Geographic Information System (GIS)-Based Maps of Appalachian Basin Oil and Gas Fields

By Robert T. Ryder, Scott A. Kinney, Steve Suitt, Matthew D. Merrill, and Michael H. Trippi

Chapter C.2 of

Coal and Petroleum Resources in the Appalachian Basin: Distribution, Geologic Framework, and Geochemical Character

Edited by Leslie F. Ruppert and Robert T. Ryder

Professional Paper 1708

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

Suggested citation:
Ryder, R.T., Kinney, S.A., Suitt, Steve, Merrill, M.D., and Trippi, M.H., 2014, Geographic information system (GIS)-based maps of Appalachian basin oil and gas fields, chap. C.2 *of* Ruppert, L.F., and Ryder, R.T., eds., Coal and petroleum resources in the Appalachian basin; Distribution, geologic framework, and geochemical character: U.S. Geological Survey Professional Paper 1708, 12 p., http://dx.doi.org/10.3133/pp1708C.2.

Contents

Figures

Geographic Information System (GIS)-Based Maps of Appalachian Basin Oil and Gas Fields

By Robert T. Ryder,[1] Scott A. Kinney,[2] Steve Suitt,[1] Matthew D. Merrill,[1] and Michael H. Trippi[1]

Introduction

One of the more recent maps of Appalachian basin oil and gas fields (and the adjoining Black Warrior basin) is the U.S. Geological Survey (USGS) compilation by Mast and others (1998) (see Trippi and others, this volume, chap. I.1). This map is part of a larger oil and gas field map for the conterminous United States that was derived by Mast and others (1998) from the Well History Control System (WHCS) database of Petroleum Information, Inc. (now IHS Energy Group). Rather than constructing the map from the approximately 500,000 proprietary wells in the Appalachian and Black Warrior part of the WHCS database, Mast and others (1998) subdivided the region into a grid of 1-mi^2 (square mile) cells and allocated an appropriate type of hydrocarbon production (oil production, gas production, oil and gas production, or explored but no production) to each cell. Each 1-mi^2 cell contains from 0 to 5 or more exploratory and (or) development wells. For example, if the wells in the 1-mi^2 cell consisted of three oil wells, one gas well, and one dry well, then the cell would be characterized on the map as an area of oil and gas production. The map by Mast and others (1998) accurately shows the distribution and types of hydrocarbon accumulation in the Appalachian and Black Warrior basins, but it does not show the names of individual fields. To determine the locality and name of individual oil and gas fields, one must refer to State oil and gas maps (for example, Harper and others, 1982), which are generally published at scales of 1:250,000 or 1:500,000 (see References Cited), and (or) published journal articles.

Other recent USGS Appalachian basin oil and gas field maps show the distribution of oil and gas production with a cell size as small as 0.25 mi^2, such as the maps converted by Trippi and others (this volume, chap. I.1) from proprietary well-location maps used in the USGS 2002 assessment of oil and gas resources of the Appalachian basin (Milici and others, 2003). Another set of Appalachian basin oil and gas cell maps (based on a cell size of 0.25 mi^2) was created for the USGS 1995 National Assessment of United States Oil and Gas Resources (Gautier and others, 1995; Beeman and others, 1996).

Between 1991 and 1994, R.T. Ryder (with R.E. Mattick, J.B. Roen, and J.R. San Filipo, USGS, Reston, Va.) compiled oil and gas fields on stable-base mylar greenline base maps (scale 1:500,000) for selected plays in the Appalachian basin. These map compilations included field names and field numbers where assigned by State agencies. The purpose of the maps was to provide supporting data for the USGS 1995 National Assessment of United States Oil and Gas Resources (Gautier and others, 1995). In particular, the greenline oil and gas field maps were linked, where possible, with production data from State records and (or) published literature in order to determine ultimate sizes for conventional fields and estimated ultimate recovery (EUR) values for wells in continuous accumulations (for definitions of the conventional and continuous terminology, see USGS National Oil and Gas Assessment Team, 1995; Schmoker, 1997; Schenk and Pollastro, 2002). This approach was used in the 1995 national oil and gas assessment because ultimate field size and EUR data were unavailable in the Appalachian region from Petroleum Information, Inc., and other commercial sources.

In 2006 and 2007, the greenline Appalachian basin field maps were digitized under the supervision of Scott Kinney and converted to geographic information system (GIS) files for chapter I.1 (this volume). By converting these oil and gas field maps to a digital format and maintaining the field names where noted, they are now available for a variety of oil and gas and possibly carbon-dioxide sequestration projects. Having historical names assigned to known digitized conventional fields provides a convenient classification scheme into which cumulative production and ultimate field-size databases can be organized. Moreover, as exploratory and development drilling expands across the basin, many previously named fields that were originally treated as conventional fields have evolved into large, commonly unnamed continuous-type accumulations. These new digital maps will facilitate a comparison between EUR values from recently drilled, unnamed parts of continuous accumulations and EUR values from named fields discovered early during the exploration cycle of continuous accumulations.

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

Methods

The greenline oil and gas maps were sent to a commercial vendor for scanning, digitizing, and conversion into ArcView shapefiles. Field outlines and associated names were assigned to specific object identification numbers and organized into attribute tables containing such data fields as field name, State-assigned field number, hydrocarbon type (oil, gas, oil and gas, or storage), and reservoir name. The map projection of the final GIS project was changed from a Lambert conformal-conic projection (used for the greenlines) to an Albers equal-area projection to conform with other GIS maps in this volume.

The oil and gas field maps shown in this chapter (figs. 1–7) are about 10 to 15 years old. Only the map of Ordovician Trenton and Black River Limestone oil and gas fields (fig. 3) has been recently updated to account for important new discoveries in New York (New York State Department of Environmental Conservation, Division of Mineral Resources, 2005) and West Virginia (Avary, 2006). The map of oil and gas fields in Upper Devonian sandstone reservoirs (fig. 7) should also be revised to show the post-1995, southward expansion of the gas fields into south-central West Virginia (Pool and others, 2005). However, the map of oil and gas fields in Lower Silurian sandstones (fig. 4) is relatively up to date. For example, the distribution of "Clinton" sandstone[3] (as used by Ryder, 2000) oil and gas fields shown in this compilation in Ohio is reasonably consistent (except for field outlines), with the distribution of "Clinton" sandstone fields shown in the more recent map of Riley and others (2004).

Results and Suggested Applications

Oil and gas field maps produced in this compilation represent seven major reservoir intervals (figs. 1–7) that include most of the total petroleum systems (TPSs), assessment units (AUs), and accumulation types (conventional vs. continuous) defined by Milici and others (2003) for the 2002 USGS assessment of undiscovered oil and gas resources in the Appalachian basin. Figures 1 through 7 show only images of the oil and gas fields, but readers can click on the link in the figure captions to see names of the oil and gas fields and selected attributes. Summary charts of the major TPSs identified by Milici and others (2003) in relation to Appalachian basin stratigraphy are shown in Ryder and others (this volume, chap. C.1). Not all TPSs and AUs defined by Milici and others (2003) are represented by the oil and gas fields shown in figures 1 through 7; however, several of the missing TPSs and AUs are represented by oil and gas field maps published elsewhere in this volume. Current maps of Devonian shale gas fields are shown in Milici and Swezey (this volume, chap. G.9) and current maps of Carboniferous coal-bed-gas fields are shown in Trippi and others (this volume, chap. D.1) and Milici (this volume, chap. G.1).

The USGS and (or) other organizations interested in the assessment of energy resources can use the GIS-based, digital oil and gas field maps provided in Trippi and others (this volume, chap. I.1) as a starting point to enhance the organization of existing and future oil and gas production databases for the Appalachian basin.

[3]The "Clinton" sandstone in Ohio was miscorrelated by drillers with strata in the type Clinton Group of New York when in fact it is equivalent to the underlying type Medina Group of New York. Although this miscorrelation has caused confusion in nomenclature, the term continues to be used widely in the literature and by the oil and gas industry. Early drillers correctly identified the informal Medina sandstone in Ohio as a partial equivalent of the type Medina Group of New York.

References Cited

General

Beeman, W.R., Obuch, R.C., and Brewton, J.B., comps., 1996, Digital map data, text, and graphical images in support of the 1995 National Assessment of United States Oil and Gas Resources: U.S. Geological Survey Digital Data Series 35, 1 CD-ROM.

Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995, 1995 National assessment of United States oil and gas resources—Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series 30, 1 CD-ROM.

Janssens, A., 1993, Oil and gas from Rose Run sandstone and Beekmantown dolomite in Ohio, *in* Riley, R.A., Harper, J.A., Baranoski, M.T., Laughrey, C.D., and Carlton, R.W., Measuring and predicting reservoir heterogeneity in complex deposystems: the Late Cambrian Rose Run Sandstone of eastern Ohio and western Pennsylvania: U.S. Department of Energy, Contract No. DE–AC22–90BC14657, p. 199–208.

Mast, R.F., Root, D.H., Williams, L.P., Beeman, W.R., and Barnett, D.L., 1998, Areas of historical oil and gas production in the conterminous United States: U.S. Geological Survey Geologic Investigations Series Map I–2582, 1 sheet, scale 1:3,750,000.

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/.)

Roen, J.B., and Walker, B.J., eds., 1996, The atlas of major Appalachian gas plays: West Virginia Geological and Economic Survey Publication V–25, 201 p.

Ryder, R.T., 2000, Stratigraphic framework and depositional sequences in the Lower Silurian regional oil and gas accumulation, Appalachian basin; from Jackson County, Ohio, through northwestern Pennsylvania, to Orleans County, New York: U.S. Geological Survey Geologic Investigations Series Map I–2726, 2 sheets, pamphlet, 8 p. (Also available online at http://pubs.usgs.gov/imap/i-2726.)

Schenk, C.J., and Pollastro, R.M., 2002, Natural gas production in the United States: U.S. Geological Survey Fact Sheet FS–113–01, 2 p. (Also available online at http://pubs.usgs.gov/fs/fs-0113-01/.)

Schmoker, J., 1997, Continuous hydrocarbon reservoirs: U.S. Geological Survey Fact Sheet FS–024–97, 3 p.

U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995, 1995 National Assessment of United States Oil and Gas Resources: U.S. Geological Survey Circular 1118, 20 p. (Also available online at http://pubs.usgs.gov/circ/1995/circ1118/execsum.html.)

Kentucky

Nuttall, B.C., 1989, Index to oil and gas fields of Kentucky: Kentucky Geological Survey Information Circular 27, Series XI, 267 p.

Wilson, E.N., and Sutton, D.G., 1973, Oil and gas map of Kentucky, sheet 3, east-central part: Kentucky Geological Survey, Series X, 1 sheet, scale 1:250,000.

Wilson, E.N., and Sutton, D.G., 1976, Oil and gas map of Kentucky, sheet 4, eastern part: Kentucky Geological Survey, Series X, 1 sheet, scale 1:250,000.

New York

New York State Department of Environmental Conservation, Division of Mineral Resources, 1986, New York State oil and gas fields: Albany, N.Y., New York Department of Environmental Conservation, Division of Mineral Resources, 1 sheet, scale 1:250,000.

New York Division of Mineral Resources, 2005, Map 3—Trenton-Black River fields, central New York, 2004, *in* New York State oil, gas, and mineral resources, 2004 (Twenty-first annual report): Albany, N.Y., New York Department of Environmental Conservation, Division of Mineral Resources, p. 14.

Ohio

Debrosse, T.A., and Vohwinkel, J.C., 1974, Oil and gas fields of Ohio: Columbus, Ohio, Ohio Division of Geological Survey in cooperation with Ohio Division of Oil and Gas, 1 sheet, scale 1:62,500.

Ohio Division of Geological Survey, 1991, County spot maps: Columbus, Ohio, Ohio Division of Geological Survey Open-File Maps, 1 sheet each, scale 1:62,500.

Riley, R.A., Baranoski, M.T., and Wickstrom, L.H., with cooperation from Wells, J.G., and Powers, D.M., 2004, Oil and gas fields map of Ohio: Ohio Division of Geological Survey Map PG–1, 1 sheet, scale 1:500,000.

Pennsylvania

Harper, J.A., Laughrey, C.D., and Lytle, W.S., 1982, Oil and gas fields of Pennsylvania: Harrisburg, Pa., Pennsylvania Bureau of Topographic and Geologic Survey, 2 sheets, scale 1:250,000.

Pennsylvania Bureau of Topographic and Geologic Survey, 1994, Deep well oil and gas exploration: Harrisburg, Pa., Pennsylvania Bureau of Topographic and Geologic Survey, 2 sheets, scale 1:250,000.

Tennessee

Born, K.E., 1943, Oil and gas in middle Tennessee: Tennessee Division of Geology Map 1, 1 sheet, scale 1:950,000.

Clendening, J.A., and McCown, M.W., 1999, Swan Creek field; Potential giant develops in east Tennessee: Oil and Gas Journal, v. 97, no. 16, p. 95–99.

Tennessee Division of Geology, 1993, Oil and gas fields of north-central Tennessee: Nashville, Tenn., Tennessee Division of Geology map, 1 sheet, scale 1:250,000.

Virginia

Milici, R.C., LeVan, D.C., and Wilkes, G.P., 1980, Part A—Regional structure and hydrocarbon potential (sheet 2), *in* Geologic structure and hydrocarbon potential along the Saltville and Pulaski thrusts in southwestern Virginia and northeastern Tennessee: Virginia Division of Mineral Resources Publication 23, 6 sheets.

Young, R.S., and Harnsberger, W.T., Jr., 1955, Geology of Bergton gas field, Rockingham County, Virginia: American Association of Petroleum Geologists Bulletin, v. 39, no. 3, p. 317–328.

West Virginia

Avary, K.L., 2006, Trenton/Black River production history and analysis, *in* Patchen, D.G., Hickman, J.B., Harris, D.C., Drahovzal, J.A., Lake, P.D., Smith, L.B., Nyahay, R., Schulze, R., Riley, R.A., Baranoski, M.T., Wickstrom, L.H., Laughrey, C.D., Kostelnik, J., Harper, J.A., Avary, K.L., Bocan, J., Hohn, M.E., and McDowell, R., A geologic play book for Trenton-Black River Appalachian basin exploration: Morgantown, W. Va., U.S. Department of Energy, p. 211–227. [Prepared for DOE Award Number DE–FC26–03NT41856.]

Cardwell, D.H., and Avary, K.L., 1982, Oil and gas fields of West Virginia: West Virginia Geological and Economic Survey Mineral Resource Series MRS–7B, 2 sheets, scale 1:250,000.

Pool, S.E., Saucer, J.T., and Avary, K.L., 2005, Upper Devonian drilling and production activity in West Virginia, *in* Recent developments in Upper Devonian sandstone plays, Petroleum Technology Transfer Council and West Virginia University Workshop Proceedings, Washington, Pa., May 26, 2005: Morgantown, W. Va., Appalachian Oil and Natural Gas Research Consortium, 37 p.

Figures 1–7

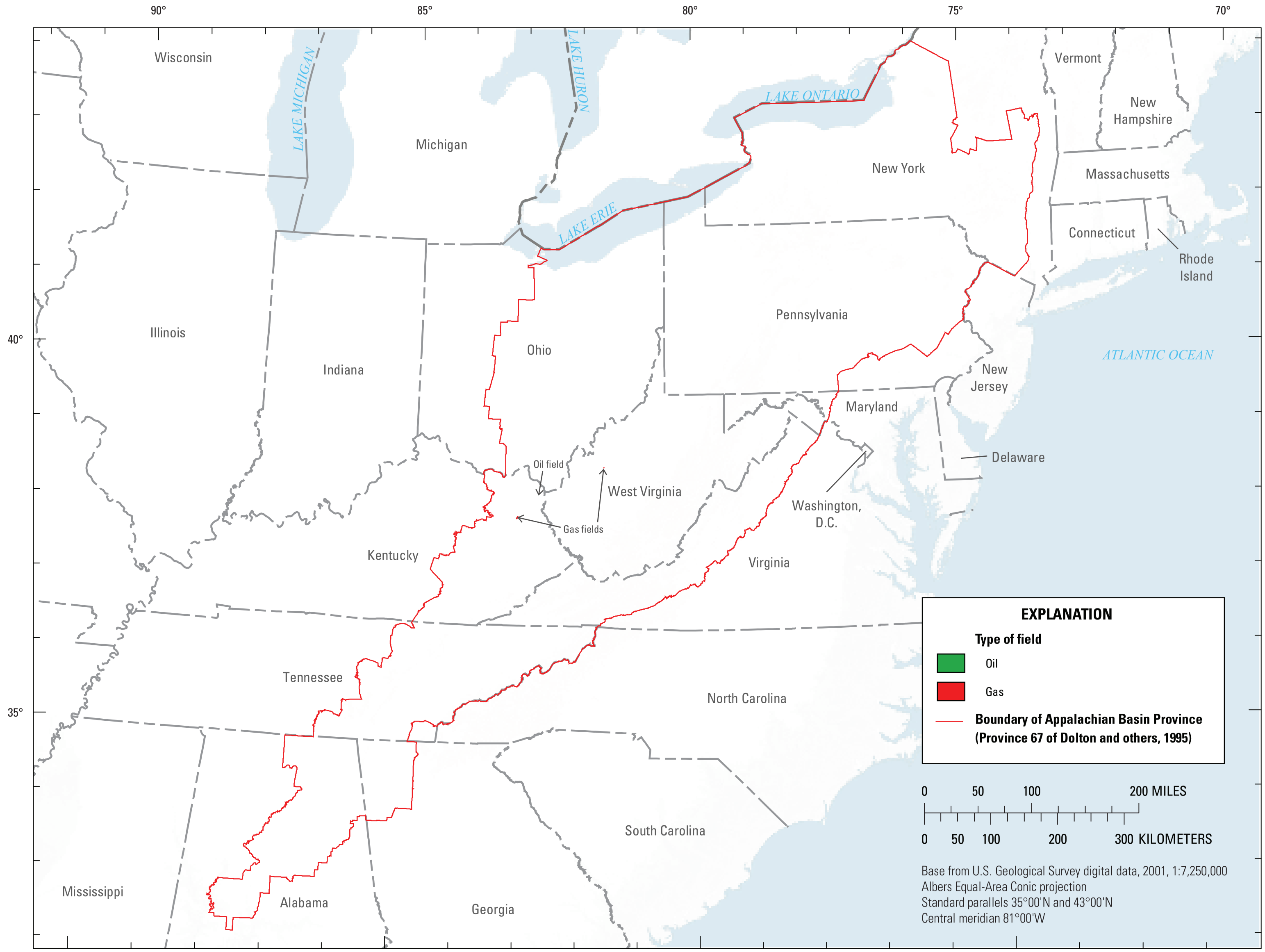

Figure 1. Oil and gas fields in the Lower to Middle Cambrian Rome Formation and the Middle to Upper Cambrian Conasauga Group. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Conasauga-Rome/Conasauga Total Petroleum System. Assessment unit as defined in Milici and others (2003): Rome Trough Assessment Unit. Accumulation type as defined in Milici and others (2003): Conventional.

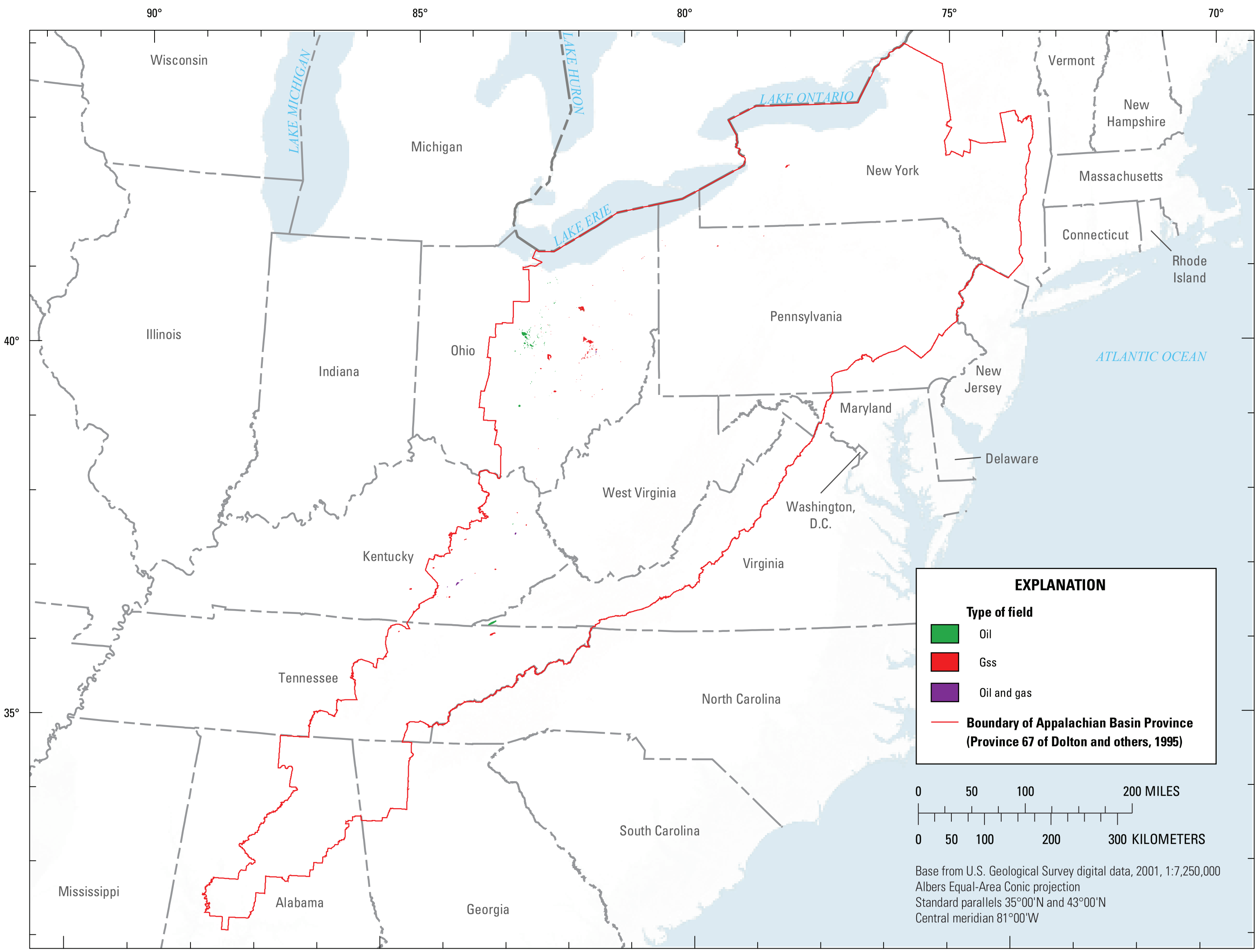

Figure 2. Oil and gas fields in the Lower to Middle Ordovician Beekmantown Group, the Upper Cambrian to Lower Ordovician Knox Group, and the Upper Cambrian Rose Run Sandstone (sandstone). Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Utica-Lower Paleozoic Total Petroleum System. Assessment unit as defined in Milici and others (2003): Knox Unconformity Assessment Unit. Accumulation type as defined in Milici and others (2003): Conventional.

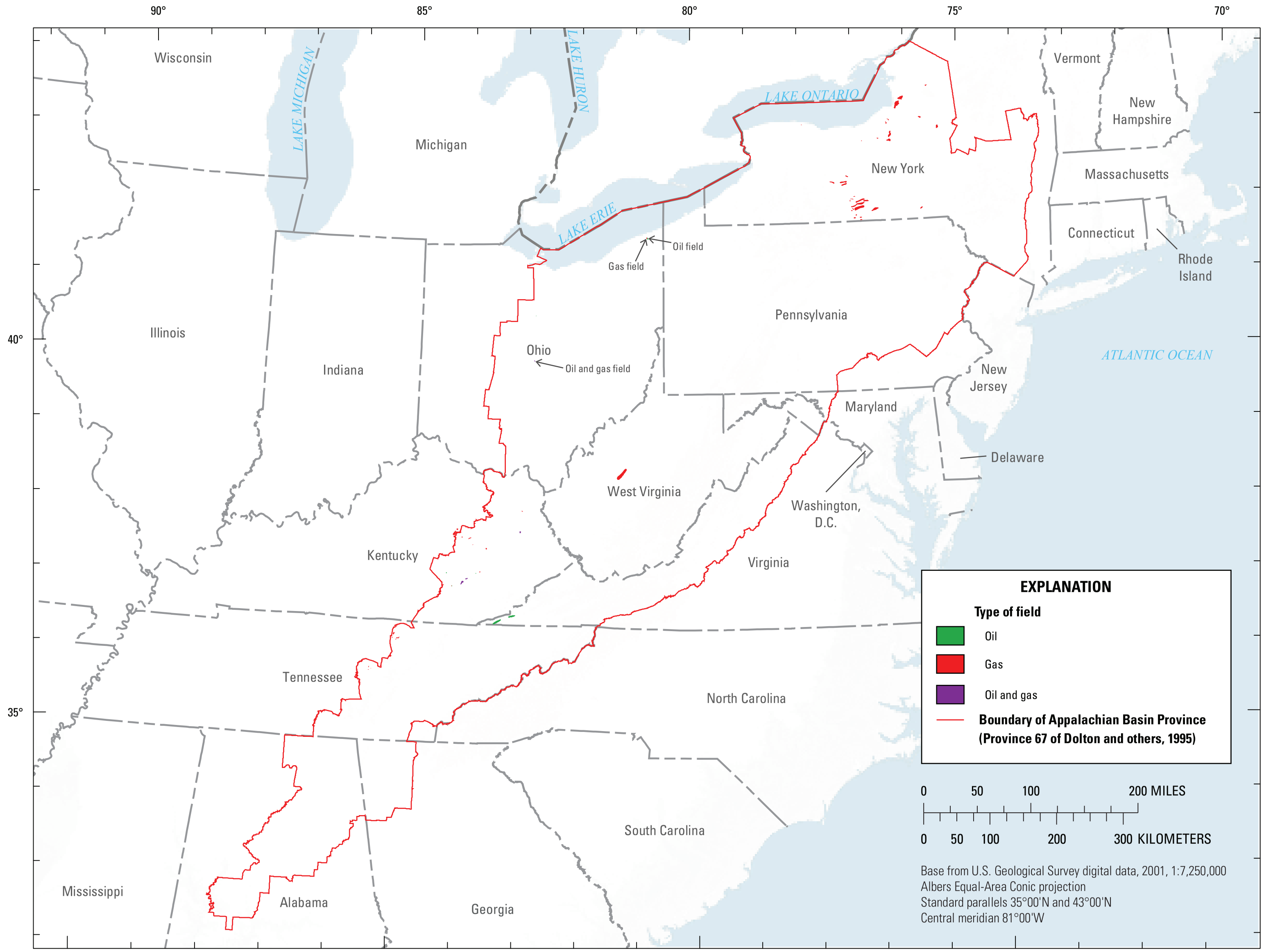

Figure 3. Oil and gas fields in the Upper Ordovician Trenton Limestone and Black River Limestone. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Utica-Lower Paleozoic Total Petroleum System. Assessment unit as defined in Milici and others (2003): Black River-Trenton Hydrothermal Dolomite Assessment Unit. Accumulation type as defined in Milici and others (2003): Conventional.

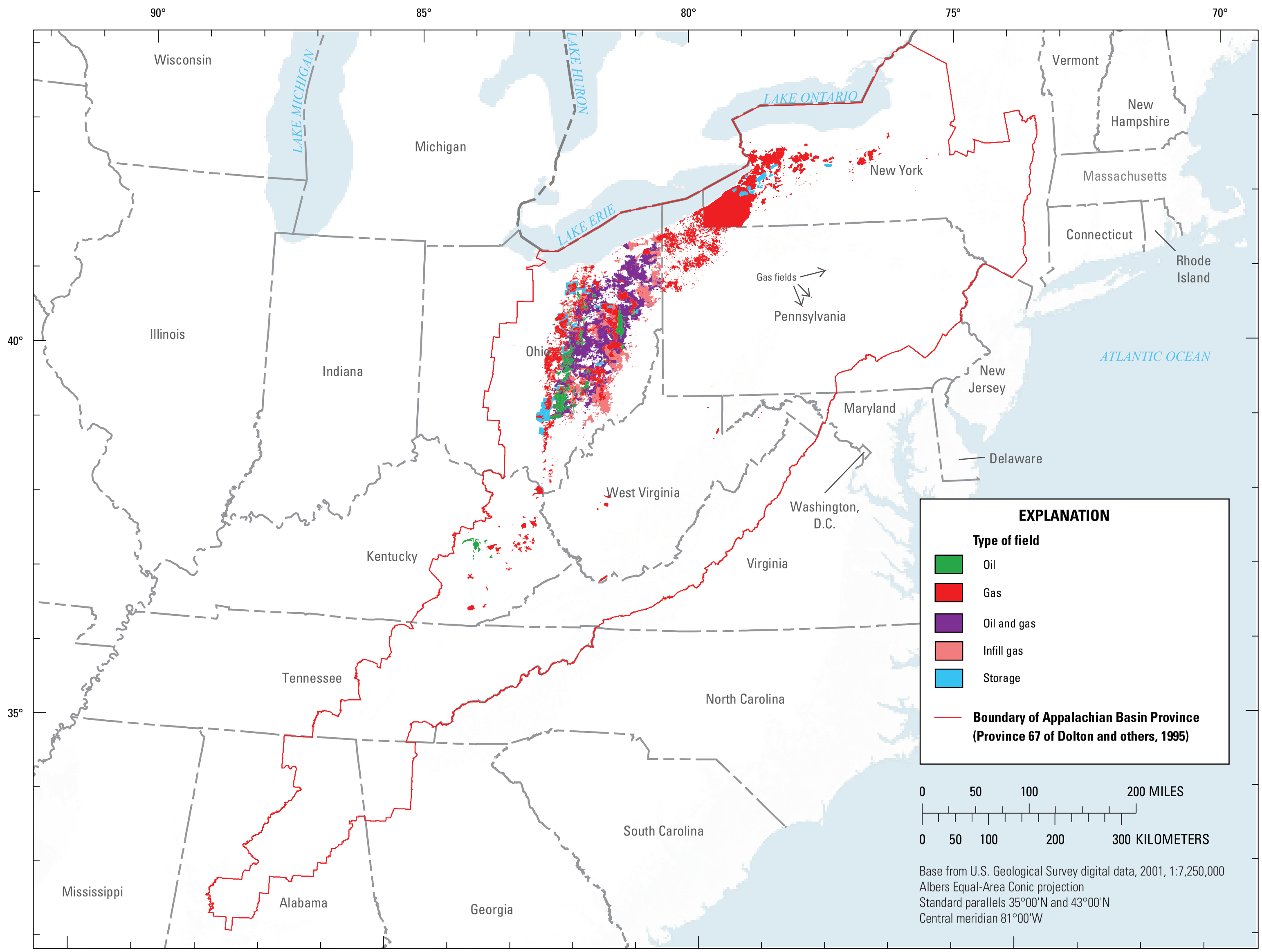

Figure 4. Oil and gas fields in the Lower Silurian "Clinton" sandstone, Medina Group, Tuscarora Sandstone, and Keefer (Big Six) Sandstone and in the Upper Ordovician Queenston Shale and Bald Eagle Formation. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Utica-Lower Paleozoic Total Petroleum System. Assessment units as defined in Milici and others (2003): Clinton-Medina Basin Center, Clinton-Medina Transitional, Clinton-Medina Transitional Northeast, and Tuscarora Basin Center Assessment Units. Accumulation types as defined in Milici and others (2003): Continuous (Clinton/Medina/Tuscarora and Queenston), and conventional (Keefer/Bald Eagle).

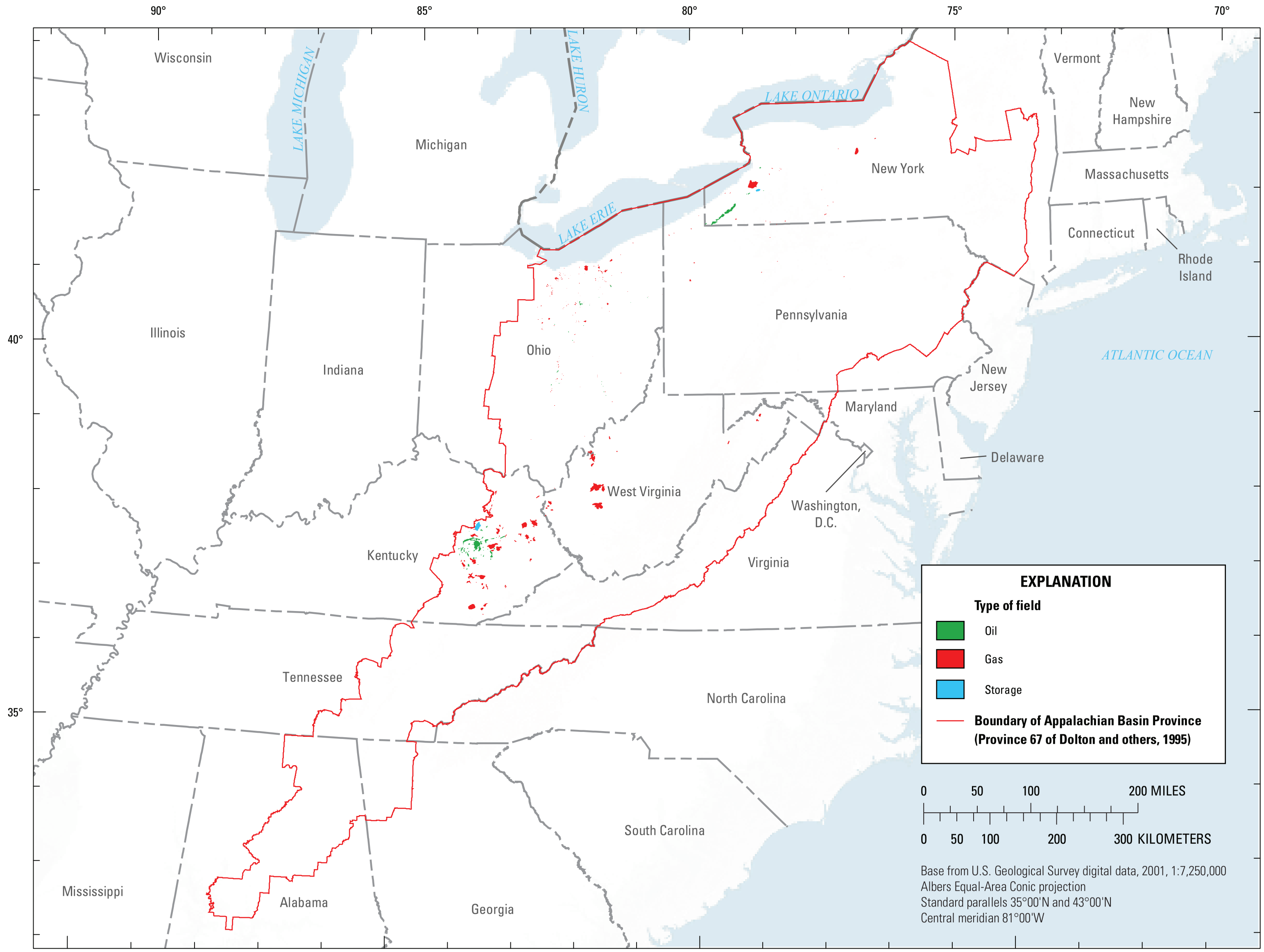

Figure 5. Oil and gas fields in the Upper Silurian Newburg Sandstone, Lockport Dolomite (Newburg zone), Lockport Dolomite, and Akron Dolomite and in the Silurian-Devonian Corniferous and Middle Devonian Onondaga Limestone. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum systems as defined in Milici and others (2003): Utica-Lower Paleozoic and Devonian Shale-Middle and Upper Paleozoic (part) Total Petroleum Systems. Assessment unit as defined in Milici and others (2003): Lockport Dolomite Assessment Unit. Accumulation type as defined in Milici and others (2003): Conventional.

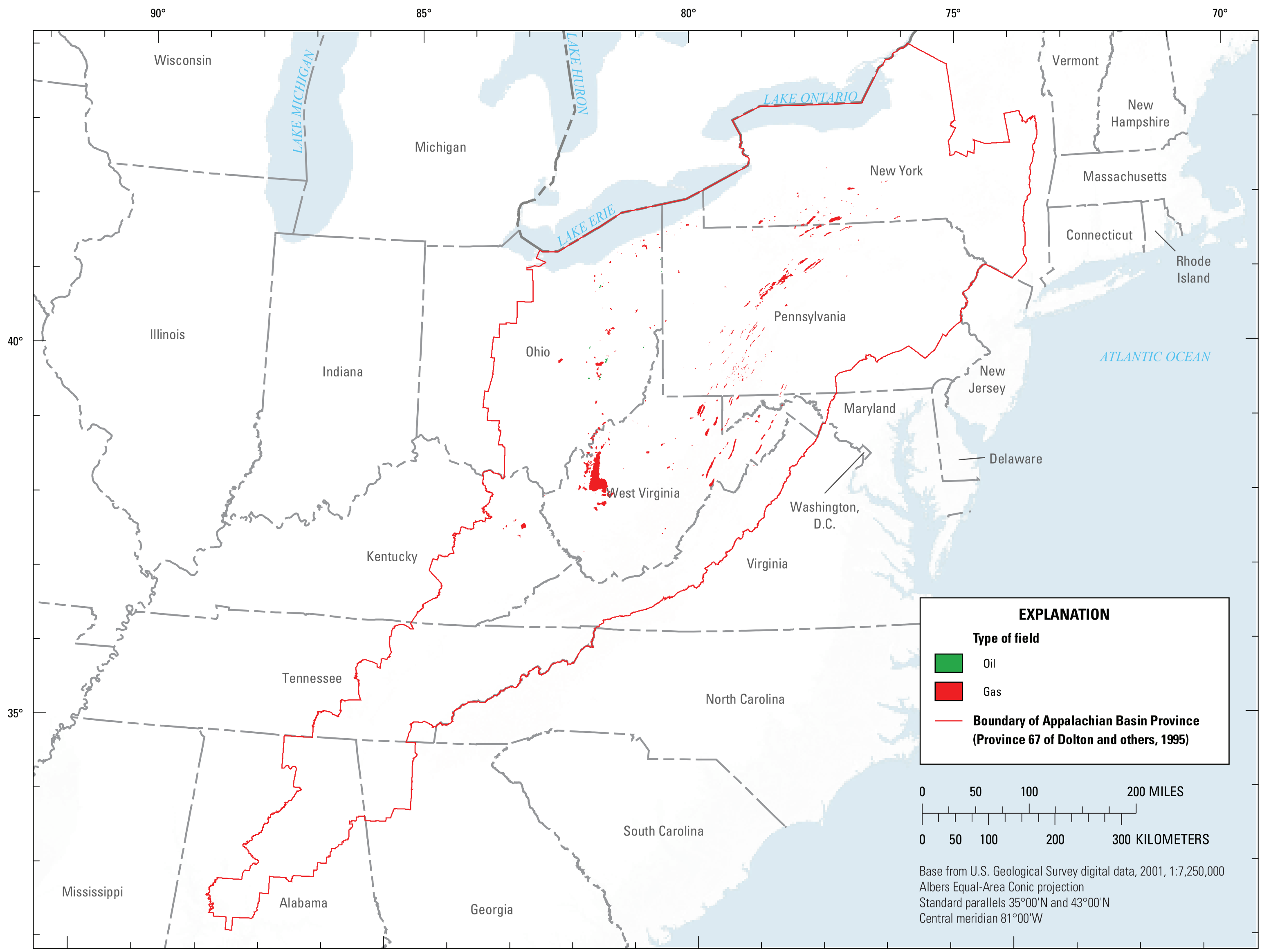

Figure 6. Oil and gas fields in the Lower Devonian Oriskany Sandstone and the Middle Devonian Huntersville Chert. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Devonian Shale-Middle and Upper Paleozoic Total Petroleum System. Assessment units as defined in Milici and others (2003): Oriskany Sandstone–Structural and Oriskany Sandstone–Stratigraphic Assessment Units. Accumulation type as defined in Milici and others (2003): Conventional.

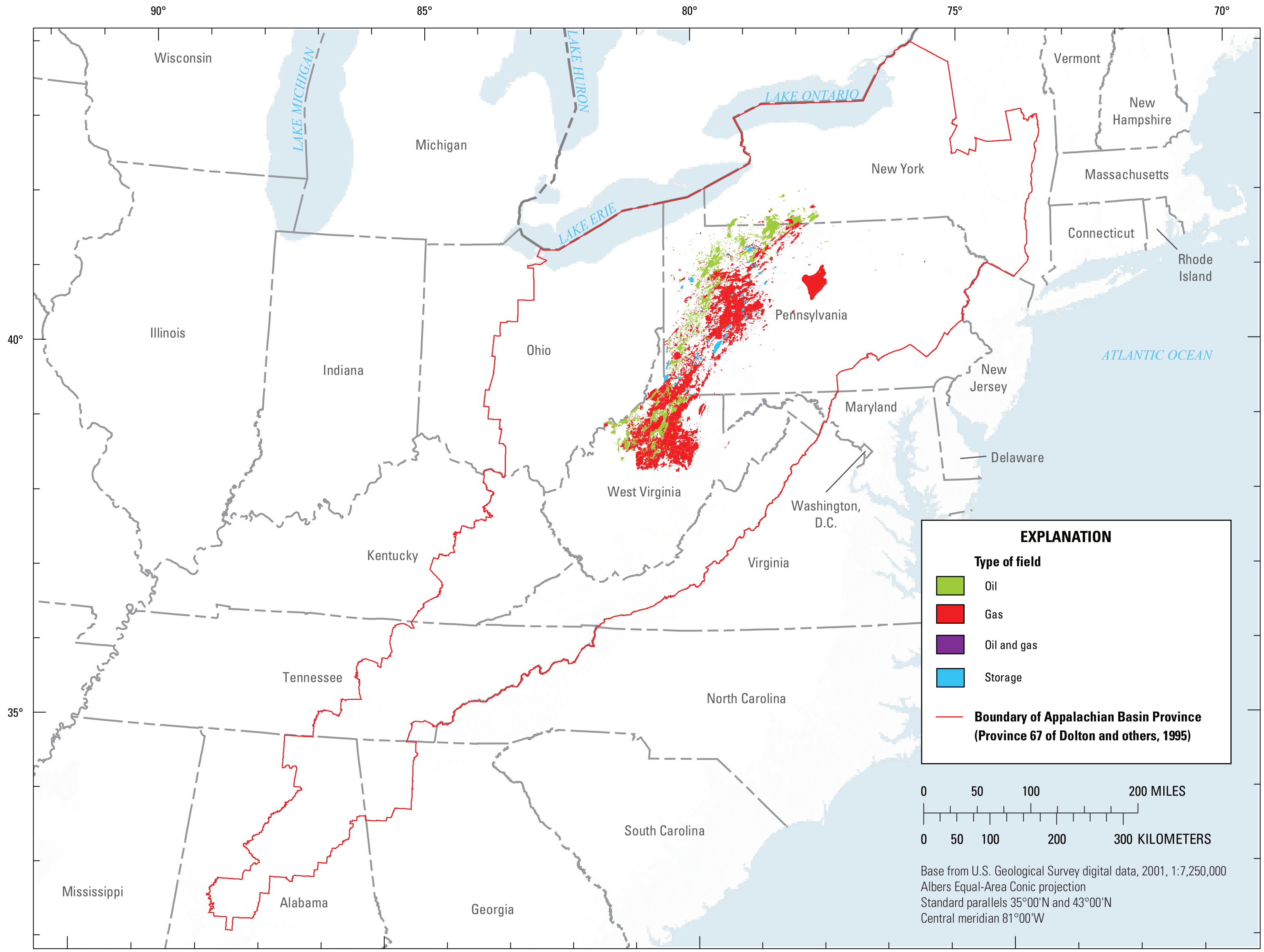

Figure 7. Oil and gas fields in Upper Devonian sandstone reservoirs. Click here to see the names of these oil and gas fields and selected attributes. Total petroleum system as defined in Milici and others (2003): Devonian Shale-Middle and Upper Paleozoic Total Petroleum System. Assessment unit as defined in Milici and others (2003): Catskill Sandstones and Siltstones Assessment Unit. Accumulation type as defined in Milici and others (2003): Continuous.