

## Remaining Exploration Potential on the United Kingdom Continental Shelf (UKCS)—an Opportunity for US Independents

About 4000 exploration and appraisal wells (including re-spuds and sidetracks) have been drilled on the UK Continental Shelf (UKCS) over the past 37 years. These wells have resulted in more than 285 producing fields and another 168 significant discoveries. Almost 60% of the wells have been drilled in the largely oil-bearing northern and central North Sea (Fig. 1). The majority of the oil is found in sandstone reservoirs ranging from Devonian to Eocene in age, with the bulk of reserves in Jurassic strata (Fig. 2). About 20% of the wells have been drilled in the gas-bearing southern North Sea. Permian desert sandstones are the most prolific reservoirs there, with significant reserves also in Carboniferous and Triassic strata.

The peak of exploration and production activity occurred in 1990. Drilling activity then declined gradually to about 100 wells a year until the oil price collapse in late 1998. The success rate across the last 30 years has been a robust 35%, using a rolling five-year centered average. Six significant discoveries have been announced so far in 2001. Of these, PanCanadian's Buzzard discovery has been described in a press release with reserves of 200–300 MMBOE, making it the largest discovery on the UKCS since Foinaven in 1992. Oil and gas production in the UK reached peak production in year 2000, and remains close to record levels at 5 MMBOE per day.

This paper will address the major new plays developed in the last decade, and summarise the opportunities for exploration in the next decade and beyond. The greatest potential for major new discoveries (Fig. 1) lies along the Atlantic Margin, where water depths are between 1,500 and 5,000 feet. The giant Foinaven and Schiehallion oil fields were discovered there in the early nineties, and both have Paleogene deepwater sandstone reservoirs. Significant discoveries will continue to be made in the relatively shallow waters of the mature North Sea oil and gas provinces.

Most of these discoveries will be made in subtle stratigraphic and structural plays, requiring state-of-the-art technology to identify the best prospects and minimise the uncertainty.

The UKCS is located on the passive continental margin of the European plate, on the eastern seaboard of the North Atlantic. One of the most significant events in its geological history was a Late Jurassic phase of crustal extension along the axis of the North Sea, which led to the formation of major rift basins in the northern and central North Sea. A world-class source rock, the Upper Jurassic Kimmeridge Clay, was deposited within these rift basins and in many other parts of the UKCS (Fig. 2). Following Early Cretaceous collapse of the rift system, post-rift thermal subsidence led to hydrocarbon generation along the axes of the basins. Migration has been essentially vertical. Most of the traps were produced as a result of the rifting or post-rift faulting, but halokinesis of Upper Permian salt is locally also an important trapping mechanism. The Kimmeridge Clay source rocks have been largely eroded from the southern North Sea or are immature. The principal source rocks for the gas there are thick Westphalian coal seams preserved in the core of the basin.

The plays developed in recent years, and the focus of future exploration activity, are likely to be in the following:

- Deepwater Atlantic Margin Tertiary play—despite two producing fields and several significant discoveries, this is still considered a frontier play, with the target reservoirs ranging from Paleocene to mid-Eocene in age.
- Upper Jurassic/Lower Cretaceous stratigraphic play, principally the lateral pinchout of deepwater sandstones of the northern and central North Sea (see Fig. 1).
- Mesozoic basin margin plays—the recent giant Buzzard oil discovery in Block 20/6 has highlighted the potential for both stratigraphic and structural traps along the margins of the North Sea's basins.

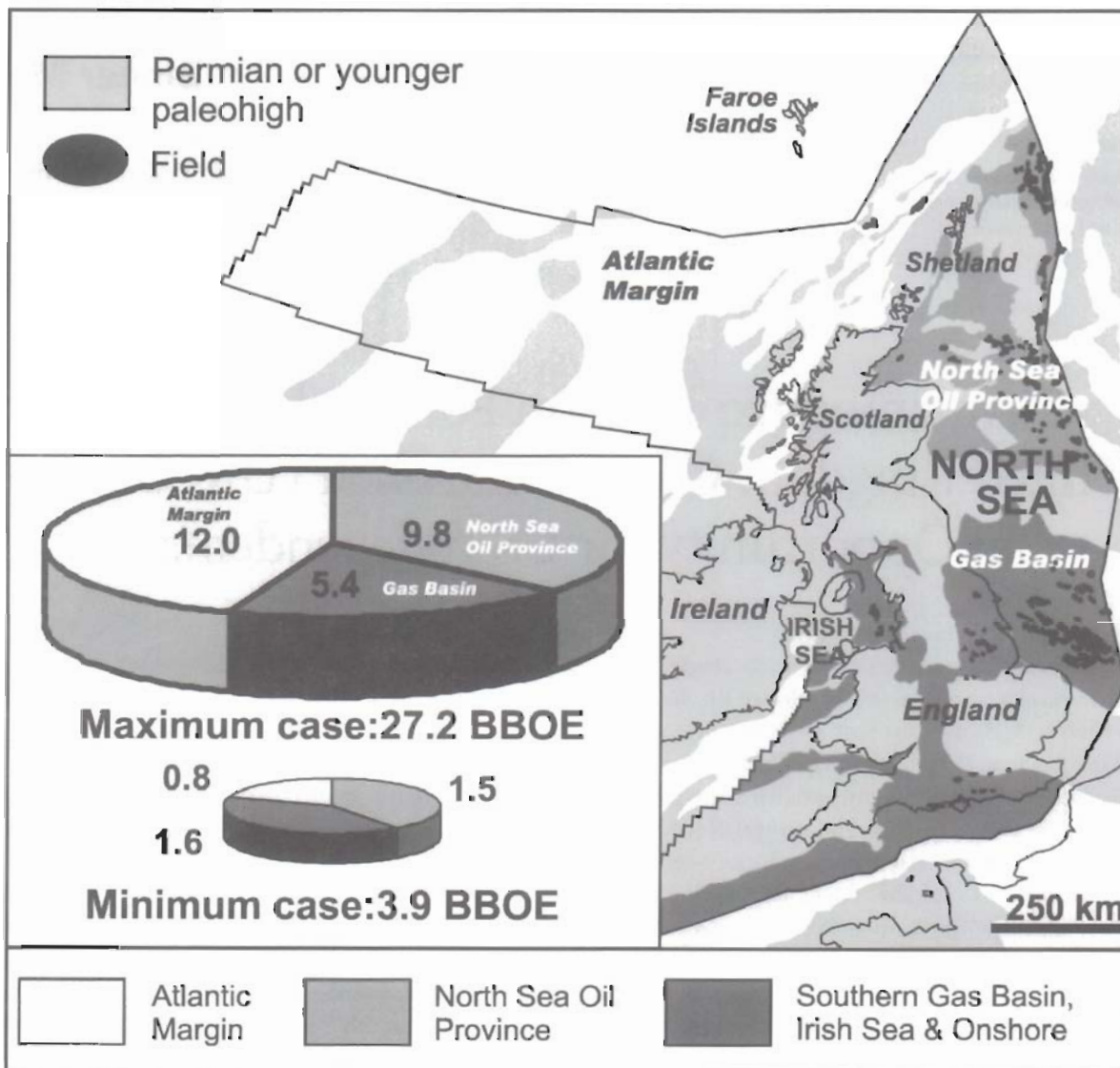


Fig. 1 Estimates of undiscovered reserves in the UK

- Deep basin plays in the central and northern North Sea, principally the High Pressure/High Temperature plays along the axes of the rift graben.
- Lower Permian aeolian margin plays—updip pinchout of the prolific Leman Sandstone at the edge of the dune belt of the southern North Sea.
- Palaeogeomorphic traps of late Palaeocene to early Eocene age around the shelf-margin in the northern North Sea and Atlantic Margin

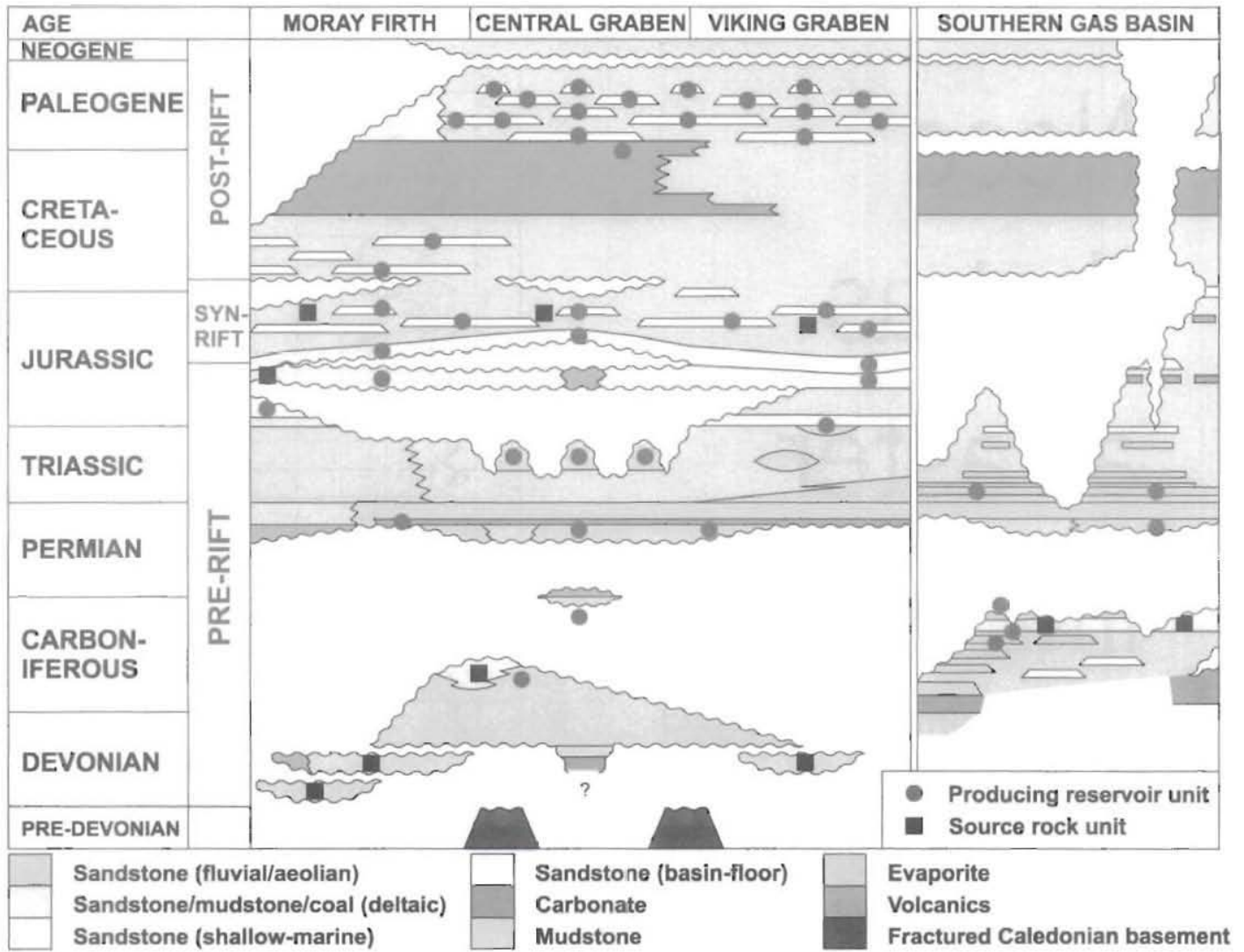
Estimates of yet-to-find reserves on the UKCS are very subjective. The 2001 edition of the UK government's publication "The Brown Book" predicts undiscovered reserves in the range 4–26 billion barrels of oil equivalent. These figures appear to be consistent with industry estimates, and could be viewed as somewhat conservative when compared to some. However, government and industry agree that the most prospective oil plays will continue to be in the central and northern North Sea, with parts of the Atlantic Margin providing the best gas opportunities.

In summary, the UKCS has proved to be a very successful exploration province in the last 35 years, with a success rate of 35% for its 4000 E&A wells. Recent successes have demonstrated that substantial reserves remain to be discovered in the mature North Sea. Exploration of the Atlantic Margin is still at a frontier stage, but this province has the potential to yield further giant oil and gas fields.

\* Note: full color versions of these figures are available at the HGS Website at <http://www.hgs.org/meet1201.htm#intd/in>

#### Biographical Sketch

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**Fig. 2 Chronostratigraphic chart of the North Sea to show the distribution of source and reservoir rocks**