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National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources in the Buda Limestone of Texas, 2025

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean conventional resources of 12 million barrels of oil and 184 billion cubic feet of gas in the Buda Limestone of Texas.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in the Upper Cretaceous (Cenomanian) Buda Limestone of Texas (fig. 1). Two assessment units (AUs) were defined that broadly encompass and expand upon the 1995 Buda Fault Zone Oil Play AU and Buda Downdip Oil Play AU (Schenk and Viger, 1996) to include the East Texas Basin Province and separate the Buda Limestone from the Fredericksburg-Buda Carbonate Platform-Reef Gas and Oil AU (Dubiel and others, 2011; Swanson and others, 2017).

The Buda Limestone is a widely extensive, 30–160-foot-thick, low-energy, coccolith-rich limestone that represents flooding of the Comanche shelf by shallow-marine seas (Rose, 2016; Loucks and others, 2019; Valencia and others, 2021). It was deposited on the Del Rio Formation and is overlain by the Eagle Ford Group, both of which are Upper Cretaceous (fig. 2). North of the San Marcos Arch and into the East Texas Basin Province, the Upper Cretaceous Woodbine Formation was deposited on the Buda Limestone and is overlain by the Eagle Ford Group. In the East Texas Basin Province, the Upper Cretaceous Maness Shale, which is absent in the northern part of the basin (Scott, 1948; Wendlandt and Shelby, 1948), was deposited onto the Buda Limestone prior to deposition of the Woodbine Formation. The Buda Limestone is generally described as unconformably bounded (Freeman, 1968; Loucks and others, 2019; Valencia and others, 2022). However, some authors have noted conformable contacts with the underlying formation in central and northeastern Texas (Martin, 1967; Brown, 1971; Mancini and Scott, 2006) and the overlying Maness Shale in the East Texas Basin Province (Lozo, 1951).

Deposition of the Buda Limestone occurred on a broad, low-relief, partially restricted shelf above storm-wave base in western Texas and transitioned to a deep-subtidal depositional environment in southern Texas (Ak, 2015; Minisini and others, 2018; Loucks and others, 2019; Valencia and others, 2021). The Buda Limestone in western Texas is characterized by an informal tripartite subdivision, whereby the lower Lechuguilla and upper Love Station members are limestone with a micritic texture, and the middle Red Light member is an argillaceous, micritic limestone (Freeman, 1968). In central Texas, the Buda Limestone was deposited in a broad, shallow-marine, semirestricted shelf environment (Valencia and others, 2022) that transitions to a nearly open-marine setting approaching the Lower Cretaceous shelf margin in southern Texas (Loucks and others, 2019). The Buda Limestone in central Texas is informally divided into a lower chalky, glauconitic biomicrite member dominated by wackestone and an upper packstone member (Martin, 1967; Valencia and others, 2022).

The Buda Limestone in the East Texas Basin Province is less known; however, it has been described at the Schneider oil and gas field in Wood County, Texas, as a marine reef complex limestone that grew on the south flank of a paleotopographic high (Ravnaas and others, 1992). This structural high resulted from growth of the Hainesville salt dome (Loocke, 1978). The lithologies at this location consist of skeletal wackestones, packstones and grainstones, coral and stromatoporoid boundstones, and skeletal grainstones (Ravnaas and others, 1992) and represent more proximal deposits on the broad carbonate shelf compared to the partially restricted shelf environment of western Texas.

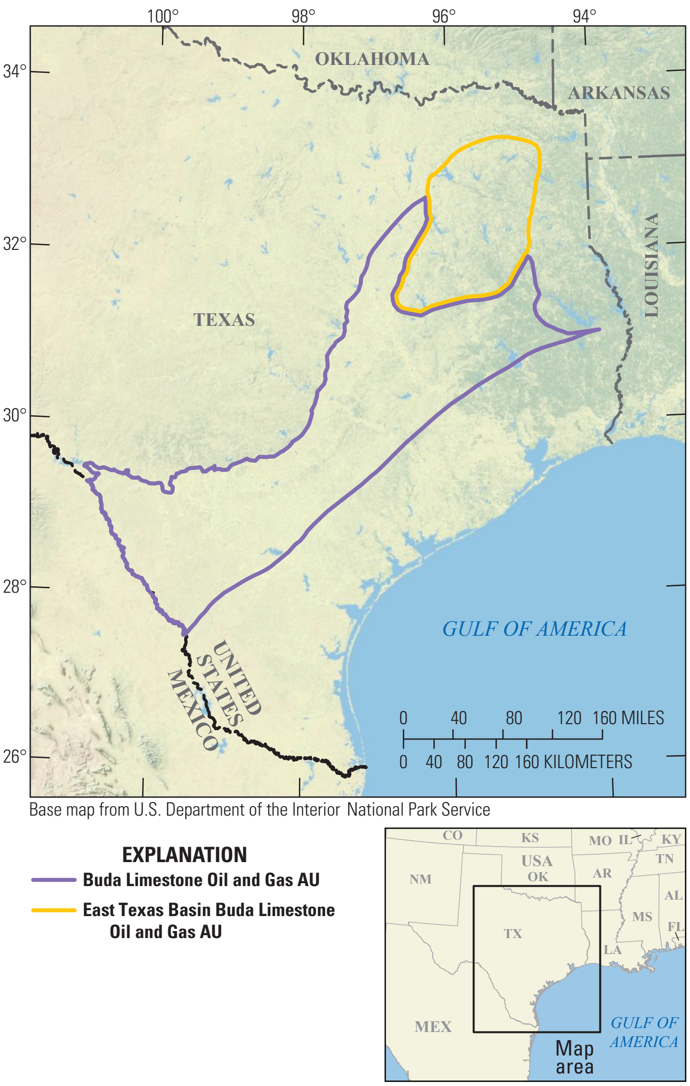

Figure 1. Map showing the location of two conventional oil and gas assessment units (AUs) in the Buda Limestone of Texas.

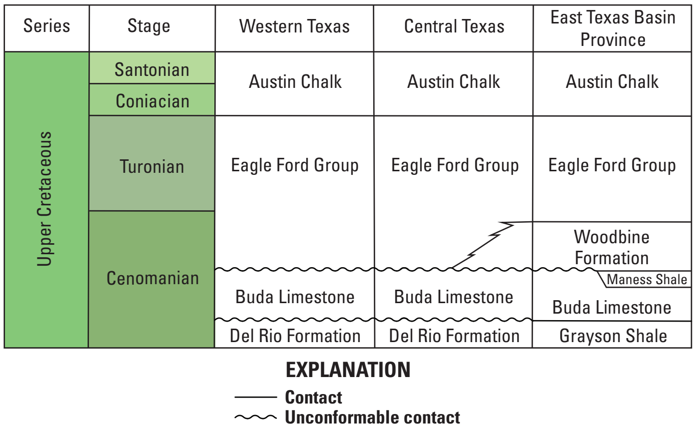

Figure 2. Generalized stratigraphic column of the Upper Cretaceous section, including the Buda Limestone, in western and central Texas and the East Texas Basin Province. Figure modified from Salvador and Quezada-Muñeton (1991) and Valencia and others (2022).

Geologic Model for Assessment

The Eagle Ford Group is considered the primary source of the hydrocarbons that migrated into the Buda Limestone through open faults and associated fractures, though the Upper Jurassic Smackover Formation may have contributed a minor wet-gas charge (Scott, 1977; Dawson, 1986; Baskin and others, 2014; Kornacki and Weissenburger, 2020).

Extensive fractures, abundant microfractures, fault-induced brecciation, or some matrix porosity in this tight limestone are necessary for hydrocarbon accumulation (Stapp, 1977; Dawson, 1986). Accumulation can occur in the Buda Limestone where larger fractures or higher effective porosity and permeability intervals are present and become stratigraphically trapped against an impermeable rock (Stapp, 1977), such as the Eagle Ford Group. Structural traps—such as growth faults or folded anticlines—or a combination of structural and stratigraphic traps also retain the hydrocarbons in the Buda Limestone (Nehring Associates Inc., 2018). Thus, oil production generally occurs where there are fractures caused by stress and compaction over buried structures (Stapp, 1977). Accumulation of hydrocarbons typically occurs in the upper Buda Limestone (Hendy, 1957; Stapp, 1977; Dawson, 1986). In central Texas, the middle part of the Buda Limestone may function as a carrier bed through which downdip hydrocarbons sourced from the Eagle Ford Group migrated updip along faults (Kornacki and Weissenburger, 2020).

Downdip of the Lower Cretaceous shelf edge in southern Texas, the potential for undiscovered oil and gas in the Buda Limestone decreases. Faulting on the reef trend suggests that downdip Eagle Ford Group gas has migrated into the Lower Cretaceous Edwards Formation (Illich and others, 2016).

The geologic model in the East Texas Basin Province is similar to the geologic model described for western and central Texas. However, oil-source typing and thermal maturity of the source rocks suggest that the oil produced from the Buda Limestone in the northern part of the basin may be sourced from Jurassic rocks, whereas to the south, any undiscovered oil may be sourced from the Eagle Ford Group and gas may be sourced from Jurassic-age rocks (Wescott and Hood, 1994). Movement of Middle Jurassic Louann Salt in the East Texas Basin Province resulted in salt diapirs in some locations that were emplaced into the Buda Limestone that may also serve as an additional structural trapping mechanism (Jackson and Harris, 1981; Ravnaas and others, 1992; Nehring Associates Inc., 2018).

Total Petroleum System and Assessment Units

The USGS defined the Upper Jurassic–Cretaceous–Tertiary Composite Total Petroleum System (TPS) and two conventional AUs: the Buda Limestone Oil and Gas AU and the East Texas Basin Buda Limestone Oil and Gas AU. The southeast boundary of the Buda Limestone Oil and Gas AU coincides with the Lower Cretaceous shelf margin. The northern boundary is defined by the updip limit of the Upper Jurassic–Cretaceous–Tertiary Composite TPS, which roughly coincides with the depositional limits and outcropping of the Buda Limestone. The Buda Limestone Oil and Gas AU boundary is further defined by the U.S.-Mexico border to the west and by the Balcones and Mexia-Talco Fault Zones, the East Texas Basin Province, and the absence of the Buda Limestone (S&P Global Commodity Insights, 2023) to the northeast.

The East Texas Basin Buda Limestone Oil and Gas AU boundary is defined by the geometry of the basin, the Mexia-Talco Fault Zone to the west, and the absence of the Buda Limestone (S&P Global Commodity Insights, 2023) to the north and east. Inclusion of the Mexia-Talco Fault Zone accounts for any potential migration out of the basin and trapping along the faults. Key assessment input data for the two defined AUs are shown in table 1 and Lohr (2026).

Table 1. Key input data for two conventional oil and gas assessment units in the Buda Limestone of Texas.

[Gray shading indicates not applicable. AU, assessment unit; MMBO, million barrels of oil; BCFG, billion cubic feet of gas]

Assessment input data—Conventional AUs	Buda Limestone Oil and Gas AU				East Texas Basin Buda Limestone Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	5	10	5.1	1	2	6	2.1
Number of gas fields	1	10	30	10.6	1	2	8	2.2
Size of oil fields (MMBO)	0.5	1	20	1.5	0.5	1	40	1.8
Size of gas fields (BCFG)	3	6	500	13.9	3	6	120	8.9
AU probability	1.0				1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered, technically recoverable conventional oil and gas resources in two AUs in the Buda Limestone of Texas (table 2). The estimated mean resources are 12 million barrels of oil (MMBO), with an F95 to F5 fractile range from 4 to 26 MMBO; 184 billion cubic feet of gas (BCFG), with an F95 to F5 fractile range from 55 to 439 BCFG; and 2 million barrels of natural gas liquids (MMBNGL), with an F95 to F5 fractile range from 0 to 4 MMBNGL.

Table 2. Results for two conventional oil and gas assessment units in the Buda Limestone of Texas.

[Gray shading indicates not applicable. Results shown are fully risked estimates. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids]

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														
Buda Limestone Oil and Gas AU	1.0	Oil	3	7	15	8	5	10	22	11	0	1	1	1
		Gas					43	119	352	147	0	1	1	1
East Texas Basin Buda Limestone Oil and Gas AU	1.0	Oil	1	3	11	4	2	4	16	6	0	0	1	0
		Gas					5	15	49	20	0	0	1	0
Total undiscovered conventional oil and gas resources			**4**	**10**	**26**	**12**	**55**	**148**	**439**	**184**	**0**	**2**	**4**	**2**

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For More Information

Assessment results are also available at the USGS Energy Resources Program website, https://www.usgs.gov/programs/energy-resources-program.

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