5		25						15	70	15			shale	
0967	7100	7125	10YR3/.5	45	25	5		15						10	75	15			shale	Marcellus
0968	7125	7150	10YR3/.5	50	20	5		25						5	75	20			shale	Marcellus
0969	7150	7175	10YR3/.5	40	20	5		30			tr			5	75	20			limshale	Marcellus
0970	7175	7200	10YR3/.5	30	15	5		50						10	90	tr			limshale	Marcellus
0971	7200	7220	10YR4/.5	25	20	5		50	tr					10	85	5			limshale	Marcellus

C.E. #1, Allegheny Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1739	7000.0		10YR3/1	30	20	5		45						20	70	10			limshale	Geneseo
1740	7025.2		10YR4/.35	45	25	5		25						20	60	20			shale	"
1741	7050.0		10YR3/1	55	20	5		20						15	70	15			"	"
1742	7075.0		N3.0	70	20	5		5						10	70	20			"	Geneseo
1743	7150.0		10YR4/.35	70	25	tr		5						25	65	10			"	Mahantango
1744	7175.0		N4.2	65	25	tr		10						25	65	10			"	"
1745	7200.0		N5.0	70	25	tr							5	25	65	10			"	"
1746	7225.1		N4.2	75	20	5							tr	25	65	10			"	"
1747	7249.8		N5.8	75	25	tr								25	55	20			"	"
1748	7275.2		N5.8	65	25			10						35	50	15			"	"
1749	7308.9		N5.8	70	25			5						25	55	20			shale	"
1750	7335.0		N2.2	55	35	5		5						15	60	25			sltshale	"
1751	7345.0		N2.2	45	35	10		10						20	70	10			sltshale	"
1752	7355.0		N3.0	55	35	5		5			tr		tr	15	70	5	10		sltshale	"
1753	7365.0		N3.2	55	35	5		5			tr		tr	15	65	20			sltshale	"
1754	7375.0		N3.5	65	30	5					tr		tr	10	55	35			shale	"
1755	7385.0		N3.8	35	15	tr		50						15	70	15			limshale	Mahantango
1756	7395.0		N3.0	80	15	5								15	60	15	10		shale	Marcellus
1757	7405.0		N3.0	75	20	5								10	70	20			shale	"
1758	7414.5		N3.2	65	25	5		5						10	70	20			shale	"
1759	7425.0		N3.5	65	25	5		5						10	70	20			shale	"
1760	7435.5		N3.2	70	25	5								5	70	25			shale	"
1761	7444.1		N3.0	40	35	5		20			tr				75	25			sltshale	"
1762	7453.4		N3.5	70	20	5		5						10	70	20			shale	"
1763	7464.1		N3.0	45	35	10		10							85	15			sltshale	"
1764	7474.6		N2.5	30	35	10		5			15		5		80	20			sltshale	"
1765	7485.4		N5.5	90		10										30			ash bed	Marcellus
1766	7496.3		N3.4	25	10	5		60			tr				80	20			limshale	Onondaga

Gordon #4, Greene Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0762	7450	7460	10YR3/.5	55	40	5								25	55	20			sltshale	Middlesex
0763	7460	7480	10YR3/.5	55	40	5								15	65	20			"	Middlesex
0764	7480	7500	10YR3/.5	70	25	5								15	65	20			shale	Middlesex
0765	7500	7550	10YR5/.5	70	25	5								20	65	15			"	
0766	7550	7570	7.5YR5/.5	70	25	5								20	60	20			"	
0767	7570	7590	10YR4/1	55	20	5		20						20	70	10			"	
0768	7590	7640	10YR4/1	50	20	5		25						10	75	15			"	
0769	7640	7650	N3.0	50	30	5		15						10	70	10	5		shale	Geneseo
0770	7650	7670	N5.0	25	10	5		60						15	70	10	5		limstone	Geneseo
0771	7680	7710	N5.0	40	15	5		40						20	60	15	5		limshale	
0772	7710	7750	7.5YR4/.5	75	20	tr		5						20	65	15			shale	
0773	7750	7780	N5.6	75	20	tr		5						25	55	20			shale	
0774	7780	7800	N5.3	50	20	tr		30						35	60	5			limshale	
0775	7800	7840	N5.0	65	25			10						25	60	15			shale	
0776	7860	7880	10YR3/.5	50	25	5		20						15	70	15			"	Marcellus
0777	7880	7900	10YR3/.5	60	25	5		10						10	70	20			"	Marcellus
0778	7900	7920	10YR3/.5	65	25	5		5						10	80	10			"	Marcellus
0779	7920	7940	10YR3/.5	50	30	5		15							65	35			"	Marcellus
0780	7940	7960	N4.0	45	30	5		20							90	10			shale	Marcellus

Christensen #1, Warren Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0728	2500	2530	7.5YR5/.5	60	25	5		10						20	60	20			shale	
0729	2530	2560	N5.3	65	25			10						20	60	15	5		"	
0730	2560	2590	N6.7	65	25			10						25	50	15	10		"	
0731	2590	2620	N6.7	60	25			15						25	55	20			"	Rhinestreet
0732	2620	2650	N6.7	65	25			10						25	65	10			"	Rhinestreet
0733	2650	2680	N6.8	70	25			5						25	60	15			"	Rhinestreet
0734	2710	2740	10YR5/.5	65	30	5								15	65	20			"	Rhinestreet
0735	2810	2830	10YR4/.5	60	35	5								10	75	10	5		"	Rhinestreet
0736	2890	2920	N5.5	65	30	5								15	60	15	10		"	Middlesex
0737	2920	2950	10YR5/.5	65	30	5								15	75	10			shale	
0738	3010	3040	10YR6/.5	15	5			75	5					10	70	10	10		limstone	
0739	3040	3070	10YR6/.5	20	10			70						15	75	5	5		limshale	
0740	3070	3100	10YR6/.5	30	15	5		50						20	60	15	5		limshale	
0741	3100	3130	10YR5/.5	45	15	5		35						25	65	10			limshale	
0742	3130	3160	10YR5/.5	45	15	5		35						20	70	10			limshale	
0743	3170	3200	10YR6/.5	55	20	5		20						20	65	15			shale	Marcellus
0744	3200	3220	10YR5/.5	65	15	5		15						20	65	15			shale	Marcellus
0745	3220	3240	10YR5/.5	60	20	5		15						20	60	20			shale	Marcellus

Mays #1, Clarion Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
0923	5420	5450	10YR4/1	45	25	5		25						15	70	15			shale	Mahantango
0924	5450	5480	10YR6/1	30	10	5		55						20	65	15			limshale	"
0925	5480	5510	10YR6/1	55	15	tr		30						25	60	15			limshale	"
0926	5510	5540	10YR6/.5	55	20	tr		25						20	65	15			shale	"
0927	5540	5570	10YR5/.5	60	20	5		15						20	65	15			"	"
0928	5570	5600	10YR5/.5	60	20	5		15						25	60	15			"	"
0929	5600	5630	10YR5/.5	60	20	tr		20						25	65	10			"	Mahantango
0930	5630	5660	10YR4/1	65	15	5		15						20	65	5	10		"	Marcellus
0931	5660	5690	10YR4/1	55	20	5		20						15	60	5	20		"	Marcellus
0932	5690	5720	10YR4/1	60	15	5		20						10	65	5	20		"	Marcellus
0933	5720	5750	10YR4/1	55	20	5		20						15	65	5	15		shale	Marcellus

Minnis #1, Mercer Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0746	3875	3881	10YR4/1	60	20	5		15						10	75	15			shale	Mahantango
0747	3881	3891	10YR4/1	15	10	5		70						10	75	15			limstone	"
0748	3891	3900	2.5Y5/1	40	15	5		40						15	65	15	5		limshale	"
0749	3900	3913	2.5Y5/1	40	15	5		40						15	65	15	5		limshale	"
0750	3913	3929	10YR4/1	45	15	5		35						15	65	15			shale	"
0751	3929	3939	2.5Y5/1	55	15	5		25						20	60	15	5		"	"
0752	3939	3950	2.5Y5/1	50	20	5		25						20	50	20	10		"	"
0753	3950	3960	2.5Y5/1	60	20	5		15						20	55	20	5		"	"
0754	3960	3970	2.5Y5/1	60	20	5		15						20	55	20	5		"	"
0755	3970	3980	2.5Y5/1	60	20	5		15						20	65	10	5		"	"
0756	3980	3990	2.5Y5/1	65	15	5		15						25	55	15	5		"	"
0757	3990	4000	2.5Y5/1	60	20	tr		20						20	65	10	5		"	"
0758	4000	4010	2.5Y5/1	65	15	5		15						20	60	20			"	"
0759	4010	4020	2.5Y5/1	70	15	5		10						15	65	20			"	"
0760	4020	4032	2.5Y5/1	65	20	5		10						20	65	15			"	"
0761	4032	4037	2.5Y5/1	60	20	5		15						20	70	10			shale	Mahantango

Metropolitan Brick #1, Beaver Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0829	3640	3645	5Y5/.5	80	20									30	50	20			shale	Rhinestreet
0830	3645	3660	5Y7/.5	80	20									25	50	25			"	"
0831	3660	3680	10YR6/.5	80	20	tr								30	55	15			"	"
0832	3680	3700	10YR6/.5	80	20	tr								30	50	20			"	"
0833	3700	3720	10YR6/.5	80	20	tr								25	50	25			"	"
0834	3720	3740	7.5YR6/.5	80	20	tr								25	55	20			"	"
0835	3740	3760	7.5YR6/.5	80	20	tr								25	55	20			"	"
0836	3760	3780	7.5YR6/.5	80	15								5	20	55	25			"	"
0837	3780	3800	7.5YR6/.5	80	15	tr							5	25	55	20			"	"
0838	3800	3820	7.5YR5/.5	80	20	tr								20	50	30			"	"
0839	3820	3840	7.5YR5/.5	80	20	tr								15	60	25			"	"
0840	3840	3860	10YR4/1	70	25	5								20	60	20			"	"
0841	3860	3880	7.5YR5/.5	75	20	5								15	55	30			"	"
0842	3880	3900	10YR4/1	70	20	5		5						15	70	15			"	"
0843	3900	3920	10YR4/1	65	30	5								15	65	20			"	"
0844	3920	3940	10YR4/1	65	30	5								15	60	25			"	"
0845	3940	3960	10YR4/1	70	25	5								20	60	20			"	"
0846	3960	3980	10YR4/1	60	25	5		10						20	65	15			"	"
0847	3980	4000	7.5YR5/.5	70	20	5		5						20	60	20			"	"
0848	4000	4020	7.5YR5/.5	70	20	5		5						20	60	20			"	Rhinestreet
0849	4020	4040	10YR5/1	65	30	5								20	60	20			"	"
0850	4040	4060	7.5YR5/.5	70	20	5		5						20	65	15			"	Middlesex
0851	4060	4080	10YR5/1	70	25	5		5						20	75	5			"	"
0852	4080	4105	10YR5/1	65	25	5		5						20	75	5			"	"
0853	4105	4115	10YR5/1	65	25	5		5						20	65	15			"	Geneseo
0854	4115	4135	10YR4/1	55	25	5		15						20	70	10			shale	"
0855	4150	4170	10YR4/1	45	15	5		35						15	65	20			limshale	Mahantango

Metropolitan Brick #1, Beaver Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0856	4170	4200	7.5YR5/.5	50	20	5		25						25	65	10			shale	Mahantango
0857	4200	4215	10YR5/1	55	15	5		25						20	55	25			"	Mahantango
0858	4215	4225	10YR6/.5	55	25	5		15						25	50	25			"	Mahantango
0859	4225	4250	10YR6/.5	65	20	5		10						30	55	15			"	Mahantango
0860	4250	4265	10YR5/1	70	25	tr		5						15	60	25			"	Marcellus
0861	4265	4300	10YR4/1	55	20	5		20						20	55	25			shale	Marcellus

Presque Isle #1, Erie Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2051	405.3		N6.5	75	15	5		5					tr						shale	
2052	545.6		10YR5/.5	75	20	5							tr						shale	Angola
2053	595.5		10YR4/.5	65	30	5							tr						shale	Angola
2054	645.5		N7.0	55	15	tr		30					tr						limshale	Angola
2055	735.6		N6.8	70	20			10					tr						shale	Angola
2056	949.4		10YR4/.5	75	20	5	tr						tr						shale	Rhinestreet
2057	995.6		10YR4/.5	55	40	5	tr	tr					5						sltshale	Rhinestreet
2058	1045.4		10YR7/1		5			95											limstone	Tully
2059	1191.3		N5.8	60	20	tr		20					tr						shale	Mahantango
2060	1241.5		10YR3/1	65	15	5		15	tr										shale	Marcellus

Blickensderfer #22, Erie Co., PA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0781	1160	1170	7.5YR4/1	45	50	5								15	70	15			siltstone	Rhinestreet
0782	1170	1180	7.5YR4/1	55	40	5								10	75	15			shale	
0783	1180	1190	7.5YR4/1	55	40	5								10	75	15			shale	
0784	1190	1200	7.5YR4/1	55	40	5								10	75	15			shale	
0785	1200	1210	7.5YR4/1	55	40	5								10	70	20			shale	
0786	1210	1220	7.5YR4/1	55	35	5		5						10	65	25			shale	
0787	1220	1230	N6.8	40	10	5		45						20	60	20			limshale	Mahantango
0788	1230	1240	N6.8	45	15	5		35						20	60	20			shale	"
0789	1240	1250	2.5Y6/.5	45	20	5		30						25	60	20			"	"
0790	1250	1260	2.5Y6/.5	50	20	5		25						20	60	20			"	"
0791	1260	1270	2.5Y6/.5	45	20	5		30						20	60	20			"	"
0792	1270	1280	2.5Y6/.5	45	20	5		30						25	65	10			"	"
0793	1280	1290	2/5Y6/.5	45	20	5		30						20	65	15			"	"
0794	1290	1300	N6.6	55	15	5		25						25	55	20			"	"
0795	1300	1310	N6.6	55	15	5		25						25	50	25			"	"
0796	1310	1320	5Y6/.5	50	15	5		30						25	60	15			"	"
0797	1320	1330	5Y5/.5	50	15	5		30						25	60	15			"	"
0798	1330	1340	5Y6/.5	55	15			30						20	60	20			"	"
0799	1340	1360	5Y6/.5	50	15			35						25	55	15	5		"	"
0800	1360	1378	5Y6/.5	55	15			30						20	60	15	5		shale	Mahantango

B & LE RR #1, Ashtabula, Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1767	512.0		N6.5	85	15	tr													shale	Chagrin
1768	535.0		N6.7	85	15								tr						shale	Chagrin
1769	558.8		N6.5	85	15														shale	Chagrin
1770	751.9		10YR5/.5	75	20	5													shale	Lower Huron
1771	771.3		10YR5/.5	75	20	5													shale	Lower Huron
1772	793.2		N5.2	75	20	5													shale	Lower Huron
1773	817.3		10YR6/.2	75	20	5													shale	Lower Huron
1774	838.5		10YR5/.5	75	20	5													shale	Lower Huron
1775	865.2		N6.6	75	20			5											shale	Java
1776	967.4		N6.7	70	20			10											shale	Java
1777	982.2		10YR3/1	75	20	5													shale	Pipe Creek
1778	982.2		10YR3/1	75	20	5								20	70	10			ash bed	Center Hill
1779	1088.0		N6.7	75	20			5			tr								shale	West Falls
1780	1094.8		N6.7	75	20			5											shale	West Falls
1781	1133.9		N6.5	75	15	tr		10											shale	West Falls
1782	1147.1		10YR5/.7	75	20	5													shale	Rhinestreet
1783	1173.2		10YR4/1	60	35	5													sltshale	Rhinestreet
1784	1192.3		N5.3	80	15	5									15	55		30	ash bed	Belpre
1785	1194.4		10YR6/.5	80	10	10													shale	Rhinestreet
1786	1322.8		10YR5/.5	70	30	tr													shale	Marcellus
1787	1338.7		10YR4/.5	60	15	5		20											shale	Marcellus
1788	1357.5		10YR4/1	70	15	tr		15											shale	Marcellus
1789	1374.0		10YR4/1	20	10	tr		70	tr										limshale	Onondago

GERALD #1, Astabula Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1589	55.4		N6.5	90	10	tr								10	65	15		10	shale	Chagrin
1590	74.6		10YR6/.9	70	30														shale	"
1591	100.5		5Y6.5/.5	65	35		tr							15	55	20		10	sltshale	"
1592	121		5Y6.5/.5	75	25														shale	"
1593	141.7		N6.7	80	20	tr								15	55	10		20	shale	"
1594	160.6		N5.5	80	20	tr													shale	"
1595	180.3		5B6/.5	95	5	tr													shale	"
1596	193.0		10YR6/1	30	25	5		40						15	50	20		15	limshale	"
1597	200		N5.5	80	20	tr								15	50	20	5	10	shale	"
1598	221		N5.8	75	25	tr							tr						"	"
1599	240.1		5B6/.5	75	20	5								10	60	20		10	"	"
1600	260.0		N6.8	80	20	tr													"	"
1601	287		5Y6.5/.5	80	20	tr								15	55	20		10	"	"
1602	301.8		N5.8	75	25	tr								15	55	20		10	"	"
1603	321.2		N5.7	80	15	5							tr						shale	"
1604	340.2		N8.0	30	45	5			20					20	50	15	10	15		"
1605	360.2		N5.1	85	15	tr													shale	"
1606	380.2		N5.4	80	15	5								10	55	25		10	"	"
1607	401.0		N5.8	80	15	5													"	"
1608	420		5B6/.5	85	15	tr								15	55	20		10	"	"
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]													"	"
1610	460.2		5B6.5/.5	85	15	tr								20	60	[illegible]			"	"
1611	480.1		5B7/.5	85	15														"	"
1612	500		5B7/.7	80	20									15	55	20		10	"	"
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]													"	"

GERALD #1, Astabula Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1617	600		N5.8	85	15	tr													shale	Chagrin
1618	620		5B7/.75	85	15														shale	Chagrin
1619	640		5B6.5/.5	85	15									15	50	30		5	shale	Lower Huron
1620	660		N7.0	60	40								tr						sltshale	"
1621	680		10YR5/.5	70	25	5								10	60	25		5	shale	"
1622	700.0		10YR5/.5	70	25	5													"	"
1623	720.0		N6.3	85	15	tr								15	60	20		5	"	"
1624	740.0		N5.0	75	20	5													"	"
1625	760.0		10YR6/.8	70	25	5								15	55	30			"	"
1626	780.0		5B7/1	85	15														"	"
1627	800.0		10YR5/.5	75	20	5								15	65	20			"	"
1628	820.0		5B7/1	70	25	5													shale	"
1629	840.0		10YR4/.8	60	35	5								15	70	15			sltshale	"
1630	860.0		10YR6/.5	70	25	5							tr						shale	"
1631	880.0		10YR5/.8	70	25	5								10	60	25		5	"	"
1632	900.0		10YR5/1	65	30	5													"	"
1633	920.0		N6.5	75	20	5							tr	5	55	35		5	"	"
1634	940.0		10YR4/1	75	25	tr							tr						"	"
1635	960.0		10YR5/1	70	25	5								10	60	30			"	"
1636	980.0		10YR5/.5	70	25	5													"	"
1637	1000.0		10YR6/.5	70	25	5						tr		15	60	25			"	"
[illegible]																				
[illegible]	1040.0		[illegible]																	
1640	1060.0		10YR4/1	45	50	5													sltshale	Java
1641	[illegible]		5B7/1	70	25			5						15	55	[illegible]			[illegible]	Java
[illegible]																				

GERALD #1, Astabula Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1645	1160.0		N5.0	70	25	5								15	60	25			shale	Java
1646	1179.0		10YR3/1	60	35	5													sltshale	Pipe Creek
1647	1200.0		5B7/1	75	20			5						20	50	30			shale	Rhinestreet
1648	1220.0		N5.0	85	15			tr											"	"
1649	1240.0		N6.1	75	25	tr								20	50	30			"	"
1650	1263.0		5B7.2/1	75	20			5					tr						"	"
1651	1280.0		10YR5/1	70	25	5								20	55	25			"	"
1652	1300.0		N6.5	60	25	5		10											shale	
1653	1320.0		10YR4/1	60	35	5								15	65	20		tr	sltshale	Rhinestreet
1654	1340.0		N6.1	65	15	tr		20											shale	Mahantango
1655	1360.0		N6.5	80	15			5						30	50	20			shale	"
1656	1380.0		N6.0	70	15	tr		15											shale	"
1657	1400.0		N6.0	50	10	5		35						25	55	20			limshale	
1658	1420.0		10YR6/.5	40	15	5		40											limshale	Mahantango
1659	1440.0		10YR4/.5	45	15	5		35						25	60	15			limshale	Marcellus
1660	1460.0		10YR4/1	45	20	5		30	tr					15	65	20			shale	Marcellus

DA-201, Lake Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1685	90.3		N6.7	75	20	tr							5	10	50	30		10	shale	Chagrin
1686	120.1		N6.7	70	30	tr							tr	10	50	30		10	shale	"
1687	149.7		N6.7	70	30	tr								15	50	25		10	shale	"
1688	180		N6.5	80	20									20	65	15			shale	"
1689	210.5		10YR6/.5	65	35									15	55	20		10	sltshale	"
1690	240.1		N6.5	80	20							tr	tr	20	50	30			shale	"
1691	270.3		10YR6/.5	60	40	tr								5	45	40		10	sltshale	"
1692	300.1		10YR7/.5	55	45	tr								10	55	25		10	sltshale	"
1693	330.1		N6.7	75	25	tr								15	45	35		5	shale	"
1694	360.1		N6.5	80	20	tr								10	50	30		10	shale	"
1695	390.2		10YR6/1	55						45				10	45	25		20	nodule	"
1696	420.1		10YR7/.5	65	30	5								10	50	30		10	shale	"
1697	450.2		N5.8	65	35	tr								10	50	30		10	sltshale	"
1698	480.0		N6.0	85	15	tr							tr	10	50	35		5	shale	"
1699	510.2		N5.8	75	25	tr								10	50	35		5	shale	"
1700	540.2		10YR6/1	50	45	tr							5	10	45	35		10	sltshale	"
1701	570.3		N5.5	75	20	5								10	55	25		10	shale	"
1702	600.0		N6.7	90	10	tr								15	45	35		5	"	"
1703	630.0		N5.0	75	20	5								20	50	30			"	"
1704	660.0		N6.7	75	25	tr								15	45	30		10	"	"
1705	690.1		N6.7	80	15								5	15	40	35		10	"	"
1706	720		N6.5	80	20	tr								15	60	20		5	"	"
1707	752.2		10YR5/.5	75	25	5								25	60	15		5	"	"
1708	780.2																			
1709	810.1		N6.5	90	10	tr								20	55	25			"	"
1710	840.1		N5.2	75	20	5								25	50	25			"	"
1711	[illegible]																			
1712	[illegible]																			

DA-201, Lake Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1713	930.2		10YR5/.5	70	25	5								20	60	20			shale	Chagrin
1714	960.2		10YR5/.5	70	25	5								20	60	20			"	Chagrin
1715	990.7		10YR4/.5	65	30	5								10	60	20		10	"	Chagrin
1716	1020		10YR5/.5	70	25	5								10	65	15		10	"	Lower Huron
1717	1050.2		10YR5/.5	65	30	5								15	60	25			"	"
1718	1080.1		10YR5/.5	70	25	5							tr	10	65	25			"	"
1719	1110.6		10YR5/.5	65	30	5							tr	10	65	25			"	"
1720	1140		10YR5/.5	75	20	tr							5	10	65	25		tr	"	"
1721	1170.1		10YR5/.5	70	25	5								10	65	25			"	"
1722	1200.2		10YR7/.5	75	25	tr								10	60	30			"	"
1723	1230.2		10YR5/.5	75	20	5								10	60	30			"	"
1724	1260.1		10YR5/.5	70	25	5								10	65	25			"	"
1725	1290.2		N7.0	75	25									20	60	20			"	Lower Huron
1726	1320.4		10YR5/.5	70	25	5						tr		10	65	25			"	Java
1727	1350.0		10YR6/.5	80	20	tr								15	65	20			"	Java
1728	1361.7		10YR2/1	65	25	5		5						10	70	20			"	Java
1729	1380.2		N7.0	75	20			5					tr	20	55	25			"	Rhinestreet
1730	1409.7		10YR6/.5	75	20	5						tr		10	65	25			"	Rhinestreet
1731	1440.1		10YR6/1	60	25	5		10						20	70	10			"	Rhinestreet
1732	1470.1		N6.7	75	15			10						25	50	25			"	Mohantango
1733	1500.9		N6.7	60	15	tr		25						20	60	20			"	Mahantango
1734	1530.1		N6.0	75	15	tr		10						25	50	25			"	Mahantango
1735	1560.1		10YR6/.5	75	20	tr		5						25	55	20			"	Mahantango
1736	1590.2		10YR4/.5	75	20			5						25	60	15			"	Marcellus
1737	1607.8		10YR4/.5	65	20	10		5			tr			10	55	20	15		shale	Marcellus

Cleveland #1, Cuyahoga Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent) Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Clay Mineralogy Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1346	101.7		N6.9	80	20	tr								10	50	25		15	shale	
1347	116		N6.7	80	20	tr								10	50	30		10	shale	
1348	130.5		N6.7	75	25	tr								5	60	25		10	shale	
1349	138.3		10YR5/.5	65	35	tr								5	60	25	tr	10	sltshale	
1350	151		10YR5/.5	65	25	5						5		5	50	40		5	shale	
1351	165.3		N6.5	80	20	tr								5	50	25		20	shale	
1352	180		10YR5/.5	65	35	tr								10	60	15	5	10	sltshale	
1353	188.5		10YR5/.5	60	35	5								5	60	20	5	10	sltshale	
1354	285		10YR4/1	60	35	5								5	50	40	tr	5	sltshale	Upper Huron
1355	350		10YR5/.5	70	25	5					tr	tr		5	50	40	tr	5	shale	Upper Huron
1356	361		N5.6	80	15	5								5	50	40	tr	5	shale	Upper Huron
1357	391		N6.8	80	15	tr							5	20	45	35			shale	Middle Huron
1358	413		N6.8	85	15									15	50	35			shale	Middle Huron
1359	422		10YR5/.5	70	25	5								15	60	20	5		shale	Middle Huron
1360	432		10YR5/.7	65	30	5								10	55	35			shale	Middle Huron
1361	447		N5.5	80	15	5							tr	15	55	30			shale	Middle Huron
1362	481		N6.9	85	15								tr	15	50	35			shale	Middle Huron
1363	490		N5.5	75	20	5							tr	15	60	25			shale	Lower Huron
1364	494		10YR4/.7	70	25	5								10	55	35			shale	"
1365	500		10YR4/.7	55	40	5								10	60	15	15		sltshale	"
1366	509		10YR4/1	65	30	5								15	55	30			shale	"
1367	546		N7.5	75	25	tr								15	50	35			shale	"
1368	559		10YR4/.7	65	30	5								15	60	25			shale	"
1369	590		10YR4/1	60	35	5								10	60	30			sltshale	"
1370	602		10YR4/.5	70	25	5						tr		10	65	25			shale	"
1371	632		10YR5/.5	65	25	10								10	60	25	5		shale	"
[illegible]	[illegible]		[illegible]	[illegible]										[illegible]					[illegible]	"
1372	701.8		10YR[illegible]/.5	75	[illegible]	5								10	60	25	5		shale	Lower Huron

Cleveland #1, Cuyahoga Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1374	703		N8.0	20		5		75											limstone	Lower Huron
1375	705		10YR3/1	70	25	5							tr	15	60	15	10		shale	Lower Huron
1376	712		N7.5	70	25	tr		5						15	65	20			shale	Java
1377	727.5		10YR5/.5	75	25									15	50	35			shale	Java
1378	737		N6.9	80	20							tr		15	55	30			shale	Java
1379	750		10YR5/.7	75	20	5						tr		10	55	35			shale	Java
1380	813		N6.8	70	15	tr		15						30	45	25			shale	Mahantango
1381	874		N6.8	55	15	tr		30						25	55	20			shale	Mahantango
1382	904		N6.4	60	15	tr		25						25	50	25			shale	Mahantango
1383	923		N6.4	65	15	5		15						25	55	20			shale	Mahantango

B-19, Erie Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1384	11.0		10YR4/.5	75	20	5								5	60	35			shale	
1385	19.7		10YR4/.6	65	30	5								10	55	35			"	
1386	30.1		N6.8	75	20	5								5	45	45		5	"	
1387	39.7		10YR5/.5	80	20	tr								5	45	45		5	"	
1388	45.6		N5.1	85	tr						10	tr	5	5	45	45		5	"	Upper Huron
1389	51.1		10YR5/.5	75	20	tr							5	5	45	45		5	"	"
1390	60.1		10YR4/.5	65	30	5								5	55	40		tr	"	"
1391	70.8		10YR5/.5	65	25	5							5	10	50	40			shale	"
1392	90.2		10YR5/.5	60	35	5								10	55	35			sltshale	"
1393	110.1		10YR5/.5	50	45	5								10	55	35			sltshale	"
1394	118.1		N5.1	70	20	5						5		10	50	40			shale	Upper Huron
1395	140.2		N6.5	70	25	5								10	50	40			"	Middle Huron
1396	140.3		N4.1	75	20	5								10	55	35			"	"
1397	153.7		N6.8	80	20	tr								10	55	30		5	"	"
1398	167.3		10YR5/.5	70	25	5						tr		10	60	30		tr	"	"
1399	175.6		10YR4/.5	65	25	10						tr		10	60	30			shale	Middle Huron
1400	195.9		10YR5/.5	60	35	5								10	60	30			sltshale	Lower Huron
1401	205.2		10YR5/.5	60	35	5								10	55	35			"	"
1402	218.3		10YR5/.5	60	35	5								10	55	35			"	"
1403	227.4		10YR4/.5	55	40	5								5	70	20		5	"	"
1404	236.3		10YR5/.5	60	35	5					tr			10	60	30		tr	sltshale	"
1405	246.4		10YR5/.5	70	25	5								10	60	30			shale	"
1406	254.5		10YR5/.5	65	30	5								10	60	30			shale	"
1407	265.2		10YR5/.5	60	35	5						tr		5	65	30			sltshale	Lower Huron
1408	276.0		N6.8	65	35									10	60	30			sltshale	Olentangy
1409	280.4		N7.0	70	30	tr								10	55	30		5	shale	Olentangy
1410	284.6		N6.6	65	25	tr	10							20	40	40			shale	Olentangy
1411	287.8		N6.6	55	15	5	25							15	55	30			shale	Mahantango

B-19, Erie Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1412	297.7		N6.6	65	15	tr		20						20	55	25			shale	Mahantango
1413	309.0		N6.6	65	15	5		15						20	60	20			shale	Mahantango
1414	328.1		N6.6	55	15	tr		30						20	50	30			shale	Mahantango
1415	338.1		N6.6	55	15	5		25						20	55	25			shale	Mahantango

McGuire #20149T, Lorrain Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1946	401.3		10YR5/.5	70	25	5							tr						shale	Cleveland
1947	420.3		N5.0	70	25	5							tr						shale	Chagrin
1948	440.3		N6.9	75	25								tr						shale	"
1949	460.2		N6.9	75	20								5						shale	"
1950	480.3		N7.0	70	15								15						shale	"
1951	500.1		N5.7	70	25	5							tr						shale	"
1952	523.1		5B6/.5	85	15	tr							tr						shale	"
1953	541.6		N5.5	70	20	5							5						shale	"
1954	560.2		N5.5	75	20	5							tr						shale	"
1955	581.5		N6.3	80	15	5							tr						shale	"
1956	604.1		N6.5	75	25						tr		tr						shale	"
1957	627.9		N5.1	70	20	10							tr						shale	"
1958	642.1		N6.8	75	20	tr	tr						5						shale	"
1959	660.1		N5.8	75	20	5													shale	"
1960	680.2		N5.8	75	20	5													shale	"
1961	700.0		N5.6	75	20	5													shale	"
1962	720.3		N5.0	65	25	5							5						shale	"
1963	740.3		N5.8	65	30	tr							5						siltshale	"
1964	760.6		10YR5/.5	60	30	5							5						siltshale	Lower Huron
1965	780.4		10YR5/.8	55	40	5							tr						siltshale	"
1966	800.2		10YR4/.8	65	30	5						tr	tr						siltshale	"
1967	820.3		10YR5/.8	65	30	5		tr					tr						siltshale	"
1968	840.2		10YR5/.8	60	35	5					tr		tr						siltshale	"
1969	860.3		10YR5/.8	70	25	5					tr		tr						shale	"
1970	880.3		10YR5/.8	65	30	5					tr		5						siltshale	"
1971	900.0		N7.0	80	15	tr							5						shale	"
1972	920.3		10YR5/.8	55	40	5							tr						siltshale	"
1973	940.3		10YR4/.8	55	30	10		5					tr						siltshale	"
1974	960.2		N7.0	75	25			tr					tr						shale	"
1975	980.6		N5.6	75	20	5	tr					tr	tr						shale	"

McGuire #20149T, Lorrain Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1976	1000.2		10YR5/1	65	30	5					tr		tr						Sltshale	Lower Huron
1977	1020.2		N7.0	70	30								tr						Sltshale	"
1978	1040.2		10YR4/1	65	30	5					tr		tr						Sltshale	"
1979	1060.2		10YR4/.5	75	20	5							tr						Shale	"
1980	1080.3		10YR4/1	65	30	5					tr		tr						Sltshale	"
1981	1100.0		N6.8	75	20	5							tr						Shale	Java
1982	1120.5		N5.9	80	20						tr		tr						Shale	"
1983	1140.0		N7.0	75	15			10					tr						Shale	"
1984	1160.2		10YR5/.5	75	20	5							tr						Shale	"
1985	1180.1		N6.1	70	15	tr		10					5						Shale	Java
1986	1200.1		N6.8	65	15	5		15											Shale	Rhinestreet
1987	1220.1		N6.8	50	10	5		35											Limshale	"
1988	1240.2		N6.5	75	20	tr		5											Shale	"
1989	1260.3		10YR6/.5	65	15	tr		20					tr						Shale	"
1990	1279.7		10YR4/1	65	25	5		5					tr						Shale	Rhinestreet

A. A. Meleski, Trumbull Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2061	1517.6		N5.8	70	20	5							5						Shale	Chagrin
2062	1552.0		N5.8	80	15	5							tr						Shale	"
2063	1571.0		10YR4/.5	65	30	5							tr						Siltshale	"
2064	1590.9		N5.0	80	15	5	tr						tr						Shale	"
2065	1632.7		N5.0	70	20	5						tr	5						Shale	"
2066	1672.5		N6.8	75	20	tr							5						Shale	"
2067	1714.9		N6.7	80	15	5					tr		tr						Siltshale	"
2068	1735.6		10YR5/.5	65	30	5							tr						Shale	"
2069	1774.5		N7.0	80	15	5					tr		tr						Shale	"
2070	1810.7		10YR5/.5	75	20	5						tr	tr						Shale	"
2071	1852.0		N6.8	85	15	tr							tr						Shale	"
2072	1871.9		10YR5/.5	65	25	5						tr	5						Shale	"
2073	1894.1		10YR5/.5	70	25	5							tr						Shale	"
2074	1930.3		N6.8	70	25	5							tr						Shale	"
2075	1971.9		10YR5/.5	20	20	tr						tr	tr						Shale	"
2076	1990.0		10YR6/.5	65	25	5							5						Shale	"
2077	2007.9		N7.0	70	20	5							5						Shale	"
2078	2051.9		10YR5/.5	80	15	tr		tr					5						Shale	Chagrin
2079	2090.1		N5.2	65	25	5					tr	tr	5						Shale	Lower Huron
2080	2110.8		10YR4/.5	70	20	10						tr	tr						Shale	Java
2081	2149.5		N6.8	70	25	5					tr		tr						Shale	Java
2082	2190.9		N7.0	80	20	tr	tr						tr						Shale	Java
2083	2231.0		10YR6/.8	70	20			10					tr						Shale	Angola
2084	2270.1		N7.0	70	25			tr					5						Shale	Angola
2085	2308.8		N5.0	70	25	5							tr						Shale	Angola
2086	2354.3		N7.0	70	25			5					tr						Shale	Angola
2087	2396.5		N7.0	80	20			tr				tr	tr						Shale	Angola
2088	2429.6		N7.0	85	15								tr						Shale	Angola
2089	2474.6		N7.0	70	20			5					5						Shale	Rhinestreet
2090	2514.2		N5.5	75	25	5						tr	tr						Siltshale	"
2091	2536.3		10YR3/1	65	30	5							tr							

A. A. Meleski, Trumbull Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2092	2548.8		10YR5/1	45	45	10	tr					tr							Siltshale	Rhinestreet
2093	2551.9		N5.1	75	10	10	tr					5							ash bed	Belpre
2094	2572.1		10YR3/1	55	25	10		10					tr						Shale	Rhinestreet
2095	2592.8		10YR3/1	60	20	5		15					tr						Shale	Rhinestreet
2096	2613.6		N6.5	75	15	tr		10					tr						Shale	Mahantango
2097	2654.8		N6.0	55	15	tr		30					tr						Limshale	Mahantango
2098	2674.8		10YR3/1	70	20	5		5					tr						Shale	Marcellus
2099	2691.6		10YR5/1	35	15	5		45											Limshale	"
2100	2706.2		10YR3/1	40	20	10	tr	30											Limshale	Marcellus

S-745, Carroll Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
389	2080.2		N7.0	65	35									25	50	10	5	10	Shale	Upper Huron
390	2090.8		N6.0	80	15	5								20	40	15	15	10	"	"
391	2100.0		N7.0	65	35									20	50	15		15	"	"
392	2110		N6.2	75	20	5								25	45	20		10	"	"
393	2120.0		N6.2	80	15	5								20	45	15	15	5	"	"
394	2130.0		N7.0	60	40									20	40	20	tr	20	"	"
395	2140.0		N6.2	75	20	5								20	45	20	5	10	"	"
396	2150.0		N6.1	80	15	5								20	40	20	10	10	"	"
397	2160.5		N6.3	80	15	5								15	50	20	5	10	"	"
398	2170.0		N6.2		15	5								20	50	15	10	5	"	"
399	2180.0		N6.0	80	15	5								15	55	20	5	5	"	"
400	2190		N6.2	80	20									20	50	25	5		"	"
401	2200.0		10YR4/.2	70	25	5								15	50	30	5		"	"
402	3080.3		N3.8	60	35	5								10	65	15	10		"	Rhinestreet
403	3090.4		N6.2	70	25	5								20	60	20	tr		"	"
404	3100		N3.8	50	45	5								15	70	5	10		"	"
405	3111.0		10YR4/.2	60	35	5								10	60	15	15		"	"
406	3120.0		10YR3/.2	60	35	5								10	60	25	5		"	"
407	3130.0		10YR4/.2	65	30	5								15	55	20	10		"	"
408	3139.0		10YR4/.2	65	30	5								15	70	10	5		"	"
409	3150.0		10YR4/.2	60	35	5								15	65	15	5		"	"
410	3160.0		N6.0	55	15	5		25						20	65	10	5		"	Olentangy
411	3170.0		N6.0	70	20	5		5						25	55	20	tr		"	"
412	3180.8		N6.1	70	20	5		5						30	50	15	5		"	"
413	3189.6		N6.0	70	20	5		5						30	45	15	10		"	"

Schockling #1, Noble Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1991	1760.4		N6.1	80	20	tr							tr						Shale	Chagrin
1992	1781.2		N6.1	80	20	tr							tr						Shale	"
1993	1797.7		N6.1	75	20								5						Shale	"
1994	1840.7		N6.0	70	30	tr							tr						Sltshale	"
1995	1873.6		N5.9	75	25	tr													Shale	"
1996	1925.2		N6.9	75	15								10						Shale	"
1997	1962.4		N6.8	65	30								5						Sltshale	"
1998	1999.5		N6.5	80	20								tr						Shale	"
1999	2049.2		N6.8	80	20								tr						Shale	"
2000	2080.7		N6.3	85	15	tr							tr						Shale	Chagrin
2001	3113.7		N6.5	75	20								5						Shale	Lower Huron
2002	3137.8		10YR4/.5	75	20	5							tr						Shale	"
2003	3174.1		N6.5	85	15	tr							tr						Shale	"
2004	3223.4		N5.8	75	20	5						tr	tr						Shale	"
2005	3256.9		N6.9	80	20	tr							tr						Shale	"
2006	3299.1		N5.0	75	20	5	tr						tr						Shale	"
2007	3312.2		N4.1	70	25	5							tr						Shale	"
2008	3336.5		10YR5/.5	75	20	5													Shale	"
2009	3353.9		10YR4/.5	80	20	tr							tr						Shale	"
2010	3398.7		10YR5/.5	70	25	5							tr						Shale	"
2011	3428.1		10YR4/.8	70	20	5					5		tr						Shale	"
2012	3456.6		10YR4/1	70	25	5							tr						Shale	Lower Huron
2013	3490.3		N6.9	75	25			tr					tr						Shale	Java
2014	3536.8		N6.5	75	25	tr		tr					tr						Shale	Java
2015	3567.0		N6.8	85	15								tr						Shale	Java

Schockling #1, Noble Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2016	3621.3		10YR3/1	75	20	5		tr					tr						Shale	Pipe Creek
2017	3658.5		N6.9	70	25			5					tr						Shale	Angola
2018	3680.1		N6.8	75	20			5					tr						Shale	"
2019	3719.2		N5.9	75	20	tr							5						Shale	"
2020	3757.0		N4.8	75	20	5							tr						Shale	
2021	3773.8		N4.0	75	20	5							tr						Shale	Angola
2022	3799.7		10YR3/1	75	20	5							tr						Shale	Rhinestreet
2023	3840.5		10YR4/.5	75	25	tr	tr						tr						Shale	"
2024	3856.2		N4.0	75	20	5							tr						Shale	"
2025	3897.2		10YR6/.5	70	25	5							tr						Shale	"
2026	3919.2		10YR5/.5	80	15	5		tr					tr						Shale	"
2027	3936.3		10YR3/1	65	30	5							tr						Siltshale	"
2028	3973.9		N5.5	80	20	tr	tr					tr	tr						Shale	"
2029	3998.1		10YR5/.5	70	25	5	tr						tr						Shale	"
2030	4017.6		10YR3/1	50	45	5							tr						Siltshale	"
2031	4034.3		10YR4/.5	60	30	5		5					tr						Siltshale	"
2032	4034.3		3Y6.5/2	10	35	5		50											Siltshale	"
2033	4056.8		10YR2/1	80	20	10					tr		tr						Shale	"
2034	4072.3		10YR2/1	65	30	5							tr						Siltshale	"
2035	4093.0		10YR2/1	60	20	5		15					tr						Shale	"
2036	4112.3		N4.7	50	20	tr		30			tr		tr						Limshale	Marcellus
2037	4128.4		N4.0	70	20	tr		10					tr						Shale	Marcellus

R-109, Washington Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
414	3490		N6.5	80	20									20	60	10	5	5	Shale	Middle Huron
415	3500.1		N7.3	40	50			10						15	50	10	5	20	Siltstone	Middle Huron
416	3510.4		N4.1	70	25	5								15	55	15	5	10	Shale	Lower Huron
417	3520.0		N4.3	70	25	5								20	55	10	10	5	"	"
418	3535		N6.0	75	20	5								15	55	15	10	5	"	"
419	3530.0		N4.3	70	25	5								15	50	25	10		"	"
420	3532.3		N4.0	70	25	5								20	60	15	5		"	"
421	3540.3		N4.0	70	25	5								20	55	15	10		"	"
422	3550.1		N6.0	65	30	5								15	50	25	5		"	"
423	3559.6		N3.5	65	30	5								20	50	25	5		"	"
424	3570.9		N4.5	70	25	5								15	50	30	5		"	"
425	3580.7		N4.0	65	30	5								10	55	20	15		"	"
426	3590		N4.5	70	25	5								15	50	20	15		"	"
427	3600.5		N4.5	70	25	5								15	50	25	10		"	"
428	3609.0		N4.0	65	30	5								20	50	30			"	"
429	3620.6		N6.0	70	25	5								20	40	25	15		"	"
430	3630.4		N4.0	75	20	5								20	45	30		5	"	"
431	3640		N6.0	70	25	5								20	55	15		10	"	"
432	3650		N5.6	75	20	5								15	60	20		5	"	"
433	3660.9		N6.2	75	25									20	50	20	5	5	"	"
434	3670		N4.3	70	25	5								15	55	15	15		"	"
435	3680		N6.3	75	20	5								15	55	15	10	5	"	"
436	3690		10YR6/.2	60	35	5								10	55	20	5	10	"	"
437	3700.4		N3.8	55	40	5								10	60	30			"	"
438	3710		N6.0	80	15	5								15	50	15	10	10	"	"

Mitchell Energy, Gallia Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1849	1848.8		N4.0	75	20	5							tr						shale	
1850	1875.1		N6.9	65	30								5						sltshale	Brea
1851	1893.6		5YR6/1	70	30								tr						sltshale	Bedford
1852	1912.7		N6.5	75	20								5						shale	Bedford
1853	1931.6		5YR6/1	75	25								tr						shale	Bedford
1854	1951.1		N5.8	75	25								tr						shale	Bedford
1855	1969.2		N6.5	75	25								tr						shale	Bedford
1856	1993.7		10YR4/1	70	30	tr						tr							sltshale	Cleveland
1857	2011.7		10YR4/1	65	30	5							tr						sltshale	Cleveland
1858	2035.3		N6.0	75	20								5						shale	Chagrin
1859	2051.7		N5.2	75	20	5							tr						"	"
1860	2072.9		N6.5	80	15								5						"	"
1861	2091.1		N6.5	80	20														"	"
1862	2112.2		N4.9	80	15	5							tr						"	"
1863	2132.6		N6.8	80	15								5						"	"
1864	2154.5		N5.8	80	20	tr							tr						"	"
1865	2173.2		N4.8	75	20	5						tr	tr						"	"
1866	2191.2		N6.8	80	20								tr						"	Chagrin
1867	2216.5		N5.5	75	20	5							tr						shale	Upper Huron
1868	2229.5		10YR5/.5	60	35	5							tr						sltshale	"
1869	2249.3		N5.6	75	20	5							tr						shale	"
1870	2271.2		10YR5/.8	55	40	5							tr						sltshale	"
1871	2289.6		N5.5	65	25	5							5						shale	"
1872	2315.0		10YR5/.8	65	30	5							tr						sltshale	"
1873	2334.1		N5.0	75	20	5						tr	tr						shale	"
1874	2349.8		N4.7	75	20	5							tr						shale	Upper Huron
1875	2370.4		N4.5	75	20	5					tr	tr	tr						shale	Middle Huron
1876	2390.2		N5.2	75	15	10							tr						shale	Middle Huron

Mitchell Energy, Gallia Co., OH

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1877	2412.2		N5.2	70	20	5							5						shale	Middle Huron
1878	2434.6		N6.2	80	15	5							tr						"	"
1879	2455.1		N5.8	70	20	5							5						"	"
1880	2470.7		10YR6/.5	75	20	5					tr		tr						"	"
1881	2493.1		N5.8	80	15	5													"	"
1882	2511.2		N6.2	85	15	tr							tr						"	"
1883	2533.4		N6.2	85	15	tr							tr						"	Middle Huron
1884	2553.9		10YR5/.5	70	25	5							tr						"	Lower Huron
1885	2572.5		N6.2	75	15	5							5						shale	"
1886	2591.9		10YR4/.8	70	30														sltshale	"
1887	2613.4		10YR5/.8	65	30	5													sltshale	"
1888	2635.2		N7.0	75	25						tr		tr						shale	"
1889	2651.8		10YR5/1	70	25	5							tr						shale	"
1890	2676.0		N6.8	80	20	tr							tr						shale	"
1891	2697.2		10YR4/1	65	30	5							tr						sltshale	"
1892	2715.6		10YR4/1	65	30	5													sltshale	"
1893	2732.3		10YR5/1	70	25	5					tr		tr						shale	"
1894	2756.4		10YR5/.5	75	20	5													shale	"
1895	2767.2		10YR5/.5	65	30	5					tr		tr						sltshale	Lower Huron

MERC-1, Monongolia Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1158	7170.1		N5.5	30	5			65						15	70	15			Limshale	Mahantango
1159	7180.2		N6.0	25	5			70						20	75	5			Limshale	"
1160	7190.0		N5.1	55	20	5		20						25	65	10			Shale	"
1161	7200.1		N4.8	40	10	tr		50						25	60	15			"	"
1162	7209.3		N5.5	45	15	5		20			15			25	60	15			"	"
1163	7210.0		N5.3	50	15	tr		35	tr					25	65	10			"	"
1164	7220.0		N5.3	60	20			20						25	50	25			"	"
1165	7230.0		10YR4/.5	65	30	5								20	60	20			"	"
1166	7240.0		N3.0	70	20	5		5						20	65	15			"	"
1167	7250.2		10YR4/.5	80	20	tr								20	60	20			"	"
1168	7260.0		N4.1	75	20	5								20	55	25			"	"
1169	7270.1		N4.1	65	25	5		5						20	55	25			"	"
1170	7280.0		N4.1	75	20	5								20	60	20			"	"
1171	7290.0		N4.5	75	20	5								20	60	20			"	"
1172	7300.0		10YR4/.5	70	25	5								20	60	20			"	"
1173	7310.1		N4.5	75	25	tr								20	65	15			"	"
1174	7320.0		N4.5	75	20	5								15	60	25			"	"
1175	7330.0		N4.5	75	20	5								20	55	25			"	"
1176	7340.0		N3.0	65	25	5		5						15	65	20			Shale	"
1177	7340.8		10YR6/.5	5	5	tr		90											Limstone	"
1178	7350.0		10YR4/1	65	25	5		5						15	65	20			Shale	"
1179	7354.8		10YR4/.5	25	10	5		60	tr		tr			20	65	15			Limshale	"
1180	7360.0		N3.0	60	30	5		5						15	75	10			Shale	"
1181	7370.0		N3.0	65	25	5		5						15	70	15			Shale	"
1182	7380.2		10YR3/.5	70	25	5		tr						15	60	25			Shale	"

MERC-1, Monongolia Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1183	7387.5		N6.9	10				90			tr			30	70				Limstone	Mahantango
1184	7390.0		N3.0	70	25	5								10	65	25			Shale	"
1185	7392.9		10YR6/.5	5	5	tr		90						30	70				Limstone	"
1186	7400.0		N3.0	75	20	5								10	65	25			Shale	"
1187	7410.1		N3.0	75	20	5								10	65	25			"	"
1188	7420.0		10YR3/.5	40	20	5		35	tr					5	65	30			"	"
1189	7430.0		N3.0	70	20	5		5						5	65	30			"	"
1190	7440.0		N3.0	70	20	5		5						5	70	25			"	"
1191	7450.0		10YR2/.5	55	25	5		15	tr						75	25			"	"
1192	7459.9		10YR3/.5	5	5			90							90	10			Limstone	"
1193	7470.0		10YR2/.5	65	25	5		5							75	25			Shale	Marcellus
1194	7480.0		10YR2/.5	60	25	5		10							80	20			Shale	Marcellus
1195	7490.0		10YR2/.5	40	40	10		10							80	20			Shale	Marcellus
1196	7500.0		N5.3	tr	5	5		90											Limstone	Onondaga
1197	7510.2		10YR6/1	tr	5	5		85	5	5	tr				85	15			Limstone	Onondaga

E-P #1, Wetzel Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1790	6103.7		N4.8	80	15	5								25	60	15			Shale	Rhinestreet
1791	6125.6		10YR3/.5	70	20	10								25	60	15			"	"
1792	6145.1		10YR5/.5	70	25	5								20	65	15			"	"
1793	6163.4		10YR3/.5	75	20	5								20	60	20			"	"
1794	6183.2		N4.8	70	20	5							5	20	60	20			"	"
1795	6216.9		10YR4/.5	75	20	tr							5	15	65	20			"	"
1796	6226.1		N4.8	70	25	tr		5						25	55	20			"	"
1797	6256.8		10YR4/1	70	25	5								15	65	20			"	"
1798	6268.9		10YR2/1	70	25	5					tr		tr	15	65	20			"	"
1799	6290.5		N5.0	70	20	5		tr					5	20	60	20			"	"
1800	6309.0		10YR5/.3	65	25	10								15	60	25			"	"
1801	6322.4		N5.8	65	25	5		5						20	60	20			"	"
1802	6341.7		N6.1	75	20			5					tr	25	60	15			"	"
1803	6360.9		N6.5	80	15			5					tr	25	65	10			"	"
1804	6384.6		N6.1	80	20	tr		tr						25	55	20			"	"
1805	6401.9		N5.8	80	20	tr								20	60	20			"	"
1806	6435.4		10YR3/.5	65	30	5					tr		tr	15	65	20			"	"
1807	6448.5		10YR4/.8	75	20	5							tr	20	60	20			"	"
1808	6470.9		10YR4/.8	55	30	5		10					tr	15	65	20			"	"
1809	6493.5		10YR4/.8	35	35	10		20					tr	15	75	10			Siltshale	Geneseo
1810	6507.7		10YR2/1	45	50	5		tr			tr		tr	15	70	15			Siltshale	Geneseo
1811	6528.6		N3.5	35	15	10		40						10	70	20			Limshale	Mahantango
1812	6544.8		10YR2/.5	35	15	5		45						15	65	20			Limshale	"
1813	6566.0		N4.5	40	20	5		35					tr	15	70	15			Limshale	"
1814	6594.4		10YR2/.5	65	20	5		5			tr		5		80	20			Shale	Marcellus
1815	6605.7		10YR 2/.5	65	25	5							5		75	25			Shale	"
1816	6622.5		N2	55	30	10		5			tr		tr		80	5	15		Shale	"

11940, Jackson Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
79	3410		N4.1	75	20	5								20	55	25	tr		Shale	Middle Huron
80	3420.6		N5.1	75	20	5								15	60	25			"	"
81	3430		N5.0	75	20	5								10	55	30		5	"	"
82	3439.1		N4.5	75	20	5								15	50	25	5	5	"	"
83	3450.4		N5.0	75	20	5								15	45	20	10	10	"	"
84	3470		N4.3	65	30	5								15	55	25	tr	5	"	"
85	3480		N4.7	75	20	5								10	55	25		10	"	"
86	3489.0		N7.0	55	40	5								15	45	15	5	20	Sltstone	"
87	3497.8		N7.0	75	25									15	45	15	10	15	Shale	"
88	3622.0		N6.5	90	10									20	55	20	5		"	"
89	3630		N5.0	75	20	5								20	55	25			"	"
90	3640		N6.5	65	30	5								10	50	20	5	15	"	"
91	3644.0		N7.0	60	40									10	50	15	5	20	Sltstone	"
92	3654.3		N4.0	70	25	5								20	60	20			Shale	"
93	3660.6		N4.0	70	25	5								15	65	20			"	Lower Huron
94	3680.5		N4.0	70	25	5								20	60	20			"	"
95	3690		N4.0	75	20	5								20	45	25	10		"	"
96	3700		N3.8	75	20	5								20	65	15	tr		"	"
97	3720		N3.8	75	20	5								20	55	25			"	"
98	3730		N6.7	70	20			10						20	55	25			"	"
99	3740		N3.9	75	20	5								20	70	10			"	"
100	3750		N3.9	75	20	5								20	60	20			"	"
101	3758.4		N6.9	75	20			5						15	55	30			"	"
102	3770		N6.5	75	20	5								15	60	15	10		"	"
103	3780		N4.0	75	20	5								20	60	15	5		"	"
104	3790		N6.5	80	15	5								20	55	20	5		"	"

12041, Jackson Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
105	3220		N4.5	80	15	5								15	50	30	5		Shale	Middle Huron
106	3230		N6.0	80	15	5								20	50	25	5		"	"
107	3240		N4.5	80	15	5								15	60	15	10		"	"
108	3250		N6.0	75	20	5								15	55	10	tr	20	"	"
109	3260		N4.5	80	15	5								20	55	10	5	10	"	"
110	3270		N6.5	75	25									25	55	20			"	"
111	3280		N4.8	75	15	10								20	55	25			"	"
112	3290		N6.5	85	15									15	55	20		10	"	"
113	3300		N4.3	80	15	5								20	55	15		10	"	"
114	3310		N5.0	80	15	5								20	50	20		10	"	"
115	3320		N6.5	85	15									15	55	20		10	"	"
116	3330		N6.5	85	15									15	55	20		10	"	"
117	3340		N5.5	80	15	5								15	50	15	10	10	"	"
118	3350		N6.5	80	20									15	50	20	5	10	"	"
119	3360		N5.5	70	20	10								15	50	20	10	5	"	"
120	3380		N6.2	75	20	5								25	45	20	10		"	"
121	3390		N6.5	80	20									25	45	25	5		"	"
122	3400		N5.3	80	15	5								25	50	15	10		"	"
123	3410		N6.7	70	15								15	25	50	25	tr		"	"
124	3420		N6.7	80	15								5	25	50	20	5		"	"
125	3440		N6.7	80	20									25	50	25	tr		"	"
126	3450		10YR5/.3	80	15	5								25	50	25			"	"
127	3460		10YR5/.3	75	20	5								20	55	25			"	Lower Huron
128	3470		10YR4/.3	75	20	5								20	50	30			"	"
129	3480		N6.7	75	20			5						25	45	30			"	"

12041, Jackson Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
130	3490		10YR4/.3	75	20	5								15	55	25	5		Shale	Lower Huron
131	3500		10YR4/.3	70	25	5								15	65	15	5		"	"
132	3510		10YR4/.3	75	20	5								20	55	20	5		"	"
133	3520		10YR4/.3	75	20	5								20	55	15	10		"	"
134	3530		N6.6	80	15	5								20	50	25	5		"	"
135	3540		10YR4/.3	80	15	5								20	55	15	10		"	"
136	3550		10YR4/.3	70	25	5								15	55	15	15		"	"
137	3560		10YR4/.3	75	20	5								15	50	20	15		"	"
138	3570		10YR4/.3	75	20	5								20	55	10	15		"	"
139	3580		10YR4/.3	80	15	5								20	55	10	15		"	"
140	3590		10YR4/.3	75	20	5								15	50	15	20		"	"
141	3600		10YR4/.3	75	20	5								15	55	25	5		"	"
142	3610		N6.7	75	20	5								20	50	15	15		"	"
143	3620		N5.6	75	20	5								15	65	15	5		"	"
144	3640		10YR4/.3	75	20	5								15	55	15	15		"	"
145	3650		N4.3	75	20	5								20	45	20	15		"	Java
146	3660		N6.7	80	20									25	50	20	5		"	Java
147	3670		N6.7	80	20									20	55	15	10		"	Java
148	3680		N6.8	75	20	5								30	40	25	5		"	Java
149	3690		10YR4/.3	85	15									25	50	15	10		"	Java
150	4020		10YR4/.3	65	15	5		15						15	70	10	5		"	
151	4030		10YR4/.3	70	25	5								15	75	5	5		"	

DK Farm #3, Mason Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
484	2670.0		N5.8	80	15	5								15	55	20		10	Shale	Lower Huron
485	2679.0		5.5Y5/.5	75	20	5								10	60	25		5	"	"
486	2690.0		N6.3	80	20									10	65	15		10	"	"
487	2700.0		N5.4	80	15	5								15	60	20		5	"	"
488	2710.0		N6.8	80	20									15	50	25		10	"	"
489	2720.9		10YR5/.5	75	20	5								15	70	10		5	"	"
490	2724.9		10YR4/.5	65	30	5								15	70	15			"	"
491	2730.0		N5.5	70	25	5								10	55	30		5	"	"
492	2735.5		10YR5/.5	65	30	5								15	60	25			"	"
493	2740.6		10YR5/.5	70	25	5								20	65	15			"	"
494	2750.1		N6.6	70	25	5								10	60	25		5	"	"
495	2760.0		10YR6/.5	70	25	5								15	60	25			"	"
496	2770.6		N6.6	70	25	5								20	60	20			"	"
497	2780.0		N6.6	80	20									15	55	25		5	"	"
498	2790.0		N5.5	75	20	5								15	60	20		5	"	"
499	2800.5		N5.0	75	20	5								15	60	15		10	"	"
500	2810.2		N5.5	70	25	5								10	70	15		5	"	"
501	2820.2		N6.6	75	25									15	60	20		5	"	"
502	2830.7		10YR5/.5	65	30	5								15	50	20		15	"	"
503	2840.0		10YR5/.5	65	30	5								15	55	20	5	5	"	"
504	2850.2		N6.5	70	25	5								15	55	20	5	5	"	"
505	2860.1		N7.0	80	20									10	60	15	5	10	"	"
506	2870.1		N6.3	65	25	5		5						15	60	15	5	5	"	"
507	2880.5		N6.6	80	20									15	55	25		5	"	"
508	2890.1		N6.6	70	25	5								15	55	25		5	"	"

Dk Farm #3, Mason Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
509	2900.0		N6.6	70	20	5							5	10	60	20		10	Shale	Lower Huron
510	2910.0		10YR5/.5	65	30	5								10	65	25			"	"
511	2920.4		N6.6	80	20									10	60	20		10	"	"
512	2930.0		10YR4/.5	70	25	5								10	65	15		10	"	"
513	2940.1		10YR4/.5	65	30	5								15	55	25			"	"
514	2950.0		10YR5/.5	75	20	5								15	60	20	5		"	"
515	2960.0		10YR5/.5	65	30	5								10	60	20	5	5	"	"
516	2970.0		10YR4/.5	65	30	5								20	55	20	5		"	"
517	2980.0		10YR4/.5	70	25	5								10	60	25		5	"	"
518	2990.7		N6.3	70	25	5								15	55	25		5	"	"
519	3000.0		10YR5/.5	75	20	5								10	65	20		5	"	"
520	3010.0		N6.6	65	30	5								15	60	25			"	"
521	3020.3		10YR4/.5	65	30	5								15	65	20			"	"
522	3030.8		10YR4/.5	60	35	5								15	70	15			"	"
523	3040.0		N7.0	80	20									30	55	15			"	"
524	3050.0		N5.0	70	25	5								15	60	15		10	"	"
525	3060.0		N6.5	70	25	5								15	60	15		10	"	Java
526	3070.0		N5.5	75	20	5								30	50	20			"	Java
527	3080.2		N6.5	75	25									25	60	15			"	Java
528	3090.0		N7.0	70	25			5						25	55	20			"	Java
529	3100.0		N5.5	75	20			5						20	55	15		10	"	Java
530	3110.3		N6.5	80	20									20	55	20		5	"	Java
531	3120.5		N7.0	75	25									25	55	20			"	Java
532	3130.6		N5.5	75	25									15	55	25		5	"	Java
533	3140.0		N5.4	80	20									5	30	40		25	Ash bed	Center Hill

DK Farm #3, Mason Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
484	2670.0		N5.8	80	15	5								15	55	20		10	Shale	Lower Huron
485	2679.0		5.5Y5/.5	75	20	5								10	60	25		5	"	"
486	2690.0		N6.3	80	20									10	65	15		10	"	"
487	2700.0		N5.4	80	15	5								15	60	20		5	"	"
488	2710.0		N6.8	80	20									15	50	25		10	"	"
489	2720.9		10YR5/.5	75	20	5								15	70	10		5	"	"
490	2724.9		10YR4/.5	65	30	5								15	70	15			"	"
491	2730.0		N5.5	70	25	5								10	55	30		5	"	"
492	2735.5		10YR5/.5	65	30	5								15	60	25			"	"
493	2740.6		10YR5/.5	70	25	5								20	65	15			"	"
494	2750.1		N6.6	70	25	5								10	60	25		5	"	"
495	2760.0		10YR6/.5	70	25	5								15	60	25			"	"
496	2770.6		N6.6	70	25	5								20	60	20			"	"
497	2780.0		N6.6	80	20									15	55	25		5	"	"
498	2790.0		N5.5	75	20	5								15	60	20		5	"	"
499	2800.5		N5.0	75	20	5								15	60	15		10	"	"
500	2810.2		N5.5	70	25	5								10	70	15		5	"	"
501	2820.2		N6.6	75	25									15	60	20		5	"	"
502	2830.7		10YR5/.5	65	30	5								15	50	20		15	"	"
503	2840.0		10YR5/.5	65	30	5								15	55	20	5	5	"	"
504	2850.2		N6.5	70	25	5								15	55	20	5	5	"	"
505	2860.1		N7.0	80	20									10	60	15	5	10	"	"
506	2870.1		N6.3	65	25	5		5						15	60	15	5	5	"	"
507	2880.5		N6.6	80	20									15	55	25		5	"	"
508	2890.1		N6.6	70	25	5								15	55	25		5	"	"

20402, Lincoln Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
152	2660		N5.7	80	20									15	50	20	5	10	Shale	Chagrin
153	2670		N6.2	80	20									15	50	15	10	10	"	"
154	2680		N6.7	75	25									20	55	5	5	15	"	"
155	2690.9		N6.7	55	45									25	45	10	5	15	"	"
156	2700.8		N6.2	85	15									20	40	20	5	15	"	"
157	2709.9		N6.7	80	20									20	50	10	5	15	"	"
158	2720		N5.7	80	15	5								20	55	10	5	10	"	"
159	2730		N6.8	75	25									20	50	15	tr	15	"	"
160	2740		N6.8	70	30									25	45	15	tr	15	"	"
161	2750.6		N6.8	70	30									20	45	20		15	"	"
162	2760		N3.0	75	20	5								15	70	15			"	"
163	2770		N5.7	85	10	5								15	60	15	tr	10	"	"
164	3000		N5.7	70	25	5								15	45	20	5	15	"	Middle Huron
165	3010		10YR5/.2	75	20	5								15	45	25	tr	15	"	"
166	3020.8		N6.5	85	15									15	50	15	5	15	"	"
167	3030		10YR5/.2	75	20	5								15	55	20		10	"	"
168	3040.3		N5.3	75	20	5								10	55	25		10	"	"
169	3050.5		N5.3	80	15	5								10	55	25	tr	10	"	"
170	3059.7		N5.3	75	20	5								15	50	25		10	"	"
171	3070		10YR5/.2	75	20	5								15	45	20		10	"	"
172	3080		N5.3	80	15	5								15	50	20		10	"	"
173	3090		N6.7	80	20									15	60	10		10	"	"
174	3100		N6.7	75	20	5								15	55	15	5	10	"	"
175	3110		N6.5	85	15									10	50	25	5	10	"	"
176	3290.9		N6.5	75	10									15	50	20	5	10	"	Lower Huron
177	3300		10YR5/.2	75	20	5								15	50	20	5	10	"	"
178	3320		N6.5	85	15									15	50	25		10	"	"
179	3330		N5.7	80	15	5								15	55	15	10	5	"	"
180	3340		10YR5/.2	75	20	5								15	60	15	tr	10	"	"
181	3350		10YR4/.2	75	20	5								20	55	10	15		"	"

20402, Lincoln Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
182	3360		10YR4/.2	70	25	5								20	60	10	10		Shale	Lower Huron
183	3370		10YR4/.2	60	35	5								15	60	15	10		"	"
184	3380		N5.7	70	25	5								15	60	20	5		"	"
185	3390		10YR4/.3	75	20	5								20	55	15	10		"	"
186	3399		N5.5	65	30	5								15	55	20	10		"	"
187	3409		10YR4/.3	70	25	5								20	75	5			"	"
188	3420.1		10YR4/.3	80	15	5								15	70	10	5		"	"
189	3439.9		10YR4/.3	70	25	5								15	65	10	10		"	"
190	3450.5		10YR4/.3	75	20	5								20	60	20	tr		"	"
191	3460		10YR4/.3	70	25	5								10	80	10			"	"
192	3470		N6.1	80	15	5								15	70	10	5		"	"
193	3480		N5.7	75	20	5								10	70	10	10		"	"
194	3489.4		10YR4/.3	60	35	5								10	70	10	10		"	"
195	3499.6		10YR4/.3	100										15	55	20	10		"	"
196	3509.8		10YR4/.3	60	30	10								10	70	15	5		"	"
197	3520		10YR4/.3	75	20	5								10	65	10	15		"	"
198	3530.6		10YR4/.3	70	25	5								15	70	5	10		"	"
199	3550		N5.7	80	20									15	60	5	20		"	"
200	3560.6		10YR4/.3	70	25	5								20	60	tr	30		"	"
201	3569.8		10YR4/.3	70	25	5								15	60	15	10		"	"
202	3579.7		10YR4/.3	65	30	5								15	75	5	5		"	"
203	3889.8		10YR4/.3	75	20	5								20	60	10	10		"	Rhinestreet
204	3899.3		10YR4/.3	65	30	5								10	65	15	10		"	"
205	3909-1		N5.3	75	20	5								10	60	10	20		"	"
206	3909-2		10YR4/.3	80	15	5								10	70	15	5		"	"
207	3920		N5.3	80	15	5								10	70	10	10		"	"
208	3929.7		10YR4/.3	65	30	5								15	65	10	10		"	"
209	3940		10YR4/.3	75	15	10								15	55	20	10		"	"
210	3950		N5.7	70	20		10							20	60	10	tr	10	ash bed	Belpre
211	3960		10YR4/.3	75	15	10								20	80				"	Rhinestreet

20403, Lincoln Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
212	2725		N6.5	50	50									35	30	10	5	20	Siltstone	Middle Huron
213	2750		N6.2	80	20									15	55	15	5	10	Shale	"
214	2775.9		N5.9	75	20	5								15	50	20	tr	15	Shale	"
215	2799		N6.8	50	50									25	45	5	10	15	Siltstone	"
216	2824		N6.8	50	50									25	50	10		15	Siltstone	"
217	2854.5		N6.3	75	25									15	55	15	tr	15	Shale	"
218	2875		N6.2	75	25	tr								15	60	10		15	"	"
219	2900		N5.8	70	25	5								15	50	25	5	5	"	"
220	2925		N5.5	75	20	5								15	55	20		10	"	"
221	2950		N5.7	70	25	5								10	55	25		10	"	"
222	2975		10YR4/.3	60	35	5								10	60	20		10	"	"
223	3001		N5.5	70	25	5								10	55	25		10	"	"
224	3024.9		N5.7	75	20	5								10	50	30	tr	10	"	"
225	3050		N5.7	70	25	5								10	55	25		10	"	"
226	3075		N6.0	80	15	5								10	50	20	10	10	"	"
227	3100		N5.3	75	20	5								15	50	30		5	"	"
228	3125.1		N5.3	100										10	50	30	tr	10	"	"
229	3149		N5.3	100										10	55	25		10	"	"
230	3174.9		N5.3	75	20	5								15	45	30		10	"	"
231	3201.5		N6.0	80	20									10	50	30		10	"	"
232	3225		N5.3	80	15	5								15	45	30	tr	10	"	"
233	3249		N6.0	80	20									15	45	30		10	"	"
234	3275		N6.0	80	20									15	55	20		10	"	"
235	3300		N6.0	80	20									15	55	20		10	"	"
236	3325		N5.5	85	10	5								15	50	25		10	"	"

20403, Lincoln Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
237	3351.5		N5.5	75	20	5								15	50	30		5	Shale	Middle Huron
238	3374.9		N5.3	75	20	5								15	65	20			"	"
239	3400		N4.1	70	25	5								20	55	25			"	
240	3425		N6.0	65	30	5								15	60	25			"	Lower Huron
241	3450		N6.0	75	20	5								15	60	25			"	"
242	3475		N6.0	70	25	5								20	60	20			"	"
243	3505		10YR4/.3	60	35	5								15	55	30			"	"
244	3525		10YR4/.5	60	35	5								15	60	15	10		"	"
245	3550		10YR4/.5	65	30	5								15	60	20	5		"	"
246	3575		10YR4/.5	70	25	5								15	60	20	5		"	"
247	3600		10YR4/.5	65	30	5								15	55	30			"	"
248	3625		10YR4/.5	65	30	5								15	65	20			"	"
249	3652		N6.6	75	25									20	50	30			"	"
250	3675		N6.3	80	20									15	55	30			"	Java
251	3700.5		N6.9	80	20									20	55	25			"	"
252	3725.6		N6.5	80	20									25	50	25			"	"
253	3750		N6.5	95	20	5								15	55	30			"	"
254	3774.5		N6.5	70	30									15	65	20			"	"
255	3799.5		N6.5	80	20									20	55	20	5		"	"
256	3825		N5.6	70	15	5								25	55	20	tr		"	"
257	3850		N6.6	75	10	5								20	60	15	5		"	"
258	3875.3		N6.3	80	20									20	55	15	10		"	Rhinestreet
259	3900		N6.3	75	20	5								20	60	15	5		"	"
260	3925		N5.9	80	20									20	55	15	10		"	"
261	3949		10YR4/.5	60	35	5								15	70	15			"	"
262	3974		10YR4/.5	75	20	5								10	70	20			"	"
263	4000		10YR4/.2	70	25	5								15	65	20			"	"
264	4025		10YR4/.5	75	20	5								15	70	15			"	"

Guinn #1115, Raleigh Co., WV

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1916	2282	2320	N5.0	65	35	tr								15	55	30			Shale	
1917	2320	2368	N5.0	70	30	tr								20	55	25			Shale	
1918	2368	2410	N6.8	60	40								tr	25	55	20			Sltshale	
1919	2410	2514	N6.8	55	45									30	45	25			"	
1920	2514	2536	N6.8	45	55	tr								40	45	15			"	
1921	2536	2570	N6.5	60	40									30	50	20			"	
1922	2570	2636	N6.8	60	40								tr	30	50	20			"	
1923	2636	2690	N6.8	60	40									30	50	20			"	
1924	2690	2761	N6.8	70	30									30	45	25			Shale	
1925	2761	2845	N6.8	70	30									30	55	15			Shale	
1926	2845	3035	N6.9	60	40	tr								40	50	10			Sltshale	
1927	3035	3099	N7.0	40	60									45	40	15			Sltshale	
1928	3099	3200	N6.9	55	45									40	50	10			Sltshale	
1929	3600	3670	N6.5	70	30									25	50	25			Shale	
1930	3670	3717	N6.1	70	30	tr								30	50	20			"	
1931	3717	3794	N6.0	70	30	tr								25	45	30			"	
1932	3794	3929	N5.8	75	25	tr								25	45	30			"	
1933	3929	4026	N5.8	75	25	tr								25	50	25			"	Huron
1934	4026	4175	N5.5	70	30	tr								25	55	20			"	"
1935	4175	4287	N5.5	75	25	tr								20	55	25			"	"
1936	4287	4487	N6.9	65	35									35	45	20			"	Java
1937	4487	4687	N6.9	60	35			5						35	55	10			"	Java
1938	4687	4962	N6.0	60	40			tr						50	40	10			Sltshale	Java
1939	4962	5067	N5.0	75	25	tr							tr	25	55	20			Shale	Rhinestreet
1940	5067	5147	N5.0	80	20	tr								20	55	25			Shale	"
1941	5147	5287	N4.5	75	20	5								15	60	25			"	"
1942	5890	5996	N4.5	70	25	5		tr					tr	20	65	15			"	"
1943	5996	6107	N4.5	75	20	tr		5						20	65	15			"	Middlesex
1944	6171	6185	N3.0	40	30	5		25						10	75	15			"	Marcellus
1945	[illegible]85	6198	10YR4/.5	30	20	5		45						10	75	15			Limshale	"

USA I-3, Pocahontas Co., WV

Sample No.	Beginning Depth	Ending Depth		Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
					Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1895	2600	2800		N6.3	65	35									40	40	20			Shale	Java
1896	2800	3000		N6.1	70	25								5	35	45	20			"	"
1897	3000	3200		N6.1	75	25									35	45	20			"	"
1898	3200	3400		N6.3	75	25									30	50	20			"	"
1899	3400	3600		N6.3	75	25								tr	30	50	20			"	"
1900	3600	3800		N6.3	75	20								5	30	45	25			"	"
1901	3800	4000		N6.5	80	20								tr	35	45	20			"	"
1902	4000	4130		N6.5	75	25									35	45	20			"	
1903	4130	4430		N6.1	75	25									35	50	15			"	
1904	4480	4780		N5.1	80	20	tr							tr	25	55	20			"	
1905	4780	4880		N5.5	80	20	tr							tr	30	55	15			"	
1906	4880	4980		N5.5	80	20	tr								30	50	20			"	Geneseo
1907	4980	5080		N5.5	70	25								5	30	55	15			"	"
1908	5080	5180		N5.1	65	30	tr		5						25	55	20			"	"
1909	5180	5280		N4.0	55	25	5		15						20	65	15			"	"
1910	5280	5380		N3.5	55	30	5		10						20	65	15			"	Mahantango
1911	5380	5480		N4.0	65	25	5		5						20	65	15			"	Mahantango
1912	5480	5580		N3.5	60	25	5		10						15	70	15			"	Marcellus
1913	5580	5680		N3.5	45	15	5		35						15	70	15			"	Marcellus
1914	5680	5780		N5.1	30	50	tr		20						20	60	20			Sltshale	Onondaga
1915	5780	5820		N5.1	55	40	5								15	60	25			Sltshale	Onondaga

R. J. Wetzel, Rockingham Co., VA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1834	2420	2470	N4.8	50	15	tr		35						30	55	15			Shale	Millboro
1835	2470	2520	N5.5	50	15	tr		35						30	50	20			"	"
1836	2520	2570	N4.3	65	20	tr		15						25	50	25			"	"
1837	2570	2620	N4.5	65	20	5		10						25	55	20			"	"
1838	2620	2670	N4.5	75	20	tr		5						25	55	20			"	"
1839	2670	2720	N4.5	60	25	5		10						25	50	25			"	"
1840	2720	2770	N3.8	70	20	5		5						20	55	25			"	"
1841	2770	2820	N4.0	80	20								tr	20	60	20			"	"
1842	2820	2870	N4.5	60	20	tr		20						30	50	20			"	"
1843	2870	2920	N4.8	50	20	tr		30						30	55	15			"	"
1844	2920	2970	N4.5	55	15	tr		30						25	50	25			"	"
1845	2970	3020	N3.2	55	25	5		15						20	60	20			"	Marcellus
1846	3020	3070	N3.2	55	30	5		10						15	65	20			"	"
1847	3070	3120	N3.2	40	15	5		40						15	60	25			Limshale	"
1848	3120	3170	N3.2	80	20									10	60	30			Shale	"

20338, Wise Co., VA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
2	4870.6		N3.3	60	35	5								15	55	25	5		Shale	Cleveland
3	4875.9		N3.5	55	40	5								10	60	25	tr		"	"
4	4880.0		N3.3	65	30	5								10	60	30			"	"
5	4885.1		N3.2	65	30	5								10	55	35			"	"
6	4890.1		N3.2	60	35	5								10	60	30			"	"
7	4895.5		N3.4	60	35	5								5	55	40			"	"
8	4900.0		N3.2	65	30	5								5	55	40			"	"
9	4905.4		N3.2	65	30	5								5	75	20			"	"
10	4910.1		N3.2	65	30	5								5	55	40			"	"
11	4915.0		N3.2	65	30	5								5	65	30			"	"
12	4920.2		N3.5	65	30	5								5	65	30			"	"
13	4925.2		N3.5	65	30	5								10	60	25	5		"	"
14	4930.2		N3.5	55	40	5								10	50	25	10	5	Siltstone	"
15	4935.0		N3.5	55	35	5	5							10	60	25		5	Shale	"
16	4940.2		N3.5	45	50	5								10	60	25		5	Siltstone	
17	4945.1		N4.0	70	25	5								10	70	15		5	Shale	
18	4950.8		N4.0	30	60	5	5							10	55	25		10	Siltstone	
19	4955.3		N5.0	70	30									10	60	25		5	Shale	
20	4960.1		N3.7	60	35	5								10	55	30		5	"	
21	4965.0		N6.8	65	30				5					20	50	25		5	"	
22	4970.0		N6.0	85	15									15	65	20			"	
23	4974.2		N6.0	80	15					5				20	55	25			"	
24	4980.0		N6.0	75	25									15	60	25			"	
25	4985.1		N4.7	65	30	5								20	60	20			"	
26	5210.0		N6.0	85	15									10	70	20			"	Middle Huron

20338, Wise Co., VA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
27	5215.0		N5.3	75	20	5								15	55	30			Shale	Middle Huron
28	5220.0		N6.2	65	15					20				15	60	25			"	"
29	5225.0		N5.7	80	20									10	65	25			"	"
30	5230.0		N6.2	75	15					10				15	60	25			"	"
31	5235.0		N5.7	75	20	5								15	55	30			"	"
32	5240.2		N4.7	70	25	5								15	65	20			"	"
33	5244.9		N4.7	80	15	5								10	60	30			"	"
34	5250.0		N3.9	70	25	5								10	60	30			"	"
35	5255.0		N5.0	80	15	5								15	60	25			"	"
36	5260.0		N4.7	80	15	5								10	60	30			"	"
37	5265.0		N3.9	70	25	5								15	55	30			"	"
38	5270.1		N5.0	75	20	5								10	60	30			"	"
39	5275.1		N4.0	70	25	5								10	65	25			"	"
40	5280.0		N5.7	75	20	5								15	60	25			"	"
41	5285.0		N4.1	75	20	5								10	65	25			"	"
42	5290.0		N4.1	80	15	5								15	65	20			"	"
43	5295.6		N4.1	80	15	5								15	65	20			"	"
44	5300.7		N4.0	75	20	5								15	80	5			"	Lower Huron
45	5305.2		N3.7	75	20	5								10	55	35			"	"
46	5312.0		N3.7	70	25	5								15	50	35			"	"
47	5315.9		N3.7	80	15	5								10	65	25			"	"
48	5320.0		N3.7	75	20	5								10	60	30			"	"
49	5325.0		N4.0	80	15	5								10	60	30			"	"
50	5330.3		N4.0	80	15	5								10	60	25	5		"	"
51	5340.4		N4.0	75	20	5								15	55	25	5		"	"

20338, Wise Co., VA

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
52	5345.8		N3.5	80	15	5								15	60	25			Shale	Lower Huron
53	5350.6		N3.5	75	20	5								10	70	20			"	"
54	5355.0		N5.7	75	20	5								10	60	30			"	"
55	5360.0		N3.5	65	25	5			5					5	70	25			"	"
56	5365.0		N3.2	70	25	5								10	65	25			"	"
57	5370.7		N3.2	70	25	5								10	70	20			"	"
58	5375.2		N3.2	70	25	5								10	60	30			"	"
59	5379.9		N3.2	70	25	5								10	70	20			"	"
60	5385.0		N3.2	70	25	5								10	60	30			"	"
61	5390.0		N3.2	75	20	5								10	65	25			"	"
62	5395.5		N6.0	75	25									10	65	25			"	"
63	5400.0		N3.4	75	20	5								10	65	25			"	"
64	5405.4		N3.4	75	20	5								10	65	25			"	"
65	5409.8		N3.2	60	35	5								10	65	20	5		"	"
66	5415.4		N3.2	75	20	5								10	65	25			"	"
67	5420.3		N3.2	70	25	5								10	60	25	5		"	"
68	5425.0		N3.5	80	15	5								10	70	20			"	"
69	5430.4		N3.2	80	15	5								10	60	30			"	"
70	5435.0		N3.4	80	15	5								10	70	20			"	"
71	5440.0		N4.1	70	20	5			5					15	60	25			"	"
72	5445.0		N3.5	70	20	5			5					10	65	25			"	"
73	5450.0		N4.1	70	30									15	65	15	5		"	"
74	5456.8		N3.2	75	25									10	60	25	5		"	"
75	5460.6		N3.2	80	20									10	65	20	5		"	"
76	5465.2		N3.2	80	20									10	65	20	5		"	"
77	5470.9		N3.2	80	20									10	65	20	5		"	"
78	5475.2		N3.2	75	25									10	65	20	5		"	"

#20336, Martin Co., Kentucky

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0333	2440.0		10YR3/.8	65	30	5								10	60	10	15	5	shale	Cleveland
0334	2460.0		10YR4/.2	65	30	5								10	55	25	5	5	"	"
0335	2480.0		10YR4/.3	60	35	5								10	55	25	5	5	"	"
0336	2500.0		10YR4/.3	35	40	5		20						10	60	20	tr	10	"	"
0337	2520.8		N5.2	65	25	10								10	55	20	5	10	"	"
0338	2529		N6.0	70	25	5								15	50	25	tr	10	"	"
0339	2540.2		N6.5	75	20								5	10	55	20	tr	15	"	"
0340	2560.1		N6.2	75	20								5	10	55	25		10	"	"
0341	2580.3		N5.2	75	20	5								10	50	25	5	10	"	Cleveland
0342	2600.0		10YR4/.3	60	35	5								05	50	30	10	5	"	"
0343	2620.0		N6.7	80	20									10	50	20	10	10	"	"
0344	2629		10YR7/.5	75	20			5						10	50	20		20	"	"
0345	2639.6		N6.7	80	20									15	50	20	tr	15	"	"
0346	2660.0		10YR4/.3	60	35	5								10	50	25	10	5	"	Upper Huron
0347	2680.0		10YR4/.4	60	35	5								10	60	15	10	5	"	"
0348	2700.2		10YR4/.5	70	25	5								5	60	25	5	5	"	"
0349	2719.5		10YR4/.5	70	25	5								10	65	20	tr	5	"	"
0350	2740.4		10YR4/.5	60	35	5								10	60	25		5	"	"
0351	2760.0		10YR4/.1	65	30	5								10	65	20		5	"	Upper Huron
0352	2780.9		N6.5	75	20	5								15	60	25			"	Middle Huron
0353	2800.0		N6.4	75	25									20	60	20			"	"
0354	2820		N5.0	75	20	5								20	60	20			"	"

#20336, Martin Co., Kentucky

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0355	2829		N6.2	75	20								5	20	60	20			shale	Middle Huron
0356	2840		N5.3	75	20	5								20	50	25	5		"	"
0357	2860.0		10YR5/.3	70	25	5								15	50	25	10		"	"
0358	2880.0		N6.5	70	25	5								15	55	25	5		"	Middle Huron
0359	2900.0		N5.0	75	20	5								20	50	20	10		"	Lower Huron
0360	2920.0		10YR4/.4	70	25	5								15	55	20	10		"	"
0361	2940.8		N6.2	70	25	5								10	60	25	5		"	"
0362	2959.6		10YR3/.4	55	35	10								10	55	30	5		"	"
0363	2980.0		10YR4/.3	65	25	5			5					20	65	10	5		"	"
0364	3000.0		N5.5	70	25	5								5	60	20	15		"	"
0365	3020.4		N6.9	65	30	5								10	55	30	5		"	"
0366	3029		10YR4/.3	70	25	5								15	50	25	10		"	"
0367	3040.0		10YR4/.3	60	35	5								10	75	5	10		"	"
0368	3060.0		10YR4/.5	65	30	5								10	60	15	15		"	"
0369	3080.0		10YR6/.4	70	25	5								15	60	20	5		"	"
0370	3100		10YR4/.5	70	25	5								15	55	20	10		"	Lower Huron
0371	3120.0		N6.5	70	25	5								15	55	25	5		"	Java
0372	3129		N6.2	70	25	5								15	60	25			"	"
0373	3140.0		N6.7	75	25									20	60	20			"	"
0374	3160		10YR4/.4	70	20	10								20	60	20			"	"
0375	3180.0		N6.8	85	15									15	55	20	10		"	Pipe Creek
0376	3200		N6.8	60	35	5								15	55	25	5		"	Pipe Creek
0377	3220.8		N6.8	70	25	5								20	55	20	5		"	West Falls
0378	3229		10YR4/.5	70	25	5								15	55	30			shale	West Falls

#20336, Martin Co., Kentucky

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0379	3240.0		N5.3	75	20	5								20	60	20			shale	West Falls
3080	3259.7		N6.7	75	25									20	60	20			"	"
0381	3280.3		10YR4/.5	70	25	5								15	65	20			"	"
0382	3300.3		N6.7	70	20			10						15	60	15	10		"	"
0383	3320.0		10YR4/.3	70	25	5								15	65	15	05		"	"
0384	3329		10YR4/.3	75	15	10								20	55	15	10		"	"
0385	3340.0		N6.7	50	15			35						15	65	10	10		shale	West Falls
0386	3360.0		10YR4/.3	60	35	5								10	65	15	10			Rhinestreet
0387	3380		N5.3	70	25	5								10	65	20	5			"
0388	3400		10YR4/.5	65	25	5		5						10	70	15	5			Rhinestreet

Skaggs-Kelley, Johnson Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1827	987.14	987.47	N6.8	65	30	tr							5	tr	55	20		25	Shale	
1828	1046.48	1046.78	10YR5/.5	65	30	5							tr	tr	65	30		5	Shale	
1829	1156.24	1156.50	10YR5/.3	70	25	5		tr							60	30		10	Shale	
1830	1204.20	1204.54	N5.3	55	40	5									65	25		10	Sltshale	
1831	1254.11	1254.53	10YR5/.5	70	30	tr									65	30		5	Shale	
1832	1402.36	1402.55	10YR4/.5	65	30	5								10	70	20			Shale	
1833	1453.26	1453.56	N6.8	75	25								tr	10	45	35		10	Shale	

NECO #5-E, Fleming Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1673	115.5		10YR5/.5	45	30	10		5		5	tr		5						shale	
1674	119.8		10YR3/.5	70	25	5								5	45	50			"	Cleveland
1675	139.5		10YR4/.5	65	30	5								5	40	55			"	Cleveland
1676	155.5		10YR6/.3	75	20	5							tr	5	40	55			"	Cleveland
1677	165.5		10YR5/.3	70	25	5							tr	5	40	50		5	"	
1678	185.5		10YR5/.3	65	25	5							5	5	50	40		5	"	Upper Huron
1679	205.5		10YR5/.3	65	30	5							tr	5	45	50			"	Middle Huron
1680	225.5		10YR5/.3	70	25	5					tr			5	50	45			"	Middle Huron
1681	245.5		10YR6/.3	65	30	5							tr	5	55	40			"	Middle Huron
1682	259.7		10YR5/.5	50	20	5		25						5	55	40			"	Middle Huron
1683	279.5		10YR4/.5	75	20	5								10	50	40			"	Lower Huron
1684	299.0		10YR5/.5	70	25	5								10	60	30			shale	Olentangy

#7239, Perry Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0439	2371.1		10YR3/.2	65	30	5								15	55	15	15		shale	Cleveland
0440	2381		10YR3/.2	60	35	5								10	65	15	10		"	"
0441	2392.0		10YR4/.2	50	40	5		5						10	55	20	15		"	"
0442	2404.2		10YR4/.2	55	35	5		5						5	60	20	15		"	"
0443	2412.0		10YR4/.2	60	35	5								5	60	15	20		"	"
0444	2422.3		N4.8	70	25	5								10	65	15	10		"	Cleveland
0445	2432.7		N4.8	70	25	5								10	60	25	5		"	
0446	2440.9		N4.3	70	25	5								10	65	20	5		"	
0447	2450.7		N6.5	70	25	5								5	70	20	5		"	Upper Huron
0448	2459.9		N4.0	65	30	5								10	50	25	15		"	"
0449	2470.2		N4.0	65	30	5								10	65	25			"	"
0450	2480		N4.5	70	25	5								5	70	20	5		"	
0451	2491.1		N4.0	60	30	5					5			5	65	25	5		"	Upper Huron
0452	2501		N4.5	70	25	5								5	65	20	10		"	Middle Huron
0453	2511.0		N4.5	70	25	5								5	65	15	15		"	"
0454	2519.9		N4.5	65	30	5								5	70	10	15		"	"
0455	2530.3		N4.5	65	30	5								5	60	35			"	"
0456	2540		N4.0	65	30	5								5	65	20	10		"	"
0457	2552.4		N4.0	70	25	5								5	65	15	15		"	"
0458	2560		N4.3	75	20	5								5	65	15	15		"	"
0459	2570.0		N4.2	70	25	5								10	65	15	10		"	
0460	2580		N4.2	70	25	5								5	65	10	20		"	Middle Huron
0461	2590.4		N4.0	70	25	5								5	65	15	15		"	Lower Huron
0462	2600.2		10YR4/.2	50	35	10			5						70	25	5		"	"
0463	2610.9		10YR4/.2	65	25	5					5			5	60	20	15		"	"
0464	2621.3		N6.5	65	25	5			5					10	60	15	15		"	"
0465	2630		N6.5	70	30									10	70	20	tr			
0466	2640		10YR4/.2	60	25	5			5		5			5	75	15	5		shale	Lower Huron

#7239, Perry Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
0467	2650.8		10YR4/.2	70	25	5								5	65	25	5		shale	Lower Huron
0468	2660		10YR4/.2	55	25	10					10			15	65	10	10		shale	Lower Huron
0469	2671.8		N6.5	65	30	5								20	70	5	5		shale	Lower Huron
0470	2680.8		N6.5	70	30									15	65	10	10		shale	Rhinestreet
0471	2690		N6.5	65	25	5			5					20	55	20	5		shale	Rhinestreet
0472	2700		N6.5	65	25	10								20	60	20	tr			

Redman #1, Russell Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1668	194.8		10YR4/1	70	15	10					5				70	30			shale	Cleveland
1669	198.2		10YR4/.5	70	25	5					tr			5	60	35			shale	
1670	207.1		10YR4/1	60	30	10									65	35			shale	Huron
1671	218.5		10YR5/.5	65	30	5					tr		tr	5	70	25			shale	Huron
1672	224.5		10YR4/1	60	25	5			10					5	70	25			shale	Huron

Jeff Story #1, Russell Co., KY

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1661	331.0		N6.5	65	30	5								5	60	35			shale	
1662	333.1		N6.7	60	35	5								5	70	25			sltshale	
1663	336.5		10YR4/.5	60	35	5								5	80	15			sltshale	Cleveland
1664	346.7		10YR2/1	65	30	5								tr	60	40			shale	
1665	357.4		10YR4/1	60	25	15			tr		tr				60	40			shale	Huron
1666	365.9		10YR6/.5	70	25	5								5	65	30			shale	Middle Huron
1667	371.5		10YR4/1	70	25	5			tr					5	65	30			shale	Lower Huron

TDG-DOE #3, Hancock Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1436	132.6		N6.2	60	30	5							5	10	45	40		5	shale	
1437	152.0		N4.8	80	15	5					tr			10	50	35		5	shale	
1438	172.4		10YR4/.2	70	25	5							tr	5	50	50		5	shale	
1439	192.6		10YR4/.5	75	20	5								5	60	30		5	shale	
1440	212.6		10YR4/.2	65	30	5								5	50	40		5	shale	
1441	232.8		10YR4/.5	60	35	5							tr	5	60	35		tr	sltshale	
1442	252.6		N5.1	65	30	tr							5	5	50	35		10	shale	
1443	273.2		10YR4/.7	55	40	5					tr		tr	10	65	20		5	sltshale	
1444	293.3		10YR4/.5	55	40	5			tr				tr	5	70	25			sltshale	Cleveland
1445	313.3		10YR4/.7	55	40	5							tr	10	60	30			sltshale	Cleveland
1446	333.0		N4.8	65	30	5						tr	tr	10	65	20		5	shale	Cleveland
1447	337.3		N6.2	75	25	tr	tr			tr				5	55	35		5	"	
1448	350.1		N4.8	70	25	5							tr	5	60	20	10	5	"	
1449	355.2		7.5Y7/1	45	15					40									"	
1450	372.4		10YR5/.5	65	30	5								10	60	25		5	"	Upper Huron
1451	390		10YR5/.5	70	25	5					tr			5	65	25		5	"	Upper Huron
1452	410		N4.8	70	25	5							tr	5	60	5		30	"	Middle Huron
1453	430		N6.2	75	25								tr	5	60	35			"	Middle Huron
1454	450.8		N4.8	70	25	5							tr	5	65	30			shale	Middle Huron
1455	470		N5.5	60	35	5				tr				10	55	35			sltshale	Middle Huron
1456	490		N5.0	75	20	5							tr	5	60	35		tr	shale	Middle Huron
1457	510		N5.0	70	25	5								5	60	35		tr	"	Middle Huron
1458	530		10YR4/.2	70	25	5							tr	5	55	40		tr	"	Middle Huron
1459	550		10YR4/.5	75	20	5								5	65	30			"	Lower Huron
1460	570		N6.5	70	30								tr						"	Lower Huron
1461	574		10YR4/.5	60	30	5			5				tr	10	65	25		tr	"	Lower Huron
1462	596.3		10YR4/.5	70	25	5								10	65	15		10	"	Lower Huron
1463	616.2		10YR4/.5	70	25	5							tr	10	55	20		15	shale	Lower Huron

TDG-DOE #3, Hancock Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1464	636.3		10YR4/.7	70	25	5								10	60	20		10	shale	Lower Huron
1465	649.5		10YR4/.5	70	25	5								10	65	25			"	Lower Huron
1466	656.3		N5.7	75	25	tr							tr	5	65	30			"	Hanover
1467	675.3		N6.5	75	15	5					tr		5	10	70	15		5	ash bed	Center Hill
1468	676.5		N6.5	70	25	5							tr	tr	20	10		70	"	Pipe Creek
1469	697.7		N6.5	80	20								tr	15	60	20		5	"	Angola
1470	717.6		N6.5	80	20								tr	10	55	20	10	5	"	Angola
1471	737.5		10YR4/.5	60	20	15					5		tr	15	60	25			shale	Rhinestreet

TDG-DOE #4, Hawkins Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1472	17.7		N6.1	75	25	tr							tr	10	55	30		5	Shale	Middle Huron
1473	37.8		N6.0	65	30	5													"	"
1474	58.0		N6.1	75	20	5								10	50	35		5	"	"
1475	77.4		10YR7/.5	50	45	5													Sltshale	"
1476	97.5		N5.5	70	25	5							tr	10	55	30		5	Shale	"
1477	117.5		N6.5	70	20	5							5						Shale	"
1478	137.5		10YR7/.5	45	50	5							tr	15	50	25		10	Sltshale	"
1479	159.0		10YR7/.5	60	35	5													"	"
1480	177.5		10YR7/.5	60	35	5								15	50	30		5	"	"
1481	197.5		10YR7/.5	60	35	5													"	"
1482	217.5		N6.8	70	25	5								10	60	20		10	Shale	"
1483	237.5		N6.5	55	40	5							tr						Sltshale	"
1484	257.8		N6.1	70	30	tr								15	55	30			Shale	"
1485	277.5		N5.8	70	25	5													Shale	"
1486	297.5		10YR6/.5	50	45	5								10	60	25		5	Sltshale	"
1487	316.5		10YR6/.5	40	55	5													Sltshale	"
1488	337.5		N5.8	75	20	5								15	50	30		5	Shale	"
1489	357.5		10YR6/.5	70	25	5													"	"
1490	377.5		N5.0	75	20	5								15	55	25		5	"	"
1491	397.6		N5.0	75	20	5													"	"
1492	417.5		10YR6/.5	70	25	5								20	55	25			"	"
1493	437.5		N5.0	75	20	5													"	"
1494	457.5		[illegible]	75	20	5								15	50	25		10	"	"
1495	477.5		[illegible]	75	25	tr							tr						"	"
1496	497.0		[illegible]	75	20	5								10	60	25		5	"	"

TDG-DOE #4, Hawkins Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1497	517.0		10YR3/.5	65	25	10							tr						Shale	Lower Huron
1498	537.0		N6.8	75	25									15	55	30			"	"
1499	557.0		N6.8	75	25								tr						"	"
1500	577.0		N6.8	75	25								tr	10	60	25		5	"	"
1501	582.0		10YR3/.5	70	25	5					tr			20	60	20			"	"
1502	597.0		10YR4/.5	70	25	5					tr		tr	15	50	30		5	"	"
1503	605.7		N6.8	75	25								tr	15	55	25		5	"	"
1504	617.0		10YR3/.5	70	25	5								10	60	15	5	10	"	"
1505	637.0		10YR4/.5	70	25	5							tr						"	"
1506	657.0		10YR4/.5	70	25	5								15	65	15	5		"	"
1507	677.0		10YR4/.5	75	20	5													"	"
1508	697.0		10YR4/.5	70	25	5							tr	10	70	20			"	"
1509	717.0		10YR5/.5	70	25	5							tr						"	"
1510	737.0		10YR4/.5	75	20	5					tr			10	65	25			"	"
1511	757.0		10YR4/.5	70	25	5													"	"
1512	777.0		N6.0	80	20	tr								20	55	25			"	"
1513	797.0		N6.0	85	15														"	"
1514	817.0		N5.1	85	15	tr								20	60	20			"	"
1515	837.0		N6.0	90	10	tr													"	"
1516	857.0		10YR5/.5	75	20	5													"	"
1517	877.0		N5.8	80	20	tr								20	55	25			"	"
1518	897.0		10YR4/.3	85	15	tr													"	"
[illegible]	[illegible]		[illegible]	[illegible]										[illegible]					"	"
1520	937.0		N4.2											15	[illegible]				"	"
1521	957.0		N5.1	75	20	5								15	55	25		5	"	"

TDG-DOE #4, Hawkins Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
1522	977.0		N5.0	80	20	tr													Shale	Lower Huron
1523	997.0		10YR6/.5	80	20	tr								20	60	20			"	"
1524	1017.0		10YR6/.8	65	25				10										"	"
1525	1037.0		N6.1	80	20									20	65	15			"	"
1526	1057.0		10YR4/.5	65	20	5			5			5							"	Pipe Creek
1527	1077.0		N6.8	80	20	tr					tr			20	65	15			"	"
1528	1097.0		N5.0	75	20	5								15	65	15		5	"	Rhinestreet
1529	1117.0		N6.8	80	20								tr						"	"
1530	1137.0		N7.0	85	15								tr	20	50	30			"	"
1531	1157.0		N6.8	80	20								tr						"	"
1532	1157.4		5Y8/.5	50	20			5		20	5			15	55	20		10	"	"
1533	1177.0		N4.0	75	20	5													"	"
1534	1197.0		N6.8	80	20								tr	15	60	25			"	"
1535	1217.0		10YR3/.5	75	20	5					tr			20	55	25			"	"
1536	1237.0		N6.8	80	20														"	"
1537	1257.0		N4.0	80	15	5								20	65	15			"	"
1538	1277.0		N4.0	75	20	5													"	"
1539	1297.0		N6.8	80	20								tr	20	60	20			"	"
1540	1317.0		10YR4/.5	80	15	5													"	"
1541	1337.0		N6.8	80	20									20	60	20			"	"
1542	1357.0		10YR7/.5	75	15								10						"	"
1543	1377.0		N6.8	80	20									20	50	30			"	"
1544	1397.0		N5.5	80	20	tr													"	"
1546	1437.0		N5.5	80	15	1								20	50	25		15	"	"
1547	1457.0		N5.8	80	20								tr						"	"

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TDG-DOE #1, Claiborne Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1416	12.8		10YR5/.7	70	25	5								10	60	30		tr	Shale	Cleveland
1417	17.8		N5.5	75	25	tr								5	55	40		tr	"	"
1418	21.5		N6.8	80	20	tr								5	60	35		tr	"	
1419	31.1		10YR5/.5	60	35	5								10	60	25		5	Sltshale	
1420	51		10YR5/.5	65	30	5								10	60	25		5	Shale	Upper Huron
1421	71.9		10YR5/.5	70	25	5							tr	5	60	30		5	"	Middle Huron
1422	92.5		N5.3	70	25	5							tr	5	55	40		tr	"	"
1423	112		N5.3	70	25	5							tr	5	65	30		tr	"	"
1424	132		N4.5	75	20	5							tr	5	65	30			"	"
1425	152		N4.1	75	20	5								10	60	30			"	Lower Huron
1426	160.6		10YR5/.7	55	40	5								10	65	15		10	Sltshale	"
1427	182.6		10YR4/.5	65	25	10								15	55	25		5	Shale	"
1428	202.5		N6.8	80	20									10	50	30		10	"	Hanover
1429	222		N7.0	80	20									10	55	25		10	"	"
1430	231.3		10YR4/.5	65	15	20					tr			tr	55	25		20	"	"

TDG-DOE #2, Clairborne Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent) Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Clay Mineralogy Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
1431	10.6		10YR41.2	70	20	5							5	tr	45	50		5	Shale	
1432	32.6		10YR4/.2	65	30	5								tr	60	40			Shale	
1433	45.1		N5.2	60	40	tr						tr		tr	60	35		5	Sltshale	Cleveland
1434	65.1		10YR4/.5	60	30	5							5	tr	55	45			Shale	"
1435	85.1		10YR4/.5	55	40	5								tr	70	20		10	Sltshale	"

Industrial Park, Grainger Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
2101	1167.3		N4.8	70	25	5						tr	tr						Shale	Cleveland
2102	1170.4		N4.8	75	20	5						tr	tr						"	"
2103	1190.3		N3.9	75	20	5							tr						"	"
2104	1210.3		10YR4/.3	70	25	5							tr						"	"
2105	1219.1		10YR4/.3	70	25	5							tr						"	"
2106	1610.3		10YR3/.5	70	25	5						tr	tr						"	Lower Huron
2107	1630.0		N5.0	70	25	5							tr						"	"
2108	1650.3		10YR3/.5	65	25	10					tr		tr						"	"
2109	1670.0		N5.8	75	20	5					tr		tr						"	"
2110	1690.2		10YR3/1	70	25	5							tr						"	"
2111	1710.8		10YR4/.8	70	25	5							tr						"	"
2112	1730.1		10YR5/.8	65	35	tr							tr						Sltshale	"
2113	1738.8		N5.8	70	30	tr					tr		tr						Sltshale	Rhinestreet
2114	1820.0		N6.8	80	20						tr		tr						Shale	"
2115	1840.1		10YR3/.5	55	25	15					5		tr						Shale	"

Dressler, Overton Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
319		181.5	10YR3/.5	70	25	5								5	65	20	10		Shale	Gassaway
320		182.8	10YR3/1	100		tr								5	60	25	10		"	"
321		184.3	10YR3/1	60	35	5								10	60	30			"	"
322		186.2	10YR3/1	55	35	10				tr				5	60	30	5		"	"
323		190.1	10YR3/1	55	25	15							5	5	60	30	5		"	"
324		192.3	10YR3/1	50	30	15		5		tr				10	60	20	10		"	"
325		194.8	10YR3/1	50	35	10		5		tr				15	60	25			"	"
326		197.3	10YR 5/.5	70	25	5								10	70	20			"	"
327		199.3	10YR3/1	65	30	5							tr	20	65	15			"	"
328		199.7	10YR3/.7	60	30	10				tr				10	70	15	5		"	"
329		200.6'	10YR4/.5	75	20	5							tr	15	65	20			"	"
330		202.5	N6.2	80	20	tr			tr					10	65	25			"	Dowelltown
331		205.3	10YR3/.6	70	20	5			5					10	60	25	5		"	"
332		207.5	10YR4/.5	60	30	5			5					10	65	20	5		"	"

NV-56, Summer Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy							
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
310	14.2		10YR3/.5	75	25						5			5	85	10			Shale	Gassaway
311	20.0		10YR4/.8	70	20	10								10	70	20			"	"
312	23.8		10YR4/.9	60	30	5							5	10	60	30			"	"
313	30.4		10YR4/.9	60	30	5			5				tr	10	60	30			"	Dowelltown
314	37.0		10YR3/.8	60	25	5			5				5	10	55	35			"	"

NV-54, Davidson Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
305	14.9		10YR4/.9	55	25	15					5			10	60	30			Shale	Gassaway
306	20.5		10YR4/1	65	20	10					5			10	70	20			"	"
307	26.5		10YR4/.9	65	30	5								10	70	20			"	"
308	33.0		10YR5/.8	65	25	5			5					10	70	20			"	Dowelltown
309	40.0		10YR4/.7	60	25			5	10					10	70	20			"	"

YB-39, Dekalb Co., Tn

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
270	142.4		N3.1	65	30	5								10	75	15			Shale	Gassaway
271	147.4		10YR3/.5	55	30	10					5			10	80	10			"	"
272	152.4		10YR3/.5	50	35	10					5			10	75	15			"	"
273	157.4		10YR3/.5	70	25	5								10	70	20			"	"
274	157.9		10YR4/.5	65	25	5							5	10	65	25			"	Dowelltown
275	163.0		10YR4/.3	65	25	5			5					10	80	10			"	"
276	167.0		10YR3/.5	65	25	10								15	70	15			"	"
277	168.0		10YR3/.8	60	25	5			5				5	10	70	20			"	"
278	173.0		10YR3/.4	65	20	5			5				5	5	70	25			"	"

WR-50, Cumberland Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
297	139.4		10YR3/.3	40	25	20				5	5		5		70	15	15		Shale	Gassaway
298	144.5		10YR3/.3	45	35	15					5			5	65	20	10		"	"
299	149.5		10YR3/.4	40	40	15					5			5	55	30	10		"	"
300	154.5		10YR3/.3	60	25	10							5	5	65	20	10		"	"
301	159.5		10YR3/.3	60	25	5					5		5	10	65	25			"	"
302	164.5		N6.0	70	25	5								15	70	15			"	Dowelltown
303	169.5		N6.5	70	25				5					15	75	10			"	"
304	174.1		N2.0	75	20	5									90	10			"	"

YB-43, Coffee Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
280	87.6		10YR3/.8	50	35	10					5			5	65	30			Shale	Gassaway
281	92.5		10YR3/.9	55	30	10					5			10	55	20	15		"	"
282	97.5		10YR3/.9	65	20	10					5			10	60	15	15		"	"
283	102.5		10YR6/.2	70	20	5							5	10	70	15	5		"	Dowelltown
284	107.0		10YR6/.8	65	25	5							5	10	65	20	5		"	"
285	112.0		10YR4/.5	60	25	5			5				5	10	65	15	10		"	"
286	116.5		10YR4/.5	65	20	5			5				5	10	65	20	5		"	"

YB-45, Moore Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
287	8.8		10YR3/.5	55	30	10					5			10	85	5			Shale	Gassaway
288	12.6		10YR3/.5	50	30	15					5			10	60	30			"	"
289	15.6		10YR5/.5	55	35	5							5		75	25			"	Dowelltown
290	20.2		10YR3/.5	60	30	5					5			10	70	20			"	"

WR-47, Marion Co., TN

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy						
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite	Lithology	Formation
291	294.0		N2.5	55	30	10					5				70	15	15		Shale	Gassaway
292	299.0		10YR3/.3	55	30	10					5				60	30	10		"	"
293	304.0		10YR3/.3	55	30	10					5				65	30	5		"	"

AL-65, Blount Co., AL

Sample No.	Beginning Depth	Ending Depth	Munsell Color	Mineralogy (percent)										Clay Mineralogy					Lithology	Formation
				Clay	Quartz	Pyrite	Plagioclase	Calcite	Dolomite	Siderite	Barite	Gypsum	Apatite	Chlorite	Illite	Mixed-layer illite-smectite	Mixed-layer illite-chlorite	Kaolinite		
265	22.6		N2.2	55	45									15	80	20			Shale	Gassaway
266	29.3		N2.2	65	35	tr								15	65	20			"	"
267	36.1		N2.2	60	35	5								15	65	20			"	"
268	52.9		N2.2	60	35	5								5	65	20			"	"
269	49.7		N2.2	60	35	5									65	30			"	"

LIST OF DRILL HOLES

1. Gulf Oil Corp.
   C. E. Leslie No. 1
   1.9 mi S of 42° 25'
   2.3 mi W of 75° 00'
   Oneonta 15' quad.
   Franklin Twp.
   Delaware Co., NY
   Elev. 1486 GL, TD 7952
   API No. 31-025-04455

2. Bradley Producing Co.
   C. C. Lobdell No. 1
   9700 N of 42° 40' N
   3150 W of 75° 20' W
   New Berlin 15' quad.
   Columbus Twp.
   Chenango Co., NY
   Elev. 1373 DF, TD 5637
   API No. 31-017-01160

3. New York State Natural Gas Corp.
   D. L. Branagan No. 1
   2 mi S of 42° 50' N
   3.4 mi W of 75° 35' W
   Morrisville 15' quad.
   Lebanon Twp.
   Madison Co., NY
   Elev. 1544 GL, TD 5703
   API No. 31-053-03970

4. Fenix and Scissen
   L and N Richards No. 1
   3600 S of 42° 20' N
   8430 W of 75° 55' W
   Greene 15' quad.
   Triangle Twp.
   Broome Co., NY
   Elev. 996 GL, TD 9640
   API No. 31-007-05087

5. C. Fralich and Suburban Propane
   Phillip Overbaugh No. 1
   Harford 15' quad.
   Harford Twp.
   Cortland Co., NY
   API No. 31-023-02308

6. New York State Natural Gas Corp.
   R. A. Butler No. 1
   Cortland 15' quad.
   Homer Twp.
   Cortland Co., NY
   API No. 31-023-00644

7. Cargill Salt Company
   Core Test No. 17
   1.29 mi S of 42° 32' 30" N
   0.27 mi W of 76° 30' W
   Lansing Twp.
   Tompkins Co., NY
   Elev. 835 DF, TD 2784
   API No. 31-109-13173

8. Great Lakes Gas Corp.
   J. W. Agard No. 1
   Genoa 15' quad.
   Ulysses Twp.
   Tompkins Co., NY
   API No. 31-109-05017

9. Belmont Quad Drilling Corp.
   E. A. Treat No. 118
   Waverly 15' quad.
   Erin Twp.
   Chemung Co., NY
   API No. 31-015-00509

10. CGS Management Co.
    Greger Borglum No. 1
    42° 41' 01" N
    77° 01' 20" W
    Penn Yan 15' quad.
    Benton Twp.
    Yates Co., NY
    API No. 31-123-04796

11. Anchor Petroleum Co.
    Blair Storage Well No. 1
    9400 S of 42° 20' N
    1800 W of 77° 15 W
    Bath 15' quad.
    Bath Twp.
    Steuben Co., NY
    Elev. 1073 GL, TD 3347
    API No. 31-101-02679

12. Empire Gas and Fuel Co.
Amos Rogers No. 1
Greenwood 15' quad.
Greenwood Twp.
Steuben Co., NY
API No. 31-101-00053

13. National Fuel Gas Supply Co.
(EGSP NY No. 1)
No. 6213 (JO)
9430 S of 42° 22' 30" N
7620 W of 77° 47' 30" W
Almond Twp.
Allegany Co., NY
Elev. 1852.7 KB, 1839.7 GL, TD 2975
API No. 31-003-13549

14. International Salt Company
H. Stewart No. 6701
42° 44' 43" N
77° 50' 24" W
Nunda 15' quad.
Livingston Co., NY
Elev. 603.45 KB, 578.45 GL, TD 1439
API No. 31-051-14100

15. Bradley Prod. Corp.
H. Ames No. 1
Wirt Twp.
Allegany Co., NY
API No. 31-003-04654

16. Great Lakes Gas Corp.
R. Hall et al No. 1
Attica 15' quad.
Bennington Twp.
Wyoming Co., NY
API No. 31-121-04542

17. Iroquois Gas Corp.
Well No. 796
42° 35' 30" N
78° 45' 10" W
Eden 15' quad.
Concord Twp.
Erie Co., NY
API No. 31-029-03269

18. Comaco Oil Inc.
Salamanca 15' quad.
Carrollton Twp.
Cattaraugus Co., NY
API No. 31-009-05106

19. Devonian Gas and Oil Co.
Seneca Nations No. 3
Allegany Indian Reservation
Randolph 15' quad.
South Valley Twp.
Cattaraugus Co., NY
Elev. 1300.6 GL, TD 4680
API No. 31-009-04088

20. C. E. Bournique et al.
Robert Bates No. 1
Chautauqua 15' quad.
Ellery Twp.
Chautaugua Co., NY
API No. 31-013-01457

21. Apache Corp.
Carnahan No. 1
1000 S of 42° 10' N
19000 W of 79° 40' W
Clymer quad.
Mina Twp.
Chautaugua Co., NY
Elev. 1485.5 GL, TD 3578
API No. 31-013-04152

22. Pure Oil Co.
C. Blemle No. 1
740 S of 41° 35' N
7700 W of 76° 20' W
Monroeton quad.
Wilmot Twp.
Bradford Co., PA
Elev. 1560.8 GL, TD 12817
API No. 37-015-00001

23. California Company
A. W. Bennett No. 1
6700 N of 41° 20' N
4350 W of 76° 30' W
Eaglesmere 15-min. quad.
Davidson Twp.
Sullivan Co., PA
Elev. 1482 DF, TD 12343
API No. 37-113-00005

24. New York State Natural Gas Corp.
Pennsylvania Tract 101 No. 1
Renova East quad.
Lycoming Co., PA
API No. 37-081-20004

25. Texaco
General Refractories No. 1
40° 56" 47" N
78° 16" 40" W
Houtzdale quad.
Clearfield Co., PA
API No. 37-033-20537

26. Peoples Natural Gas Corp.
Weldon No. 1
3.0 mi S of 40° 40' N
1.5 mi W of 78° 20' W
Altoona quad.
Antis Twp.
Blair Co., PA
Elev. 1473 GL, TD 5820
API No. 37-013-20006

27. Pennzoil
Reidingsfelder No. 1
6950 S of 40° 20' N
4475 W of 78° 50' W
Johnstown quad.
Richland Twp.
Cambria Co., PA
Elev. 2218 GL, TD 9590
API No. 37-021-20013

28. Peoples Natural Gas Co.
N. R. Mowry No. 1
Berlin quad.
Allegheny Twp.
Somerset Co., PA
Elev. 1952 GL, TD 9253
API No. 37-111-20029

29. Peoples Natural Gas Co.
H. K. Dupre No. 1
Donegal quad.
Middle Creek Twp.
Somerset Co., PA
Elev. N/A, TD 8189
API No. 37-111-20034

30. Zenith Oil Co.
Ryan No. 2
Bruceton Mills quad.
Fayette Co., PA
API No. 37-051-20094

31. Minard Run Oil Company
(EGSP-PA No. 1)
Minard Run Exploration No. 1
1100 S 41° 52' 30" N
2900 E 78° 37' 30" W
Cyclone quad.
Lafayette Twp.
McKean Co., PA
Elev. 2260 GL, TD 5230
API No. 37-083-36382

32. Peoples Natural Gas
L. M. Martin No. 4
2 mi S of 40° 55' N
1 mi W of 79° 20' W
Rural Valley quad.
Wayne Twp.
Armstrong Co., PA
Elev. 1585 GL, TD 6891
API No. 37-005-00005

33. Gruy Federal, Inc.
(EGSP-PA No. 4)
Glenn McCall No. 5
White Twp.
Indiana quad.
Indiana Co., PA
Elev. 1535 KB, 1523 GL, TD 7868
API No. 37-063-25073

34. Fox and Sloan
F. M. Sloan No. 1
Greensburg quad.
Franklin Twp.
Westmoreland Co., PA
Elev. N/A, TD 7415
API No. 37-129-00080

35. Combustion Engineering
(EGSP-PA No. 2)
Consolidated Edison Power System No. 1
40° 11' 30" N
79° 53' 30" W
Monongahela quad.
Allegheny Co., PA
Elev. 759, TD 7505
API No. 37-003-20980

36. Fox and Coen
Gordon No. 4
Waynesburg quad.
Green Co., PA
API No. 37-059-20038

37. Columbia Gas Transmission Corp.
H. Christensen No. 1
41° 55' 14" N
78° 33' 12" W
Corry quad.
Warren Co., PA
Elev. 1525 GL, TD 4664
API No. 37-123-24704

38. Fairman et al
J. May No. 1
1.7 mi N of 41° 10' N
2 mi W of 79° 20' W
Clarion quad.
Clarion Twp.
Clarion Co., PA
Elev. 1451 KB, TD 7906
API No. 37-031-20168

39. United Natural Gas Corp.
Minnis No. 1
Stoneboro quad.
Mercer Co., PA
API No. 37-085-00018

40. Quaker State Oil Refining Co.
Metropolitian Industries No. 1
40° 45" 01" N
80° 27' 38" W
Columbiana quad.
East Palestine Twp.
Beaver Co., PA
Elev. 948 GL, TD 6654
API No. 37-007-20054

41. Monsanto Research Corp.
(EGSP-PA No. 3)
Presque Isle State Park No. 1
4100 S of 42° 10' 00" N
440 W of 80° 07' 30" W
Erie North quad.
Erie Co., PA
Elev. 580, TD 1276
API No. 37-049-20846

42. Ohio Oil Co.
N. Blickensdefer No. 22
4.09 mi W of 80° 30' W
1.74 mi S of 42° 00' N
Girard quad.
Springfield Twp.
Erie Co., PA
Elev. 642 GL, TD 4457
API No. 37-049-00412

43. Thurlow Weed and Associates
(EGSP-OH No. 4)
Bessemer and Lake Erie RR No. 1
6500 S of 41° 57' 30" N
2900 W of 80° 32' 30" W
Conneaut Twp., Conneaut quad.
Ashtabula Co., OH
Elev. 583 GL
API No. 34-007-21087

44. International Salt Company
Fred C. Gerald No. 1
40° 10' 32" N
80° 52' 21" W
Saybrook Twp., Ashtabula South quad.
Ashtabula Co., OH
Elev. 691 GL, TD 2400
API No. 34-007-06002

45. Diamond Alkali Company
Diamond Alkali Company No. 201
728,530 N, 2,338,560 E
Lot 18, Concord Twp., Mentor quad.
Lake., OH
Elev. 882 GL, TD 3104
API No. 34-085-06002

46. International Salt Company
Whiskey Island Core
City of Cleveland No. 1
666,160 N
2,214,770 E
Cuyahoga Co., OH
Elev. 582.9 GL, TD 2400
API No. 34-035-01001

47. Ohio Edison Company
Erie Nuclear Power Plant No. B-19
611,971 N
2,006,989 E
Berlin Twp.
Erie Co., OH
Elev. 656.5 GL, TD 346
API No. 34-043-20057

48. Columbia Gas Transmission Corp.
(EGSP-OH No. 5)
B & R McGuire No. 20149T
568,600 N
2,130,500 E
1,315 FNL X FEL Lot 65
Grafton Twp., Lagrange quad.
Lorain Co., OH
Elev. 878 GL, 888 KB, TD 1340
API No. 34-093-21100

49. Columbia Gas Transmission Corp.
(EGSP-OH No. 7)
Anna A Meleski
975 FSL X 1,855 FEL Lot 16
Newton Twp.
Newton Falls quad.
Trumbull Co., OH
Elev. 962 KB, 951 GL, TD 2710
API No. 34-155-21238

50. Belden and Blake, Inc.
(EGSP-OH No. 1)
Glen-Gary No. S-745
40° 37' 34" N
81° 17' 54" W
Rose Twp.
Carroll Co., OH
Elev. 1045 KB, 1039 GL, TD 5187
API No. 34-019-20835

51. Thurlow Weed and Associates
(EGSP-OH No. 3)
Louise Beckholt No. 1
40° 23' 53" N
82° 30' 10" W
Fredericktown quad.
Clinton Twp.
Knox Co., OH
Elev. 990 GL, TD 1260
API No. 34-083-22599

52. Donohue Anstey and Morrill
(EGSP-OH No. 8)
Schockling No. 1
625,730 N,
2,291,950 E
Enoch Twp.
Macksburg quad.
Noble Co., OH
Elev. 860 GL
API No. 34-121-22255

53. River Gas Company
(EGSP-OH No. 2)
Florence L. House No. R109
39° 23' 36" N
81° 33' 48" W
Fleming quad.
Washington Co., OH
Elev. 828 KB, 816 GL, TD 6262
API NO. 34-167-23521

54. Mitchell Energy Corp.
(EGSP-OH No. 6-4)
Straight-Wisemandle Unit 1-B
3100 FNL X 740 FWl Sec. 35
Harrison Twp.
Gallia Co., OH
Elev. 921 KB, 910 GL, TD 3072
API No. 34-053-20477

55. U.S. Department of Energy
(EGSP-WV No. 6)
MERC No. 1
0.13 mi N of 39° 40' N
3.15 mi W of 79° 55' W
Morgan Dist.
Monongalia Co., WV
Elev. 973 KB, 959 GL, TD 7520
API No. 47-061-20370

56. Mobay Chemical Corp.
(EGSP-WV No. 7)
H. Emch and A. Pyles Unit No. 1
39° 40' 37" N
80° 49' 26" W
New Martinsville quad.
Proctor Dist.
Wetzel Co., WV
Elev. 1344 GL, 1355 KB, TD 7007
API No. 47-103-20645

57. Consolidated Gas Company
(EGSP-WV No. 1)
E. L. Bailer No. 11940
0.32 mi S of 38° 50' 00" N
2.18 mi W of 81° 50' 00" W
Jackson Co., WV
Elev. 846 KB, 835 GL, TD 3935
API No. 47-035-21369

58. Consolidated Gas Company
(EGSP-WV No. 2)
W. L. Pinnell 12041
38° 57' 35" N
81° 49' 08" W
Jackson Co., WV
Elev. 673 KB, 662 GL, TD 3744
API No. 47-035-21371

59. Reel Energy, Inc.
(EGSP-WV No. 5)
D/K Farm No. 3
38° 55' 30" N
82° 03' 45" W
Cheshire quad.
Robinson Dist.
Mason Co., WV
Elev. 675 KB, 665 Gl, TD 3420
API No. 47-053-20146

60. Columbia Gas Transmission Corp
(EGSP-WV No. 4)
No. 20402
4.83 mi S of 38° 10' 00" N
3.94 mi W of 82° 10' 10" W
Lincoln Co., WV
Elev. 1163 KB, 1153 Gl, TD 3983
API No. 47-043-21636

61. Columbia Gas Transmission Corp
(EGSP-WV No. 3)
No. 20403
4.5 mi S of 38° 10' 00" N
3.1 mi W of 82° 10' 00" W
Lincoln Co., WV
Elev. 1202 KB, 1190 GL, TD 4065
API No. 47-043-21637

62. Godfrey L. Cabot
C. E. Quinn No. 1
3.27 mi S of 37° 50' N
4.62 mi W of 80° 50' W
Meadow Creek quad.
Richmond Dist.
Raleigh Co., WV
Elev. 1294 GL, TD 6397
API No. 47-081-00036

63. Columbian Carbon Co.
USA I-3 No. 1297
Durbin quad.
Greenbank Dist.
Pocahontas Co., WV
Elev. N/A, TD 6055
API No. 47-075-00015

64. Shell Oil Co.
R. J. Whetzel No. 1
4.7 mi N of 38° 50' N
2.1 mi W of 78° 55' W
Orkney Springs quad.
Rockingham Co., VA
Elev. 1464.8 GL, TD 14,176
API No. 45-165-20007

65. Columbia Gas Transmission Corp.
(EGSP-VA No. 1)
No. 20338
37° 00' 37" N
82° 41' 14" W
Flat Gap quad.
Wise Co., VA
Elev. 2405.5 KB, 2395.5 GL, TD 5741
API No. 45-195-20253

66. Columbia Gas Transmission Corp.
(EGSP-KY No. 3)
No. 20336
2750 FNL X 1650 FWL Sec. 16-P-85
Kermit quad.
Martin Co., KY
Elev. 994 KB, 934 GL, TD 3457
API No. 16-159-31020

67. Ashland Oil Company
(EGSP-KY No. 4)
Skaggs-Kelley Unit No. 3-RS
36° 57' 40" N, 82° 56' 20" W
1780 FNL X 1230 FEL Sec. 12-R-79
Redbush quad.
Johnson Co., KY
Elev. 961 GL, 972 KB, TD 1510
API No. 16-115-33985

68. Nuclear Engineering Company
NECO No. 5E (Maxey Flats)
2600 FSL X 600 FEL Sec. 25-V-72
Plummers Landing quad.
Fleming Co., KY
Elev. 1022, TD 317
API No. 16-069-06001

69. Kentucky West Virginia Gas
(EGSP-KY No. 1)
Nicholas Combs No. 7239
1960 FNL X 325 SWL Sec. 19-K-76
Hazard North quad.
Perry Co., KY
Elev. 1090 KB, 1080 GL, TD 3734
API No. 16-193-28982

70. W. Blankenship
(KGS No. C-182)
Redman No. 1
1500 FNL X 200 FWL Sec. 9-G-53
Russell Springs quad.
Russell Co., KY
Elev. 960, TD 235
API No. 16-207-90003

71. Murray Drilling Co.
Jeff Story (Bell) No. 1
800 FNL X 900 FWL Sec. 1-E-53
Jamestown quad.
Russell Co., KY
Elev. 995
API No. 16-207-32515

72. Tennessee Geological Survey
(EGSP-TN No. 3)
803,150 N
2,836,050 E
Sneedville quad.
Hancock Co., TN
Elev. 1230, TD 755.6
API No. 41-067-01001

73. Tennessee Geological Survey
(EGSP-TN No. 4)
761,500 N
2,855,050 E
Pressmens Home quad.
Hawkins Co., TN
Elev. 1245, TD 1525.1
API No. 41-073-01002

74. Tennessee Geological Survey
(EGSP-TN No. 1)
767,150 N
2,756,500 E
Howard Quarter quad.
Claiborne Co., TN
Elev. 1100, TD 254
API No. 41-025-06001

Tennessee Geological Survey
(EGSP-TN No. 2)
765,900 N
2,755,300 E
Howard Quarter quad.
Claiborne Co., TN
Elev. 1120, TD 115.6
API No. 41-025-06002

75. Grainger County Commission
(EGSP-TN No. 9)
Grainger Co. Industrial Park
36° 18' 56" N
83° 24' 23" W
Avondale quad.
Grainger Co., TN
API No. 41-057-01003

76. Dresser Industries
OCI-8 Diamond Drill Hole
100 FSL X 1650 FWL Sec. 4-38-52 E
Crawford quad.
Overton Co., TN
Elev. 900+ GL, TD 409+
API No. 41-133-90001

77. U.S. Bureau of Mines
NV-56, Watkins Gran
36° 23' 55" N
86° 35' 45" W
Cottontown quad.
Sumner Co., TN
Elev. N/A, TD 44.9
API No. 41-165-06001

78. U.S. Bureau of Mines
NV-54, G. F. Stenberg
36° 15' 05" N
86° 52' 15" W
Forest Grove quad.
Davidson Co., TN
Elev. N/A, TD 41.7
API No. 41-037-01001

79. U.S. Bureau of Mines
YB-39, Everett Pedigo
35° 58' 30" N
85° 45' 45" W
Smithville quad.
Dekalb Co., TN
Elev. N/A, TD 179.1
API No. 41-041-01001

80. U.S. Bureau of Mines
WR-50, J. C. Kammer and Son
35° 52' 10" N
84° 53' 30"
Dorton quad.
Cumberland Co., TN
Elev. N/A, TD 177.2
API No. 41-035-06001

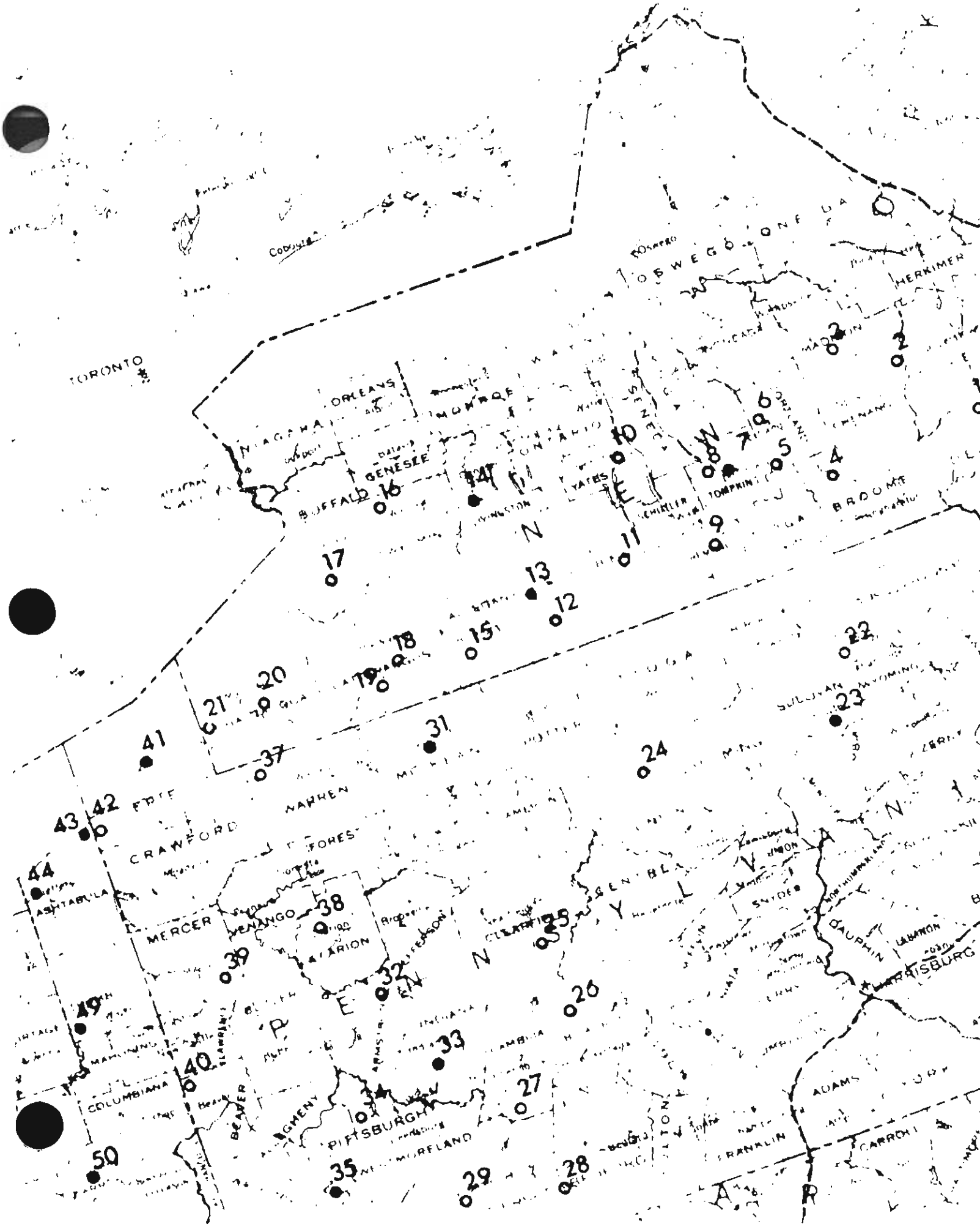
81. U.S. Bureau of Mines
YB-43, Hockett
35° 38" N
86° 05' W
Fredonia quad.
Coffee Co., TN
Elev. N/A, TD 119.3
API No. 41-031-01001

82. U.S. Bureau of Mines
YB-45, Cumberland Springs Land
35° 19' 30" N
86° 15' 40" W
Cumberland Springs quad.
Moore Co., TN
Elev. N/A, TD 21.4
API No. 41-127-01001

83. U.S. Bureau of Mines
WR-47, Mattie Barber
35° 11' 15" N
85° 26' W
Ketner Gap quad.
Marion Co, TN
Elev. N/A, TD 311.8
API No. 41-115-01001

84. U.S. Bureau of Mines
AL-65, Paul Freeman
34° 04' 05" N
86° 29' 20" W
Susan Moore quad.
Blount Co., AL
Elev. N/A, TD 52.4
API No. 01-009-01001

Figure 1. Map showing location of drill holes from which samples were analyzed. Solid dots indicate that samples were taken from drill cores. Open circles indicate that samples were taken from drill cutting. (Dashed line is boundary of Appalachian basin.)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BROOME
CHENANGO
SULLIVAN
WYOMING
CRAWFORD
WARREN
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VENANGO
CLARION
CLEARFIELD
SNYDER
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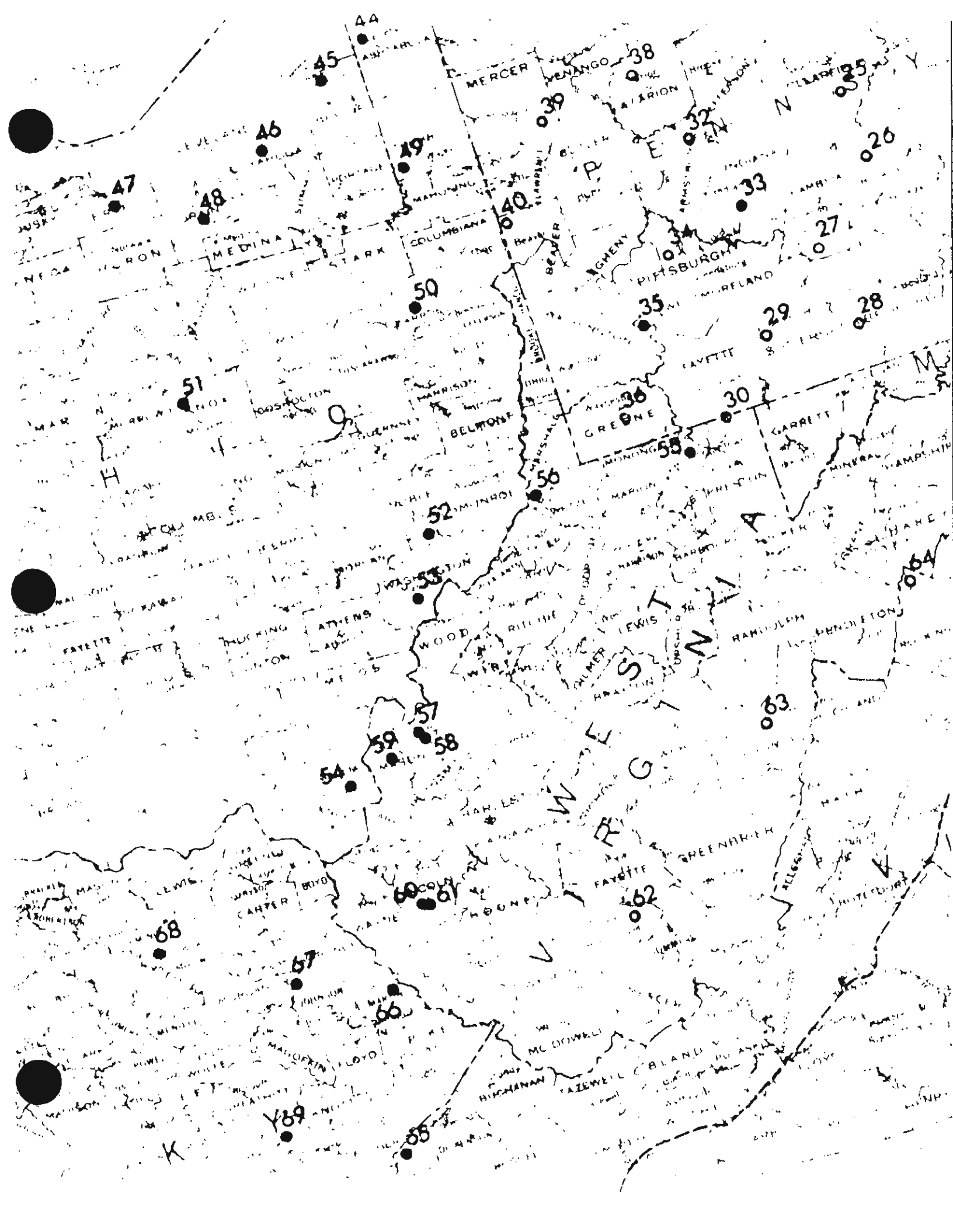

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MORELAND
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BELMONT
COLUMBIANA
MEDINA
STARK
HARRISON
WASHINGTON
ATHENS
WOOD
RITCHIE
LEWIS
RANDOLPH
PENDLETON
GREENBRIER
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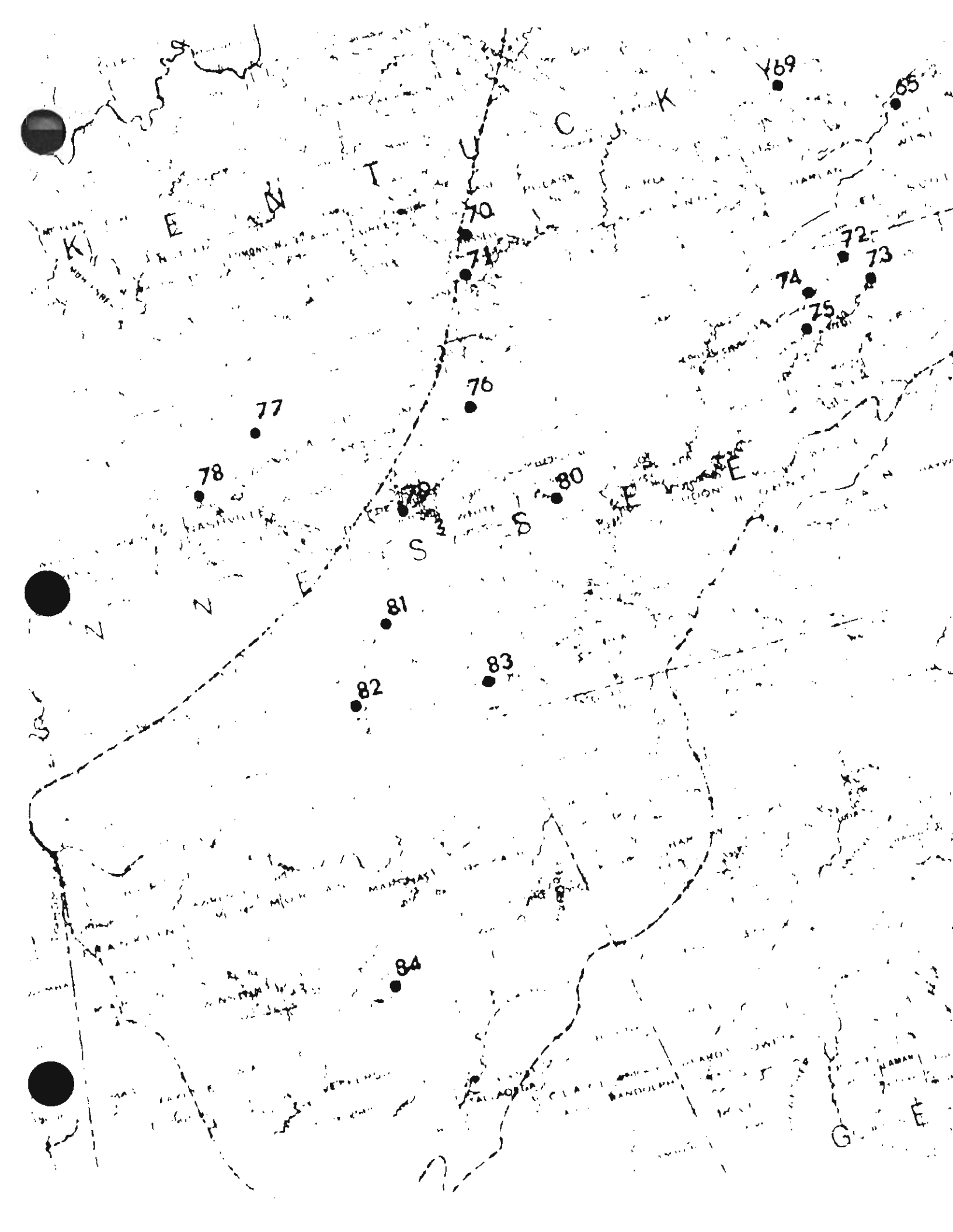
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Figure 1. Map showing location of drill holes from which samples were analyzed. Solid dots indicate that samples were taken from drill cores. Open circles indicate that samples were taken from drill cutting. (Dashed line is boundary of Appalachian basin.)

LIST OF DRILL HOLES

1. Gulf Oil Corp.
   C. E. Leslie No. 1
   1.9 mi S of 42° 25'
   2.3 mi W of 75° 00'
   Oneonta 15' quad.
   Franklin Twp.
   Delaware Co., NY
   Elev. 1486 GL, TD 7952
   API No. 31-025-04455

2. Bradley Producing Co.
   C. C. Lobdell No. 1
   9700 N of 42° 40' N
   3150 W of 75° 20' W
   New Berlin 15' quad.
   Columbus Twp.
   Chenango Co., NY
   Elev. 1373 DF, TD 5637
   API No. 31-017-01160

3. New York State Natural Gas Corp.
   D. L. Branagan No. 1
   2 mi S of 42° 50' N
   3.4 mi W of 75° 35' W
   Morrisville 15' quad.
   Lebanon Twp.
   Madison Co., NY
   Elev. 1544 GL, TD 5703
   API No. 31-053-03970

4. Fenix and Scissen
   L and N Richards No. 1
   3600 S of 42° 20' N
   8430 W of 75° 55' W
   Greene 15' quad.
   Triangle Twp.
   Broome Co., NY
   Elev. 996 GL, TD 9640
   API No. 31-007-05087

5. C. Fralich and Suburban Propane
   Phillip Overbaugh No. 1
   Harford 15' quad.
   Harford Twp.
   Cortland Co., NY
   API No. 31-023-02308

6. New York State Natural Gas Corp.
   R. A. Butler No. 1
   Cortland 15' quad.
   Homer Twp.
   Cortland Co., NY
   API No. 31-023-00644

7. Cargill Salt Company
   Core Test No. 17
   1.29 mi S of 42° 32' 30" N
   0.27 mi W of 76° 30' W
   Lansing Twp.
   Tompkins Co., NY
   Elev. 835 DF, TD 2784
   API No. 31-109-13173

8. Great Lakes Gas Corp.
   J. W. Agard No. 1
   Genoa 15' quad.
   Ulysses Twp.
   Tompkins Co., NY
   API No. 31-109-05017

9. Belmont Quad Drilling Corp.
   E. A. Treat No. 118
   Waverly 15' quad.
   Erin Twp.
   Chemung Co., NY
   API No. 31-015-00509

10. CGS Management Co.
    Greger Borglum No. 1
    42° 41' 01" N
    77° 01' 20" W
    Penn Yan 15' quad.
    Benton Twp.
    Yates Co., NY
    API No. 31-123-04796

11. Anchor Petroleum Co.
    Blair Storage Well No. 1
    9400 S of 42° 20' N
    1800 W of 77° 15 W
    Bath 15' quad.
    Bath Twp.
    Steuben Co., NY
    Elev. 1073 GL, TD 3347
    API No. 31-101-02679

12. Empire Gas and Fuel Co.
Amos Rogers No. 1
Greenwood 15' quad.
Greenwood Twp.
Steuben Co., NY
API No. 31-101-00053

13. National Fuel Gas Supply Co.
(EGSP NY No. 1)
No. 6213 (JO)
9430 S of 42° 22' 30" N
7620 W of 77° 47' 30" W
Almond Twp.
Allegany Co., NY
Elev. 1852.7 KB, 1839.7 GL, TD 2975
API No. 31-003-13549

14. International Salt Company
H. Stewart No. 6701
42° 44' 43" N
77° 50' 24" W
Nunda 15' quad.
Livingston Co., NY
Elev. 603.45 KB, 578.45 GL, TD 1439
API No. 31-051-14100

15. Bradley Prod. Corp.
H. Ames No. 1
Wirt Twp.
Allegany Co., NY
API No. 31-003-04654

16. Great Lakes Gas Corp.
R. Hall et al No. 1
Attica 15' quad.
Bennington Twp.
Wyoming Co., NY
API No. 31-121-04542

17. Iroquois Gas Corp.
Well No. 796
42° 35' 30" N
78° 45' 10" W
Eden 15' quad.
Concord Twp.
Erie Co., NY
API No. 31-029-03269

18. Comaco Oil Inc.
Salamanca 15' quad.
Carrollton Twp.
Cattaraugus Co., NY
API No. 31-009-05106

19. Devonian Gas and Oil Co.
Seneca Nations No. 3
Allegany Indian Reservation
Randolph 15' quad.
South Valley Twp.
Cattaraugus Co., NY
Elev. 1300.6 GL, TD 4680
API No. 31-009-04088

20. C. E. Bournique et al.
Robert Bates No. 1
Chautauqua 15' quad.
Ellery Twp.
Chautaugua Co., NY
API No. 31-013-01457

21. Apache Corp.
Carnahan No. 1
1000 S of 42° 10' N
19000 W of 79° 40' W
Clymer quad.
Mina Twp.
Chautaugua Co., NY
Elev. 1485.5 GL, TD 3578
API No. 31-013-04152

22. Pure Oil Co.
C. Blemle No. 1
740 S of 41° 35' N
7700 W of 76° 20' W
Monroeton quad.
Wilmot Twp.
Bradford Co., PA
Elev. 1560.8 GL, TD 12817
API No. 37-015-00001

23. California Company
A. W. Bennett No. 1
6700 N of 41° 20' N
4350 W of 76° 30' W
Eaglesmere 15-min. quad.
Davidson Twp.
Sullivan Co., PA
Elev. 1482 DF, TD 12343
API No. 37-113-00005

24. New York State Natural Gas Corp.
Pennsylvania Tract 101 No. 1
Renova East quad.
Lycoming Co., PA
API No. 37-081-20004

25. Texaco
General Refractories No. 1
40° 56" 47" N
78° 16" 40" W
Houtzdale quad.
Clearfield Co., PA
API No. 37-033-20537

26. Peoples Natural Gas Corp.
Weldon No. 1
3.0 mi S of 40° 40' N
1.5 mi W of 78° 20' W
Altoona quad.
Antis Twp.
Blair Co., PA
Elev. 1473 GL, TD 5820
API No. 37-013-20006

27. Pennzoil
Heidingsfelder No. 1
6950 S of 40° 20' N
4475 W of 78° 50' W
Johnstown quad.
Richland Twp.
Cambria Co., PA
Elev. 2218 GL, TD 9590
API No. 37-021-20013

28. Peoples Natural Gas Co.
N. R. Mowry No. 1
Berlin quad.
Allegheny Twp.
Somerset Co., PA
Elev. 1952 GL, TD 9253
API No. 37-111-20029

29. Peoples Natural Gas Co.
H. K. Dupre No. 1
Donegal quad.
Middle Creek Twp.
Somerset Co., PA
Elev. N/A, TD 8189
API No. 37-111-20034

30. Zenith Oil Co.
Ryan No. 2
Bruceton Mills quad.
Fayette Co., PA
API No. 37-051-20094

31. Minard Run Oil Company
(EGSP-PA No. 1)
Minard Run Exploration No. 1
1100 S 41° 52' 30" N
2900 E 78° 37' 30" W
Cyclone quad.
Lafayette Twp.
McKean Co., PA
Elev. 2260 GL, TD 5230
API No. 37-083-36382

32. Peoples Natural Gas
L. M. Martin No. 4
2 mi S of 40° 55' N
1 mi W of 79° 20' W
Rural Valley quad.
Wayne Twp.
Armstrong Co., PA
Elev. 1585 GL, TD 6891
API No. 37-005-00005

33. Gruy Federal, Inc.
(EGSP-PA No. 4)
Glenn McCall No. 5
White Twp.
Indiana quad.
Indiana Co., PA
Elev. 1535 KB, 1523 GL, TD 7868
API No. 37-063-25073

34. Fox and Sloan
F. M. Sloan No. 1
Greensburg quad.
Franklin Twp.
Westmoreland Co., PA
Elev. N/A, TD 7415
API No. 37-129-00080

35. Combustion Engineering
(EGSP-PA No. 2)
Consolidated Edison Power System No. 1
40° 11' 30" N
79° 53' 30" W
Monongahela quad.
Allegheny Co., PA
Elev. 759, TD 7505
API No. 37-003-20980

36. Fox and Coen
Gordon No. 4
Waynesburg quad.
Green Co., PA
API No. 37-059-20038

37. Columbia Gas Transmission Corp.
H. Christensen No. 1
41° 55' 14" N
78° 33' 12" W
Corry quad.
Warren Co., PA
Elev. 1525 GL, TD 4664
API No. 37-123-24704

38. Fairman et al
J. May No. 1
1.7 mi N of 41° 10' N
2 mi W of 79° 20' W
Clarion quad.
Clarion Twp.
Clarion Co., PA
Elev. 1451 KB, TD 7906
API No. 37-031-20168

39. United Natural Gas Corp.
Minnis No. 1
Stoneboro quad.
Mercer Co., PA
API No. 37-085-00018

40. Quaker State Oil Refining Co.
Metropolitian Industries No. 1
40° 45" 01" N
80° 27' 38" W
Columbiana quad.
East Palestine Twp.
Beaver Co., PA
Elev. 948 GL, TD 6654
API No. 37-007-20054

41. Monsanto Research Corp.
(EGSP-PA No. 3)
Presque Isle State Park No. 1
4100 S of 42° 10' 00" N
440 W of 80° 07' 30" W
Erie North quad.
Erie Co., PA
Elev. 580, TD 1276
API No. 37-049-20846

42. Ohio Oil Co.
N. Blickensdefer No. 22
4.09 mi W of 80° 30' W
1.74 mi S of 42° 00' N
Girard quad.
Springfield Twp.
Erie Co., PA
Elev. 642 GL, TD 4457
API No. 37-049-00412

43. Thurlow Weed and Associates
(EGSP-OH No. 4)
Bessemer and Lake Erie RR No. 1
6500 S of 41° 57' 30" N
2900 W of 80° 32' 30" W
Conneaut Twp., Conneaut quad.
Ashtabula Co., OH
Elev. 583 GL
API No. 34-007-21087

44. International Salt Company
Fred C. Gerald No. 1
40° 10' 32" N
80° 52' 21" W
Saybrook Twp., Ashtabula South quad.
Ashtabula Co., OH
Elev. 691 GL, TD 2400
API No. 34-007-06002

45. Diamond Alkali Company
Diamond Alkali Company No. 201
728,530 N, 2,338,560 E
Lot 18, Concord Twp., Mentor quad.
Lake., OH
Elev. 882 GL, TD 3104
API No. 34-085-06002

46. International Salt Company
Whiskey Island Core
City of Cleveland No. 1
666,160 N
2,214,770 E
Cuyahoga Co., OH
Elev. 582.9 GL, TD 2400
API No. 34-035-01001

47. Ohio Edison Company
Erie Nuclear Power Plant No. B-19
611,971 N
2,006,989 E
Berlin Twp.
Erie Co., OH
Elev. 656.5 GL, TD 346
API No. 34-043-20057

48. Columbia Gas Transmission Corp.
(EGSP-OH No. 5)
B & R McGuire No. 20149T
568,600 N
2,130,500 E
1,315 FNL X FEL Lot 65
Grafton Twp., Lagrange quad.
Lorain Co., OH
Elev. 878 GL, 888 KB, TD 1340
API No. 34-093-21100

49. Columbia Gas Transmission Corp.
(EGSP-OH No. 7)
Anna A Meleski
975 FSL X 1,855 FEL Lot 16
Newton Twp.
Newton Falls quad.
Trumbull Co., OH
Elev. 962 KB, 951 GL, TD 2710
API No. 34-155-21238

50. Belden and Blake, Inc.
(EGSP-OH No. 1)
Glen-Gary No. S-745
40° 37' 34" N
81° 17' 54" W
Rose Twp.
Carroll Co., OH
Elev. 1045 KB, 1039 GL, TD 5187
API No. 34-019-20835

51. Thurlow Weed and Associates
(EGSP-OH No. 3)
Louise Beckholt No. 1
40° 23' 53" N
82° 30' 10" W
Fredericktown quad.
Clinton Twp.
Knox Co., OH
Elev. 990 GL, TD 1260
API No. 34-083-22599

52. Donohue Anstey and Morrill
(EGSP-OH No. 8)
Schockling No. 1
625,730 N,
2,291,950 E
Enoch Twp.
Macksburg quad.
Noble Co., OH
Elev. 860 GL
API No. 34-121-22255

53. River Gas Company
(EGSP-OH No. 2)
Florence L. House No. R109
39° 23' 36" N
81° 33' 48" W
Fleming quad.
Washington Co., OH
Elev. 828 KB, 816 GL, TD 6262
API NO. 34-167-23521

54. Mitchell Energy Corp.
(EGSP-OH No. 6-4)
Straight-Wisemandle Unit 1-B
3100 FNL X 740 FWl Sec. 35
Harrison Twp.
Gallia Co., OH
Elev. 921 KB, 910 GL, TD 3072
API No. 34-053-20477

55. U.S. Department of Energy
(EGSP-WV No. 6)
MERC No. 1
0.13 mi N of 39° 40' N
3.15 mi W of 79° 55' W
Morgan Dist.
Monongalia Co., WV
Elev. 973 KB, 959 GL, TD 7520
API No. 47-061-20370

56. Mobay Chemical Corp.
(EGSP-WV No. 7)
H. Emch and A. Pyles Unit No. 1
39° 40' 37" N
80° 49' 26" W
New Martinsville quad.
Proctor Dist.
Wetzel Co., WV
Elev. 1344 GL, 1355 KB, TD 7007
API No. 47-103-20645

57. Consolidated Gas Company
(EGSP-WV No. 1)
E. L. Bailer No. 11940
0.32 mi S of 38° 50' 00" N
2.18 mi W of 81° 50' 00" W
Jackson Co., WV
Elev. 846 KB, 835 GL, TD 3935
API No. 47-035-21369

58. Consolidated Gas Company
(EGSP-WV No. 2)
W. L. Pinnell 12041
38° 57' 35" N
81° 49' 08" W
Jackson Co., WV
Elev. 673 KB, 662 GL, TD 3744
API No. 47-035-21371

59. Reel Energy, Inc.
(EGSP-WV No. 5)
D/K Farm No. 3
38° 55' 30" N
82° 03' 45" W
Cheshire quad.
Robinson Dist.
Mason Co., WV
Elev. 675 KB, 665 Gl, TD 3420
API No. 47-053-20146

60. Columbia Gas Transmission Corp
(EGSP-WV No. 4)
No. 20402
4.83 mi S of 38° 10' 00" N
3.94 mi W of 82° 10' 10" W
Lincoln Co., WV
Elev. 1163 KB, 1153 Gl, TD 3983
API No. 47-043-21636

61. Columbia Gas Transmission Corp
(EGSP-WV No. 3)
No. 20403
4.5 mi S of 38° 10' 00" N
3.1 mi W of 82° 10' 00" W
Lincoln Co., WV
Elev. 1202 KB, 1190 GL, TD 4065
API No. 47-043-21637

62. Godfrey L. Cabot
C. E. Quinn No. 1
3.27 mi S of 37° 50' N
4.62 mi W of 80° 50' W
Meadow Creek quad.
Richmond Dist.
Raleigh Co., WV
Elev. 1294 GL, TD 6397
API No. 47-081-00036

63. Columbian Carbon Co.
USA I-3 No. 1297
Durbin quad.
Greenbank Dist.
Pocahontas Co., WV
Elev. N/A, TD 6055
API No. 47-075-00015

64. Shell Oil Co.
R. J. Whetzel No. 1
4.7 mi N of 38° 50' N
2.1 mi W of 78° 55' W
Orkney Springs quad.
Rockingham Co., VA
Elev. 1464.8 GL, TD 14,176
API No. 45-165-20007

65. Columbia Gas Transmission Corp.
(EGSP-VA No. 1)
No. 20338
37° 00' 37" N
82° 41' 14" W
Flat Gap quad.
Wise Co., VA
Elev. 2405.5 KB, 2395.5 GL, TD 5741
API No. 45-195-20253

66. Columbia Gas Transmission Corp.
(EGSP-KY No. 3)
No. 20336
2750 FNL X 1650 FWL Sec. 16-P-85
Kermit quad.
Martin Co., KY
Elev. 994 KB, 934 GL, TD 3457
API No. 16-159-31020

67. Ashland Oil Company
(EGSP-KY No. 4)
Skaggs-Kelley Unit No. 3-RS
36° 57' 40" N, 82° 56' 20" W
1780 FNL X 1230 FEl Sec. 12-R-79
Redbush quad.
Johnson Co., KY
Elev. 961 GL, 972 KB, TD 1510
API No. 16-115-33985

68. Nuclear Engineering Company
NECO No. 5E (Maxey Flats)
2600 FSL X 600 FEL Sec. 25-V-72
Plummers Landing quad.
Fleming Co., KY
Elev. 1022, TD 317
API No. 16-069-06001

69. Kentucky West Virginia Gas
(EGSP-KY No. 1)
Nicholas Combs No. 7239
1960 FNL X 325 SWL Sec. 19-K-76
Hazard North quad.
Perry Co., KY
Elev. 1090 KB, 1080 GL, TD 3734
API No. 16-193-28982

70. W. Blankenship
(KGS No. C-182)
Redman No. 1
1500 FNL X 200 FWL Sec. 9-G-53
Russell Springs quad.
Russell Co., KY
Elev. 960, TD 235
API No. 16-207-90003

71. Murray Drilling Co.
Jeff Story (Bell) No. 1
800 FNL X 900 FWl Sec. 1-E-53
Jamestown quad.
Russell Co., KY
Elev. 995
API No. 16-207-32515

72. Tennessee Geological Survey
(EGSP-TN No. 3)
803,150 N
2,836,050 E
Sneedville quad.
Hancock Co., TN
Elev. 1230, TD 755.6
API No. 41-067-01001

73. Tennessee Geological Survey
(EGSP-TN No. 4)
761,500 N
2,855,050 E
Pressmens Home quad.
Hawkins Co., TN
Elev. 1245, TD 1525.1
API No. 41-073-01002

74. Tennessee Geological Survey
(EGSP-TN No. 1)
767,150 N
2,756,500 E
Howard Quarter quad.
Claiborne Co., TN
Elev. 1100, TD 254
API No. 41-025-06001

Tennessee Geological Survey
(EGSP-TN No. 2)
765,900 N
2,755,300 E
Howard Quarter quad.
Claiborne Co., TN
Elev. 1120, TD 115.6
API No. 41-025-06002

75. Grainger County Commission
(EGSP-TN No. 9)
Grainger Co. Industrial Park
36° 18' 56" N
83° 24' 23" W
Avondale quad.
Grainger Co., TN
API No. 41-057-01003

76. Dresser Industries
OCI-8 Diamond Drill Hole
100 FSL X 1650 FWL Sec. 4-38-52 E
Crawford quad.
Overton Co., TN
Elev. 900+ GL, TD 409+
API No. 41-133-90001

77. U.S. Bureau of Mines
NV-56, Watkins Gran
36° 23' 55" N
86° 35' 45" W
Cottontown quad.
Sumner Co., TN
Elev. N/A, TD 44.9
API No. 41-165-06001

78. U.S. Bureau of Mines
NV-54, G. F. Stenberg
36° 15' 05" N
86° 52' 15" W
Forest Grove quad.
Davidson Co., TN
Elev. N/A, TD 41.7
API No. 41-037-01001

79. U.S. Bureau of Mines
YB-39, Everett Pedigo
35° 58' 30" N
85° 45' 45" W
Smithville quad.
Dekalb Co., TN
Elev. N/A, TD 179.1
API No. 41-041-01001

80. U.S. Bureau of Mines
WR-50, J. C. Kemmer and Son
35° 52' 10" N
84° 53' 30"
Dorton quad.
Cumberland Co., TN
Elev. N/A, TD 177.2
API No. 41-035-06001

81. U.S. Bureau of Mines
YB-43, Hockett
35° 38" N
86° 05' W
Fredonia quad.
Coffee Co., TN
Elev. N/A, TD 119.3
API No. 41-031-01001

82. U.S. Bureau of Mines
YB-45, Cumberland Springs Land
35° 19' 30" N
86° 15' 40" W
Cumberland Springs quad.
Moore Co., TN
Elev. N/A, TD 21.4
API No. 41-127-01001

83. U.S. Bureau of Mines
WR-47, Mattie Barber
35° 11' 15" N
85° 26' W
Ketner Gap quad.
Marion Co, TN
Elev. N/A, TD 311.8
API No. 41-115-01001

84. U.S. Bureau of Mines
AL-65, Paul Freeman
34° 04' 05" N
86° 29' 20" W
Susan Moore quad.
Blount Co., AL
Elev. N/A, TD 52.4
API No. 01-009-01001