Coal and Petroleum Resources in the Appalachian Basin—Index Maps of Included Studies

By Leslie F. Ruppert, Michael H. Trippi, and Scott A. Kinney

Chapter B.1 of
Coal and Petroleum Resources in the Appalachian Basin: Distribution, Geologic Framework, and Geochemical Character
Edited by Leslie F. Ruppert and Robert T. Ryder

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U.S. Department of the Interior
U.S. Geological Survey

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Contents

Figures

Conversion Factors

Multiply	By	To obtain
	Length	
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Mass	
pound	0.4536	kilogram
short ton (2,000 pounds avoirdupois)	0.9072	metric ton (megagram = 1,000 kilograms)
	Calorific value	
British thermal unit (Btu)	1,055.056	joule (J)
British thermal unit per pound avoirdupois (Btu/lb)	2,326	joule per kilogram (J/kg)

Coal and Petroleum Resources in the Appalachian Basin—Index Maps of Included Studies

By Leslie F. Ruppert,[1] Michael H. Trippi,[1] and Scott Kinney[2]

Introduction

This chapter B.1 of U.S. Geological Survey (USGS) Professional Paper 1708 provides index maps for many of the studies described in other chapters of the report. Scientists of the USGS and State geological surveys studied coal and petroleum resources in the central and southern Appalachian structural basins. In the southern Appalachian basin, studies focused on the coal-bearing parts of the Black Warrior basin in Alabama. The scientists used new and existing geologic data sets to create a common spatial geologic framework for the fossil-fuel-bearing strata of the central Appalachian basin and the Black Warrior basin in Alabama.

Digital data have been compiled into a geographic information system (GIS) that is included in chapter I.1 (Trippi and others, this volume). Shape files and related metadata for features shown in the index maps of this chapter can be downloaded from chapter I.1.

The study area for the Appalachian basin resource framework study includes the fossil-fuel-bearing strata of the following States (listed alphabetically): Alabama, Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The outline of the study area is shown in figure 1; it differs from the boundary of the Appalachian Basin Province (Province 67) defined for the 1995 National Oil and Gas Assessment (NOGA) by the U.S. Geological Survey (1996a). The difference is that the study area includes regions where the Pennsylvanian coal-bearing strata crop out but does not include all of the oil- and gas-bearing strata of the Black Warrior basin, Alabama.

The reasons for providing the index maps in this chapter are to show the locations of different studies, to give an overview of topics covered, and to help the user choose which chapter to read. Figures 1 and 2 show the study area outline and county names. Figure 3 shows oil and gas production in 1995 and 2005. Figure 4 shows locations of Upper Devonian sandstone oil and gas fields. Figure 5 shows major coal regions and coal fields. Figure 6 shows coal production by county.

Figure 7 shows the locations of 10 cross sections of regional extent through the subsurface of the Appalachian basin. Figure 8 shows conodont alteration index sample locations and interpreted isograds for Ordovician rocks.

Figure 9 shows vitrinite-reflectance data for Pennsylvanian coal in the Appalachian basin. Figure 10 shows the locations of coalbed-methane (CBM) assessment units in the study area, and figure 12 shows counties producing CBM. Figure 12 shows sulfur content of coal delivered to powerplants from coal-producing counties in the Appalachian basin and Black Warrior basin.

Figure 13 shows locations of wells in Ohio and Pennsylvania where oil and gas were sampled in Lower Silurian reservoirs. Figure 14 shows the Conasauga-Rome/Conasauga Total Petroleum System and selected wells in the Rome trough in Kentucky and West Virginia having oil and gas production and shows. Figure 15 shows the locations of samples from Silurian reservoirs in Kentucky, New York, Ohio, Pennsylvania, and West Virginia; the samples yielded total organic carbon data. Figure 16 shows the locations of the Ben Hur and Rose Hill oil fields, Virginia, and the Swan Creek oil field, Tennessee.

The one index map that is not shown is the areal extent of the shale gas plays in the basin. The extents of the plays can be found in Coleman and others (this volume, chap. G.13).

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[1]U.S. Geological Survey, Reston, Va.
[2]U.S. Geological Survey, Denver, Colo.

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Hatch, J.R., Pawlewicz, M.J., Charpentier, R.R., Cook, T.A., Crovelli, R.A., Klett, T.R., Pollastro, R.M., and Schenk, C.J. (all of the U.S. Geological Survey Black Warrior Basin Province Assessment Team), 2003, Assessment of undiscovered oil and gas resources of the Black Warrior Basin Province, 2002: U.S. Geological Survey Fact Sheet FS–038–03, 2 p. (Also available online at http://pubs.usgs.gov/fs/fs-038-03/.)

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Figures 1–16

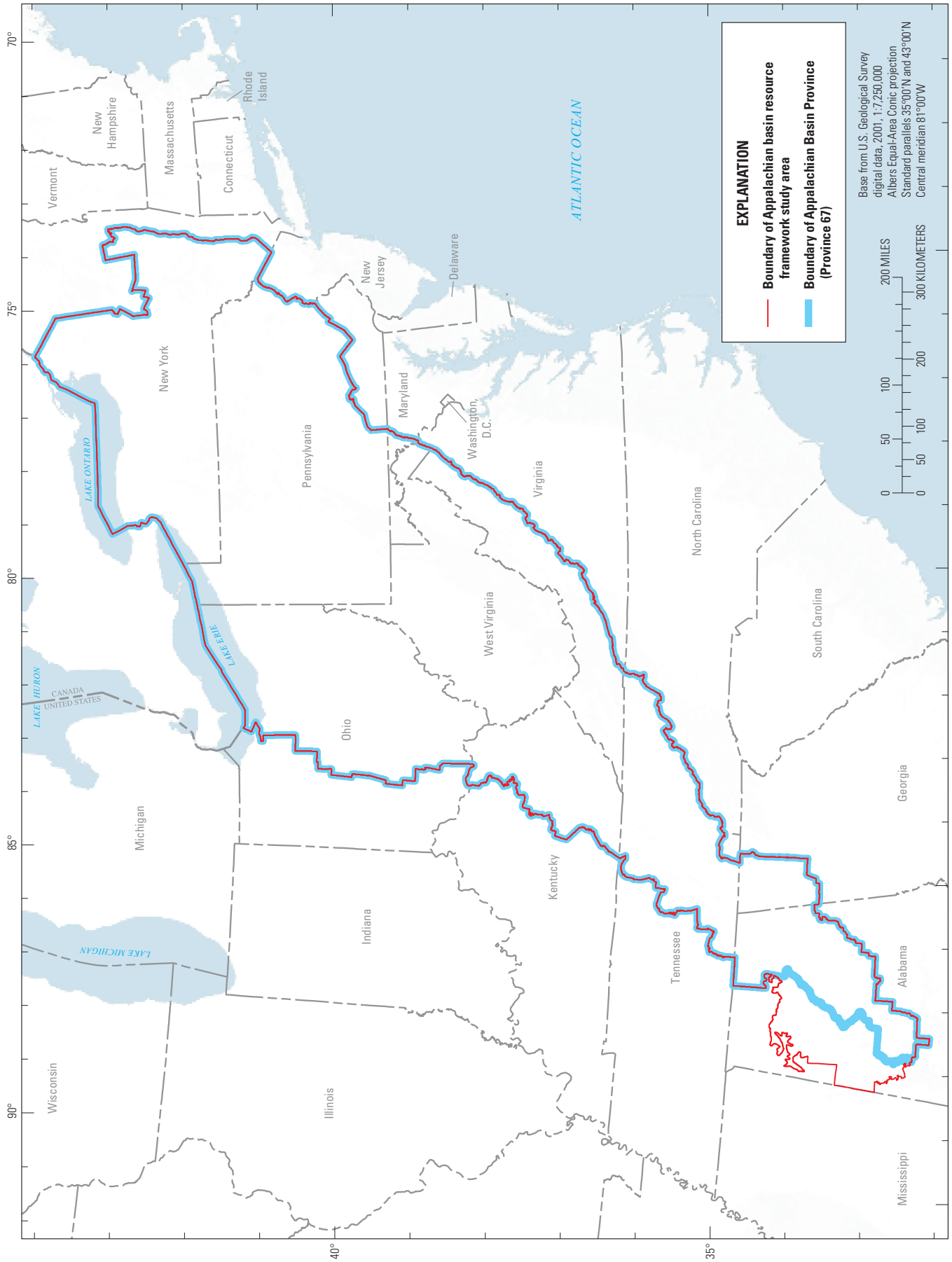
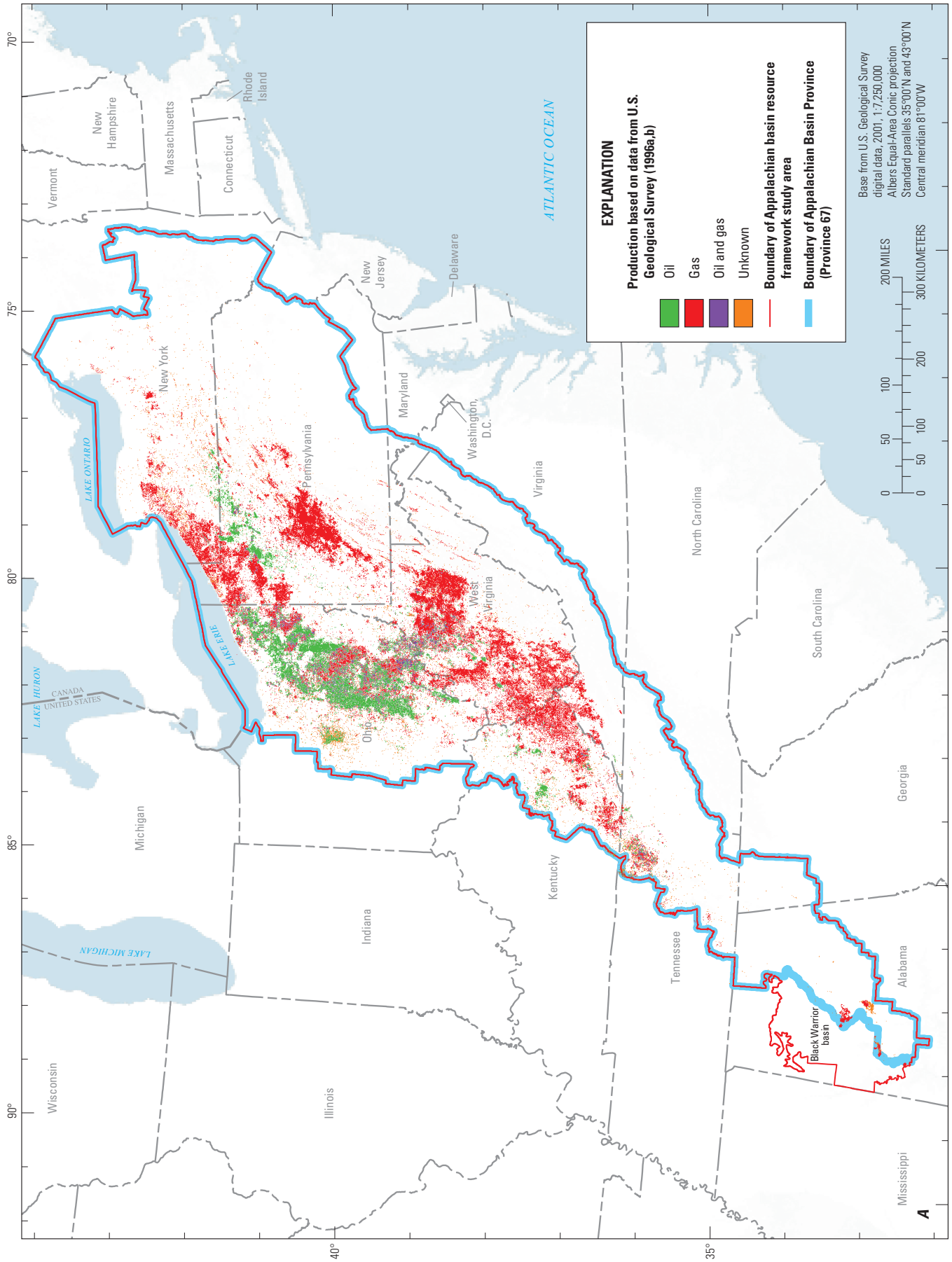

EXPLANATION
Boundary of Appalachian basin resource framework study area
Boundary of Appalachian Basin Province (Province 67)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
CANADA
UNITED STATES
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New York
New Jersey
Delaware
Pennsylvania
Maryland
Washington, D.C.
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Tennessee
Kentucky
Ohio
Indiana
Illinois
Michigan
Wisconsin
70°
75°
80°
85°
90°
40°
35°

Figure 1 (facing page). Index map of the Appalachian basin resource framework study area showing the difference between the study area outline and the boundary of the Appalachian Basin Province (Province 67) defined for the 1995 National Oil and Gas Assessment (NOGA) by the U.S. Geological Survey (1996a). The Appalachian basin resource framework study area includes the fossil-fuel-bearing strata of the States of Alabama, Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The difference between the study area and Province 67 is that the study area includes regions where the Pennsylvanian coal-bearing strata crop out but does not include all of the oil- and gas-bearing strata of the Black Warrior basin, Alabama. The shape files and related metadata for the outline of the study area can be downloaded from Trippi and others (this volume, chap. I.1). See figure 2 of this chapter for county names.


EXPLANATION
Boundary of Appalachian basin resource framework study area
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
CANADA
UNITED STATES
New York
Pennsylvania
West Virginia
Ohio
Kentucky
Tennessee
Alabama
Georgia
Mississippi
South Carolina
North Carolina
Virginia
Maryland
Delaware
New Jersey
Connecticut
Rhode Island
Massachusetts
Vermont
New Hampshire
Michigan
Indiana
Illinois
Wisconsin
Washington, D.C.
70°
75°
80°
85°
90°
40°
35°

Figure 2 (facing page). Index map of the Appalachian basin resource framework study area showing State and county boundaries within the study area.


EXPLANATION
Production based on data from U.S. Geological Survey (1996a,b)
Oil
Gas
Oil and gas
Unknown
Boundary of Appalachian basin resource framework study area
Boundary of Appalachian Basin Province (Province 67)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
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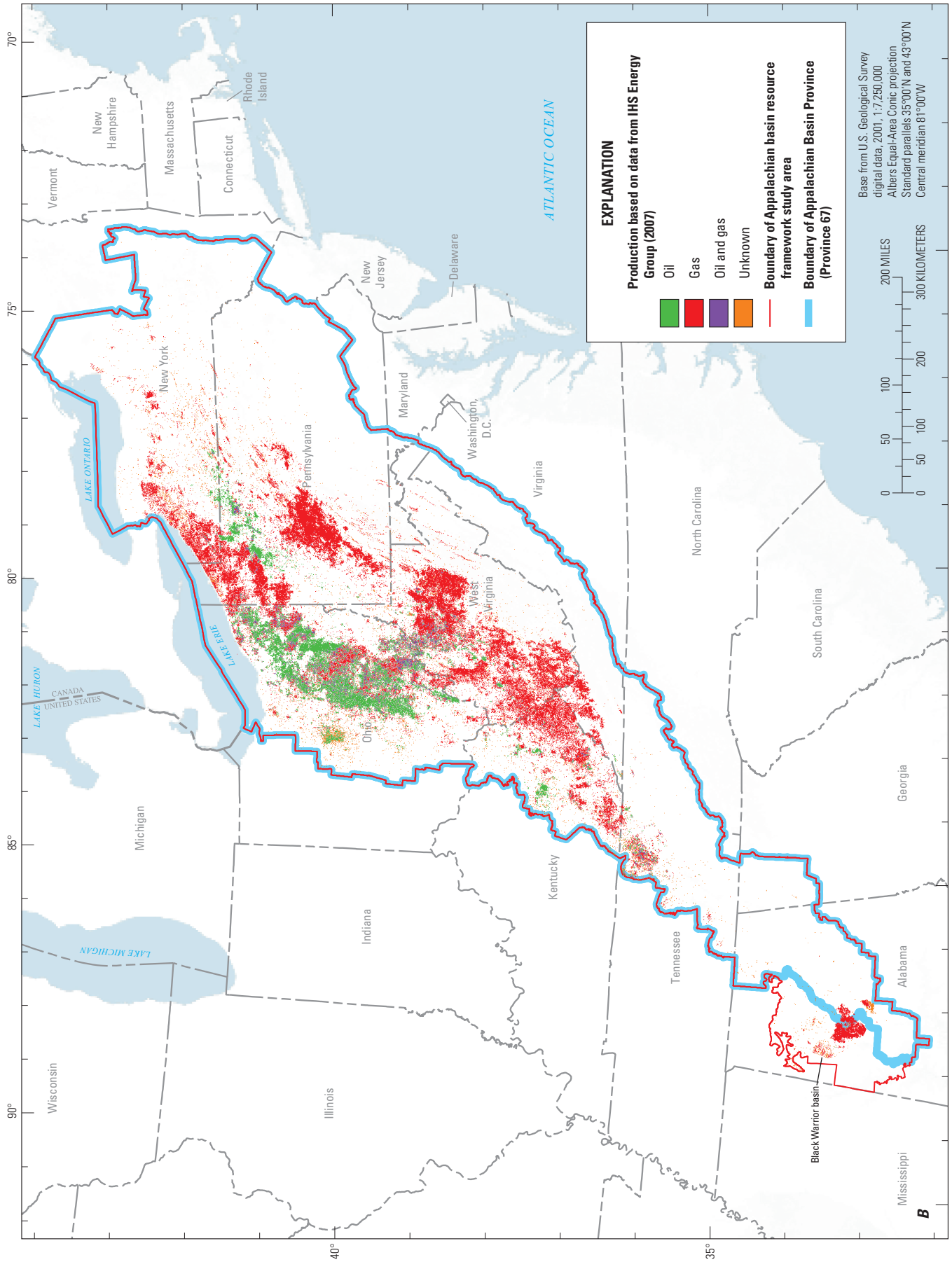
UNITED STATES
Vermont
New Hampshire
Massachusetts
Rhode Island
Connecticut
New York
New Jersey
Delaware
Pennsylvania
Maryland
Washington, D.C.
Virginia
West Virginia
Ohio
Michigan
Indiana
Kentucky
Tennessee
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Wisconsin
Illinois
Black Warrior basin
A
70°
75°
80°
85°
90°
40°
35°

Figure 3 (facing page). Index maps of the Appalachian basin resource framework study area showing oil and gas production in the Appalachian basin and the coal-bearing part of the Black Warrior basin as of (*A*) 1995 and (*B*) 2005. The data in part *A* are from the 1995 National Oil and Gas Assessment (NOGA) by the U.S. Geological Survey (1996a), and the plot (U.S. Geological Survey, 1996b) shows a subset of the national oil and gas production map of the conterminous United States by Mast and others (1998). Cells representing one-quarter square mile of land surface were created and coded according to type of production (predominantly oil, gas, oil and gas, and unknown from miscellaneous wells drilled for oil and gas) reported in the proprietary Petroleum Information Well History Control System oil and gas database (IHS Energy Group, 2003). The miscellaneous wells include wells that were dry, plugged, or used for storage or injection or other purposes. The map in part *B* uses the same cells as the map in part *A* to show oil and gas production as of 2005 (IHS Energy Group, 2007), before the widespread development of the Marcellus Shale. Comparison of parts *A* and *B* shows that production increased between 1995 and 2005 throughout the Appalachian basin, most notably in Alabama and Virginia. Many of the new wells were producing coalbed methane from Lower Pennsylvanian coals. Ryder and others (this volume, chap. C.1) present the stratigraphic framework of the basin in Ohio and West Virginia and associated petroleum systems. Data on more than 500,000 public oil and gas wells from State geological surveys can be queried and downloaded from Trippi and others (this volume, chap. I.1).


EXPLANATION
Production based on data from IHS Energy Group (2007)
Oil
Gas
Oil and gas
Unknown
Boundary of Appalachian basin resource framework study area
Boundary of Appalachian Basin Province (Province 67)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
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Massachusetts
Rhode Island
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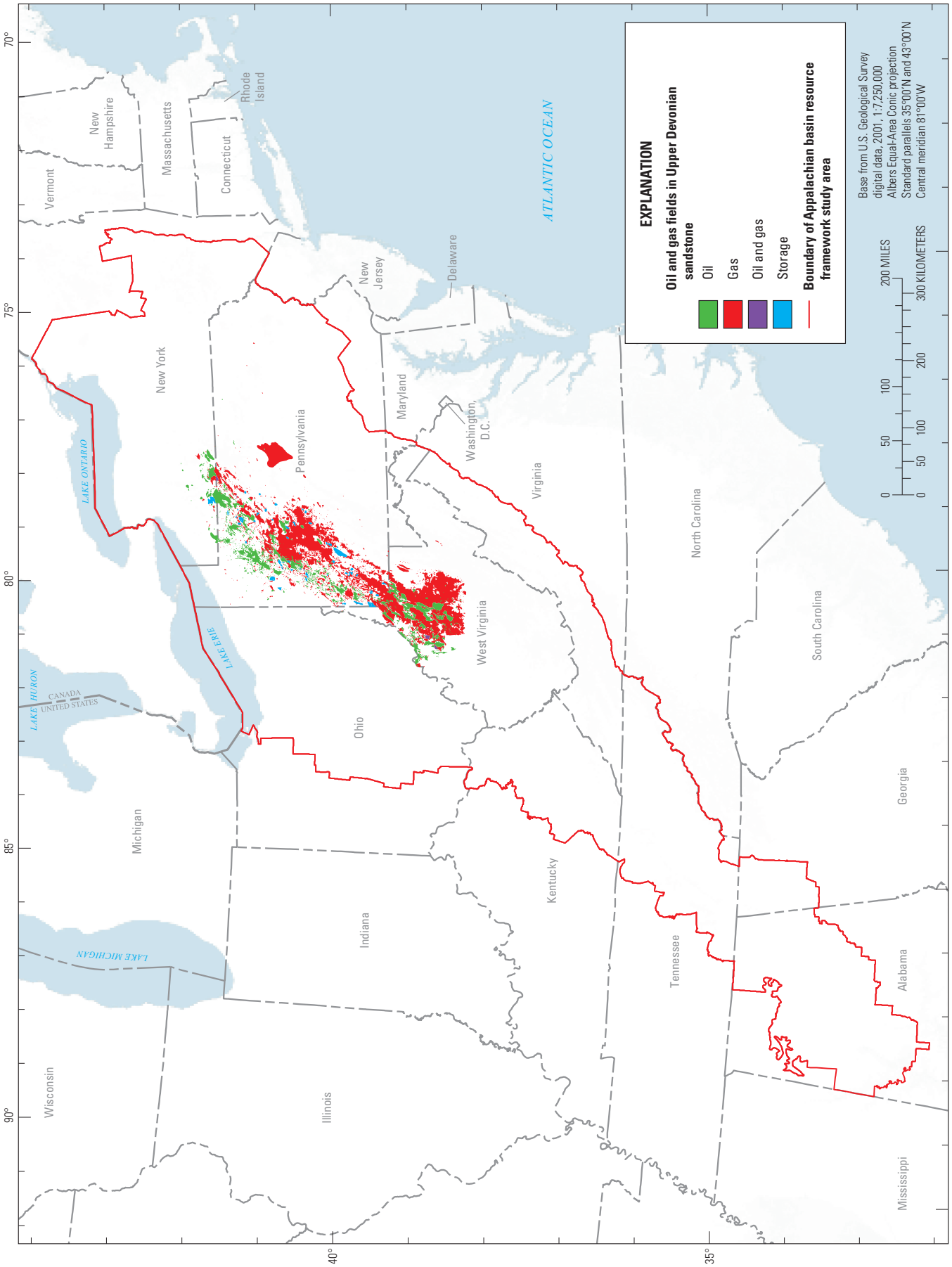
New York
New Jersey
Delaware
Maryland
Washington, D.C.
Pennsylvania
Virginia
West Virginia
Ohio
Kentucky
Indiana
Illinois
Michigan
Wisconsin
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Tennessee
Black Warrior basin
70°
75°
80°
85°
90°
40°
35°
B

Figure 3 (facing page). Continued.


EXPLANATION
Oil and gas fields in Upper Devonian sandstone
Oil
Gas
Oil and gas
Storage
Boundary of Appalachian basin resource framework study area
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
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Rhode Island
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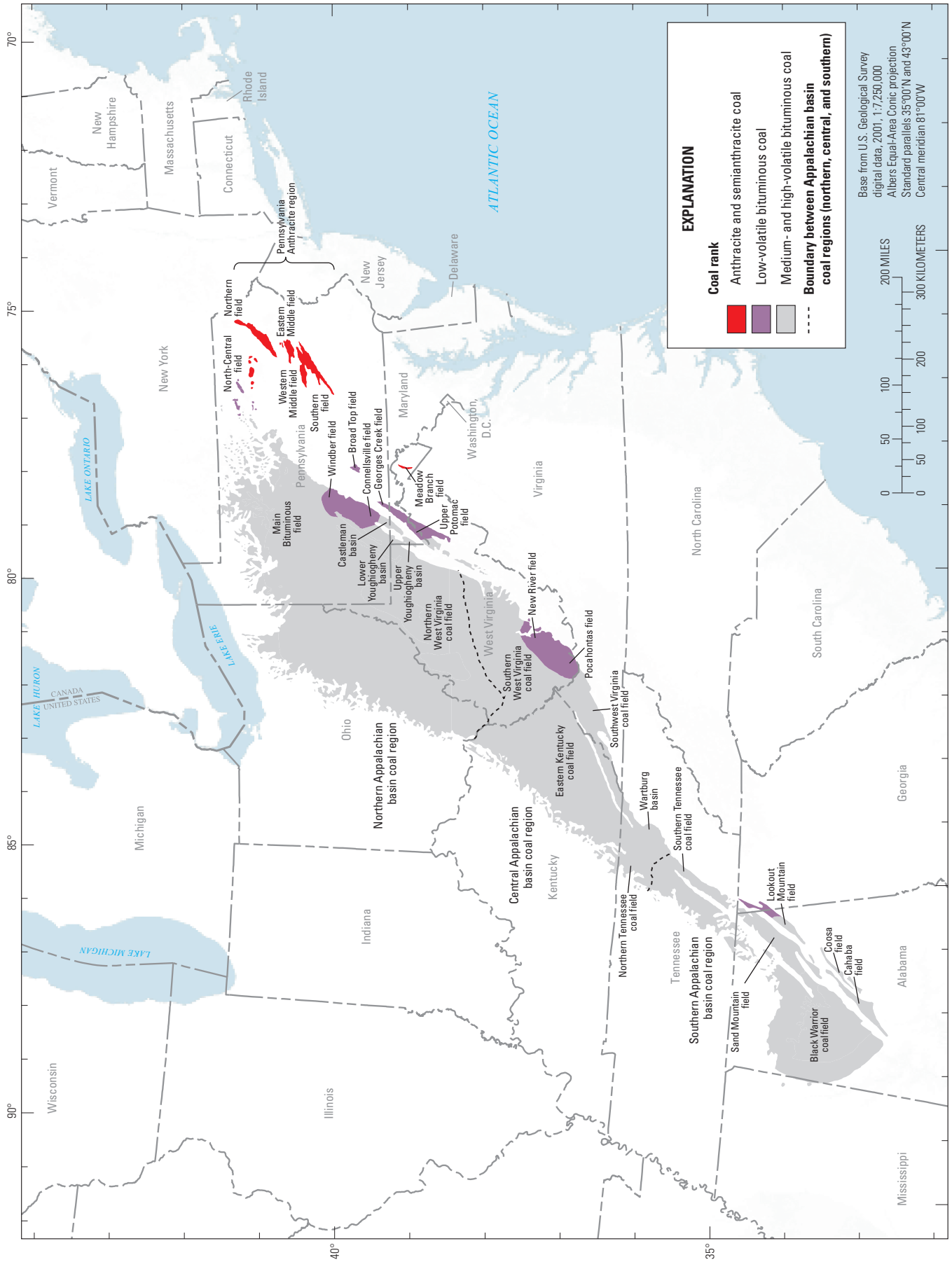
New York
New Jersey
Delaware
Pennsylvania
Maryland
Washington, D.C.
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Tennessee
Kentucky
Ohio
Indiana
Illinois
Michigan
Wisconsin
70°
75°
80°
85°
90°
40°
35°

Figure 4 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of oil and gas fields in Upper Devonian sandstone reservoirs. This map is one of a series of seven maps (Ryder and others, this volume, chap. C.2) that use oil and gas field names and numbers assigned by the State geological surveys of Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennessee, and West Virginia. The maps were compiled from State oil and gas maps or other published sources (see chap. C.2). The other six maps show oil and gas fields in the following reservoirs: (1) Lower to Middle Cambrian Rome Formation and Middle to Upper Conasauga Group reservoir; (2) Lower to Middle Ordovician Beekmantown Group, Lower to Middle Ordovician and Upper Cambrian Knox Group, and Upper Cambrian Rose Run Sandstone (sandstone) reservoirs; (3) Upper Ordovician Trenton Limestone and Black River Limestone reservoirs; (4) Lower Silurian "Clinton" sandstone, Medina Group, Tuscarora Sandstone, and Keefer (Big Six) Sandstone reservoirs and Upper Ordovician Queenston Shale and Bald Eagle Formation reservoirs; (5) Upper Silurian Newberg Sandstone, Lockport Dolomite (Newberg zone), Lockport Dolomite, and Akron Dolomite reservoirs and Silurian-Devonian Corniferous and Middle Devonian Onondaga Limestone reservoirs; and (6) Lower Devonian Oriskany Sandstone and Middle Devonian Huntersville Chert reservoirs.


EXPLANATION
Coal rank
Anthracite and semianthracite coal
Low-volatile bituminous coal
Medium- and high-volatile bituminous coal
Boundary between Appalachian basin coal regions (northern, central, and southern)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
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LAKE ERIE
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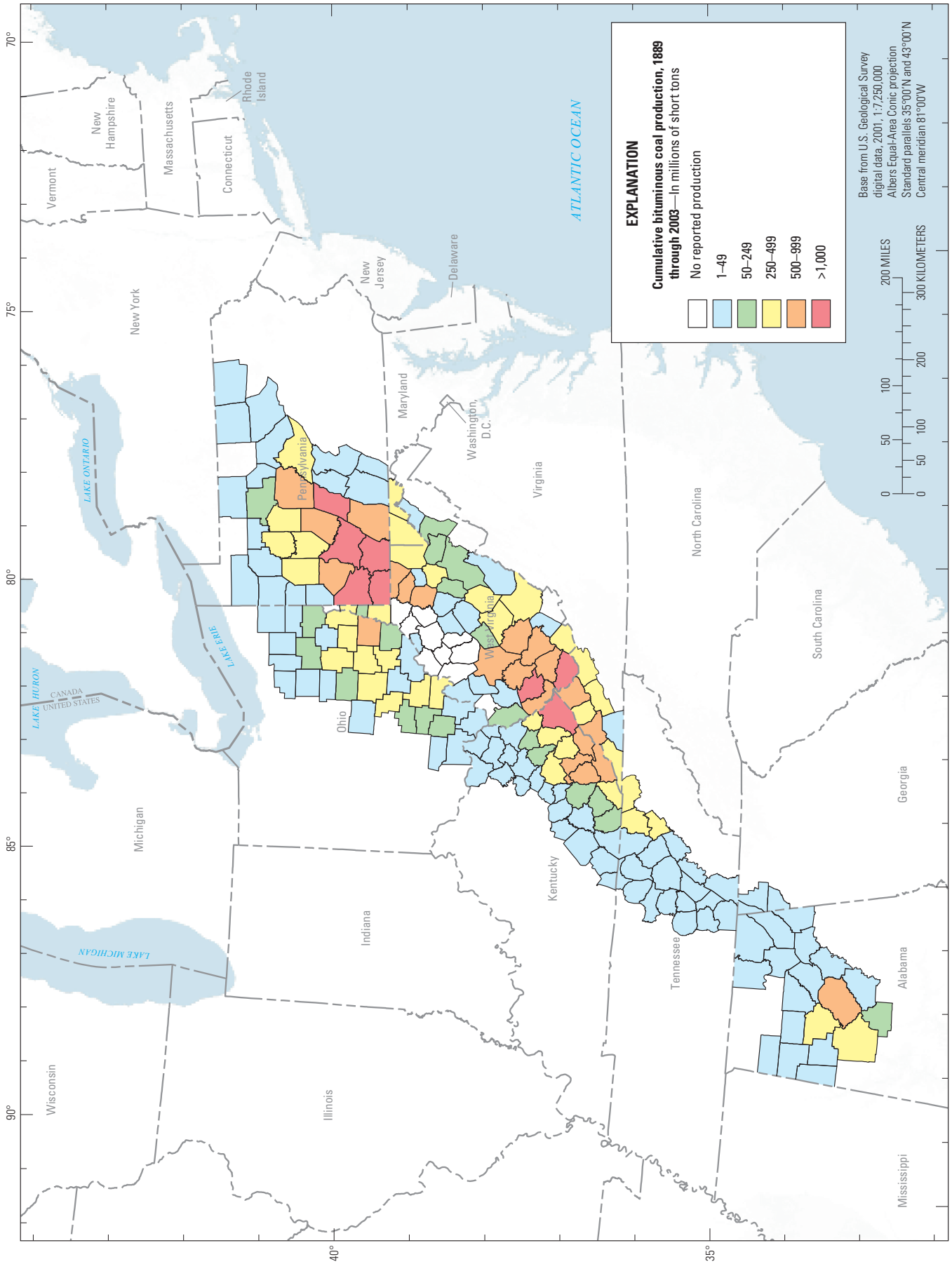
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Ohio
Kentucky
Tennessee
Michigan
Indiana
Illinois
Wisconsin
Alabama
Mississippi
Pennsylvania Anthracite region
Northern field
Eastern Middle field
Western Middle field
Southern field
North-Central field
Broad Top field
Windber field
Connellsville field
Georges Creek field
Meadow Branch field
Upper Potomac field
Main Bituminous field
Castleman basin
Lower Youghiogheny basin
Upper Youghiogheny basin
Northern West Virginia coal field
Southern West Virginia coal field
New River field
Pocahontas field
Southwest Virginia coal field
Northern Appalachian basin coal region
Central Appalachian basin coal region
Southern Appalachian basin coal region
Eastern Kentucky coal field
Wartburg basin
Southern Tennessee coal field
Northern Tennessee coal field
Lookout Mountain field
Sand Mountain field
Black Warrior coal field
Coosa field
Cahaba field
70°
75°
80°
85°
90°
40°
35°

Figure 5 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of the northern, central, and southern Appalachian coal regions, coal fields, and the Pennsylvania Anthracite region. The outcrop extent of the coal-bearing strata of the Appalachians has been informally subdivided into the northern, central, and southern Appalachian basin coal regions; the region boundaries are based on the characteristics of the sedimentary rocks and the coals. The boundary between the northern and central regions is based on the hinge line of Arkle (1974). It represents the approximate position of a hinge line separating the northern Appalachian basin coal region areas containing the younger (later Middle to Late Pennsylvanian) higher sulfur and higher ash coals typical of northern West Virginia, Ohio, Maryland, and Pennsylvania from the central Appalachian basin coal region containing outcrops of older (Early to early Middle Pennsylvanian), relatively low sulfur and low ash coals of southern West Virginia, western Virginia, and eastern Kentucky. Coal fields in Maryland and far eastern northern West Virginia are included in the northern Appalachian basin coal region. The boundary between the central and the southern Appalachian coal regions is placed at the southern margin of the Wartburg basin of Tennessee on the basis of structural and sedimentological features (Milici, 1974). Abundant coal resources of the Black Warrior, Cahaba, and Coosa fields of Alabama have historically been included within the Appalachian basin coal resource base as part of the southern Appalachian basin coal region. In addition, the Pennsylvania Anthracite region occurs only in the Valley and Ridge Province; however, it has historically been placed in the northern Appalachian basin coal region resource base. The traditional treatment is shown on this map.

Two types of coal fields occur in the northern Appalachian basin coal region: bituminous-rank fields and anthracite-rank fields. Coal in the southern and central regions is bituminous. Bituminous coal fields in the study area include the following: Main Bituminous, North-Central, Broad Top, and northern extension of the Upper Potomac (also called Georges Creek basin) coal fields in Pennsylvania; Upper Potomac coal field in Maryland and West Virginia (which in Maryland includes the Lower and Upper Youghiogheny basins and the Castleman and Georges Creek basins); Northern and Southern West Virginia coal fields in West Virginia; Southwest Virginia coal field in Virginia; Eastern Kentucky coal field in Kentucky; Northern, and Southern Tennessee coal fields in Tennessee; and the Black Warrior basin and the Sand Mountain, Lookout Mountain, Cahaba, and Coosa coal fields of Alabama. Ohio is not subdivided into coal fields or regions. Anthracite-rank fields include the Western Northern (not shown), Southern, Northern, Eastern Middle, and Western Middle anthracite fields in Pennsylvania.

Ruppert and others (this volume, chap. D.2) discuss the coal regions as part of a larger study on coal and marker bed correlations. Milici (this volume, chap D.3) quantifies past coal production and forecasts future coal production in the Appalachian basin coal regions (see fig. 6 of this chapter). Tewalt and Ruppert (this volume, chap. D.4) provide an overview on Appalachian basin coal assessments and current coal research within the USGS and the State geological surveys of Alabama, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.


EXPLANATION
Cumulative bituminous coal production, 1889 through 2003—In millions of short tons
No reported production
1–49
50–249
250–499
500–999
>1,000
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
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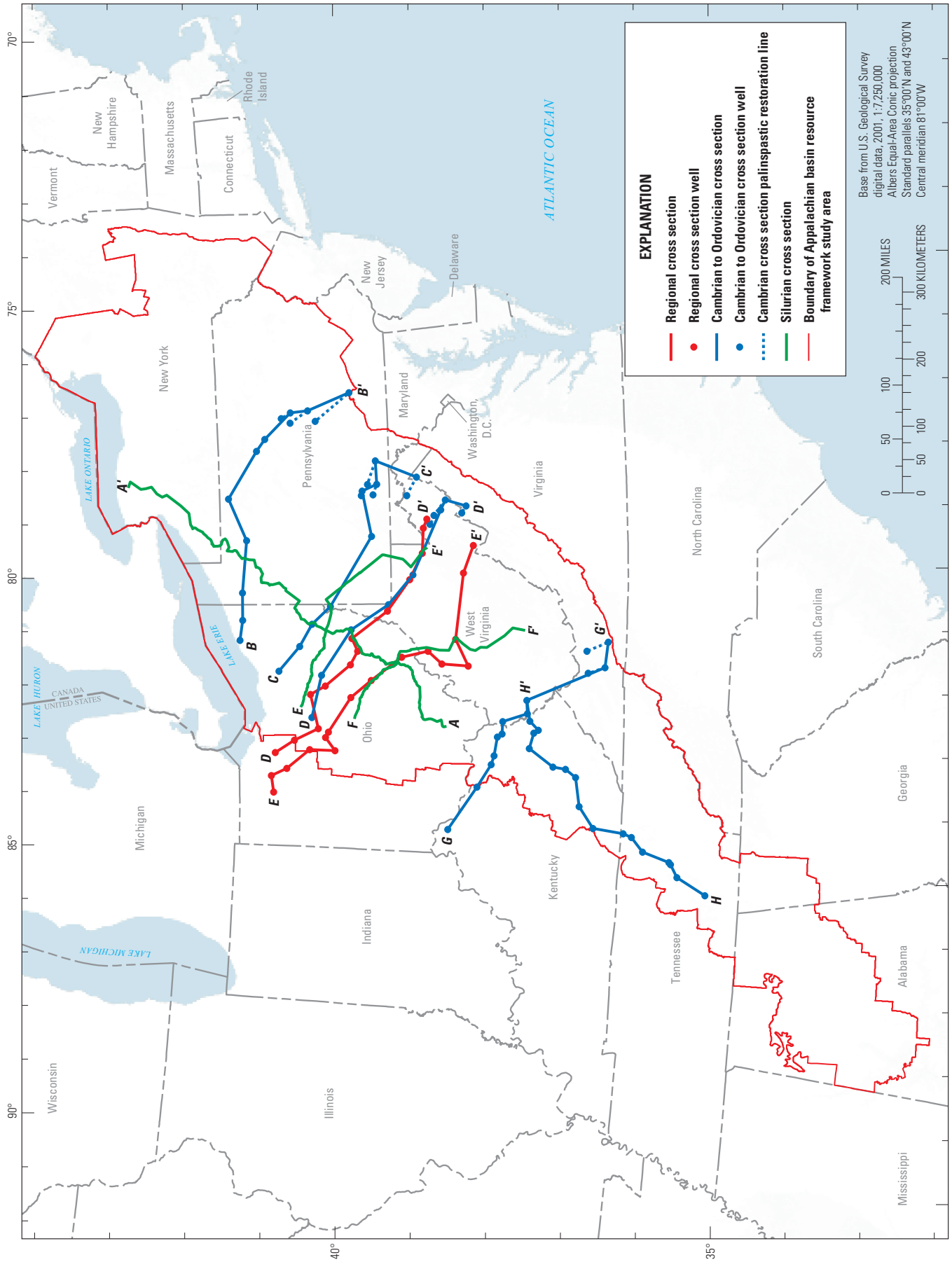
Delaware
Maryland
Washington, D.C.
Pennsylvania
Virginia
West Virginia
Ohio
Kentucky
Indiana
Michigan
Wisconsin
Illinois
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Tennessee
70°
75°
80°
85°
90°
40°
35°

Figure 6 (facing page). Index map of the Appalachian basin resource framework study area showing cumulative production of bituminous coal by county for the years 1899 through 2003. This map is one of a series of four maps by Milici and Polyak (this volume, chap. D.3) showing the following: (1) decade of maximum coal production by county, (2) amount (in short tons) of coal produced in each county during the decade of maximum coal production, (3) cumulative coal production by county for the years 1899 through 2003, and (4) annual coal production by county in 2003. These maps and the accompanying discussion, predictions, and tables in chapter D.3 are an update of Milici (1999). See figure 2 of this chapter for county names and the boundary of the study area.


EXPLANATION
Regional cross section
Regional cross section well
Cambrian to Ordovician cross section
Cambrian to Ordovician cross section well
Cambrian cross section palinspastic restoration line
Silurian cross section
Boundary of Appalachian basin resource framework study area
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
CANADA
UNITED STATES
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Washington, D.C.
Virginia
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Figure 7 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of 10 cross sections of regional extent through the subsurface of the Appalachian basin. The sections are shown and described in 11 papers by Robert T. Ryder and others (this volume, chap. E). The 10 cross sections are subdivided into three groups: (1) restored cross sections emphasizing Cambrian and Ordovician rocks (5 cross sections), (2) restored cross sections emphasizing Lower and Upper (part) Silurian rocks (3 cross sections), and (3) regional geologic (structural) cross sections illustrating the entire preserved section of Paleozoic rocks (2 cross sections). The stratigraphic units in the restored cross sections are constructed with respect to a horizontal lithologic datum, whereas the stratigraphic units in the geologic (structural) cross sections are constructed with respect to a sea-level datum. The control points for the cross sections are exploratory wells drilled for oil and gas; many of the wells reached igneous and metamorphic basement rocks of Mesoproterozoic age. Cambrian-Ordovician cross sections *B*–*B*′, *C*–*C*′, and *G*–*G*′ contain palinspastic reconstructions showing restoration to their original geographic position before deformation.

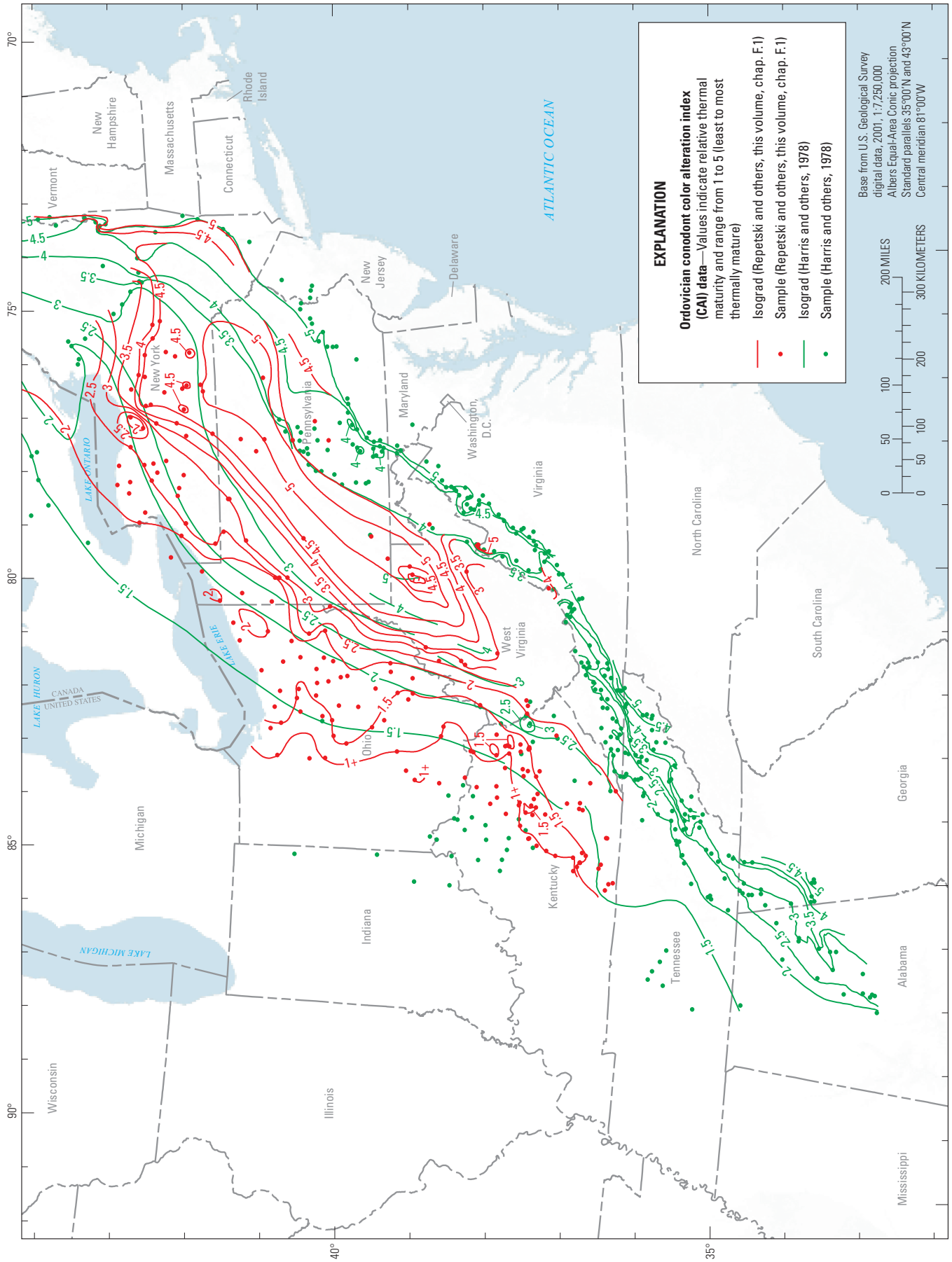
EXPLANATION
Ordovician conodont color alteration index (CAI) data—Values indicate relative thermal maturity and range from 1 to 5 (least to most thermally mature)
Isograd (Repetski and others, this volume, chap. F.1)
Sample (Repetski and others, this volume, chap. F.1)
Isograd (Harris and others, 1978)
Sample (Harris and others, 1978)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
ATLANTIC OCEAN
LAKE ONTARIO
LAKE ERIE
LAKE HURON
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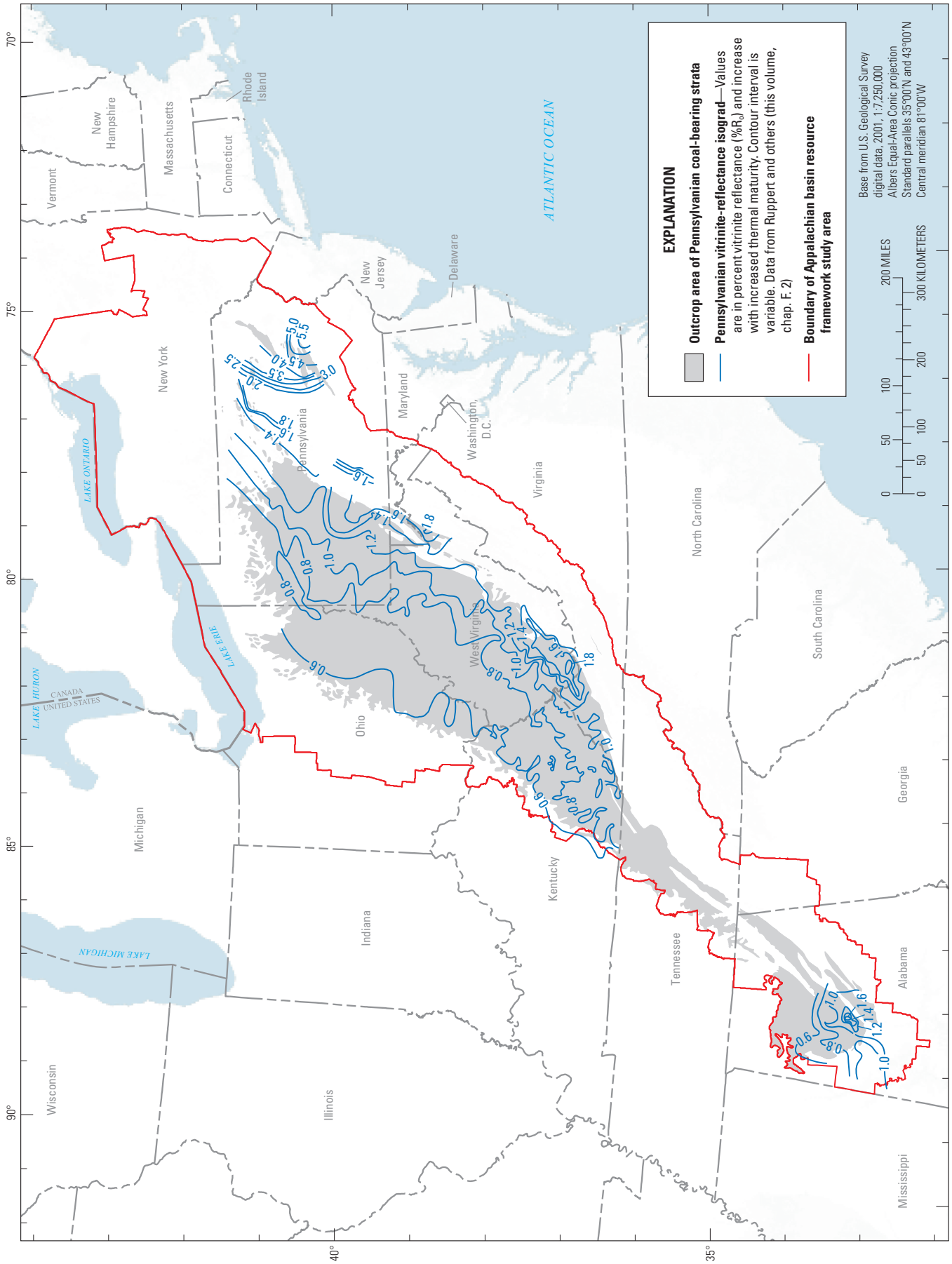
Figure 8 (facing page). Index map of the Appalachian basin resource framework study area showing conodont color alteration index (CAI) sample locations and interpreted isograds for Ordovician rocks; CAI data are from Harris and others (1978) and Repetski and others (this volume, chap. F.1). Repetski and others (this volume, chap. F.1) present new CAI isograd maps for Ordovician and Silurian through Middle Devonian carbonate rocks and maps showing reflectance of dispersed vitrinite in Middle and Upper Devonian black shales in the Allegheny Plateau structural province. The maps show data for all or parts of Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia and are used to interpret thermal history and address implications for the geology and petroleum resource potential of the Appalachian basin. See figure 1 of this chapter for the boundary of the study area. The new CAI isograd maps complement, and in some areas replace, the maps by Harris and others (1978) that show CAI isograds for Ordovician carbonate rocks and Silurian through Middle Devonian carbonate rocks in the Appalachian basin.


EXPLANATION
Outcrop area of Pennsylvanian coal-bearing strata
Pennsylvanian vitrinite-reflectance isograd—Values are in percent vitrinite reflectance (%R_o) and increase with increased thermal maturity. Contour interval is variable. Data from Ruppert and others (this volume, chap. F. 2)
Boundary of Appalachian basin resource framework study area
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
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Georgia
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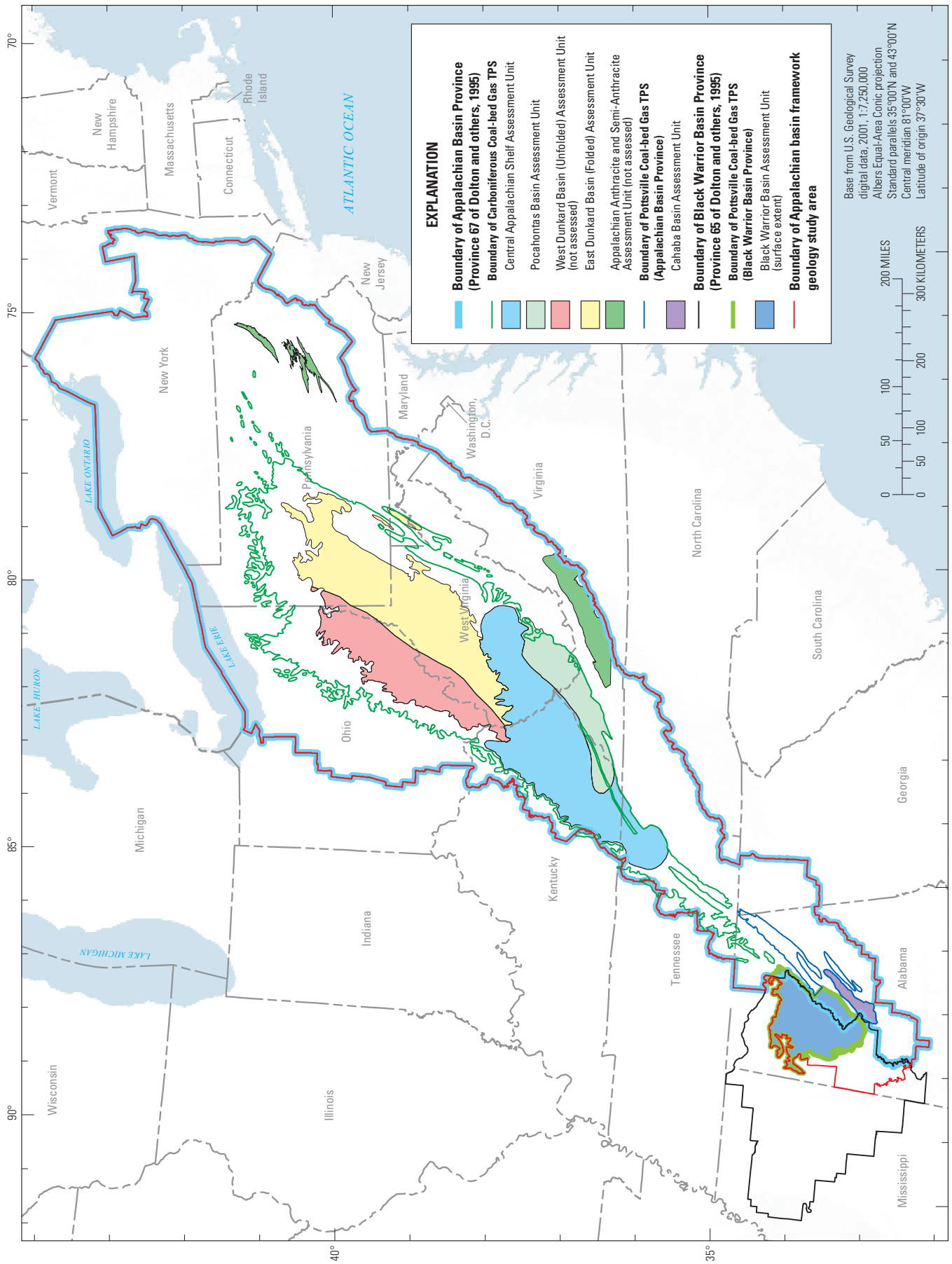
Figure 9 (facing page). Index map of the Appalachian basin resource framework study area showing interpreted isograds for percent vitrinite reflectance ($\%R_o$) for Pennsylvanian coal beds. For visual acuity, the approximately 2,800 sample locations are not shown. Isograd values range from 0.6 $\%R_o$ in Ohio and the west side of the Eastern Kentucky coal field to 5.5 $\%R_o$ in the Southern Anthracite field, Schuylkill County, Pennsylvania (see figs. 2 and 5 for county and coal field locations, respectively). This map and maps of Lower, Middle, and Upper Pennsylvanian coal beds in the Appalachian basin are used to interpret the thermal history and address implications for coalbed-methane potential in the Appalachian basin. The Pennsylvanian thermal maturity maps compiled for this study are provided and discussed in Ruppert and others (this volume, chap. F.2). They complement the conodont alteration index (CAI)-based thermal maturity maps for the Ordovician and Devonian rocks of Harris and others (1978) and Repetski and others (this volume, chap. F.1); see figure 8 of this chapter.


EXPLANATION
Boundary of Appalachian Basin Province (Province 67 of Dolton and others, 1995)
Boundary of Carboniferous Coal-bed Gas TPS
Central Appalachian Shelf Assessment Unit
Pocahontas Basin Assessment Unit
West Dunkard Basin (Unfolded) Assessment Unit (not assessed)
East Dunkard Basin (Folded) Assessment Unit
Appalachian Anthracite and Semi-Anthracite Assessment Unit (not assessed)
Boundary of Pottsville Coal-bed Gas TPS (Appalachian Basin Province)
Cahaba Basin Assessment Unit
Boundary of Black Warrior Basin Province (Province 65 of Dolton and others, 1995)
Boundary of Pottsville Coal-bed Gas TPS (Black Warrior Basin Province)
Black Warrior Basin Assessment Unit (surface extent)
Boundary of Appalachian basin framework geology study area
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
Latitude of origin 37°30'W
0 50 100 200 MILES
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Michigan
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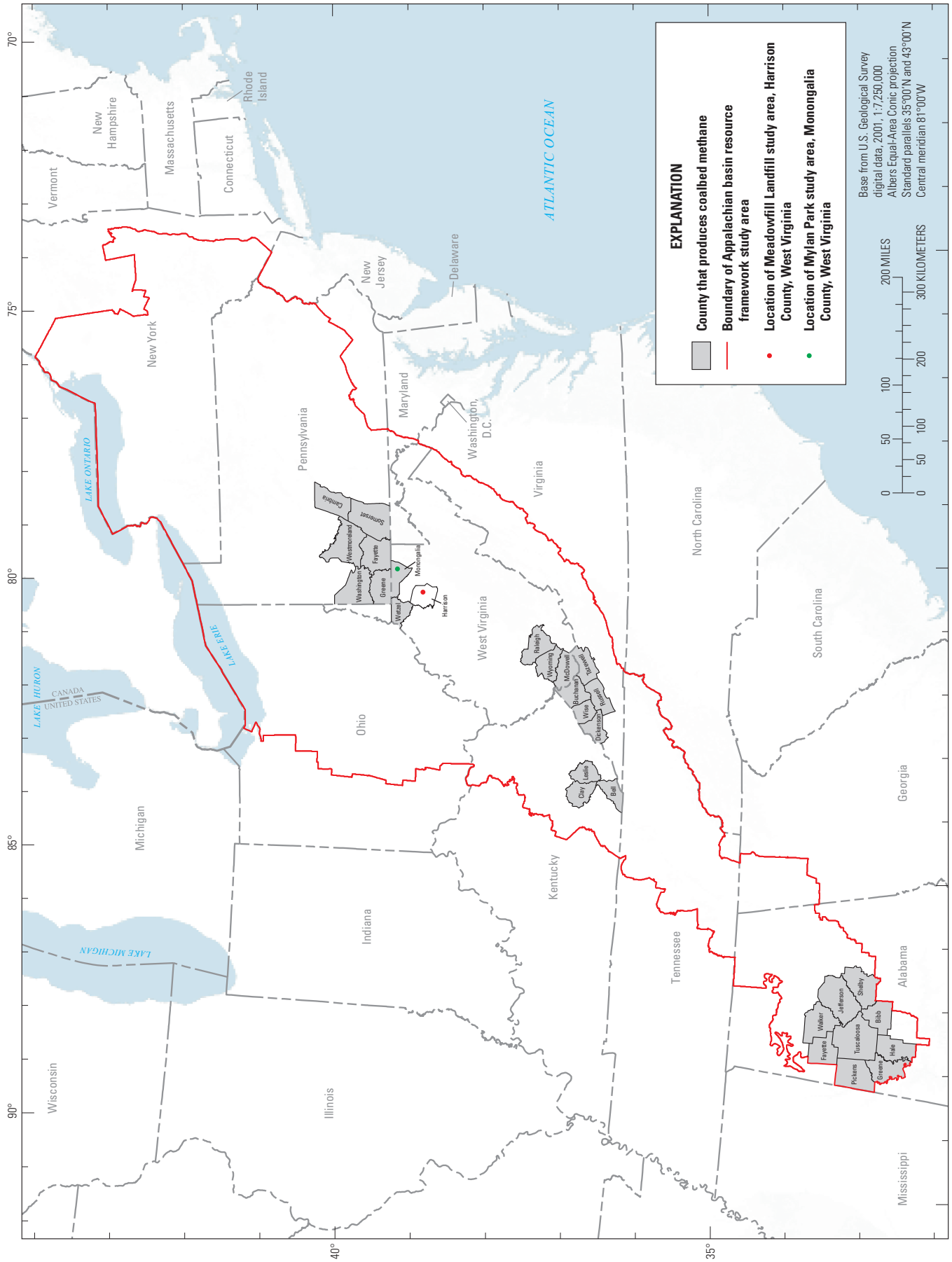
Figure 10 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of coalbed-methane (CBM) assessment units. During the 2002 National Oil and Gas Assessment (NOGA), the U.S. Geological Survey defined two assessment provinces that encompassed the southern and central parts of the Appalachian basin: the Appalachian Basin Province, which stretches from New York State to Alabama, and the Black Warrior Basin Province in Alabama and Mississippi. For assessment of CBM, the Appalachian Basin Province was divided into two total petroleum systems: the Carboniferous Coal-bed Gas Total Petroleum System (TPS) and the Pottsville Coal-bed Gas TPS. The Carboniferous Coal-bed Gas TPS consists of the following five assessment units (AUs): (1) the Pocahontas Basin AU in southern West Virginia, eastern Kentucky, and southwestern Virginia; (2) the Central Appalachian Shelf AU in Tennessee, eastern Kentucky, and southern West Virginia; (3) the East Dunkard (Folded) AU in western Pennsylvania and northern West Virginia; (4) the West Dunkard (Unfolded) AU in Ohio and adjacent parts of Pennsylvania and West Virginia; and (5) the Appalachian Anthracite and Semi-Anthracite AU in Pennsylvania and Virginia. Milici (this volume, chap. G.1) discusses geology and CBM production potential of the Carboniferous Coal-bed Gas TPS and the assessments reported by Milici and others (2003), Milici (2004), and Milici and Hatch (2004). The results of the assessment of undiscovered oil and gas resources of the Black Warrior Basin Province were released by Hatch and others (2003), Milici and Hatch (2004), and Hatch and Pawlewicz (2007, which includes an assessment of the Pottsville Coal-bed Gas TPS in the Black Warrior Basin Province).


EXPLANATION
County that produces coalbed methane
Boundary of Appalachian basin resource framework study area
Location of Meadowfill Landfill study area, Harrison County, West Virginia
Location of Mylan Park study area, Monongalia County, West Virginia
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
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Cambria
Somerset
Westmoreland
Fayette
Washington
Greene
Monongalia
Wetzel
Harrison
Raleigh
Wyoming
McDowell
Buchanan
Tazewell
Wise
Dickenson
Russell
Clay
Leslie
Bell
Shelby
Jefferson
Walker
Fayette
Tuscaloosa
Bibb
Pickens
Greene
Hale
90°
85°
80°
75°
70°
40°
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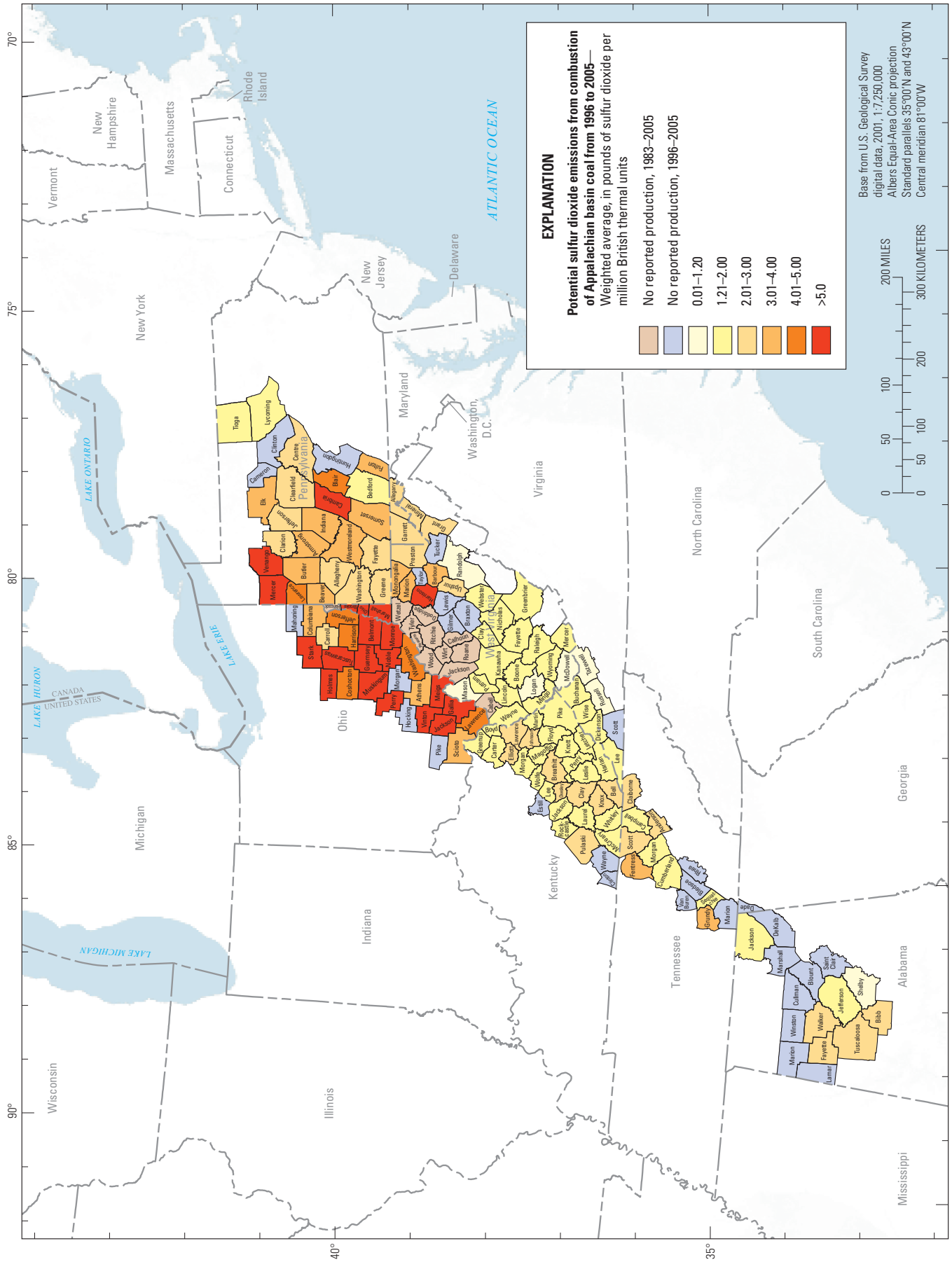
Figure 11 (facing page). Index map of the Appalachian basin resource framework study area showing counties producing coalbed methane (CBM). Milici and Polyak (this volume, chap. G.2 , which supersedes Milici, 2002) discuss CBM production and potential in the study area and suggest that although most of the CBM production occurs in the Pocahontas basin in Virginia and the Black Warrior basin (see fig. 10 of this chapter), potential exists throughout the study area. In addition to the CBM-producing counties, this map also shows the locations of two CBM wells discussed by Ruppert and others (this volume, chaps. G.3 and G.4).


EXPLANATION
Potential sulfur dioxide emissions from combustion of Appalachian basin coal from 1996 to 2005—Weighted average, in pounds of sulfur dioxide per million British thermal units
No reported production, 1983–2005
No reported production, 1996–2005
0.01–1.20
1.21–2.00
2.01–3.00
3.01–4.00
4.01–5.00
>5.0
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
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40°
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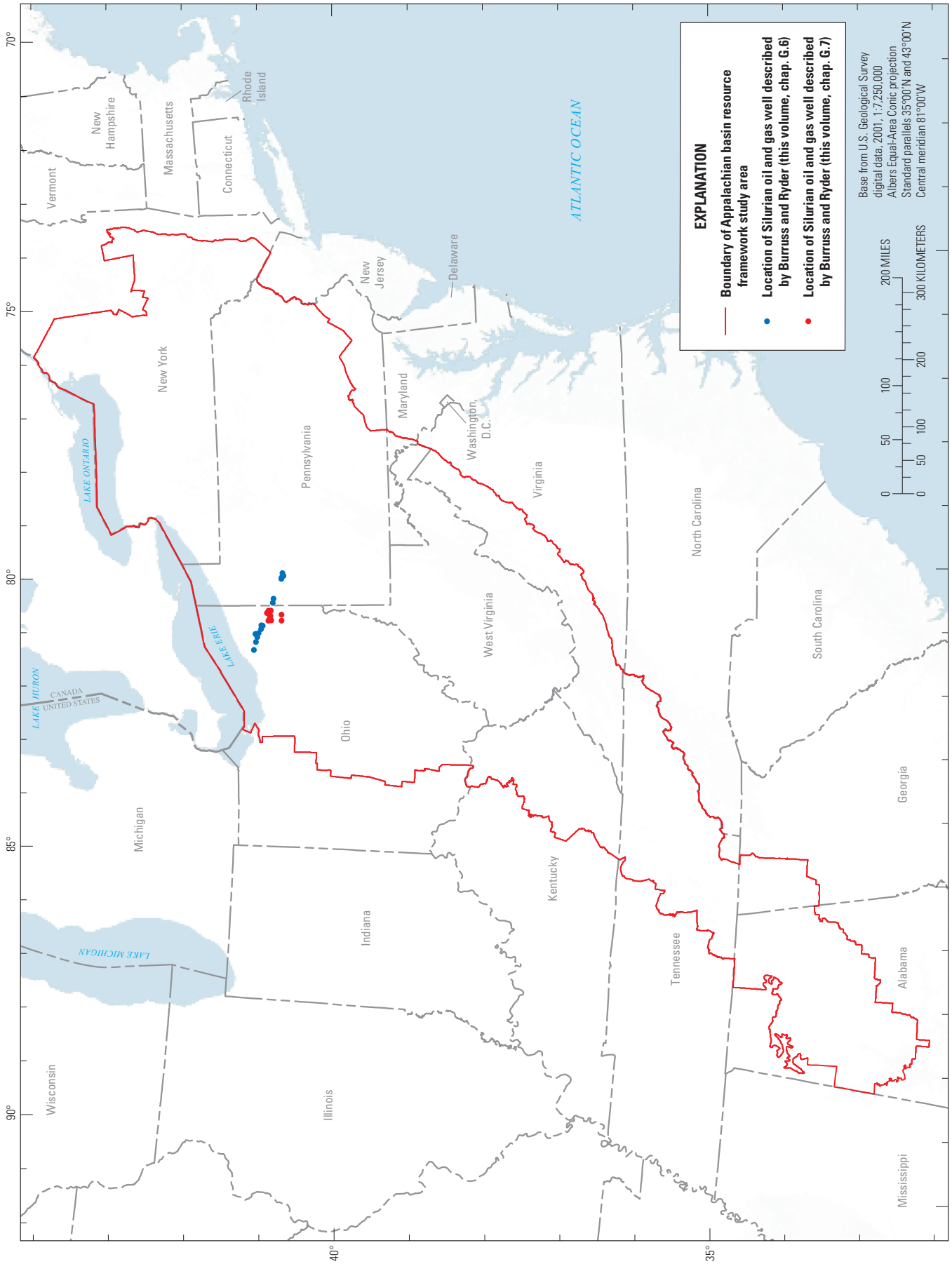
Figure 12 (facing page). Index map of the Appalachian basin resource framework study area showing potential sulfur dioxide emissions from combustion of coal delivered to powerplants from coal-producing counties for the years 1996 through 2005. The measured sulfur content of the coal is expressed as pounds of sulfur dioxide per million British thermal units (lbs SO_2/MMBtu). This map is one of four maps by Trippi and others (this volume, chap. G.5) updating maps by Attanasi and Milici (1998), which showed average sulfur content by county of coal delivered to powerplants for the years 1983 through 1995.


EXPLANATION
Boundary of Appalachian basin resource framework study area
Location of Silurian oil and gas well described by Burruss and Ryder (this volume, chap. G.6)
Location of Silurian oil and gas well described by Burruss and Ryder (this volume, chap. G.7)
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
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0 50 100 200 300 KILOMETERS
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Figure 13 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of wells in Geauga and Trumbull Counties, Ohio, and Mercer and Butler Counties, Pennsylvania, where oil and gas were sampled in Lower Silurian reservoirs. Burruss and Ryder (this volume, chap. G.6) discuss the origin and sources of 12 gas samples and 11 oil samples from 14 wells. In a companion paper, Burruss and Ryder (this volume, chap. G.7) examine the origin and sources of 10 oil and 3 gas samples from 10 additional wells in Trumbull County, Ohio. See figure 2 of this chapter for county names.

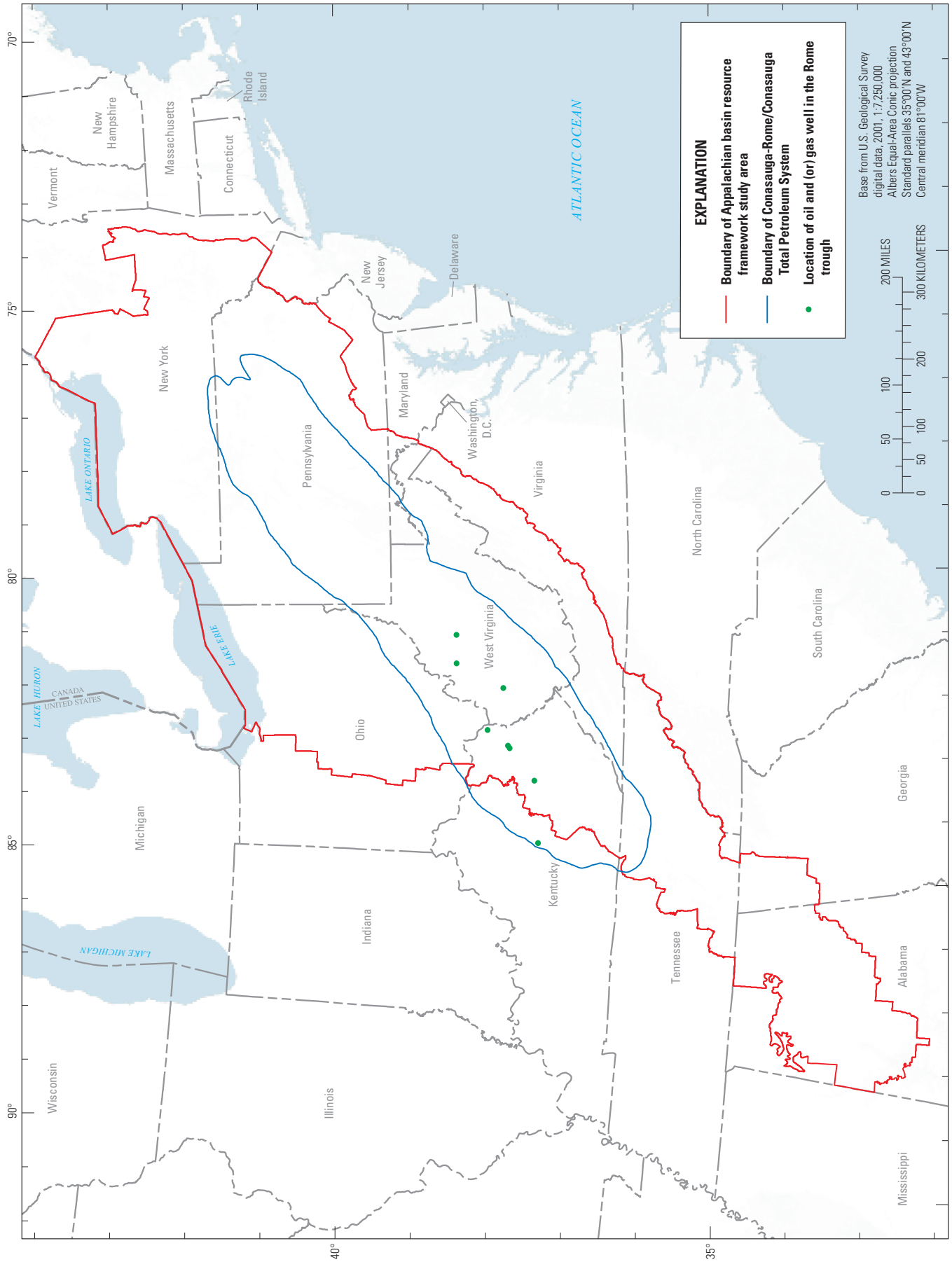
EXPLANATION
Boundary of Appalachian basin resource framework study area
Boundary of Conasauga-Rome/Conasauga Total Petroleum System
Location of oil and (or) gas well in the Rome trough
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
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Figure 14 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of the Conasauga-Rome/Conasauga Total Petroleum System and of selected wells in the Rome trough that had oil and gas production and shows. Ryder and others (this volume, chap. G.8) provide evidence confirming a new petroleum system in the Rome trough of Kentucky and West Virginia. The source rock is the Cambrian Conasauga Group, and reservoirs are in the Cambrian Rome Formation and Conasauga Group. Strata of the Conasauga Group occur as far south as Alabama but were not included in this total petroleum system.

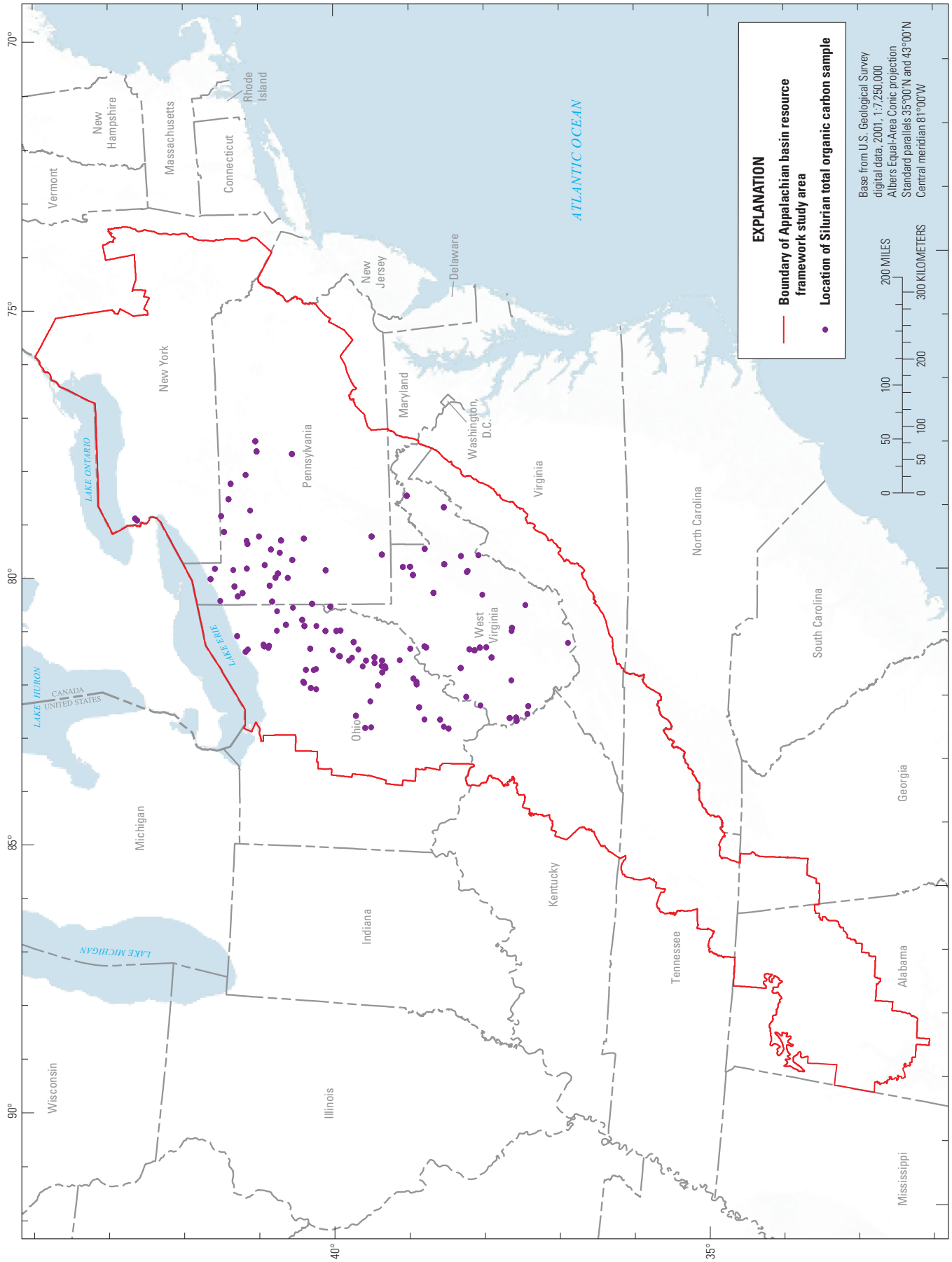
EXPLANATION
Boundary of Appalachian basin resource framework study area
Location of Silurian total organic carbon sample
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
0 50 100 200 300 KILOMETERS
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Figure 15 (facing page). Index map of the Appalachian basin resource framework study area showing the locations of samples from Silurian reservoirs in Kentucky, New York, Ohio, Pennsylvania, and West Virginia; the samples were analyzed for total organic carbon. Ryder and others (this volume, chap. G.11) evaluate the source rock potential of Silurian strata by using new total organic carbon and pyrolysis data; they conclude that only the Salina Group and the correlative Wills Creek Formation and Tonoloway Limestone have the potential for generating significant amounts of hydrocarbons.

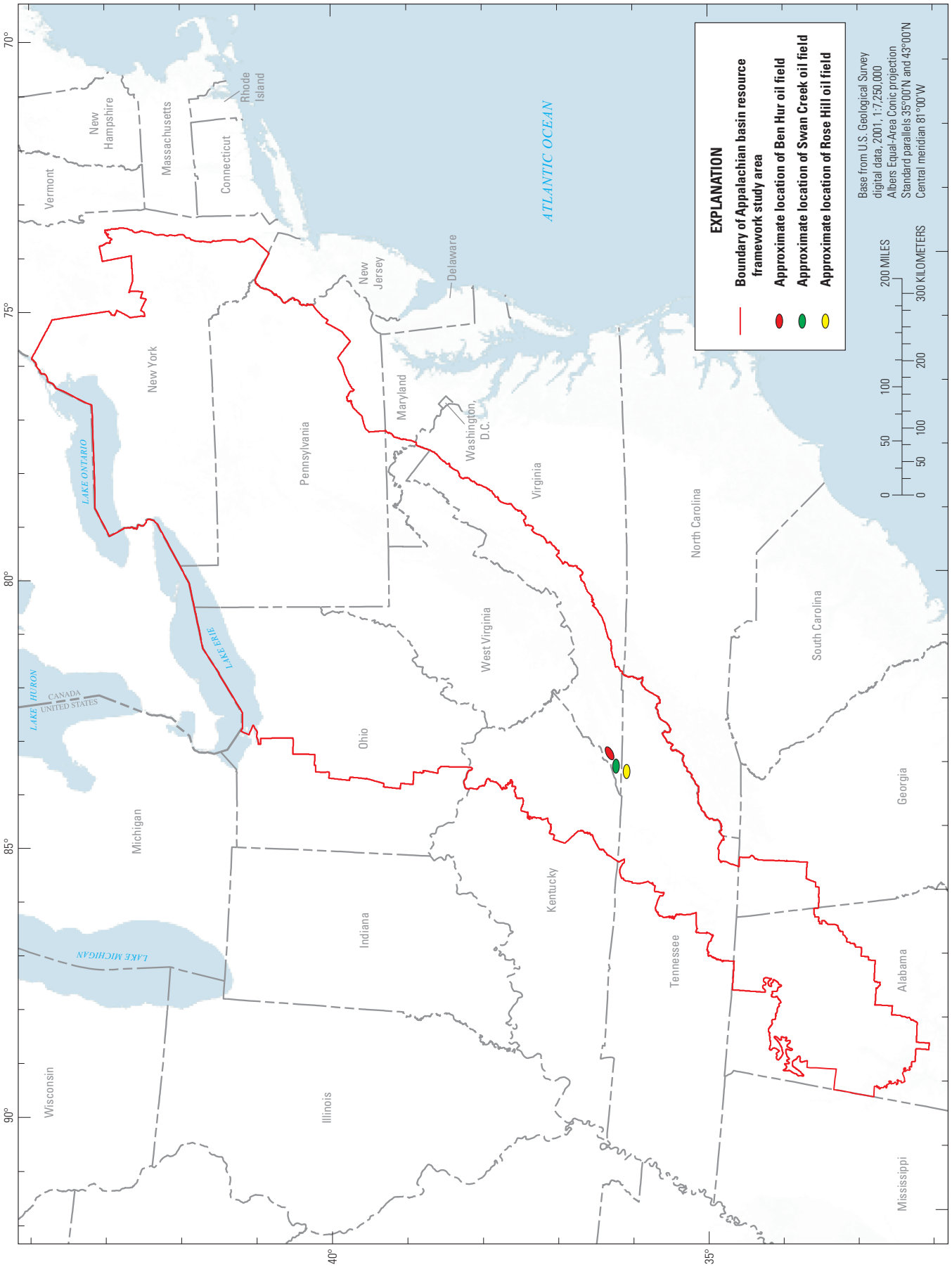
EXPLANATION
Boundary of Appalachian basin resource framework study area
Approximate location of Ben Hur oil field
Approximate location of Swan Creek oil field
Approximate location of Rose Hill oil field
Base from U.S. Geological Survey digital data, 2001, 1:7,250,000
Albers Equal-Area Conic projection
Standard parallels 35°00'N and 43°00'N
Central meridian 81°00'W
0 50 100 200 MILES
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Figure 16 (facing page). Index map of the Appalachian basin resource framework study area showing the approximate locations of the Ben Hur and Rose Hill oil fields, Lee County, Virginia, and the Swan Creek oil field, Hancock and Claiborne Counties, Tennessee. See figure 2 of this chapter for county names. Dennen and others (this volume, chap. G.12) discuss the molecular and isotopic composition of oil and gas in 17 wells from the Cambrian-Ordovician Knox Group and the Middle Ordovician Stones River and Trenton Groups in the Cumberland overthrust sheet.