STATE OF OHIO
Richard F. Celeste, Governor
DEPARTMENT OF NATURAL RESOURCES
Joseph J. Sommer, Director
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

Information Circular No. 56

LITHOLOGIC AND GEOPHYSICAL DESCRIPTION OF A CONTINUOUSLY CORED HOLE IN WARREN COUNTY, OHIO, INCLUDING DESCRIPTION OF THE MIDDLE RUN FORMATION (PRECAMBRIAN?) AND A SEISMIC PROFILE ACROSS THE CORE SITE

by

Douglas L. Shrake, Paul J. Wolfe, Benjamin H. Richard, E. Mac Swinford, Lawrence H. Wickstrom, Paul E. Potter, and Gary W. Sitler

Columbus
1990

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DIVISION OF GEOLOGICAL SURVEY
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LITHOLOGIC AND GEOPHYSICAL DESCRIPTION OF A CONTINUOUSLY CORED HOLE IN WARREN COUNTY, OHIO, INCLUDING DESCRIPTION OF THE MIDDLE RUN FORMATION (PRECAMBRIAN?) AND A SEISMIC PROFILE ACROSS THE CORE SITE

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INTRODUCTION

This report presents (1) a lithologic column, selected geophysical logs, and a core description from a 5,380-foot-deep continuously cored hole, and (2) a seismic profile from an 8-mile-long seismic reflection survey in Warren County, southwestern Ohio (fig. 1). The core hole, DGS 2627, was drilled by the Ohio Department of Natural Resources, Division of Geological Survey between October 1987 and May 1989 as part of an ongoing series of core holes documenting the geology, stratigraphy, structure, and mineral and hydrocarbon potential of Lower Paleozoic and older rocks in western Ohio. The seismic survey, administered by the Departments of Geological Sciences and Physics of Wright State University, was conducted to determine the nature of the pre-Mount Simon subsurface geology in the vicinity of the core hole.

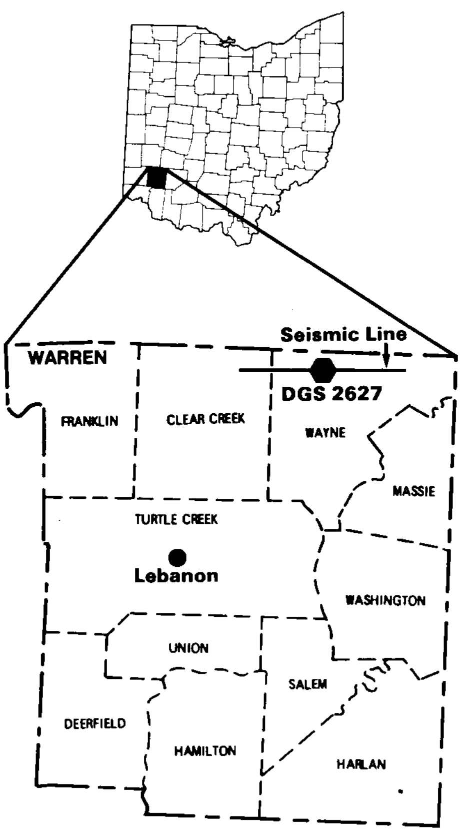


FIGURE 1.—Location of core site DGS 2627 and seismic line in Warren County, Ohio.

The objective of the core hole was to drill through the Paleozoic section into the rocks underlying the Mount Simon Sandstone (Upper Cambrian). Prior to drilling, project geologists expected to encounter crystalline basement below the Mount Simon. However, after a continuous section from the Drakes Formation (Upper Ordovician) through the Mount Simon Sandstone had been cored, a new sedimentary unit was encountered at 3,470 feet below the surface. A total of 1,910 feet of this pre-Mount Simon unit was cored without encountering crystalline rock. This new sedimentary unit, herein named the Middle Run Formation and described in this report, was unexpected and represents an exciting discovery.

After a substantial thickness (approximately 700 feet) of the Middle Run Formation had been drilled, it was decided to conduct a seismic survey to determine if crystalline basement was within the depth capacity (5,700 feet) of the drill rig. A consortium of government, academic, and industry representatives was formed to generate funding for acquisition of a seismic line and additional drilling equipment. Local utilities, oil companies, and individuals were solicited for funds to support the project. Adequate funding (see Acknowledgments) was received to acquire 8 miles of seismic data and drill rods to deepen the hole to a seismic reflector within the Middle Run Formation.

ACKNOWLEDGMENTS

The successful completion of the Warren County core hole and seismic survey was possible only with the generous contributions and support of the following individuals and businesses.

Drilling contributors: Ashland Exploration, Inc., Belden & Blake Corp., Columbia Natural Resources, Inc., CNG Development Co., Dr. Richard H. Durrell, Lomak Petroleum (Ohio), Inc., Paragon Energy Co., Petro Evaluation Services, Inc., Quaker State Corp., and Stone Resources and Energy Corp.

Seismic contributors: Cincinnati Gas & Electric Co., Dayton Power & Light Co., Columbia Natural Resources, Inc., Hosking Geophysical Corp., Paragon Geophysical, Inc., Stocker & Sitler, Inc., Strata Search, Inc., Stroder & Unruh Geophysical Corp., Unocal, Inc., and Woods Geophysical, Inc.

The authors thank other Survey employees who assisted in the preparation of this report. Ronald A. Riley provided computer plots of the geophysical logs. James Wooten assisted in preparing the core for examination at the Survey's core facility. Ronald G. Rea assisted with the fluorescence examination. David A. Stith conducted the x-ray diffraction analysis. Gregory A. Schumacher assisted in the description of the Black River Group, Wells Creek Formation, and a portion of the Knox interval. Angelena M. Bailey assisted in the preparation of the text.

DRILLING AND DISCUSSION OF CORE 2627

by

Douglas L. Shrake, E. Mac Swinford, and Lawrence H. Wickstrom

LOCATION AND DRILLING INFORMATION

The Ohio Division of Geological Survey (DGS) core hole DGS 2627 is located in an American Aggregates Corporation quarry approximately 1 mile northeast of the town of Lytle in the NE¼ sec. 14, T. 3, R. 5, Wayne Township, Warren County, Ohio (fig. 2). DGS 2627 was drilled using the Survey's Longyear Hydro-44 diamond core-drill rig operated by Michael J. Mitchell, driller, and Mark E. Clary, drilling assistant. The drill rig was sited on bedrock (ground elevation 1,005 feet), but the topmost 11.6 feet of bedrock was drilled with a tri-cone roller bit to set 10 feet of NW surface casing ($3\frac{1}{2}$-inch outside diameter). Over the course of the project, surface-casing depth was increased to 30 feet.

The hole was cored to a depth of 2,690 feet using NQ drill bits ($2\frac{23}{64}$-inch hole diameter, $1\frac{7}{8}$-inch core diameter) and NCQ drill rods ($2\frac{3}{4}$-inch outside diameter). From 2,020 to 2,030 feet the Knox Dolomite was drilled with a tri-cone roller bit and was not cored because of poor coring conditions. Shredded money acquired from the U.S. Federal Reserve Bank in Cincinnati, Ohio, was used as lost circulation material in the Knox (Crowell, 1989). The shredded money was flushed down through the drill string and forced into the formation, where it sealed off the formation and returned fluid circulation to the core hole. The NCQ drill string was set as intermediate casing to seal off freshwater aquifers and vugular zones within the Knox Dolomite which were causing loss of circulation of drilling fluids.

The hole was continuously cored from 2,690 feet to 5,380 feet (total depth) using BQ drill bits ($2\frac{23}{64}$-inch hole diameter, $1\frac{7}{16}$-inch core diameter) with BCQ drill rods ($2\frac{3}{16}$-inch outside diameter). A fracture/fault-related hole collapse occurred as the drill string was being raised off the bottom of the core hole for routine maintenance. The collapsed material wedged the bottom of the drill string at approximately 5,185 feet. After an unsuccessful attempt to free the stuck drill string by pressurizing the hole, the Survey contracted with Perfection Services, Inc., to sever the drill string immediately above the collapsed zone. A total of 37 feet of drill string was abandoned in the borehole between 5,175 feet and 5,212 feet. Therefore, the core hole could

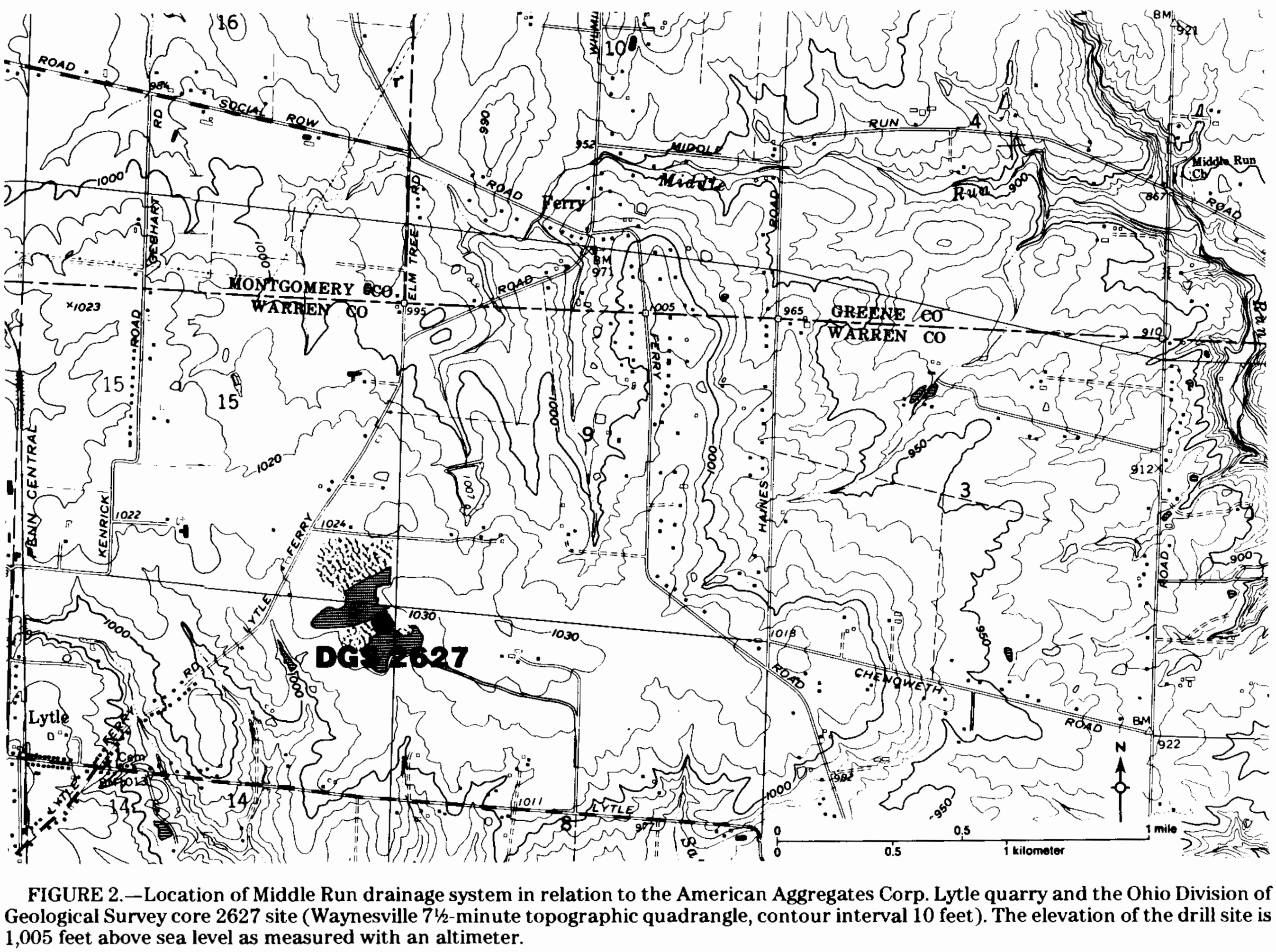


FIGURE 2.—Location of Middle Run drainage system in relation to the American Aggregates Corp. Lytle quarry and the Ohio Division of Geological Survey core 2627 site (Waynesville 7½-minute topographic quadrangle, contour interval 10 feet). The elevation of the drill site is 1,005 feet above sea level as measured with an altimeter.

only be logged down to 5,175 feet and not to its total depth of 5,380 feet.

Upon completion of drilling operations, the Survey contracted with BPB Instruments, Inc., to geophysically log the borehole. Logging was performed in a two-stage process to maintain open-hole logging conditions. During logging of the BCQ portion of the borehole, the NCQ intermediate casing remained in the borehole because of poor uphole conditions in the Knox Dolomite. Upon completion of the BCQ-logging phase, the BCQ portion of the hole was grouted with 4,388 pounds of portland cement by Cemenco-Service, Inc. The NCQ intermediate casing was removed and the NCQ portion of the hole was geophysically logged and then grouted with 9,870 pounds of portland cement. The open-hole portions from both phases of logging were combined by BPB Instruments, Inc.

The geophysical-log suite for DGS 2627 consists of gamma ray, neutron-porosity, three-arm caliper, resistivity, sonic, bulk density, temperature, and verticality logs. The temperature log was not run between the surface and 2,690 feet because the NCQ drill string, set as intermediate casing, would have interfered with the tool response. The sonic log was not run between 2,690 and 5,175 feet (the BCQ portion of the hole) because the diameter of the tool was larger than the diameter of the hole. Collapse of the bottom of the borehole and subsequent abandonment of the drill rods prohibited geophysical logging below 5,175 feet.

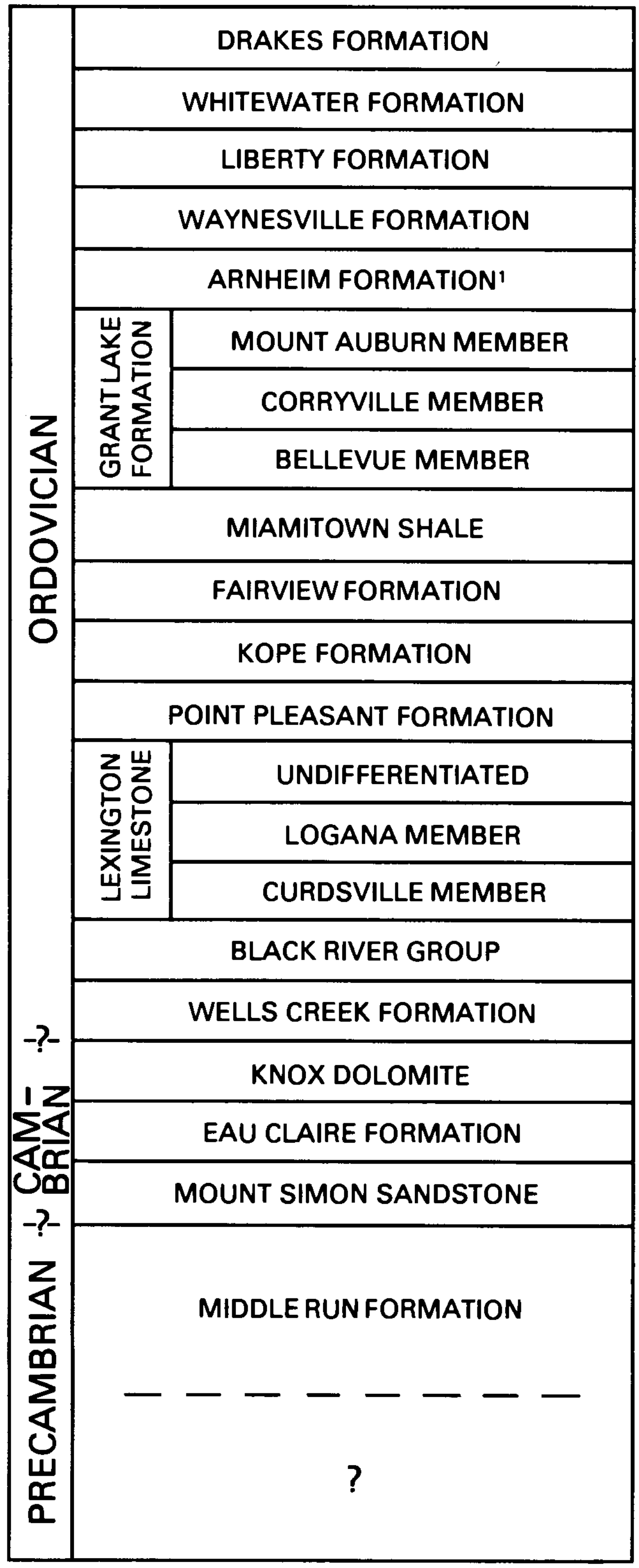
The gamma ray, neutron-porosity, and caliper logs are shown on plate 1. The continuous verticality analysis, not included in this report, indicates the maximum borehole tilt was 2.8° and the total depth of the borehole over the logged portion of the hole (5,175 feet) was shortened by a maximum of 0.95 foot. The gamma ray, neutron-porosity, bulk density, caliper, resistivity, and sonic logs will be available on computer tape in LIS format and on microfilm at the Ohio Division of Geological Survey.

CORE-DESCRIPTION AND SAMPLING METHODS

The brief lithologic description of core DGS 2627 (see Appendix B) in this report was generated after the geophysical-log suite was received. In this way, the description and the depth of the formation contacts and lithologic intervals previously determined from core examination could be verified against the geophysical-log suite. Core depths are consistently 1 to 5 feet lower than the geophysical-log depths from the surface to a zone of no core recovery from 2020.0 to 2037.5 feet. Core depths are 5 to 12 feet lower than geophysical-log depths from 2037.5 to 5175.0 feet.

The surface of the core was examined, and a number of 1- to 4-inch-long core pieces considered to be representative lithologies of the described intervals were sawed lengthwise with a diamond-blade saw. Sawed carbonate-core pieces were etched with hydrochloric acid. All sawed pieces were examined using a binocular microscope to document texture, fabric, and composition. A sample from 1629.3 feet was analyzed by x-ray diffraction to verify the presence of silica within an interval suspected to be weathered chert.

In general, the techniques and format used for the core description follow the American Association of Petroleum Geologists Sample Examination Manual (Swanson, 1981). Dunham's (1962) classification was used for carbonate rocks. Bedding-thickness classes follow McKee and Weir (1953). Rock colors were derived from the Geological Society of America rock-color chart (Goddard, 1948). Wentworth's (1922) grain-size classification was used for grain-size determination. Shale terminology is from Potter and others (1980). The shale/limestone percentages in the unit



[1]Arnheim formation is considered to be informal by the Ohio Division of Geological Survey.

FIGURE 3.—Stratigraphic nomenclature of the section cored in DGS 2627. Units are not to scale.

descriptions for the Whitewater Formation through the Lexington Limestone undifferentiated were calculated using the method described by Sweet and others (1974) and were averaged over the described interval.

Visible signs of oil and natural gas were recorded during drilling and as the core was recovered and examined. The hydrocarbon shows are indicated on the lithologic column on plate 1 at the depth at which they were documented. The entire core was examined with an ultraviolet light to detect hydrocarbon fluorescence. Appendix A lists the results of the hydrocarbon fluorescence examination.

The stratigraphic nomenclature (fig. 3) in this report is derived from several sources. The Drakes, Whitewater, Liberty, Waynesville, Arnheim, Grant Lake, Fairview, and Kope Formations and the Miamitown Shale are used as in Schumacher and others (in prep.). The Point Pleasant Formation and the Lexington Limestone are used as in Sweet and others (1974). Subdivisions of the Lexington Limestone are derived from Stith (1986). Figure 4 compares the stratigraphic position and usage of the Point Pleasant Formation as used in southwestern Ohio and in this report with the position and usage in northwestern Ohio as in Wickstrom and Gray (1988). The Black River Group is used as in Stith (1979, 1986). The Wells Creek Formation, Knox Dolomite, Eau Claire Formation, and Mount Simon Sandstone are used as in Janssens (1973).

MIDDLE RUN FORMATION, A NEW SUBSURFACE STRATIGRAPHIC UNIT

The sedimentary stratigraphic unit encountered below the Mount Simon Sandstone (Upper Cambrian) in DGS 2627 is herein named the Middle Run Formation. As no surficial exposures of the Middle Run Formation are known, the basal 1,910 feet of DGS 2627 is designated as the type section for the Middle Run Formation. The formation is named after a stream that heads near the quarry in which DGS 2627 was drilled (fig. 2). The lithologic description of the formation is included in the core description (Appendix B) in this report. The contact between the Middle Run Formation and the overlying Mount Simon Sandstone is sharp. The lower contact of the Middle Run was not reached in this core, but is estimated from the seismic profile to be at approximately 7,000 feet below the surface of the core site (pl. 2). The Middle Run Formation is assumed to be Late Precambrian in age. An expanded discussion of the Middle Run Formation will be published in the Ohio Journal of Science (Shrake, in prep.).

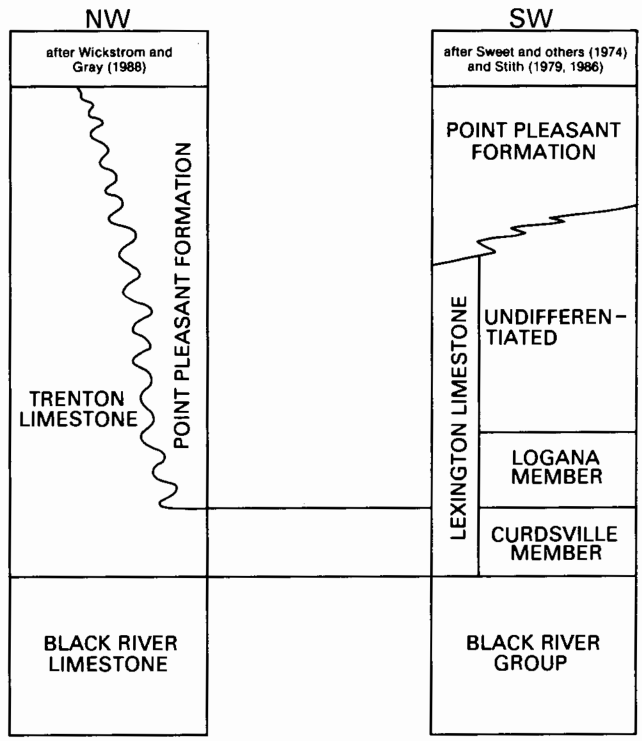


FIGURE 4.—Generalized columns comparing the stratigraphic nomenclature for a portion of the Ordovician-age rocks in northwestern and southwestern Ohio. Correlations, delineated by lines connecting columns, after Wickstrom and Gray (1988). No time boundaries are inferred.

SEISMIC REFLECTION SURVEY AND INTERPRETATION

by

Paul J. Wolfe and Benjamin H. Richard

SEISMIC PROFILE

In October 1988, Paragon Geophysical, Inc., ran an 8-mile seismic line from west to east centered on the DGS 2627 borehole. A seismic shot-point map giving the line location is shown on plate 2. Buried utilities and numerous houses in some areas interfered with uniform data acquisition. The land surface along the path of the line is generally flat to gently rolling and covered by a thin (20 feet or less) layer of till and alluvium except for the deep ravine occupied by Mill Run, on the east end of the seismic line, where thicker deposits are present.

ACQUISITION OF THE SEISMIC DATA

The seismic survey was intended to show as much detail as possible about the Lower Paleozoic section in the region of the core hole. For this reason, the survey parameters were chosen to optimize resolution in the depth range of 3,000 to 6,000 feet. Emphasis was on generating and recording high frequencies and using moderately short station spacings to maximize resolution within the constraints of costs, local conditions, and rapid acquisition.

The seismic source was a pattern of two holes, 10 feet apart, loaded with one-half pound of non-nitro dynamite. The shot holes were drilled to a depth of 5 feet or to bedrock, whichever was encountered first. When bedrock was encountered at a depth significantly less than 5 feet, the charges were reduced to one-quarter pound.

Each station was to be a source point, which would have resulted in a 60-fold common-depth-point seismic line. This distribution would have allowed the data to have maximum noise cancellation and reflected energy summing. However, because of the location of houses or other features which prevented shooting, some stations were excluded as source points. A plot of the fold data collected is on plate 2.

Field filters consisted of (1) an 18-hertz (Hz) (with 36 decibel/octave roll off) low-cut filter to reduce low-frequency noise, (2) a 128-Hz (with 36 decibel/octave roll off) high-cut filter to prevent frequency aliasing, and (3) a 60-Hz notch filter to reduce power-line-noise pickup.

PROCESSING OF THE SEISMIC DATA

Several seismic-processing companies (see Acknowledgments) independently processed the seismic data. Most companies used similar standard processing sequences. A list of typical processing steps is given on plate 2. In addition, some companies used frequency-domain, two-dimensional filtering to suppress strong surface-noise trains in the records. One company used refraction statistics analysis, and some companies used special deconvolution procedures to reduce the strong multiple reflections generated by the Paleozoic section. Three seismic profiles are presented on plate 2: unmigrated, migrated, and migrated and interpreted.

SYNTHETIC SEISMOGRAM

Because the sonic log for DGS 2627 was not run below 2,690 feet, the bottom section of the sonic log for the Armco #1 well (Butler Co., Lemon Twp., permit 4), about 12 miles west of DGS 2627, was appended to the end of the DGS 2627 sonic log. The Armco well was logged through the Mount Simon Sandstone, and its sonic log was adjusted to make the interfaces observed on the log correspond to the proper depths from the DGS 2627 core. A synthetic seismogram was constructed from the composite log. This synthetic seismogram and the modified velocity log are on plate 2 adjacent to the migrated and interpreted seismic profile. The lower reflections on the synthetic seismogram were a little earlier than on the actual seismic profile. As no check shot was available, the velocity of the carbonate unit between 1,090 feet and 2,681 feet was decreased by 10 percent; this adjustment produced a reasonably good match between the synthetic seismogram and the seismic profile. Convolution of the reflection coefficients with a 20-30-50-90-Hz zero-phase bandpass wavelet produced the final version of the synthetic seismogram presented on plate 2.

INTERPRETATION

The seismic profiles reveal some unexpected deep structure. The upper portion shows flat-lying, relatively uniform reflections which can be identified as the Paleozoic units by using the synthetic seismogram. The base of the Mount Simon Sandstone corresponds to a reflection at 0.49 second on the seismic profile, and to 0.48 second on the synthetic seismogram.

The lower part of the section shows eastward-dipping reflections, some of which are quite strong. There are also zones of weak or no reflections, particularly below the Mount Simon on the east end of the line. Weak reflectors that are dipping to the east roll over to more nearly horizontal near the center of the profile. The reflection at about 0.64 second at shot point 300 is thought to correspond to the siltstone zone observed on the geophysical logs between 4,760 and 4,840 feet. This reflection was the target horizon after drilling resumed.

The strong reflectors in the deeper portion of the profile show a complex history of deformation. The contact with the Paleozoic sediments is thought to be an angular unconformity. Relief on this surface appears to have influenced deposition of the overlying rocks.

The migrated and interpreted seismic profile (pl. 2) has been marked to indicate what are believed to be the major fault zones. No direct evidence exists on the nature of most of these rocks, and there are no other seismic profiles yet available to allow the construction of a three-dimensional model for further interpretion of these data. For these reasons, the interpretation presented here must be considered tentative.

At the west end of the profile is a high-angle normal fault that flattens at depth. This fault is possibly related to a time of extension preceding the Grenville collision and which included deposition of the Middle Run Formation.

A thrust-fault surface dipping to the east cuts across the center of the profile. This surface may indicate thrusting from the east possibly associated with collision of the Grenville Province with the Eastern Granite-Rhyolite Province (Pratt and others, 1989). This fault may continue upward to the erosional surface on which the Mount Simon Sandstone was deposited, but the upper end is difficult to ascertain because there are no strong reflectors.

Near the center of the profile, between shot points 295 and 340, is a zone of generally weak, discontinuous reflectors. Two nearly vertical faults are drawn on the section, but they represent a highly disturbed zone with many faults. The zone has some similarities to a flower structure, which is caused by strike-slip movement, but there are no other data to support or refute this hypothesis. The movement here is thought to postdate the thrusting because the reflectors in the thrust sheet and the dipping reflectors to the west both terminate at this zone.

Near the east end of the profile another fault is tentatively identified on the basis of reflection character and dip changes. There is little vertical offset across this fault. Although a single line is drawn on the profile, the actual faulting probably involved a zone of complex deformation and faulting. The relationship of this zone to the thrust fault which cuts across the center of the profile is not clear at this time.

On the basis of similarity to deep Precambrian layered sequences noted elsewhere in the Midwest and the lack of magnetic anomalies, the signatures observed on this profile are more likely to be a part of the Eastern Granite-Rhyolite Province rather than the Grenville Province (Van Schmus and Hinze, 1985; Pratt and others, 1989; Cannon and others, 1989). These rocks extend below the bottom of the profile, which is calculated at 17,600 feet below the surface using 18,000 ft/sec for the average seismic velocity.

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APPENDIX A.—HYDROCARBON SHOWS AND FLUORESCENCE IN CORE DGS 2627

Footage	*Show or staining*	*Fluorescence*	*Remarks*
431.8-431.9	spotty	pale yellow	
433.3-433.4		pale yellow to pale blue	in laminae
434.0-436.6	spotty, no visible stain	pale yellow	
440.5	spotty	pale yellow	
442.9-443.2	pinpoint to spotty	pale yellow	
469.6	spotty	pale yellow to light blue	
469.7	spotty	pale yellow	
480.8	spotty	pale yellow to pale blue	
990.7-993.6	patchy	dull brown	along laminae in limestone
1005.4-1005.8	patchy, oil show	brown to blue	on bedding plane
1006.5-1006.9	patchy, oil show	brown to blue	along vertical fracture in limestone
1008.8-1009.0	spotty	yellow to pale blue	in shale
1011.5-1013.0	patchy, oil show	dark brown to yellow to blue	fracture, bleeding oil
1020.7-1021.0	patchy, no visible stain	yellow	in limestone
1027.4-1028.0	patchy, no visible stain	light blue	diffuse, in limestone
1028.8-1029.6	patchy	yellow to pale blue	in limestone
1031.0-1031.8	patchy, no visible stain	yellow to pale blue	in limestone
1038.9-1039.5	slight brown stain visible, mottled to spotty	pale brown	in limestone
1048.5-1049.1	spotty to mottled	yellow to pale blue	in silty limestone
1050.5-1051.2	spotty	pale yellow	in dark-brown shale
1051.4-1051.7	mottled	pale yellow	in dark-brown shale
1064.4-1067.2	spotty, minor brown visible stain	pale blue to brown	along fracture
1076.4-1076.5	spotty	pale yellow	along fractures
1085.3		dull brown	along bedding plane and shale parting
1089.0	patchy, visible stain	pale blue to white	in limestone and along fractures
1107.3-1108.8	pinpoint	pale yellow	in limestone
1113.0-1125.6	pinpoint to mottled, heavy oil stain	pale yellow to light blue	along fractures
1160.2-1160.7	pinpoint to spotty	pale blue	in limestone
1173.0-1175.0	pinpoint to spotty	yellow to bright blue	in limestone
1187.3-1250.2	pinpoint, visible brown stain	yellow to brown	along fractures
1268.0-1268.5	pinpoint, no visible stain	light blue	in limestone
1270.0-1273.0	pinpoint to mottled	light blue	
1274.0-1289.7	mottled, some stain	pale yellow, light blue to brown	along fractures
1290.0-1293.0	spotty, no visible stain	yellow to blue	
1302.5-1305.5	brown stain	yellow to brown	along fractures
1312.0-1313.2	brown stain	yellow to blue	along fractures
1323.3-1329.0	pinpoint to spotty minor brown stain visible	yellow to brown	
1330.0-1331.0	pinpoint to spotty	pale blue	
1337.3-1339.4	spotty, no visible stain	yellow to brown	along fractures
1340.5-1343.0		yellow to brown	along fractures
1355.3-1355.5	no visible stain	yellow	along fractures
1362.1-1364.5	spotty, brown stain	yellow to brown	
1382.6-1383.3	pinpoint to spotty	light blue	
1406.2-1409.0	pinpoint to spotty	pale yellow to light blue	in vugs and fractures
1410.0-1412.6	pinpoint to patchy slight light stain	yellow to blue	in fractures
1435.8-1437.1	brown stain	light blue to brown	along fractures
1442.8-1443.0	spotty, no visible stain	light blue	in micritic limestone
1456.7-1457.1	spotty	light blue	
1467.0	no visible stain	pale yellow to blue	along bedding
1468.0-1468.2		light blue	along fractures
1490.7-1494.9	brown stain	yellow to brown	along fractures
1504.7	pinpoint	light blue	
1522.5	pinpoint, no visible stain	light blue	
1529.0	pinpoint	light blue	
1659.7	spotty	pale blue	
1665.1-1665.3	pinpoint	light blue	
1672.8	spotty, brown stain	light blue to brown	
1881.2	patchy, no visible stain	light blue	in nodular bed
1900.1	patchy, no visible stain	yellow	in nodule
1932.0-1932.5	spotty, no visible stain	yellow	along fractures

APPENDIX A.—HYDROCARBON SHOWS AND FLUORESCENCE IN CORE DGS 2627—Continued

Footage	*Show or staining*	*Fluorescence*	*Remarks*
1972.0-1974.0	spotty, no visible stain	pale yellow	in vuggy limestone
2052.4	patchy, no visible stain	pale yellow to white	on bedding plane
2078.8-2079.0	patchy, no visible stain	pale yellow to white	along fractures
2134.7-2137.2	mottled, no visible stain	light blue	
2163.4	spotty, no visible stain	light blue to pale yellow	in vugs
2190.5	spotty, no visible stain	pale yellow	in vug
2571.0-2573.5	spotty, no visible stain	bright yellow	in vugs
2642.2-2646.5	spotty	yellow	along fractures and bedding plane

APPENDIX B.—LITHOLOGIC DESCRIPTION OF CORE DGS 2627

Depths are taken from geophysical logs except for zones of no core recovery, in which case depths are taken from core footage. Comparable depths from the core are given at the end of some descriptions. Elevation (altimeter) is 1,005 feet.

Depth (feet)	
0-11.6	No core; interval drilled with tri-cone roller bit to set casing.
11.6-54.0	Shale, greenish-gray (5 GY 6/1), medium-light-gray (N 6), and light-brownish-gray (5 YR 6/1), dolomitic, silty; calcareous in part; sparsely fossiliferous; upper contact not present; lower contact gradational and placed at base of lowest dominantly dolomitic shale interval (51.0 feet in core). DRAKES FORMATION.
54.0-128.0	Interbedded limestone and shale. Limestone (wackestone and packstone) (51%), medium-light-gray (N 6) to medium-dark-gray (N 4), fine- to coarse-crystalline, argillaceous, silty, fossiliferous (primarily bryozoans, brachiopods, and corals), thin-bedded; shale clasts; irregular bedding. Shale, medium-gray (N 5) to medium-light-gray (N 6), calcareous, silty, thin-bedded, fossiliferous. Lower contact gradational and placed at base of lowest dominantly irregular-bedded-limestone interval (131.1 feet in core). WHITEWATER FORMATION.
128.0-146.0	Interbedded limestone and shale. Limestone (wackestone and packstone) (51%), medium-gray (N 5), fine- to medium-crystalline, argillaceous, silty, generally thin-planar-bedded. Shale, light-olive-gray (5 Y 6/1) to greenish-gray (5 GY 6/1), calcareous, silty, sparsely fossiliferous, thin-bedded, faintly laminated. Lower contact gradational and placed at base of limestone overlying a thick-bedded, sparsely fossiliferous shale (148.5 feet in core). LIBERTY FORMATION.
146.0-259.5	Interbedded shale and limestone. Shale (73%), greenish-gray (5 GY 6/1) to dark-greenish-gray (5 GY 4/1), silty, nonfossiliferous to sparsely fossiliferous, thick- to thin-bedded. Limestone, medium-gray (N 5), thin-irregular- to planar-bedded, as in interval 128.0-146.0 feet. Lower contact placed at base of lowest thick-bedded shale overlying nodular limestone of Arnheim formation (informal unit) (262.3 feet in core). WAYNESVILLE FORMATION.
259.5-323.5	Interbedded shale and limestone. Shale (68%), medium-gray (N 5) to olive-gray (5 Y 6/1), silty, thin- to thick-bedded; calcareous in part; upper portion fossiliferous, lower portion generally nonfossiliferous. Limestone (wackestone to grainstone), medium-gray (N 5) to medium-dark-gray (N 4), fine- to coarse-crystalline, argillaceous, silty, fossiliferous (primarily brachiopods and bryozoans); upper portion nodular bedded, lower portion thin to medium planar to irregular bedded. Lower contact placed at base of 2.5-foot-thick zone of gradation (334.5 feet in core). ARNHEIM FORMATION (informal unit).
323.5-457.0	Interbedded shale and limestone. Shale (63%), greenish-gray (5 GY 6/1) to dark-greenish-gray (5 GY 4/1), calcareous to dolomitic, thin- to thick-bedded; fossiliferous in upper and lower portions, nonfossiliferous in middle portion. Limestone (wackestone to grainstone), medium-gray (N 5) to medium-dark-gray (N 4), fine- to coarse-crystalline; very argillaceous in upper portion; fossiliferous (primarily brachiopods, bryozoans, and echinoderms); upper portion nodular bedded, middle portion generally thin to medium planar bedded, and lower portion thin irregular bedded. Lower contact gradational to interfingering and placed at base of a 3-foot-thick irregular-bedded limestone interval which overlies thick-bedded shale (459.5 feet in core). GRANT LAKE FORMATION.
457.0-465.0	Shale, greenish-gray (5 GY 6/1), thick-bedded, fossiliferous (bivalves, gastropods, and echinoderms); calcareous to dolomitic cement; minor thin-bedded, fine-crystalline, silty limestone. Lower contact interfingering and placed at base of lowest thick-bedded shale (468.7 feet in core). MIAMITOWN SHALE.
465.0-520.0	Interbedded shale and limestone. Shale (67%), medium-gray (N 5) to light-olive-gray (5 Y 6/1), dolomitic to calcareous, sparsely fossiliferous, thin-to thick-bedded. Limestone (wackestone to grainstone), medium-dark-gray (N 4) to medium-gray (N 5), fine- to medium-crystalline, argillaceous, silty, fossiliferous (primarily bryozoans and brachiopods), thin- to medium-bedded. Lower contact placed at top of 2-foot-thick zone of gradation (522.5 feet in core). FAIRVIEW FORMATION.
520.0-819.0	Shale (85%), light-olive-gray (5 Y 6/1) to olive-gray (5 Y 4/1), becoming dark greenish gray (5 GY 4/1) to brownish gray (5 YR 4/1) near base; thick to thin bedded; dolomitic; silty; nonfossiliferous to sparsely fossiliferous; pyritic; sparse, thin- to medium-bedded limestone beds as in interval 465.0-520.0 feet. Lower contact gradational and placed at base of lowest thick-bedded shale (821.1 feet in core). KOPE FORMATION.
819.0-928.0	Interbedded shale and limestone. Shale (85%), medium-dark-gray (N 4) to olive-gray (5 Y 4/1), becoming olive-black (5 Y 2/1) near base; dolomitic to calcareous; thick to medium bedded. Limestone, medium-gray (N 5) to medium-dark-gray (N 4), medium- to coarse-crystalline, argillaceous, silty, dolomitic, sparsely fossiliferous; in thin beds and laminae. Lower contact gradational and placed at base of lowest shale overlying the limestone-rich Lexington Limestone (930.9

APPENDIX B.—LITHOLOGIC DESCRIPTION OF CORE DGS 2627—Continued

Depth (feet)

feet in core). POINT PLEASANT FORMATION.

928.0-1020.0 Interbedded limestone and shale. Limestone (54%) (wackestone to packstone), medium-dark-gray (N 4) to brownish-gray (5 YR 4/1), fine- to coarse-grained, argillaceous, silty, fossiliferous (primarily bryozoans and brachiopods), thin- to thick-bedded. Shale, olive-gray (5 Y 4/1) to olive-black (5 Y 2/1), calcareous to dolomitic, sparsely fossiliferous to nonfossiliferous, thin- to medium-bedded. A 0.3-foot-thick calcareous, fossiliferous (primarily brachiopods), olive-gray (5 Y 4/1) bentonitic shale, which slakes readily, at 945.0 feet (core). Lower contact placed at base of a medium-bedded limestone within a 10-foot-thick zone of gradation (1023.1 feet in core). LEXINGTON LIMESTONE UNDIFFERENTIATED.

1020.0-1058.0 Shale, olive-gray (5 Y 4/1) to olive-black (5 Y 2/1), calcareous, medium- to thin-bedded; fossiliferous in part (primarily thin-shelled brachiopods); faintly laminated; thin beds to laminae of coarse- to fine-crystalline, argillaceous, fossiliferous, olive-gray (5 Y 4/1) to light-olive-gray (5 Y 6/1) limestone from 1029.0 to 1030.0 feet. Lower contact placed at base of lowest shale overlying the limestone-rich underlying unit (1061.9 feet in core). LOGANA MEMBER OF LEXINGTON LIMESTONE.

1058.0-1090.5 Limestone (wackestone to grainstone), medium-gray (N 5) to brownish-gray (5 YR 4/1), medium- to fine-crystalline; dominantly coarse crystalline in lower 10 feet; fossil hash (primarily brachiopods and bryozoans); nodular to irregular bedded; medium-dark-gray (N 4) shale in thin beds, partings, and stylolitic seams; poor to fair intercrystalline porosity within coarse-crystalline beds. Bentonitic shale 0.2 foot thick at 1069.3 feet (core) and 0.4 foot thick at 1073.8 feet (core). Lower contact sharp and undulatory (1094.5 feet in core) and placed at the base of a 4.4-foot-thick interval of interbedded micritic and bioclastic, coarse-grained limestone with undulatory, discontinuous shale partings and pyrite-filled fractures and laminae. CURDSVILLE MEMBER OF LEXINGTON LIMESTONE. BASE OF LEXINGTON LIMESTONE.

1090.5-1130.0 Limestone (mudstone), light-olive-gray (5 Y 6/1) to olive-gray (5 Y 4/1), micritic, argillaceous; minor amount of chert; fossiliferous (brachiopods, bryozoans, and ostracods); birdseye structures; burrow mottled; vertical spar-filled fractures; abundant dolomitic-argillaceous limestone in thin discontinuous laminae or stylolitic seams; bentonite 1.6 feet thick at 1097.2 feet (core); bentonitic shale 0.1 foot thick at 1117.1 feet (core). Lower contact placed at top of a 5-foot-thick zone of gradation. TOP OF BLACK RIVER GROUP.

1130.0-1166.0 Limestone (mudstone), light-olive-gray (5 Y 6/1) to medium-gray (N 5), burrow-mottled, fossiliferous (primarily brachiopods, ostracods, and bryozoans); chert nodules; sparry calcite in vertical fractures; stylolites; medium-dark-gray (N 4) argillaceous limestone in laminae, stylolitic seams, and thin beds; burrows filled with argillaceous, micritic, olive-gray (5 Y 4/1) dolomitic limestone. Lower contact gradational and placed at base of a burrow-mottled interval (1168.8 feet in core).

1166.0-1415.0 Limestone (mudstone), light-olive-gray (5 Y 6/1), olive-gray (5 Y 4/1), yellowish-gray (5 Y 7/2), to light-brownish-gray (5 YR 6/1), micritic to microcrystalline; sparry calcite cement in part; minor amount of argillaceous material disseminated throughout or concentrated as laminae; minor amount of chert and disseminated pyrite; pelloidal in part; fossiliferous (primarily pelmatozoans, ostracods, and brachiopods); bioturbated in part; laminated in part; burrows filled with argillaceous, olive-gray (5 Y 4/1) micritic limestone and sparry calcite; birdseye structures; vugs filled with sparry calcite; stylolites; fractures commonly oil stained; bentonite 0.1 foot thick at 1178.2 feet (core). Lower contact placed at top of a 3-foot-thick zone of gradation (1420.0 feet in core).

Depth (feet)

1415.0-1462.0 Limestone (mudstone), light-olive-gray (5 Y 6/1), olive-gray (5 Y 4/1), to brownish-gray (5 YR 4/1), micritic; some sparry calcite; rare to abundant argillaceous material concentrated as laminae and thin beds; rare pyrite; fossiliferous (as above); pelloidal in part; stylolites; slickensides; bioturbated; sparry-calcite-filled burrows and vugs; thin-bedded medium-gray (N 5) to brownish-gray (5 YR 4/1) shale abundant from 1413.2 to 1426.3 feet (core). Lower contact stylolitic (1466.8 feet in core). UPPER ARGILLACEOUS UNIT of Stith (1979).

1462.0-1527.0 Limestone (mudstone), light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 8/1), micritic; minor argillaceous material; sparsely disseminated fine-grained pyrite in part; sparry calcite; fossiliferous (primarily pelmatozoans, ostracods, and brachiopods); burrows filled with olive-gray (5 Y 4/1) micritic limestone or sparry calcite; birdseye structures; oil staining along some vertical fractures; vugs at base. Lower contact stylolitic (1531.8 feet in core). CARNTOWN UNIT of Stith (1979).

1527.0-1555.0 Limestone (mudstone), olive-gray (5 Y 4/1) to light-olive-gray (5 Y 6/1), micritic; abundant argillaceous material in part; pyrite; stylolites; bioturbated; birdseye structures; sparry-calcite-filled fractures and vugs; sparsely fossiliferous (primarily brachiopods and ostracods). Lower contact gradational and placed at base of a sucrosic limestone which overlies an argillaceous dolomite (1560.2 feet in core). LOWER ARGILLACEOUS UNIT of Stith (1979). BASE OF BLACK RIVER GROUP.

1555.0-1609.0 Dolomite, greenish-gray (5 GY 6/1) to dark-greenish gray (5 GY 4/1), fine-crystalline; abundant to very abundant argillaceous material; glauconite associated with argillaceous-rich intervals; pyrite-filled burrows; minor fossils; slickensides; interbedded with bioturbated, yellowish-gray (5 Y 8/1), micritic to fine-grained dolomite containing minor amounts of pyrite. Dolomite, olive-gray (5 Y 4/1), in basal 5.5 feet; very argillaceous in part; glauconitic; minor pyrite; chert; collophane?; fossil hash; distinct zones of rounded lithoclasts (possible rip-up clasts). Lower contact sharp and undulatory (1614.3 feet in core). WELLS CREEK FORMATION.

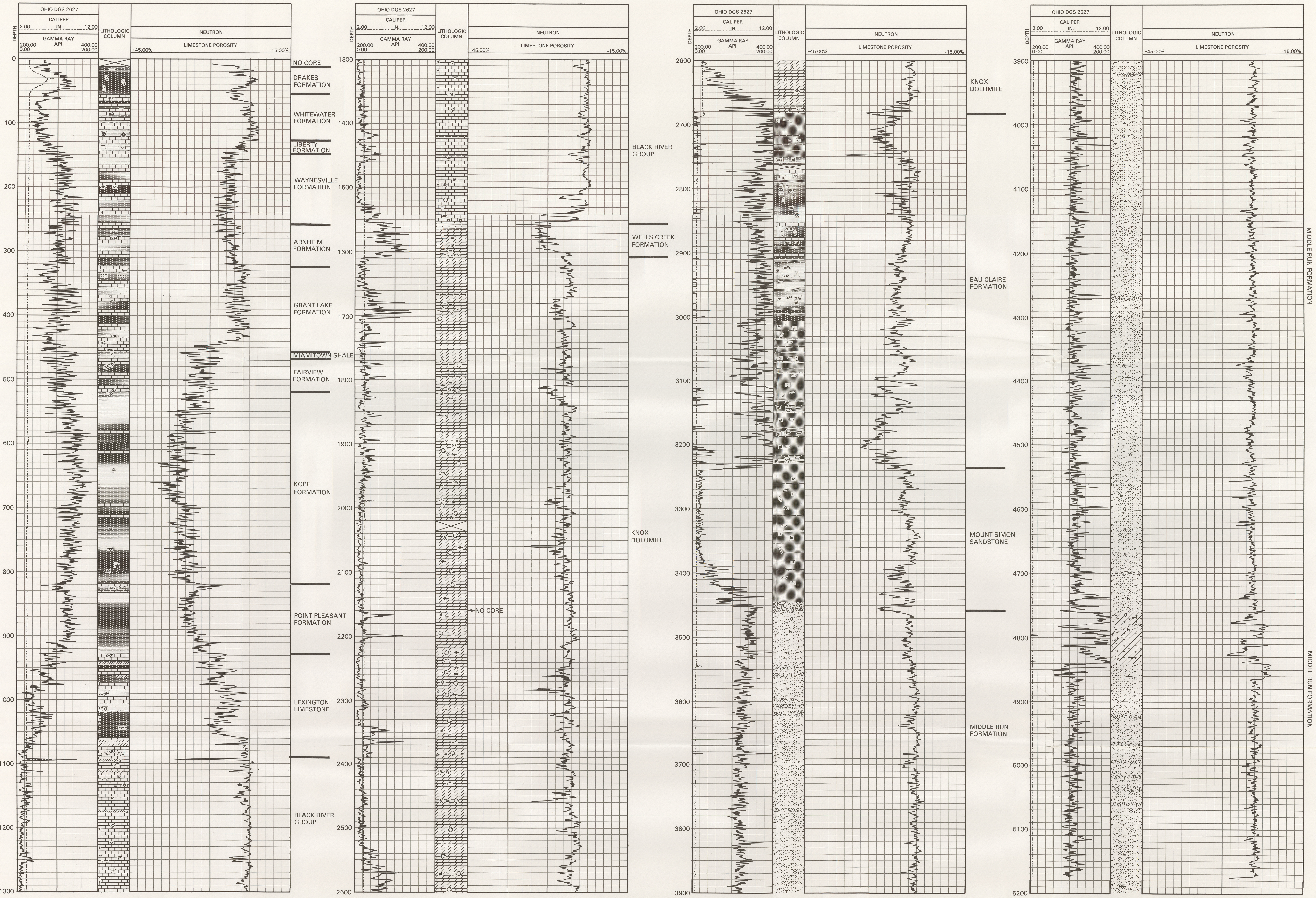
1609.0-1674.0 Dolomite, light-olive-gray (5 Y 6/1), light-gray (N 7), to yellowish-gray (5 Y 8/1), fine- to medium-crystalline; pyritic; argillaceous material present as irregular laminae, thin beds, and along stylolitic seams; minor chert associated with stromatolites; vertical fractures; poor vugular and intercystalline porosity; a 1.5-foot-thick interval of friable, bluish-white (5 B 9/1) chert containing pyrite and euhedral dolomite crystals at 1629.3 feet (core). TOP OF KNOX DOLOMITE.

APPENDIX B.—LITHOLOGIC DESCRIPTION OF CORE DGS 2627—Continued

Depth (feet)	
1674.0-1697.0	Dolomite, as above, with very argillaceous, glauconitic, greenish-gray (5 GY 6/1) dolomite in irregular laminae to medium to thick beds; desiccation cracks; 1.4-foot-thick brecciated dolomite at 1693.4 feet (core). Lower contact sharp (1697.6 feet in core).
1697.0-1809.0	Dolomite, light-gray (N 7) to light-olive-gray (5 Y 6/1), very fine crystalline to medium-crystalline; minor glauconite and pyrite; fractures with argillaceous material and coarse-grained euhedral dolomite and pyrite filling; stylolites; some very argillaceous, glauconitic greenish-gray (5 GY 6/1) to grayish-green (10 GY 5/2) dolomite in laminae and thin beds; friable, bluish-white (5 B 9/1) chert near base (lower contact 1813.2 feet in core).
1809.0-2020.0	Dolomite, as above; zones of abundant fractures filled with euhedral dolomite and minor pyrite; vuggy and intercrystalline porosity; thin oolitic dolomite beds; 0.3-foot-thick bed of rounded to subrounded quartz grains in dolomitic cement at 1902.8 feet (core).
2020.0-2037.5	Core loss and/or very broken core. Interval drilled with tri-cone roller bit.
2037.5-2383.0	Dolomite, as in interval 1809.0-2020.0 feet; core loss and/or very broken core from 2153.5 to 2160.0 feet (core). Base at 2376.0 feet in core.
2383.0-2391.0	Dolomite, medium-gray (N 5), fine-crystalline, moderately to very argillaceous; sparse pyrite; abundant argillaceous dolomite as irregular laminae and stylolitic seam filling; good vuggy porosity. Lower contact placed at the top of a 1-foot-thick zone of gradation (2386.1 feet in core).
2391.0-2531.0	Dolomite, light-gray (N 7) to light-olive-gray (5 Y 6/1), fine- to medium-crystalline, slightly argillaceous; minor glauconite; good vuggy, fracture, and intercrystalline porosity; brecciated in part. Lower contact placed at the top of a 3-foot-thick zone of gradation.
2531.0-2618.0	Dolomite, medium-gray (N 5) to medium-light-gray (N 6), fine- to medium-crystalline, moderately to very argillaceous; argillaceous, glauconitic dolomite in thin laminae and beds; laminated at base; stylolites; fractures; fair vuggy and intercrystalline porosity. Lower contact interbedded and placed in the middle of a 7-foot-thick zone of interbedding (2629.8 feet in core).
2618.0-2681.0	Dolomite, light-olive-gray (5 Y 6/1) to olive-gray (5 Y 4/1), fine- to medium-crystalline; argillaceous throughout, becoming very argillaceous at base; minor glauconite near base; distinctly laminated; some disturbed bedding; trilobite fragments. Zones of rounded and flat lithoclasts in calcite cement with pelloids and fossiliferous matrix; stylolites; fractures; thin interbeds of greenish-black (5 G 2/1) dolomitic shale predominant in basal 5.3 feet; lower contact placed at the base of an 8-foot-thick zone of gradation (2691.0 feet in core). BASE OF KNOX DOLOMITE.
2681.0-2749.0	Sandstone, light-olive-gray (5 Y 6/1), brownish-gray (5 YR 4/1), to light-gray (N 7), very fine grained to fine-grained; glauconitic in part; argillaceous in part; zones of argillaceous laminae; interbedded with dark-greenish-gray (5 GY 4/1) to olive-black (5 Y 2/1) shale that is calcareous in part; contacts between shales and sandstones generally sharp. TOP OF EAU CLAIRE FORMATION.
2749.0-2847.0	Shale and silty shale, dark-greenish-gray (5 GY 4/1), brownish-gray (5 YR 4/1), to olive-black (5 Y 2/1); calcareous in part; glauconitic in part; trace of disseminated pyrite; scattered fossils (trilobite fragments); interbedded with and containing clasts of limestone and sandstone. Limestone, brownish-gray (5 YR 4/1) to olive-gray (5 Y 4/1), micritic to medium-crystalline. Sandstone, olive-gray (5 Y 4/1), very fine-grained to fine grained; grains subrounded to rounded. Both limestone and sandstone glauconitic and argillaceous in part. Possible slickensides present in shale in interval 2783.0-2795.0 feet.
2847.0-3002.0	Siltstone, sandstone, shale, and limestone, intermixed and interbedded in nodular, irregular, and wispy bedding. Limestone and siltstone interbedded with shale at top; grain size increases and limestone is absent towards base. Many of the siltstones and limestones appear to be clasts (rip-up clasts) in shale matrix. Siltstone, light-gray (N 7) to light-olive-gray (5 Y 6/1). Sandstone, pinkish-gray (5 YR 8/1) to brownish-gray (5 YR 4/1), very fine grained to medium-grained; grains subrounded to rounded; well sorted and cemented; feldspathic in part; no apparent porosity. Limestone as in interval 2749.0-2847.0 feet. Shale, olive-gray (5 Y 4/1); some zones up to 4 feet thick. Glauconite and trace of pyrite disseminated throughout and localized along partings and contacts.
3002.0-3094.0	Sandstone, medium-gray (N 5), olive-gray (5 Y 4/1) to light-brown (5 YR 6/4), very fine grained to medium-grained; grains rounded to subrounded; moderately well sorted to well-sorted, feldspathic; poor porosity. Interlayered in wispy and mottled bedding with greenish-black (5 GY 2/1) to olive-gray (5 Y 4/1) shale and siltstone. Minor sandstone as in interval 3094.0-3127.0 feet in 0.5- to 3-foot-thick zones with good porosity. Glauconite as staining and disseminated grains throughout sandstone and shale.
3094.0-3127.0	Sandstone, light-brownish-gray (5 YR 6/1), pale-yellowish-brown (10 YR 6/2), to dusky-green (5 G 3/2), fine- to medium-grained, moderately well sorted to well-sorted, feldspathic to arkosic; crossbedded in zones. Fine-grained glauconite, disseminated throughout and as staining in streaks and thin discontinuous beds, abundant near base. Good intergranular porosity in zones.
3127.0-3150.0	Sandstone, pale-brown (5 YR 5/2), fine- to coarse-grained, moderately well sorted to well-sorted; feldspathic in part; glauconitic in part; scattered shell fragments (brachiopods?), some replaced by pyrite. Shale, olive-black (5 Y 2/1) to olive-gray (5 Y 4/1), as wispy and mottled interbeds; shale contains clasts of sandstone in part.
3150.0-3167.0	Sandstone, as in interval 3094.0-3127.0 feet.
3167.0-3189.0	Sandstone, grayish-orange-pink (5 YR 7/2), medium- to coarse-grained, poorly sorted to well-sorted, feldspathic; bioturbated in zones. Shale, olive-gray (5 Y 4/1) to olive-black (5 Y 2/1), as abundant partings and wispy stringers. Fine- to medium-grained glauconite disseminated throughout sandstone and concentrated in layers within shale, also as staining; interval 3182.0-3185.0 feet has heavy concentration of glauconite.
3189.0-3206.0	Sandstone, as in interval 3094.0-3127.0 feet. Shale, olive-gray (5 Y 4/1) to olive-black (5 Y 2/1), as minor stringers and partings; good intercrystalline porosity.
3206.0-3235.0	Sandstone and shale, as in interval 3167.0-3189.0 feet; scattered brachiopod fragments; moderate porosity in thin zones. Lower contact placed within a 5-foot-thick zone of gradation (3245.0 feet in core). BASE OF EAU CLAIRE FORMATION.

APPENDIX B.—LITHOLOGIC DESCRIPTION OF CORE DGS 2627—Continued

Depth (feet)	
3235.0-3458.0	Sandstone, blackish-red (5 R 2/2), grayish-red, (5 R 4/2), to yellowish-gray (5 Y 7/2) (color varies along distinct and irregular beds), fine- to coarse-grained; grains subrounded to rounded; well-sorted; lower 14 feet conglomeratic; quartz dominant; feldspathic in part; glauconitic near top; siliceous cement dominates except in the basal 10 feet, where hematitic cement dominates; hematitic in part as staining, grains, grain coating, and as intergranular cement; crossbedding in small zones; minor fractures. Minor dusky-red (5 R 3/4), olive-gray (5 Y 4/1), to greenish-gray (5 GY 6/1) siltstone and shale in thin layers and partings. Entire interval has moderate to good porosity, very friable in part. Lower contact sharp and placed at the base of a 0.15-foot-thick bed of friable, porous, poorly sorted, subangular to subrounded, medium- to coarse-grained, pinkish-gray (5 YR 8/1), quartz-rich sandstone with siliceous cement and fine-grained quartz matrix (3470.4 feet in core). MOUNT SIMON SANDSTONE.
3458.0-4760.0	Sandstone, grayish-red (5 R 4/2), grayish-red-purple (5 RP 4/2), to moderate-red (5 R 4/6), fine- to medium-grained; grains subrounded to subangular; moderately well sorted to moderately poorly sorted; abundant lithic clasts; siliceous cement with minor zones of calcite cement; very fine grained to fine-grained quartz matrix; some hematitic matrix and coating on quartz grains; iron-magnesium-rich minerals and mica disseminated throughout; faintly laminated and crossbedded in part; minor quartz- and calcite-filled fractures; no visible porosity. Thin interbeds of pebbly to coarse-grained, poorly sorted, pale-red (5 R 6/2) to grayish-red (5 R 4/2), lithic sandstone; calcite and silica cement; fine-grained to very fine grained quartz matrix; pebble-sized lithic clasts commonly consist of fine-grained to very fine grained hematitic sandstone; less common are thin interbeds of siltstone to very fine grained, well-sorted, siliceous-cemented, hematitic, quartz sandstone. Lower contact sharp (4772.3 in core). TOP OF MIDDLE RUN FORMATION.
4760.0-4840.0	Siltstone, dark-reddish-brown (10 R 3/4), very fine grained, moderately well sorted to well-sorted; silica cemented with calcite-rich laminae; quartz rich with minor fine-grained lithic clasts; hematite matrix; iron-magnesium minerals disseminated in parts; no visible porosity; with interbeds of sandstone as in interval 3458.0-4760.0 feet. Lower contact gradational over 10 feet (4852.0 in core).
4840.0-5380.0	Sandstone as in interval 3458.0-4760.0 feet. Hole not geophysically logged below 5,175 feet because of the collapse of the borehole and pipe left in the hole at approximately 5,185 feet. TOTAL DEPTH.



LITHOLOGIC SYMBOLS AND ABBREVIATIONS

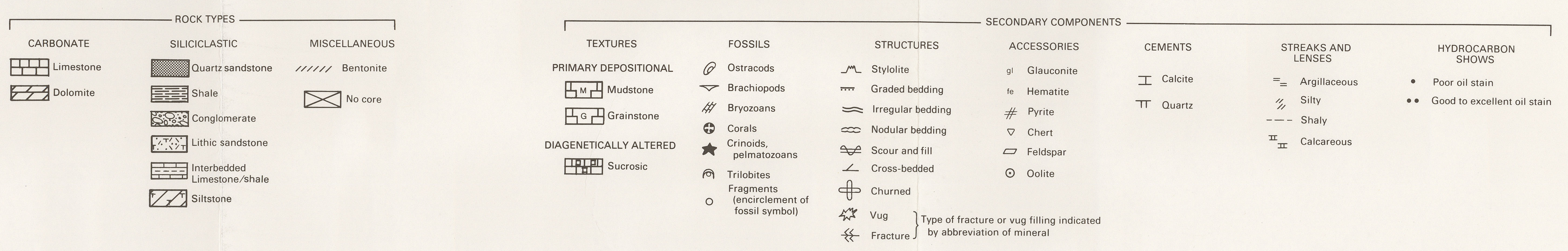


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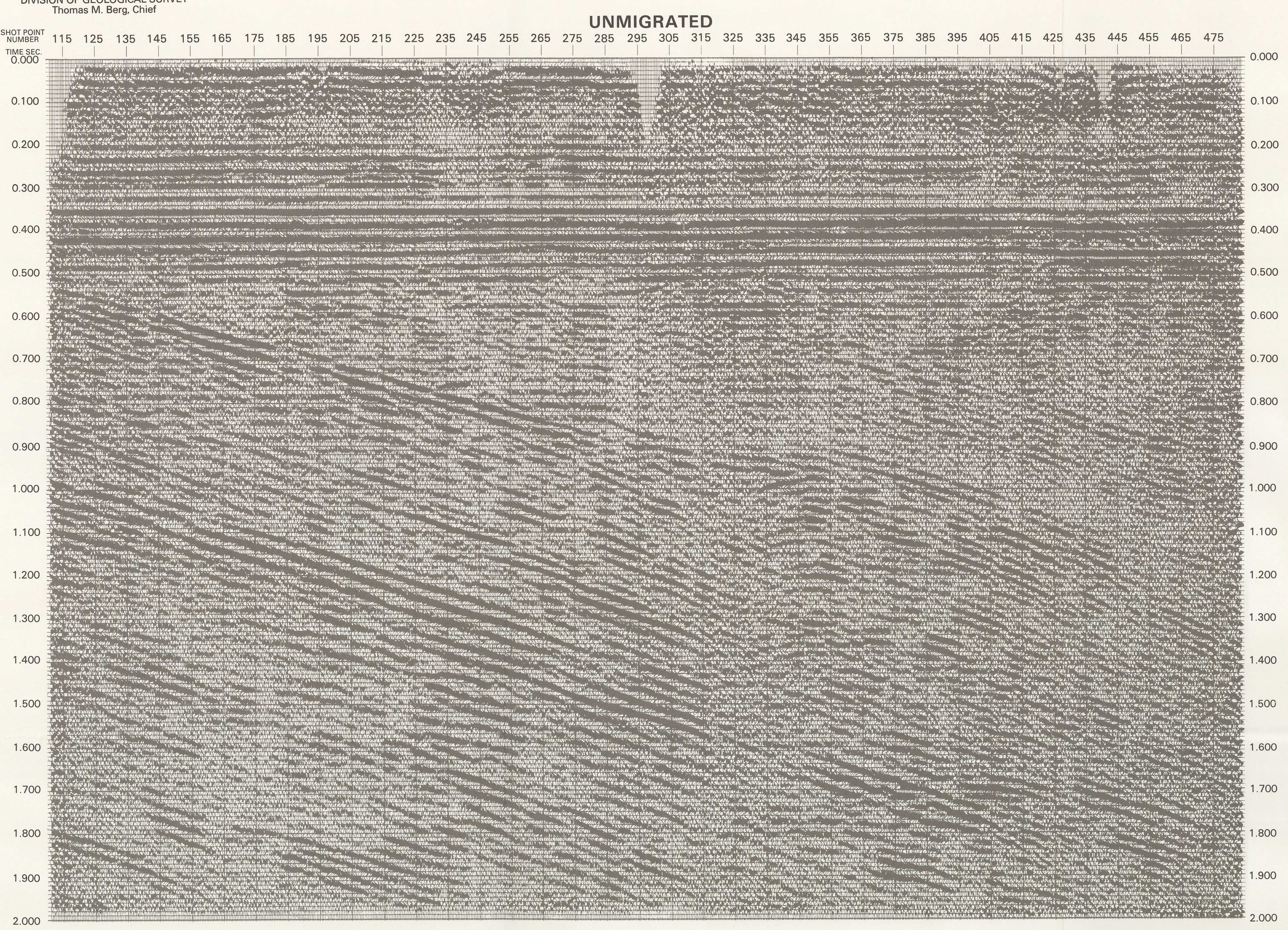
PLATE 1.—GEOPHYSICAL LOGS AND LITHOLOGIC COLUMN FOR OHIO DIVISION OF GEOLOGICAL SURVEY CORE DGS 2627, WAYNE TOWNSHIP, WARREN COUNTY, OHIO

STATE OF OHIO
Richard F. Celeste, Governor
DEPARTMENT OF NATURAL RESOURCES
Joseph J. Sommer, Director
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

eres 017

STATE OF OHIO
Richard F. Celeste, Governor
DEPARTMENT OF NATURAL RESOURCES
Joseph J. Sommer, Director
DIVISION OF GEOLOGICAL SURVEY
Thomas M. Berg, Chief

UNMIGRATED



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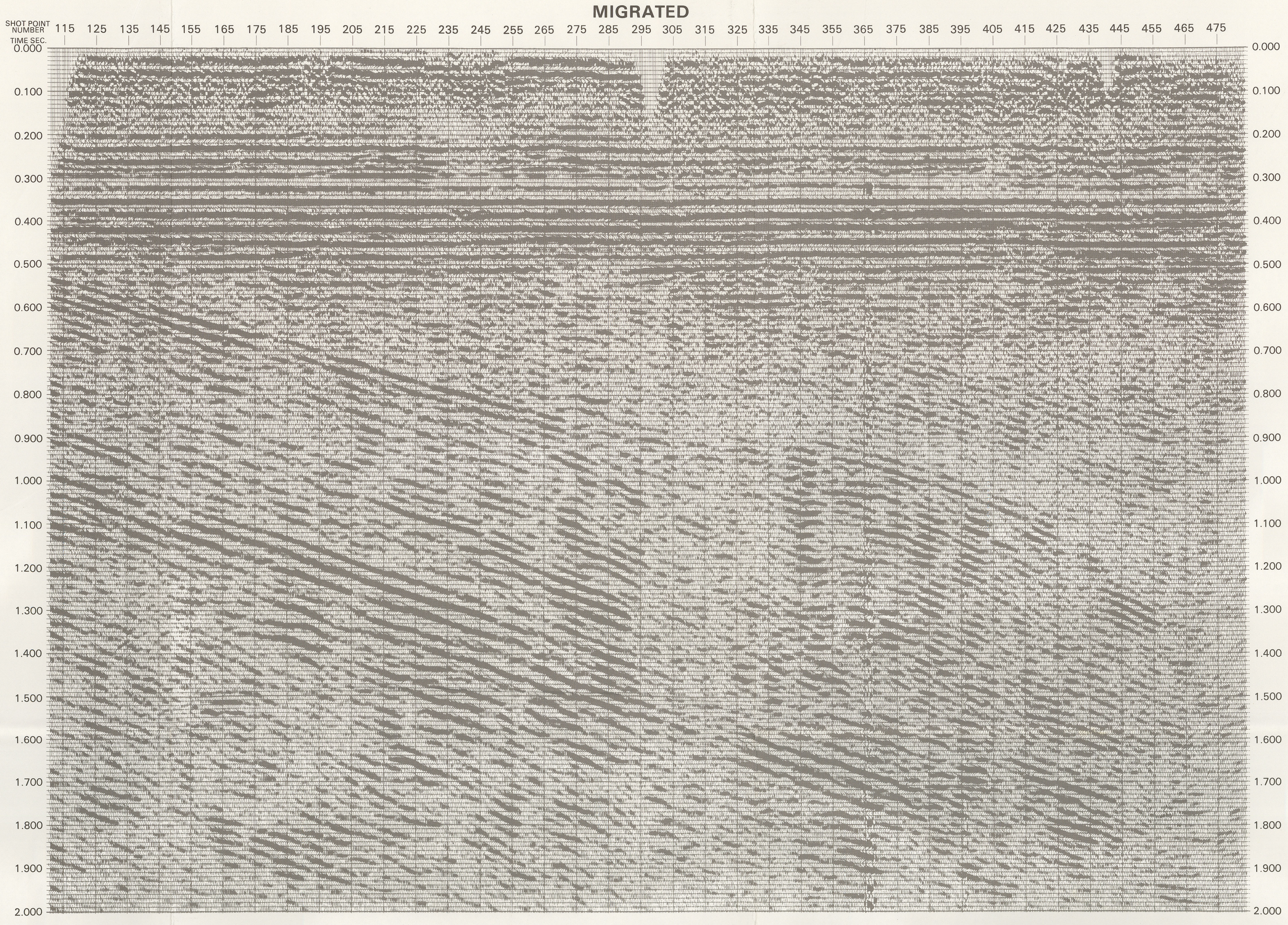
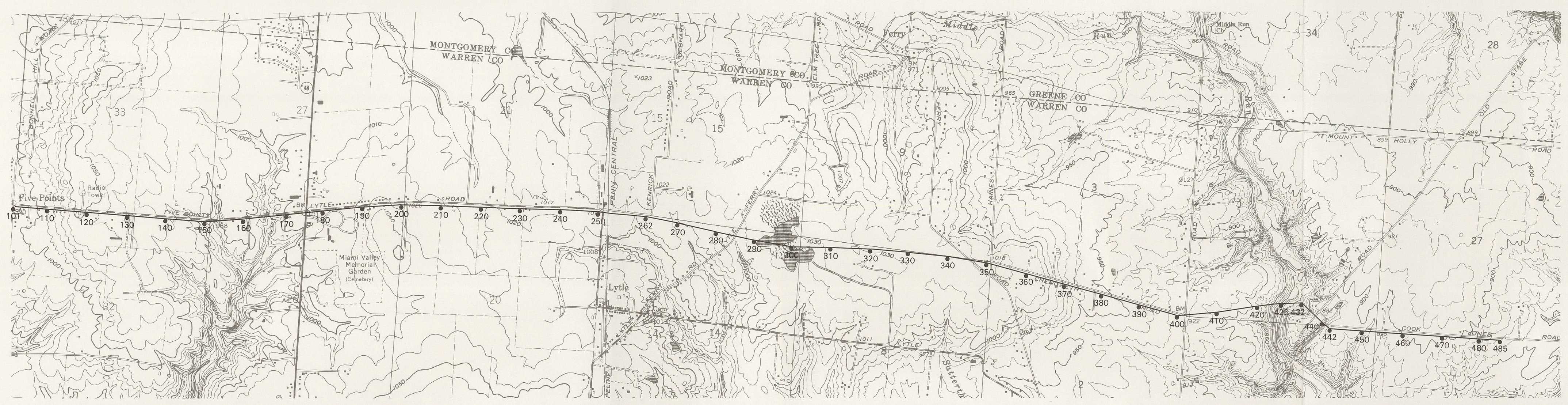
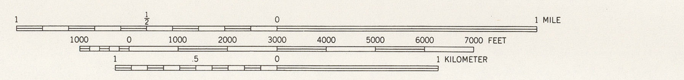
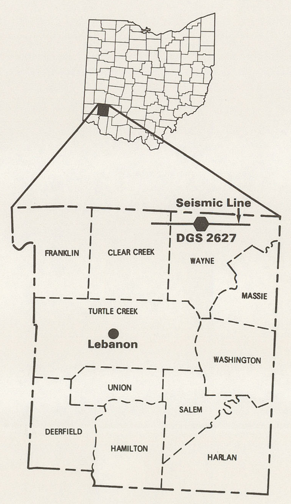


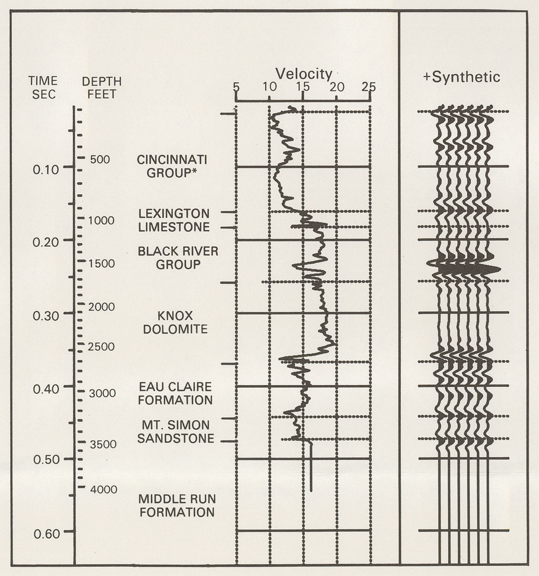


Location of seismic line plotted on portions of the Springboro and Waynesville 7½-minute U.S. Geological Survey quadrangles





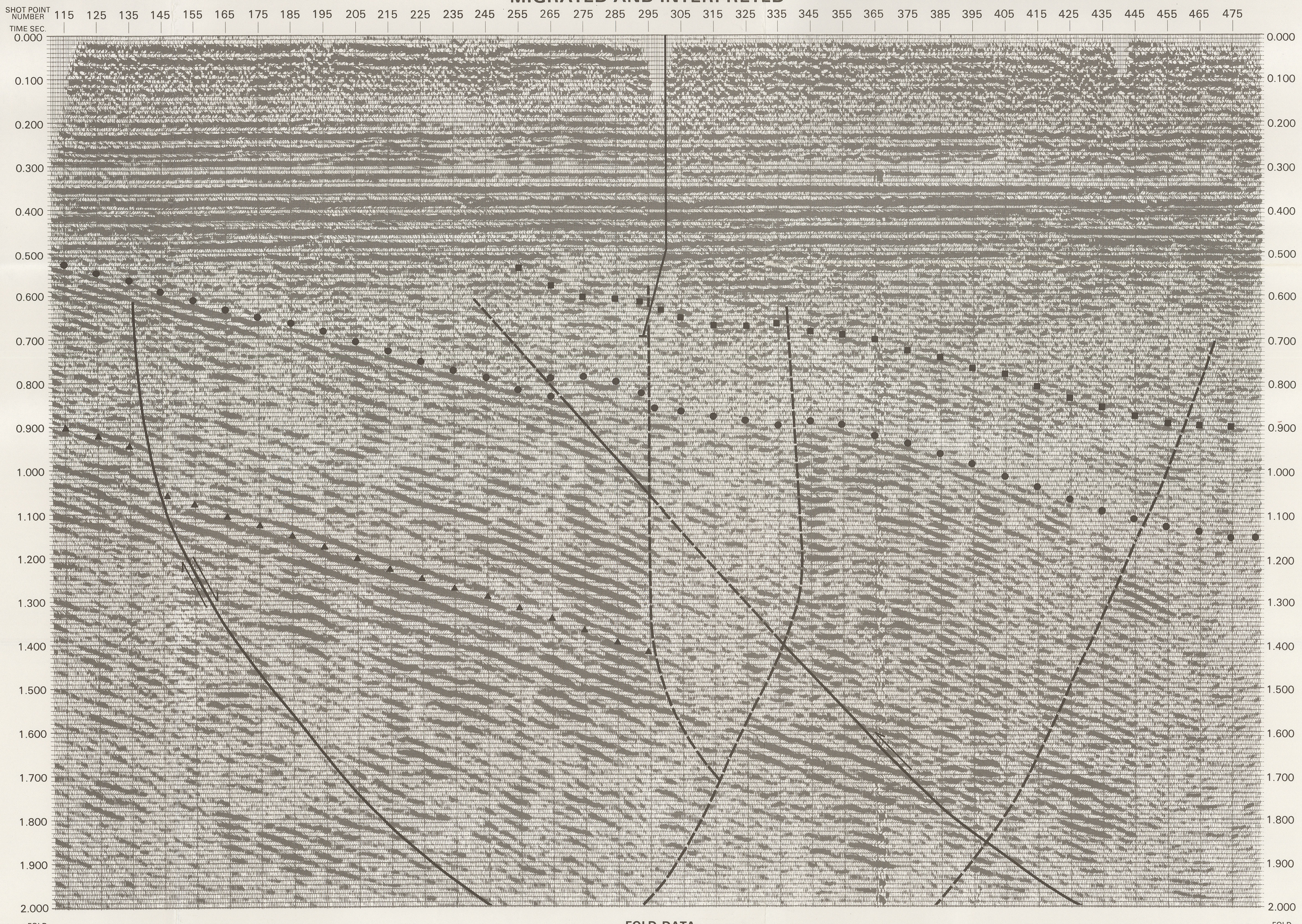
WARREN COUNTY

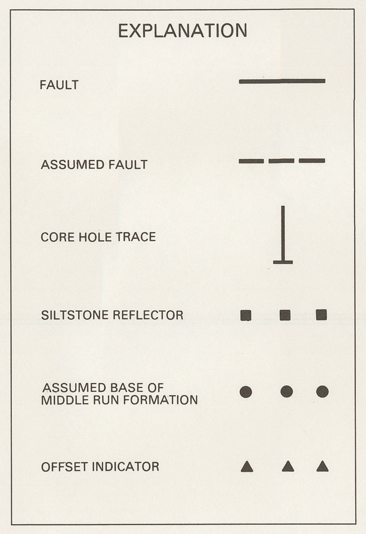


*Includes Drakes Formation through Point Pleasant Formation

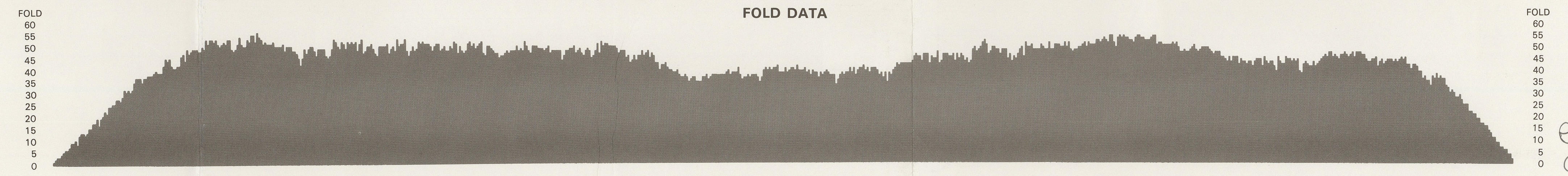
SYNTHETIC SEISMOGRAM

MIGRATED AND INTERPRETED





FOLD DATA



ACQUISITION PARAMETERS

Source: two 5-ft holes with ½ lb of explosive
Geophones: twelve 28-Hz geophones per trace
Recording instrument: DFS V
Recording channels: 120
Station interval: 110 ft
Source interval: 110 ft
Spread: 6710 ft ← 220 ft ← x → 220 ft → 6710 ft
Sample interval: 2 milliseconds
Field filters: Low-cut 18 Hz
High-cut 128 Hz
Notch 60 Hz
Line length: 8 miles

TYPICAL PROCESSING SEQUENCE

Demultiplex
F-K filter
Phase compensation
Spherical divergence
Deconvolution
Statics
Velocity analysis
Normal moveout
Mute
Filter 25-90 Hz
Spectral balancing
Residual statics
Stack
Migration

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PLATE 2.—UNMIGRATED, MIGRATED, AND MIGRATED AND INTERPRETED SEISMIC PROFILES OF SEISMIC LINE ODNR-1-88 IN CLEAR CREEK AND WAYNE TOWNSHIPS, WARREN COUNTY, OHIO, AND SYNTHETIC SEISMOGRAM