

# Assessment of Undiscovered Oil and Gas Resources of the East Greenland Rift Basins Province

*Northeast Greenland is the prototype for the U.S. Geological Survey's Circum-Arctic Oil and Gas Resource Appraisal. Using a geology-based methodology, the USGS estimates the mean undiscovered, conventional petroleum resources in the province to be approximately 31,400 MMBOE (million barrels of oil equivalent) of oil, gas, and natural gas liquids.*

## Introduction

In 2007 the U.S. Geological Survey (USGS) completed an assessment of the potential for undiscovered, technically recoverable (assuming the absence of sea ice) oil and gas resources in the East Greenland Rift Basins Province (fig. 1). Northeast Greenland has been selected as the prototype for the new U.S. Geological Survey Circum-Arctic Resource Appraisal (CARA) because the area shares important characteristics with many arctic basins, including sparse data, significant resource potential, great geological uncertainty, and significant technical barriers to exploration and development. This study, which

supersedes a previous USGS assessment of the same area completed in 2000, was necessary because of new information made available through collaboration with the Geological Survey of Denmark and Greenland (GEUS), which significantly changes the geological understanding of the area.

As defined for CARA, the province includes an area of approximately

500,000 square kilometers, most of which underlies less than 500 meters of water offshore east of Greenland between 70° and 82° North.

## Assessment Units

In collaboration with GEUS, the East Greenland Rift Basins Province was subdivided into seven geologically distinctive Assessment Units (AU), of which five were quantitatively assessed (fig. 1). These are: North Danmarkshavn

Salt Basin, South Danmarkshavn Basin, Thetis Basin, Northeast Greenland Volcanic Province, and Liverpool Land Basin. Jameson Land Basin and the Jameson Land Basin Subvolcanic Extension were defined as AUs but were not quantitatively assessed.

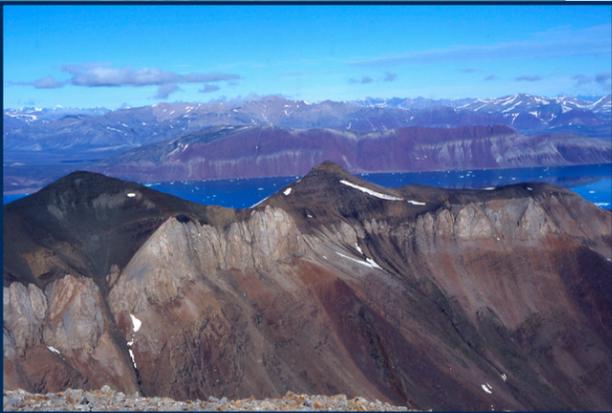
## Petroleum System Elements

Onshore studies by GEUS and other organizations suggest that at least four stratigraphic intervals may contain potentially good source rocks for liquid petroleum. On the basis of considerations of the geological history of related areas in western Norway and burial history modeling, Upper Jurassic strata are believed to contain particularly promising petroleum source rocks. Possible trapping mechanisms are expected to vary widely across the province. Potential traps in the North Danmarkshavn Salt Basin AU are dominated by structures formed through salt tectonics; those in the Southern Danmarkshavn Basin and the Northeast Greenland Volcanic Province probably are characterized by extensional structures and by stratigraphic traps in submarine fan complexes. Prospective inversion structures of Tertiary age are present along the western margin of South Danmarkshavn Basin AU, and the large horst block structures, which separate the Danmarkshavn and Thetis Basins, may provide numerous opportunities for traps in fault blocks, along a major unconformity

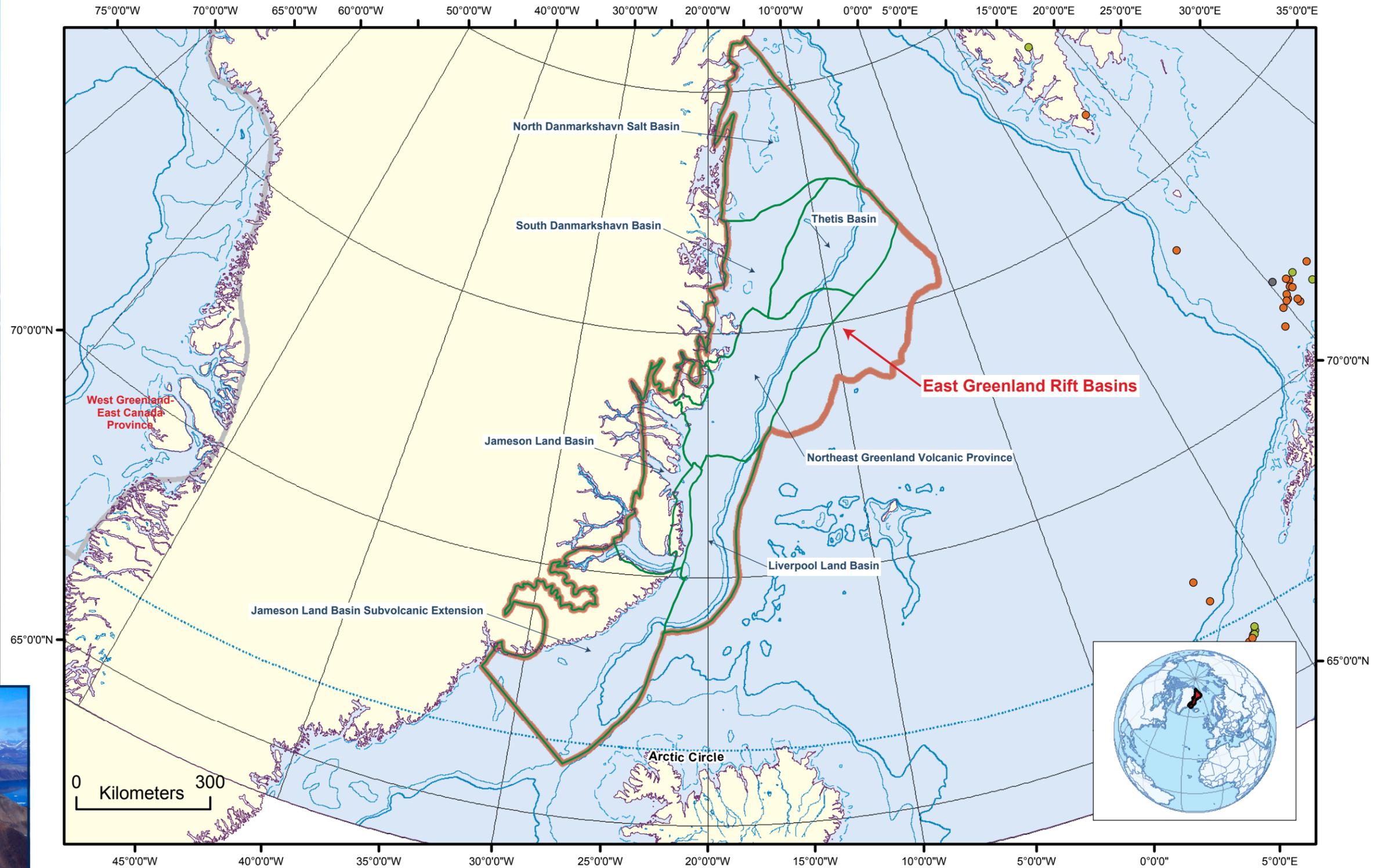
and in various facies-related permeability barriers. Possible reservoirs are considered most likely within shallow marine to nonmarine sandstones of Middle Jurassic age, in Upper Jurassic synrift deposits, in Cretaceous sandstones in submarine fan complexes, within progradational sequences of Paleogene age, and in Upper Carboniferous to Lower Permian warm-water carbonate sequences, especially in northern Danmarkshavn Basin. Marine shales are expected to provide the main sealing lithologies in most AUs.

### Resource Summary

Most of the undiscovered oil, gas, and natural gas liquids is likely in the offshore parts of the province and is inferred to belong to an Upper Jurassic Composite Total Petroleum System. The resource estimates for the East Greenland Rift Basins Province and for the various AUs are tabulated in table 1. The USGS estimates that the East Greenland Rift Basins Province contains approximately (mean) 31,400 MMBOE of oil, natural gas, and natural gas liquids. Of the five assessed AUs, North Danmarkshavn Salt Basin and the South Danmarkshavn Basin are estimated to contain the most of the undiscovered petroleum resources.



Wegener Halvø (seen from southeast to the northwest): Devonian below unconformity, Permian carbonate build-ups overlain by Ravnefjeld formation source rock and Wordie Creek formation mudstones. Photograph by Stefan Piasecki (GEUS).



**Figure 1. East Greenland Rift Basins.**

### EXPLANATION

- |  |                      |                              |
|--|----------------------|------------------------------|
| Assessed Arctic Province Boundary and Code | Water depth (meters) | Oil and gas field (IHS-2006) |
| Arctic Assessment Unit Name and Code       | -1000                | <b>COMMODITY</b>             |
|  | -500                 | Gas                          |
|  | -100                 | N                            |
|  |                      | Oil                          |

Clarke\_1866\_Stereographic\_North\_Pole  
 Stereographic\_North\_Pole  
 False\_Easting: 0.000000  
 False\_Northing: 0.000000  
 Central\_Meridian: 130.000000  
 Standard\_Parallel\_1: 75.000000

**Table 1. East Greenland Rift Basins 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). 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. 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
North Danmarkshavn Salt Basin AU	0.65	Oil	0	1,989	11,793	3,274	0	3,827	26,779	7,255	0	264	2,123	570
		Gas					0	23,820	107,409	32,756	0	2,284	10,730	3,237
South Danmarkshavn Basin AU	0.72	Oil	0	3,228	13,996	4,384	0	6,325	32,081	9,700	0	449	2,603	761
		Gas					0	19,344	83,621	26,251	0	1,844	8,362	2,598
Northeast Greenland Volcanic Province AU	0.26	Oil	0	0	2,757	497	0	0	6,212	1,105	0	0	492	87
		Gas					0	0	16,551	3,003	0	0	1,651	297
Thetis Basin AU	0.49	Oil	0	0	2,095	537	0	0	4,908	1,184	0	0	397	93
		Gas					0	0	12,489	3,206	0	0	1,251	317
Liverpool Land Basin AU	0.29	Oil	0	0	1,122	209	0	0	2,528	464	0	0	200	37
		Gas					0	0	6,740	1,255	0	0	672	124
Jameson Land Basin AU	0.07	Oil	Not quantitatively assessed											
		Gas	Not quantitatively assessed											
Jameson Land Basin Subvolcanic Extension AU	0.04	Oil	Not quantitatively assessed											
		Gas	Not quantitatively assessed											
<b>Total Conventional Resources</b>					<b>8,901</b>				<b>86,179</b>				<b>8,121</b>	



**Katedralen/Ugleelv in Jameson Land: Jurassic succession with Sortehat formation, Pelion formation (reservoir sandstone), Fossilbjerg formation, and Hareelv formation (source rock). Photograph by Stefan Piasecki (GEUS).**

### For Further Information

Assessment results are available online at: <http://energy.usgs.gov/arctic/> or contact Donald L. Gautier, the Task Leader for the Circum-Arctic Resource Appraisal ([gautier@usgs.gov](mailto:gautier@usgs.gov)).

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### Acknowledgment

While the resource estimates reported here are the product and responsibility of the U.S. Geological Survey, the geological analysis of northeastern Greenland used for this study was completed in collaboration with GEUS, the Geological Survey of Denmark and Greenland.