

Assessment of Undiscovered Oil and Gas Resources in the Cherokee Platform Province Area of Kansas, Oklahoma, and Missouri, 2015

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean volumes of undiscovered, technically recoverable resources of 463 million barrels of oil, 11.2 trillion cubic feet of gas, and 35 million barrels of natural gas liquids in the Cherokee Platform Province area of Kansas, Oklahoma, and Missouri.

Introduction

As part of the U.S. Geological Survey's (USGS) National and Global Petroleum Assessment Project, the USGS completed an assessment of the conventional and continuous (unconventional) oil and gas resources in the area of the Cherokee Platform Province (fig. 1). The area lies in southeastern Kansas, northeastern Oklahoma, and southwestern Missouri. This assessment is based on the geologic characteristics of each total petroleum system (TPS) defined in this assessment. These geologic characteristics include information on the hydrocarbon source rocks, reservoir rocks, and hydrocarbon traps. In this study, three TPSs were defined and within these three are four assessment units (AUs). The assessment input data for each AU are shown in table 1.

Total Petroleum Systems

Three TPSs were defined for the Cherokee Platform Province area: (1) Paleozoic Composite TPS, (2) Woodford/Chattanooga TPS, and (3) Desmoinesian Coal TPS (table 2). The primary hydrocarbon source rock for the Paleozoic Composite TPS is the Woodford/Chattanooga Shale. Additional minor sources of hydrocarbons include Middle Ordovician shale and limestone and thin Middle and Upper Pennsylvanian marine black shale. Both the Woodford/Chattanooga TPS and the Desmoinesian Coal TPS are self-sourced. The Paleozoic Composite TPS contains conventional hydrocarbon resources, whereas the Woodford/Chattanooga Shale and Desmoinesian Coal TPSs contain continuous resources.

Assessment Units

The four AUs identified in this assessment include: (1) Paleozoic Conventional AU, (2) Woodford Biogenic Gas AU, (3) Woodford Shale Oil AU, and (4) Desmoinesian Coalbed Gas AU (fig. 1). The oldest producing well in the Paleozoic Conventional AU was drilled in 1900, and most of the historical production has been from sandstone reservoirs in the Middle Pennsylvanian Cherokee Group (Nehring Associates, 2014). The Woodford Biogenic Gas AU is located in the east-central portion of the Cherokee Platform Province and is restricted to where the Woodford/Chattanooga Shale is at depths of 1,250 feet or shallower. Most of the gas produced from this AU has been from Wagoner County, Oklahoma. The

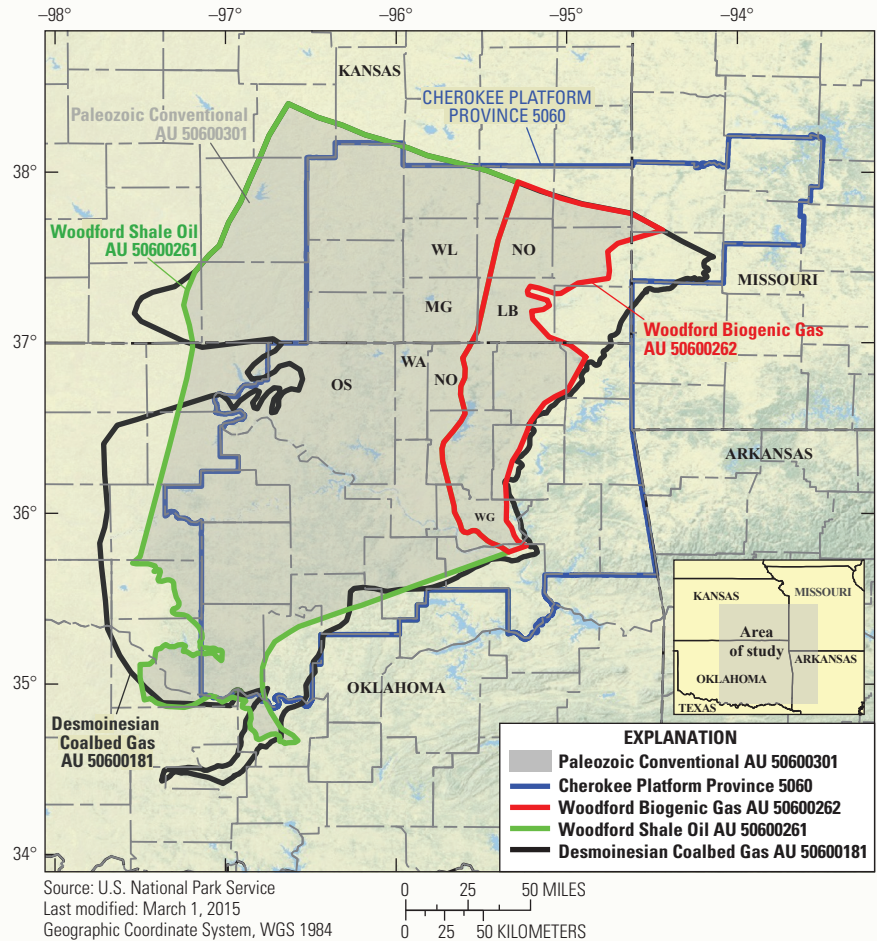


Figure 1. Location of the Cherokee Platform Province 5060 and the conventional and continuous oil and gas assessment unit boundaries. [AU, assessment unit; WG, Wagoner County; OS, Osage County; WA, Washington County; NO, Nowata County; WL, Wilson County; NO, Neosho County; MG, Montgomery County; LB, Labette County]

Woodford Shale Oil AU covers parts of southeastern Kansas and northeastern Oklahoma. Most production in this AU has been from oil accumulations in the southwestern part of the AU. The Desmoinesian Coalbed Gas AU boundary is defined by Desmoinesian outcrop (East, 2013), net coal thickness (Peterson and Jacobs, 1997), and borehole data (Cherokee Group coalbed stratigraphic tops data from IHS Energy, 2014). Most gas production from this AU is from Montgomery, Wilson, Neosho, and Labette Counties in Kansas, and Nowata, Washington, and Osage Counties in Oklahoma (IHS Energy, 2014) (fig. 1). Within the Desmoinesian Coalbed Gas AU, a sweet spot area was delineated based a 10 foot or greater net coal thickness.

Resource Summary

The USGS methodology for predicting undiscovered volumes of hydrocarbons (Charpentier and Cook, 2011) was used to quantitatively assess oil and gas resources in one conventional AU and three continuous AUs in the Cherokee Platform Province area (table 2). Total mean volumes of conventional resources in the Paleozoic Conventional AU are 3 million barrels of oil (MMBO), 140 billion cubic feet of gas (BCFG), and 4 million barrels of natural gas liquids (MMBNGL). For the three continuous AUs, the total mean volumes are 460 MMBO (continuous oil), 11,104 BCFG (shale gas, biogenic gas, and coalbed gas), and 31 MMBNGL.

Table 1. Key assessment input data for the three continuous and one conventional assessment units in the Cherokee Platform Province area.

[EUR (estimated ultimate recovery per well); MMBO, million barrels of oil; BCFG, billion cubic feet of gas; AU, assessment unit, %, percent. The average EUR input is the minimum, median, maximum, and calculated mean]

Assessment input data				
Woodford Shale Oil AU	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	3,000,000	6,000,000	11,500,000	6,833,333
Average drainage area of wells (acres)	120	160	200	160
Percentage of total AU area that is untested (%)	96	98	100	98.0
Success ratio (%)	15	30	50	31.7
Average EUR (MMBO)	0.02	0.03	0.12	0.035
Woodford Biogenic Gas AU	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	100,000	350,000	2,480,000	976,667
Average drainage area of wells (acres)	60	80	100	80
Percentage of total AU area that is untested (%)	90	95	100	95.0
Success ratio (%)	10	30	50	30.0
Average EUR (BCFG)	0.06	0.11	0.3	0.12
Desmoinesian Coalbed Gas AU	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	5,000,000	5,500,000	16,976,000	9,158,667
Average drainage area of wells (acres)	60	80	160	100
Percentage of total AU area that is untested (%)	88	92	96	92.0
Percentage of untested AU area in sweet spots (%)	50	90	95	78.3
Success ratio (%) in sweet spots	75	85	95	85.0
Average EUR (MMBO) in sweet spots	0.06	0.15	0.6	0.175
Success ratio (%) in nonsweet spots	5	10	20	11.7
Average EUR (MMBO) in nonsweet spots	0.03	0.1	0.5	0.122
Undiscovered fields				
Paleozoic Conventional AU	Minimum	Mode	Maximum	Calculated mean
Number of oil fields	1	3	10	3.2
Number of gas fields	1	15	40	15.8
Sizes of oil fields (MMBO)	0.5	0.8	3	0.9
Sizes of gas fields (BCFG)	3	7	60	8.7

Table 2. Assessment results for conventional and continuous oil and gas resources in the Cherokee Platform Province area. [MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids; TPS, total petroleum system; AU, assessment unit. Results shown are fully risked estimates. For gas accumulations, all liquids are included under the NGL (natural gas liquids) category. F95 represents a 95 percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Shading indicates not applicable]

Total Petroleum Systems (TPSs) and Assessment Units (AUs)	AU probability	Accumulation type	Total undiscovered resources											
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Desmoinesian Coal TPS														
Desmoinesian Coalbed Gas AU	1.0	Gas					4,123	8,691	20,590	10,044	4	18	61	23
Woodford/Chattanooga TPS														
Woodford Shale Oil AU	1.0	Oil	195	403	924	460	246	553	1,345	644	2	6	16	7
Woodford Biogenic Gas AU	1.0	Gas					90	341	993	416	0	0	2	1
Total continuous resources			195	403	924	460	4,459	9,585	22,928	11,104	6	24	79	31
Paleozoic Composite TPS														
Paleozoic Conventional AU	1.0	Oil	1	3	5	3	0	2	8	3	0	0	0	0
		Gas					72	130	229	137	2	4	7	4
Total conventional resources			1	3	5	3	72	132	237	140	2	4	7	4
Total undiscovered resources			196	406	929	463	4,531	9,717	23,165	11,244	8	28	86	35

References Cited

- Charpentier, R.R., and Cook, T.A., 2011, USGS methodology for assessing continuous petroleum resources: U.S. Geological Survey Open-File Report 2011–1167, 75 p., available at <http://pubs.usgs.gov/of/2011/1167/>.
- East, J.A., 2013, Coal fields of the conterminous United States—National coal resource assessment updated version: U.S. Geological Survey Open-File Report 2012–1205, 1 sheet, scale 1:5,000,000, available at <http://pubs.usgs.gov/of/2012/1205/>.
- IHS Energy, 2014, International petroleum exploration and production database [current through December 2014]: Available from IHS Energy, 15 Inverness Way East, Englewood, CO 80112.
- Nehring Associates, Inc., 2014 [data current as of December 2014], The significant oil and gas fields of the United States: Database available from Nehring Associates, Inc., P.O. Box 1655, Colorado Springs, CO 80901.
- Peterson, K., and Jacobs, L.M., 1997, Coalbed methane, a viable resource—Osage Mineral Estate: Oklahoma City Geological Society Shale Shaker, v. 48, p. 67–78.

For Further Information

Assessment results are available at the USGS Central Energy Resources Science Center Web site: <http://energy.cr.usgs.gov/oilgas/noga/>.

Cherokee Platform Province Assessment Team

Ronald M. Drake II (task leader; rmdrake@usgs.gov), Joseph R. Hatch, Christopher J. Schenk, Ronald R. Charpentier, Timothy R. Klett, Phuong A. Le, Heidi M. Leathers, Michael E. Brownfield, Stephanie B. Gaswirth, Kristen R. Marra, Janet K. Pitman, Christopher J. Potter, and Marilyn E. Tennyson.