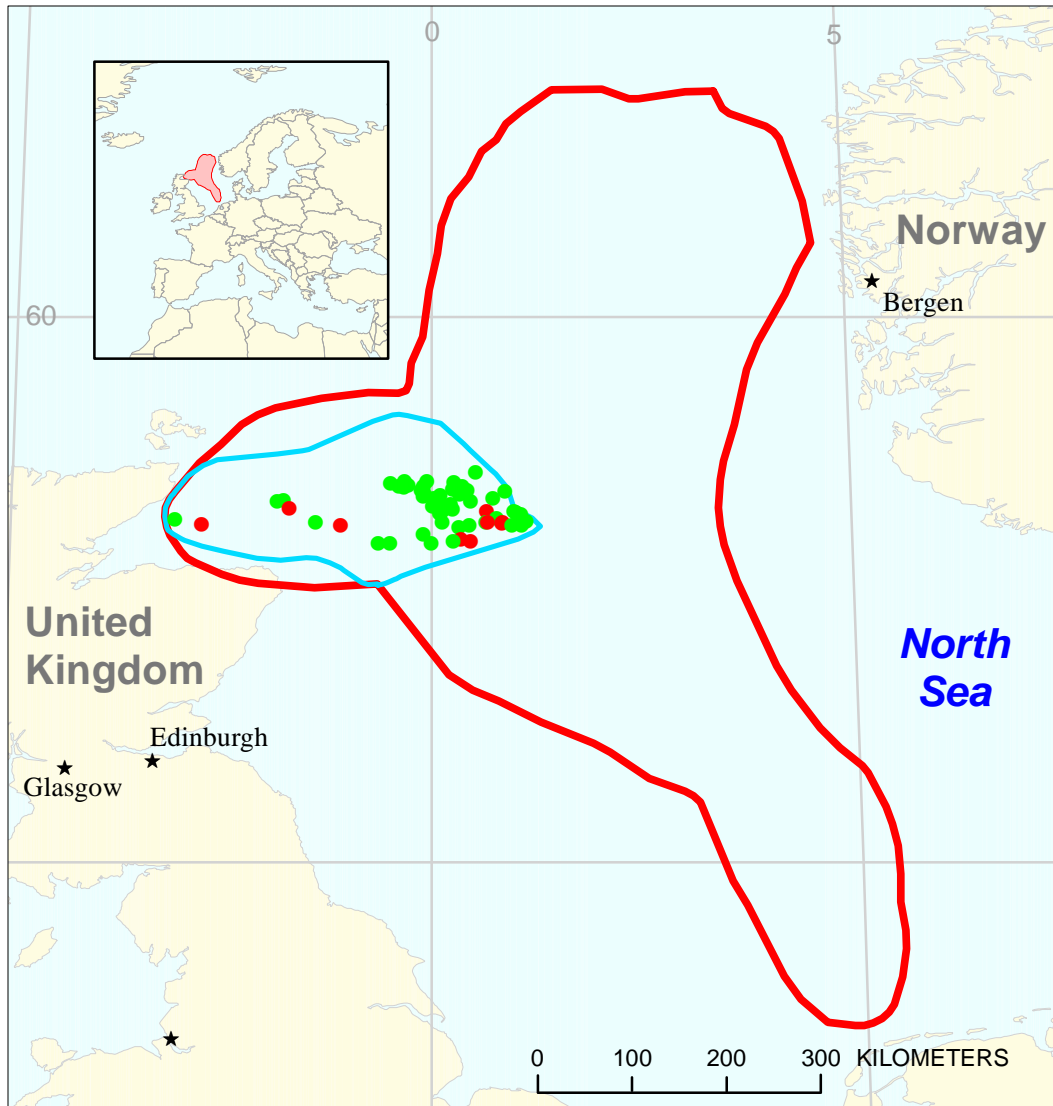



# Moray Firth Assessment Unit 40250102



 Moray Firth Assessment Unit 40250102

 North Sea Graben Geologic Province 4025

**USGS PROVINCE:** North Sea Graben (4025)

**GEOLOGIST:** D.L. Gautier

**TOTAL PETROLEUM SYSTEM:** Kimmeridgian Shales (402501)

**ASSESSMENT UNIT:** Moray Firth (40250102)

**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 Moray Firth area in the west central part of the northern North Sea. For the purposes of this assessment, the area of the Witch Ground Graben is included as a subset of the Moray Firth.

**SOURCE ROCKS:** Virtually all significant oil and gas accumulations in the northern North Sea are believed to have been generated in 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 thicken to 3000 m. The actual source rocks are black shales that display high radioactivity and have total organic carbon (TOC) contents of 2 percent to 15 percent or more and average about 5 percent TOC. The typical kerogen types in 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. In the outer Moray Firth, Lower Jurassic shales are largely absent, and the Kimmeridge Clay Formation there rests unconformably on older rocks.

**MATURATION:** In contrast to the Viking and Central Grabens, in the Moray Firth, fine-grained rocks of the Kimmeridgian are only locally mature with respect to oil generation. This fact may be responsible for the generally less hydrocarbon-rich character of the Moray Firth.

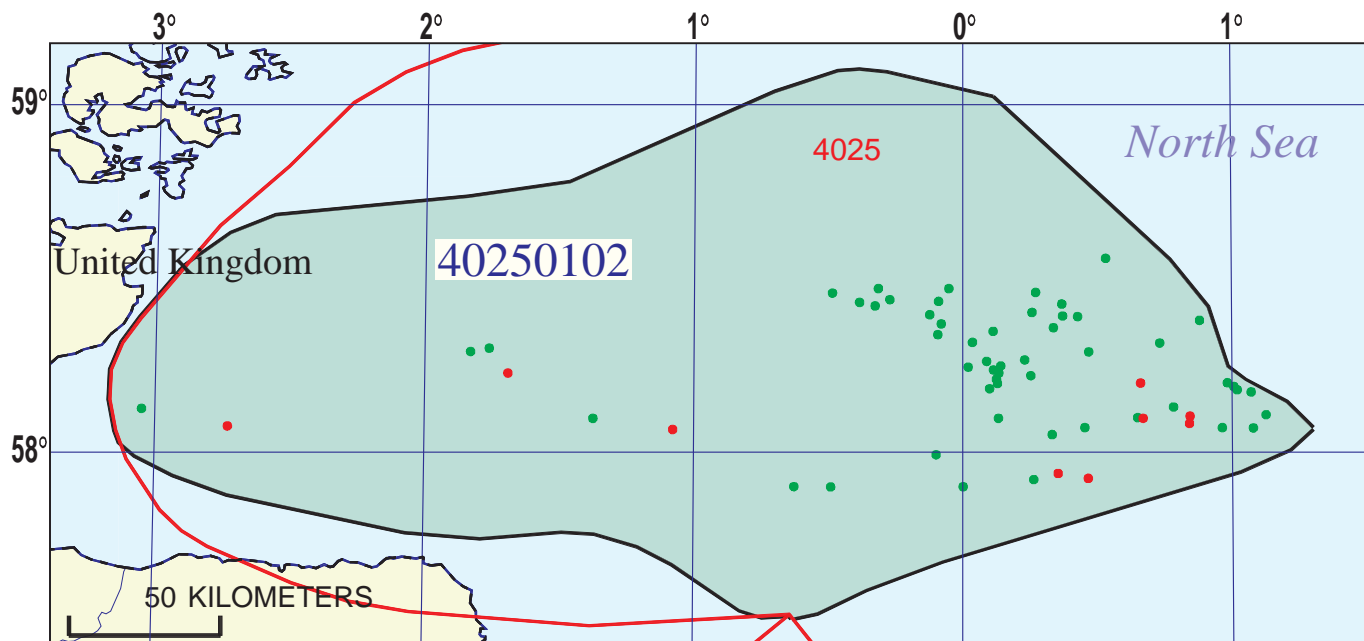
**MIGRATION:** The near-universal predominance of upper Jurassic marine shales as source rocks in the Central Graben has resulted in a wide variety of migration styles and pathways, including stratigraphically downward migration into pre-Jurassic reservoir rocks in fault blocks. In the Moray Firth, the largest fields, Claymore and Piper are relatively near the thermally mature source rocks of the Central Graben, and were presumably sourced via significant distances of lateral migration.

**RESERVOIR ROCKS:** The most significant reservoir rocks in the outer Moray Firth consist of shallow marine Piper Formation and deltaic sandstones of the Sgiath Formation. Lower Cretaceous sandstones also locally form reservoirs, as do some pre-Jurassic rocks of various lithologies. Neither Cretaceous Chalk nor Tertiary sandstones are regionally significant reservoir rocks in this area.

**TRAPS AND SEALS:** Moray Firth traps include fault blocks draped with Jurassic mudstones, Cretaceous chalk, or shale of Tertiary age. In contrast to the Central Graben, salt tectonics have been less important in controlling structural relationships in the Moray Firth. Stratigraphic traps are dominant in the upper Jurassic and younger sandstones. Seals are Jurassic shale, Cretaceous chalk, or Tertiary shale.

**REFERENCES:**

- Pegrum, R.M. and Spencer, A.M., 1990, Hydrocarbon plays in the northern North Sea, *in* Brooks, Jim, ed., Classic petroleum provinces: London, The Geological Society Special Publication 50, p. 441-470.
- Abbotts, I.L., ed., 1991, United Kingdom Oil and Gas Fields-25Years Commemorative Volume: London, Geological Society Memoir 14, p. 21-207.
- Maher, C.E., Schmitt, H.R.H., and Green, S.C.H., 1992, Piper Field, in N. H. Foster and E.A. Beaumont, compilers, Structural Traps VI, Treatise of Petroleum Geology Atlas of Oil and Gas Fields: Tulsa American Association of Petroleum Geologists, p. 85-106.



## Moray Firth Assessment Unit - 40250102

### EXPLANATION

- Hydrography
- Shoreline
- 4025 — Geologic province code and boundary
- Country boundary
- Gas field centerpoint
- Oil field centerpoint
- 40250102 — Assessment unit code and boundary

Projection: Robinson. Central meridian: 0

**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:..... Moray Firth Number: 40250102  
 \* 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 mmmboe 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: 48 Gas: 9  
 Established (>13 fields) X Frontier (1-13 fields) Hypothetical (no fields)

Median size (grown) of discovered oil fields (mmboe):  
 1st 3rd 91.1 2nd 3rd 26.8 3rd 3rd 32.1  
 Median size (grown) of discovered gas fields (bcfg):  
 1st 3rd 172 2nd 3rd 159 3rd 3rd

**Assessment-Unit Probabilities:**

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

**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)	<u>12</u>	median no.	<u>45</u>	max no.	<u>120</u>
Gas fields:.....min. no. (>0)	<u>2</u>	median no.	<u>15</u>	max no.	<u>30</u>

**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	<u>2</u>	median size	<u>10</u>	max. size	<u>400</u>
Gas in gas fields (bcfg):.....min. size	<u>12</u>	median size	<u>50</u>	max. size	<u>500</u>

**AVERAGE RATIOS FOR UNDISCOVERED FIELDS, TO ASSESS COPRODUCTS**

(uncertainty of fixed but unknown values)

<u>Oil Fields:</u>	minimum	median	maximum
Gas/oil ratio (cfg/bo).....	400	800	1200
NGL/gas ratio (bnl/mmcf).....	30	60	90
<u>Gas fields:</u>	minimum	median	maximum
Liquids/gas ratio (bnl/mmcf).....	25	50	75
Oil/gas ratio (bo/mmcf).....			

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**SELECTED ANCILLARY DATA FOR UNDISCOVERED FIELDS**

(variations in the properties of undiscovered fields)

<u>Oil Fields:</u>	minimum	median	maximum
API gravity (degrees).....	20	38	50
Sulfur content of oil (%).....			
Drilling Depth (m) .....	300	2500	5000
Depth (m) of water (if applicable).....	24	110	174
<u>Gas Fields:</u>	minimum	median	maximum
Inert gas content (%).....			
CO <sub>2</sub> content (%).....			
Hydrogen-sulfide content (%).....			
Drilling Depth (m).....	1000	3500	4500
Depth (m) of water (if applicable).....	24	110	174

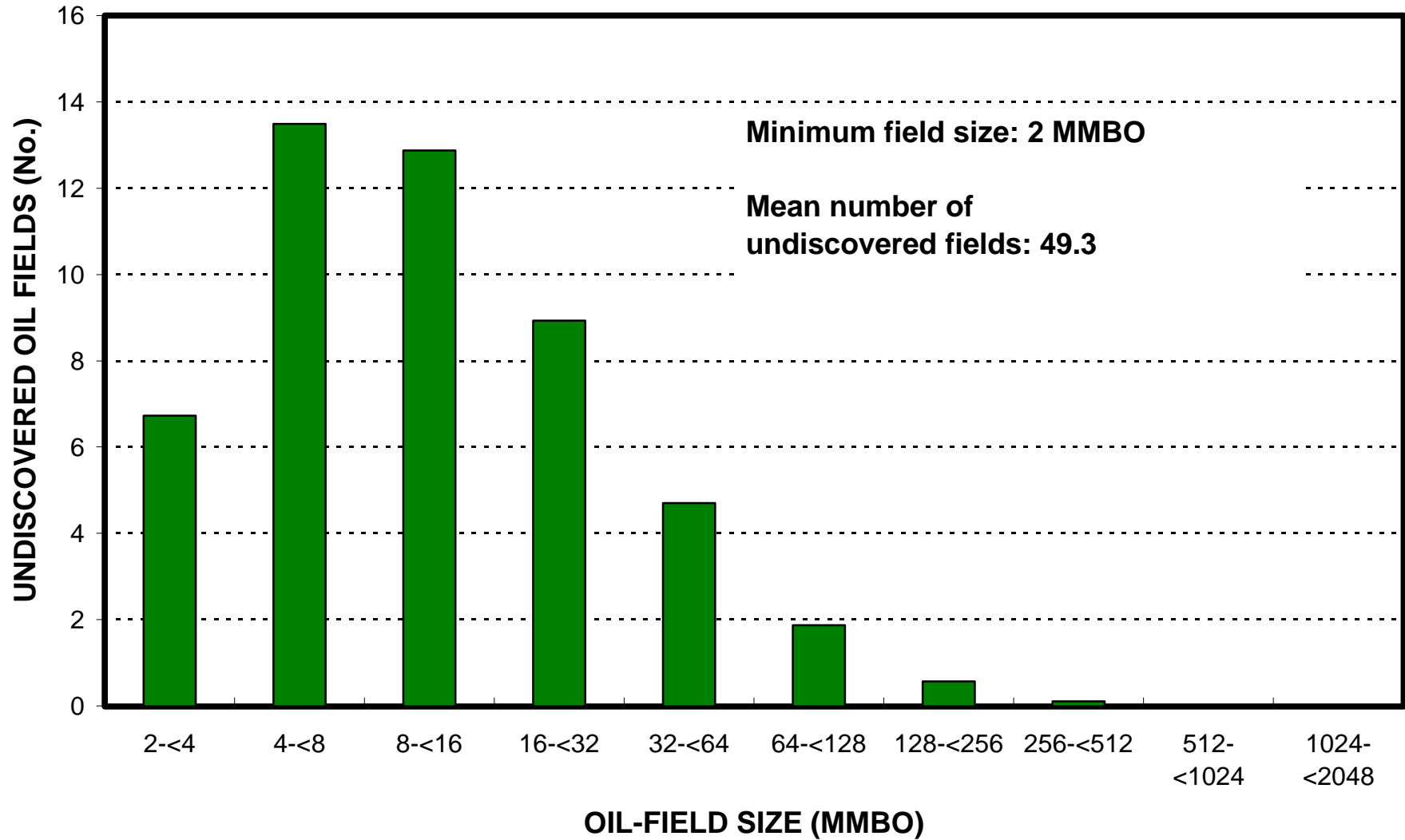
**ALLOCATION OF UNDISCOVERED RESOURCES IN THE ASSESSMENT UNIT  
TO COUNTRIES OR OTHER LAND PARCELS** (uncertainty of fixed but unknown values)

1. United Kingdom represents 100 areal % of the total assessment unit

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

# Moray Firth, AU 40250102

## Undiscovered Field-Size Distribution





# Moray Firth, AU 40250102

## Undiscovered Field-Size Distribution

