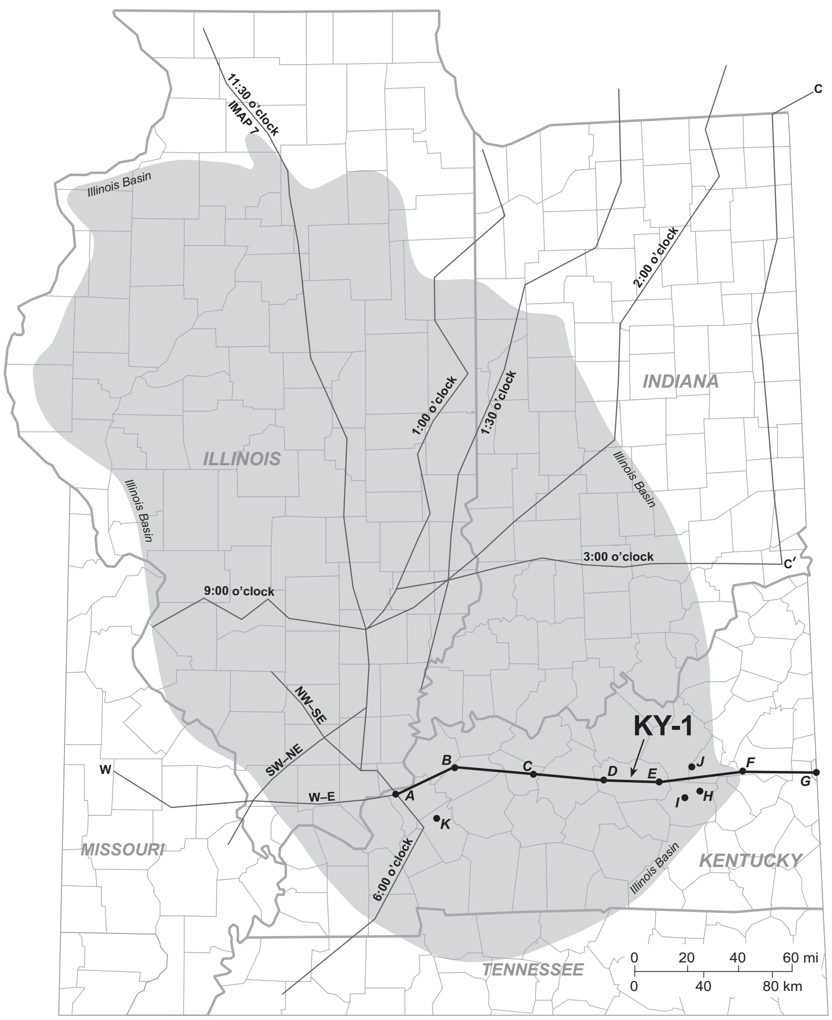
Kentucky Geological Survey
James C. Cobb, State Geologist and Director
University of Kentucky, Lexington

Lithostratigraphy of Precambrian and Paleozoic Rocks along Structural Cross Section KY-1, Crittenden County to Lincoln County, Kentucky



Martin C. Noger and James A. Drahovzal

Report of Investigations 13 **Series XII, 2005**

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Lithostratigraphy of Precambrian and Paleozoic Rocks along Structural Cross Section KY-1, Crittenden County to Lincoln County, Kentucky

Martin C. Noger and James A. Drahovzal

Abstract

This east–west cross section across western Kentucky is one of a network of regional cross sections prepared by the Illinois Basin Consortium that illustrate the structural and stratigraphic framework of the Illinois Basin. The structural cross section uses wireline logs of deep tests, as well as proprietary reflection seismic data, to show the relationship of Paleozoic rocks to each other from the surface to the top of the Precambrian unconformity.

The line of the cross section extends east from the complexly faulted Western Kentucky Fluorspar District across the Moorman Syncline and the underlying Rough Creek Graben to the Cincinnati Arch in central Kentucky. The cross section extends across the northern, deepest part of the asymmetrical Rough Creek Graben. Relatively minor changes in stratigraphic thickness occur within the Paleozoic from the arch west, with a few units pinching out to the east. Extensive post-Paleozoic erosion, however, has rendered the middle and upper part of the Paleozoic section an overall west-thickening wedge that has been further accentuated by the extreme thickening that occurs in the lower part of the section, especially in the Eau Claire Formation, which expands nearly 15 times and to a depth approaching 30,000 ft in the Rough Creek Graben.

As a result of this study, changes in stratigraphic nomenclature are recommended. The recommended changes include raising the Cambrian-Ordovician Knox Group to supergroup status in Kentucky with two groups recognized within it. Southern Illinois and southwestern Indiana formation nomenclature is recommended for the Lower Ordovician Beekmantown Group of western Kentucky; it differs from that in the area of the Cincinnati Arch and eastern Kentucky, where Appalachian formation terminology is recommended together with the Rose Run Formation. Recognition of the Pecatonica Formation eastward from western Kentucky results in the subdivision of the Ordovician High Bridge Group into five lithologic units in central and eastern Kentucky.

Introduction

Structural cross section KY-1 shows the relationship of Paleozoic rocks to each other from Crittenden County to Lincoln County, Ky. (Plate 1A) and the relationship of the Paleozoic rocks to the top of basement in the same area (Plate 1B). This cross section is one of a network of regional cross sections prepared by the Illinois Basin Consortium (Kentucky, Illinois, and Indiana geological surveys) that illustrate the structural and stratigraphic framework of the Illinois Basin (Fig. 1). These structural cross sections, which were constructed using wireline logs of deep tests, cross major geologic features in Kentucky, Illinois, and Indiana (Fig. 2).

The line of cross section KY-1 extends east from the complexly faulted Western Kentucky Fluorspar District, across the Moorman Syncline and the underlying Rough Creek Graben, to the Cincinnati Arch in central Kentucky. This cross section intersects the 6 o'clock structural cross section (Whitaker and others, 1992) in western Kentucky at the Shell Oil Co. No. 1 Davis drillhole in Crittenden County (Fig. 2). The KY-1 cross section is an extension of the west–east cross section published by the Illinois State Geological Survey (Sargent and others, 1992). The KY-1 cross section is generally perpendicular to the eastern depositional slope of the Illinois Basin and extends down the northern, deepest part of the asymmetrical Rough Creek Graben. Only un-

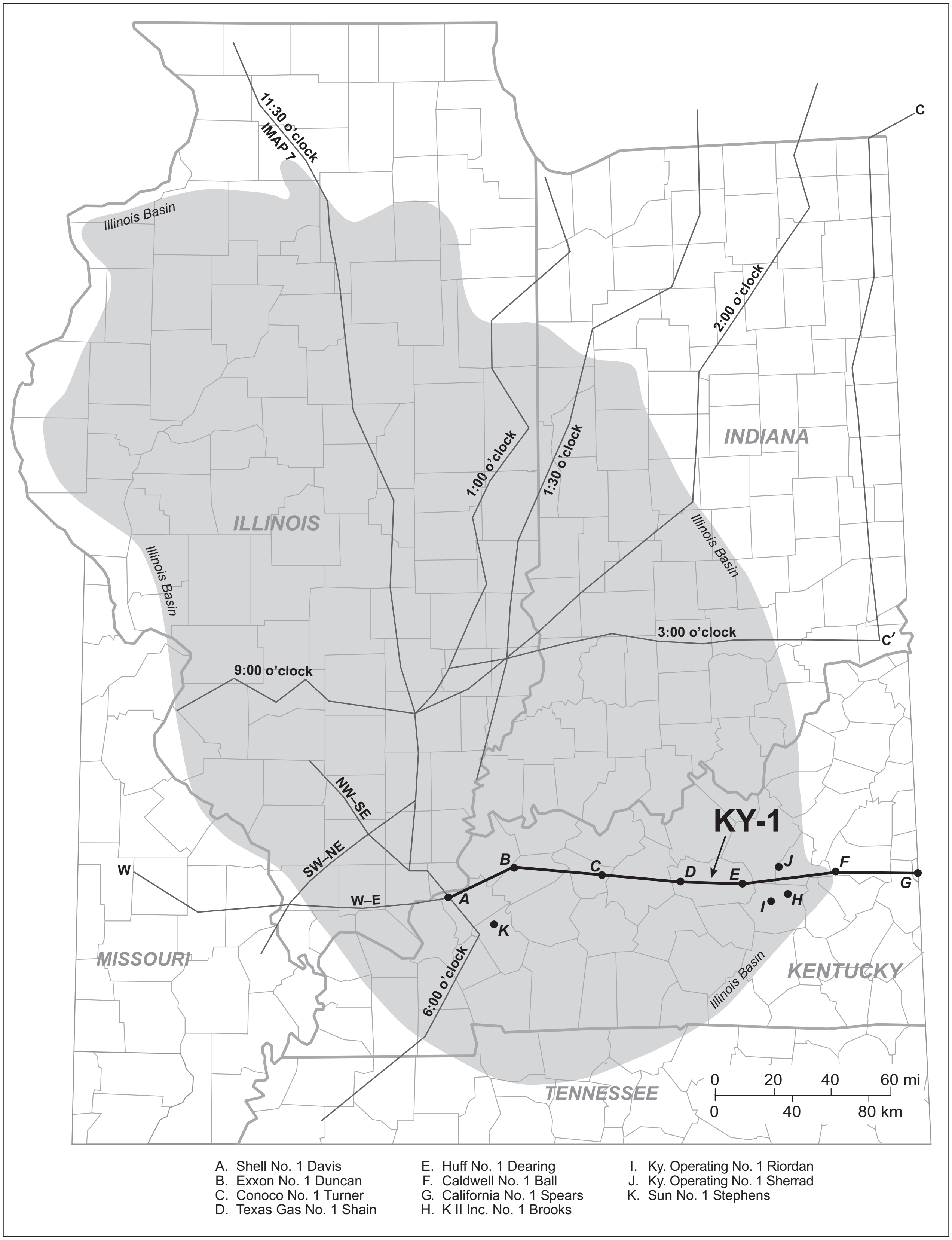


Figure 1. Locations of the KY-1 cross section and the other Illinois Basin Consortium cross-section lines in and adjacent to the Illinois Basin (shaded area).

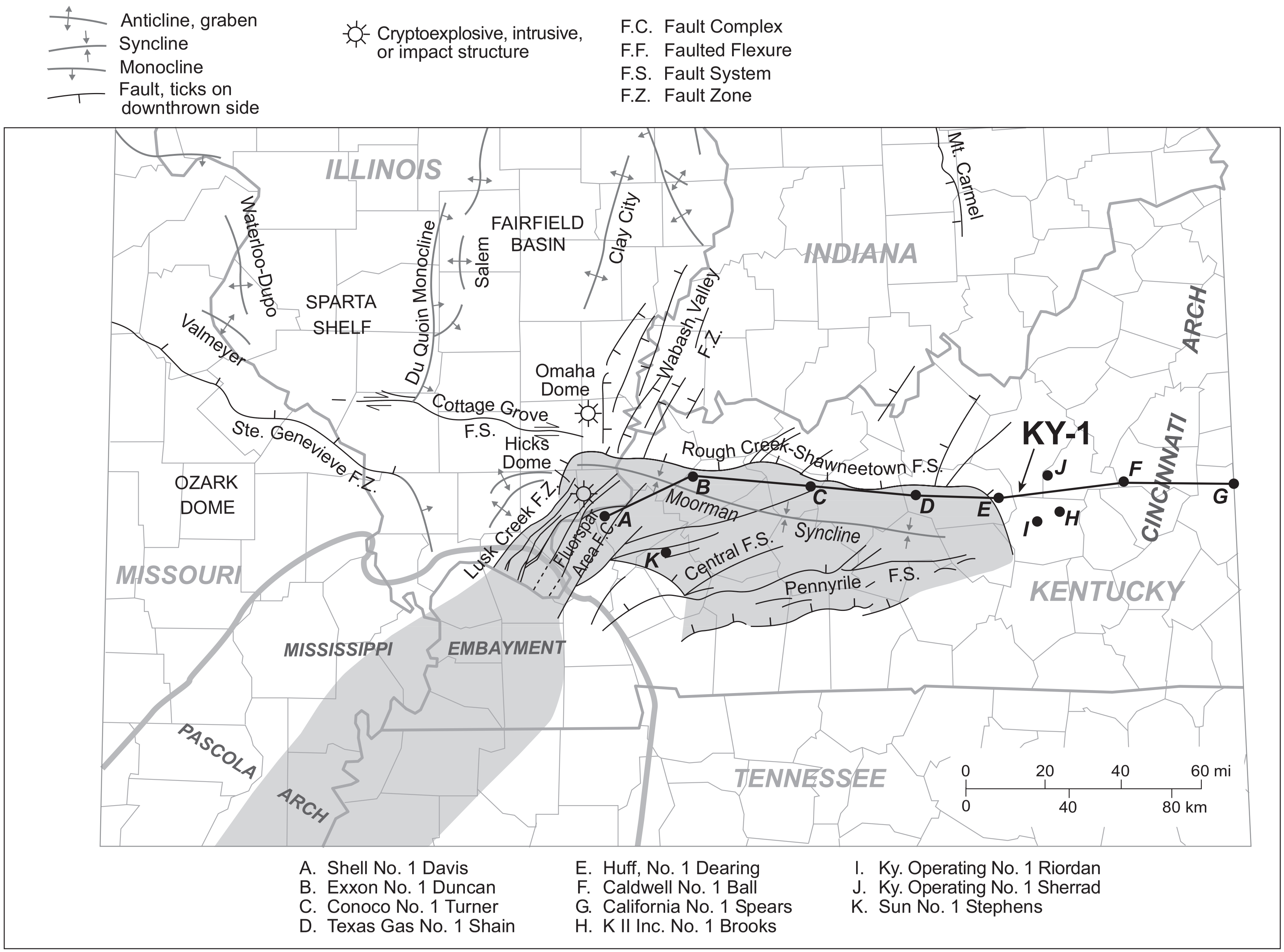


Figure 2. Major structural features of the southern Illinois Basin (from Nelson, 1991). The east–west part of the shaded area is the Rough Creek Graben and the northwest-oriented part is the Reelfoot Rift (from Kolata and Hildenbrand, 1997).

conformities at the sequence or subsequence boundaries as defined by Sloss (1963, 1982) are shown on the cross section. Drillholes shown on the cross section and map showing selected structural features in the Illinois Basin are referred to in the text by farm name.

Sequences

"The shifting base level on the North American continent during the past 570 m.y. has resulted in the deposition of major rock stratigraphic units that are interregional in extent and separated by interregional unconformities" (Kolata, 1991a). The major divisions of these stratigraphic units are the sequences of Sloss (1963) (Fig. 3).

Each sequence represents a major transgressive-regressive cycle of deposition. The major sequences along cross section KY-1, from oldest to youngest, are the Sauk, Tippecanoe, Kaskaskia, and Absaroka (Sloss, 1963). The Tejas sequence, the youngest depositional sequence, consisting of fluvial sand and gravels and lacustrine and aeolian (loess) deposits of Pleistocene and Holocene age, is not delineated on cross section KY-1. Rock-stratigraphic boundaries are based primarily on changes in wireline log signatures supplemented by sample studies where available.

Structure and Tectonics

The overall structure along the line of the cross section is that of an asymmetrical syncline with a shallow-dipping eastern flank and a steeply dipping western flank that extends north of the axis of the Moorman Syncline (Fig. 2). Superimposed on the regional synclinal structure are more local structures, many of which are associated with high-angle faults that have a long reactivation history.

The shallow structural configuration between wells was taken primarily from structure horizons mapped on 1:24,000-scale geologic quadrangle maps, using the following horizons: the base of the Springfield (W. Ky. No. 9) coal bed, the base of the Vienna Limestone, and the base of the New Albany Shale (Glick, 1963; Kehn, 1964, 1966, 1975a, b; Amos, 1965, 1970; Franklin, 1965, 1969; Goudarzi, 1968, 1969; Seeland, 1968; Johnson, 1971a, b; Lewis and Taylor, 1971; Johnson and Smith, 1972a, b, 1975; Fairer and others, 1975; Hansen, 1975, 1976a, b; Moore, 1977a, b; Gildersleeve, 1978; Gildersleeve and Johnson, 1978a, b; Hansen and Smith, 1978). Surface faults are projected vertically downward into the Eau Claire Formation as defined in Kentucky and Indiana.

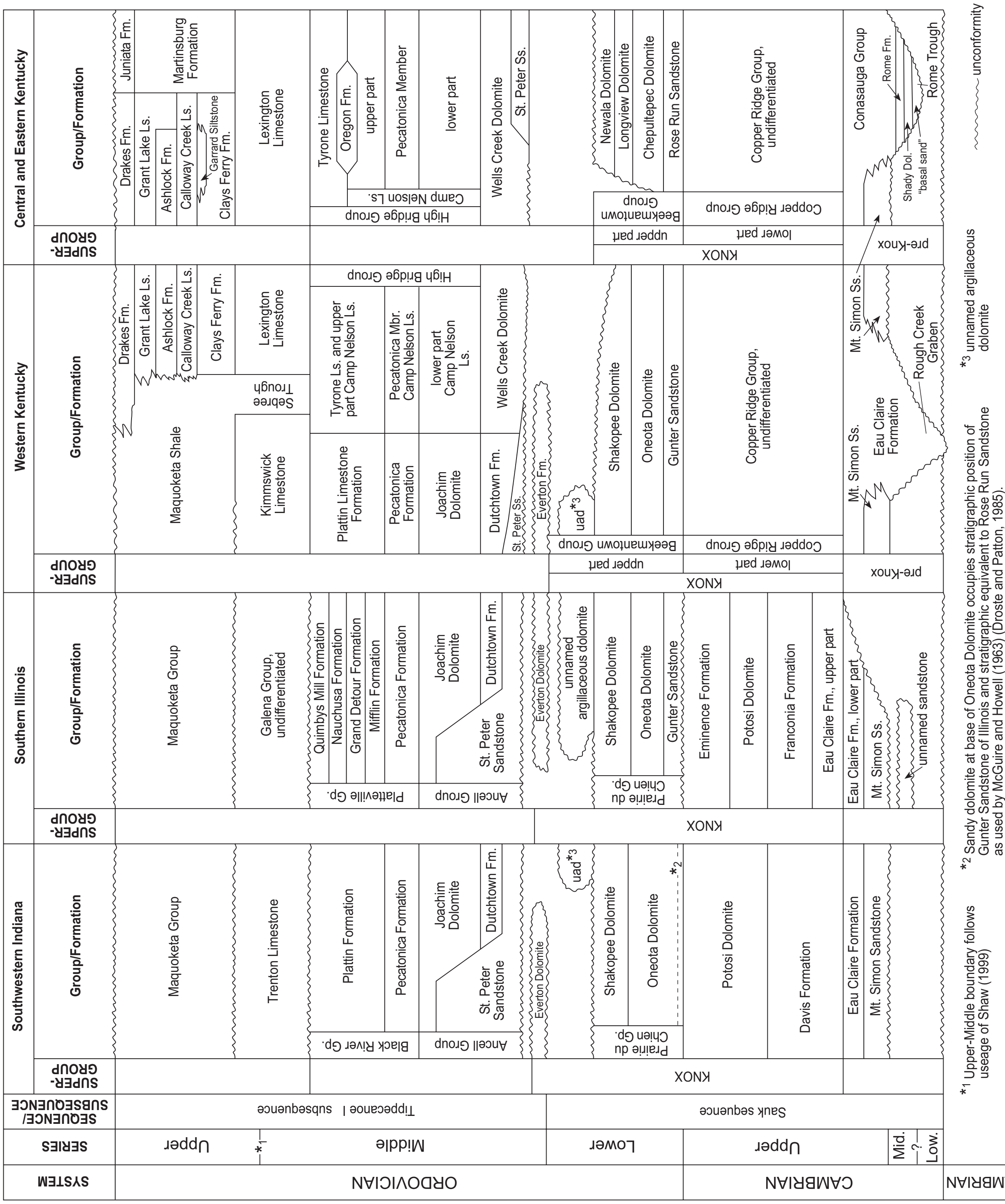
The deep structural configuration for the top of the Precambrian surface was determined from regional Precambrian mapping based on proprietary seismic-reflection data that were tied to Precambrian penetrations (Plate 1B). The seismic-derived mapping is based on earlier efforts, including those of Hester (1988), Bertagne and Leising (1991), Goetz and others (1992), Pratt and others (1992), Drahovzal and others (1992), Drahovzal (1994, 1997), Potter and others (1995, 1997), and Wheeler and others (1997), but is primarily from preliminary 1:1,000,000-scale deep-horizon maps being compiled for carbon sequestration research at the Kentucky Geological Survey (Solis and others, 2005). In constructing these compilations, seismic-reflection interpretations were made for the top of the Precambrian, top of the Eau Claire Formation, and top of the Knox Group. The interpreted two-way travel times in seconds were converted to approximate true depth in feet below sea level. The interval velocities used in making these conversions were based on correlation to nearby wells and interpretation of available sonic log data. The specific velocities used in the conversion ranged from 13,780 to 16,500 ft/s for the post-Knox interval, 20,000 to 21,400 ft/s for the Knox interval, and 18,000 to 18,700 ft/s for the Eau Claire interval.

Subsurface information is inadequate to determine exact relationships between surface faults and faults interpreted from seismic data at the Precambrian level.

The tectonic history of the area began with two rifting events. The first was during the Middle Proterozoic; its full geographic extent is poorly understood, but it involved at least central and western Kentucky, western Ohio and southeastern Indiana, and possibly parts of western Indiana and southern Illinois (Drahovzal and others, 1992; Drahovzal, 1997; Stark, 1997; McBride and Kolata, 1999). The second event followed in the Late Proterozoic to Early Cambrian, resulting in the formation of the Rough Creek Graben and associated Reelfoot Rift (Burke and Dewey, 1973; Soderberg and Keller, 1981; Bertagne and Leising, 1991; Kolata and Nelson, 1991; Nelson, 1991; Potter and others, 1995, 1997; Wheeler and others, 1997). Evidence of this rifting is shown by the greatly expanded Eau Claire Formation, which thickens by nearly 15 times into the Rough Creek Graben and extends to a depth of nearly 30,000 ft below sea level (Plate 1B).

By the Early Cambrian, the proto-Illinois Basin was part of a broad cratonic embayment that was open to the south. The most rapid tectonic subsidence throughout the Paleozoic occurred in the southern Illinois Basin, resulting in a thicker and more complete sedimentary section there.

Beginning in Late Mississippian time and extending through the Late Pennsylvanian and Early Permian, the area was under contraction, primarily in a northwest direction, from forces associated with the Alleghanian Orogeny in the southern Appalachians (Kolata and Nelson, 1991). This reversed the motion on the major Rough Creek Graben boundary faults—the Lusk and



*1 Upper-Middle boundary follows useage of Shaw (1999)

*2 Sandy dolomite at base of Oneota Dolomite occupies stratigraphic position of Gunter Sandstone of Illinois and stratigraphic equivalent to Rose Run Sandstone as used by McGuire and Howell (1963) (Droste and Patton, 1985).

*3 unnamed argillaceous dolomite

Figure 3. Lithostratigraphic units of the Sauk sequence and Tippecanoe I subsequence in Kentucky, southeastern Illinois, and southwestern Indiana (from Shaver, 1984; Patchen and others, 1984).

the Rough Creek–Shawneetown Fault Systems—creating reverse faults and arching on the south side of the Rough Creek Fault System in Kentucky (Fig. 2). During this episode, the southern boundary faults apparently were largely impassive.

With the development of the Atlantic Ocean and the opening of the Gulf of Mexico in Triassic and Jurassic time, extensional forces reversed the motion again on the northern faults and reactivated the southern boundary faults, resulting in extensive normal fault movement throughout western Kentucky and the development of the Moorman Syncline (Strunk, 1984; Kolata and Nelson, 1991). It was also during this time that the Pascola Arch on the south was uplifted and the Illinois Basin assumed a configuration similar to that of today.

Lithostratigraphy

Precambrian

Precambrian basement rocks along cross section KY-1 originally assigned to the Eastern Granite-Rhyolite Province are now considered part of the East Continent Rift Basin (Drahovzal and others, 1992; Drahovzal, 1997; Stark, 1997; Dean and Baranoski, 2002a, b). The East Continent Rift Basin consists primarily of sedimentary rocks with some associated mafic and felsic volcanic rocks (Harris, 1991a; Drahovzal and others, 1992; Drahovzal, 1997; Drahovzal and Harris, 2004). Precambrian sedimentary strata are composed of red-gray, fine- to medium-grained lithic arenites containing interbeds of red shale and siltstone. This dominantly sedimentary unit has been formally designated the Middle Run Formation at the type locality in Warren County, Ohio (Shrake, 1991), and has been correlated with and thought to be equivalent to similar rocks in the subsurface of Kentucky. The volcanic rocks are composed of basalts and rhyolites.

Only two wells along cross section KY-1 have penetrated Precambrian rocks (Plate 1B). The Conoco Co. No. 1 Turner well in McLean County in western Kentucky was drilled on a horst block in the Rough Creek Graben. The drillhole penetrated 268 ft (13,934 to 14,202 ft) of red-orange to light gray, fine- to medium-grained granite containing potassium feldspar, quartz, pyroxenes, spinels, and pyrite. No exploration test wells that penetrate Precambrian rocks have been drilled in the deeper part of the Rough Creek Graben. Seismic data in the western part of the graben, however, have been interpreted to indicate folded and thrust-faulted equivalents of possible Middle Run and associated volcanic rocks of Middle Proterozoic age overlain by relatively undeformed Late Proterozoic equivalents (Drahovzal, 1997; Potter and others, 1997).

The other basement test, the California Co. No. 1 Spears well in Lincoln County in central Kentucky, is located on the axis of the Cincinnati Arch. The drillhole penetrated 356 ft of Precambrian volcanics classified as rhyolite porphyry (Brown, 1951). A thin interval of Precambrian sedimentary rock (arkose) is interbedded with the rhyolite. Whether this interval is a true Middle Run equivalent is uncertain. The Spears well is interpreted to lie within the East Continent Rift Basin (Harris, 1991b; Drahovzal and others, 1992).

Three wells drilled in the vicinity of cross section KY-1, the K II Inc. No. 1 J.H. Brooks and the Kentucky Operating No. 1 Riordan, both in Hart County, and the Kentucky Operating No. 1 V. Sherrard in Larue County, encountered lithic arenites below the Mount Simon Sandstone (Fig. 1). These lithic arenites have been identified as the Middle Run Formation (Harris, 2000; Drahovzal and Harris, 2004). Lithologic descriptions of rock cuttings from 6,468 to 8,252 ft from the Brooks well describe the composition of the Middle Run as red-brown, fine- to medium-grained lithic arenites with interbeds of red shale and siltstone. These wells are within the East Continent Rift Basin.

Chronostratigraphic data are very limited along cross section KY-1. Reliable radiometric dating has not been attempted on granites in the Turner well because diagenetic alteration has contaminated the original composition (Larry Snee, U.S. Geological Survey, personal commun., 1994). The Middle Run Formation may be as young as Early Cambrian, but because of the significant unconformity with the Mount Simon and lithologic similarities to Precambrian units in northern Michigan and Wisconsin, it is correlated with Middle Proterozoic (Keweenawan; 1.2 to 1.1 Ga) rocks (Daniels, 1982; Green, 1982; Van Schmus and Hinze, 1985; Dickas, 1986; Harris, 1991b; Drahovzal and others, 1992).

Structural relationships also indicate an older age for the Middle Run. In Kentucky and Ohio, rocks of the Grenville Province (approximately 1.0 Ga) are thrust over the Middle Run rocks, indicating an age consistent with the Mesoproterozoic (Drahovzal and others, 1992; Hauser, 1993, 1996; Drahovzal, 1997; Stark, 1997; Dean and Baranoski, 2002a, b). Evidence from several seismic profiles in the area also indicate that the pre-Mount Simon interval is likely much older than the Mount Simon rocks, since strongly dipping Middle Run rocks or their equivalents form a marked angular unconformity with the overlying Cambrian rocks (Shrake and others, 1990; Hauser, 1993, 1996; Drahovzal, 1997; Potter and others, 1997; Stark, 1997; Dean and Baranoski, 2002a, b).

The only isotopic date along cross section KY-1 was reported by M.N. Bass (consulting geologist, written commun., 1969) in a file in the KGS well record database for the Spears well. The isotopic age for the quartz trachyte is 1.02 Ga, which is consistent with the timing of Keweenawan rifting in the central United States (Dickas, 1986; Drahovzal and others, 1992).

Sauk Sequence

The Sauk sequence includes all the rocks of the Cambrian System and the Lower Ordovician. It is bounded unconformably below by Precambrian rocks and above by Middle Ordovician rocks. The sequence consists of two major lithostratigraphic units: a lower section of siliciclastics and carbonates of the Mount Simon Sandstone and the overlying Eau Claire Formation, which includes the expanded pre-Knox sedimentary section in the Rough Creek Graben (Harris, 1995), and an upper carbonate section, primarily dolomites of the overlying Knox Supergroup. Along cross section KY-1, the Sauk sequence ranges in thickness from an estimated 22,000 ft in the vicinity of the Exxon No. 1 Duncan drillhole in western Kentucky to about 4,450 ft in the Spears drillhole in central Kentucky (Plate 1B). The basal siliciclastics and carbonate section ranges from an estimated 17,000 ft in the Duncan well to about 2,720 ft in the Spears well. Carbonates of the overlying Knox Supergroup range in thickness from an estimated 5,500 ft in the Shell Davis well in western Kentucky to 2,930 ft in the Spears well.

Commercial hydrocarbon production has not been established from rocks of the Sauk sequence in western Kentucky. Bitumen staining noted in pre-Knox dolomites in the Turner drillhole in McLean County, however, indicates that the hydrocarbons were migrating in the basin (Harris, 1995). In addition, the pre-Knox in the same well had several gas shows, both in the dolomites and in the deeper siliciclastics. Recent investigation of limited seismic data available to the Illinois Basin Consortium provides relatively strong evidence for basin-floor fan deposition in pre-Knox rocks in the western basal part of the Rough Creek Graben. The fan complexes represent an important potential hydrocarbon reservoir facies that has not been tested in the graben (Drahovzal, 1994). In south-central Kentucky, hydrocarbons are being produced from reservoirs in the upper part of the Knox carbonates, which are also the host rock for zinc deposits in the same area (Anderson, 1991). In eastern Kentucky, gas is being produced from reservoirs in sandstones of the Rome Formation of Middle Cambrian age.

Mount Simon Sandstone and Eau Claire Formation (Lower(?), Middle, Upper Cambrian). In western Kentucky outside of the Rough Creek Graben, the sedimentary sequence from the top of the Precambrian surface to the base of the Knox Supergroup consists of two lithostratigraphic units: siliciclastics of the Mount Simon Sandstone and mixed carbonates and siliciclastics of the overlying Eau Claire Formation. In southern Illinois, the Eau Claire includes an upper carbonate-rich unit overlying a lower section of mixed carbonates and siliciclastics (Treworgy and others, 1997). This upper carbonate-rich portion of the Eau Claire in Illinois is included in the lower part of the Knox Supergroup in Kentucky and Indiana (Fig. 3). The underlying mixed-carbonate and siliciclastic unit constitutes the entire Eau Claire Formation in western Kentucky and southwestern Indiana (Droste and Patton, 1985; Treworgy and others, 1997).

The Mount Simon consists of fine- to coarse-grained, partly pebbly sandstone with thin zones of interbedded shale and siltstone (Buschbach, 1975; Becker and others, 1987). The base of the Mount Simon rests unconformably on the Precambrian erosion surface, in some cases onlapping onto that surface as in southern Illinois (Potter and others, 1997). The contact with the overlying Eau Claire Formation is conformable (Buschbach, 1975).

The Eau Claire (Kentucky-Indiana) is composed of varicolored, glauconitic, micaceous shales; very fine- to medium-grained, feldspathic, glauconitic sandstones; oolitic and fossiliferous limestones; and oolitic dolomites. The contact between the Eau Claire and overlying Knox is conformable. Lithologically, the siliciclastic content of the Eau Claire produces a higher response on gamma-ray logs than dolomites of the overlying Knox. The boundary is placed at the top of Eau Claire rocks with higher gamma-ray readings.

The pre-Knox sedimentary section outside the Rough Creek Graben averages about 2,500 ft in thickness (Bertagne and Leising, 1991). Along and in the vicinity of cross section KY-1 east of the Rough Creek Graben, the pre-Knox sequence ranges from about 750 ft in the Brooks well in Hart County to about 1,500 ft in the Spears well in Lincoln County.

Based on interpretation of partly proprietary seismic-reflection profiles and sparse well information, the pre-Knox sedimentary section thickens dramatically along the downthrown side of the Rough Creek Graben's northern boundary fault, the Rough Creek Fault System (Bertagne and Leising, 1991; Drahovzal, 1994, 1997; Potter and others, 1997; Wheeler and others, 1997). Along cross section KY-1 within the Rough Creek Graben, the pre-Knox sedimentary sequence ranges in thickness from about 17,000 ft in the vicinity of the Duncan drillhole to about 11,000 ft at the eastern boundary of the Rough Creek Graben, east of the Texas Gas No. 1 Shain drillhole in Grayson County (Plate 1B). The Mount Simon has not been identified in the thicker pre-Knox sedimentary sequence encountered in drillholes within the Rough Creek Graben, and apparently does not extend into the graben (Harris, 1995).

The Turner well, a Precambrian test drilled on a horst block within the Rough Creek Graben, penetrated 3,950 ft; the Duncan well, 2,690 ft; the Shain well, 5,121 ft; and the Stevens well, 1,757 ft of pre-Knox sediments without encountering a lithologic unit identifiable as the Mount Simon Sandstone.

The Mount Simon previously projected to lie beneath the Davis and Stevens drillholes on the 6 o'clock structural cross section (Whitaker and others, 1992) is likely not actually present there. This stratigraphic relationship is thought to be similar to that observed in the Rome Trough of eastern Kentucky, where the Mount Simon Sandstone north of the trough grades laterally into the Conasauga/Rome interval in the trough (Ryder and others, 1997; Harris and others, 2004).

Pre-Knox sediments in the Rough Creek Graben are lithologically similar to Eau Claire strata outside the graben, and the sedimentary sequence in the graben has been placed in the Eau Claire Formation for convenience.

Harris (1995) recognized four depositional sequences in the Eau Claire Formation in the Turner drillhole, which penetrated about 3,950 ft of pre-Knox sedimentary rocks. The oldest sequence (approximately 1,900 ft thick) is dominated by sandstone and interpreted to represent marine synrift deposits. Overlying the synrift clastics is a 1,100-ft-thick interval of fine- to medium-grained glauconitic sandstones; fossiliferous, oolitic limestones; and green shales that is interpreted as late synrift to early post-rift deposits. The upper two sequences consist of a 600-ft-thick zone of dolomitized, oolitic grainstone overlain by a 350-ft-thick shale-dominated interval consisting of green shales, siltstone, and oolitic limestone. These intervals are interpreted as marine post-rift deposits. Bitumen staining was noted in post-rift dolomites, indicating that oil moved through the interval. Gas shows were reported in both the post-rift oolitic dolomites as well as within the synrift siliciclastic zone (James Goodwin, consulting geologist, written commun., 1994). The bitumen staining and gas shows suggest the presence of Cambrian source rocks in the Rough Creek Graben.

Data from two cores taken in the Turner well suggest a possible angular unconformity within the Eau Claire (James Goodwin, consulting geologist, written commun., 1994). The first core, from a depth of 10,312 to 10,340 ft, consists of oolitic dolomite with horizontal bedding, whereas the second core, from a depth of 11,073 to 11,101 ft, consists of interbedded limestone and shale with beds dipping 25 to 30°. A dipmeter log indicates an overall change in dip from south to west-northwest at a depth of 11,050 ft.

The thinner pre-Knox Cambrian section (Mount Simon Sandstone and Eau Claire Formation) outside of the Rough Creek Graben is regarded as Late Cambrian in age (Palmer, 1982; Droste and Patton, 1985; Buschbach, 1975), but the thicker pre-Knox sequence (Eau Claire Formation) in the graben is considered to include rocks of Middle and Early Cambrian and possibly late Precambrian age (Goetz and others, 1992). Although a precise Upper–Middle Cambrian boundary has not been established in the Rough Creek Graben, paleontologic studies of trilobite fragments from a limestone and shale interval in the Turner well, 1,181 to 1,200 ft below the top of the Eau Claire, and from a shale zone in the Shain well, 4,905 to 4,910 ft below the top of the Eau Claire, indicate early Middle Cambrian and Middle Cambrian ages for these intervals of the Eau Claire (Schwalb, 1982; James Goodwin, consulting geologist, written commun., 1994). Interpretation of seismic-reflection data indicates that an additional 6,000 ft of pre-Knox sedimentary section below the trilobite-shale zone in the Shain drillhole could contain rocks of Early Cambrian and late Precambrian age.

The Eau Claire Formation (Kentucky-Indiana) is laterally equivalent to the Rome Formation and the overlying Conasauga Group of central and eastern Kentucky (Shaver, 1984). Along cross section KY-1, the change from central and eastern Kentucky terminology to western Kentucky terminology is made at the Spears well in Lincoln County.

Knox Supergroup (Upper Cambrian and Lower Ordovician). The Knox Dolomite, named for Knox County, Tenn. (Safford, 1869), has been used with various stratigraphic ranks and intervals for many years throughout the central United States (Droste and Patton, 1985). The Knox Dolomite has the rank of supergroup in Illinois and Indiana, of group in Kentucky and Tennessee, and of formation in Ohio. The Knox is dominated by dolomite and dolomitic limestone with varying amounts of sandstone, chert, and shale. Knox sediments were deposited on a broad continental shelf (Harris, 1973).

In southern Illinois, the Knox Supergroup (Megagroup) comprises all the rocks in the stratigraphic succession from the top of the mixed siliciclastic and carbonate unit of the lower part of the Eau Claire Formation (Illinois) to the base of the St. Peter Sandstone of the Ancell Group (Kolata, 1991a, Figs. 2-5, 2-7). The Knox has been subdivided into nine stratigraphic units: in ascending order, the carbonate-rich unit of the upper part of the Illinois Eau Claire Formation, Franconia Formation, Potosi Dolomite, and Eminence Formation of Late Cambrian age; the Gunter Sandstone, Oneota Dolomite, Shakopee Dolomite, and unnamed argillaceous dolomite unit (Whitaker and others, 1992) of Early Ordovician age; and the Everton Dolomite of Middle Ordovician age (Fig. 3).

In southwestern Indiana, the Knox Supergroup consists of the sediments from the top of the Eau Claire Formation (Kentucky-Indiana) to the base of either the St. Peter Sandstone or the Dutchtown Formation of the Ancell Group (Droste and Patton, 1985). The Knox Supergroup has been subdivided into four formations: in ascending order, the Potosi Dolomite of Late Cambrian age; the Oneota and Shakopee Dolomites of the Prairie du Chien Group of Early Ordovician age; and the Everton Dolomite of Middle Ordovician age (Fig. 3). The Potosi is laterally equivalent to the Potosi Dolomite and Eminence Formations of Illinois (Droste and Patton, 1985). A light-colored, partly sandy dolomite at the base of the Oneota occupies the stratigraphic position of the Gunter Sandstone of Illinois, and is the stratigraphic equivalent of the Rose Run sand as used by McGuire and Howell (1963) (Droste and Patton, 1985).

In western Kentucky, the Knox Supergroup comprises the stratigraphic succession from the top of the Eau Claire Formation (Kentucky-Indiana) to the sub-Tippecanoe erosional unconformity at the base of the Everton Formation, St. Peter Sandstone, or Wells Creek Dolomite. The Knox Supergroup was subdivided into eight formations based primarily on stratigraphic nomenclature imported from the outcrop area in Missouri (Shaver, 1984). In ascending order, they are the Elvins Formation, Potosi Dolomite, and Eminence Dolomite of Late Cambrian age; and the Gunter Sandstone, Gasconade Dolomite, Roubidoux Formation, Jefferson City Dolomite, and Cotter Dolomite of Early Ordovician age (Shaver, 1984).

Identifying formations for many of these units in western Kentucky is unfeasible because of a paucity of drillholes that penetrate through the Knox, only generalized lithologic descriptions of drillhole cuttings, lithologic similarity of stratigraphic units, and some formational boundaries that have been defined by insoluble residues. Nomenclature revision will be required.

In central and eastern Kentucky, the Knox Supergroup has been defined to comprise the stratigraphic section from the top of the Conasauga Group to the sub-Tippecanoe erosional unconformity at the base of the St. Peter Sandstone or Wells Creek Dolomite. In ascending order, the Knox was divided into two formations: the Copper Ridge Dolomite of Late Cambrian age and the Beekmantown Dolomite of Early Ordovician age. The Beekmantown was subdivided, in ascending order, into the Chepultepec Dolomite, which included the Rose Run Sandstone in the lower part of the unit, and the Longview and Newala Dolomites in the upper part (McGuire and Howell, 1963). This terminology needs to be slightly revised for statewide uniformity of Knox nomenclature, however. We propose herein a stratigraphic classification that combines some of the nomenclature currently being used in adjacent parts of southern Illinois and southwestern Indiana and in central and eastern Kentucky for the Knox in Kentucky. We recommend that the stratigraphic classification of the Knox in Kentucky be elevated from group to supergroup rank and be divided into two groups: in ascending order, the Copper Ridge Group of Late Cambrian age and the Beekmantown Group of Early Ordovician age (Fig. 3).

In western Kentucky, the Knox Supergroup overlies the Eau Claire Formation (Kentucky-Indiana) and unconformably underlies the Everton Dolomite, the St. Peter Sandstone, or the Wells Creek Dolomite. In central and eastern Kentucky, the Knox Supergroup overlies the Conasauga Group and unconformably underlies either the St. Peter Sandstone or the Wells Creek Dolomite (Fig. 3).

The maximum known thickness of the Knox Supergroup in Kentucky is 5,997 ft, which was encountered in the Sun Oil Co. No. 1 Stevens drillhole in Caldwell County, about 26 mi south of the Duncan drillhole. Along cross section KY-1, the Knox Supergroup ranges in thickness from an estimated 5,500 ft in the Davis drillhole to 2,930 ft in the Spears drillhole, and is divided into informal units labeled lower Knox and upper Knox.

Copper Ridge Group. The Copper Ridge Group consists of all the strata from the top of the Eau Claire Formation (Kentucky-Indiana) to the base of the Gunter Sandstone in western Kentucky and from the top of the Conasauga Group to the base of the Rose Run Sandstone, which is the stratigraphic equivalent of the Gunter Sandstone (McGuire and Howell, 1963; Willman and Buschbach, 1975; Droste and Patton, 1985) in central and eastern Kentucky (Fig. 3). Further subdivision of the Copper Ridge Group is beyond the scope of this report.

The Copper Ridge is composed of very fine- to medium-grained, occasionally coarsely crystalline, partially oolitic dolomite. The colors are primarily shades of brown with intervals of gray. Chert in the Copper Ridge is white to gray and partially oolitic. The Copper Ridge contains several thin argillaceous or sandy intervals that produce higher gamma-ray responses than overlying and underlying dolomites. These intervals appear to be of regional extent and could be used to divide the Copper Ridge into mappable lithologic units. The Copper Ridge Group thins depositionally from an estimated thickness of 2,850 ft in the Davis well to 1,480 ft in the Spears well.

Beekmantown Group. The Beekmantown Group consists of all the rocks in the stratigraphic interval from the base of the Gunter Sandstone to the sub-Tippecanoe unconformity at the base of the Everton Formation, St. Peter Sandstone, or Wells Creek Dolomite in western Kentucky and to the base of either the St. Peter or Wells Creek in central and eastern Kentucky (Fig. 3).

In central and eastern Kentucky, the Beekmantown is subdivided into four formations: in ascending order, the Rose Run Sandstone and the Chepultepec, Longview, and Newala Dolomites (Fig. 3). See McGuire and Howell (1963) for lithologic descriptions and other criteria used to pick the boundaries of these stratigraphic units.

In western Kentucky, the Beekmantown is subdivided into four formations: in ascending order, the Gunter Sandstone, Oneota Dolomite, Shakopee Dolomite, and unnamed argillaceous dolomite.

The Beekmantown Group ranges in thickness from 2,650 ft in the Davis drillhole to 1,430 ft in the Spears well. The sub-Tippecanoe erosional unconformity at the top of the Beekmantown accounts for most of the thinning of the upper Knox. Subsurface information is too sparse to determine local erosional relief at the top of the Beekmantown along cross section KY-1, but up to 400 ft of erosional relief has been recorded in south-central Kentucky (Anderson, 1991).

Commercial quantities of oil and gas are being produced from reservoirs in the Beekmantown Group at or near the sub-Tippecanoe erosional unconformity in eastern and south-central Kentucky (McGuire and Howell, 1963). In western Kentucky, possible hydrocarbon traps in the Beekmantown associated with the sub-Tippecanoe unconformity are buried paleotopographic hills, truncated porous zones, and pre-Tippecanoe folds.

The Gunter Sandstone crops out in central Missouri and has been traced in the subsurface across southern Illinois to the Duncan drillhole shown on cross section KY-1 in western Kentucky (Sargent and others, 1992). The Gunter consists of very fine- to medium-grained, occasionally coarse-grained sandstone with thin interbeds of dolomite. Where sandstone is absent, the stratigraphic position of the Gunter is recognized in cuttings and cores by the presence of occasional sand grains near the base of the overlying Oneota (Sargent and others, 1992; Droste and Patton, 1985). The Gunter ranges from 10 to 40 ft in thickness along cross section KY-1. A combination of gamma-ray logs and lithologic descriptions of rock samples from the test holes is advantageous in locating the Gunter interval in drillholes.

The contact between the Gunter and the underlying Copper Ridge Group is conformable (Shaver, 1984). The boundary is placed at the base of the lowest sandstone bed or zone of sandy dolomite in the Gunter, which is stratigraphically equivalent to the Rose Run Sandstone of central and eastern Kentucky (Willman and Buschbach, 1975; Droste and Patton, 1985).

The Oneota Dolomite is typically a finely to moderately crystalline, light gray to brownish-gray, cherty dolomite that contains minor amounts of sand and thin shaly beds near the base. The chert is generally light colored and in part oolitic. Along cross section KY-1, the Oneota ranges in thickness from about 1,150 ft in the Davis well in western Kentucky to about 1,300 ft in the Spears well in central Kentucky.

The contacts between the Oneota Dolomite and underlying Gunter Sandstone and overlying Shakopee Dolomite are conformable (Shaver, 1984). The contact between the Oneota and the Gunter is placed at the top of the highest sandstone bed or zone of sandy dolomite of the Gunter. The purity of the Oneota distinguishes it lithologically from the overlying shaly, sandy dolomites of the Shakopee and produces lower gamma-ray and spontaneous-potential signatures than the Shakopee (Treworgy and others, 1997). The boundary between the Oneota and overlying Shakopee is placed at the top of Oneota rocks with generally lower gamma-ray readings.

The Shakopee Dolomite consists of argillaceous to pure, very finely to finely crystalline dolomite with interbeds of sandstone and shale. The dolomite ranges from white to shades of gray and brown; brown is more prevalent in the lower part of the unit. The chert is light-colored and in part oolitic. In the lower part of the Shakopee, sandstone zones several tens of feet thick interbedded in dolomite are present from 8,280 to 8,700 ft in the Duncan drillhole and from 5,722 to 6,042 ft in the Turner drillhole. The amount of sandstone decreases west and east from these drillholes. These Shakopee sandstones may be related to the sandstones noted in the Shakopee by Dawson (1960) and Droste and Patton (1985). The Shakopee ranges in thickness from about 1,100 ft in the Davis well in western Kentucky to about 500 ft in the Spears well in central Kentucky.

The upper boundary of the Shakopee is an erosional break with the overlying Everton Dolomite, St. Peter Sandstone, or Wells Creek Dolomite, except possibly in the vicinity of the Davis drillhole, where an unnamed argillaceous dolomite unit overlies the Shakopee.

A shaly or argillaceous dolomite unit previously unrecognized as being distinct from and overlying the Shakopee is present only in wells in southernmost Illinois, adjacent parts of western Kentucky, and possibly southernmost Indiana (Whitaker and others, 1992). The unit is composed of brown to gray, very finely to finely crystalline, argillaceous, silty, slightly cherty dolomite with thin intervals of black, dolomitic shale and anhydrite. The unit, 460 ft thick in the Davis drillhole, is absent in the Duncan and other drillholes along the line of cross section KY-1. The lower unit boundary may be gradational with the underlying Shakopee (Whitaker and others, 1992).

The increased argillaceous content of the unnamed argillaceous dolomite produces higher responses on gamma-ray logs than the underlying Shakopee, and the contact between the units is placed at the base of the unnamed argillaceous dolomite with higher gamma-ray readings.

Tippecanoe Sequence

The Tippecanoe sequence consists of the stratigraphic succession between major unconformities at the top of the Knox Supergroup of Early Ordovician age and at the base of rocks of Middle Devonian age. The sequence is the thickest in southern Illinois and western Kentucky (Kolata, 1991b). Along cross section KY-1, the sequence ranges in thickness from about 3,200 ft in the Davis well in western Kentucky to about 1,300 ft in the Spears well in central Kentucky.

In Tippecanoe rocks in Kentucky, hydrocarbons are produced from reservoirs in the Wells Creek Dolomite, High Bridge Group, Lexington Limestone, and Calloway Creek (Leipers) Limestone of Middle and Late Ordovician age and from Silurian and Early Devonian carbonates associated with the pre-Middle Devonian unconformity along the southeastern margin of the Illinois Basin.

In the Illinois Basin, the Tippecanoe sequence is subdivided into two subsequences (Sloss, 1982), which are separated by widespread unconformities (Kolata, 1991b). In southern Illinois and southwestern Indiana, the Tippecanoe I subsequence extends from the base of either the Everton Dolomite or the St. Peter Sandstone to the top of the Upper Ordovician Maquoketa Group (Droste and Patton, 1985; Kolata, 1991b). In western Kentucky, the Tippecanoe I subsequence extends from the base of the Everton Formation (Dolomite) or St. Peter Sandstone to the top of the Upper Ordovician Maquoketa Shale, and in central and eastern Kentucky to the top of the Upper Ordovician Drakes Formation.

The Tippecanoe II subsequence extends from the base of the Silurian carbonate formations to the top of the Lower Devonian Clear Creek Limestone in western Kentucky. It has been thinned by Paleozoic erosion in central Kentucky.

Tippecanoe I Subsequence, Western Kentucky. In western Kentucky, Tippecanoe I subsequence strata have been divided into eight formations (Shaver, 1984): in ascending order, the Everton Formation, St. Peter Sandstone, Dutchtown Formation, Joachim Dolomite, Pecatonica Formation, and Plattin Formation of Middle Ordovician age; the Kimmswick Limestone of Middle and Late Ordovician age; and the Maquoketa Shale and Drakes Formation of Late Ordovician age. The Everton and St. Peter are shown as a single unit along cross section KY-1. The Middle–Upper Ordovician boundary in western Kentucky follows the usage of Shaw (1999), who placed the boundary at the base of the Cincinnatian Series, which in turn is defined as the basal contact of the Eden Shale in the Cincinnati region of southwestern Ohio (Sweet and Bergstrom, 1971).

In Illinois, the Everton consists of a lower sandstone and an upper sandy dolomite section (Willman and Buschbach, 1975). The overlying St. Peter is a pure, mature quartzarenite with well-rounded frosted grains (Treworgy and others, 1997). In western Kentucky, the upper part of the Everton and the lower part of the St. Peter appear to be facies of one another. The St. Peter–like sandstone beds in the upper part of the Everton make it difficult to differentiate which of the sandstones may be correlative with the St. Peter Sandstone, so the units are combined as a single unit on cross section KY-1. The Everton–St. Peter unit ranges in thickness from 360 ft in the Davis drillhole to 0 ft east of the Shain well, where the unit apparently pinches out.

The lower boundary of the Everton–St. Peter unit is an erosional break with the underlying Knox Supergroup, except in the vicinity of the depocenter in southern Illinois and adjacent western Kentucky, where the absence of distinctive changes in lithology and the dramatic expansion basinward of the Everton suggests that the stratigraphic succession may be conformable (Shaw, 1999). Where the Everton–St. Peter is missing, the Wells Creek Dolomite rests on the erosion surface on top of the Knox.

The contact between the Everton–St. Peter unit and the overlying Dutchtown Formation is conformable (Shaver, 1984). Lithologically, the boundary is placed on top of the highest sandstone bed of the Everton–St. Peter below the argillaceous carbonates of the Dutchtown, which generally produce higher responses on gamma-ray logs than the sandy carbonates of the Everton–St. Peter. The boundary is placed at the base of the Dutchtown rocks with higher gamma-ray readings.

Winslow (1894) and McQueen (1937) defined the Joachim as a dolomite in its type area, and the underlying Dutchtown as principally a limestone. In the subsurface, however, both units may be dolomite or limestone or both, thereby eliminating the main distinguishing characteristic between the Dutchtown and Joachim (Sargent and others, 1992). The lower part of the combined Dutchtown-Joachim is generally shalier, as evidenced by higher readings on gamma-ray logs; this criterion is used to distinguish the units in the Davis well (Whitaker and others, 1992). The undivided Dutchtown-Joachim is laterally correlative with the lower part of the High Bridge Group and Wells Creek Dolomite of central Kentucky (Fig. 3).

The Pecatonica Formation consists of predominantly dark brown, micro- to fine-grained, slightly dolomitic limestone. The Pecatonica conformably overlies and underlies argillaceous carbonates of the Joachim Dolomite and Plattin Limestone, respectively. The Pecatonica has a distinctive signature on radioactive and electric logs (Schwalb, 1969; Kolata, 1991b). Lithologically, the argillaceous carbonates of the underlying Joachim and overlying Plattin produce higher responses on gamma-ray and spontaneous-potential logs than limestones of the Pecatonica. The boundary between the Pecatonica and underlying Joachim is placed at the top of Joachim rocks with higher gamma-ray readings. The boundary between the Pecatonica and overlying Plattin is placed at the top of Pecatonica rocks with lower gamma-ray readings.

The Plattin Limestone is a dominantly brown, micrograined (lithographic), slightly argillaceous and dolomitic limestone. The upper part of the Plattin contains two bentonite beds that are useful for local and regional correlation.

The Mud Cave of drillers' terminology (Millbrig of Huff and Kolata [1990]) is present at or near the top of the unit, and the Pencil Cave (Deicke of Huff and Kolata [1990]) occurs 15 to 30 ft below the top of the Plattin. The Plattin is stratigraphically equivalent to that part of the Camp Nelson Limestone above the proposed Pecatonica Member, the Oregon Formation (if present), and the Tyrone Limestone of the High Bridge Group of central Kentucky (Fig. 3). The Plattin is 115 ft thick in the Davis well.

The Plattin is overlain by the Kimmswick Limestone, except in the area of a submarine low, variously named the Sebree Valley (Schwalb, 1982), Kope Trough (Keith, 1985), or Sebree Trough (Bergstrom and Mitchell, 1987). Along the axis of the Sebree Trough, the Maquoketa Shale (Kolata and others, 2001) overlies the Plattin, and the Kimmswick is missing, either by submarine scouring or nondeposition.

On cross section KY-1, the contact between the Plattin and either the overlying Kimmswick or Maquoketa is placed at the top of the Mud Cave bentonite or the highest occurrence of micrograined (lithographic) limestone of the Plattin.

The Kimmswick Limestone is composed of gray to brown, medium- to coarse-grained, fossiliferous limestone. The unit, about 80 ft thick in the Davis drillhole, thins east to about 30 ft in the Turner well and is absent along the axis of the Sebree Trough, which is filled with an unusually thick section of Maquoketa siliciclastics. The trough separates the Kimmswick Limestone from the stratigraphically equivalent Lexington Limestone of central Kentucky (Kolata and others, 2001).

The contact between the Kimmswick and the overlying Maquoketa Shale is placed at the highest occurrence of a thick interval of bioclastic limestone. This contact is very distinctive on gamma-ray logs; the Maquoketa siliciclastics have higher readings.

The Maquoketa Shale consists of dark gray or black organic shale with siltstone and minor limestone interbeds. High levels of organic carbon occur in dark-colored shale in the lower part of the Maquoketa. Total organic carbon values commonly range from 2 to 5 percent, but locally are as much as 16 percent (Kolata and Graese, 1983). The lower part of the Maquoketa in the Sebree Trough is contemporaneous with the Kimmswick (Trenton) and Lexington Limestones (Kolata and others, 2001). The upper part of the Maquoketa is laterally equivalent to the Clays Ferry Formation, Garrard Siltstone, Calloway Creek Limestone, Ashlock Formation, Grant Lake Limestone, and Drakes Formation in central and western Kentucky. The lithologies of the Drakes Formation, which extends in the subsurface from its area of outcrop in central Kentucky to the Turner drillhole in western Kentucky, are discussed below. The Maquoketa underlies the Sexton Creek Limestone or Brassfield Dolomite of Early Silurian age. The boundary between the Maquoketa and these units is placed at the highest occurrence of shale or siltstone beneath the overlying carbonates. This contact is disconformable and easily picked on geophysical logs (Kolata and Noger, 1991).

Tippecanoe I Subsequence, Central Kentucky. The Tippecanoe I subsequence in central Kentucky has been subdivided into eight rock-stratigraphic units: in ascending order, the St. Peter Sandstone, Wells Creek Dolomite, and High Bridge Group of Middle Ordovician age; the Lexington Limestone of Middle and Late Ordovician age; and the Clays Ferry Formation, Calloway Creek Limestone, Garrard Siltstone, Ashlock Formation, Grant Lake Limestone, and Drakes Formation of Late Ordovician age.

The St. Peter Sandstone of central and eastern Kentucky consists of fine- to coarse-grained dolomitic sandstone. Although the unit occupies a stratigraphic position similar to the St. Peter of the Illinois Basin, the formations are not in lateral continuity and differ in lithic character (Price, 1981). On cross section KY-1, the St. Peter of central and eastern Kentucky is identified in the Spears drillhole as a thin (10 ft) sandy dolomite underlying the Wells Creek Dolomite.

The name "Wells Creek Dolomite" was originally proposed by Lusk (1927) for 350 ft of strata above the Beekmantown Dolomite and said by him to be exposed only in the Wells Creek Basin in Stewart County, Tenn.

No reference section was identified. Bertall and Collins (1945) described the Wells Creek as green, argillaceous dolomite that is 150 to 200 ft thick in its type area. This is about half the thickness reported by Lusk (1927). Bertall and Collins (1945) applied the name to 432 ft (3,072 to 3,514) of tan to green, silty to sandy, argillaceous dolomite interbedded with dark brown to tan, dense limestone encountered below the Murfreesboro Limestone and above rocks of Beekmantown age in the Ada Bell Oil Co. No. 2-A, Trigg County, Ky. Freeman (1953) identified the 432-ft interval as the Everton Formation.

Shaw (1999) noted that Jewell (1969) assigned the Wells Creek lithologies in central Tennessee to an unnamed member of the Murfreesboro Limestone and that Kidd and Copeland (1971) reported that the name "Wells Creek Dolomite" was abandoned by the Tennessee Division of Geology in favor of the name "Pond Springs Formation" (Milici and Smith, 1969). The term "Wells Creek Dolomite" has been retained in Kentucky, however (Dever, 1980; Gooding, 1992; Harris and others, 2004).

The lithologic criteria that have been used to identify the Wells Creek in the subsurface in Kentucky are variable. Dever (1980) noted that in central Kentucky the Wells Creek is silty and dolomitic, and placed the top of the Wells Creek below the last occurrence downsection of micrograined lithographic limestone, a lithology characteristic of the High Bridge Group. Gooding (1992) placed the contact in south-central Kentucky between the Wells Creek and the overlying High Bridge Group where the lithology changes from a zone of medium to dark gray interbedded shale and limestone at the base of the High Bridge Group to a tan to medium gray, fine- to medium-grained dolomitic limestone with minor, very thin shale beds at the top of the Wells Creek.

Freeman (1953) placed the boundary in the Spears drillhole between the Wells Creek and the overlying High Bridge Group where the lithology changed from grayish-brown, dense, slightly argillaceous limestone at the base of the High Bridge to cream-colored, finely crystalline dolomite interbedded with very fine-grained limestone and green shale. This lithologic change apparently produces slightly higher gamma-ray response in the Wells Creek than in the overlying High Bridge. The Wells Creek conformably overlies the St. Peter Sandstone and rests unconformably on the Knox Supergroup where the St. Peter is absent.

Along cross section KY-1, the Wells Creek averages about 50 ft in thickness and extends west from the Spears well in central Kentucky to the Duncan well in western Kentucky. The Wells Creek has not been recognized in the Davis well and probably intergrades into the Dutchtown Formation west of the Duncan well.

The Middle Ordovician High Bridge Group, which contains the oldest rocks exposed in Kentucky, was deposited as part of a vast complex of carbonate tidal flats that extended over most of the craton of the eastern United States (Cressman and Noger, 1976). The thickest section is near Camp Nelson in Jessamine County in central Kentucky, where 440 ft is exposed above river level (Wolcott, 1969). The base of the High Bridge is not exposed in Kentucky.

The High Bridge as exposed at the surface was subdivided into three formations (Miller, 1905): in ascending order, the Camp Nelson Limestone, Oregon Formation, and Tyrone Limestone. The base of the High Bridge was not defined.

The Pecatonica Formation of western Kentucky, Illinois, and Indiana (Schwalb, 1969; Kolata and Noger, 1991) has not been previously recognized in central Kentucky. Recent correlation of wireline logs, however, indicates that the Pecatonica is present in the middle part of the Camp Nelson in central Kentucky. The unit can be identified by the distinctive gamma-ray signature consistent with the Pecatonica in western Kentucky where it is overlain and underlain by argillaceous limestone and shale that produce higher readings on gamma-ray logs than limestone of the Pecatonica.

The Pecatonica may be equivalent to the Carntown unit (Stith, 1981) of the Black River Group (High Bridge) in Boone County in northern Kentucky. The Carntown is underlain by the lower argillaceous unit and overlain by the upper argillaceous unit (Stith, 1981). These units are similar to the argillaceous zones below and above the Pecatonica in central and western Kentucky. The lower argillaceous unit overlies the Wells Creek Dolomite.

The Carntown unit, which is over 98 percent pure carbonate (Stith, 1981), may be equivalent to the high-carbonate (95 percent) zone from 572 to 627.5 ft in the lower part of the Camp Nelson Limestone in the Asarco corehole in Fayette County in central Kentucky (Dever, 1980). Stratigraphic correlation of wireline logs along cross section KY-1 indicates that some of the lithologic units of the High Bridge Group are regionally persistent. Detailed mapping of these stratigraphic units could outline additional areas where rocks of the High Bridge Group could be a source of carbonate rocks of high chemical purity.

Because the Pecatonica is identifiable in the High Bridge Group and because the base of the High Bridge is undefined, the stratigraphic nomenclature of the High Bridge Group must be revised. We recommend that the High Bridge Group be subdivided into five lithologic units: in ascending order, the lower part of the Camp Nelson Limestone, the Pecatonica Member of the Camp Nelson Limestone, the upper part of the Camp Nelson

Limestone, the Oregon Formation, and the Tyrone Limestone (Fig. 3).

The contact between the lower part of the Camp Nelson Limestone of the High Bridge Group and the underlying Wells Creek Dolomite has been previously discussed. The contact between the lower part of the Camp Nelson Limestone and the overlying Pecatonica Member of the Camp Nelson is conformable and placed at the top of the argillaceous limestones of the lower part of the Camp Nelson that have higher gamma-ray readings. The boundary between the Pecatonica Member and the overlying upper part of the Camp Nelson Limestone is placed on top of Pecatonica rocks with lower gamma-ray readings. The boundary between the upper part of the Camp Nelson and the overlying Oregon Formation (if present) is placed at the base of the lowest dolomite bed of the Oregon. The boundary between the Oregon and the overlying Tyrone Limestone is placed at the top of the highest dolomite bed of the Oregon. Where the Oregon is absent, the Camp Nelson Limestone and overlying Tyrone Limestone are not readily distinguishable, and the units are combined. The Oregon is not present along cross section KY-1.

The upper part of the Tyrone Limestone contains two bentonite beds that are useful for regional correlation: the Mud Cave of drillers' terminology (Millbrig of Huff and Kolata [1990]) and the Pencil Cave (Deicke of Huff and Kolata [1990]). The Mud Cave occurs at or near the top of the formation and the Pencil Cave 15 to 30 ft below the top (Wolcott and others, 1972). The contact between the Tyrone and the overlying Lexington Limestone is disconformable (Miller, 1905; Cressman, 1973), and is placed at the top of the Mud Cave bentonite or the highest micrograined limestone bed underlying bioclastic limestone of the Lexington.

The Lexington Limestone was named by M.R. Campbell (1898). It is of Late Ordovician age, but the upper part is equivalent to the basal beds of the type Cincinnatian Series in southwestern Ohio (Bergstrom and Sweet, 1966, p. 288; Cressman, 1973). A discussion of the Middle and Upper Ordovician boundary is found in Webby (1998).

The Lexington Limestone consists of predominantly bioclastic and fossiliferous limestone and minor shale that were deposited in relatively shallow, but highly agitated, water (Cressman, 1973). The Lexington thins west from 185 ft in the Spears drillhole to 6 ft in the Turner drillhole in the vicinity of the Sebree Trough (Schwalb, 1982; Keith, 1985; Bergstrom and Mitchell, 1987; Kolata and others, 2001). The Lexington Limestone is laterally equivalent to the Kimmswick Limestone of western Kentucky. Along cross section KY-1 the change in nomenclature from Lexington to Kimmswick is made in the vicinity of the Sebree Trough.

The contact between the Lexington Limestone and overlying Clays Ferry Formation is conformable (Cressman, 1973). The contact is distinct on radioactive logs. The increased argillaceous content of the Clays Ferry produces a higher gamma-ray signature than limestone of the Lexington. The boundary is placed at the base of Clays Ferry rocks with higher gamma-ray readings.

In central Kentucky, the Upper Ordovician above the Lexington Limestone consists of more than 20 formations, members, and beds (Weir and others, 1984, Fig. 2, p. E 4). The lithic units were deposited on an extensive shelf in open marine water of shallow to moderate depth, but locally in intertidal and supratidal environments. The units are conformable, and in places intertongue and intergrade (Weir and others, 1984).

Along cross section KY-1, the Upper Ordovician section above the Lexington Limestone consists of six formations and five members. The formations are, in ascending order, the Clays Ferry Formation, Garrard Siltstone, Calloway Creek Limestone, Ashlock Formation, Grant Lake Limestone, and Drakes Formation. The Grant Lake is combined with the underlying Ashlock on this cross section. The Ashlock consists, in ascending order, of the Tate, Gilbert, Stingy Creek, Terrill, and Reba Members. Only the Tate and Gilbert Members are present along cross section KY-1. The Drakes consists, in ascending order, of the Rowland, Bardstown, and Saluda Dolomite Members. Members of the Ashlock and Drakes are too thin to show on this cross section.

The Clays Ferry, Calloway Creek, and Ashlock–Grant Lake intergrade into and intertongue with the lower and middle parts of the laterally equivalent Maquoketa Shale west of the Shain drillhole in western Kentucky. The Drakes extends west from the area of outcrop in central Kentucky to the Turner drillhole in western Kentucky and apparently pinches out in the upper part of the Maquoketa between the Turner and Duncan drillholes. See Weir and others (1984) for descriptions of lithologic criteria used to pick contacts between Upper Ordovician lithologic units at surface exposures.

The Clays Ferry Formation was named by Weir and Greene (1965, p. B14–B17), and is composed of subequal amounts of interbedded limestone and shale (30 to 60 percent each) and minor siltstones (5 to 10 percent). The limestone is composed of whole and fragmented fossils in a micrograined or fine- to medium-grained matrix. The shale is clayey to silty. Siltstone is the most abundant lithology in the upper part of the Clays Ferry Formation, and has been contorted in ball and pillow structures at some surface exposures. The lithic units are various shades of gray (Weir and others, 1984). Along cross section KY-1, the Clays Ferry ranges in thickness from 200 ft in the Spears well to 234 ft in the Shain well and intergrades into the Maquoketa Shale west of the Shain well.

The Clays Ferry is overlain conformably by either the Garrard Siltstone or Calloway Creek Limestone where the Garrard is absent. Radioactive-log characteristics are the best basis for picking the contact between the Clays Ferry and Garrard/Calloway Creek. The increased argillaceous content of the Clays Ferry produces a higher gamma-ray signature than either the Garrard or Calloway Creek, and the boundary is placed at the top of the Clays Ferry rocks with higher gamma-ray readings.

The Garrard Siltstone (Campbell, 1898, p. 2) consists of an interbedded sequence of quartz siltstone, greenish-gray shale, and silty limestone. Shale accounts for about 20 percent and limestone less than 10 percent. Siltstone beds are locally contorted into ball-and-pillow structures in some surface exposures (Weir and others, 1984). Along cross section KY-1, the Garrard thins west from a thickness of 70 ft in the Spears drillhole to about 30 ft in the Ball drillhole, and feathers out into a zone of shale and limestone in the upper part of the Clays Ferry west of the Ball drillhole.

The contact between the Garrard Siltstone and overlying Calloway Creek Limestone is conformable. The interbedded sequence of siltstone, shale, and limestone of the Garrard produces a higher gamma-ray response than limestone of the Calloway Creek. The boundary is placed at the top of the Garrard rocks with higher readings.

The Calloway Creek Limestone was defined by Weir and others (1965, p. D6–D9, D20–D21). It is dominantly medium gray, fossiliferous limestone with thin stringers of shale. Limestone accounts for more than 70 percent of the formation (Weir and others, 1984). Along cross section KY-1, the Calloway Creek thins west from a thickness of 120 ft in the Spears well to 30 ft in the Shain well, and pinches out in the Maquoketa Shale west of the Shain drillhole. The Calloway Creek is laterally equivalent to the Leipers Limestone of south-central Kentucky and the Fairview Formation of north-central Kentucky.

The contact between the Calloway Creek and the overlying Ashlock Formation is conformable. In the subsurface, the boundary is difficult to determine without reliable lithologic descriptions of rock cuttings from drillholes. Generally, limestone of the Calloway Creek produces a lower gamma-ray signature than the overlying Ashlock, so the boundary is placed at the top of Calloway Creek rocks with lower gamma-ray readings.

The Ashlock Formation was named by Weir and others (1965, p. D9–D12, D23–D29). In central Kentucky, it consists of an alternating sequence of limestone and dolomitic mudstone that locally intertongue, pinch out, and intergrade (Weir and others, 1984). The Ashlock is subdivided, in ascending order, into the Tate, Gilbert, Stingy Creek, Terrill, and Reba Members. Along cross section KY-1, the Ashlock consists of only the Tate and Gilbert Members.

The Tate is composed of greenish-gray, sparsely fossiliferous, argillaceous, laminated, slightly glauconitic, dolomitic limestone and calcareous dolomite with thin interbeds of gray shale. The overlying Gilbert is dominantly medium to dark gray, fossiliferous, micrograined limestone interbedded with fine- to medium-grained limestone and silty shale. The Gilbert is overlain by the Grant Lake Limestone.

The Grant Lake Limestone was defined by Peck (1966, p. B14–B16, B23–B24). It is composed of light to medium gray, fossiliferous limestone intermixed with shale. Limestone accounts for 70 to 90 percent of the formation. On cross section KY-1 the Grant Lake and members of the Ashlock are shown as a single unit.

The Grant Lake and the upper part of the Ashlock have been removed by post-Ordovician erosion in the Spears well. The unit ranges from 81 ft in thickness in the Ball well to 95 ft in the Shain well, and intergrades into the middle of the Maquoketa Shale west of the Shain well.

The contact between the Grant Lake and overlying Drakes Formation is conformable. Argillaceous dolomite and dolomitic mudstone in the lower part of the Drakes generally produces a higher gamma-ray signature than limestone of the Grant Lake, and the boundary is placed at the top of the Grant Lake rocks with lower gamma-ray readings.

The Drakes Formation was defined by Weir and others (1965, p. D16–D19, D30–D31). Along cross section KY-1, the Drakes consists, in ascending order, of the Rowland, Bardstown, and Saluda Dolomite Members. These members are too thin to delineate separately on cross section KY-1.

The Rowland Member consists of limestone, dolomite, and shale. Limestone is mostly greenish-gray, micrograined, dolomitic, argillaceous, sparsely fossiliferous, and slightly glauconitic. Dolomite is greenish-gray, fine-grained, and argillaceous. Greenish-gray shale occurs as thin interbeds.

The Bardstown Member (Peterson, 1970) is composed predominantly of greenish-gray, fine- to medium-grained, argillaceous, fossiliferous limestone. Less abundant (5 to 25 percent) is medium gray, medium- to very coarse-grained limestone with abundant fossils that contains minor interbeds of greenish-gray, calcareous shale. In some surface exposures the Bardstown contains colonial coral heads as much as 4 ft in diameter.

The Saluda Dolomite Member is composed of greenish-gray, very fine-grained, argillaceous, silty, sparsely fossiliferous, slightly glauconitic dolomite with interbeds of gray shale.

The Drakes, which has been removed by post-Ordovician erosion in the Spears well, thins west from a thickness of 108 ft in the Ball well to 16 ft in the Turner well, and pinches out in the upper part of the Maquoketa Shale between the Turner and Duncan drillholes.

Along cross section KY-1, the Drakes is overlain by either the Brassfield (Sexton Creek) of Early Silurian age or the Sellersburg Limestone (Boyle) of Middle Devonian age. Paleontologic studies show that the Ordovician-Silurian contact is an unconformity (Rexroad, 1967). The sub-Kaskaskia unconformity at the base of Middle Devonian rocks cuts through Lower Devonian and Silurian strata into Upper Ordovician rocks.

Radioactive logs supplemented by detailed lithologic descriptions provide the best basis for picking the contact between the Drakes and overlying formations. Along cross section KY-1, the greater argillaceous content of the Drakes Formation produces a higher gamma-ray response than the cherty, glauconitic dolomite of the Brassfield or the cherty, fossiliferous limestone and dolomite of the Sellersburg. Along cross section KY-1, the boundary is placed at the top of Drakes rocks with increased gamma-ray readings.

Tippecanoe II Subsequence. The Tippecanoe II subsequence consists of rocks of the entire Silurian System and the Lower Devonian Series. The lithostratigraphic correlations of the rocks in the Tippecanoe II subsequence and above that have been used for cross section KY-1 are from Shaver (1984).

Silurian strata are dominantly carbonates that range in thickness from 700 ft in the Davis drillhole to 0 ft at their eroded updip edge east of the Dearing drillhole. In western Kentucky, the Silurian section has been subdivided, in ascending order, into the Sexton Creek Limestone, St. Claire Limestone, Moccasin Springs Formation, and Bailey Limestone. In central and west-central Kentucky, the units, in ascending order, are the Brassfield Dolomite, Osgood Formation, Laurel Dolomite, Waldron Shale, Louisville Limestone (Lego, local usage), Dixon Limestone (Formation), Brownsport Formation, Decatur Limestone, and Bailey Limestone (Shaver, 1984; Seale, 1985).

The Sexton Creek Limestone grades east into the Brassfield Dolomite. The St. Claire Limestone is correlative with the Osgood Formation, Laurel Dolomite, Waldron Shale, and Louisville Limestone. The Moccasin Springs Formation is equivalent to the Dixon and Brownsport Formations, and the Bailey Limestone includes the Decatur Limestone in west-central Kentucky (Shaver, 1984; Seale, 1985).

The change from western Kentucky nomenclature to central Kentucky nomenclature on cross section KY-1 is made west of the Shain drillhole, where the Osgood Formation and Waldron Shale are projected to pinch out into the St. Claire Limestone.

The Sexton Creek Limestone unconformably overlies the Maquoketa Shale of Late Ordovician age. The unit is composed of fine-grained, cherty, glauconitic limestone that grades east into the Brassfield Dolomite. The Sexton Creek is combined with the overlying St. Claire Limestone on cross section KY-1.

The Brassfield Dolomite unconformably overlies carbonates of the Drakes Formation of Late Ordovician age. The Brassfield consists of finely to moderately crystalline, cherty, glauconitic dolomite. Along cross section KY-1, the Brassfield has been combined with the overlying Osgood Formation.

In western Kentucky, the St. Claire Limestone consists of white to pink, fine-grained limestone commonly mottled with pink to red patches. In central and west-central Kentucky, the correlative equivalents to the St. Claire are the Osgood Formation, Laurel Dolomite, Waldron Shale, and Louisville Limestone.

The Osgood Formation is primarily composed of green and red calcareous shales ranging in thickness from 20 to 40 ft. The unit thins west from the outcrop area in central Kentucky, and apparently pinches out into the St. Claire west of the Shain drillhole. The contact between the Osgood and overlying Laurel Dolomite is conformable and placed at the top of the highest bed of varicolored shale of the Osgood. The contact is identifiable on gamma-ray logs by the higher gamma-ray readings in the Osgood.

The Laurel Dolomite is fine-grained limestone. Along and near the outcrop area of the Laurel on the eastern flank of the Illinois Basin, it has been altered to a vuggy-weathering dolomite ranging in thickness from 30 to 40 ft (Peterson, 1981; Seale, 1985). Major oil and gas production is obtained from dolomite reservoirs in the Laurel along the eastern flank of the Illinois Basin and in west-central Kentucky. The contact between the Laurel and overlying Waldron Shale is conformable and placed at the base of the lowest shale bed of the Waldron. The clay content of the Waldron Shale produces a higher response on gamma-ray logs than carbonates of the Laurel.

The Waldron is a thin (5 to 10 ft), gray to greenish-gray, calcareous shale that thins west from the outcrop area in central Kentucky and pinches out west of the Shain drillhole. The Waldron is combined with the overlying Louisville Limestone on cross section KY-1.

The Louisville Limestone (Lego, local usage) is composed of finely crystalline, calcitic dolomite. Where the underlying Waldron Shale is absent, the Louisville is hard to distinguish from the Laurel. The Louisville grades west into the upper part of the St. Claire Limestone (Seale, 1985). Commercial hydrocarbons are produced from reservoirs in the Louisville along the eastern flank of the Illinois Basin in west-central Kentucky.

The Moccasin Springs Formation of western Kentucky is laterally equivalent to the Dixon Limestone and overlying Brownsport Formation of west-central and central Kentucky (Seale, 1985). The Dixon and Brownsport intergrade to the west into the Moccasin Springs. The Dixon and Brownsport are shown as a single unit on cross section KY-1, and the nomenclature is changed from Moccasin Springs to Dixon Limestone and Brownsport Formation at a vertical cutoff west of the Shain well.

The Moccasin Springs is composed of alternating red, gray, and green-gray, silty, argillaceous limestone, siltstone, and silty calcareous shale. The contact between the Moccasin Springs and underlying St. Claire is conformable and placed at the base of the lowest bed of argillaceous limestone or calcareous shale of the Moccasin Springs. The lower alternating beds of argillaceous limestone and siltstone have widely traceable electric-log signatures that are informally referred to as the 2 Kick and 3 Kick zones (Willman and Atherton, 1975).

The Dixon Limestone consists of alternating argillaceous limestones and red, green, and gray-green shale. The contact between the Dixon and underlying Louisville is conformable and placed at the base of the lowest bed of argillaceous limestone or shale of the Dixon. The overlying Brownsport Formation and the Dixon are combined as a single unit on cross section KY-1.

The Brownsport Formation is subdivided into three members: in ascending order, the Beech River Member, Bob Limestone Member, and Lobelville Member (Shaver, 1984). The Beech River consists of an alternating gray, argillaceous limestone and green-gray to brown shales. The Bob is a medium- to coarse-grained limestone that locally contains oolites and glauconite (Seale, 1985). The Lobelville is similar in lithology to the Beech River.

The Silurian-Devonian boundary in the subsurface in the Illinois Basin has been placed between the Moccasin Springs Formation and the Bailey Limestone (Freeman, 1951; Willman and Atherton, 1975). Droste and Shaver (1987) indicated that the Bailey may be Silurian in age. We also place the Silurian-Devonian boundary at the top of the Bailey Limestone.

The Bailey is a silty, argillaceous, cherty, fine-grained limestone. In western Kentucky, the Bailey overlies the Moccasin Springs Formation in the Davis, Duncan, and Turner drillholes. To the east, in the Shain well, the Decatur, a medium- to coarse-grained limestone, underlies the Bailey (Shaver, 1984). The Decatur intertongues with the lower part of the Bailey between the Shain and Turner drillholes. The Bailey and Decatur are combined as a single unit on cross section KY-1.

The contact between the Bailey Limestone and the underlying Moccasin Springs Formation is conformable and placed at the top of the highest bed of argillaceous limestone or calcareous shale of the Moccasin Springs. The contact between the Decatur Limestone and the underlying Brownsport Formation is conformable and placed at the base of the lowest bed of medium- to coarse-grained limestone of the Decatur. The Bailey-Decatur Limestone generally displays higher readings on gamma-ray logs than the underlying units do.

Lower Devonian strata are dominantly cherty carbonates that range in thickness from about 800 ft in the Davis well in western Kentucky to 0 ft at their eroded edge in the vicinity of the Dearing well on the eastern flank of the Illinois Basin. The strata have been divided, in ascending order, into four formations: the Flat Gap, Grassy Knob, Backbone, and Clear Creek Limestones (Shaver, 1984). On cross section KY-1, the Flat Gap is combined with the overlying Grassy Knob, and the Backbone with the overlying Clear Creek.

The Flat Gap Limestone is composed of white to light gray, medium- to coarse-grained limestone commonly containing pink grains. The Grassy Knob Limestone consists of generally nonfossiliferous dolomitic limestone and interbedded chert. The contact between the Flat Gap and the underlying Bailey Limestone is gradational and placed at the top of the highest bed of silty, argillaceous limestone of the Bailey. The Bailey generally displays higher readings on gamma-ray logs than the overlying units.

The Backbone Limestone is composed of light gray crinoidal limestone. The Clear Creek Limestone consists of light-colored, slightly argillaceous, fossiliferous, very fine-grained limestone with abundant interbeds of chert. The contact between the Backbone and the underlying Grassy Knob is very gradational. The boundary is placed at the top of the highest dolomitic limestone of the Grassy Knob. A combination of wireline logs and lithologic descriptions of rock cuttings from drillholes is useful in determining the boundary between the Grassy Knob and overlying stratigraphic units. Oil is being produced from reservoirs in the Clear Creek Limestone below the Middle Devonian unconformity in Edmonson and Warren Counties, Ky.

The end of the Early Devonian was marked by a widespread drop in sea level that exposed the margins of the basin to erosion while deposition apparently continued in the south-central part of the Illinois Basin

(Norby, 1991). The unconformity or its correlative surface marks the Tippecanoe-Kaskaskia sequence boundary (Treworgy others, 1997).

Kaskaskia Sequence

The Kaskaskia sequence includes the strata between the unconformity at the base of rocks of Middle Devonian age and the unconformity at the base of sediments of Pennsylvanian age. The sequence consists of a basal section of dominantly Middle Devonian carbonates that are overlain by Lower Mississippian distal deltaic sediments. These clastics are overlain by shallow carbonates of Mississippian age. The remainder of the sequence is composed of alternating units of sandstone, shale, and limestone of the Chesterian Series (Upper Mississippian). The Kaskaskia is the most prolific hydrocarbon-producing sequence in Kentucky. Most production has been and is from Chesterian sandstones. Other significant Kaskaskia production is obtained from reservoirs in the shallow-water carbonates underlying the Chesterian Series. Gas is being commercially produced from reservoirs in Upper Devonian black shales.

Middle and Upper Devonian Strata. Middle Devonian carbonates and Upper Devonian shales deposited on the sub-Kaskaskia erosional surface east of the Davis drillhole progressively overlap older strata of Early Devonian, Silurian, and Late Ordovician age. In the vicinity of and west of the Davis well in the deeper part of the Illinois Basin, however, the contact between Lower and Middle Devonian rocks may be conformable (Droste and Shaver, 1987). Middle and Upper Devonian rocks may be conformable (Droste and Shaver, 1987). Middle and Upper Devonian strata are subdivided into four stratigraphic units: in ascending order, the Dutch Creek Sandstone, Jeffersonville Limestone, Sellersburg Limestone, and New Albany Shale (Shaver, 1984).

The Dutch Creek Sandstone is composed of fine- to medium- to coarse-grained, frosted, well-rounded, carbonate-cemented quartz sand grains. Along the line of cross section KY-1, the Dutch Creek consists of thin intervals (10 to 20 ft) of interbeds of sandstone and sandy dolomite or variable amounts of quartz grains in the basal part of the overlying Jeffersonville Limestone. The unit is combined with the Jeffersonville Limestone as a single unit on cross section KY-1 and labeled “Djd.” The lower boundary of the Dutch Creek is at the erosion surface on the top of Lower Devonian strata.

The Dutch Creek Sandstone is a significant oil-producing unit in Illinois. A large area of potentially productive Dutch Creek occurs in the subsurface of southern Indiana and adjoining western Kentucky (Devera and Hasenmueller, 1991, Fig. 8-3).

The Jeffersonville Limestone (Grand Tower of Illinois) is a gray to brown, coarse-grained, fossiliferous limestone that is in part dolomitic. The unit contains irregular stringers of chert. In the basal part, a coral-stromatoporoid zone overlain by brachiopod zones has been recognized in well cuttings (Droste and Shaver, 1975). The contact between the Jeffersonville and underlying Dutch Creek Sandstone is conformable. The boundary is placed at the top of the highest sandstone or sandy dolomite bed of the Dutch Creek. Where the Dutch Creek or an equivalent sandy horizon is absent, the lower boundary is placed where the brown limestones and brown organic chert of the Jeffersonville overlie lighter-colored Lower Devonian carbonates and Silurian carbonates (Freeman, 1951). The Jeffersonville ranges in thickness from about 200 ft in the Davis well to 0 ft at the eroded updip edge.

The Sellersburg (Boyle) Limestone consists of two lithic units. The lower unit is a gray, argillaceous, fine-grained limestone and shale that may correlate with the Silver Creek Limestone Member of the Sellersburg in the outcrop area along the western flank of the Cincinnati Arch. The upper unit is a light gray to brown, coarse-grained, bioclastic limestone that correlates with the Beechwood Limestone Member of the Sellersburg. The Beechwood Limestone Member and the Boyle Limestone (Dolomite) are laterally equivalent (Kepferle, 1986). The Boyle Limestone is composed of coarse-grained bioclastic limestone and thin dolomite beds containing crinoids and horn corals. On cross section KY-1, the boundary between the Sellersburg and Boyle is arbitrarily placed east of the Dearing drillhole, where the Boyle becomes highly variable in thickness (3 to 40 ft) and is combined with the overlying New Albany Shale. From the arbitrary boundary west to the Davis well, the Sellersburg thickens from 40 to 90 ft. The contact between the Sellersburg and underlying Jeffersonville Limestone is unconformable (Shaver, 1984). Where the lower argillaceous limestone unit of the Sellersburg overlies the Jeffersonville, the boundary is placed at the lowest argillaceous limestone or shale of the Sellersburg. Where the Beechwood Limestone/Boyle Limestone overlies the Jeffersonville, the boundary is placed at the base of the lowest bed of bioclastic limestone of the Beechwood/Boyle.

Shaver (1984) showed the New Albany as being Late Devonian in age on the COSUNA chart. Treworgy and others (1997) listed the upper part of the New Albany as being Kinderhookian (Mississippian) age. We follow Shaver’s (1984) usage.

The New Albany Shale consists of brownish-black, organic-rich shale and green-gray, organic-poor shale. The unit ranges in thickness from 60 ft in the vicinity of the Ball well to 445 ft in the Davis well.

The contact between the New Albany Shale and the underlying Sellersburg Limestone is equivocal. Shaver (1984) showed it as being unconformable; however, Sargent and others (1992) showed it as conformable across southern Illinois and in Kentucky. Boberg and others (1994, Plate 5) showed it as unconformable in southern Illinois, conformable in most of western Kentucky, but becoming unconformable up the western flank of the Cincinnati Arch in and east of Hart County, Ky. Cross section KY-1 shows the contact as conformable. The boundary is placed at the base of the lowest shale bed of the New Albany. The contact is very distinct on gamma-ray logs, where the readings are much higher in the New Albany Shale than in limestones of the Sellersburg. The contact between the New Albany and the overlying New Providence Shale is conformable. That boundary is placed at the top of the highest bed of black shale of the New Albany. The contact is very pronounced on gamma-ray logs because of the higher radioactive content of New Albany shales.

The New Albany Shale is considered the major hydrocarbon source rock of the Illinois Basin because of its high organic content and the maturity of the organic material in the shale (Barrows and Cluff, 1984). Gas has been produced from fractured reservoirs in the New Albany from at least 40 fields in western Kentucky (Hamilton-Smith, 1993).

Mississippian System. Detailed descriptions of the lithologies and facies relationships of the Mississippian System can be found in Sable and Dever (1990).

Rocks of mostly Osagean age along cross section KY-1 west of Dry Fork in Marion County are subdivided into two lithologic units: in ascending order, the New Providence Shale and the Fort Payne Formation. East of Dry Fork, Osagean strata are subdivided into three stratigraphic units: in ascending order, the New Providence Shale Member, Nancy and Halls Gap Members undivided, and Muldraugh Member of the Borden Formation. The Borden Formation in the vicinity of Dry Fork is interpreted to be a southwest-facing, northwest-trending delta deposit defined by the contact between the carbonate-poor rocks of the New Providence Shale, Nancy, and Halls Gap Members, and the overlying carbonate-rich Muldraugh Member (Peterson and Kepferle, 1970).

In westernmost Kentucky, the New Providence Shale is given formational rank as a unit between the New Albany Shale and the Fort Payne Formation (Briensburg quadrangle) (Lambert and MacCary, 1964; Sable and Dever, 1990). In central Kentucky, the New Providence has the stratigraphic rank of member of the Borden Formation, as a unit between the New Albany Shale and the Nancy Member of the Borden Formation (Weir and others, 1966). In the subsurface along cross section KY-1 from the Davis drillhole east to the vicinity of Barren Run in Larue County, the New Providence Shale ranges from 15 to 30 ft in thickness. From Barren Run east to Dry Fork in Marion County, a distance of about 20 mi, the New Providence thickens from 30 ft to about 100 ft. The nomenclatural change from formational rank to member of the Borden is made in the vicinity of Barren Run.

In the subsurface, the New Providence consists of greenish-gray clay shale. The clay content of the New Providence produces a higher response on gamma-ray logs than is produced by limestone and shale of the overlying Fort Payne. The boundary between the New Providence and Fort Payne is placed at the top of New Providence rocks with higher gamma-ray readings.

The Nancy and Halls Gap Members consist of silty shale and quartzose siltstone, respectively. The members abruptly wedge out west of Dry Fork, and the overlying carbonate-rich Muldraugh Member abruptly thickens across a belt about 2 mi wide (Kepferle, 1973), where the carbonate-poor members thin (Peterson and Kepferle, 1970).

The Muldraugh Member is composed of dolomitic siltstone, crinoidal limestone, and silty dolomite containing a conspicuous glauconite zone (Floyds Knob Formation of Stockdale [1939]) in the basal part of the unit. The contact between the Muldraugh and underlying Halls Gap is placed at the base of the zone of abundant glauconite. The Muldraugh Member of the Borden Formation is considered a thinned lateral equivalent of the Fort Payne Formation that onlaps the Borden delta detrital rocks. The Fort Payne is composed of dark gray, dolomitic siltstone; argillaceous, cherty limestone; and shale.

Rocks of late Osagean and Meramecian age in Kentucky are predominantly limestone, dolomite, and siltstone that accumulated on intracratonic platforms and in shallow basins (Sable and Dever, 1990). Along cross section KY-1, these strata are divided into three stratigraphic units: in ascending order, a unit consisting of the Salem and Harrodsburg Limestones or Salem and Warsaw Limestones, the St. Louis Limestone, and the Ste. Genevieve Limestone.

The Harrodsburg, Salem, and Warsaw Limestones are primarily light gray, occasionally crossbedded, fossil-fragmental limestones that were deposited under moderately high-energy subtidal conditions (Sable and Dever, 1990). The arbitrary boundary between the Salem and Harrodsburg and the Salem and Warsaw units is shown on the cross section by a dashed line east of the McLean-Ohio County boundary. The unit ranges in thickness from about 100 ft in the vicinity of the Ball well to 140 ft in the Turner well. West from the Turner drillhole, the unit increases in thickness to 360 ft in the Davis drillhole, and the underlying Fort Payne thins reciprocally from 440 ft to 260 ft. Minor gas production has been obtained from this unit in Grayson County.

Limestones of the Salem and Harrodsburg or Salem and Warsaw units produce a lower response on gamma-ray logs than limestone and shale of the underlying Fort Payne do. The contact between the units is placed at the base of the Salem and Harrodsburg or Salem and Warsaw Limestones with lower gamma-ray readings.

The St. Louis Limestone consists of mainly very fine-grained dolomitic carbonates and evaporites deposited in quiet-water, subtidal to probable supratidal environments (Sable and Dever, 1990). The St. Louis generally thins east from about 400 ft in the Davis well to about 300 ft in the area of outcrop in Larue County.

A combination of lithologic descriptions of rock samples from drillholes and gamma-ray logs facilitates picking a contact in the subsurface between the St. Louis and underlying Salem and Harrodsburg or Salem and Warsaw unit. On gamma-ray logs the Salem and Harrodsburg or Salem and Warsaw unit generally has an overall lower response than overlying and underlying units do.

The Ste. Genevieve Limestone is composed of oolitic, bioclastic limestone deposited in a shallow-water, moderately high-energy subtidal environment (Sable and Dever, 1990). The Ste. Genevieve Limestone thins east from about 220 ft in the vicinity of the Davis well to about 180 ft near the area of outcrop in Larue County. Oolite beds in the Ste. Genevieve, informally known as McClosky sands, are a major oil-producing zone in many fields in western Kentucky (Schwalb and others, 1972).

In the surface, the contact between the Ste. Genevieve and underlying St. Louis is placed between abundant oolitic limestones of the Ste. Genevieve and micrograined, cherty, dolomitic limestone of the St. Louis. The contact between the Ste. Genevieve Limestone and the overlying Renault Limestone is placed between oolitic limestones of the Ste. Genevieve and micritic limestones of the Renault. Oolitic limestones of the Ste. Genevieve generally produce low responses on gamma-ray logs.

Rocks of Chesterian age have been subdivided into more than 20 formations, which consist of alternating, interbedded units of limestone and shale, and sandstone and shale that range in thickness from 1,000 ft in the Duncan drillhole to 500 ft in the area of outcrop in Larue County. The carbonate units were deposited on a shallow marine shelf that was periodically interrupted by deposition of deltaic and littoral sandstone and shale (Grabowski, 1986). Because of the numerous formations, individual units are not described here; see 1:24,000-scale 7.5-minute geologic quadrangle maps along the line of cross section KY-1 (Glick, 1963; Kehn, 1964, 1966, 1975a, b; Amos, 1965, 1970; Franklin, 1965, 1969; Goudarzi, 1968, 1969; Seeland, 1968; Johnson, 1971a, b; Lewis and Taylor, 1971; Johnson and Smith, 1972a, b, 1975; Fairer and others, 1975; Hansen, 1975, 1976a, b; Moore, 1977a, b; Gildersleeve, 1978; Gildersleeve and Johnson, 1978a, b; Hansen and Smith, 1978). Rocks of Chesterian age have been divided into lower and upper parts in the cross section. The lower part includes the rocks from the base of the Vienna Limestone (a marker that was used to compile part of the structural configuration shown on cross section KY-1) down to the top of the Ste. Genevieve. The upper part includes strata from the base of the Vienna Limestone up to the unconformity at the base of rocks of Pennsylvanian age. Numerous sandstone and limestone units of the Chesterian Series are major oil-producing units in western Kentucky (Schwalb and others, 1972).

Absaroka Sequence

The Absaroka sequence consists of strata between the unconformity at the base of the Pennsylvanian System and the unconformity at the base of the Cretaceous System. In Kentucky, the Absaroka sequence is represented by the Pennsylvanian and Permian Systems. Only strata of Pennsylvanian age are present along cross section KY-1. The strata consist of sandstone, siltstone, shale, coal, and limestone that were deposited in deltaic, fluvial, and shallow marine environments.

Sandstone units in the Absaroka sequence are important reservoirs for oil, gas, tar sands, and groundwater, and more than 2.2 billion tons of coal has been mined from the sequence. Nomenclature for stratigraphic units of Pennsylvanian age has recently been revised by the Kentucky and Illinois geological surveys. The revised formations are, in ascending order, the Caseyville, Tradewater, Carbondale, Shelburn, Patoka, Bond, and Mattoon Formations (Greb and others, 1992; Tri-State Committee on Correlation of the Pennsylvanian System in the Illinois Basin, 2001).

Caseyville and Tradewater Formations. The Caseyville Formation in Kentucky includes the strata from the base of the Pennsylvanian up to the base of the Bell coal (W. Ky. No. 1b) and its equivalents where they are present, or to the top of the uppermost, massive, quartzose, pebbly sandstone (Greb and others, 1992). West of the Turner well, the Caseyville was placed at the top of the uppermost massive sandstone overlying the Mississippian-Pennsylvanian systemic boundary, along the sub-Pennsylvanian unconformity. East from the vicinity of the Turner well, the Caseyville and overlying Tradewater Formation are combined because the boundary is difficult to discern where the Bell and Hawesville coals are absent and a thick upper Caseyville sandstone has not been developed (Greb and others, 1992).

The Caseyville Formation is primarily a quartzose sandstone containing pebbles and granules of quartz; it can vary abruptly in thickness because the unconformable surface on which it was deposited has a topographic relief of a few hundred feet (Greb and others, 1992, Fig. 14). In areas of sparse drillhole information along cross section KY-1, Greb and others' (1992, Fig. 15) isopach map of the Caseyville Formation was used as a guide in plotting the thickness of the unit.

The location of the Mississippian-Pennsylvanian unconformity at the base of the Caseyville Formation shown east of the Commodore Fault (between wells A and B on Plate 1A) is based on detailed surface geologic mapping (Seeland, 1968) and differs from the interpretation of Sargent and others (1992).

Sandstone units of the Caseyville Formation are important reservoirs for oil, gas, tar sands, and groundwater in western Kentucky (Schwalb and others, 1972; Greb and others, 1992, p. 18–19).

Tradewater Formation. The Tradewater Formation includes the rocks between the top of uppermost Caseyville pebbly sandstone (or the base of the Bell coal bed) and the base of the Davis (W. Ky. No. 6) coal bed (or the top of the Yeargins Chapel Limestone where the Davis coal is absent).

The Tradewater consists of about equal amounts of sandstone and shale with numerous limestone beds and several important coal beds. The sandstones in the lower part of the formation are similar to the quartzose sandstones in the underlying Caseyville. In the upper part of the Tradewater, the sandstones are thinner and contain more clay, feldspar, and mica. The formation ranges from about 450 to 550 ft along the line of cross section KY-1. In areas of sparse subsurface control, Greb and others' (1992, Fig. 23) isopach map of the Tradewater Formation was used as a guide in plotting the thickness of the unit. Discontinuous sandstone lenses in the Tradewater Formation are economic hydrocarbon reservoirs (Bauer, 1957), and more-continuous sandstone bodies are important aquifers (Davis and others, 1974).

Carbondale Formation. The Carbondale Formation is composed of strata between the base of the Davis coal bed (or the Yeargins Chapel Limestone where the coal is missing) and the base of the Providence Limestone. Where the Providence is missing, the top of the underlying Herrin (W. Ky. No. 11) coal bed is the top of the formation.

The Carbondale Formation consists of sandstone, siltstone, silty shale, and coal, which were deposited in fluvial and deltaic environments, and limestones and marine shales that were deposited during marine transgressions. The Davis (W. Ky. No. 6), Springfield (W. Ky. No. 9), and Herrin (W. Ky. No. 11) coal beds contain more than two-thirds of the total coal resources of the Western Kentucky Coal Field (Greb and others, 1992). The Springfield coal is an important marker that was used to compile part of the structural configuration shown on cross section KY-1. The interval from the top of the Springfield coal to the base of the Providence Limestone averages 125 ft.

McLeansboro Group. Rocks of Pennsylvanian age above the base of the Providence Limestone or the top of the Herrin coal bed have a varied nomenclatural history. The strata are now assigned to the McLeansboro Group, and include, in ascending order, the Shelburn, Patoka, Bond, and Mattoon Formations. Those units were mapped as the Sturgis Formation (Kehn, 1973) on 7.5-minute geologic quadrangle maps along cross section KY-1. Lithology of the McLeansboro Group is similar to that of the underlying Carbondale Formation, with detrital and marine rocks occurring in repetitive sequences (Greb and others, 1992).

The Shelburn Formation includes strata from the base of the Providence Limestone (or the top of the Herrin coal bed) to the top of the West Franklin (Madisonville in Kentucky) Limestone. The unit averages about 240 ft in thickness along cross section KY-1.

The Patoka Formation includes rocks from the top of the West Franklin Limestone to the base of the Carthage Limestone. The Patoka ranges in thickness from 240 to 280 ft along the line of cross section KY-1.

The Bond Formation includes rocks from the base of the Carthage Limestone to the top of the Livingston Limestone. The overlying Mattoon Formation is composed of rocks from the top of the Livingston Limestone to the top of the erosional limit of Pennsylvanian rocks above the Livingston Limestone. In Kentucky, the upper boundary is locally placed at the base of the Mauzy Formation of Permian age. The formations have been combined on cross section KY-1 because the Livingston has not been mapped in Kentucky. Limited subsurface data indicate that the Livingston is discontinuous in Kentucky (Greb and others, 1992). The combined formations are about 600 ft thick west of the Duncan drillhole.

Conclusions

We recommend that the Cambrian-Ordovician Knox Group be raised to supergroup status in Kentucky and that two groups be recognized within it. The Upper Cambrian Copper Ridge Group is not subdivided in this report. In western Kentucky, the Lower Ordovician Beekmantown Group includes the Gunter Sandstone, Oneota Dolomite, Shakopee Dolomite, and an unnamed argillaceous dolomite unit. On the Cincinnati Arch and in eastern Kentucky, the Beekmantown Group includes the Rose Run Sandstone, Chepultepec Dolomite, Longview Dolomite, and Newala Dolomite.

We recommend that the Ordovician High Bridge Group in central and eastern Kentucky be revised to include five lithologic units. This change results from recognition of the Pecatonica Formation in central and eastern Kentucky. The High Bridge consists, in ascending order, of the lower part of the Camp Nelson Limestone, the Pecatonica Member of the Camp Nelson Limestone, the upper part of the Camp Nelson Limestone, the Oregon Formation, and the Tyrone Limestone.

References Cited

Amos, D.H., 1965, Geology of the Shetlerville and Rosiclare quadrangles, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-400, scale 1:24,000.

Amos, D.H., 1970, Geologic map of the Blackford quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-873, scale 1:24,000.

Anderson, W.H., 1991, Mineralization and hydrocarbon emplacement in the Cambrian–Ordovician Mascot Dolomite of the Knox Group in south-central Kentucky: Kentucky Geological Survey, ser. 11, Report of Investigations 4, 31 p.

Barrows, M.H., and Cluff, R.M., 1984, New Albany Shale Group (Devonian-Mississippian) source rocks and hydrocarbon generation in the Illinois Basin, *in* Demaison, G., and Murris, R.J., eds., Petroleum geochemistry and basin evaluation: American Association of Petroleum Geologists Memoir 35, p. 111–138.

Bauer, C.B., 1957, West Dixie Pool, Henderson County, Kentucky, *in* McGrain, P., ed., Proceedings of the technical session, Kentucky Oil and Gas Association twenty-first annual meeting, May 24, 1957: Kentucky Geological Survey, ser. 9, Special Publication 11, p. 31–40.

Becker, L.E., Andrews, J.J., and Dawson, T.A., 1987, Pre-Knox (Cambrian) stratigraphy in Indiana: Indiana Geological Survey Bulletin 57, 72 p.

Bergstrom, S.M., and Mitchell, C.E., 1987, Geology of Middle and Upper Ordovician Sebree Trough, northwest of the Cincinnati Arch—Ohio, Indiana and Kentucky [abs.]: American Association of Petroleum Geologists Bulletin, v. 71, p. 1101.

Bergstrom, S.M., and Sweet, W.C., 1966, Conodonts from the Lexington Limestone (Middle Ordovician) of Kentucky and its lateral equivalents in Ohio and Indiana: Bulletins of American Paleontology, v. 50, no. 229, p. 271–441.

Bertagne, A.J., and Leising, T.C., 1991, Interpretation of seismic data from the Rough Creek Graben of western Kentucky and southern Illinois, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 199–208.

Bertall, R., and Collins, J.B., 1945, Subsurface stratigraphy and structure of the pre-Trenton Ordovician and Upper Cambrian rocks of central Tennessee: Tennessee Division of Geology, Oil and Gas Investigation Preliminary Chart 4, 1 sheet.

Boberg, W.S., Lumm, D.K., Frankie, W.T., and Hamilton-Smith, T., 1994, Stratigraphic cross sections showing members of the New Albany Shale (Devonian and Mississippian) in the Illinois Basin, *in* Hasenmueller, N.R., and Comer, J.B., Gas potential of the New Albany Shale (Devonian and Mississippian) in the Illinois Basin: Gas Research Institute, GRI 92/0391, Illinois Basin Studies 2, Plate 5.

Brown, W.R., 1951, Sodaclase-dacite from the California Company No. 1 A.R. Spears deep test, Lincoln County, Kentucky: Journal of Geology, v. 59, no. 2, p. 175–178.

Burke, K., and Dewey, J.F., 1973, Plume-generated triple junctions: Key indicators in applying plate tectonics to old rocks: Journal of Geology, v. 81, p. 406–433.

Buschbach, T.C., 1975, Cambrian System, *in* Willman, H.B., ed., Handbook of Illinois stratigraphy: Illinois State Geological Survey Bulletin 95, p. 34–36.

Campbell, M.R., 1898, Description of the Richmond quadrangle, Kentucky: U.S. Geological Survey Geologic Atlas, Folio 46, 4 plates.

Cressman, E.R., 1973, Lithostratigraphy and depositional environments of the Lexington Limestone (Ordovician) of central Kentucky: U.S. Geological Survey Professional Paper 768, 61 p.

Cressman, E.R., and Noger, M.C., 1976, Tidal-flat carbonate environments in the High Bridge (Middle Ordovician) of central Kentucky: Kentucky Geological Survey, ser. 10, Report of Investigations 18, 15 p.

Daniels, P.A., Jr., 1982, Upper Precambrian sedimentary rocks: Oronto Group, Michigan-Wisconsin, *in* Wold, R.J., and Hinze, W.J., eds., Tectonic history of the Lake Superior Basin: Geological Society of America Memoir 156, p. 107–133.

Davis, R.W., Plebuch, R.O., and Whitman, H.M., 1974, Hydrology and geology of deep sandstone aquifers of Pennsylvanian age in part of the Western Coal Field region, Kentucky: Kentucky Geological Survey, ser. 10, Report of Investigations 15, 26 p.

Dawson, T.A., 1960, Deep test well in Lawrence County, Indiana—Drilling techniques and stratigraphic interpretations: Indiana Geological Survey Report of Progress 22, 36 p.

Dean, S., and Baranoski, M., 2002a, Ohio Precambrian—1: A look at western Ohio's Precambrian tectonic setting: Oil and Gas Journal, July 22, 2002.

Dean, S., and Baranoski, M., 2002b, Ohio Precambrian—2: Deeper study of Precambrian warranted in western Ohio: Oil and Gas Journal, July 29, 2002, p. 37–40.

Dever, G.R., Jr., 1980, High-carbonate and low-silica stone in the High Bridge Group (Middle Ordovician), Fayette County, central Kentucky: Kentucky Geological Survey, ser. 11, Information Circular 4, 45 p.

Devera, J.A., and Hasenmuller, N.R., 1991, Middle and Upper Devonian Series through Mississippian Kinderhookian Series, *in* Leighton, M.R., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 113–123.

Dickas, A.B., 1986, Comparative Precambrian stratigraphy and structure along the Mid-Continental Rift: American Association of Petroleum Geologists Bulletin, v. 70, no. 3, p. 225–238.

Drahovzal, J.A., 1994, Basin-floor fan complexes: A new exploration strategy for the Rough Creek Graben, *in* Ridgley, J.L., Drahovzal, J.A., Keith, B.D., and Kolata, D.R., eds., Proceedings of the Illinois Basin Energy and Mineral Resources Workshop: Kentucky Geological Survey Open-File Report OF-94-12 (Illinois State Geological Survey Open-File Report 94-4; Indiana Geological Survey Open-File Report 94-12; U.S. Geological Survey Open-File Report 94-298), p. 7–8.

Drahovzal, J.A., 1997, Proterozoic sequences and their implication for Precambrian and Cambrian evolution of western Kentucky: Evidence from seismic reflection data: Seismological Research Letters, v. 68, no. 4, p. 553–556.

Drahovzal, J.A., and Harris, D.C., 2004, Potential reservoirs for geologic sequestration in the East Continent Rift Basin: www.uky.edu/KGS/emsweb/midcarb/SequesterECRB.htm and www.midcarb.org/Documents/Potential%20Reservoirs%20for%20Geologic%20Sequestration%20in%20the%20East%85.pdf [accessed 11-21-05].

Drahovzal, J.A., Wickstrom, L.H., Walker, D., Baranoski, M.T., Keith, B.D., and Furer, L.C., 1992, The East Continent Rift Basin: A new discovery: Kentucky Geological Survey, ser. 11, Special Publication 18, 25 p.

Droste, J.B., and Patton, J.B., 1985, Lithostratigraphy of the Sauk sequence in Indiana: Indiana Geological Survey Occasional Paper 47, 24 p.

Droste, J.B., and Shaver, R.H., 1975, Jeffersonville Limestone (Middle Devonian) of Indiana—Stratigraphy, sedimentation, and relation to Silurian reef-bearing rocks: American Association of Petroleum Geologists Bulletin, v. 59, p. 393–412.

Droste, J.B., and Shaver, R.H., 1987, Upper Silurian and Lower Devonian stratigraphy of the central Illinois Basin: Indiana Geological Survey Special Report 39, 29 p.

Fairer, G.M., Norris, R.L., and Johnson, W.D., Jr., 1975, Geologic map of the Beech Grove quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1230, scale 1:24,000.

Franklin, G.J., 1965, Geology of the Hanson quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-365, scale 1:24,000.

Franklin, G.J., 1969, Geologic map of the Nebo quadrangle, Webster and Hopkins Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-777, scale 1:24,000.

Freeman, L.B., 1951, Regional aspect of Silurian and Devonian stratigraphy in Kentucky: Kentucky Geological Survey, ser. 9, Bulletin 6, 565 p.

Freeman, L.B., 1953, Regional subsurface stratigraphy of the Cambrian and Ordovician in Kentucky and vicinity: Kentucky Geological Survey, ser. 9, Bulletin 12, 352 p.

Gildersleeve, B., 1978, Geologic map of the Leitchfield quadrangle, Grayson County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1316, scale 1:24,000.

Gildersleeve, B., and Johnson, W.D., Jr., 1978a, Geologic map of the Spring Lick quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1475, scale 1:24,000.

Gildersleeve, B., and Johnson, W.D., Jr., 1978b, Geologic map of the Caneyville quadrangle, Grayson County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1472, scale 1:24,000.

Glick, E.E., 1963, Geology of the Clarkson quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-278, scale 1:24,000.

Gooding, P.J., 1992, Unconformity at the top of the Knox Group (Cambrian–Ordovician) in the subsurface of south-central Kentucky: Kentucky Geological Survey, ser. 11, Thesis 4, 40 p.

Goetz, L.K., Taylor, T.J., Macarevich, R.L., Brewster, D., and Sonnad, J., 1992, Deep gas play probed along the Rough Creek Graben in Kentucky part of southern Illinois Basin: Oil and Gas Journal, v. 90, no. 38, p. 97–107.

Goudarzi, G.H., 1968, Geologic map of the Hartford quadrangle, Ohio County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-741, scale 1:24,000.

Goudarzi, G.H., 1969, Geologic map of the Equality quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-815, scale 1:24,000.

Grabowski, G.J., Jr., 1986, Mississippian System, *in* McDowell, R.C., ed., The geology of Kentucky—A text to accompany the Geologic Map of Kentucky: U.S. Geological Survey Professional Paper 1151-H, p. 19–31.

Greb, S.F., Williams, D.A., and Williamson, A.D., 1992, Geology and stratigraphy of the Western Kentucky Coal Field: Kentucky Geological Survey, ser. 11, Bulletin 2, 77 p.

Green, J.C., 1982, Geology of the Keweenawan extrusive rocks, *in* Wold, R.J., and Hinze, W.J., eds., Tectonic history of the Lake Superior Basin: Geological Society of America Memoir 156, p. 47–56.

Hamilton-Smith, T., 1993, Gas exploration in the Devonian shales of Kentucky: Kentucky Geological Survey, ser. 11, Bulletin 4, 31 p.

Hansen, D.E., 1975, Geologic map of the Sebree quadrangle, Webster County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1238, scale 1:24,000.

Hansen, D.E., 1976a, Geologic map of the Dixon quadrangle, Webster County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1293, scale 1:24,000.

Hansen, D.E., 1976b, Geologic map of the Sacramento quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1306, scale 1:24,000.

Hansen, D.E., and Smith, A.E., 1978, Geologic map of the Livermore quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1467, scale 1:24,000.

Harris, D.C., 1991a, Chapter 2, Precambrian geology, *in* Wickstrom, L.H., ed., The geology and geophysics of the East Continent Rift Basin: Indiana Geological Survey Open-File Report 92-04, p. 6–18.

Harris, D.C., 1991b, Chapter 3, Precambrian geology, *in* Wickstrom, L.H., ed., The geology and geophysics of the East Continent Rift Basin: Indiana Geological Survey Open-File Report 92-04, p. 19–66.

Harris, D.C., 1995, Lithostratigraphy and hydrocarbon potential of the Cambrian (pre-Knox) interval in the Conoco No. 1 Turner well, Rough Creek Graben, western Kentucky [abs.]: American Association of Petroleum Geologists Bulletin, v. 79, p. 1414.

Harris, D.C., 2000, Petroleum stratigraphy of the Middle Run Formation (Precambrian) in Kentucky [abs.]: American Association of Petroleum Geologists Bulletin, v. 84, no. 9, p. 1385.

Harris, D.C., Hickman, J.B., Baranoski, M.T., Drahovzal, J.A., Avary, K.L., and Nuttall, B.C., 2004, Rome Trough Consortium final report and data distribution: Kentucky Geological Survey Open-File Report OF-04-06, 1 CD-ROM.

Harris, L.D., 1973, Dolomitization model for Upper Cambrian and Lower Devonian carbonate rocks in the eastern United States: U.S. Geological Survey, Journal of Research, v. 1, p. 63–78.

Hauser, E.C., 1993, Grenville foreland thrust belt hidden beneath the eastern U.S. Midcontinent: Geology, v. 21, p. 61–64.

Hauser, E.C., 1996, Midcontinent rifting in a Grenville embrace, *in* van der Pluijm, B.A., and Catacosinos, P.A., eds., Basement and basins of eastern North America: Geological Society of America Special Paper 308, p. 67–75.

Hester, N.C., 1988, Seismic stratigraphy and structure of the Moorman Trough, *in* Zuppann, C.W., and Keith, B.D., eds., Geology and petroleum production of the Illinois Basin, v. 2: Indiana Geological Survey, p. 13.

Huff, W.D., and Kolata, D.R., 1990, Correlation of the Ordovician Deicke and Millbrig K-bentonites between the Mississippi Valley and the southern Appalachians: American Association of Petroleum Geologists Bulletin, v. 74, p. 1736–1747.

Jewell, J.W., 1969, An oil and gas evaluation of north Alabama: Alabama Geological Survey Bulletin, v. 93, 65 p.

Johnson, W.D., Jr., 1971a, Geologic map of the Horton quadrangle, Ohio County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-915, scale 1:24,000.

Johnson, W.D., Jr., 1971b, Geologic map of the Rosine quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-928, scale 1:24,000.

Johnson, W.D., Jr., and Smith, A.E., 1972a, Geologic map of the Glenville quadrangle, McLean and Daviess Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1046, scale 1:24,000.

Johnson, W.D., Jr., and Smith, A.E., 1972b, Geologic map of the Utica quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-995, scale 1:24,000.

Johnson, W.D., Jr., and Smith, A.E., 1975, Geologic map of the Calhoun quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1239, scale 1:24,000.

Kehn, T.M., 1964, Geology of the Slaughters quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-360, scale 1:24,000.

Kehn, T.M., 1966, Geologic map of the Providence quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-491, scale 1:24,000.

Kehn, T.M., 1973, Sturgis Formation (Upper Pennsylvanian), a new map unit in the Kentucky coal fields: U.S. Geological Survey Bulletin 1394-B, 24 p.

Kehn, T.M., 1975a, Geologic map of the Bordley quadrangle, Union and Webster Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1275, scale 1:24,000.

Kehn, T.M., 1975b, Geologic map of the Sturgis quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1273, scale 1:24,000.

Keith, B.D., 1985, Facies, diagenesis, and the upper contact of the Trenton Limestone of northern Indiana, *in* Budai, J.M., and Cersone, K.R., eds., Ordovician and Silurian rocks of the Michigan Basin and its margins: Michigan Basin Geological Society, Special Paper 4, p. 15–32.

Kepferle, R.C., 1973, Geologic map of the Raywick quadrangle, central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1048, scale 1:24,000.

Kepferle, R.C., 1986, Devonian System, *in* McDowell, R.C., ed., The geology of Kentucky—A text to accompany the Geologic Map of Kentucky: U.S. Geological Survey Professional Paper 1151-H, p. 15–19.

Kidd, J.T., and Copeland, C.W., 1971, Review of subsurface stratigraphy of northern Alabama, *in* Drahovzal, J.A., and Neathery, T.L., eds., The Middle and Upper Ordovician of the Alabama Appalachians (guidebook for Alabama Geological Society ninth annual field trip, December 3–4): Alabama Geological Society, p. 137–150.

Kolata, D.R., 1991a, Overview of sequences, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 59–75.

Kolata, D.R., 1991b, Tippecanoe sequence overview, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 87–99.

Kolata, D.R., and Graese, A.M., 1983, Lithostratigraphy and depositional environments of the Maquoketa Group (Ordovician) in northern Illinois: Illinois State Geological Survey Circular 528, 48 p.

Kolata, D.R., and Hildenbrand, T.G., 1997, Structural underpinnings and neotectonics of the southern Illinois Basin: An overview: Seismological Research Letters, v. 68, no. 4, p. 499–510.

Kolata, D.R., Huff, W.D., and Bergstrom, S.M., 2001, The Ordovician Sebree Trough, an oceanic passage to Mid-continent United States: Geological Society of America Bulletin, v. 113, no. 8, p. 1067–1078.

Kolata, D.R., and Nelson, W.J., 1991, Tectonic history of the Illinois Basin, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 263–285.

Kolata, D.R., and Noger, M.C., 1991, Tippecanoe I subsequence—Middle Ordovician Series, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 89–99.

Lambert, T.W., and MacCary, L.M., 1964, Geology of the Briensburg quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-327, scale 1:24,000.

Lewis, R.Q., Sr., and Taylor, A.R., 1971, Geologic map of the Hustonville quadrangle, Casey and Lincoln Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-916, scale 1:24,000.

Lusk, R.G., 1927, The significance of structure in the accumulation of oil in Tennessee: American Association of Petroleum Geologists Bulletin, v. 11, p. 905–917.

McBride, J.H., and Kolata, D.R., 1999, Upper crust beneath the central Illinois Basin, United States: Geological Society of America Bulletin, v. 11, p. 375–394.

McGuire, W.H., and Howell, P., 1963, Oil and gas possibilities of the Cambrian and Lower Ordovician in Kentucky: Lexington, Ky., Spindletop Research Center, 216 p.

McQueen, H.S., 1937, Dutchtown, a new Lower Ordovician formation in southeastern Missouri: Missouri Geological Survey and Water Resources, 59th Biennial Report, 1935–1936, App. 1, 27 p.

Milici, R.C., and Smith, J.W., 1969, Stratigraphy of the Chickamauga Supergroup in its type area and in Precambrian Appalachian problems: Georgia Geological Survey Bulletin 80, 55 p.

Miller, A.M., 1905, Lead and zinc bearing rocks of central Kentucky: Kentucky Geological Survey, ser. 3, Bulletin 2, 35 p.

Moore, S.L., 1977a, Geologic map of the Bradfordsville quadrangle, central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1386, scale 1:24,000.

Moore, S.L., 1977b, Geologic map of the Bradfordsville Northeast quadrangle, central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1396, scale 1:24,000.

Nelson, W.J., 1991, Structural styles of the Illinois Basin, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 209–243.

Norby, R.D., 1991, Biostratigraphic zones in the Illinois Basin, *in* Leighton, M.W., Kolata, D.R., Oltz, D.F., and Eidel, J.J., eds., Interior cratonic basins: American Association of Petroleum Geologists Memoir 51, p. 179–194.

Palmer, A.R., 1982, Fossils of Dresbackian and Franconian (Cambrian) age from the subsurface of west-central Indiana: Indiana Geological Survey Special Report 29, 12 p.

Patchen, D.G., Avary, K.L., and Erwin, R.B., coords., 1984, Southern Appalachian region correlation chart: American Association of Petroleum Geologists, Correlation of Stratigraphic Units of North America (COSUNA) Chart, Series 8, 1 sheet.

Peck, J.H., 1966, Upper Ordovician formations in the Maysville area, Kentucky: U.S. Geological Survey Bulletin 1244-B, p. B1–B30.

Peterson, W.L., 1970, Bardstown Member of the Drakes Formation in central Kentucky, *in* Cohee, G.V., Bates, R.G., and Wright, W.D., Changes in stratigraphic nomenclature by the U.S. Geological Survey: U.S. Geological Survey Bulletin 1294-A, p. A36–A41.

Peterson, W.L., 1981, Lithostratigraphy of the Silurian rocks exposed on the west side of the Cincinnati Arch in Kentucky: U.S. Geological Survey Professional Paper 1151-C, 29 p.

Peterson, W.L., and Kepferle, R.C., 1970, Deltaic deposits of the Borden Formation in central Kentucky: U.S. Geological Survey Professional Paper 700-D, p. D49–D54.

Potter, C.J., Goldhaber, M.B., Heigold, P.C., and Drahovzal, J.A., 1995, Structure of the Reelfoot–Rough Creek Rift System, Fluorspar Area Fault Complex, and Hicks Dome, southern Illinois and western Kentucky—New constraints from regional seismic reflection data: U.S. Geological Survey Professional Paper 1538-Q, 19 p.

Potter, C.J., Drahovzal, J.A., Sargent, M.L., and McBride, J.M., 1997, Proterozoic structure, Cambrian rifting, and younger faulting as revealed by a regional seismic reflection network in the southern Illinois Basin: Seismological Research Letters, v. 68, no. 4, p. 553–566.

Pratt, T.L., Hauser, E.C., and Nelson, K.D., 1992, Widespread buried Precambrian layered sequences in the U.S. Mid-continent: Evidence for large Proterozoic depositional basins: American Association of Petroleum Geologists Bulletin, v. 76, p. 1384–1401.

Price, M.L., 1981, A regional study of the St. Peter Sandstone in eastern Kentucky, *in* Luther, M.K., ed., Proceedings of the technical sessions, Kentucky Oil and Gas Association thirty-eighth annual meeting, July 6–7, 1974: Kentucky Geological Survey, ser. 11, Special Publication 3, p. 1–19.

Rexroad, J.A., C.B., 1967, Stratigraphy and conodont paleontology of the Brassfield in the Cincinnati Arch area: Indiana Geological Survey Bulletin 36, 64 p.

Ryder, R.T., Repetski, J.E., and Harris, A.G., 1997, Stratigraphic framework of Cambrian and Ordovician rocks in the central Appalachian Basin from Campbell County, Kentucky, to Tazwell County, Virginia: U.S. Geological Survey Miscellaneous Investigations Series Map I-2530, 1 sheet.

Sable, E.G., and Dever, G.R., Jr., 1990, Mississippian rocks in Kentucky: U.S. Geological Survey Professional Paper 1503, 125 p.

Safford, J.M., 1869, Geology of Tennessee: Nashville, Tenn., S.C. Mercer, 550 p.

Sargent, M.L., Treworgy, J.D., and Whitaker, S.T., 1992, East–west cross section in the Illinois Basin, Ozark Dome, Missouri to Rough Creek Graben, western Kentucky: Illinois Geological Survey Open-File Series 1992-4, 1 sheet.

Schwalb, H.R., 1969, Paleozoic geology of the Jackson Purchase Region, Kentucky: Kentucky Geological Survey, ser. 10, Report of Investigations 10, 40 p.

Schwalb, H.R., 1982, Paleozoic geology of the New Madrid area: U.S. Nuclear Regulatory Commission NUREG CR-2909, 61 p.

Schwalb, H.R., Wilson, E.N., and Sutton, D.G., 1972, Oil and gas map of Kentucky, sheet 2, west-central part: Kentucky Geological Survey, ser. 10, scale 1:250,000.

Seale, G.L., 1985, Relationship of possible Silurian reef trend to middle Paleozoic stratigraphy of the southern Illinois Basin of western Kentucky: Kentucky Geological Survey, ser. 11, Thesis 3, 63 p.

Seeland, D.A., 1968, Geologic map of part of the Repton quadrangle in Crittenden County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-754, scale 1:24,000.

Shaver, R.H., coord., 1984, Midwestern Basin and Arches Region correlation chart: American Association of Petroleum Geologists, Correlation of Stratigraphic Units of North America (COSUNA) Chart, Series 8, 1 sheet.

Shaw, T.H., 1999, Early–Middle Ordovician lithostratigraphy, biostratigraphy, and depositional environments of the Illinois Basin: New York, N.Y., The City University of New York, doctoral dissertation, 929 p.

Shrake, D.L., 1991, The Middle Run Formation: A new stratigraphic unit in the subsurface of southwestern Ohio: Ohio Journal of Science, v. 90, p. 49–55.

Shrake, D.L., Wolfe, P.J., Richard, B.H., Swinford, E.M., Wickstrom, L.H., Potter, P.E., and Sitler, G.W., 1990, 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: Ohio Geological Survey Information Circular 56, 11 p.

Sloss, L.L., 1963, Sequences in the cratonic interior of North America: Geological Society of America Bulletin, v. 74, p. 93–113.

Sloss, L.L., 1982, The Mid-continent Province: United States, *in* Palmer, A.R., ed., Perspectives in regional geological synthesis: Geological Society of America, Decade of North American Geology, Special Publication 1, p. 21–39.

Soderberg, R.K., and Keller, G.R., 1981, Geophysical evidence for deep basin in western Kentucky: American Association of Petroleum Geologists Bulletin, v. 65, p. 226–234.

Solis, M.P., Drahovzal, J.A., Greb, S.F., and Hickman, J.B., 2005, Western Kentucky Precambrian structure map [abs.]: Mountains of Opportunity, 34th annual meeting of the Eastern Section of the American Association of Petroleum Geologists, Morgantown, W.Va., p. 34.

Stark, T.J., 1997, The East Continent Rift Complex: Evidence and conclusions, *in* Ojakangas, R.W., Dickas, A.B., and Green, J.C., eds., Middle Proterozoic to Cambrian rifting, central North America: Geological Society of America Special Paper 312, p. 253–266.

Sith, D.A., 1981, Chemical composition, stratigraphy, and depositional environments of the Black River Group (Middle Ordovician), southwestern Ohio: Geological Society of America Bulletin, v. 92, pt. 1, p. 629–633.

Stockdale, P.B., 1939, Lower Mississippian rocks of the east-central interior: Geological Society of America Special Paper 22, 248 p.

Strunk, K.L., 1984, Structural relationships of the Cottage Grove and Shawneetown Fault Systems near Equality, Illinois, as inferred from geophysical data: Carbondale, Southern Illinois University, master's thesis, 72 p.

Sweet, W.C., and Bergstrom, S.M., 1971, The American Upper Ordovician standard XIII. A revised time-stratigraphic classification of North American Middle and Upper Ordovician rocks: Geological Society of America Bulletin, v. 82, p. 613–628.

Treworgy, J.D., Whitaker, S.T., and Lasemi, Z., 1997, Structural cross section of the Paleozoic rocks in Illinois, Wayne County to Stephenson County: Illinois State Geological Survey, Illinois Map 7, 1 sheet.

Tri-State Committee on Correlation of the Pennsylvanian System in the Illinois Basin, 2001, Toward a more uniform stratigraphic nomenclature by rock units (formations and groups) of the Pennsylvanian System in the Illinois Basin: Indiana Geological Survey, Illinois Basin Consortium, Illinois Basin Series 5, 26 p.

Van Schmus, W.R., and Hinze, W.J., 1985, The Midcontinent Rift System: Annual Review of Earth and Planetary Sciences, v. 13, p. 345–383.

Webby, B., 1998, Steps toward a global standard for Ordovician stratigraphy: Newsletters on Stratigraphy, v. 36, p. 1–33.

Weir, G.W., and Greene, R.C., 1965, Clays Ferry Formation (Ordovician)—A new map unit in south-central Kentucky: U.S. Geological Survey Bulletin 1224-B, p. B1–B18.

Weir, G.W., Greene, R.C., and Simmons, G.C., 1965, Calloway Creek Limestone and Ashlock and Drakes Formations (Upper Ordovician) in south-central Kentucky: U.S. Geological Survey Bulletin 1224-D, p. D1–D36.

Weir, G.W., Gualtieri, J.L., and Schlanger, S.O., 1966, Borden Formation (Mississippian) in south- and southeast-central Kentucky: U.S. Geological Survey Bulletin 1224-F, 38 p.

Weir, G.W., Peterson, W.L., and Swadley, W C, 1984, Lithostratigraphy of Upper Ordovician strata exposed in Kentucky: U.S. Geological Survey Professional Paper 1151-E, 121 p.

Wheeler, R.L., Rhea, S., Diehl, S.F., Drahovzal, J.A., Bear, G.W., and Sargent, M.L., 1997, Seismotectonic map showing faults, igneous rocks, and geophysical neotectonic features in the vicinity of the lower Wabash Valley, Illinois, Indiana, and Kentucky: U.S. Geological Survey Geologic Investigations Series I-2583-D, scale 1:250,000.

Whitaker, S.T., Treworgy, J.D., and Noger, M.C., 1992, 6 o'clock cross section in the Illinois Basin: Wayne County, Illinois, to Gibson County, Tennessee: Illinois State Geological Survey Open-File Series 1992-10, 1 sheet.

Willman, H.B., and Atherton, E., 1975, Silurian System, *in* Willman, H.B., Atherton, E., Buschbach, T.C., Collinson, C., Frye, J.C., Hopkins, M.E., Lineback, J.A., and Simon, J.A., eds., Handbook of Illinois stratigraphy: Illinois State Geological Survey Bulletin 95, p. 87–104.

Willman, H.B., and Buschbach, T.C., 1975, Ordovician System, *in* Willman, H.B., Atherton, E., Buschbach, T.C., Collinson, C., Frye, J.C., Hopkins, M.E., Lineback, J.A., and Simon, J.A., eds., Handbook of Illinois stratigraphy: Illinois State Geological Survey Bulletin 95, p. 47–87.

Winslow, A., 1894, Lead and zinc deposits: Missouri Geological Survey Bulletin, v. 6–7, 763 p.

Wolcott, D.E., 1969, Geologic map of the Little Hickman quadrangle, central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-843, scale 1:24,000.

Wolcott, D.E., Cressman, E.R., and Conner, J.J., 1972, Trend-surface analysis of the thickness of the High Bridge Group (Middle Ordovician) of central Kentucky and its bearing on the nature of the post-Knox unconformity: U.S. Geological Survey Professional Paper 800-B, p. B25–B33.

KENTUCKY GEOLOGICAL SURVEY
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY, LEXINGTON

REPORT OF INVESTIGATIONS 13
SERIES XII, 2005

PLATE 1

Plate 1 A. Structural cross section KY-1.

Martin C. Noger and James A. Drahovzal

scale: 0–20 mi; 0–30 km

vertical scale: 2 in. = 1000 ft

LOCATION OF CROSS SECTION KY-1

Martin C. Noger is a Kentucky native, born in Hazard. He attended the University of Kentucky, where he received a degree in geology. M.C., as he is known to his friends, left the state and worked in the oil and gas industry for several years before returning to Kentucky to join the Kentucky Geological Survey in 1968. M.C. served as head of the Areal Geology Section and as a distinguished geologist in the Petroleum and Stratigraphy Section at the Survey until 1993. From 1993 to 2001, he served as half-time geologist emeritus. Among his most noted accomplishments was managing the KGS-USGS cooperative statewide areal geologic mapping project, which was completed in 1978. His perseverance and untiring efforts to ensure completion of this monumental program resulted in the publication of 707 detailed geologic maps, making Kentucky the first state to have such coverage and making it among the best-mapped areas of the world. M.C.'s participation in geologic debates during the cooperative mapping program gave him an unequaled knowledge of Kentucky stratigraphy and made him a valuable resource often consulted by industry, the public, and the Survey staff. During his emeritus service to KGS, M.C., among his other duties, advised in the development and implementation of the digital mapping program, which resulted in the digitization of all 707 geologic maps. This program again resulted in a first for Kentucky—this time, the first state to have complete digital geologic coverage. In addition to mapping, M.C.'s accomplishments include work and publications in stratigraphy, with particular emphasis on the Ordovician, tar-sand resources, conventional oil and gas resources, and planning and geologic hazards. His experience in the geology of Kentucky is evident in this publication, which details the geology along a transect from near the Cincinnati Arch west to near the Illinois state line. The detailed stratigraphic relationships worked out in this publication will serve as the basis for future studies in this geologically challenging area.

For information on obtaining copies of this cross section and other Kentucky Geological Survey maps and publications call:
Public Information Center
(859) 257-3896 ext. 126
Toll free: (877) 778-7827 ext. 126

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Cartography by Terry Hounshell

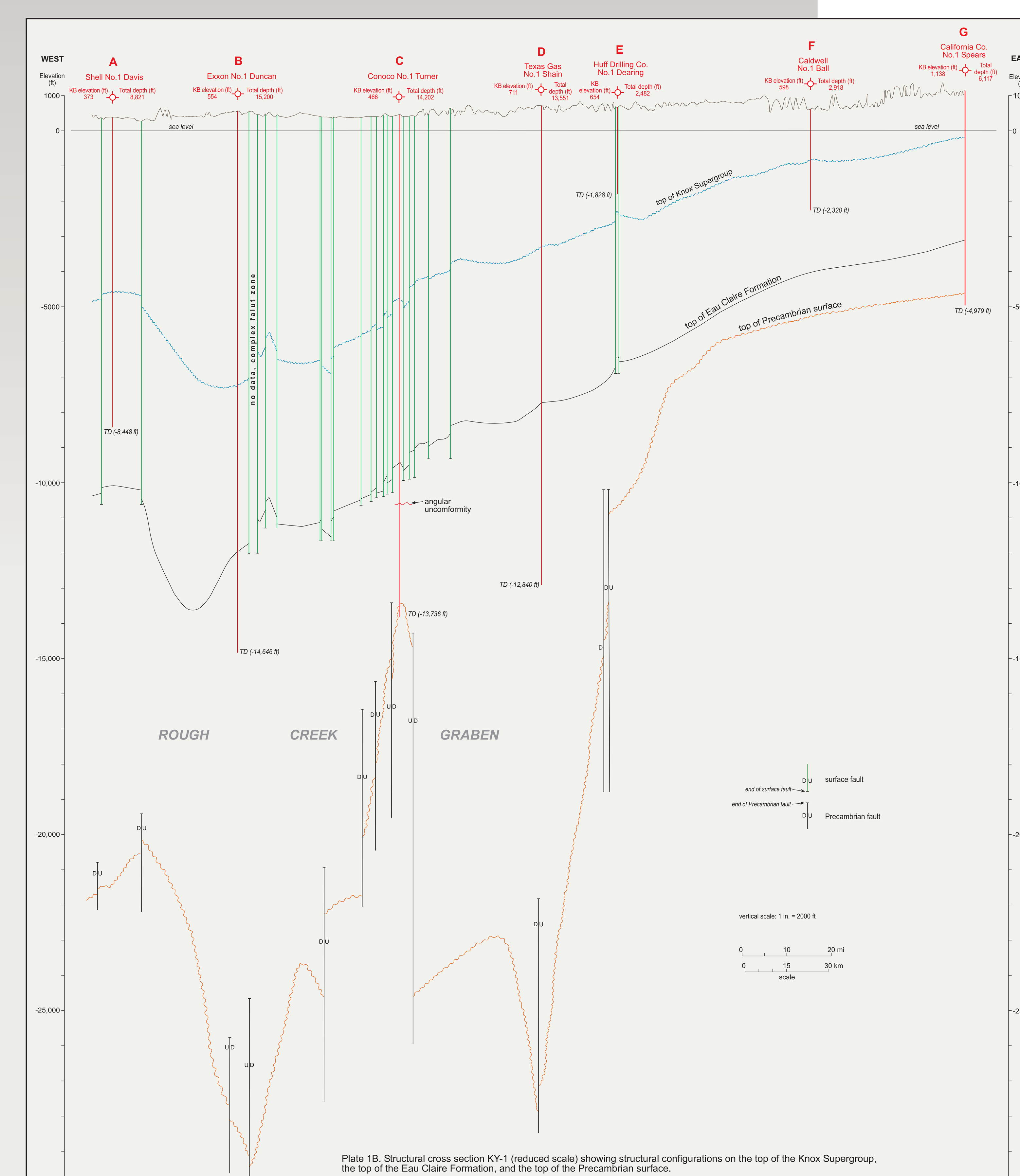

Plate 1B. Structural cross section KY-1 (reduced scale) showing structural configurations on the top of the Knox Supergroup, the top of the Eau Claire Formation, and the top of the Precambrian surface.

About the senior author: Martin C. Noger is a Kentucky native, born in Hazard. He attended the University of Kentucky, where he received a degree in geology. M.C., as he is known to his friends, left the state and worked in the oil and gas industry for several years before returning to Kentucky to join the Kentucky Geological Survey in 1968. M.C. served as head of the Areal Geology Section and as a distinguished geologist in the Petroleum and Stratigraphy Section at the Survey until 1993. From 1993 to 2001, he served as half-time geologist emeritus. Among his most noted accomplishments was managing the KGS-USGS cooperative statewide geologic mapping project, which was completed in 1978. His perseverance and untiring efforts to ensure completion of this monumental program resulted in the publication of 707 detailed geologic maps, making Kentucky the first state to have such coverage and making it among the best-mapped areas of the world. M.C.'s participation in geologic debates during the cooperative mapping program gave him an unequaled knowledge of Kentucky stratigraphy and made him a valuable resource often consulted by industry, the public, and the Survey staff. During his emeritus service to KGS, M.C., among his other duties, advised in the development and implementation of the digital mapping program, which resulted in the digitization of all 707 geologic maps. This program again resulted in a first for Kentucky—this time, the first state to have complete digital geologic coverage. In addition to mapping, M.C.'s accomplishments include work and publications in stratigraphy, with particular emphasis on the Ordovician, tar-sand resources, conventional oil and gas resources, and planning and geologic hazards. His experience in the geology of Kentucky is evident in this publication, which details the geology along a transect from near the Cincinnati Arch west to near the Illinois state line. The detailed stratigraphic relationships worked out in this publication will serve as the basis for future studies in this geologically challenging area.