

Assessment of Undiscovered Oil and Gas Resources of the West Greenland–East Canada Province, 2008

Using a geology-based assessment methodology, the U.S. Geological Survey estimated a mean of 7.3 billion barrels of oil and a mean of 52 trillion cubic feet of undiscovered natural gas in the West Greenland–East Canada Province north of the Arctic Circle.

Introduction

The U.S. Geological Survey (USGS) recently assessed the undiscovered oil and gas potential of the West Greenland–East Canada Province as part of the USGS Circum-Arctic Oil and Gas Resource Appraisal effort. The West Greenland–East Canada Province is essentially the offshore area between west Greenland and east Canada and includes Baffin Bay, Davis Strait, Lancaster Sound, and Nares Strait west of and including Kane Basin (fig. 1). The tectonic evolution of the West Greenland–East Canada Province led to the formation of several major structural domains that are the geologic basis for the five assessment units (AU) defined in this study (fig. 1). The five AUs encompass the entire province. Each AU was assessed in its entirety for undiscovered, technically recoverable (assuming absence of sea ice) oil and gas resources, but the assessment results reported here are only for those portions of each AU that are north of the Arctic Circle, as that latitude defines the area of the Circum-Arctic oil and gas assessment.

Geologic Definition of Assessment Units

The tectonic evolution of the West Greenland–East Canada province was complex and included (1) at least two phases of Cretaceous rifting and thermal subsidence between west Greenland and Canada; (2) counterclockwise rotation of Greenland driven largely by adjacent plate movements and the thermal effects of mantle plumes; (3) the development of the Ungava transform fault zone concomitant with the opening of Baffin Bay basin and the Labrador Sea; and (4) compression in the northern part of the province (Eurekan Orogeny) as Greenland rotated and collided with Canada in the Paleogene (Harrison and others, 1999; Funck and others, 2007). The AUs reflect this geologic history. The Eurekan Structures AU (AU-1, fig. 1) is characterized by inverted structures developed in the northern part of the province during the Eurekan Orogeny. The Northwest Greenland Rifted Margin AU (AU-2, fig. 1) and the Northeast Canada Rifted Margin AU (AU-3, fig. 1) encompass the rifted, conjugate continental margins. The Baffin Bay Basin AU



Figure 1. The West Greenland–East Canada Province (tan line) contains Baffin Bay, Davis Strait, Lancaster Sound, and Nares Strait west of and including Kane Basin. Five assessment units (red lines) were defined in this study: AU-1, Eurekan Structures AU; AU-2, Northwest Greenland Rifted Margin AU; AU-3, Northeast Canada Rifted Margin AU; AU-4, Baffin Bay Basin AU; AU-5, Greater Ungava Fault Zone AU. Dashed yellow lines represent portions of those AUs that extend south of the Arctic Circle.

(AU-4, fig. 1) reflects the oceanic(?) part of Baffin Bay where there is greater than 8 km of sediment. The Greater Ungava Fault Zone AU (AU-5, fig. 1) includes strike-slip structures along a broad zone of the Ungava transform fault.

The USGS defined a Mesozoic–Cenozoic Composite Total Petroleum System (TPS) in the West Greenland–East Canada Province; the five AUs are included within this TPS. Several petroleum source rocks are postulated to be present, including possible source rocks within Ordovician, Lower and Upper Cretaceous, and Paleogene stratigraphic intervals (Bojesen-Koefoed and others, 1999, 2004).

Resource Summary

The USGS assessed undiscovered technically recoverable conventional oil and gas resources in the five AUs within the Mesozoic-Cenozoic TPS, but the resource estimates reported here are only for those portions of the AUs that are north of the Arctic Circle (table 1). For conventional resources in the West Greenland–East Canada Province, the estimated means were 7,275 million barrels of oil (MMBO), 51,816 billion cubic feet of natural gas (BCFG), and 1,152 million barrels of natural-gas liquids (MMBNGL). The assessment indicates that about half of undiscovered oil and gas resources in the province are estimated to be in the rifted margin AUs (table 1).

Table 1. West Greenland-East Canada Province assessment results.

[MMBO, million barrels of oil. BCFG, billion cubic feet of gas. MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas accumulations, all liquids are included as NGL (natural gas liquids). Undiscovered gas resources are the sum of nonassociated and associated gas. F95 represents a 95 percent chance of at least the amount tabulated; other fractiles are defined similarly. AU probability is the chance of at least one accumulation of minimum size within the AU. TPS, total petroleum system; AU, assessment unit. Gray shading indicates not applicable]

Total Petroleum Systems (TPS) and Assessment Units (AU)	AU Probability	Field Type	Total Undiscovered Resources											
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Mesozoic-Cenozoic Composite TPS														
Eurekan Structures AU	0.25	Oil	0	0	6,626	1,133	0	0	10,490	1,784	0	0	285	48
		Gas					0	0	39,428	6,806	0	0	1,055	181
Northwest Greenland Rifted Margin AU	0.50	Oil	0	260	10,900	2,746	0	157	10,488	2,547	0	4	237	57
		Gas					0	1,090	61,086	15,251	0	25	1,386	339
Northeast Canada Rifted Margin AU	0.50	Oil	0	0	3,470	850	0	0	3,318	787	0	0	76	18
		Gas					0	0	17,577	4,374	0	0	418	97
Baffin Bay Basin AU	0.28	Oil	0	0	8,470	1,555	0	0	16,128	2,934	0	0	244	44
		Gas					0	0	50,598	9,338	0	0	1,126	206
Greater Ungava Fault Zone AU	0.30	Oil	0	0	5,037	991	0	0	11,105	2,143	0	0	195	38
		Gas					0	0	29,950	5,852	0	0	635	124
Total Conventional Resources					7,275				51,816				1,152	

References

Bojesen-Koefoed, J.A., Christiansen, F.G., Nytoft, H.P., and Pedersen, A.K., 1999, Oil seepage onshore West Greenland—Evidence of multiple source rocks and oil mixing, *in* Fleet, A.J., and Boldy, S.A.R., eds., *Petroleum geology of north-west Europe*. Proceedings of the 5th Conference: Geological Society of London, p. 305–314.

Bojesen-Koefoed, J.A., Nytoft, H.P., and Christiansen, F.G., 2004, Age of oils in West Greenland—Was there a Mesozoic seaway between Greenland and Canada?: *Geological Survey of Denmark and Greenland Bulletin*, v. 4, p. 49–52.

Funck, T., Jackson, H.R., Loudon, K.E., and Klingelhofer, F., 2007, Seismic study of the transform-rifted margin in Davis Strait between Baffin Island (Canada) and Greenland—What happens when a plume meets a transform: *Journal of Geophysical Research*, v. 112, B04402, 22 p.

Harrison, J.C., Mayr, U., McNeil, D.H., Sweet, A.R., McIntyre, D.J., Eberle, J.J., Harington, C.R., Chalmers, J.A., Dam, G., and Nohr-Hansen, H., 1999, Correlation of Cenozoic sequences of the Canadian Arctic region and Greenland—Implications for the tectonic history of northern North America: *Canadian Petroleum Geology Bulletin*, v. 47, no. 3, p. 223–254.

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For Further Information

Assessment results are available at the USGS Energy Program website, <http://energy.usgs.gov/arctic>, or contact Donald L. Gautier, Task Leader for the USGS Circum-Arctic Oil and Gas Resource Appraisal (gautier@usgs.gov).