

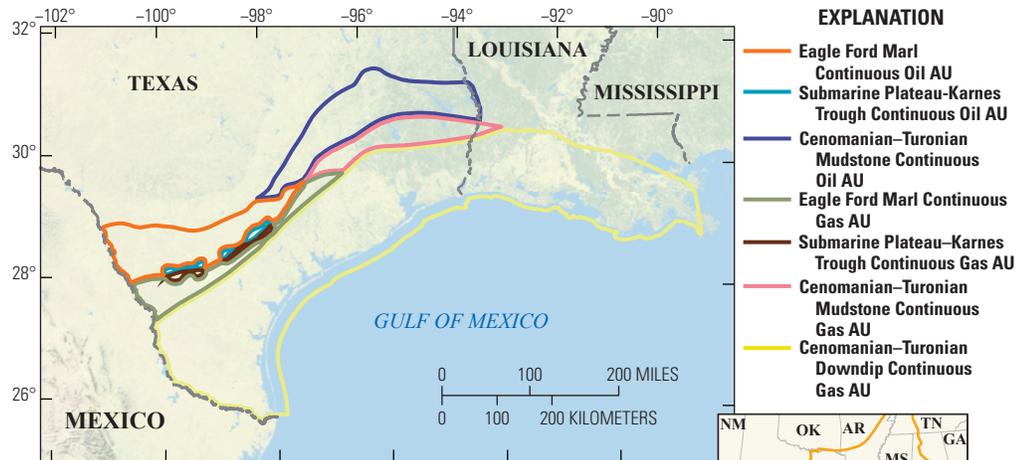
U.S. Gulf Coast Petroleum Systems Project

# Assessment of Undiscovered Oil and Gas Resources in the Eagle Ford Group and Associated Cenomanian–Turonian Strata, U.S. Gulf Coast, Texas, 2018

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 8.5 billion barrels of oil and 66 trillion cubic feet of gas in continuous accumulations in the Upper Cretaceous Eagle Ford Group and associated Cenomanian–Turonian strata in onshore lands of the U.S. Gulf Coast region, Texas.

## Introduction

The U.S. Geological Survey (USGS) assessed undiscovered, technically recoverable hydrocarbon resources in self-sourced continuous reservoirs of the Upper Cretaceous Eagle Ford Group and associated Cenomanian–Turonian strata, which are present in the subsurface across the U.S. Gulf Coast region, Texas (fig. 1). The USGS completes geology-based assessments using the elements of the total petroleum system (TPS), which include source rock thickness, organic richness, and thermal maturity for self-sourced continuous accumulations. Assessment units (AUs) within a TPS are defined by strata that share similar structural and petroleum-charge histories along with lithology and stratigraphy.

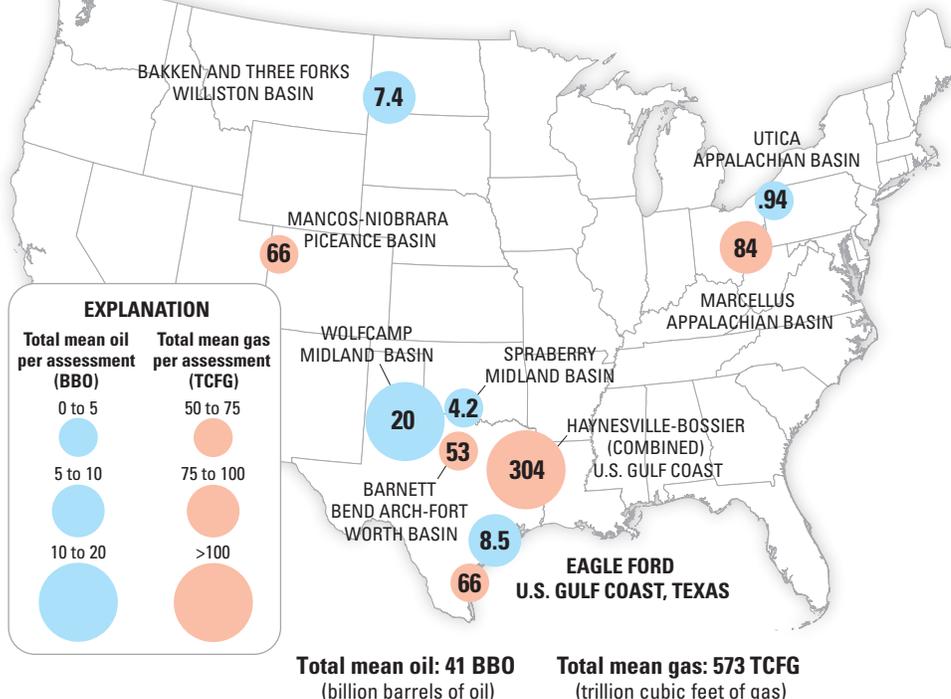


Base map from U.S. Department of the Interior National Park Service

**Figure 1.** Map showing the extent of the seven assessment units (AUs) in the Eagle Ford Group and associated Cenomanian–Turonian strata in the U.S. Gulf Coast region, Texas.

Upper Jurassic–Cretaceous–Tertiary Composite Total Petroleum System boundary (part) shown in orange.

## Top five USGS assessment results for mean continuous oil and gas resources (Undiscovered, technically recoverable resources)



## Total Petroleum System and Geologic Models for Assessment

The Eagle Ford Group contains one of the most prolific continuous accumulations of oil and gas in the United States (fig. 2); its composition is predominantly mudstone and calcareous mudstone (marl) with organic-rich intervals. These marine strata were deposited in outer shelf and upper slope environments during the Cenomanian–Turonian ages (Denne and Breyer, 2016). The assessed rock interval

**Figure 2.** Bubble map showing the relative sizes of the top five U.S. Geological Survey assessment results through 2018 for continuous oil and gas resources in the United States. Quantitative assessment results are from Coleman and others (2011), Kirschbaum and others (2012), Gaswirth and others (2013, 2016), Marra and others (2015, 2017), Hawkins and others (2016), and Paxton and others (2017a, b).

includes mudstone strata that may be slightly older than Eagle Ford Group strata but are not well understood in terms of age or distribution. Therefore, these units are referred to as “associated Cenomanian–Turonian strata.” To better capture the resource heterogeneity of this interval, Eagle Ford Group marl strata are defined as having less than 25 percent clay, and Cenomanian–Turonian mudstone strata are defined as having more than 25 percent clay, based on work by Donovan and others (2017). The Eagle Ford Group and associated Cenomanian–Turonian strata are part of the Upper Jurassic–Cretaceous–Tertiary Composite TPS in onshore lands of the U.S. Gulf Coast region, Texas (Dubiel and others, 2012).

### Assessment Units

Seven continuous AUs (fig. 1) were defined for the Eagle Ford Group and associated Cenomanian–Turonian strata across the study area, based on lithology, stratal thickness, thermal maturity,

regional geologic features, and spatial distribution of productive fairways.

The Eagle Ford Marl Continuous Oil AU is defined by the United States–Mexico border, the 25-percent-clay line, and the thermal maturity window for oil (0.6–1.3 percent modeled vitrinite reflectance) (fig. 1). Within this AU is the Submarine Plateau–Karnes Trough Continuous Oil AU, which is an area of thicker Eagle Ford Group strata (greater than 120 feet), as mapped by Hammes and others (2016) (fig. 1). The thicker interval is interpreted to have provided additional source rock and reservoir potential. The Cenomanian–Turonian Mudstone Continuous Oil AU is bounded by the 25-percent-clay line, the eastern extent of production of Cenomanian–Turonian oil (at about the Texas–Louisiana State line), and the thermal maturity window for oil (0.6–1.3 percent modeled vitrinite reflectance) (fig. 1).

The Eagle Ford Marl Continuous Gas AU is defined by the United

States–Mexico border, the 25-percent-clay line, the updip limit of gas generation (1.3 percent modeled vitrinite reflectance), and the Lower Cretaceous shelf margin as illustrated by Donovan and others (2015) (fig. 1). The Submarine Plateau–Karnes Trough Continuous Gas AU is defined as the area within the Eagle Ford Marl Continuous Gas AU that has Eagle Ford Group strata greater than 120 feet thick, which is interpreted to have additional source rock and reservoir potential. The Cenomanian–Turonian Mudstone Continuous Gas AU is defined by the 25-percent-clay line, the updip limit of gas generation (1.3 percent modeled vitrinite reflectance), and the outboard expression of the Upper Cretaceous shelf margin as illustrated by Galloway (2008) (fig. 1). The Cenomanian–Turonian Downdip Continuous Gas AU (fig. 1), which extends to the State–Federal waters boundary, was not quantitatively assessed because of a lack of data.

Table 1 lists input data used to calculate undiscovered resources in the six quantitatively assessed AUs.

**Table 1.** Key input data for six assessment units in the Eagle Ford Group and associated Cenomanian–Turonian strata in the U.S. Gulf Coast region, Texas.

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

Assessment input data— Continuous AUs	Eagle Ford Marl Continuous Oil AU				Submarine Plateau–Karnes Trough Continuous Oil AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	3,783,000	5,021,000	5,661,000	4,821,667	320,000	406,000	497,000	407,667
Average drainage area of wells (acres)	60	100	120	93.3	60	100	120	93.3
Percentage of area untested in AU	63	73	76	70.7	4	22	36	20.7
Success ratio (%)	85	90	95	90	95	97	99	97
Average EUR (MMBO)	0.05	0.15	0.3	0.156	0.11	0.2	0.35	0.207
AU probability	1.0				1.0			
Assessment input data— Continuous AUs	Cenomanian–Turonian Mudstone Continuous Oil AU				Eagle Ford Marl Continuous Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	2,600,000	4,210,000	7,270,000	4,693,333	1,100,000	2,000,000	2,850,000	1,983,333
Average drainage area of wells (acres)	80	120	140	113.3	80	120	140	113.3
Percentage of area untested in AU	97	98	99	98	88	93	95	92
Success ratio (%)	50	70	90	70	80	85	90	85
Average EUR (MMBO, oil; BCFG, gas)	0.01	0.11	0.2	0.113	1	2.5	4.5	2.579
AU probability	1.0				1.0			
Assessment input data— Continuous AUs	Submarine Plateau–Karnes Trough Continuous Gas AU				Cenomanian–Turonian Mudstone Continuous Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	270,000	372,000	436,000	359,333	1,000	1,500,000	3,000,000	1,500,333
Average drainage area of wells (acres)	80	120	140	113.3	120	140	160	140
Percentage of area untested in AU	84	88	90	87.3	100	100	100	100
Success ratio (%)	90	95	99	94.7	10	50	90	50
Average EUR (BCFG)	1.5	3	5	3.079	0.3	0.9	3	1.012
AU probability	1.0				1.0			

## Undiscovered Resources Summary

The USGS assessed undiscovered, technically recoverable oil and gas resources for six continuous AUs in the Eagle Ford Group and associated Cenomanian–Turonian strata, U.S. Gulf Coast region, Texas (table 2). The estimated mean totals for oil and gas resources in the Eagle Ford Marl, Submarine Plateau–Karnes Trough, and Cenomanian–Turonian Mudstone Continuous Oil and Gas AUs are 8,515 million barrels of oil (MMBO), or 8.5 billion barrels of oil, with an F95–F5 range from 5,266 to 12,846 MMBO; 65,981 billion cubic feet of gas (BCFG), or 66 trillion cubic feet of gas, with an F95–F5 range from 37,984 to 104,048 BCFG; and 1,891 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 1,032 to 3,093 MMBNGL (table 2). These assessment results for the Eagle Ford Group and associated Cenomanian–Turonian strata are among the top five largest continuous resources for both oil and gas assessed by the USGS in the United States (fig. 2).



**Table 2.** Results for six assessment units in the Eagle Ford Group and associated Cenomanian–Turonian strata in the U.S. Gulf Coast region, Texas.

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of 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. Shading indicates not applicable]

Total petroleum system 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
Upper Jurassic–Cretaceous–Tertiary Composite Total Petroleum System														
Eagle Ford Marl Continuous Oil AU	1.0	Oil	3,397	4,962	7,443	5,129	5,689	9,810	16,328	10,240	100	192	354	205
Submarine Plateau–Karnes Trough Continuous Oil AU	1.0	Oil	77	178	302	182	223	526	941	546	6	15	30	16
Cenomanian–Turonian Mudstone Continuous Oil AU	1.0	Oil	1,792	3,064	5,101	3,204	3,134	6,008	11,037	6,412	56	118	236	128
<b>Total undiscovered continuous oil resources</b>			<b>5,266</b>	<b>8,204</b>	<b>12,846</b>	<b>8,515</b>	<b>9,046</b>	<b>16,344</b>	<b>28,306</b>	<b>17,198</b>	<b>162</b>	<b>325</b>	<b>620</b>	<b>349</b>
Eagle Ford Marl Continuous Gas AU	1.0	Gas					21,922	34,303	52,061	35,304	614	1,019	1,634	1,057
Submarine Plateau–Karnes Trough Continuous Gas AU	1.0	Gas					5,908	7,943	10,843	8,100	224	316	449	324
Cenomanian–Turonian Mudstone Continuous Gas AU	1.0	Gas					1,108	4,464	12,838	5,379	32	132	390	161
Cenomanian–Turonian Downdip Continuous Gas AU		Gas	Not quantitatively assessed											
<b>Total undiscovered continuous gas resources</b>							<b>28,938</b>	<b>46,710</b>	<b>75,742</b>	<b>48,783</b>	<b>870</b>	<b>1,467</b>	<b>2,473</b>	<b>1,542</b>
<b>Total undiscovered continuous resources</b>			<b>5,266</b>	<b>8,204</b>	<b>12,846</b>	<b>8,515</b>	<b>37,984</b>	<b>63,054</b>	<b>104,048</b>	<b>65,981</b>	<b>1,032</b>	<b>1,792</b>	<b>3,093</b>	<b>1,891</b>



Upper Eagle Ford Group at Lozier Canyon, near Del Rio, Texas. Photograph by Stanley T. Paxton, U.S. Geological Survey.

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Banner image shows organic-rich (darker) interval in the lower Eagle Ford Group at Lozier Canyon, near Del Rio, Texas. Photograph by Stanley T. Paxton, U.S. Geological Survey.

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### For More Information

Assessment results are also available at the USGS Energy Resources Program website at <https://energy.usgs.gov>.