

Assessment of Undiscovered Oil and Gas Resources in Sandstone Reservoirs of the Cotton Valley Group, U.S. Gulf Coast, 2015

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered mean volumes of 14 million barrels of conventional oil, 430 billion cubic feet of conventional gas, 34,028 billion cubic feet of continuous gas, and a mean total of 391 million barrels of natural gas liquids in sandstone reservoirs of the Upper Jurassic–Lower Cretaceous Cotton Valley Group in onshore lands and State waters of the U.S. Gulf Coast region.

Introduction

The U.S. Geological Survey (USGS) assessed undiscovered oil and gas resources in sandstone reservoirs of the Upper Jurassic–Lower Cretaceous (Tithonian–Berriasian) Cotton Valley Group, which is present in the subsurface in an arcuate belt from south Texas to the Florida Panhandle. The USGS conducts geology-based assessments of undiscovered petroleum by evaluating components of a total petroleum system (TPS), including source and reservoir rocks, seals and traps, and the geohistory of petroleum products. Strata in each assessment unit (AU) share similar stratigraphic, structural, and petroleum-charge histories. The USGS defined four AUs for the Cotton Valley Group in the Upper Jurassic–Cretaceous–Tertiary Composite TPS for the onshore lands and State waters of the U.S. Gulf Coast region (fig. 1).

Geologic Model for Assessment

Potential reservoirs in the Cotton Valley Group include fluvial-deltaic and shallow-marine “blanket” sandstones of moderate to high porosity and permeability and their “massive” downdip counterparts with lower porosity and permeability (Eoff and others, in press). The Upper Jurassic Smackover, Haynesville, and Bossier Formations were likely sources of oil and gas. Seals are intraformational mudstone or thin limestone, and the Knowles Limestone is a regional seal. Traps are stratigraphic, structural, or in combination, but low-permeability reservoirs can retain petroleum in the absence of well-defined closures.

Assessment Units

Three AUs were assessed for conventional oil and gas accumulations, and one AU was assessed as a continuous gas accumulation (fig. 1). Two of the AUs overlap in east Texas

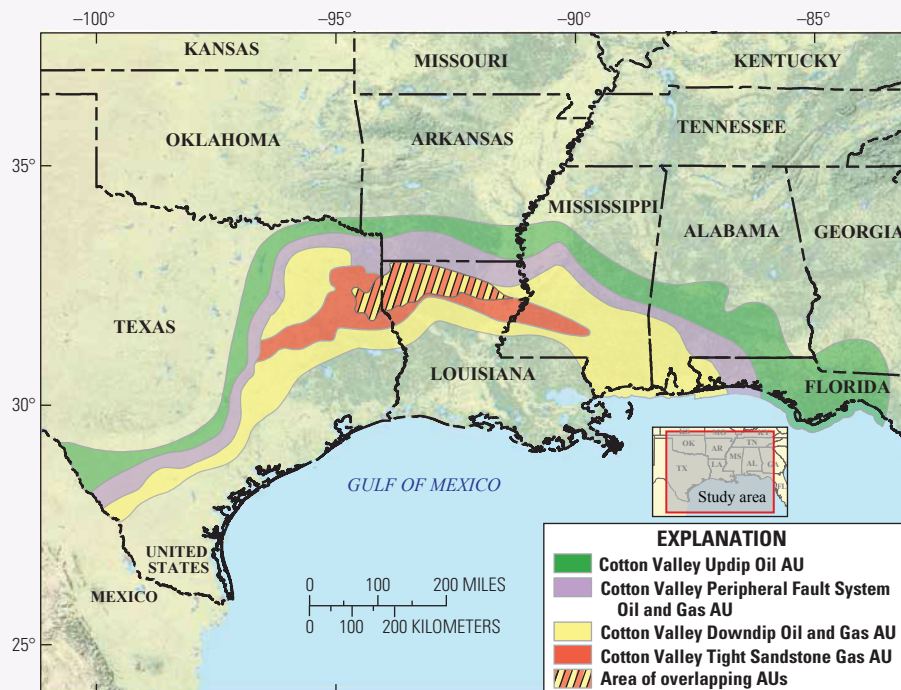


Figure 1. Map of the U.S. portion of the Gulf of Mexico Basin with the four assessment units (AUs) in the Cotton Valley Group.

and north Louisiana; production data from separate volumes of rock were assigned to each to estimate their respective resources. Table 1 lists key input data used to predict volumes of undiscovered petroleum in the four AUs.

The Cotton Valley Updip Oil AU is present between the updip limit of the Cotton Valley Group and a regional system of faults. No production has been reported to date, so migration pathways and trapping mechanisms remain uncertain. Potential conventional accumulations would be expected in paralic or fluvial-deltaic sandstone of the Schuler Formation.

The Cotton Valley Peripheral Fault System Oil and Gas AU forms an envelope around the peripheral fault system. The downdip boundary of the AU corresponds to the outer margins of the East Texas Basin and the North Louisiana and Mississippi Salt Basins, and it approximates the updip limit of thick Middle Jurassic salt in areas between the basins. Reservoirs are predominantly of paralic and fluvial-deltaic facies.

The Cotton Valley Downdip Oil and Gas AU includes the aforementioned salt basins and intervening areas not included in other AUs. The southern boundary of the AU corresponds to the approximate downdip limit of sandstone. Reservoirs are fluvial-deltaic and marine

sandstones, including the “blanket” tongues of sandstone. Oil and gas accumulations are associated with low-amplitude salt-related structures along basin margins.

The Cotton Valley Tight Sandstone Gas AU is mapped accordant with the distribution of low-porosity, low-permeability “massive” units of the Terryville Sandstone. It extends from the southwest corner of the East Texas Basin across the Sabine uplift area and northern Louisiana into southern Mississippi.

Resource Summary

The USGS assessed undiscovered oil and gas resources for three conventional AUs and one continuous AU defined for sandstone reservoirs of the Cotton Valley Group, resulting in estimated mean volumes of 14 million barrels of oil (MMBO) and 34,458 billion cubic feet of gas (BCFG) (table 2). These estimates include mean oil resources from the Cotton Valley Updip Oil AU (1 MMBO), the Cotton Valley Peripheral Fault System Oil and Gas AU (2 MMBO), and the Cotton Valley Downdip Oil and Gas AU (11 MMBO). Mean conventional and continuous gas resources are 430 BCFG and 34,028 BCFG, respectively, with the latter estimate for the Cotton Valley Tight Sandstone Gas AU.

Table 1. Key assessment input data for three conventional assessment units and one continuous assessment unit in the Cotton Valley Group.

[AU, assessment unit; EUR, estimated ultimate recovery per well; MMBO, million barrels of oil; BCFG, billion cubic feet of gas; %, percent. The average EUR input is the minimum, median, maximum, and calculated mean. Gray shading indicates not applicable]

Assessment input data—Conventional AUs				
Cotton Valley Updip Oil AU	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	7	15	7.23
Number of gas fields	0	0	0	0.00
Sizes of oil fields (MMBO)	0.5	0.7	10	0.92
Sizes of gas fields (BCFG)				
AU probability	0.20			
Cotton Valley Peripheral Fault System Oil and Gas AU	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	3	11	3.28
Number of gas fields	0	0	0	0.00
Sizes of oil fields (MMBO)	0.5	0.7	3	0.78
Sizes of gas fields (BCFG)				
AU probability	0.90			
Cotton Valley Downdip Oil and Gas AU	Minimum	Median	Maximum	Calculated mean
Number of oil fields	0	5	20	5.52
Number of gas fields	1	25	100	27.55
Sizes of oil fields (MMBO)	0.5	1.5	20	2.07
Sizes of gas fields (BCFG)	3	10	200	15.37
AU probability	1.00			
Assessment input data—Continuous AU				
Cotton Valley Tight Sandstone Gas AU	Minimum	Median	Maximum	Calculated mean
Potential production area of AU (acres)	2,000,000	3,000,000	12,869,000	5,956,333
Average drainage area of wells (acres)	40	120	180	113
Percentage of total AU area that is untested (%)	85	90	95	90.0
Success ratio (%)	50	70	80	66.7
Average EUR (BCFG)	0.8	1	1.2	1.007
AU probability	1.0			

Table 2. Assessment results for three conventional assessment units and one continuous assessment unit in the Cotton Valley Group.

[TPS, total petroleum system; AU, assessment unit; MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids. For gas accumulations, all liquids are included as NGL (natural gas liquids). Results shown are fully risked estimates. 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. Gray shading indicates not applicable]

Total petroleum system (TPS) and assessment units (AUs)	AU prob- ability	Accu- mulation type	Total undiscovered resources											
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Upper Jurassic–Cretaceous–Tertiary Composite TPS														
Cotton Valley Updip Oil AU	0.2	Oil	0	0	8	1	0	0	4	1	0	0	0	0
		Gas					0	0	0	0	0	0	0	0
Cotton Valley Peripheral Fault System Oil and Gas AU	0.9	Oil	0	2	5	2	0	1	3	1	0	0	0	0
		Gas					0	0	0	0	0	0	0	0
Cotton Valley Downdip Oil and Gas AU	1.0	Oil	3	10	24	11	2	6	16	7	0	0	1	0
		Gas					162	380	821	421	2	4	10	5
Total conventional resources			3	12	37	14	164	387	844	430	2	4	11	5
Upper Jurassic–Cretaceous–Tertiary Composite TPS														
Cotton Valley Tight Sandstone Gas AU	1.0	Gas					13,128	30,152	67,775	34,028	126	328	837	386
Total unconventional resources							13,128	30,152	67,775	34,028	126	328	837	386
Total undiscovered resources			3	12	37	14	13,292	30,539	68,619	34,458	128	332	848	391

Reference Cited

Eoff, J.D., Dubiel, R.F., Pearson, O.N., and Whidden, K.J., in press, Geologic framework for the assessment of undiscovered oil and gas resources in sandstone reservoirs of the Upper Jurassic–Lower Cretaceous Cotton Valley Group, U.S. Gulf of Mexico region: Gulf Coast Association of Geological Societies Transactions, v. 65.

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For Additional Information

Assessment results also are available at the USGS Energy Resources Program Web site (<http://energy.usgs.gov>).