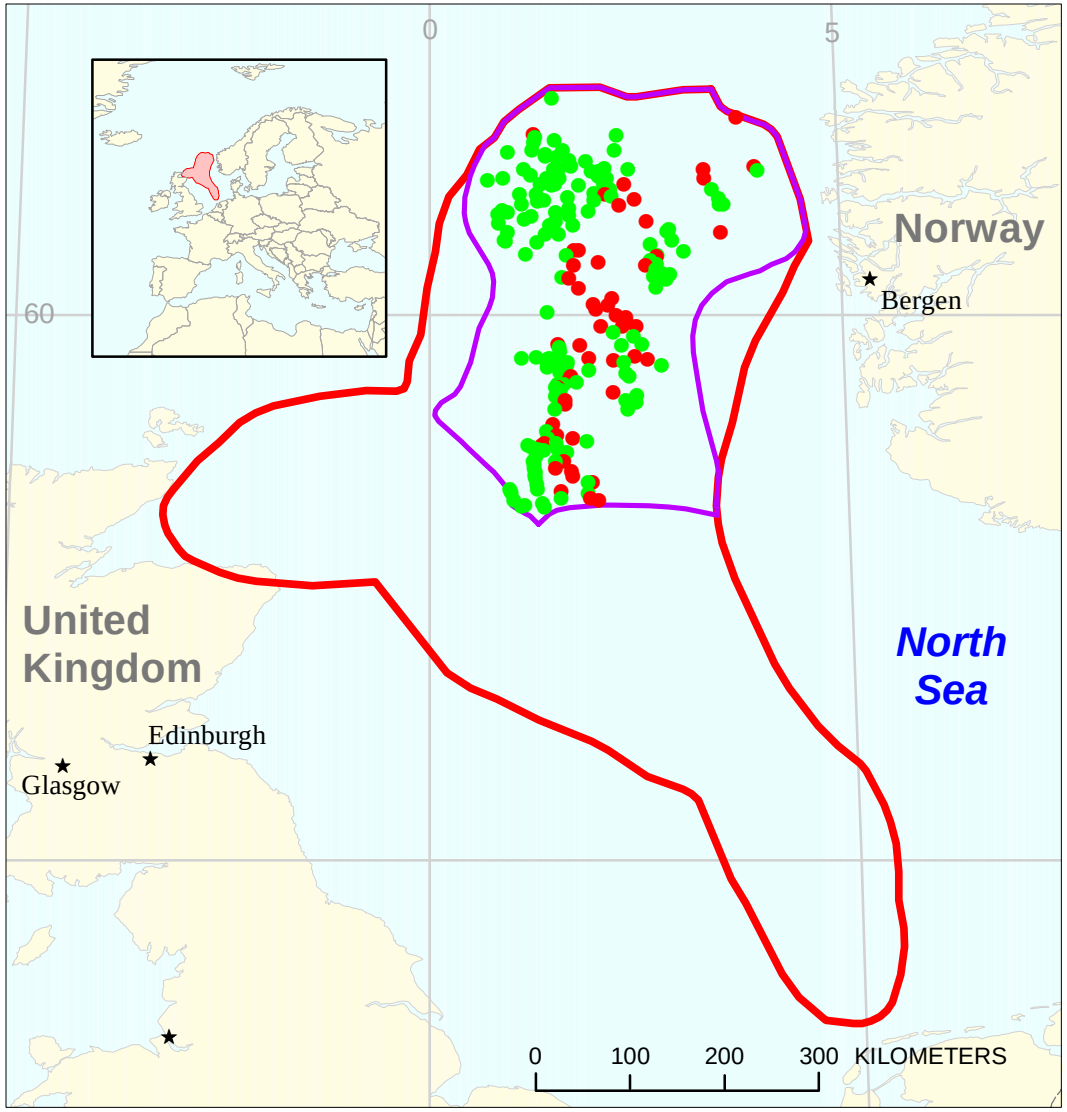
Go to Table of Contents

Go to index map

Viking Graben
Assessment Unit 40250101



Viking Graben Assessment Unit 40250101
North Sea Graben Geologic Province 4025

Geologic Summary

Detailed map of this assessment unit

Exploration/Discovery-History Data
- Plots of Known Field Sizes
- Plots of Grown Resources
- Tables

Assessment Input Data

Assessment Results
- Assessment Unit Summary
- Detailed Assessment Results
- Undiscovered Field-Size Distributions

USGS PROVINCE: North Sea (4025) **GEOLOGIST:** D.L. Gautier

TOTAL PETROLEUM SYSTEM: Kimmeridgian Shales (402501)

ASSESSMENT UNIT: Viking Graben (40250101)

DESCRIPTION: The total petroleum system and corresponding assessment unit coincide with the extent of oil and gas accumulations and thermally mature, organic matter-rich marine shales of late Jurassic and earliest Cretaceous age in and adjacent to the Viking Graben of the northern North Sea.

SOURCE ROCKS: Virtually all significant oil and gas accumulations in the northern North Sea are believed to have been generated within certain fine-grained, organic-carbon-rich marine strata of late Jurassic and earliest Cretaceous age. These Kimmeridgian shales accumulated in oxygen-starved rift basins and may locally attain thickness of 3000 m. The actual source rocks are black shales that display high radioactivity and have total organic carbon (TOC) contents of 2 to 15 percent or more and average about 5 percent TOC. The typical kerogen types within the hot shales are mixtures of organic matter commonly described as Type II kerogen reflecting a mixture of planktonic marine algae and degraded terrigenous humic organic matter.

MATURATION: Burial of Viking Graben source rocks has been more or less continuous from the time of deposition until the present day. Some source rocks achieved thermal maturity with respect to oil and gas generation as early as late Cretaceous time and continuing to the present day in some areas. Thus newly generated oil and gas has been available to traps almost continuously during post-early Cretaceous Viking Graben history.

MIGRATION: At various places within the Viking Graben, oil and gas migration has occurred laterally, stratigraphically downward, and vertically upward into and through permeable rocks and fractures of pre-rift, syn-rift, and post-rift age.

RESERVOIR ROCKS: Significant reservoir rocks include Triassic rocks and outstanding Lower to Middle Jurassic sandstone reservoirs, including those of the Brent Group, deposited prior to latest Jurassic rifting. Submarine fan complexes containing excellent sandstone reservoirs formed contemporaneously with Late Jurassic rifting. Also, Upper Jurassic sandstone reservoirs of the Troll Field reservoir are hundreds of meters thick, with porosity in excess of 30 percent. Submarine fan and channel sandstones of Paleogene age also constitute significant reservoirs in the Viking Graben.

TRAPS AND SEALS: Largest accumulations occur within fault blocks formed during rifting. Stratigraphically entrapped hydrocarbons occur abundantly in submarine channel and fan complex sandstones deposited during and subsequent to rifting. Extra-rift sandstones of the Troll Delta also stratigraphically entrap hydrocarbons. Fine-grained marine mudstones of Tertiary age generally blanket and deeply bury most traps in the Viking Graben and provide a generally effective regional seal in addition to that provided by stratigraphic lithologic heterogeneities.

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Abbotts, I.L., ed., 1991, United Kingdom Oil and Gas Fields-25Years Commemorative Volume: London, Geological Society, Memoir 14, p. 21-207.

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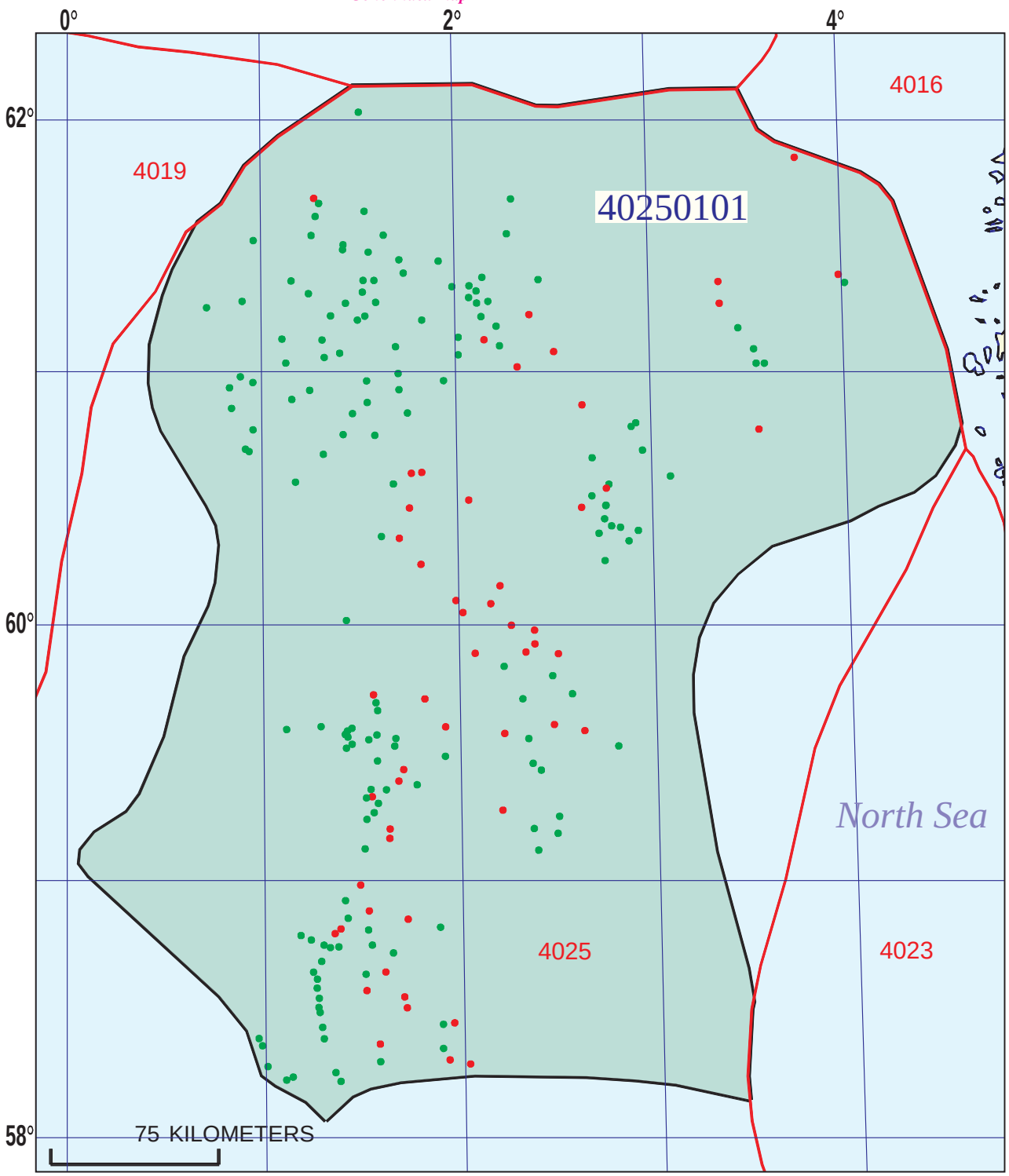
Morton, A.C., Haszeldine, R.S., Giles, M.R., and Brown, S., 1992, Geology of the Brent Group: London, Geological Society, Special Publication 61, 506 p.



Viking Graben
Assessment Unit - 40250101

EXPLANATION

- Hydrography
- Shoreline
- 4025 Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 40250101 Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

USGS science for a changing world

SEVENTH APPROXIMATION
NEW MILLENNIUM WORLD PETROLEUM ASSESSMENT
DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS

Date:……..	8/3/99		
Assessment Geologist:……..	D.L. Gautier		
Region:……..	Europe	Number:	4
Province:……..	North Sea Graben	Number:	4025
Priority or Boutique……	Priority		
Total Petroleum System:……	Kimmeridgian Shales	Number:	402501
Assessment Unit:……..	Viking Graben	Number:	40250101
* Notes from Assessor	MMS growth function.		

CHARACTERISTICS OF ASSESSMENT UNIT

Oil (<20,000 cfg/bo overall) **or** Gas (≥20,000 cfg/bo overall):… Oil

What is the minimum field size?……. 2 mmboe grown (≥1mmboe)
(the smallest field that has potential to be added to reserves in the next 30 years)

Number of discovered fields exceeding minimum size:…… Oil: 153 Gas: 52
Established (>13 fields) X Frontier (1-13 fields) _____ Hypothetical (no fields) _____

Median size (grown) of discovered oil fields (mmboe):
1st 3rd 81.2 2nd 3rd 35.9 3rd 3rd 55.8
Median size (grown) of discovered gas fields (bcfg):
1st 3rd 429 2nd 3rd 455 3rd 3rd 270

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered field ≥ minimum size……	1.0
2. **ROCKS:** Adequate reservoirs, traps, and seals for an undiscovered field ≥ minimum size……	1.0
3. **TIMING OF GEOLOGIC EVENTS:** Favorable timing for an undiscovered field ≥ minimum size	1.0

Assessment-Unit GEOLOGIC Probability (Product of 1, 2, and 3):…….. 1.0

4. **ACCESSIBILITY:** Adequate location to allow exploration for an undiscovered field ≥ minimum size…… 1.0

UNDISCOVERED FIELDS

Number of Undiscovered Fields: How many undiscovered fields exist that are ≥ minimum size?:
(uncertainty of fixed but unknown values)

Oil fields:……min. no. (>0)	40	median no.	150	max no.	400
Gas fields:……min. no. (>0)	15	median no.	60	max no.	150

Size of Undiscovered Fields: What are the anticipated sizes (**grown**) of the above fields?:
(variations in the sizes of undiscovered fields)

Oil in oil fields (mmbo)……min. size	2	median size	17	max. size	1500
Gas in gas fields (bcfg):……min. size	12	median size	100	max. size	6000

Assessment Unit (name, no.)
Viking Graben, 40250101

AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Fields:	minimum	median	maximum
Gas/oil ratio (cfg/bo)……	500	1000	1500
NGL/gas ratio (bngl/mmcfg)……	30	60	90

Gas fields:	minimum	median	maximum
Liquids/gas ratio (bngl/mmcfg)……	20	40	60
Oil/gas ratio (bo/mmcfg)……			

SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS

(variations in the properties of undiscovered fields)

Oil Fields:	minimum	median	maximum
API gravity (degrees)……	10	40	55
Sulfur content of oil (%)……			
Drilling Depth (m) ……	1000	2750	5000
Depth (m) of water (if applicable)……	30	180	400

Gas Fields:	minimum	median	maximum
Inert gas content (%)……			
CO_2 content (%)……			
Hydrogen-sulfide content (%)……			
Drilling Depth (m)……	1250	3500	5000
Depth (m) of water (if applicable)……	30	180	400

Assessment Unit (name, no.)
Viking Graben, 40250101

ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT TO COUNTRIES OR OTHER LAND PARCELS (uncertainty of fixed but unknown values)

1. United Kingdom represents 37 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		40	
Portion of volume % that is offshore (0-100%).....		100	

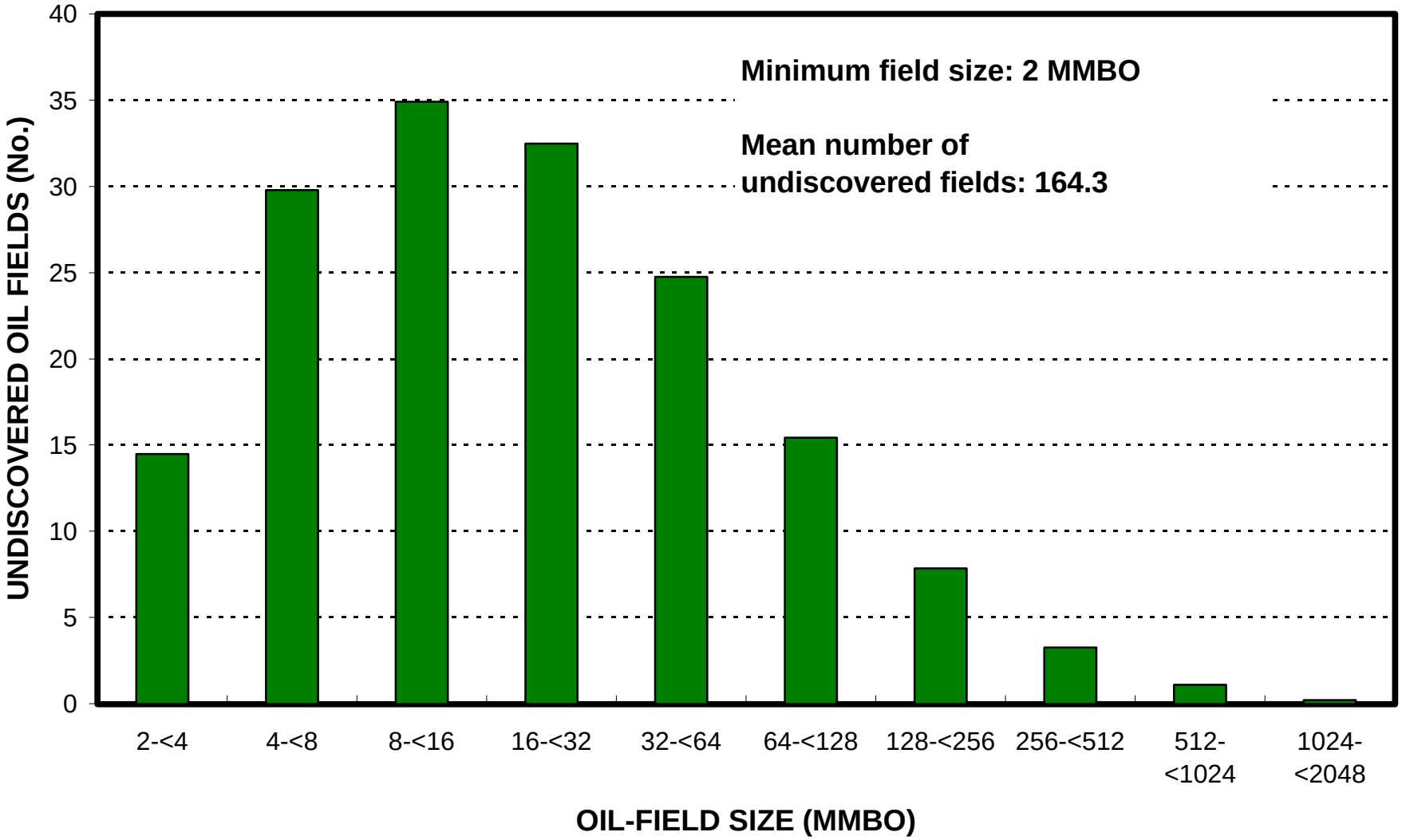
Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		40	
Portion of volume % that is offshore (0-100%).....		100	

2. Norway represents 63 areal % of the total assessment unit

Oil in Oil Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		60	
Portion of volume % that is offshore (0-100%).....		100	

Gas in Gas Fields:	minimum	median	maximum
Richness factor (unitless multiplier):.....			
Volume % in parcel (areal % x richness factor):...		60	
Portion of volume % that is offshore (0-100%).....		100	

Viking Graben, AU 40250101
Undiscovered Field-Size Distribution



Viking Graben, AU 40250101
Undiscovered Field-Size Distribution