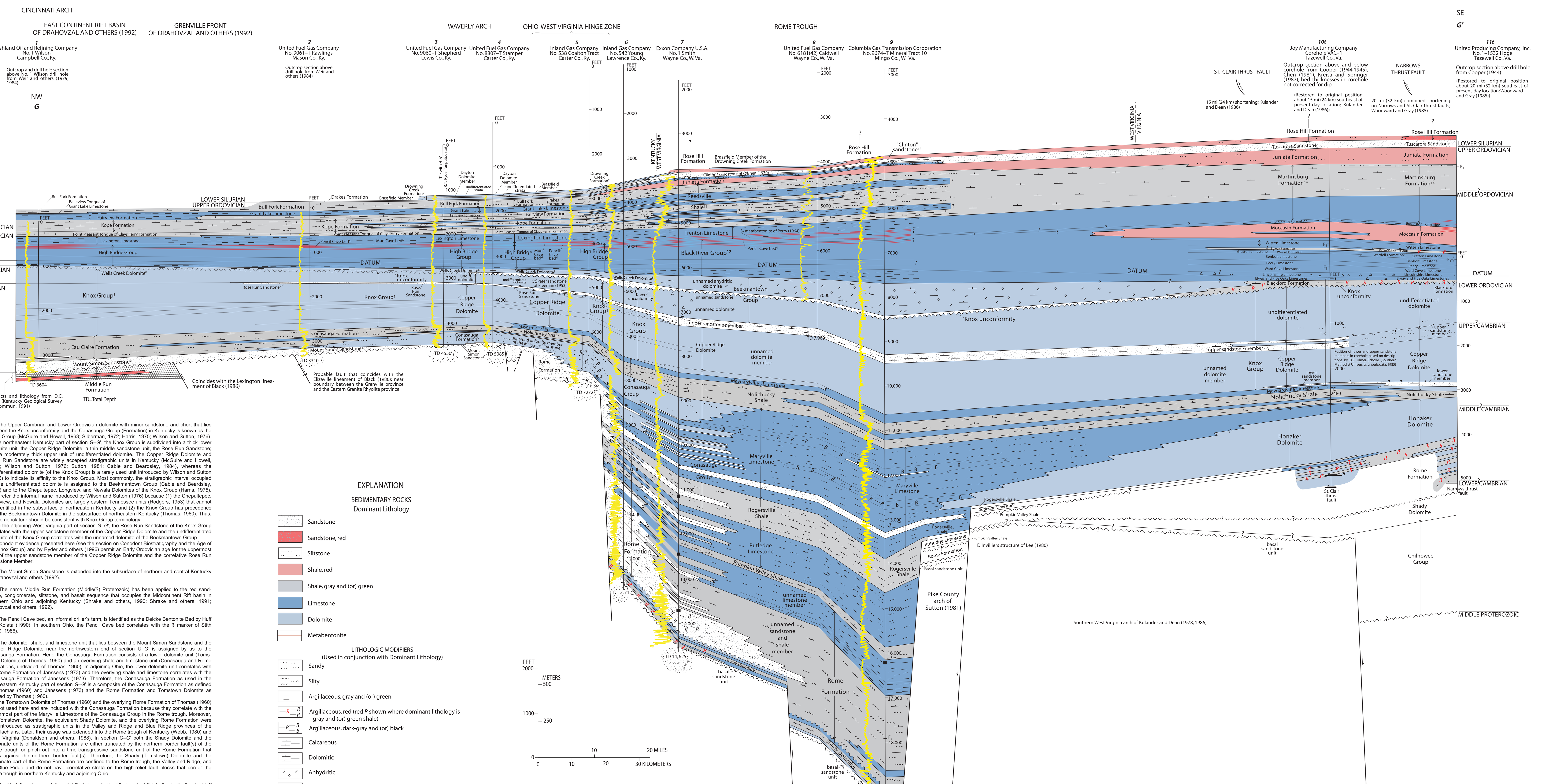

[1]The Upper Cambrian and Lower Ordovician dolomite with minor sandstone and chert that lies between the Knox unconformity and the Conasauga Group (Formation) in Kentucky is known as the Knox Group (McGuire and Howell, 1963; Silberman, 1972; Harris, 1975; Wilson and Sutton, 1976). In the northeastern Kentucky part of section *G–G′*, the Knox Group is subdivided into a thick lower dolomite unit, the Copper Ridge Dolomite; a thin middle sandstone unit, the Rose Run Sandstone; and a moderately thick upper unit of undifferentiated dolomite. The Copper Ridge Dolomite and Rose Run Sandstone are widely accepted stratigraphic units in Kentucky (McGuire and Howell, 1963; Wilson and Sutton, 1976; Sutton, 1981; Cable and Beardsley, 1984), whereas the undifferentiated dolomite (of the Knox Group) is a rarely used unit introduced by Wilson and Sutton (1976) to indicate its affinity to the Knox Group. Most commonly, the stratigraphic interval occupied by the undifferentiated dolomite is assigned to the Beekmantown Group (Cable and Beardsley, 1984) and to the Chepultepec, Longview, and Newala Dolomites of the Knox Group (Harris, 1975). We prefer the informal name introduced by Wilson and Sutton (1976) because (1) the Chepultepec, Longview, and Newala Dolomites are largely eastern Tennessee units (Rodgers, 1953) that cannot be identified in the subsurface of northeastern Kentucky and (2) the Knox Group has precedence over the Beekmantown Dolomite in the subsurface of northeastern Kentucky (Thomas, 1960). Thus, the nomenclature should be consistent with Knox Group terminology.

In the adjoining West Virginia part of section *G–G′*, the Rose Run Sandstone of the Knox Group correlates with the upper sandstone member of the Copper Ridge Dolomite and the undifferentiated dolomite of the Knox Group correlates with the unnamed dolomite of the Beekmantown Group.

Conodont evidence presented here (see the section on Conodont Biostratigraphy and the Age of the Knox Group) and by Ryder and others (1996) permit an Early Ordovician age for the uppermost part of the upper sandstone member of the Copper Ridge Dolomite and the correlative Rose Run Sandstone Member.

[2]The Mount Simon Sandstone is extended into the subsurface of northern and central Kentucky by Drahovzal and others (1992).

[3]The name Middle Run Formation (Middle(?) Proterozoic) has been applied to the red sandstone, conglomerate, siltstone, and basalt sequence that occupies the Midcontinent Rift basin in southern Ohio and adjoining Kentucky (Shrake and others, 1990; Shrake and others, 1991; Drahovzal and others, 1992).

[4]The Pencil Cave bed, an informal driller's term, is identified as the Deicke Bentonite Bed by Huff and Kolata (1990). In southern Ohio, the Pencil Cave bed correlates with the ß marker of Stith (1979, 1986).

[5]The dolomite, shale, and limestone unit that lies between the Mount Simon Sandstone and the Copper Ridge Dolomite near the northwestern end of section *G–G′* is assigned by us to the Conasauga Formation. Here, the Conasauga Formation consists of a lower dolomite unit (Tomstown Dolomite of Thomas, 1960) and an overlying shale and limestone unit (Conasauga and Rome Formations, undivided, of Thomas, 1960). In adjoining Ohio, the lower dolomite unit correlates with the Rome Formation of Janssens (1973) and the overlying shale and limestone unit correlates with the Conasauga Formation of Janssens (1973). Therefore, the Conasauga Formation as used in the northeastern Kentucky part of section *G–G′* is a composite of the Conasauga Formation as defined by Thomas (1960) and Janssens (1973) and the Rome Formation and Tomstown Dolomite as defined by Thomas (1960).

The Tomstown Dolomite of Thomas (1960) and the overlying Rome Formation of Thomas (1960) are not used here and are included with the Conasauga Formation because they correlate with the uppermost part of the Maryville Limestone of the Conasauga Group in the Rome trough. Moreover, the Tomstown Dolomite, the equivalent Shady Dolomite, and the overlying Rome Formation were first introduced as stratigraphic units in the Valley and Ridge and Blue Ridge provinces of the Appalachians. Later, their usage was extended into the Rome trough of Kentucky (Webb, 1980) and West Virginia (Donaldson and others, 1988). In section *G–G′* both the Shady Dolomite and the carbonate units of the Rome Formation are either truncated by the northern border fault(s) of the Rome trough or pinch out into a time-transgressive sandstone unit of the Rome Formation that abuts against the northern border fault(s). Therefore, the Shady (Tomstown) Dolomite and the carbonate part of the Rome Formation are confined to the Rome trough, the Valley and Ridge, and the Blue Ridge and do not have correlative strata on the high-relief fault blocks that border the Rome trough in northern Kentucky and adjoining Ohio.

[6]The Mud Cave bed, an informal driller's term, is identified as the Millbrig Bentonite Bed by Huff and Kolata (1990). In adjoining Ohio and West Virginia, the Mud Cave bed correlates with the α marker of Stith (1979, 1986) and the S_2 bentonite of Perry (1964), respectively.

[7]The Drowning Creek Formation as defined by McDowell (1983) in northeastern Kentucky consists, in ascending order, of the Brassfield Member, undifferentiated rocks, and the Dayton Dolomite Member. The Drowning Creek Formation and its basal dolomite or limestone unit, the Brassfield Member, extends for a short distance into southwestern West Virginia (McDowell, 1983).

[8]The Middle Ordovician Wells Creek Dolomite as used in northern Kentucky by McGuire and Howell (1963) and Wilson and Sutton (1976) correlates with the Wells Creek Formation as used in Ohio by Stith (1979), Wickstrom and others (1985), and Shrake and others (1990). In the vicinity of the Rome trough, in northeastern Kentucky, the Wells Creek Dolomite is underlain by the St. Peter sandstone. The St. Peter sandstone and the Wells Creek Dolomite correlate with the unnamed sandstone and the unnamed anhydritic dolomite of the Beekmantown Group, respectively, as defined in West Virginia by Ryder (1992a). The St. Peter sandstone and the unnamed sandstone of the Beekmantown Group overlie a widespread erosion surface known as the Knox unconformity.

Strata equivalent to the Wells Creek in West Virginia are assigned to the Beekmantown Group because of their anhydritic dolomite lithology and 300- to 600-ft (91- to 183-m) thickness. These characteristics make them more akin to the Beekmantown Group previously defined in West Virginia (Prouty and others, 1959; Wagner, 1966; Ryder, 1992a) than to the 150-ft (46-m)-thick argillaceous dolomite and shale unit that constitutes the Wells Creek Dolomite in Kentucky. The sandstone assigned to the St. Peter sandstone is reassigned to part of the Beekmantown Group in West Virginia because of its stratigraphic position between thick dolomite members of the Beekmantown Group.

[9]We follow the nomenclature of Webb (1980) that recognizes the Maryville Limestone, Nolichucky Shale, and Maynardville Limestone of the Conasauga Group in the subsurface of Kentucky. In contrast, the Kentucky Geological Survey follows the nomenclature of Thomas (1960) and McGuire and Howell (1963) that places the thick carbonates in the Rome Formation rather than in the Conasauga Group.

[10]An assemblage of fossils consisting of inarticulate brachiopods (lingulids), mollusks (*Hyolithes*), and trilobites (*Alokistacarella*) was recovered from a cored sequence (17,906 to 17,915 ft; 5,458 to 5,460 m) in the Columbia Gas Transmission Corporation No. 9674–T Mineral Tract 10 drill hole in Mingo County, W. Va. (Donaldson and others, 1975) (drill hole 9, megafossil locality F_1). This cored shale and siltstone sequence is within the lower half of the Rome Formation and 1,150 ft (351 m) above the Lower Cambrian Shady Dolomite. Donaldson and others (1988, p. 9) state that "the fossil data indicate an age of Middle Cambrian for these shales although the possibility of a Late Cambrian age is possible." Judging from these fossil data, we consider the Rome Formation in the Columbia Gas Transmission Corporation No. 9674–T Mineral Tract 10 drill hole to be Middle Cambrian in age (fig. 2). However, a late Early Cambrian age for the lowermost part of the Rome Formation at this locality cannot be ruled out.

At the western margin of the Rome trough, the Rome Formation climbs abruptly upsection at the expense of most of the Conasauga Group and steps westward across progressively higher fault blocks of the adjoining Ohio-West Virginia hinge zone. The Rome Formation at the western margin of the Rome trough and the adjoining Ohio-West Virginia hinge zone is probably entirely Middle Cambrian in age.

[11]The Reedsville Shale is extended into the subsurface of western West Virginia by Calvert (1963).

[12]We follow Cable and Beardsley (1984) and use the name Black River Group for the limestone sequence in western West Virginia between the Beekmantown Group and the Trenton Limestone. The Black River Group extends into southern and southeastern Ohio (Stith, 1979), but the lowermost strata of the group in West Virginia are slightly older than the lowermost strata in Ohio.

[13]The Lower Silurian "Clinton" sandstone and shale of Janssens (1977) and the "Clinton" sands of Pepper and others (1953) in Ohio have been extended into adjoining West Virginia and Kentucky as the "Clinton" sandstone of O'Brien (1970).

[14]In southwestern Virginia and adjoining West Virginia the name Martinsburg Formation is applied to the shale and limestone sequence of Middle and Late Ordovician age between the Eggleston and Juniata Formations (Butts, 1940; Cooper, 1944, 1945; McDowell and Schultz, 1990). The Martinsburg Formation as used here is equivalent to the Trenton Limestone and Reedsville Shale of western West Virginia.

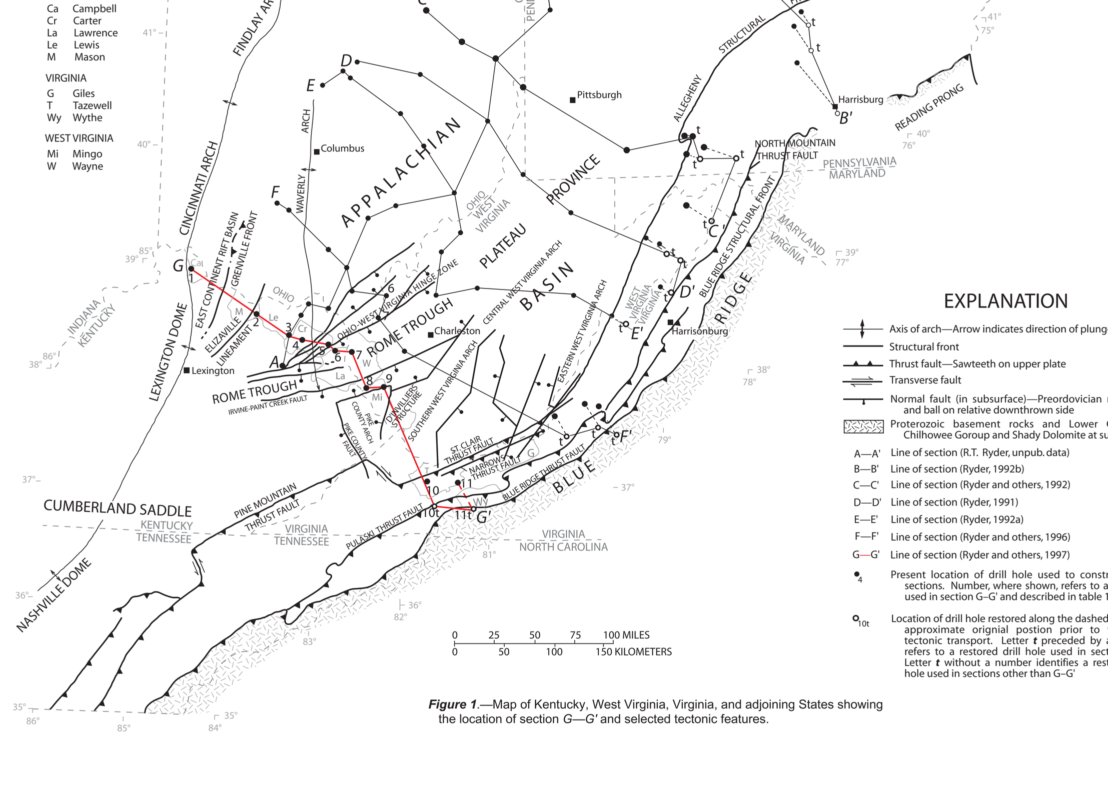

Figure 1.—Map of Kentucky, West Virginia, Virginia, and adjoining States showing the location of section *G—G′* and selected tectonic features.

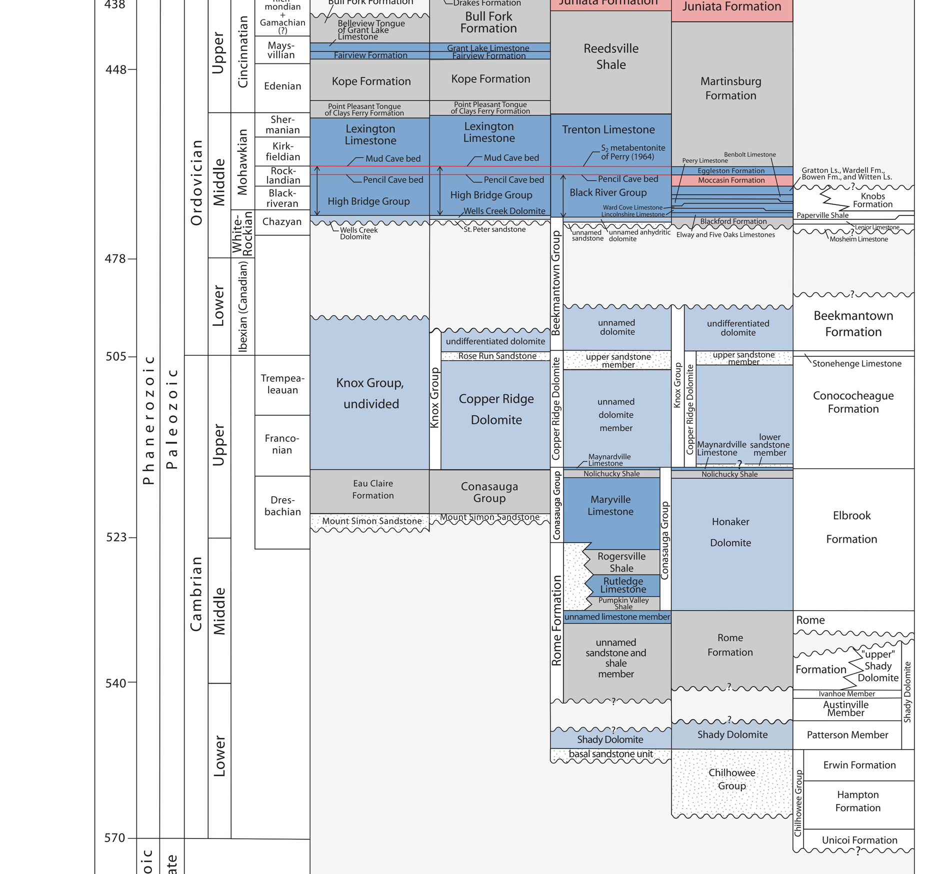

Figure 2.—Correlation chart of Proterozoic, Cambrian, and Ordovician rocks along section *G–G′* and in the adjoining Pulaski thrust sheet of Wythe County, Va. Absolute age (Ma) is taken from the geological time scale compiled by Palmer (1983). The time scale is nonlinear. North American chronostratigraphic units are modified after Barnes and others (1981), Ross and others (1982), and Palmer (1983).

DISCUSSION

Introduction

Cross section *G–G′* is the sixth in a series of restored stratigraphic cross sections drawn by the senior author to show the stratigraphic framework of Cambrian and Ordovician rocks in the Appalachian basin from Pennsylvania to Tennessee. The sections show complexly intertongued carbonate and siliciclastic lithofacies, marked thickness variations, key marker horizons, unconformities, and stratigraphic nomenclature of the Cambrian and Ordovician sequence. Several of the drill holes along the cross sections have yielded a variety of whole and (or) fragmented conodont elements. The identifiable conodonts are used to differentiate strata of Middle Cambrian, Late Cambrian, and Early Ordovician age, and their conodont color alteration index (CAI) values are used to establish the thermal maturity of the sequence. Macrofossil collections from drill holes and (or) outcrop sections along the restored sections provide additional biostratigraphic data. In addition to providing lithologic, nomenclatural, and paleontologic details of Cambrian and Ordovician strata, these cross sections also help to define and delineate the structure of the block-faulted Proterozoic basement rocks beneath the sedimentary cover of the Appalachian basin. Previously completed cross sections in this series are *F–F′* (Ryder and others, 1996), *E–E′* (Ryder, 1992a), *D–D′* (Ryder, 1991), *C–C′* (Ryder and others 1992), and *B–B′* (Ryder, 1992b) (fig. 1).

Section *G–G′* is about 255 mi (410 km) long. The section is constructed on the basis of eleven drill holes that are from 6 to 80 mi (10–129 km) apart and range in depth from 2,480 to 19,591 ft (756–5,971 m) (fig. 1, table 1). Eight of the eleven drill holes bottomed in crystalline basement rocks of Middle Proterozoic age or sandstone of Middle(?) Proterozoic age. Drill holes 10 and 11, which are located east of the St. Clair thrust fault, were restored 15 to 20 mi (24–32 km) southeastward to compensate for tectonic transport along underlying Alleghanian thrust faults (Woodward and Gray, 1985; Kulander and Dean, 1986).

Methodology and Stratigraphic Nomenclature

Borehole geophysical logs were used to establish most of the correlations between drilled stratigraphic units in section *G–G′*. In drill holes 10 and 11, where geophysical logs were not obtained, correlations between drilled stratigraphic units are based primarily on lithology. Lithologic logs, produced by the Geological Sample Log Company (Pittsburgh, Pa.) and other sources, were used to establish the lithofacies in and between the drill holes. The drilled Cambrian and Ordovician sequence at the southeastern end of section *G–G′* (drill holes 10 and 11) was supplemented by measured outcrop sections reported by Cooper (1944, 1945), Chen (1981), and Kreisa and Springer (1987). The upper part of the Upper Ordovician sequence at the northwestern end of section *G–G′* was furnished by measured outcrop sections and drill holes reported by Weir and others (1979, 1984).

Section *G–G′* has been restored to a horizontal datum located at the base of a widespread 60- to 100-ft (18- to 30-m)-thick micritic limestone located near the base of the High Bridge Group in Kentucky, near the base of the Black River Group in West Virginia, and at the base of the Lincolnshire Limestone in Virginia. This largely micritic limestone was selected as the datum horizon for section *G-G′* because it appears to be the most widespread and easily recognizable subsurface and surface marker unit in the Cambrian and Ordovician sequence of the central Appalachian basin. Metabentonite beds in the High Bridge Group, Lexington Limestone, Black River Group, Trenton Limestone, Eggleston Formation, Moccasin Formation, and Martinsburg Formation are also good marker units.

Much of the stratigraphic nomenclature used in section *G–G′* follows the nomenclature used by Ryder and others (1996) in adjoining section *F–F′*. The reader is also referred to Ryder (1992a) for a more detailed discussion of the stratigraphic nomenclature applied to the Cambrian sequence in the Rome trough part of West Virginia and adjoining Kentucky. Existing nomenclature established by the State Geological Surveys of Kentucky, Virginia, and West Virginia is preferred in section *G–G′*, but in certain places modifications and additions are recommended. At some localities on section *G–G′*, footnotes clarify the use of specific stratigraphic terms. The following stratigraphic investigations are particularly applicable to this investigation: (1) McGuire and Howell (1963), Cressman (1973), Cressman and Noger (1976), Webb (1980), Sutton (1981), and Weir and others (1984) in Kentucky; (2) Patchen and others (1984) and Donaldson and others (1988) in West Virginia; and (3) Cooper (1944, 1945), Read (1980), and Rader (1982) in Virginia.

The correlation chart (fig. 2) shows the chronostratigraphic position and nomenclature of Cambrian and Ordovician units identified in selected tectonic provinces along section *G–G′*. Moreover, this chart compares the nomenclature and chronostratigraphic position of Cambrian and Ordovician units in section *G–G′* with those in the adjoining Pulaski thrust sheet in southern Wythe County, Virginia (Rankin and others, 1972; Espenshade and others, 1975; Read, 1980; Rader, 1982; Barnaby and Read, 1990).

European chronostratigraphic units (for example, Tremadocian through Ashgillian Stages) commonly do not apply to the cratonal and platformal Ordovician rocks of North America (Ross and others, 1984). Therefore, in this paper we apply North American chronostratigraphic units used by Barnes and others (1981) and Ross and others (1982) rather than the European chronostratigraphic units used by Palmer (1983) and the Correlation of Stratigraphic Units of North America (COSUNA) (for example, see Patchen and others, 1984). Our correlation chart (fig. 2) subdivides the Ordovician System into the Lower, Middle, and Upper North American Series of Barnes and others (1981) and equates them with the Ibexian, Whiterockian and Mohawkian combined, and Cincinnatian Series of Ross and others (1982), respectively. In addition, because of its well-established usage in North America, the Canadian Series of Barnes and others (1981) is shown as being equivalent to the Ibexian Series of Ross and others (1982).

The Blackriveran through Gamachian(?) Stages of the Ordovician (fig. 2) follow the definitions of Barnes and others (1981) and Ross and others (1982). The Chazyan as used by Barnes and others (1981) is retained in this paper as a formal stage because of its long-time usage in North America. In contrast, Ross and others (1982) recognize the Chazyan as a chronostratigraphic unit of historical interest rather than a formal stage of the Ordovician System.

Conodont Biostratigraphy and the Age of the Knox Group

Identifiable conodonts were recovered from 11 of the 17 samples collected between the depths of 25 and 2,461 ft (8–750 m) in the Joy Manufacturing Company VAC–1 corehole (f_1 on cross section and table 2). Judging from the lithologic character, the top of the core consists of Middle Ordovician limestone, probably from the Blackford Formation and Elway Limestone, and the bottom of the core consists of Upper Cambrian Maynardville Limestone. According to a preliminary core description by ARCO geologists and I.P. Montanez (University of California, Riverside, unpub. data, 1985), the top of the Copper Ridge Dolomite is at 1,350 ft (411 m), and the Knox unconformity is between 188 and 192 ft (57–59 m). Conodonts recovered from the core at a depth of 25 ft (8 m) are Middle Ordovician in age, whereas conodonts recovered at depths of 270, 490, 945, 1,240, and 1,302 ft (82, 149, 288, 378, and 397 m) are Early Ordovician in age. The distribution of these conodonts supports the position of the Knox unconformity as noted by ARCO geologists and I.P. Montanez (unpub. data, 1985).

The ~2,210-ft (674-m)-thick dolomite between the Knox unconformity and Maynardville Limestone in the Joy Manufacturing Company VAC–1 corehole is assigned here to the Knox Group as defined by Cooper (1945) in outcrop studies in Tazewell County, Virginia. Cooper (1945) reports that the Claypool Hill-Cedar Bluff measured section of the Knox Group in Tazewell County consists, in ascending order, of (1) a 775-ft (236-m)-thick oolitic dolomite that contains a thin sandstone bed in the lowermost part; (2) a 430-ft (131-m)-thick dolomite and sandstone unit; (3) a 307-ft (94-m)-thick cherty dolomite; (4) an 80-ft (24-m)-thick dolomite and limestone unit; (5) a 150-ft (46-m)-thick cherty dolomite; and (6) a 295-ft (90-m)-thick pink dolomite. The upper five units of the measured section constitute the undivided Lower Ordovician part of the Knox Group shown in the Tazewell County part of the geologic map of Virginia (Milici and others, 1963). The basal unit of Cooper's (1945) measured section corresponds to the Upper Cambrian Copper Ridge Dolomite as shown in Tazewell County on the geologic map of Virginia (Milici and others, 1963). In eastern Tennessee and southwestern Virginia, strata equivalent to the Lower Ordovician part of the Knox Group in Tazewell County are subdivided, in ascending order, into the Chepultepec, Kingsport, and Mascot Dolomites, whereas strata equivalent to the Upper Cambrian part of the Knox Group in Tazewell County retain the name Copper Ridge Dolomite (Rodgers, 1953; Miller and Fuller, 1954; Harris and Miller, 1963).

The 1,404-ft (428-m)-thick dolomite interval in the Joy Manufacturing VAC–1 corehole—between the Knox unconformity and the base of a 227-ft (69-m)-thick sandstone zone identified by D.S. Ulmer-Scholle (Southern Methodist University, unpub. data, 1985)—contains Early Ordovician conodonts and fragments of possible Late Cambrian conodonts. This dolomite interval is correlated here with (1) the upper five units of the Knox Group measured in outcrop by Cooper (1945) and (2) the undivided Lower Ordovician part of the Knox Group as mapped by Milici and others (1963). Moreover, the underlying 884-ft (269-m)-thick dolomite interval between the sandstone zone of Ulmer-Scholle (unpub. data, 1985) and the Maynardville Limestone contains only fragments of primitive conodonts of probable Late Cambrian age. It is correlated here with (1) the 775-ft (236-m)-thick, basal oolitic dolomite member measured by Cooper (1945) and (2) the Copper Ridge Dolomite shown by Milici and others (1963) on the geologic map of Virginia. Guided by the outcrop terminology of Milici and others (1963), we subdivided the Knox Group in the Joy Manufacturing Company VAC–1 corehole and in the adjoining subsurface of Tazewell County into the Copper Ridge Dolomite and an overlying undifferentiated dolomite.

However, our definition and that of ARCO geologists (unpub. data, 1985) of the Copper Ridge Dolomite, unlike that of Milici and others (1963), includes most of the 430-ft (131-m)-thick dolomite and sandstone unit of Cooper (1945) in outcrop and the correlative sandstone zone of Ulmer-Scholle (unpub. data, 1986) in the Joy Manufacturing Company VAC–1 corehole. These sandstone beds (upper sandstone member) that we have added to the top of the Copper Ridge Dolomite correlate with a dolomite and sandstone unit of Late Cambrian and Early Ordovician(?) age in Giles County, Virginia, that Perry and others (1979) and Schultz and others (1986) recognize as the Chepultepec Dolomite, but that Bartholomew (1987) and Ryder and others (1996) recognize as the Copper Ridge Dolomite. Ryder and others (1996) identify this dolomite and sandstone unit in Giles County, and in adjoining counties in Virginia and West Virginia, as the upper sandstone member of the Copper Ridge Dolomite. In the Joy Manufacturing Company VAC–1 corehole, the presence of Early Ordovician conodonts 67 ft (20 m) above the upper sandstone member of the Copper Ridge Dolomite—and an absence of identifiable Cambrian conodonts within it—indicate that a Late Cambrian and Early Ordovician(?) age also is appropriate for the Copper Ridge Dolomite in Tazewell County.

The identified conodonts from the Joy Manufacturing Company VAC–1 corehole support the stratigraphic studies by Butts (1940), Cooper (1944), and Mussman and Read (1986) and the conodont studies by Harris and Repetski (1982, 1983) where the Knox unconformity throughout southwestern and central Virginia was defined by limestone of early Middle Ordovician (Chazyan) age resting disconformably on the Beekmantown Group (Dolomite) or upper part of the Knox Group of Early Ordovician age.

Basement Structure

Details of the structural configuration of block-faulted Middle Proterozoic basement rocks underlying the Appalachian basin in Kentucky and West Virginia are poorly understood because (1) few drill holes have penetrated the sedimentary cover, (2) few magnetic and gravity data have been calibrated to known basement rock types and structures, and (3) very few seismic profiles have been published. Because the basement faults accompanying section *G–G′* are based on limited data and, thus, are highly conjectural, they are shown on figure 1 as 40- to 140-mi (64- to 225-km)-long, incomplete line segments.

The east-northeast- to northeast-trending, fault-controlled Rome trough is recognized as the dominant element of basement structure in Kentucky and adjoining West Virginia (McGuire and Howell 1963; Cardwell, 1977; Harris, 1978; Ammerman and Keller, 1979; Webb, 1980; Sutton, 1981; Cable and Beardsley, 1984). On section *G–G′*, the Rome trough is shown as a conspicuous graben system in which Middle Proterozoic rocks of the Grenville orogenic belt have been downdropped 5,000 to 6,500 ft (1,524–1,981 m) along bounding normal faults. The north side of the graben is flanked by the southern end of the Ohio-West Virginia hinge zone of Ryder (1922a) (Middle Cambrian hinge of Read, 1989), whereas the south side is flanked by a segmented, high-standing fault block that consists of the Pike County arch of Sutton (1981), the D'Invilliers structure of Lee (1980), and the Southern West Virginia arch of Kulander and Dean (1978, 1986).

The basement-involved normal faults that bound the Rome trough and the intratrough depression on section *G–G′* are based on (1) surface traces of faults such as the Irvine-Paint Creek fault (McDowell and others, 1981), (2) previous structural interpretations (Cardwell, 1977; Weaver and McGuire, 1977; Sutton, 1981; Cable and Beardsley, 1984; Black, 1986; Lowry and others, 1990), and (3) several published seismic profiles (Lee, 1980; Sutton, 1981; Wallace and others, 1986). The normal fault on section *G–G′* that offsets the basement rocks of the Ohio-West Virginia hinge zone is based on an abrupt thickness change in drilled Cambrian strata. The Southern West Virginia arch and the contiguous D'Invilliers structure and Pike County arch are expressed as positive anomalies on magnetic and gravity maps (Zietz and others, 1977; Kulander and Dean, 1978; Ammerman and Keller, 1979; Zietz and others 1980; Zietz and Bond, 1984; Kulander and others, 1987). The magnetic and gravity anomalies define the eastern Kentucky and southwestern West Virginia part of the New York-Alabama lineament of King and Zietz (1978). Block-faulted terrane east and southeast of the Southern West Virginia arch, shown on section *G–G′*, is based on seismic data of Gresko (1985) and epicenter data of Bollinger and Wheeler (1988).

A rift basin that developed prior to the deposition of the Mount Simon Sandstone contains the Middle Run Formation (Shrake and others, 1991) and is closely aligned with the Kentucky-Ohio trough defined by Black (1986) on the basis of magnetic data. Recently, this rift basin was named the East Continent Rift basin by Drahovzal and others (1992). Drahovzal and others (1992) suggest that the rift basin is bounded on the east by a major thrust fault that marks the Grenville Front. We show this fault on figure 1 and section *G–G′* as being approximately coincident with the Lexington lineament of Black (1986).

Between the Ohio-West Virginia hinge zone and the East Continent Rift basin, the basement rocks have been uplifted into a broad, south-plunging arch that was named the Waverly arch by Woodward (1961). Undoubtedly, the basement rocks that constitute the Waverly arch have been cut by normal faults, but their offset on section *G–G′* is too small to be detected by thickness changes in drilled basal Cambrian strata. The Elizaville lineament of Black (1986), a northeast-trending linear magnetic anomaly that crosses section *G–G′* several miles west of the United Fuel Gas Company No. 9061–T Rawlings drill hole (fig. 1), very likely is caused by a basement fault that cuts the west flank of the Waverly arch. The dip direction and relative offset of the fault are unknown but it lies near the boundary of the Grenville province and the older Eastern Granite Rhyolite province as shown by Van Schmus (1992).

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Table 1.—Drill holes used in section *G–G′*.
[Locations shown on figure 1]

Number	Name	Location	Permit no.	Lithologic log[1]	Cored intervals (ft) and formation	Total depth (ft)	Age of oldest rocks drilled (formation)
1	Ashland Oil and Refining Company No. 1 Wilson.	Carter Coordinates: 25–DD–62, Campbell County, Ky.	10851	GSLC		3,604	Middle(?) Proterozoic (Middle Run Formation).
2	United Fuel Gas Company No. 9061–T Rawlings.	Carter Coordinates: 15–Y–71 Mason County, Ky.	3990	GSLC, MH		3,310	Middle Proterozoic.
3	United Fuel Gas Company No. 9060–T Shepherd.	Carter Coordinates: 19–W–75, Lewis County, Ky.	2579	GSLC, MH		4,550	Middle Proterozoic.
4	United Fuel Gas Company No. 8807–T Stamper.	Carter Coordinates: 3–V–77, Carter County, Ky.	398E9	GSLC		5,085	Middle Proterozoic.
5	Inland Gas Company No. 538 Coalton Tract.	Carter Coordinates: 14–V–81, Carter County, Ky.	22935	GSLC		7,272	Middle Proterozoic.
6	Inland Gas Company No. 542 Young.	Carter Coordinates: 6–U-82, Lawrence County, Ky.	24502	GSLC		12,712	Middle Proterozoic.
7	Exxon Company U.S.A. No. 1 Smith.	Butler District, Wayne County, W. Va	1572	E	10,435–10,441, 10,468–10,492; Maryville Limestone. 11,135–11,200; Rogersville Shale. 12,435–12,500, 13,705–13,741; Rome Formation.	14,625	Middle Proterozoic.
8	United Fuel Gas Company No. 6181(42) Caldwell.	Lincoln District, Wayne County, W. Va	465	GSLC		7,900	Late Cambrian (Copper Ridge Dolomite).
9	Columbia Gas Transmission Corporation No. 9674–T Mineral Tract 10.	Harvey District, Mingo County, W. Va.	805	GSLC	16,201–16,260, 17,906–17,915; Rome Formation. 19,531–19,537; Middle Proterozoic basement rocks.	19,591	Middle Proterozoic.
10	Joy Manufacturing Company Corehole VAC–1.	Pounding Mill quadrangle, Tazewell County, Va.	—	—	Surface to total depth; Elway and Five Oaks Limestones, undivided, Knox Group, and Maynardville Limestone.	2,480	Late Cambrian (Maynardville Limestone).
11	United Producing Company Inc. No. 1–1532 Hoge.	Garden Mountain quadrangle, Tazewell County, Va.	—	VDMR	—	5,632	Early and Middle Cambrian (Rome Formation) thrust over Late Cambrian (Copper Ridge Dolomite).

[1]Lithologic logs from Geological Sample Log Company (GSLC), Pittsburgh, Pa.; McGuire and Howell (1963) (MH); Exxon Company U.S.A. (unpub. data) (E); and Virginia Division of Mineral Resources (VDMR) well no. 12, described by W.J. Souder.

Table 2.—Conodonts from the Joy Manufacturing Company VAC–1 corehole, Tazewell County, VA.
[Seventeen samples ~800 g each) were taken from the core between 25 and 2,461 ft and processed for conodonts; only the productive samples are listed. CAI, conodont color alteration index, is a measure of organic maturation (Epstein and others, 1977)]

Sample interval (ft)	USGS collection no.	Stratigraphic unit	Conodonts	Age	CAI	Comments
25–26	11088–CO	Elway and Five Oaks Limestones, undivided.	2 cardiodelloid elements and 4 truchergnathodoid elements of *Curtognathus* sp. 13 *Erismodus* cf. *E. asymmetricus*. 6 *Panderodus* sp. 1 Sa or Sb element of *Plectodina*? sp. 1 *Polycaulodus*? sp. 1 *Scalpellodus*? sp. 16 indeterminate fragments.	Middle Ordovician; late Whiterockian (upper *Histiodella holodentata* Zone) or younger Middle Ordovician	1½	Limestone.
270–271	11089–CO	Undifferentiated dolostone of the Knox Group.	1 drepanodontiform element of *Drepanoistodus* sp. 2 *Eucharodus parallelus*. 14 *Glyptoconus quadraplicatus*. 1 *Paraserratognathus*? *abruptus*. 2 oistodontiform elements of *Paroistodus*? sp. 2 symmetrical 5-costate elements and 2 asymmetrical 5-costate elements of *Tropodus comptus*. 1 unassigned drepanodontiform element. 2 indeterminate fragments.	late Early Ordovician; late Ibexian (*Oepikodus communis* Zone)	1½	Dolostone; age constrained by conodont faunule from 490–491 ft.
490–491	11090–CO	Undifferentiated dolostone of the Knox Group.	1 *Eucharodus parallelus*. 1 *Parapanderodus striatus*. 1 *Protopanderodus gradatus*.	late Early Ordovician; late Ibexian (*Oepikodus communis* Zone)	1½	Dolostone.
945–946	11091–CO	Undifferentiated dolostone of the Knox Group.	1 drepanodontiform element and 1 suberectiform element of *Drepanoistodus*? sp. 3 indeterminate fragments.	Early Ordovician (based on constraints from overlying and underlying collections)	2–2½	Dolostone; most specimens etched and whitened, possibly from acid preparation.
1,240–1,241	11092–CO	Undifferentiated dolostone of the Knox Group.	1 drepanodontiform element of *Drepanoistodus* cf. *D. pervetus*. 1 *Teridontus*? sp.	early, but not earliest, Early Ordovician; early Ibexian	~2½	Dolostone.
1,302–1,303	11093–CO	Undifferentiated dolostone of the Knox Group.	1 *Oneotodus simplex*. 11 coniform elements of *Rossodus*? n. sp.	early Early Ordovician; Ibexian (*Rossodus manitouensis* Zone or, most likely, low Fauna D)	2–2½	Dolostone.
1,396–1,397	No CO number assigned.	Copper Ridge Dolomite of the Knox Group.	Indeterminate non-conodont fragments, probably phosphatic brachiopods.	Late Cambrian(?)	—	Dolostone.
1,552–1,553	No CO number assigned.	Copper Ridge Dolomite of the Knox Group.	Indeterminate non-conodont fragments, possibly phosphatic brachiopods.	Late Cambrian(?)	—	Dolostone.
1,932–1,933	No CO number assigned.	Copper Ridge Dolomite of the Knox Group.	1 indeterminate fragment of euconodont coniform(?) element.	No older than Late Cambrian.	~ 2½	Dolostone.
2,359–2,360	No CO number assigned.	Copper Ridge Dolomite of the Knox Group.	Indeterminate non-conodont phosphatic fragments.	Late Cambrian(?)	—	Dolostone.
2,460–2,461	11094–CO	Maynardville Limestone of the Conasauga Group.	1 phosphatic brachopod valve of an indeterminate genus and species.	Late Cambrian(?)	—	Limestone that contains shale partings.

STRATIGRAPHIC FRAMEWORK OF CAMBRIAN AND ORDOVICIAN ROCKS IN THE CENTRAL APPALACHIAN BASIN FROM CAMPBELL COUNTY, KENTUCKY, TO TAZEWELL COUNTY, VIRGINIA

By
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1997

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2004