

Coal and Coalbed-Methane Resources in the Appalachian and Black Warrior Basins—Maps Showing the Distribution of Coal Fields, Coal Beds, and Coalbed- Methane Fields

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

Chapter D.1 of

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Distribution, Geologic Framework, and Geochemical Character**

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Conversion Factors

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
	Mass	
ton, short (2,000 lb)	0.9072	megagram (Mg)

Horizontal coordinate information is referenced to North American Datum of 1927 (NAD 27).

Coal and Coalbed-Methane Resources in the Appalachian and Black Warrior Basins—Maps Showing the Distribution of Coal Fields, Coal Beds, and Coalbed-Methane Fields

By Michael H. Trippi,¹ Leslie F. Ruppert,¹ Robert C. Milici,¹ and Scott A. Kinney²

Introduction

The maps contained in this chapter show the locations of coal fields, coal beds assessed by the U.S. Geological Survey (USGS) in 2000, and coalbed-methane fields in the central and southern Appalachian basin study areas, which include the coal-producing parts of the Black Warrior basin. The maps were compiled and modified from a variety of sources such as Tully (1996), Northern and Central Appalachian Basin Coal Regions Assessment Team (2001), Hatch and others (2003), Milici (2004), and unpublished data from the State geological surveys of Pennsylvania, West Virginia, Virginia, and Alabama. The terms “coalbed methane” and “coal-bed gas” are used interchangeably in this report. All of the figures are located at the end of this report.

The Appalachian basin historically has been subdivided into three coal regions on the basis of regional geologic structure and stratigraphy: the northern region in western Pennsylvania, eastern Ohio, western Maryland, and northern West Virginia; the central region in west-central and south-western West Virginia, eastern Kentucky, northern Tennessee, and southwestern Virginia; and the southern region in southern Tennessee, northern Alabama, and northwestern Georgia. The Appalachian basin is one of the most important coal-producing regions in the Nation and the world, and coal has been mined there throughout the last three centuries. The coal is primarily used within the Eastern United States for electrical power generation, but some of it is suitable for metallurgical uses. In 2008, the Appalachian basin produced about 320 million short tons of coal from 1,278 underground and surface coal mines (Energy Information Agency, 2009a).

Coalbed-methane production in the Appalachian basin coal regions is an increasingly important resource. In 2008, 247 billion cubic feet (bcf) of coalbed methane was produced

in the basin from Alabama (107 bcf), Virginia (101 bcf), West Virginia (28 bcf), and Pennsylvania (11 bcf) (Energy Information Agency, 2009b). Coalbed-methane exploration is ongoing in all of the States in the Appalachian basin coal regions, and production is expected to increase.

The study area for most reports in this volume is the Appalachian basin. The term “Appalachian basin study area” (shortened from “Appalachian basin geologic framework study area”) includes all of the Appalachian Basin Province (Province 67) and part of the neighboring Black Warrior Basin Province (Province 65) of Dolton and others (1995). The boundaries for these two provinces and the study area are shown on figure 1.

Coal Regions and Fields

Two types of coal fields occur in the northern Appalachian basin coal region: bituminous-rank fields and anthracite-rank fields (fig. 1). Bituminous-rank coal fields include (1) the Main Bituminous, North-Central, Broad Top, and Georges Creek coal fields of Pennsylvania; (2) the Upper Potomac, Georges Creek, Lower and Upper Youghiogheny, and Castleman coal basins of Maryland and West Virginia; and (3) the Northern West Virginia coal field. Ohio bituminous coal regions are located in the northern Appalachian basin coal region but are not subdivided into coalfields or regions. Anthracite-rank fields include the Southern, Northern, Eastern Middle, and Western Middle anthracite fields of Pennsylvania. The central Appalachian basin coal region contains only bituminous-rank fields, including (1) the Southern West Virginia coal field, (2) the Eastern Kentucky coal field, (3) the Southwest Virginia coal field, and (4) the Northern Tennessee coal field. The southern Appalachian basin coal region also contains only bituminous-rank coal fields, including (1) the Southern Tennessee coal field and (2) the Black Warrior basin and the Sand Mountain, Lookout Mountain, Cahaba, and Coosa fields of Alabama and part of Georgia.

¹U.S. Geological Survey, Reston, Va.

²U.S. Geological Survey, Denver, Colo.

Coal Beds or Zones

The USGS assessed four coal beds and two coal zones in 2000 (Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001, and reports contained therein). Except for the Lower Kittanning coal bed, each assessment includes the following information: (1) maps (including shapefiles and metadata) showing the areal extent of the coal bed, mined areas, structure contours, overburden thickness, and geochemical parameters; (2) reports on the geology and mining history of the coal bed; and (3) tables of data on the original and remaining resources by overburden, reliability, and coal-bed-thickness categories and by State and county. The Lower Kittanning coal bed assessment only includes maps showing its areal extent and geochemical parameters and a history of the mining of the coal bed.

Pittsburgh Coal Bed

The results of the Pittsburgh coal bed assessment (Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001; Tewalt, Ruppert, Bragg, Carlton, and others, 2001) indicate that of the original 34 billion short tons (bst) of coal, 16 bst remain after more than 200 years of mining (fig. 2). Previously mined coal had a mean thickness of 7.0 ft and was found at depths less than 1,000 ft. Although most of the remaining coal is thinner (less than 3.5 ft thick) and deeper (greater than 1,000 ft), there are blocks of extensive, 6- to 8-ft-thick coal beds in southwestern Pennsylvania and the northern panhandle of West Virginia that have not yet been mined.

Upper Freeport Coal Bed

The results of the Upper Freeport coal bed assessment (Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001; Ruppert, Tewalt, Wallack, and others, 2001) indicate that of the original 93 bst of coal, 66 bst remain after more than 150 years of mining (fig. 3). Most of the remaining coal is thinner, deeper, and higher in ash yield and sulfur content than previously mined coal.

Lower Kittanning Coal Bed

The Lower Kittanning coal bed (fig. 4) was not quantitatively assessed because mine maps were not compiled and correlated stratigraphic data were not available, but the coal bed report includes the following information: (1) maps of the areal extent of the coal bed and its geochemical parameters and (2) reports on the geology and mining history of the coal bed (Milici, Freeman, Carlton, and others, 2001; Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001). Results indicate that significant resources of this coal

bed remain. The remaining coal is characterized by a medium ash yield and a medium to high sulfur content.

Fire Clay Coal Zone

The results of the Fire Clay coal zone assessment (Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001; Tewalt, Ruppert, Bragg, and others, 2001) indicate that of the original 6.3 bst of coal, 5.1 bst remain after more than 125 years of mining (fig. 5). Most of the remaining coal is thinner and deeper than previously mined coal.

Pond Creek Coal Zone

The results of the Pond Creek coal zone assessment (Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001; Ruppert, Tewalt, Bragg, and others, 2001) indicate that of the original 11 bst of coal, 8.7 bst remain after more than 130 years of mining (fig. 6). Most of the remaining coal is thinner and deeper than previously mined coal.

Pocahontas No. 3 Coal Bed

The results of the Pocahontas No. 3 coal bed assessment (Milici, Freeman, and Bragg, 2001; Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001) indicate that of the original 7.2 bst of coal, 5.1 bst remain after more than 125 years of mining (fig. 7). Most of the remaining coal is thinner and deeper than previously mined coal and more costly to mine. Also, the Pocahontas No. 3 coal bed is a significant coalbed-methane resource.

Coal-Bed Gas Total Petroleum Systems and Assessment Units

The USGS, under the National Oil and Gas Assessment (NOGA) project, assessed the Carboniferous Coal-bed Gas Total Petroleum System (TPS) in the northern and central parts of the Appalachian Basin Province in 2002 (Milici and others, 2003; Milici, 2004; Milici and Hatch, 2004). Five assessment units (AU) were studied and evaluated by Milici (2004): (1) the Pocahontas Basin AU in southwestern Virginia, southern West Virginia, and eastern Kentucky; (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 (fig. 8).

The USGS also assessed the Pottsville Coal-bed Gas TPS in 2002 (Milici and others, 2003; Milici, 2004; Milici and Hatch, 2004). The Pottsville Coal-bed Gas TPS is found in both the Appalachian Basin Province and in the neighboring Black Warrior Basin Province (fig. 8); only the Cahaba Basin AU, in the Appalachian Basin Province was assessed for coalbed methane. Milici (this volume, chap. G.1) discusses the geology, coalbed-methane-production potential, and assessment results of the Carboniferous Coal-bed Gas TPS and the Pottsville Coal-bed Gas TPS in the Appalachian Basin Province.

For the 2002 USGS Oil and Gas Assessment of the Black Warrior Basin Province, Hatch and others (2003) defined the Pottsville Coal-bed Gas TPS and assessed the coalbed-methane resources in the Black Warrior basin AU (fig. 8). The results of the assessment of undiscovered coalbed-methane resources of the Black Warrior Basin Province were initially released by Hatch and others (2003) and later by Milici and Hatch (2004) and U.S. Geological Survey Black Warrior Basin Assessment Team and others (2007). Details of that assessment are not included in this volume, but can be found in U.S. Geological Survey Black Warrior Basin Assessment Team (2007).

Coalbed Methane

Milici and Polyak (this volume, chap. G.2) discuss coalbed-methane production and potential resources throughout the study area and suggest that although most of the coalbed-methane production occurs in the Pocahontas Basin AU in Virginia (fig. 8) and the Black Warrior Basin AU in Alabama (fig. 8), the potential for additional coalbed-methane resources exists throughout the study area. Figure 9 shows that the following three types of coal either contain coalbed methane or have the potential to produce it: (1) anthracite and semi-anthracite, (2) low-volatile bituminous, and (3) medium- and high-volatile bituminous.

Figures 10 through 16 are small- and large-scale maps showing locations of coalbed-methane wells and fields within the study area. Data used to show these well locations were provided by A.K. Markowski (Pennsylvania Geological Survey, written commun., 2007); K.L. Avary (West Virginia Geological and Economic Survey, written commun., 2007), R.C. Milici (unpublished data compiled by J.E. Nolde (independent consultant, Charlottesville, Va.) for Milici in 2007), and J.C. Pashin (Geological Survey of Alabama, written commun., 2007). The outlines of the coalbed-methane fields in Pennsylvania, West Virginia, and Virginia were hand drawn by the authors using the above-named sources. Coalbed-methane-field outlines in Alabama were provided by J.C. Pashin (Geological Survey of Alabama, written commun., 2007).

References Cited

- Dolton, G.L., Varnes, K.L., Gautier, D.L., and Barnett, D.L., 1995, Oil and gas resources assessment areas, 1995, lower 48 States: U.S. Geological Survey Open-File Report 95-75-I, 1 sheet, scale 1:5,000,000.
- Energy Information Agency, 2009a, Annual Coal Report 2008: Washington, D.C., U.S. Department of Energy, 77 p., accessed December 10, 2012, at <http://www.eia.gov/coal/annual/archive/05842008.pdf>.
- Energy Information Agency, 2009b, Coalbed methane production 2003–2008: Washington, D.C., U.S. Department of Energy Web page accessed December 10, 2012, at http://www.eia.gov/dnav/ng/ng_prod_coalbed_s1_a.htm.
- 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., 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/>).
- Milici, R.C., 2004, Assessment of Appalachian basin oil and gas resources; Carboniferous Coal-bed Gas Total Petroleum System: U.S. Geological Survey Open-File Report 2004-1272, 98 p., available only online at <http://pubs.usgs.gov/of/2004/1272/>.
- Milici, R.C., Freeman, P.A., Carlton, R.W., Bragg, L.J., Butler, D.T., and Tewalt, S.J., 2001, Geology and geochemistry of the Middle Pennsylvanian Lower Kittanning coal bed, Allegheny Group, northern Appalachian Basin coal region, chap. E of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 67 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>).
- Milici, R.C., Freeman, P.A., and Bragg, L.J., 2001, A digital resource model of the Lower Pennsylvanian Pocahontas No. 3 coal bed, Pottsville Group, central Appalachian Basin coal region, chap. H of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 57 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>).

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- Milici, R.C., Ryder, R.T., Swezey, C.S., Charpentier, R.R., Cook, T.A., Crovelli, R.A., Klett, T.R., Pollastro, R.M., and Schenk, C.J., 2003, Assessment of undiscovered oil and gas resources of the Appalachian Basin Province, 2002: U.S. Geological Survey Fact Sheet FS-009-03, 2 p. (Also available online at <http://pubs.usgs.gov/fs/fs-009-03/>.)
- Milici, R.C., and Hatch, J.R., 2004, Assessment of undiscovered Carboniferous coal-bed gas resources of the Appalachian Basin and Black Warrior Basin Provinces, 2002: U.S. Geological Survey Fact Sheet 2004-3092, 2 p. (Also available online at <http://pubs.usgs.gov/fs/2004/3092/>.)
- Northern and Central Appalachian Basin Coal Regions Assessment Team, 2001, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 10 chapters, 592 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>.)
- Ruppert, L.F., Tewalt, S.J., Wallack, R.N., Bragg, L.J., Brezinski, D.K., Carlton, R.W., Butler, D.T., and Calef, F.J., III, 2001, A digital resource model of the Middle Pennsylvanian Upper Freeport coal bed, Allegheny Group, northern Appalachian Basin coal region, chap. D of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 97 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>.)
- Ruppert, L.F., Tewalt, S.J., Bragg, L.J., Weisenfluh, G.A., Thacker, E.E., Blake, B.M., Jr., Sites, R.S., Freeman, P.A., Butler, D.T., and Bryant, L.C., 2001, A digital resource model of the Middle Pennsylvanian Pond Creek coal zone, Pottsville Group, central Appalachian Basin coal region, chap. G of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 88 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>.)
- Tewalt, S.J., Ruppert, L.F., Bragg, L.J., Carlton, R.W., Brezinski, D.K., Wallack, R.N., and Butler, D.T., 2001, A digital resource model of the Upper Pennsylvania Pittsburgh coal bed, Monongahela Group, northern Appalachian Basin coal region, chap. C of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 102 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>.)
- Tewalt, S.J., Ruppert, L.F., Bragg, L.J., Weisenfluh, G.A., Thacker, E.E., Sites, R.S., Blake, B.M., Jr., Freeman, P.A., Bryant, L.C., and Butler, D.T., 2001, A digital resource model of the Middle Pennsylvanian Fire Clay coal zone, Pottsville Group, central Appalachian Basin coal region, chap. F of Northern and Central Appalachian Basin Coal Regions Assessment Team, 2000 resource assessment of selected coal beds and zones in the northern and central Appalachian Basin coal regions (ver. 1.0): U.S. Geological Survey Professional Paper 1625-C, 72 p., spatial data, 2 CD-ROMs. (Version 1.01 available online at <http://pubs.usgs.gov/pp/p1625c/>.)
- Tully, John, compiler, 1996, Coal fields of the conterminous United States: U.S. Geological Survey Open-File Report 96-92, 1 sheet, scale: 1:5,000,000, available only online at <http://pubs.usgs.gov/of/1996/of96-092/>.
- U.S. Geological Survey Black Warrior Basin Province Assessment Team, Hatch, J.R., and Pawlewicz, M.J., compilers, 2007, Geologic assessment of undiscovered oil and gas resources of the Black Warrior Basin Province, Alabama and Mississippi: U.S. Geological Survey Digital Data Series DDS-69-I, 5 chapters, 76 p., 1 CD-ROM. (Also available online at <http://pubs.usgs.gov/dds/dds-069/dds-069-i/>.)

Figures 1–16

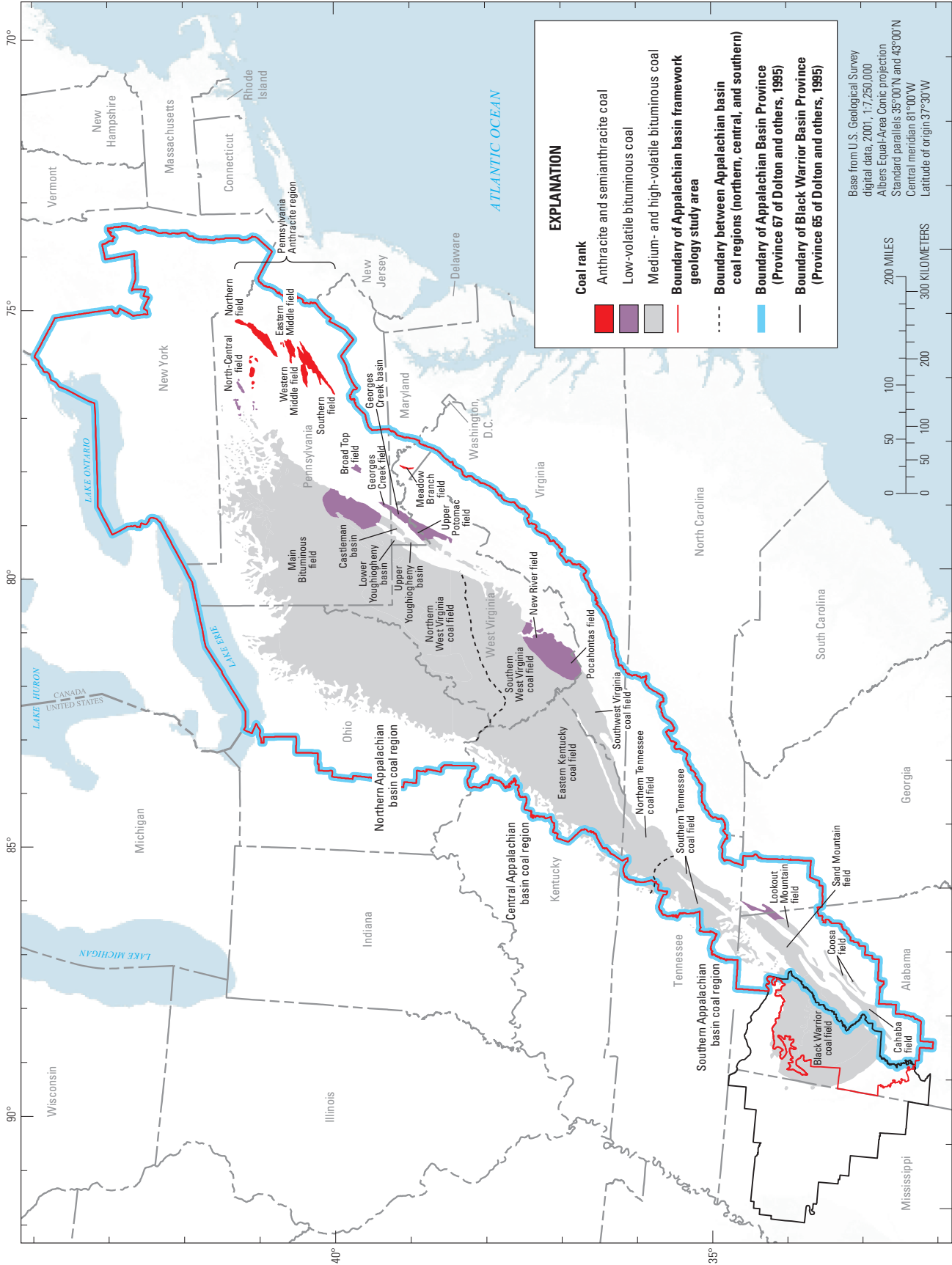


Figure 1. Map showing coal regions and fields in the Appalachian basin study area. Shapefiles and related metadata for this map can be queried and downloaded from Trippi and others (this volume, chap. 1.1). D.C., District of Columbia.

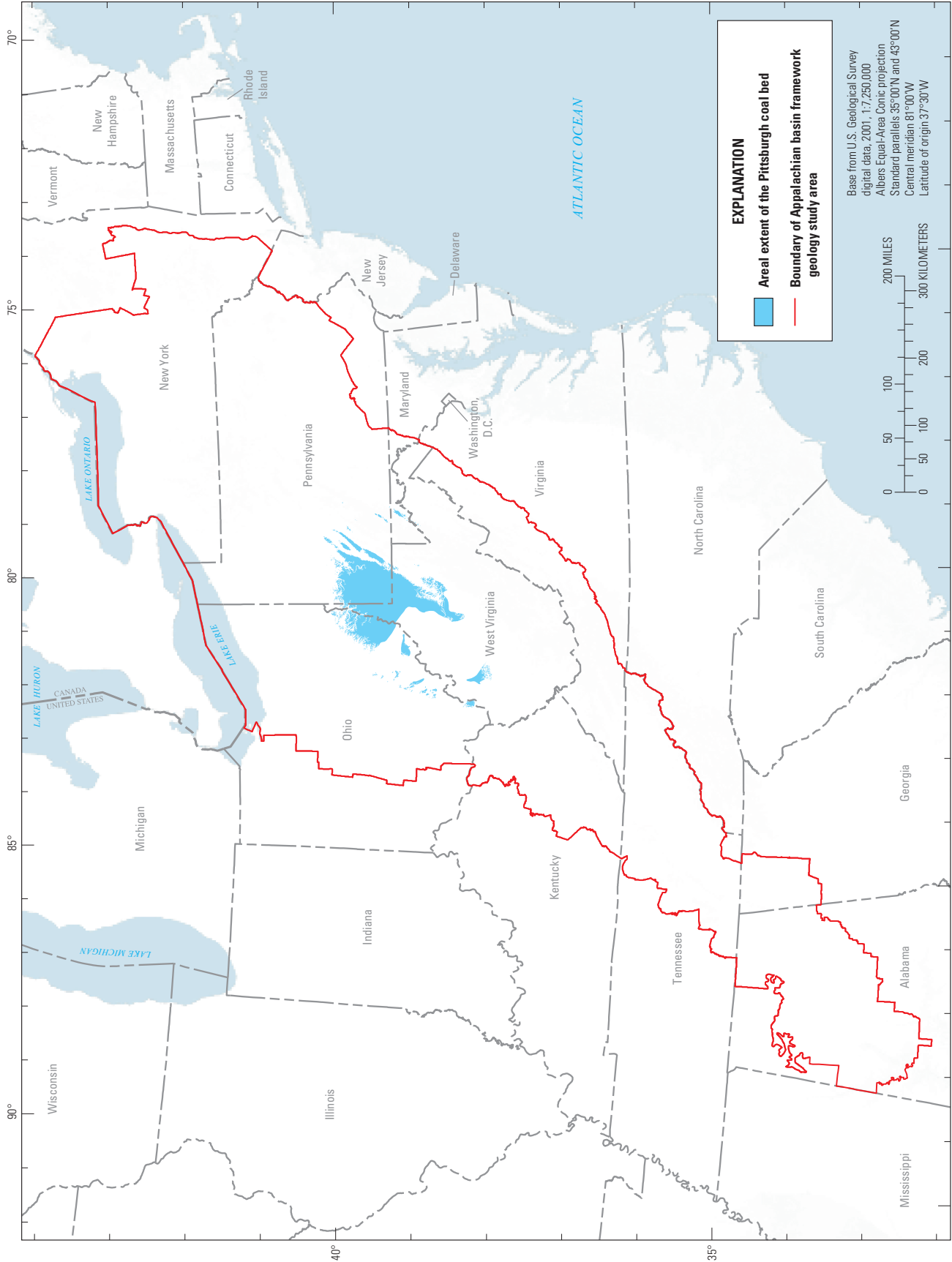


Figure 2. Map showing the areal extent of the Upper Pennsylvanian Pittsburgh coal bed of the Monongahela Group in the Appalachian basin study area. Shapefiles and metadata for the Pittsburgh coal bed assessment can also be downloaded from Trippi and others (this volume, chap. I.1). D.C., District of Columbia.

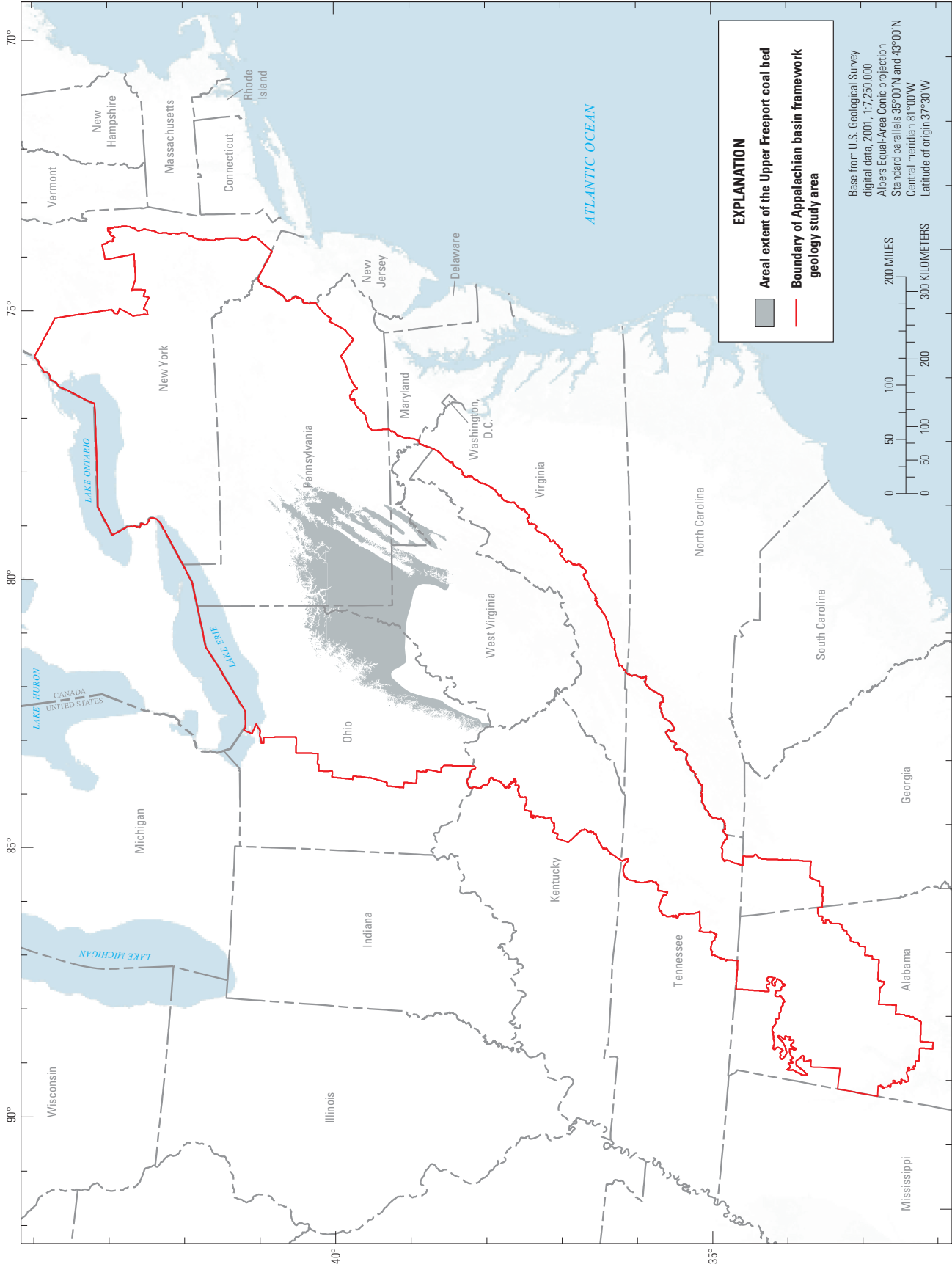


Figure 3. Map showing the areal extent of the Middle Pennsylvanian Upper Freeport coal bed of the Allegheny Group in the Appalachian basin study area. Shapefiles and metadata for the Upper Freeport coal bed assessment can also be downloaded from Trippi and others (this volume, chap. 1.1). D.C., District of Columbia.

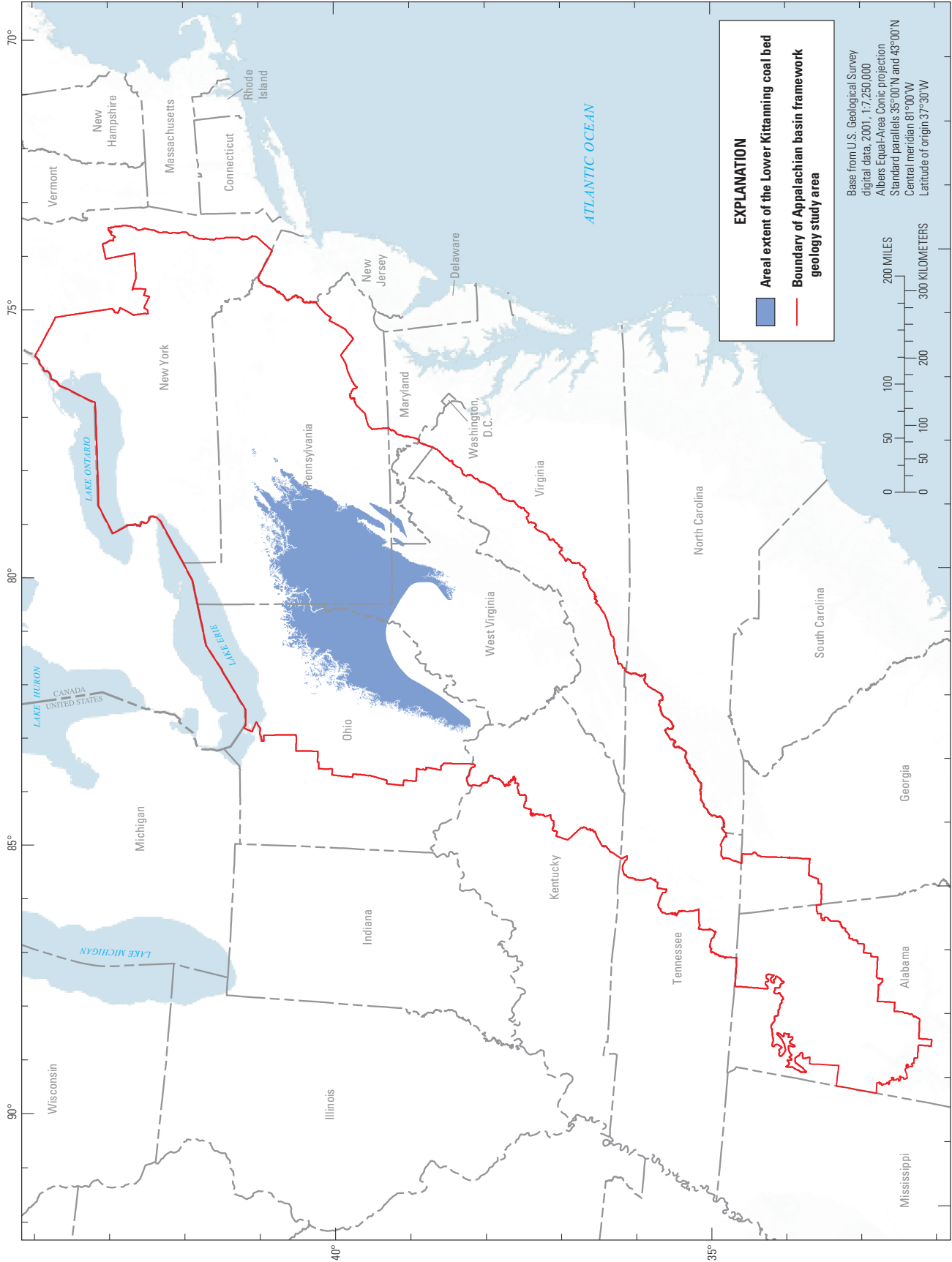


Figure 4. Map showing the areal extent of the Middle Pennsylvanian Lower Kittanning coal bed of the Allegheny Group in the Appalachian basin study area. Shapefiles and metadata for the Lower Kittanning coal bed can also be downloaded from Trippi and others (this volume, chap. I.1). D.C., District of Columbia.

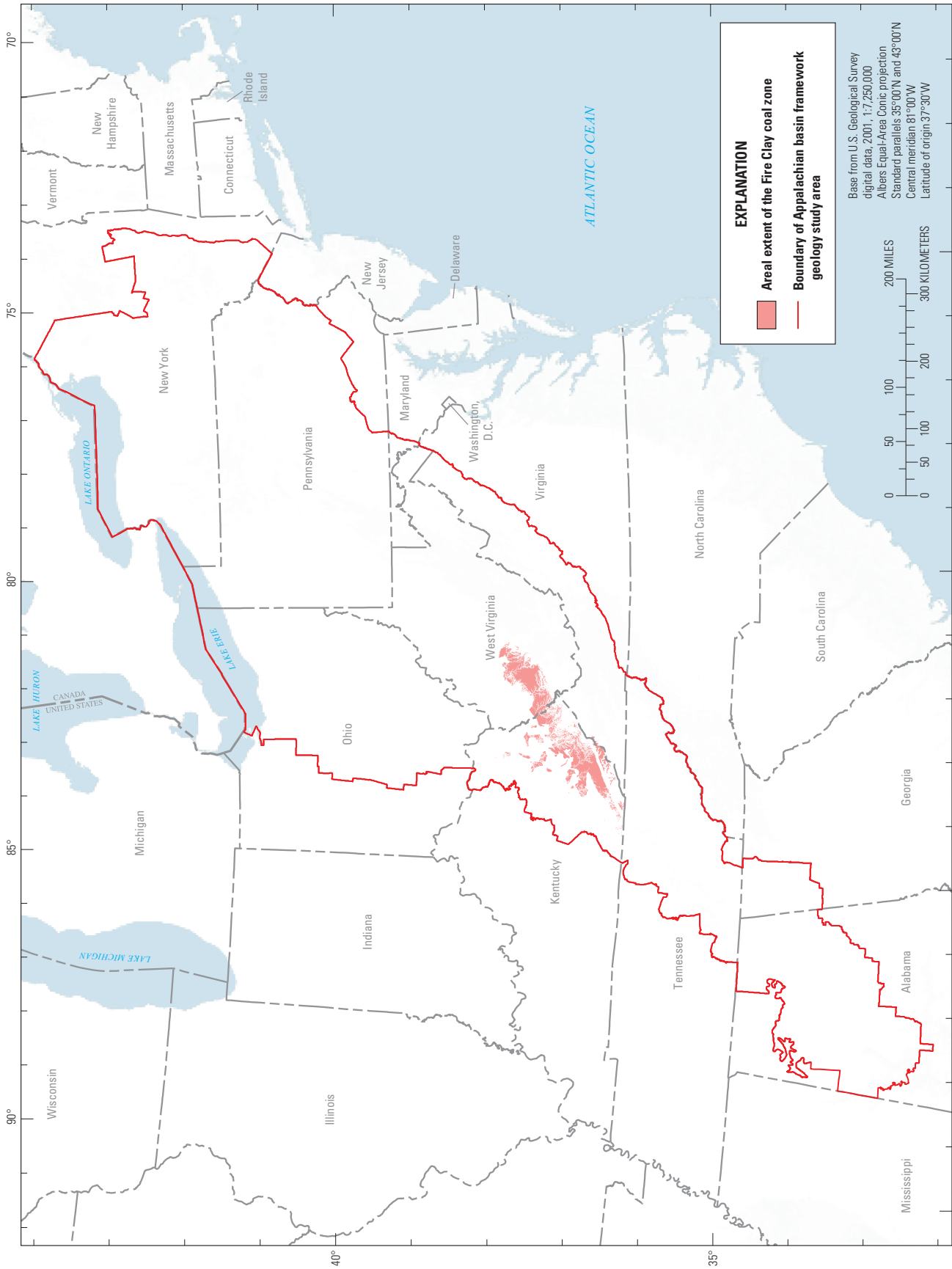


Figure 5. Map showing the areal extent of the Middle Pennsylvanian Fire Clay zone of the Pottsville Group in the Appalachian basin study area. Shapefiles and metadata for the Fire Clay coal zone assessment can also be downloaded from Trippi and others (this volume, chap. 1.1). D.C., District of Columbia.

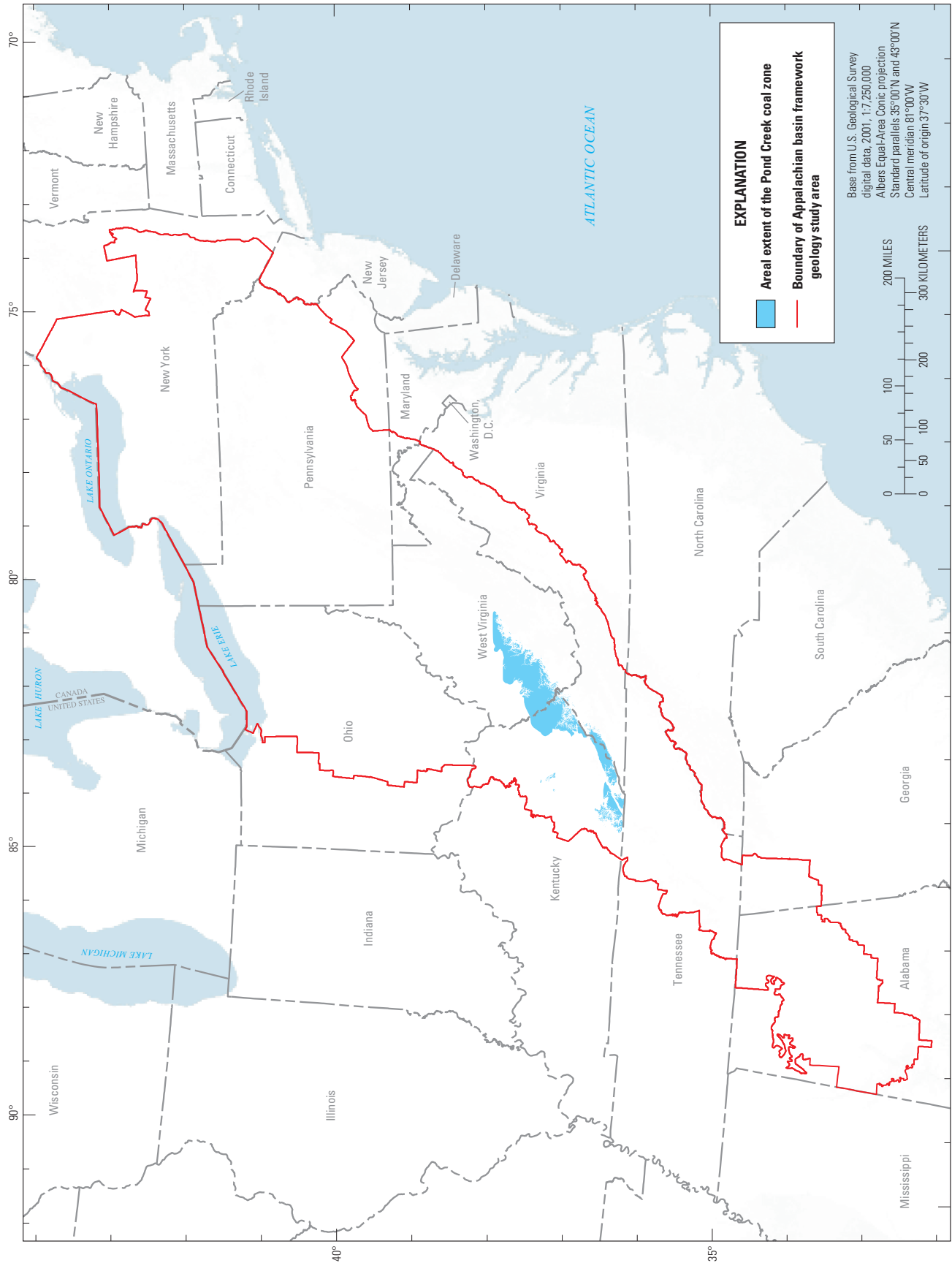


Figure 6. Map showing the areal extent of the Middle Pennsylvanian Pond Creek coal zone of the Pottsville Group in the Appalachian basin study area. Shapefiles and metadata for the Pond Creek coal zone assessment can also be downloaded from Trippi and others (this volume, chap. I.1). D.C., District of Columbia.

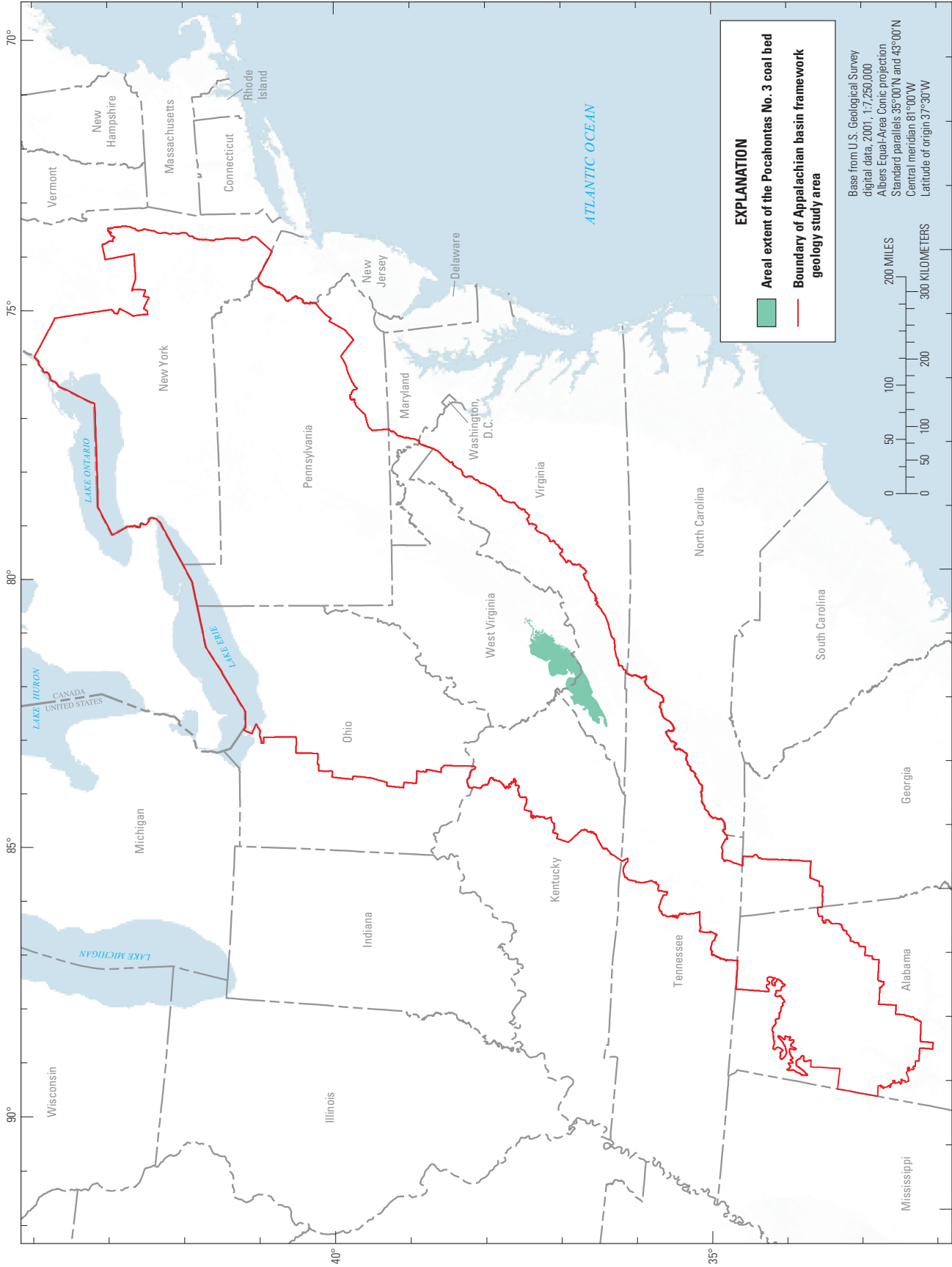


Figure 7. Map showing the areal extent of the Lower Pennsylvanian Pocahontas No. 3 coal bed of the Pottsville Group in the Appalachian basin study area. Shapefiles and metadata for the Pocahontas No. 3 coal bed assessment can also be downloaded from Trippi and others (this volume, chap. 1.1). D.C., District of Columbia.

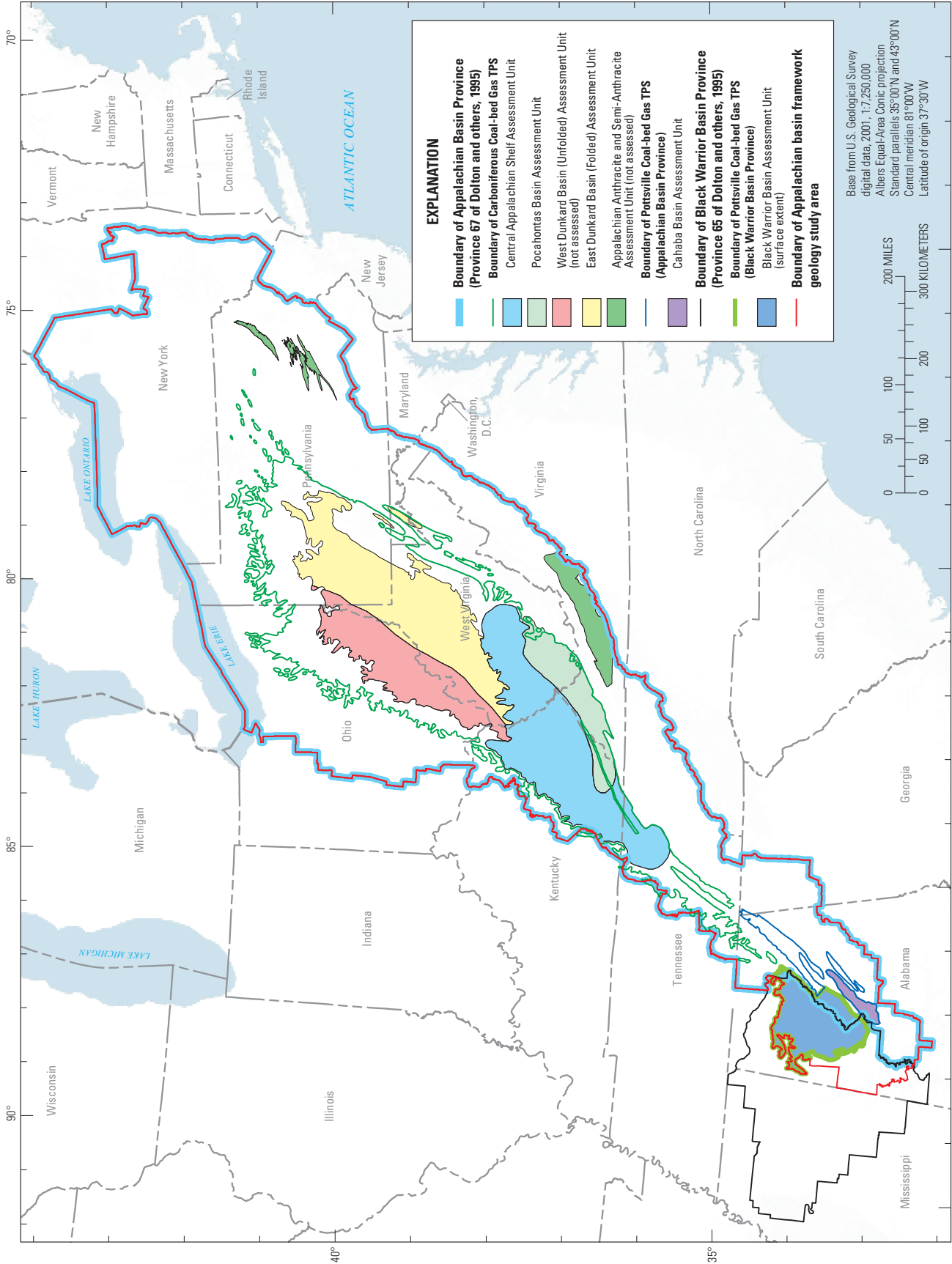


Figure 8. Map showing the locations of Total Petroleum Systems (TPS) and Assessment Units (AU) in the Appalachian basin study area. Shapfiles and related metadata for this map can be downloaded from Trippi and others (this volume, chap. I.1). D.C., District of Columbia.

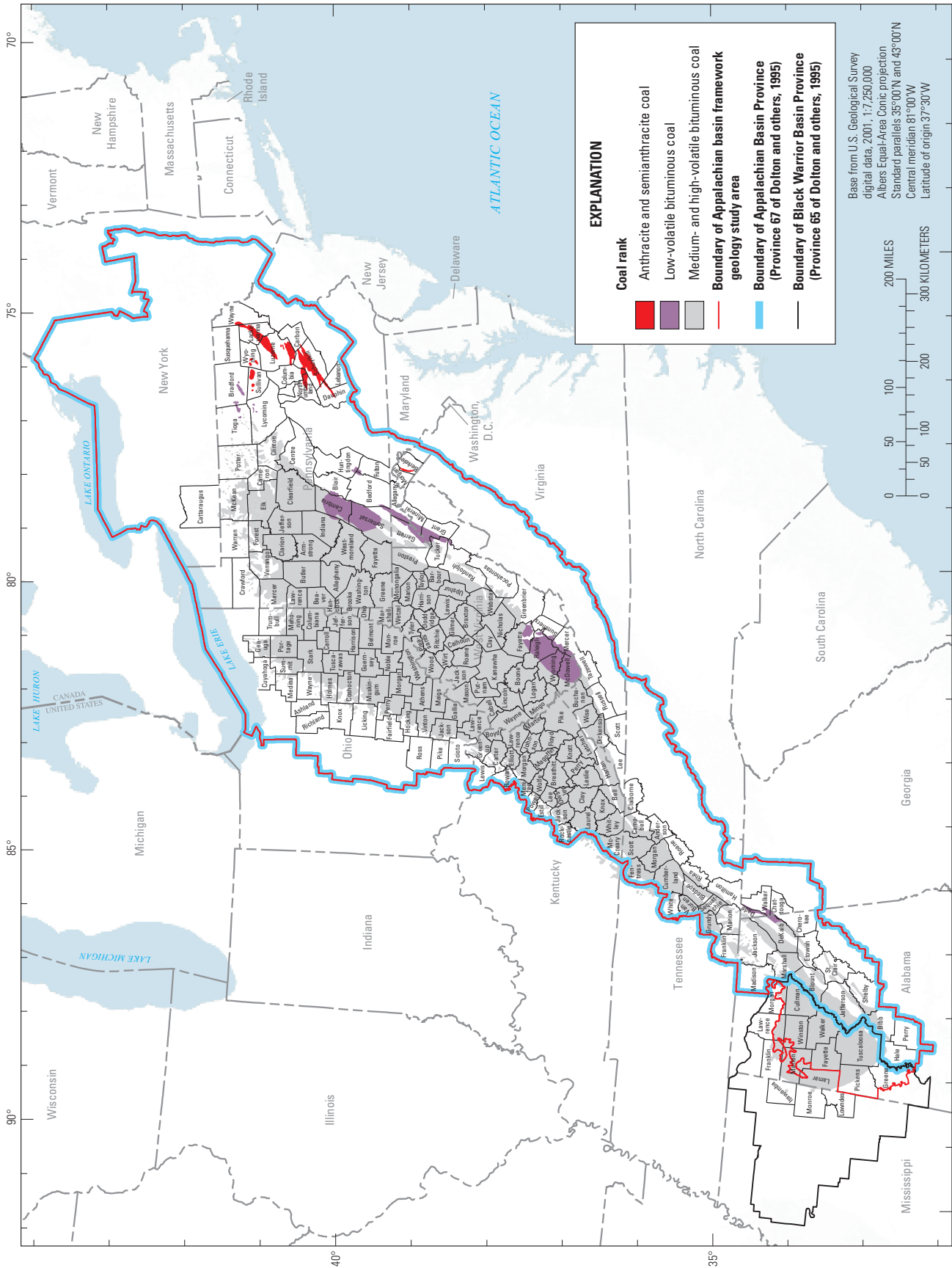


Figure 9. Map showing counties in the Appalachian basin geologic framework study area, locations of coal fields, and type of coal. These coals contain coalbed methane or have the potential to produce coalbed methane.

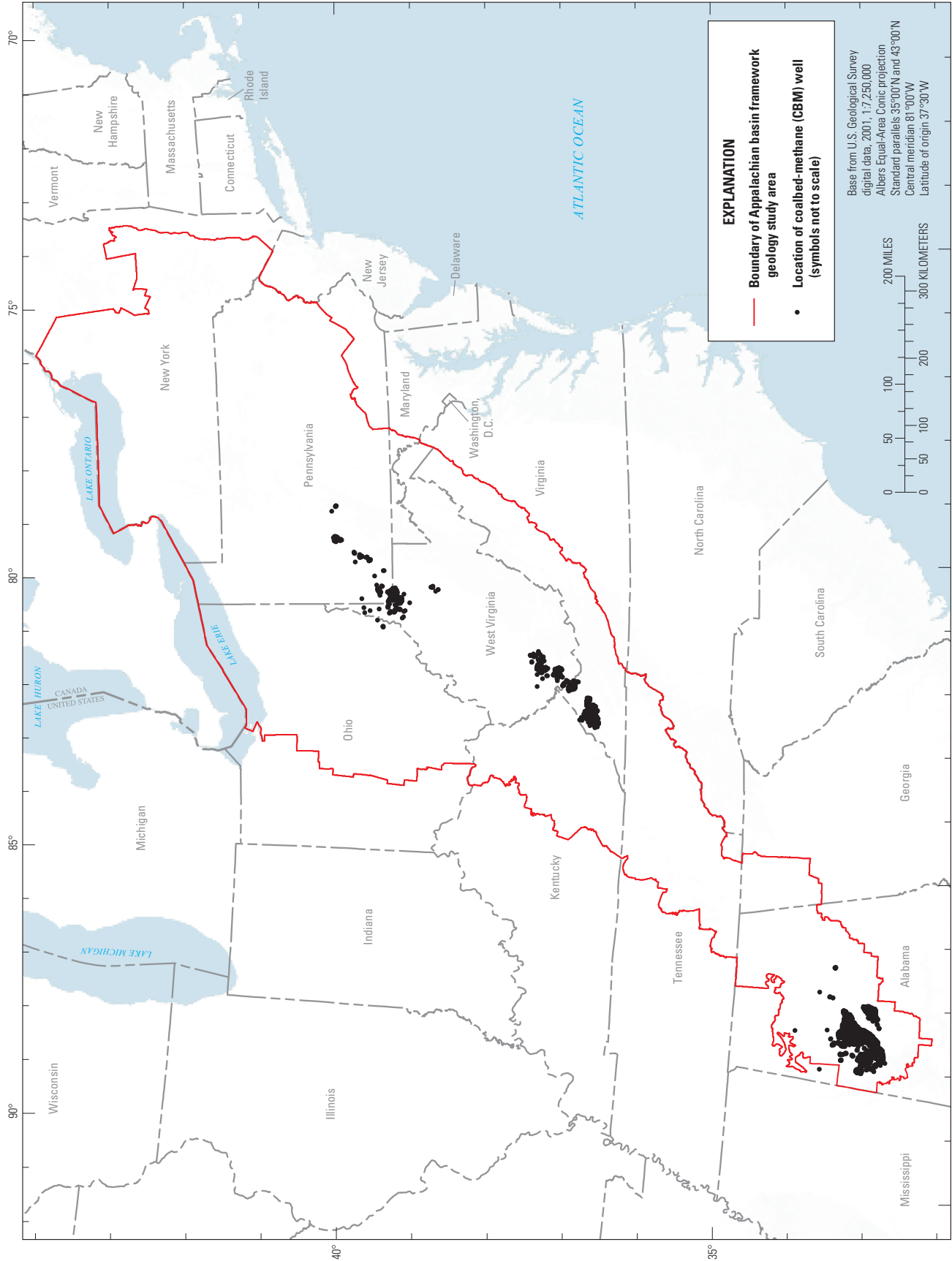


Figure 10. Map showing the locations of coalbed-methane wells in the study area. Detailed maps of these well locations and the coalbed-methane fields they belong to are provided in figures 12 through 16. D.C., District of Columbia.

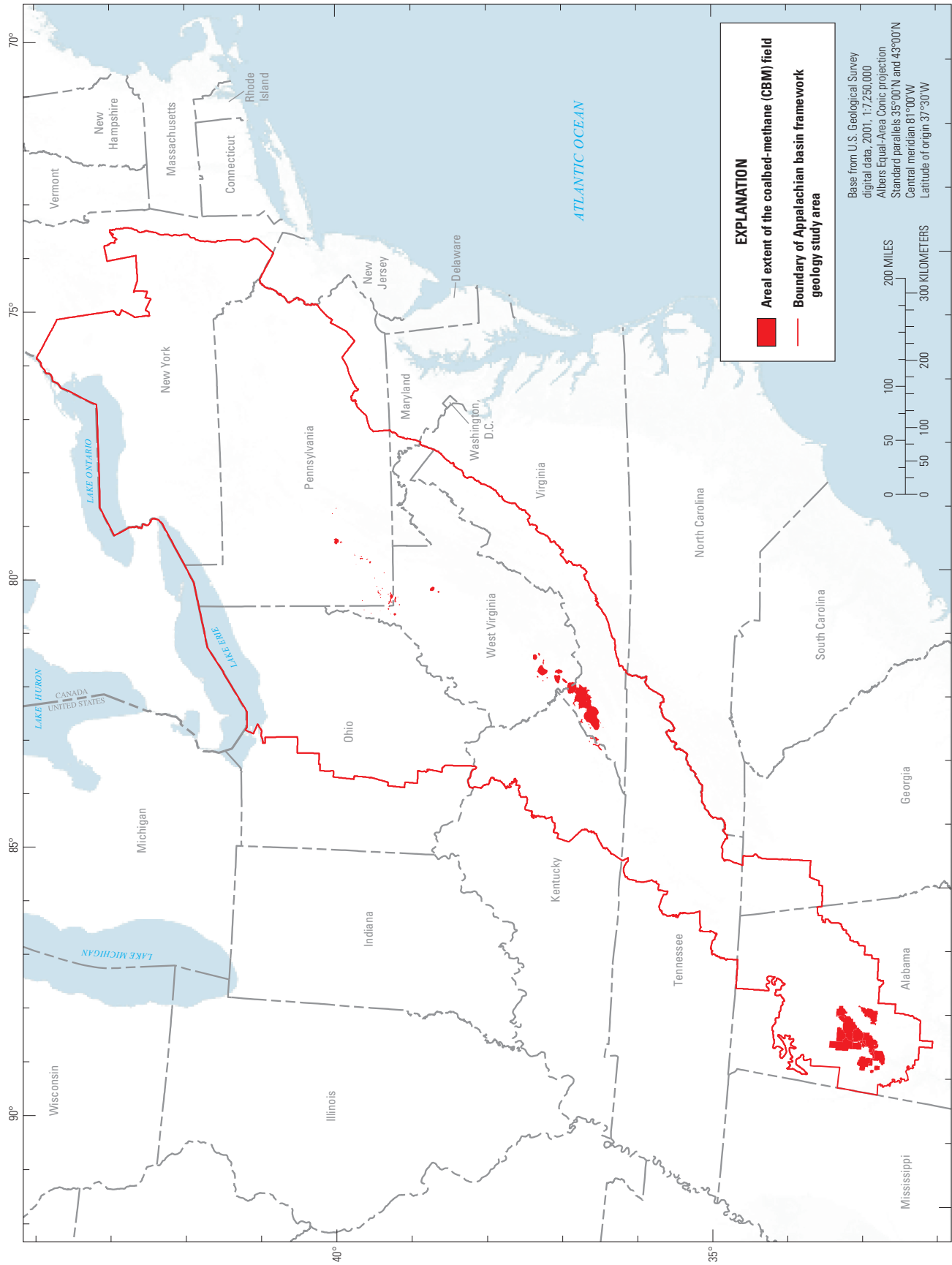


Figure 11. Map showing the locations of coalbed-methane fields in the study area. Detailed maps of wells and the associated coalbed-methane fields are provided in figures 12 through 16. D.C., District of Columbia.

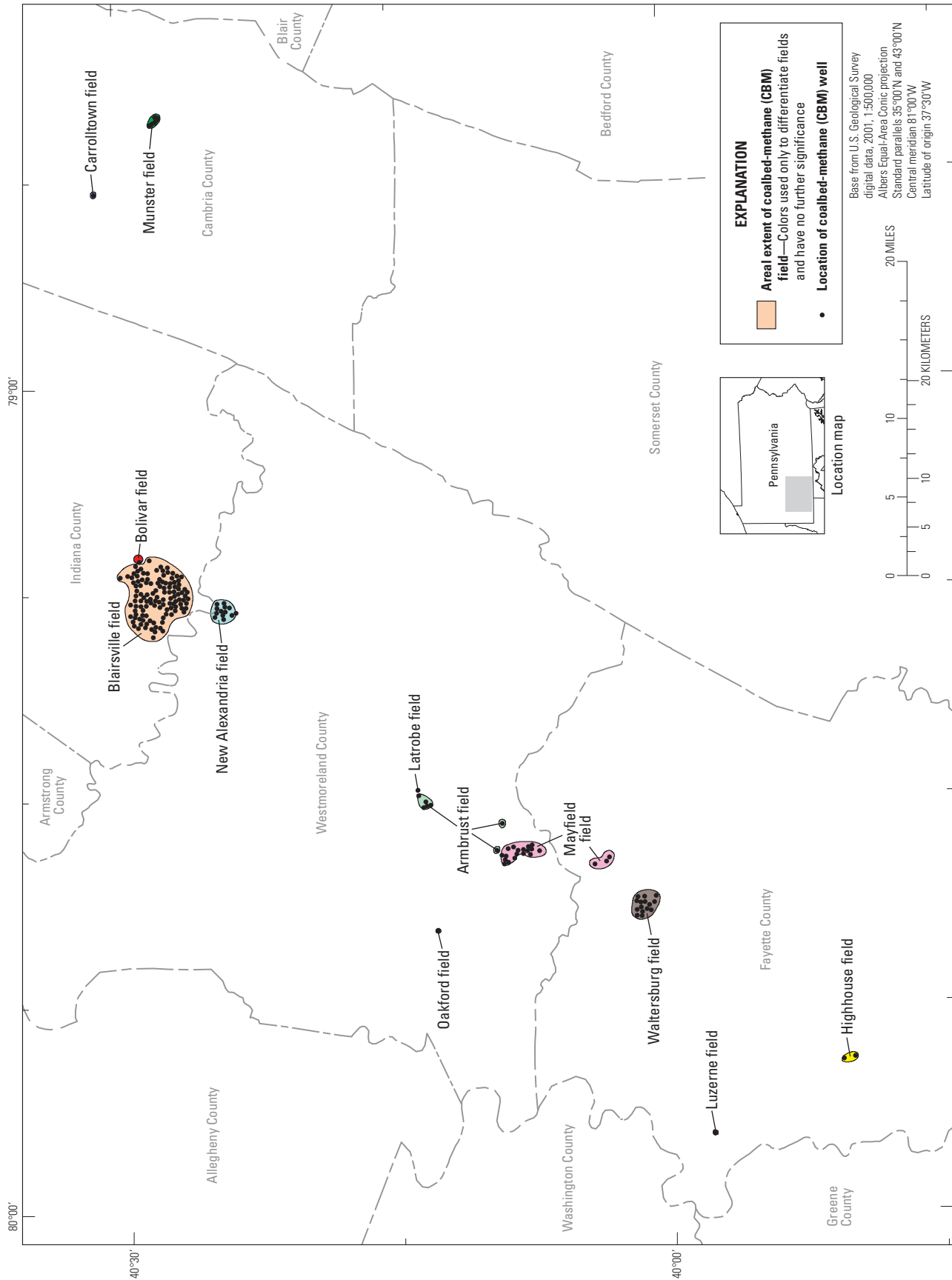


Figure 12. Detailed map showing the locations of coalbed-methane wells and fields in Indiana, Cambria, Westmoreland, and Fayette Counties in a portion of southwestern Pennsylvania.

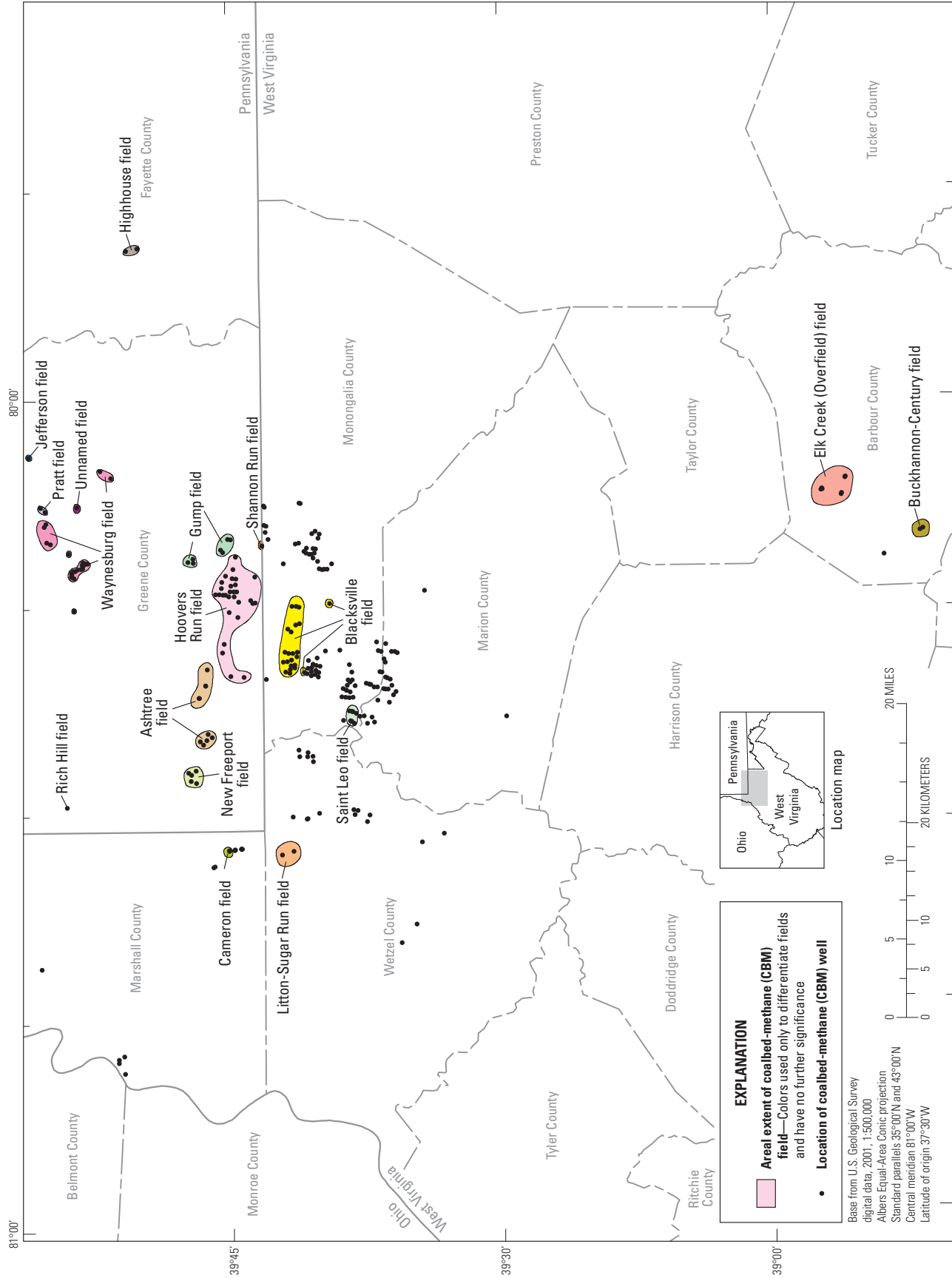


Figure 13. Detailed map showing the locations of coalbed-methane wells and fields in Greene and Fayette Counties in a portion of southwestern Pennsylvania, and in Marshall, Wetzel, Monongalia, Marion, and Barbour Counties in northern West Virginia.

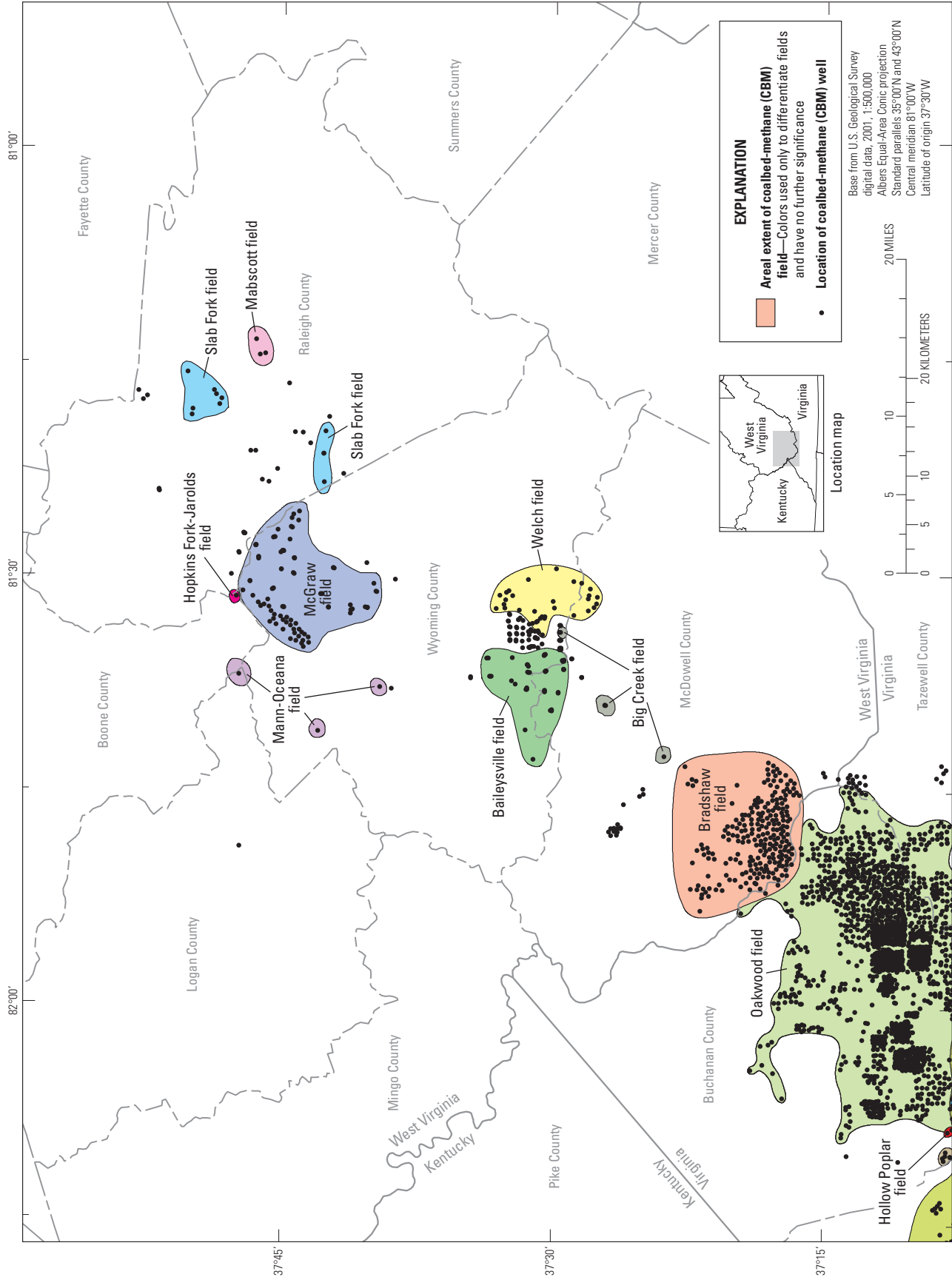


Figure 14. Detailed map showing the locations of coalbed-methane wells and fields in Raleigh, Logan, Wyoming, and McDowell Counties in southern West Virginia, and Buchanan and Tazewell Counties in southwestern Virginia.

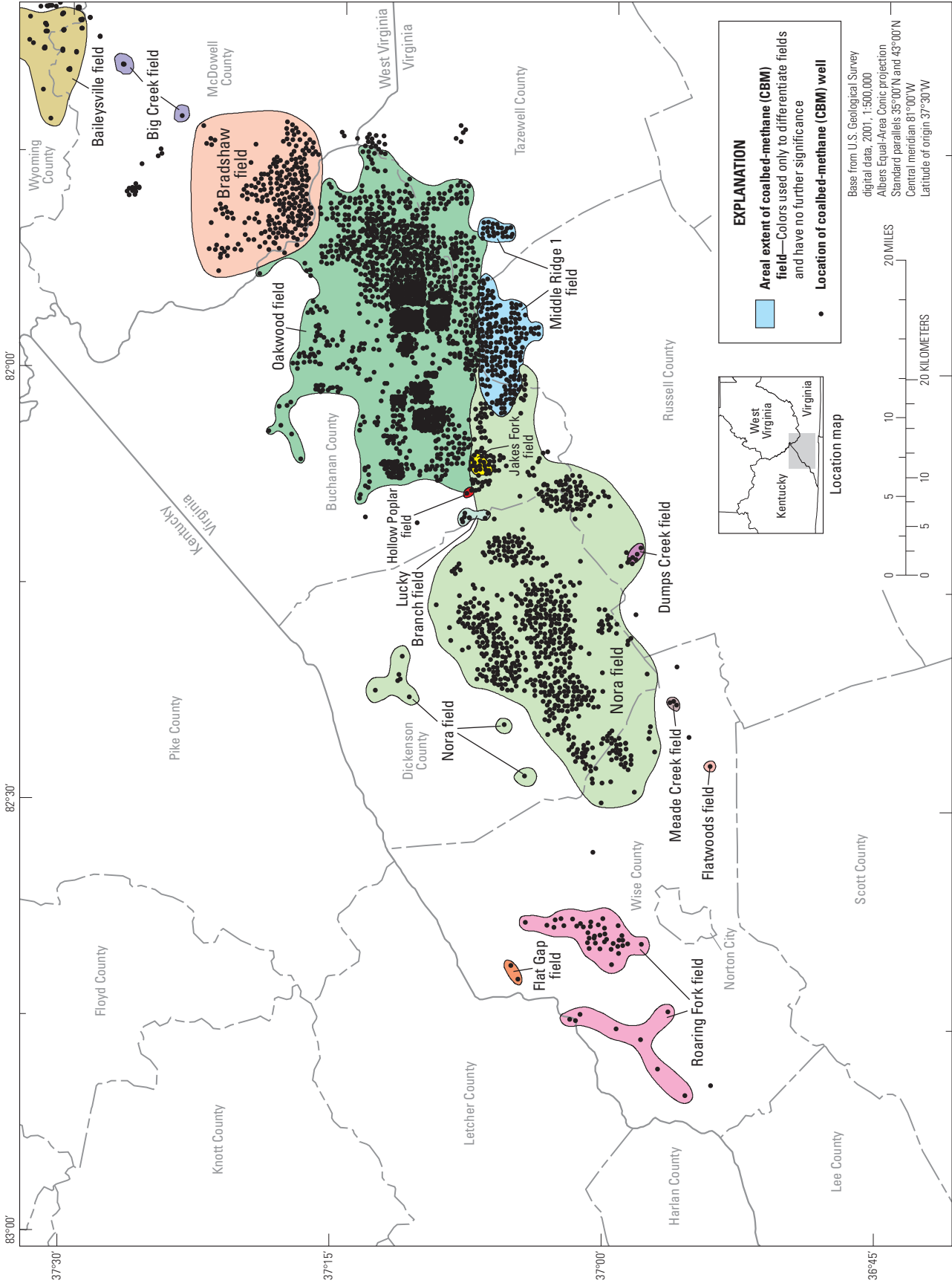


Figure 15. Detailed map showing the locations of coalbed-methane wells and fields in Wyoming and McDowell Counties in southern West Virginia, and Buchanan, Tazewell, Dickenson, Russell, and Wise Counties in southwestern Virginia.

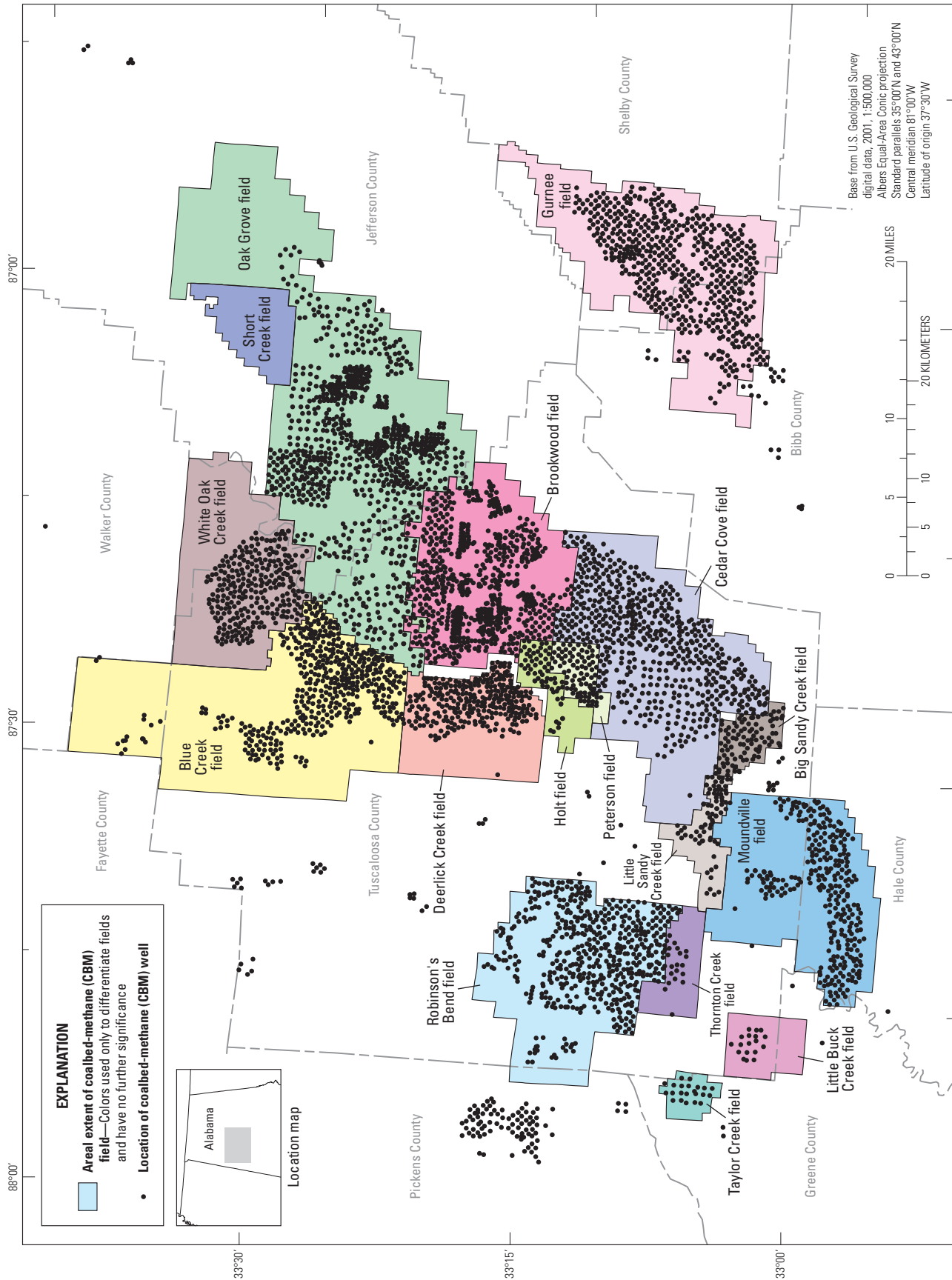


Figure 16. Detailed map showing the locations of coalbed-methane wells and fields in Walker, Pickens, Tuscaloosa, Jefferson, Greene, Hale, Bibb, and Shelby Counties in northern Alabama.