

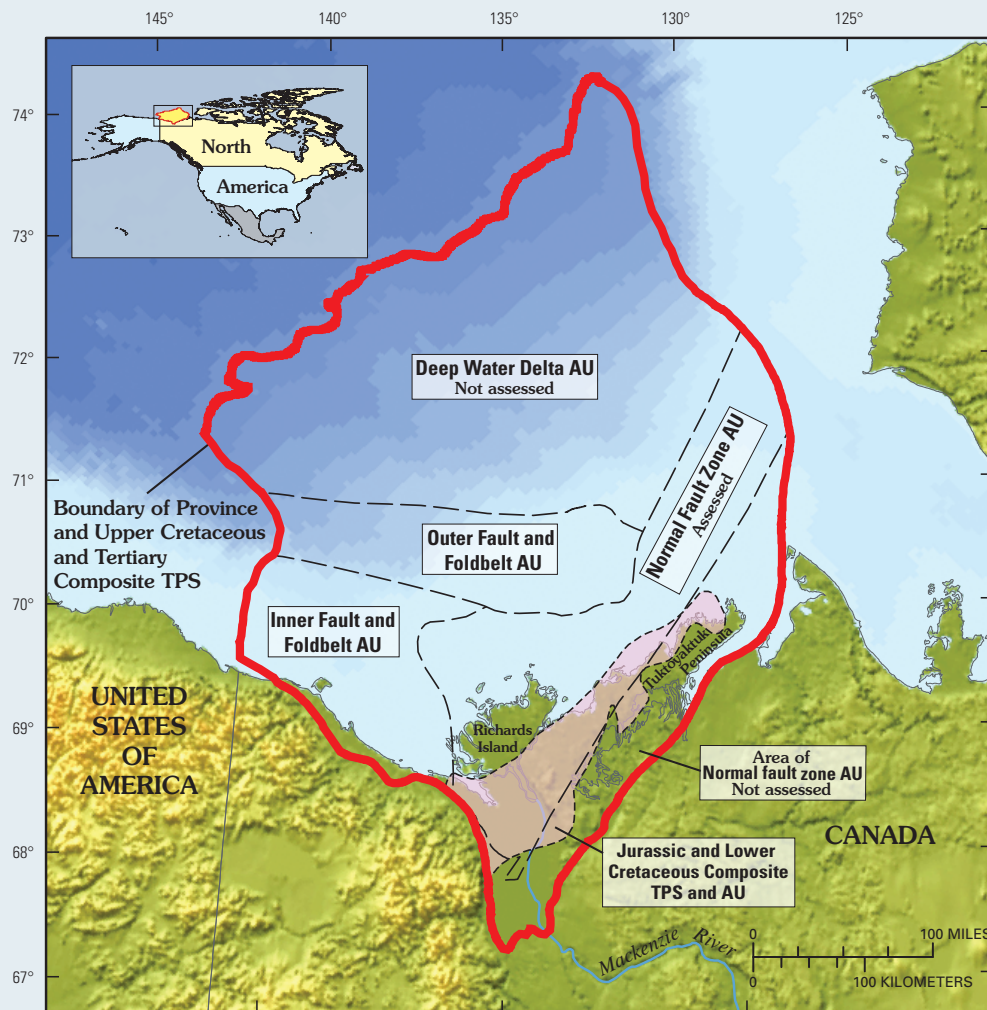
## World Energy Assessment Project Fact Sheet

# Assessment of Undiscovered Oil and Gas Resources of the Mackenzie Delta Province, North America, 2004

*Using a geology-based assessment methodology, the U.S. Geological Survey estimated a mean of 40 trillion cubic feet of undiscovered nonassociated gas, a mean of 10.5 billion barrels of undiscovered oil (with 46.6 trillion cubic feet of associated gas), and a mean of 4.0 billion barrels of undiscovered natural gas liquids in the Mackenzie Delta Province of North America, exclusive of the unassessed deep-water portion of the province.*

## Introduction

In 2004 the U.S. Geological Survey (USGS) completed an assessment of the potential for undiscovered oil and gas in the Mackenzie Delta Province of northern North America (fig. 1). This assessment provides a better understanding of the potential contribution of circum-Arctic petroleum reserves to world energy supply. This province was identified during the World Petroleum Assessment 2000 conducted by the USGS (U.S. Geological Survey World Energy Assessment Team, 2000) but was not assessed then because its known petroleum volume at the time was considered insufficient to be included in that effort. It represents, however, the first province assessed for the USGS Arctic Assessment task of the World Energy project within the Energy Resources Team, Denver, Colorado. The Mackenzie Delta Province is the most data-rich and well-explored province included in the Arctic Assessment task but, with only about 250 exploration wells in a delta complex roughly equivalent in area and sediment thickness to the Mississippi delta complex, it remains a frontier area compared with most other world petroleum provinces. The Mackenzie Delta Province (fig. 1), as defined for this assessment, is bounded on the north by the 3,000-m isobath and on the east and west primarily by basin-floor geometry related



**Figure 1.** Mackenzie Delta Province of northern North America. AU, assessment unit; TPS, total petroleum system; light-pink area, a deeper TPS below more extensive, shallower TPS.

to Cenozoic deltaic depositional systems. On the south and southeast, it is bounded by outcrops of rocks included in two total petroleum systems (TPS) that are described below.

On the basis of the essential geologic elements of a TPS (hydrocarbon source rocks, favorable timing of hydrocarbon generation and migration, reservoir rocks, and hydrocarbon traps), two composite TPS are defined for the Mackenzie Delta Province: the Jurassic and Lower Cretaceous Composite TPS and the Upper Cretaceous and Tertiary Composite TPS. Shale of the Upper Jurassic to Lower Cretaceous Husky Formation and coal beds in the Lower Cretaceous Kamik Formation are the probable source rocks for the Jurassic and Lower Cretaceous Composite TPS. Probable source rocks for the Upper Cretaceous and Tertiary Composite TPS include the Upper Cretaceous Boundary Creek and Smoking Hills Formations, the Upper Cretaceous to Paleocene Fish River sequence, the Eocene Taglu and Richards sequences, and the Oligocene Kugmallit sequence. One assessment unit (AU), the Jurassic and Lower Cretaceous AU, was defined for the Jurassic and Lower Cretaceous

**Table 1.** Mackenzie Delta Province assessment results.

[AU, assessment unit; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids; MMBO, million barrels of oil; NGL, natural gas liquids; TPS, total petroleum system. For geologic elements of the AU, results shown are fully risked estimates rounded to the nearest unit. For gas accumulations, all liquids are included as NGL. F95 denotes a 95 percent chance of at least the amount tabulated. Other fractiles defined similarly. Fractiles are additive only under the assumption of perfect positive correlation. Gray shading indicates not applicable]

Total petroleum systems and assessment units	Field type	Total undiscovered resources												
		Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)				
		F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean	
Conventional oil and gas resources	Jurassic and Lower Cretaceous Composite TPS													
	Jurassic and Lower Cretaceous AU	Oil	10	22	40	23	46	108	215	117	3	6	14	7
		Gas					3,429	9,954	19,476	10,518	169	512	1,092	556
	Upper Cretaceous and Tertiary Composite TPS													
	Normal Fault Zone AU	Oil	1,544	3,622	6,957	3,867	6,605	16,573	35,048	18,176	108	291	667	327
		Gas					6,269	15,099	28,568	16,001	304	779	1,616	847
	Outer Fault and Foldbelt AU	Oil	1,746	4,868	9,656	5,197	7,530	22,245	48,537	24,431	418	1,295	3,082	1,465
		Gas					3,107	9,630	20,775	10,488	153	497	1,167	556
	Inner Fault and Foldbelt AU	Oil	320	1,221	2,929	1,373	836	3,326	8,600	3,842	14	58	162	69
		Gas					710	2,699	6,448	3,028	35	139	359	161
	Deep Water Delta AU	Not quantitatively assessed												
	Total conventional resources	Oil	3,621	9,734	19,582	10,460	15,016	42,252	92,399	46,566	543	1,651	3,924	1,868
		Gas					13,515	37,382	75,266	40,035	661	1,927	4,234	2,121
	Total undiscovered oil and gas resources	Oil and gas	3,621	9,734	19,582	10,460	28,532	79,634	167,666	86,601	1,204	3,578	8,158	3,989

Composite TPS (fig. 1). Four AUs were defined for the Upper Cretaceous and Tertiary Composite TPS: the Normal Fault Zone, the Outer Fault and Foldbelt, the Inner Fault and Foldbelt, and the Deep Water Delta. Quantitative estimates of the undiscovered oil and gas resources were made for four of the five AUs (table 1); the Deep Water Delta AU was not assessed. The possibility of a TPS composed of lower Paleozoic source and reservoir rocks was recognized, but no AUs were defined and no assessment was made.

Because of the great thickness of deltaic deposits in the Mackenzie Delta Province—more than 14 km of Upper Cretaceous to Holocene strata—some uncertainty exists regarding the exact ages of, and the richness and type of organic matter in, the principal source rocks. In addition, because of structural complexity and numerous unconformities, traps may not have been preserved. In spite of these and other risks and uncertainties, there is ample evidence that at least two major composite petroleum systems have been active in the assessed portions of the province. As of 2002, about 250 wells had been drilled and about 50 hydrocarbon accumulations discovered. The potential for unconventional resources such as gas from hydrates also exists, but for this assessment only conventional resources were assessed.

## Resource Summary

For the four AUs assessed in the Mackenzie Delta Province, the USGS made the following estimates (see table 1): (1) 13.5–75.3 (mean, 40.0) trillion cubic feet (TCF) of nonassociated gas (gas in gas fields); (2) 3.6–19.6 (mean, 10.5) billion barrels of oil containing 15.0–92.4 (mean, 46.6) TCF of associated gas (gas in oil fields); and (3) 1.2–8.2 (mean, 4.0) billion barrels of natural gas liquids. These estimates do not include resources in the Deep Water Delta AU, which was not assessed.

About 75 percent of the estimated undiscovered nonassociated gas reserves is assigned to the offshore in three assessment units: the

Normal Fault Zone AU, the Outer Fault and Foldbelt AU, and the Inner Fault and Foldbelt AU. About 40 percent (16 TCF) of the total mean undiscovered nonassociated gas (40 TCF) is estimated to be in the Normal Fault Zone AU (table 1). The Jurassic and Lower Cretaceous AU and the Outer Fault and Foldbelt AU are each estimated to contain about 26 percent of the total mean undiscovered nonassociated gas. The remaining nonassociated gas (3 TCF) was assigned to the Inner Fault and Foldbelt AU.

Virtually all of the undiscovered oil, associated gas, and natural gas liquids are expected in the offshore parts of the three AUs that were assessed in the Upper Cretaceous and Tertiary Composite Total Petroleum System.

## For Further Information

Assessment results are available at the USGS Central Energy Team website: <http://energy.cr.usgs.gov/oilgas/>, or contact Regional Coordinators for North America Kenneth Bird ([kbird@usgs.gov](mailto:kbird@usgs.gov)) or David Houseknecht ([dhouse@usgs.gov](mailto:dhouse@usgs.gov)).

## Mackenzie Delta Province Assessment Team

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## Reference Cited

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