Stratigraphic plays of the UKCS

Introduction

The majority of the fields and significant discoveries on the United Kingdom Continental Shelf (UKCS) are found in structural traps, with just 12% in combination structural/stratigraphic traps and only 6% in stratigraphic traps (Fig. 1).

With respect to existing fields and discoveries, stratigraphic and combination traps occur mainly within Upper Jurassic syn- and post-Jurassic post-rift play fairways (Fig. 2). Fields and discoveries within pre-rift play fairways (Middle Jurassic and older) occur predominantly in structural traps.

Although mounded deep-water channel and fan traps are in part structural, since differential compaction often results in 4-way dip closures, the origin of such traps is stratigraphic, and they are designated as such in this evaluation. Many tilted fault block traps have eroded crests, and thereby include a component of stratigraphic entrapment, but most of such traps are essentially structural.

What proportion of the yet-to-find resources on the UKCS is located within stratigraphic or combination traps, and in which plays are these traps most likely to occur?

The sheet-like geometry and sand-rich nature of many of the pre-rift reservoirs (Fig. 3) make stratigraphic entrapment unlikely. Exceptions are combination traps like the Carboniferous Tyne gas field complex, where the trap is defined by a combination of dip closure and erosional pinch-out of late Westphalian red beds beneath the base Permian unconformity. The Ravenspurn North Field is an example of a combination stratigraphic pinchout/dip trap at the margin of the Rotliegend (Lower Permian) play. The geometry and lateral distribution of deep-water mass flow deposits are highly conducive to full or partial stratigraphic entrapment; 50% of deep-water syn-rift reservoirs are located within stratigraphic and combination traps. Major recent discoveries like Buzzard, an Upper Jurassic stratigraphic pinchout/dip trap, are obvious analogues for future syn-rift targets, but these require the development of a strong conceptual model.

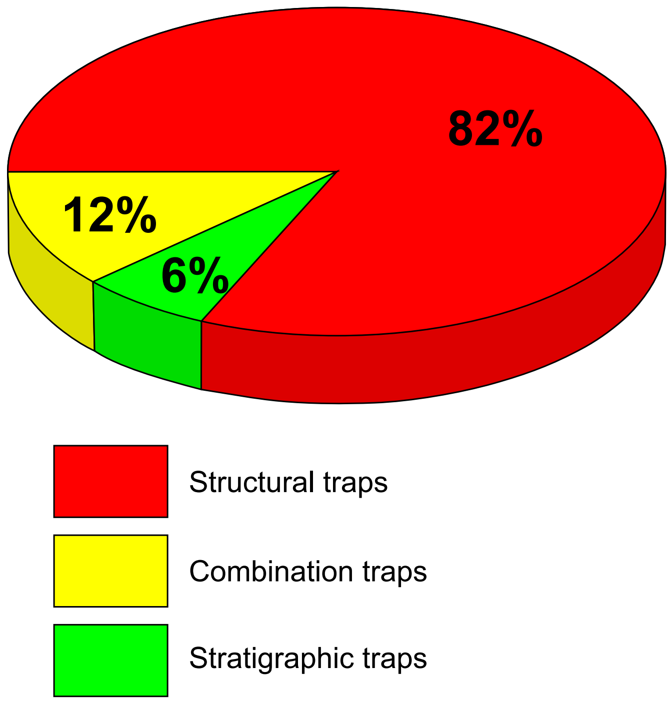


Fig. 1 Proportion of trap types in UKCS fields and discoveries (end 2011 data)

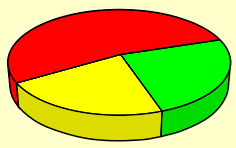
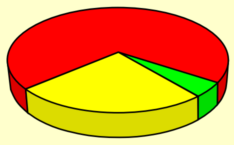
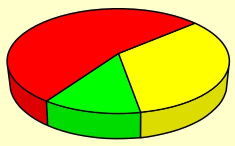
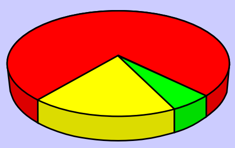
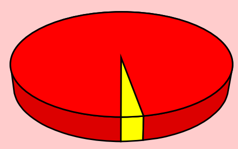
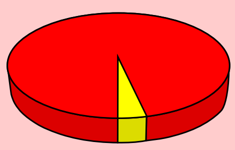
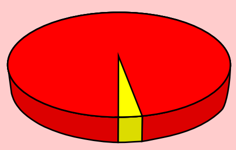
Post-rift	**Paleogene**	Structural: drape across fault blocks and salt structures. Combination: combined dip and stratigraphic pinchout traps, combined palaeogeomorphic and basement drape traps. Stratigraphic: detached basin-floor channel and fan mounds.	Structural: e.g. Forties, Montrose, Andrew, Machar, Foinaven Combination: e.g. East Foinaven, Gannet F, Schiehallion Stratigraphic: e.g. Alba, Frigg, Everest, Gryphon, Harding, Pilot	
	Upper Cretaceous	Existing UKCS fields and discoveries are located mainly within structural traps. However, an increasing number of traps have been shown to include a component of stratigraphic entrapment by low porosity reservoir units following post-charge trap tilting. The Danish sector's Halfdan Field is a 'stratigraphic' dynamic constriction trap.	Structural: e.g. Kyle, Banff, Orion Combination: e.g. Joanne, Fife, Flora	
	Lower Cretaceous	Many successfully tested structural closures have been found to have an element of stratigraphic entrapment, i.e. hydrocarbon-water contact is deeper than spill point. The Scapa Field is a combination syncline and stratigraphic pinchout trap that was only discovered by accident during appraisal drilling on the Claymore Field.	Structural: e.g. Hannay, Victory Combination: e.g. Britannia, Captain, Claymore, Cromarty, Goldeneye, Scapa, Stratigraphic: e.g. Highlander	
Syn-rift	**Upper Jurassic**	Trap type is highly variable. Many of the combination traps were initially interpreted to be structural traps (e.g. Brae fields). Deep-water sandstone reservoirs commonly have an element of stratigraphic trapping; shallow-marine sandstones occur mainly in structural traps.	Structural: e.g. Durward, East Brae, Janice, Piper, Renee, Solan, Telford Combination: e.g. Kittiwake, Magnus, South, Central & North Brae Stratigraphic: e.g. Dauntless, Highlander, Miller, Tartan	
Pre-rift	**Middle Jurassic**	Structural trap types predominate. Simple and complex tilted or horst fault block traps; crestal slumping and degradation is common in the Brent province (East Shetland Basin). Successful hanging-wall traps are relatively uncommon.	Structural: e.g. Beatrice, Beinn, Brent, Ninian, Seagull Combination: e.g. Beryl	
	Triassic - Lower Jurassic	Structural trap types predominate. Simple and complex tilted horst fault block traps; successful hanging-wall traps are relatively rare. Commonly found stacked in the same trap with overlying Middle Jurassic reservoirs. Triassic (Skagerrak Formation) reservoirs in Central North Sea occur in salt-controlled mini-basins.	Structural: e.g.Beryl, Esmond, Hewett, Judy, Marnock, Morecambe, Statfjord Combination: e.g. Kittiwake, Strathmore	
	Palaeozoic	Almost entirely structural traps found. Reservoirs range from fractured basement rocks, through Devonian, Carboniferous and Permian strata.	Structural: e.g. Argyll, Buchan, Clair, Innes, Leman, Murdoch Combination: e.g. Auk, Tyne complex, Murdoch K (CMS-III), Ravenspurn North	

Fig. 2 Proportion of trap types in UKCS fields and discoveries (end 2012 data)

Modified after Stoker *et al.* (2006)

Stratigraphic plays of the UKCS

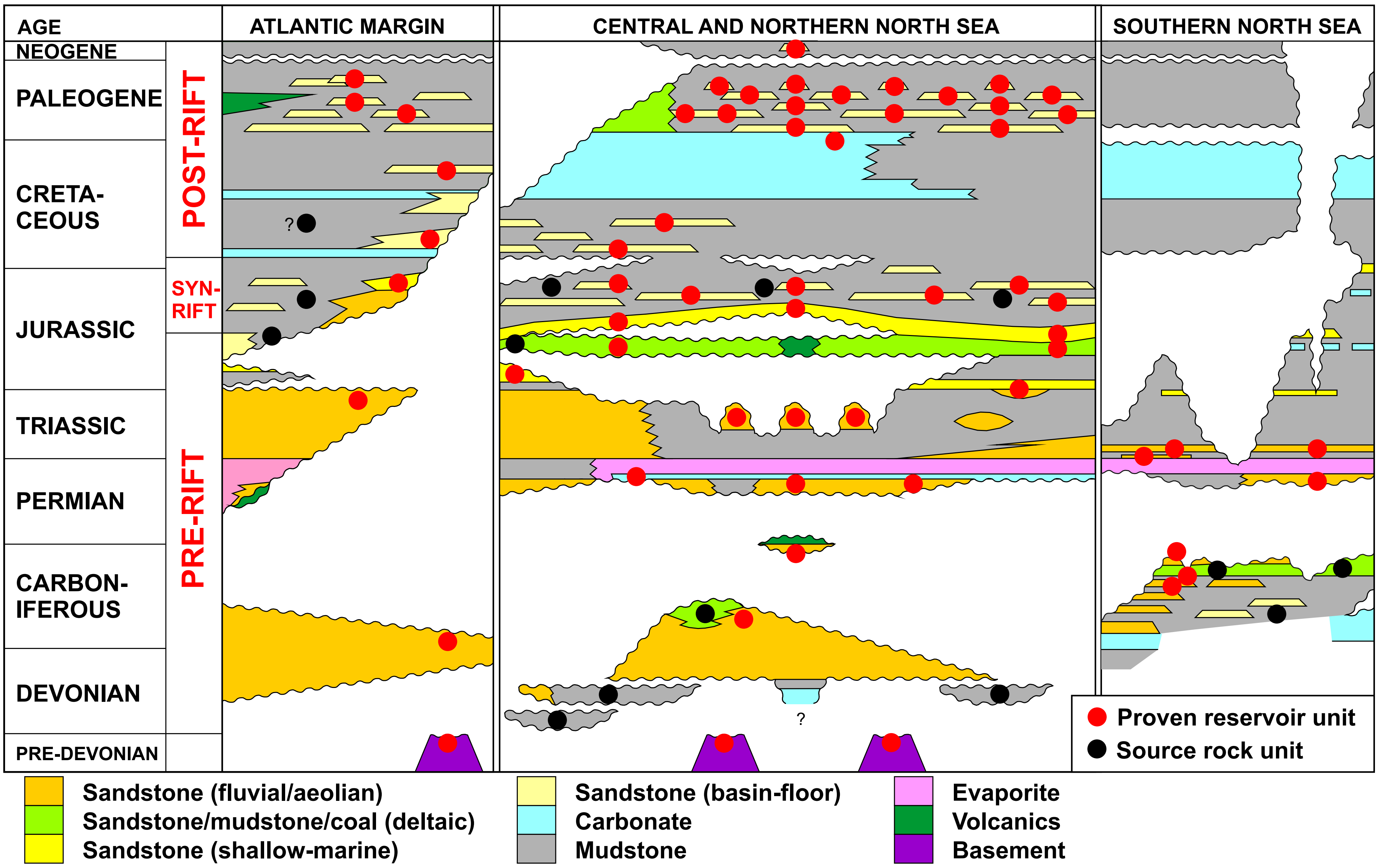
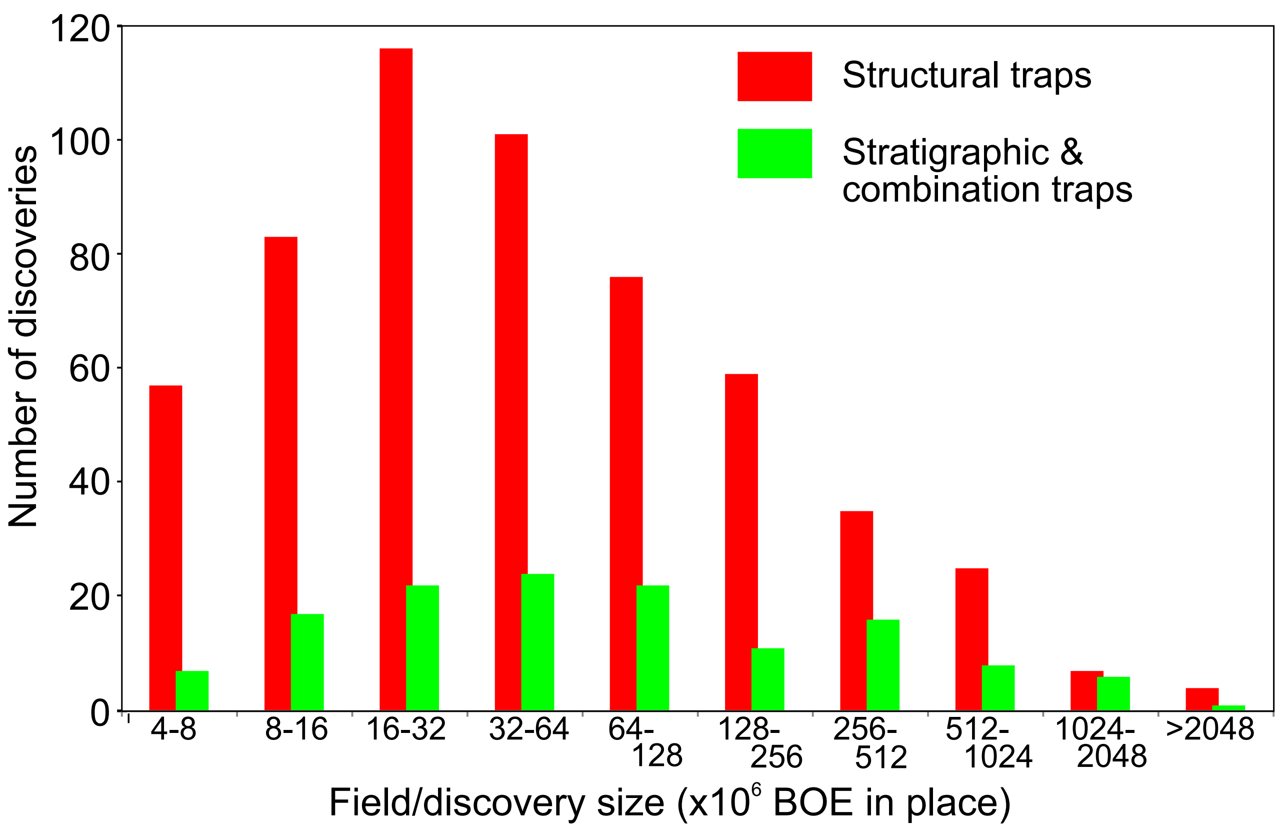


Fig. 3 Simplified stratigraphy and lithofacies in UKCS oil and gas basins

Fig. 4 Field size distribution chart for UKCS fields and discoveries in structural traps, and in stratigraphic and combination traps (end 2012 data).

The relatively flat to irregular distribution for the stratigraphic and combination trap population is suggestive of an immature population.

Modified after Stoker *et al*. 2006.



Reference:

Stoker, SJ, Gray, JC, Haile, P, Andrews, IJ & Cameron, TDJ. 2006. The importance of stratigraphic plays in the undiscovered resources of the UK Continental Shelf. In: Allen, M.R., Goffey, G.P., Morgan, R.K. & Walker, I.M. (eds). *The Deliberate Search for the Stratigraphic Trap*. Geological Society, London, Special Publication, **254,** 153-167.

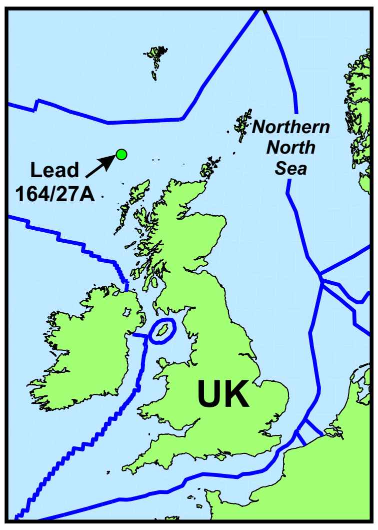
Paleogene stratigraphic plays

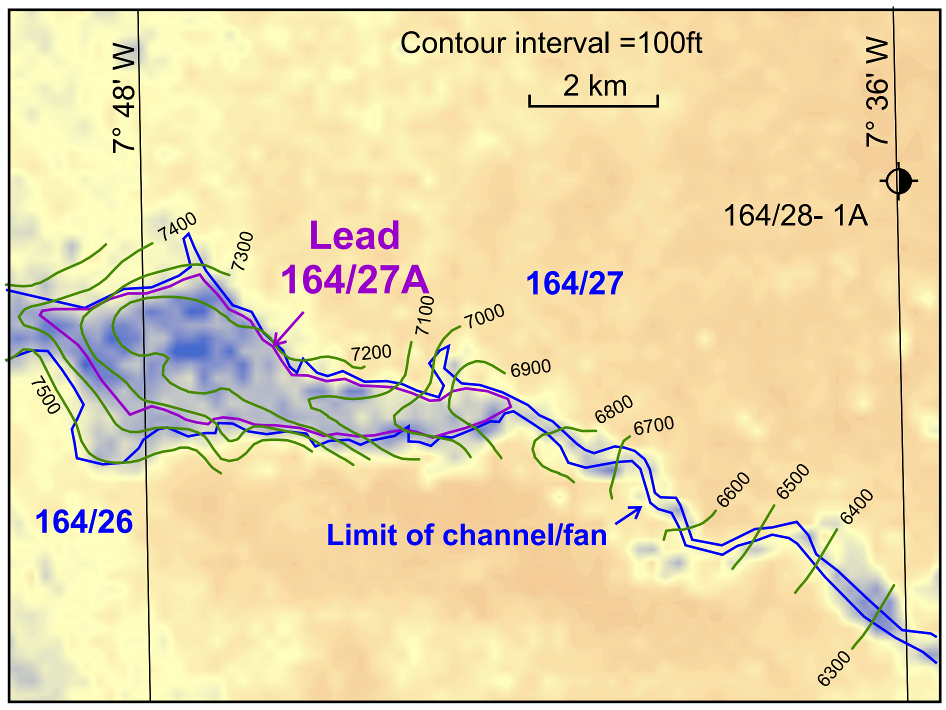
Half of all Paleogene UKCS hydrocarbon discoveries occur in traps with full or partial stratigraphic entrapment (Fig 2). This is because the majority of Paleogene reservoirs are deep-water sandstones, whose geometry commonly lends itself to stratigraphic entrapment. Stratigraphic pinch-out traps generally occur where Paleogene sandstones onlap and pinchout onto the flanks of basin-margin highs, as exemplified by the Everest and Fleming fields adjacent to the Jaeren High in the Central North Sea (O'Connor and Walker 1993) and the Laggan discovery on the eastern margin of the Faeroe-Shetland Basin.

Combination traps offer the best potential, as a link to structure dramatically increases a stratigraphic prospect's chance of success. The most promising traps tend to either have a palaeogeomorphic component or are linked to an amplitude or AVO anomaly. The use of AVO has had mixed success in the West of Shetland area, where true Class III (increasing amplitude with offset angle) anomalies have proved elusive. In the future, the use of electromagnetic imaging techniques may be important in the further derisking of stratigraphic traps.

In the Faroe-Shetland Basin, the search for stratigraphic traps has concentrated on Vaila Formation (Paleocene) sandstones beneath the Kettla Tuff, which, with adjacent claystones, acts as a regional seal. The reservoirs are known informally in BP T-zone terminology as the T31-T35 sandstones. In the Judd Sub-basin, the Foinaven Field, in stratigraphically equivalent strata, is a faulted anticline with elements of stratigraphic pinch-out on its south-east margin.

Stratigraphic or combination traps are the focus of current Paleogene exploration in the North Sea, where only small 4-way dip Paleogene traps remain untested. They form a particularly important component of remaining Paleogene prospects along the Atlantic Margin province, where they have the potential to contribute significantly to the remaining up to 6.5 bboe undiscovered reserves currently predicted by DECC (2012; https://www.gov.uk/oil-and-gas-uk-field-data#uk-oil-and-gas-reserves) for this province.





MC3D seismic data courtesy of PGS

Fig. 6 Seismic attribute map (RMS amplitude) showing the limit of a stratigraphic trap, Lead 164/27A. High amplitudes are interpreted as due to the presence of Eocene mass-flow sandstones within slope channels. See more of Lead 164/27A

Lead 164/27A: an Eocene slope channel mass-flow sandstone trap

Several examples of Eocene channel systems are clearly imaged on seismic data from the eastern slope margin and floor of the Rockall Basin. The Tobermory gas discovery has been made within contemporary basin-floor fan deposits in the Faroe-Shetland Basin. For the Rockall Basin examples, the presence of an effective migration route from Jurassic and/or unproven mid-Cretaceous source rocks is the principal exploration risk.

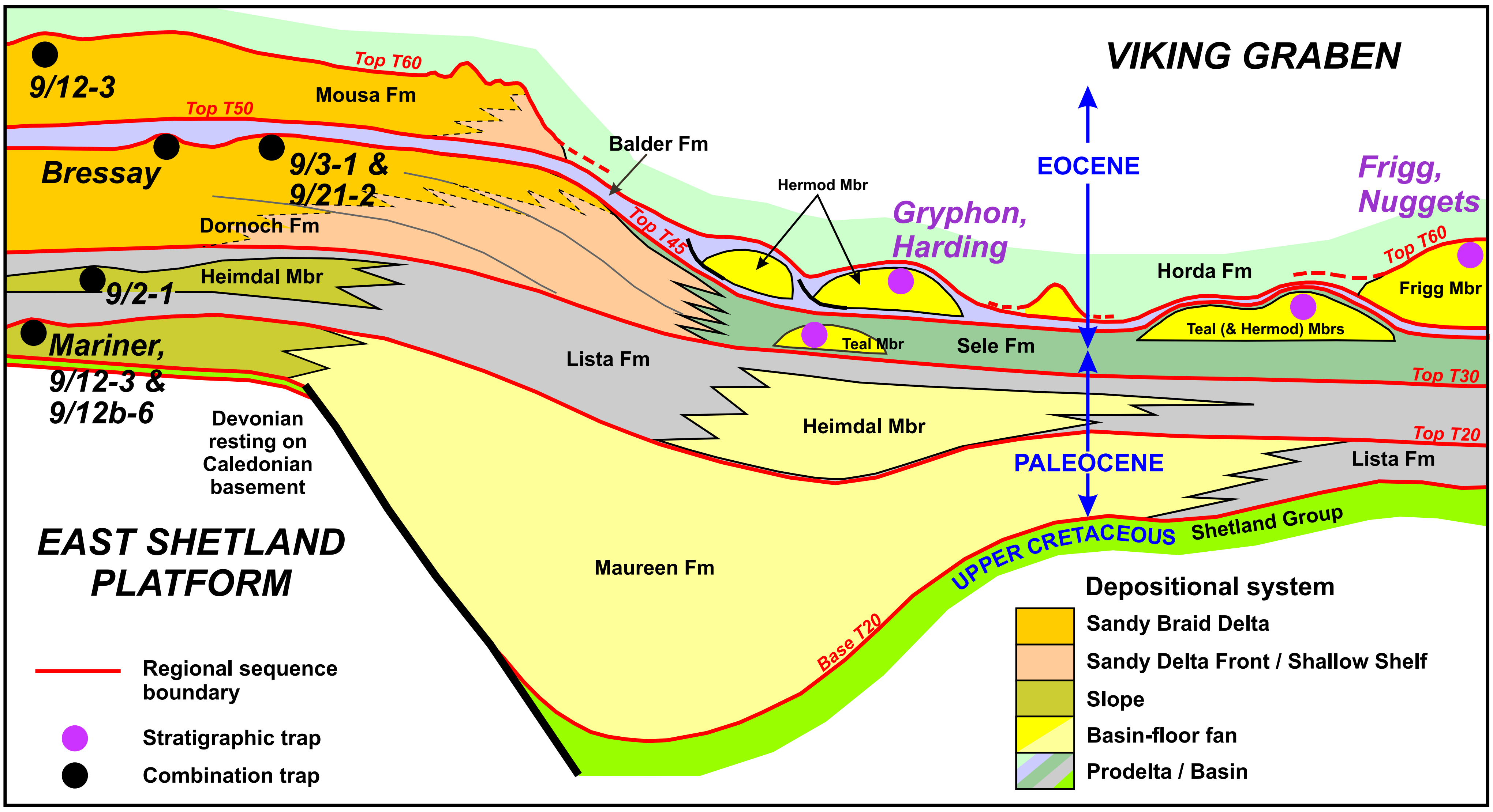
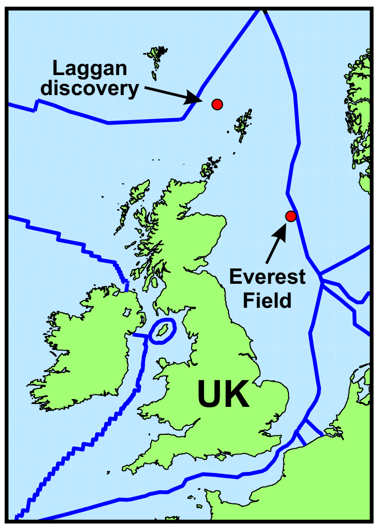


Fig. 5 Schematic sequence stratigraphic section showing Paleogene depositional system and trap types, Northern North Sea

Stratigraphic plays of the UKCS

The Everest Field: a successful stratigraphic pinch-out trap, Central North Sea

The Everest Field is a complex of laterally-offset, stacked gas-condensate reservoirs in the Paleocene Maureen Formation and Mey (Andrew) and Forties Sandstone Members where they pinch out laterally on the western flank of the Jaeren High, in the Central North Sea (Fig. 7). The Forties Sandstone Member is separated into two lobes by an interlobe area of sand-poor sediments that was drilled in 1975 by the first exploration well (22/9-1), hence delaying discovery of the field.



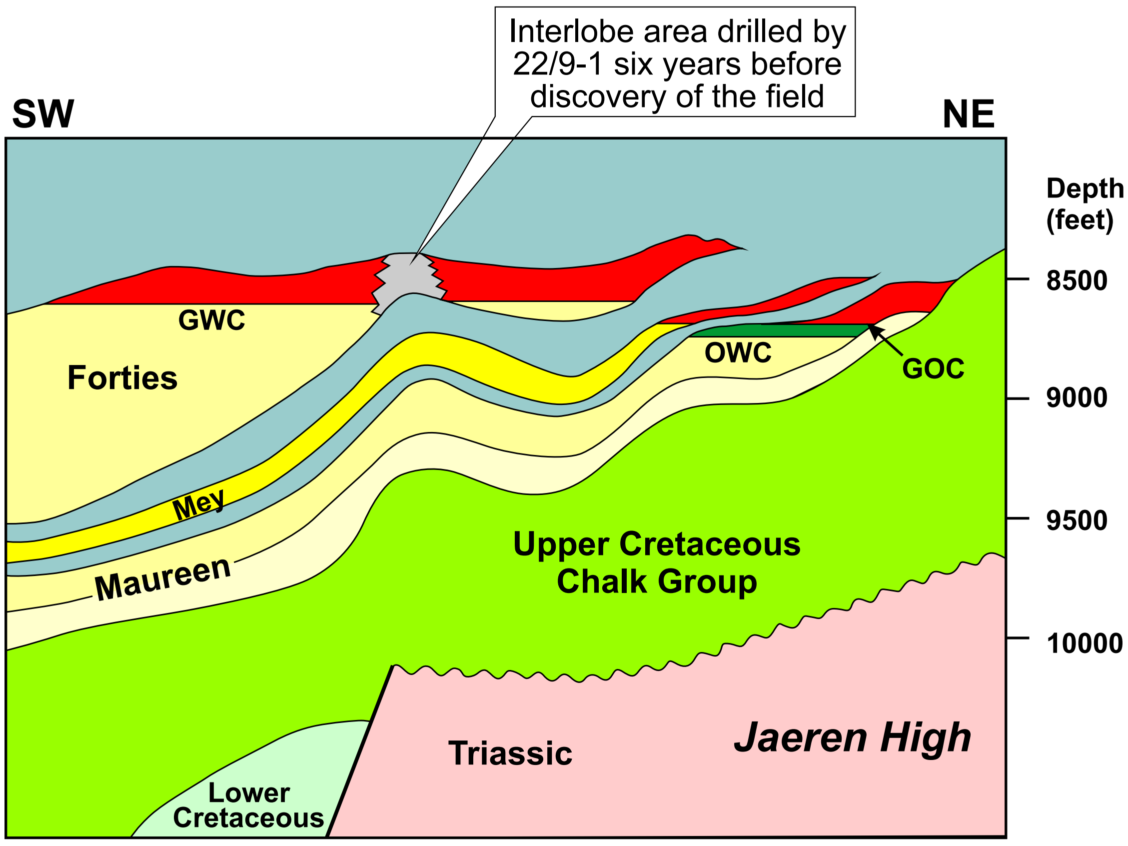


Fig. 7 Geoseismic section across the Everest Field (after O'Connor and Walker, 1993)

The Laggan gas discovery: a successful stratigraphic trap with an associated amplitude anomaly, Faroe-Shetland Basin

Shell well 206/1-2 discovered the Laggan gas accumulation in 1986. Ten years later Total drilled a second well on Laggan (206/1-3 was located 4 km to the southwest of 206/1-2). Both wells encountered gas within good quality sequence T35 sands. T35 sands have high porosity, high permeability, and have ubiquitous chlorite grain coating, enhancing porosity of the sands.

Currently, it is difficult to separate out anomalously high seismic amplitudes associated with gas to those related to the high porosity but water-wet sandstone. High amplitudes extend beyond the GWC. The updip limit of the gas accumulation is a pinch-out against a northeast trending growth fault, which also coincides with the high amplitude cut-off (Figs. 8 & 9).

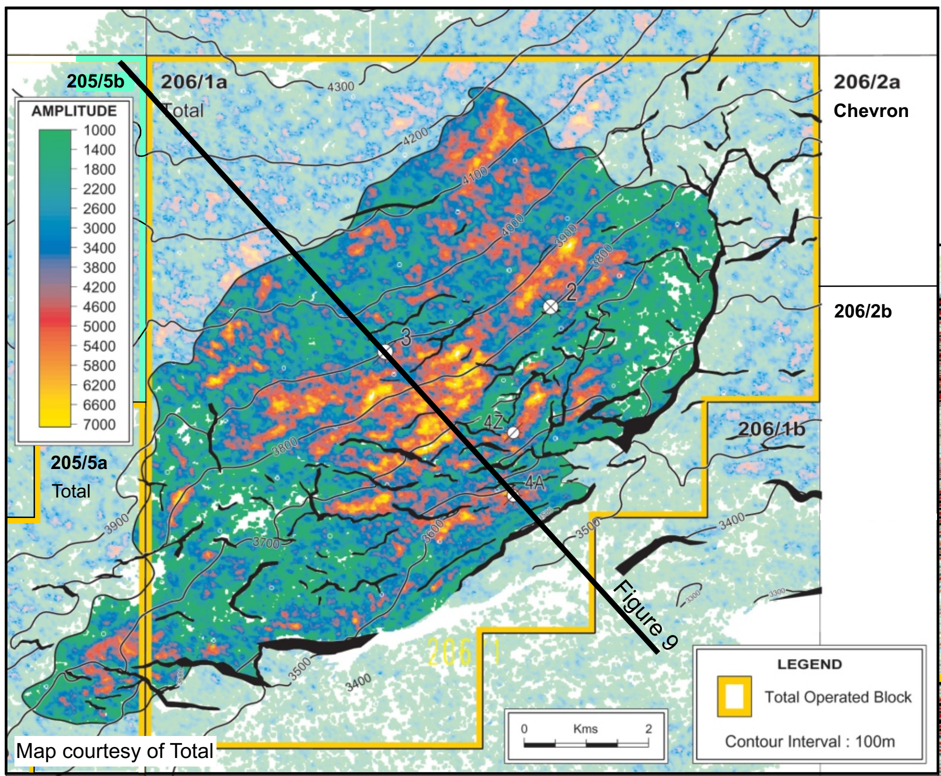


Fig. 8 Laggan amplitude anomaly

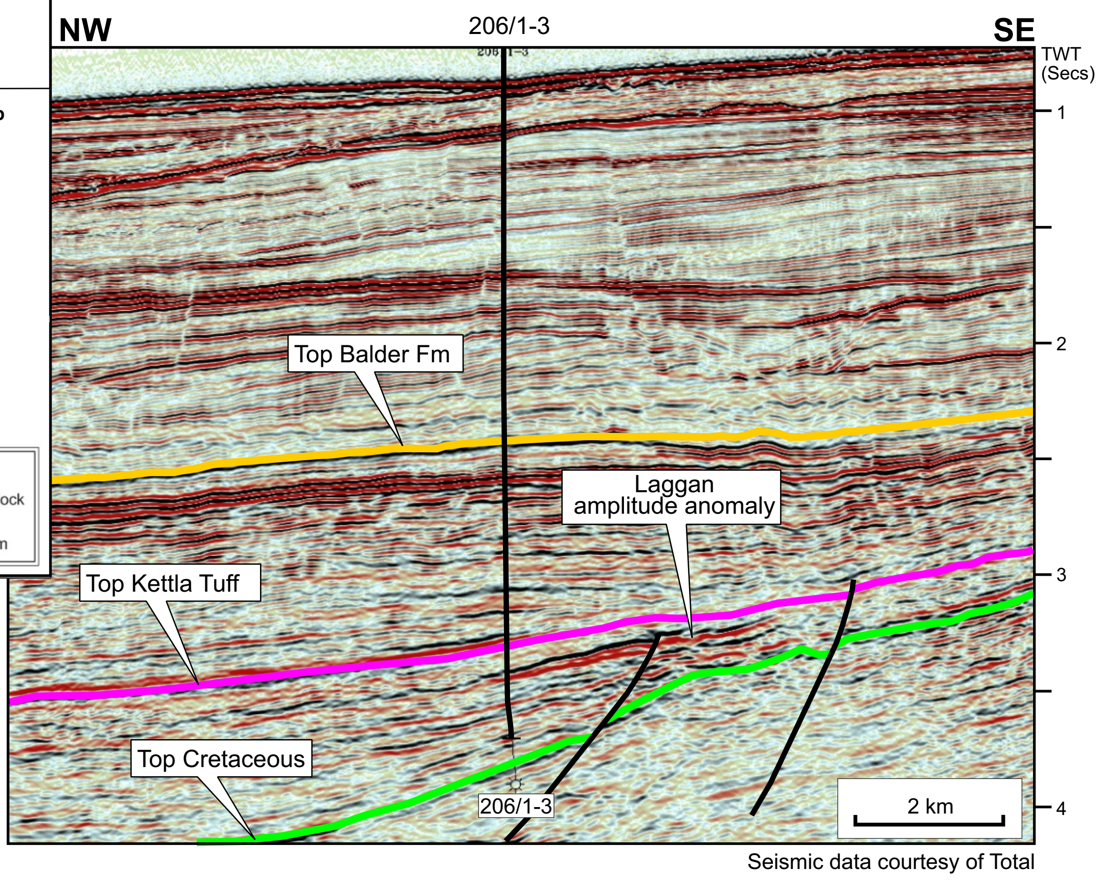


Fig. 9 Seismic section across the Laggan gas discovery

Paleogene references:

Ahmadi, ZM, Sawyers, M, Kenyon-Roberts, S, Stanworth, CW, Kugler, KA, Kristensen, J, and Fugelli, EMG. 2003. Paleocene. 235-259 in *The Millennium Atlas: petroleum geology of the central and northern North Sea.* Evans, D, Graham, C, Armour, A, and Bathurst, P (editors and coordinators). (London: The Geological Society of London)

Jones, E, Jones, R, Ebdon, C, Ewen, D, Milner, P, Plunkett, J, Hudson, G, and Slater, G. 2003. Eocene. 261-277 in *The Millennium Atlas: petroleum geology of the central and northern North Sea.* Evans, D, Graham, C, Armour, A, and Bathurst, P (editors and coordinators). (London: The Geological Society of London)

O'Connor, SJ, and Walker, D. 1993. Paleocene reservoirs of the Everest trend. In: Parker, JR (ed.) *Petroleum Geology of Northwest Europe: Proceedings of the 4th Conference*. The Geological Society, London, pp. 145-160.

Underhill, JR. 2001. Controls on the genesis and prospectivity of Paleogene palaeogeomorphic traps, East Shetland Platform, UK North Sea. *Marine and Petroleum Geology*, Vol. 18, pp. 259-281.

Stratigraphic plays of the UKCS

Lower Cretaceous stratigraphic plays

72% of UKCS Lower Cretaceous fields and discoveries are located within combination or stratigraphic traps. The limited lateral and vertical distribution of coarse clastics within the Lower Cretaceous section gives considerable opportunity for full or partial stratigraphic entrapment. The mass-flow genesis of much of the Lower Cretaceous coarse-clastic sediment means that mounding, enhanced by differential compaction, provides the mechanism for palaeogeomorphic entrapment.

The Scapa and Britannia fields and the Lower Cretaceous part of the Highlander Field were found by serendipity during drilling to deeper, structural Jurassic targets. Each of these discoveries is located within a low or syncline, and has a strong stratigraphic trapping component. Since seismic imaging of Lower Cretaceous sandstones in the North Sea is commonly poor, a robust depositional model must be developed from well and other data, or more sophisticated seismic techniques need to be employed. Morgan *et al*. (2002) and Morgan and Went (2004) showed that anomalous AVO effects can be recognised from long-offset (6 km) 3D seismic data within channel-like features and lobate, fan-like bodies, which can be implied to represent the presence of sandstones.

The established Lower Cretaceous deep-marine sandstone play fairway of the UK North Sea is mostly limited to the Moray Firth basins (Figs. 10 & 11). Although Lower Cretaceous sandstones have been found in 131 wells within the UK Central Graben area outside the established fairways, there has been little direct exploration of this play in those areas. Milton-Worssell *et al*. (2006) suggest that the potential exists for at least 26 undrilled Lower Cretaceous deep-water stratigraphic leads in the Central Graben area.

See also poster:
Lower Cretaceous deep-water sand plays, UK Central Graben

Fig. 10 Late Ryazanian-Barremian fairway

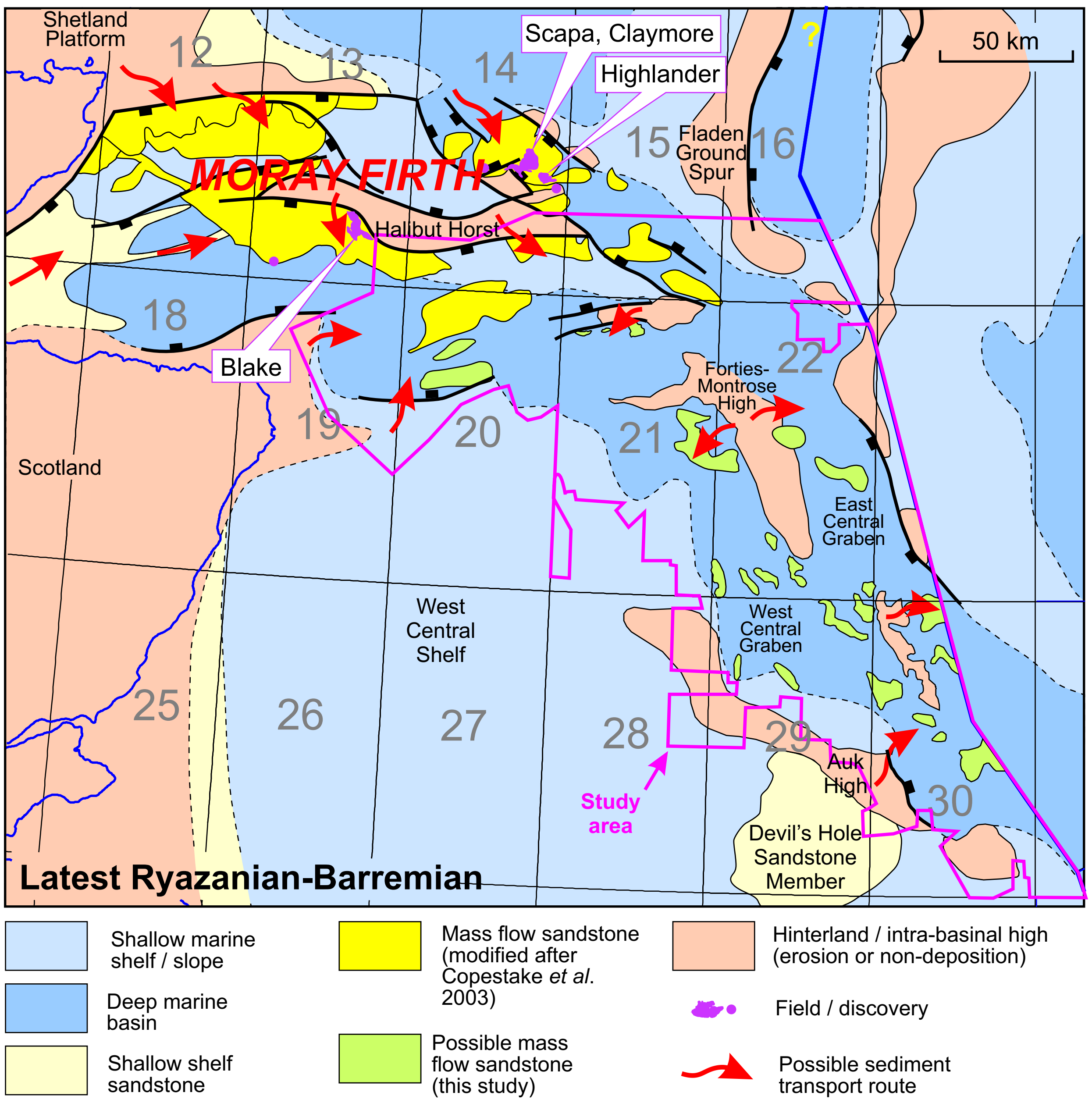
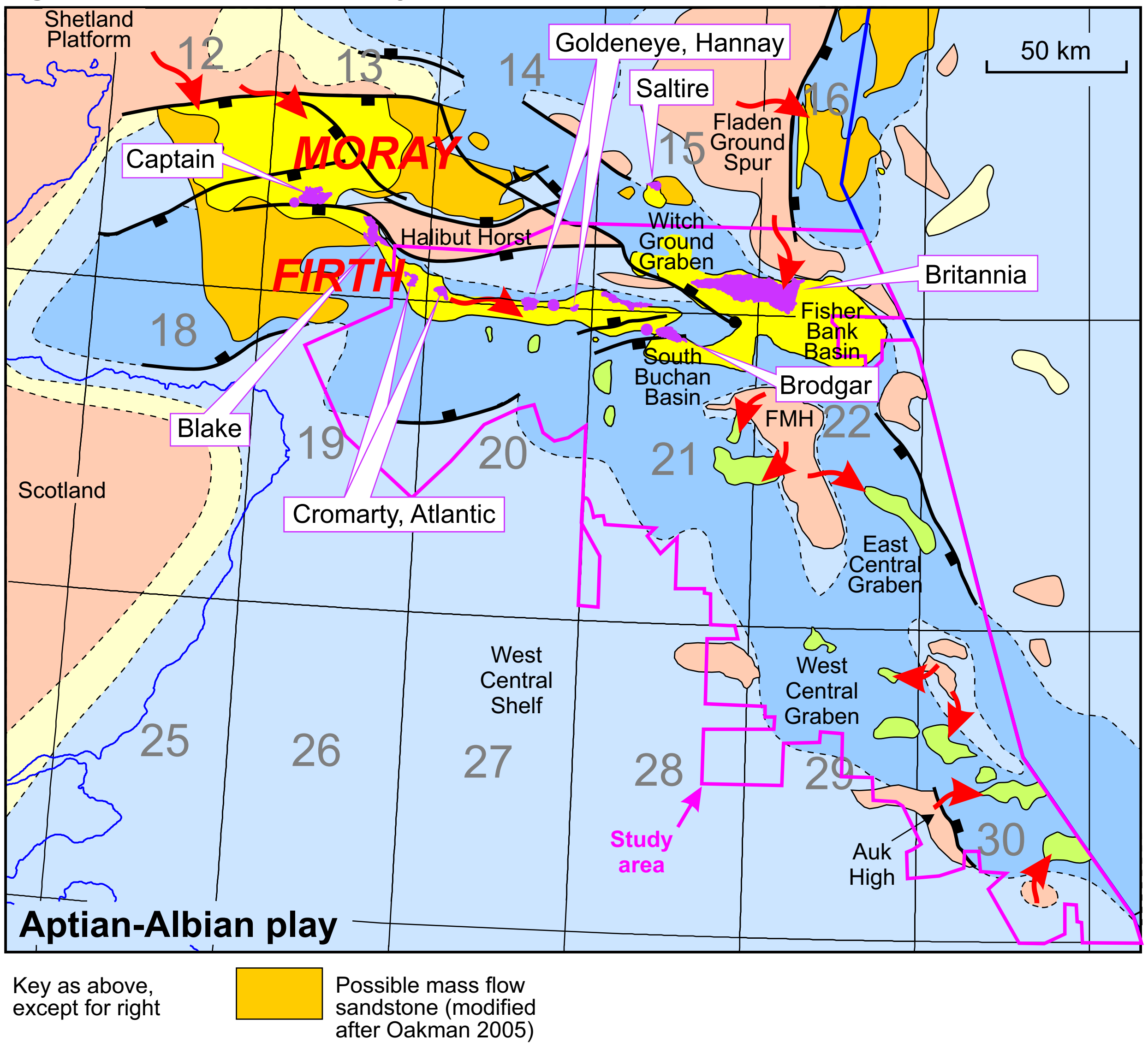


Fig. 11 Aptian-Albian fairway



Upper Jurassic deep-water sandstone stratigraphic plays

Upper Jurassic sandstones are widely developed in the UKCS rift basins; however, the earliest Upper Jurassic sandstones (e.g. Piper and Fulmar formations) are deltaic to shallow-marine sediments that pre-date the main rifting phase. Syn-rift clastics are predominantly deep-water mass-flow deposits (e.g. Brae Formation and Burns and Claymore Sandstone members in the Viking Graben and Moray Firth), whose lateral distribution and geometry is highly conducive to at least partial stratigraphic entrapment. Upper Jurassic syn-rift clastics are interbedded with the Kimmeridge Clay Formation, a world-class oil source rock that has generated much of the oil in the North Sea. Fraser *et al*. (2003) have summarised the range of trap types in which Upper Jurassic reservoirs have been found.

The Brae complex and Miller fields are examples of combined structural and stratigraphic pinch-out traps that were originally conceived to be structural traps. In the South Viking Graben, Upper Jurassic coarse clastics of the Brae Formation form a number of overlapping fan bodies (Figs. 12 & 13). The South, Central and North Brae fields were initially obvious targets, since each has substantial 4-way dip closure due to compactional drape. However, testing of the Brae structures found that the oil-water contacts were much deeper than the spill point of the structural closures mapped, and appraisal drilling confirmed the importance of stratigraphic pinch-out at these fields (Roberts 1991, Stephenson 1991, Turner & Allen 1991).

Many of the Upper Jurassic deep-water sandstone reservoirs within stratigraphic pinch-out traps are located above an underlying structural trap (e.g. 'Hot Lens' reservoir of the Tartan Field, Fig. 14). Predicting the distribution and pinch-out of such deep-water sandstones is critical to this play, and relies on the development of a well-grounded conceptual model since these reservoirs are typically poorly-resolved on seismic data. The discovery of the large Buzzard Field, a stratigraphic pinch-out trap located on the southern margin of the Moray Firth Basin (Doré 2002), is a testament to the potential for spectacular success in this play.

Fraser *et al*. (2003) suggest that Upper Jurassic deep-water reservoirs may be the most important exploration play for the future.

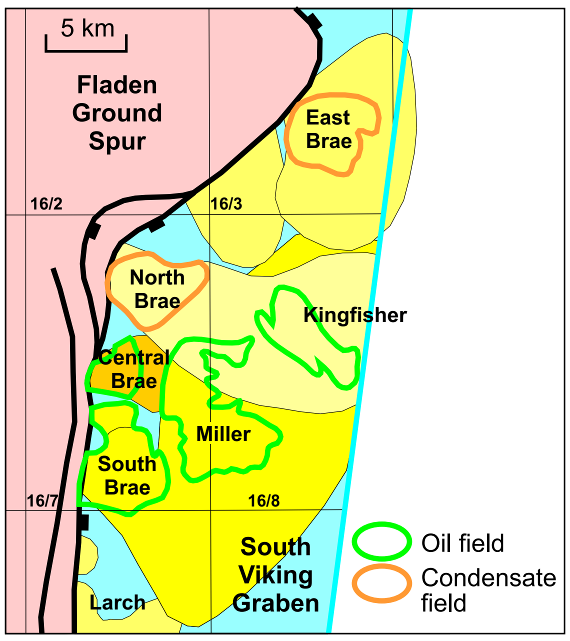


Fig. 12 Overlapping Upper Jurassic fans of the Brae-Miller area, South Viking Graben
Incorporating information from: Garland (1993), Roberts (1991), Stephenson (1991) and Turner & Allen (1991)

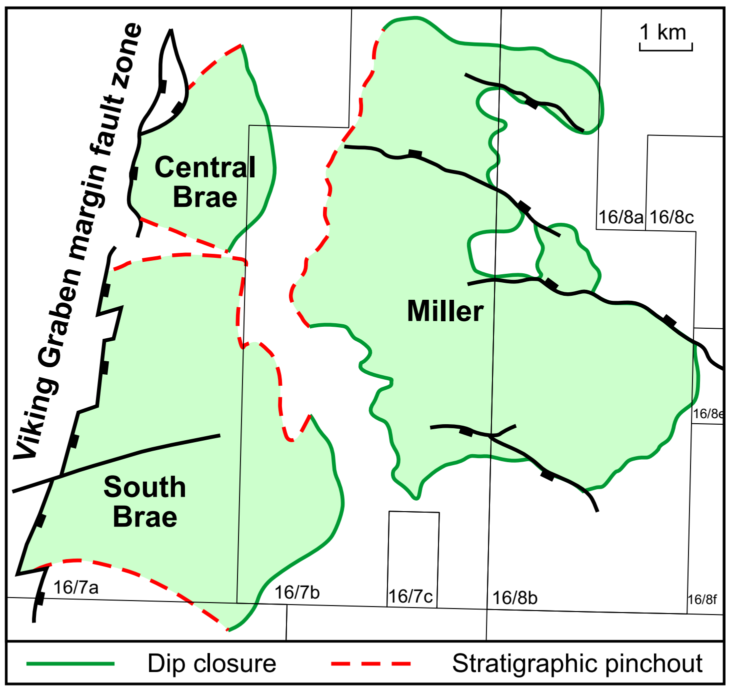
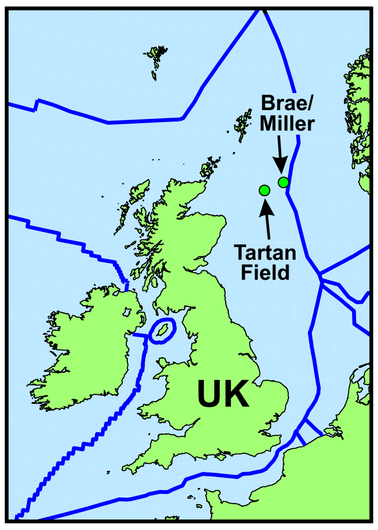


Fig. 13 Stratigraphic trapping importance at the South Brae, Central Brae and Miller fields, South Viking Graben
Incorporating information from: Garland (1993), Roberts (1991) and Turner & Allen (1991)



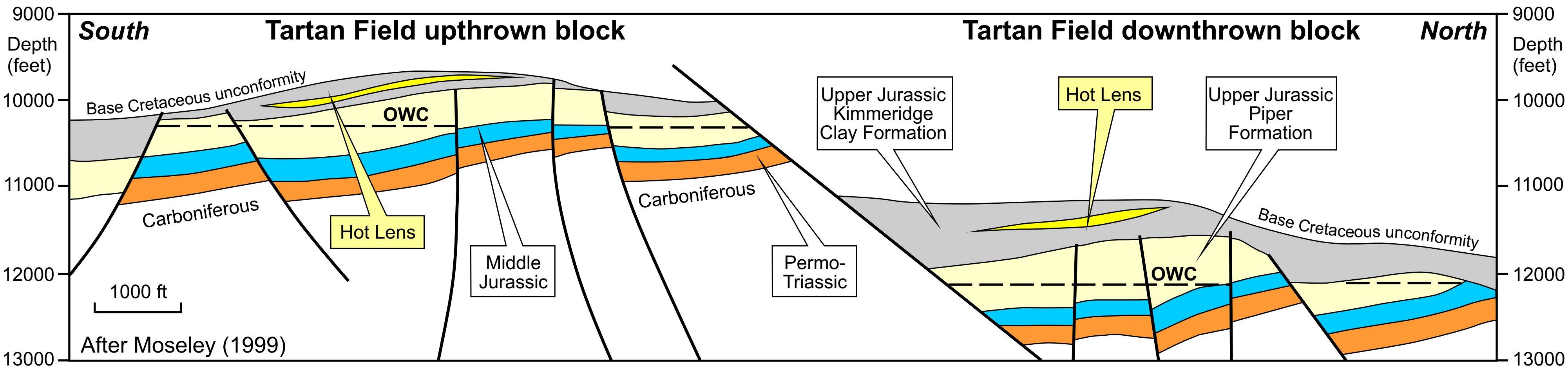


Fig. 14 Stratigraphic entrapment of the Upper Jurassic 'Hot Lens' reservoir at the Tartan Field, Moray Firth

Upper Jurassic deep-water references:

Doré, G. 2002. The Buzzard Field - an overlooked North Sea giant. *Extended abstracts*, Petex 2002 CD-ROM

Fraser, SI, Robinson, AM, Johnson, HD, Underhill, JR, Kadolsky, DGA, Connell, R, Johannessen, P, and Ravnås, R. 2003. Upper Jurassic. 157-189 in *The Millennium Atlas: petroleum geology of the central and northern North Sea.* Evans, D, Graham, C, Armour, A, and Bathurst, P (editors and coordinators). (London: The Geological Society of London).

Garland, CR. 1993. Miller Field: reservoir stratigraphy and its impact on development. In: Parker, JR (ed.) *Petroleum Geology of Northwest Europe: Proceedings of the 4th Conference*, Geological Society, London, pp. 231-240.

Moseley, BA. 1999. Downthrown closures of the Outer Moray Firth. In: Fleet, AJ and Boldy, SAR (eds) *Petroleum Geology of Northwest Europe: Proceedings of the 5th Conference*, Geological Society, London. pp. 861-878.

Roberts, MJ. 1991. The South Brae Field, Block 16/7a, UK North Sea. 49-54 in Abbotts, IL (ed.), *United Kingdom Oil and Gas Fields, 25 Years Commemorative Volume*, Geological Society Memoir No. 14.

Stephenson. 1991. The Kopervik fairway, Moray Firth, UK. *Petroleum Geoscience*, Vol. 6, pp. 265-274.

Turner, CC and Allen, PJ. 1991. The Central Brae Field, Block 16/7a, UK North Sea. 49-54 in Abbotts, IL (ed.), *United Kingdom Oil and Gas Fields, 25 Years Commemorative Volume*, Geological Society Memoir No. 14.

Upper Jurassic shallow-marine sandstone stratigraphic play

Upper Jurassic shallow-marine sandstones (Fulmar Formation) occur within stratigraphic and combination traps on the West Central Shelf of the UK Central North Sea (e.g. Dauntless and Kittiwake oil fields).

Fulmar Formation sandstones are thought to have been deposited within and at the edges of marine embayments that formed in response to the dissolution of underlying salt diapirs (Stewart & Clark 1999, Stewart *et al*. 1999, Fraser *et al*. 2003). In much the same way, underlying Triassic fluvial sandstones of the Skagerrak Formation are believed to have developed within palaeo-valleys located along the crests of dissolving salt walls and diapirs. Within this model of deposition, potential Triassic and Upper Jurassic sandstone reservoirs are thought to lie above the salt walls/diapirs, but not above the structurally higher minibasins or 'pods' of Triassic mudstone which formed between the salt highs (Fig. 15; Stewart *et al*. 1999).

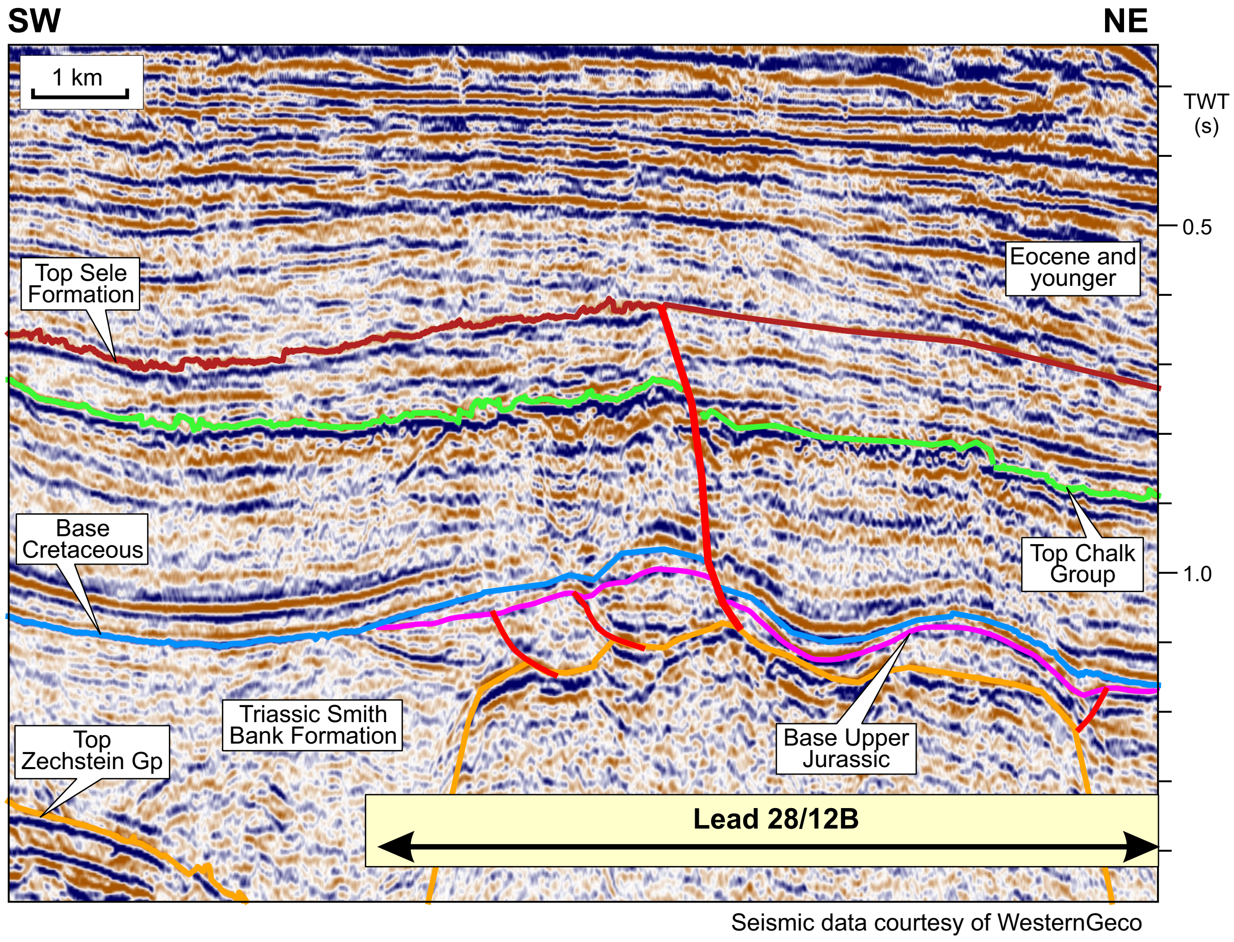
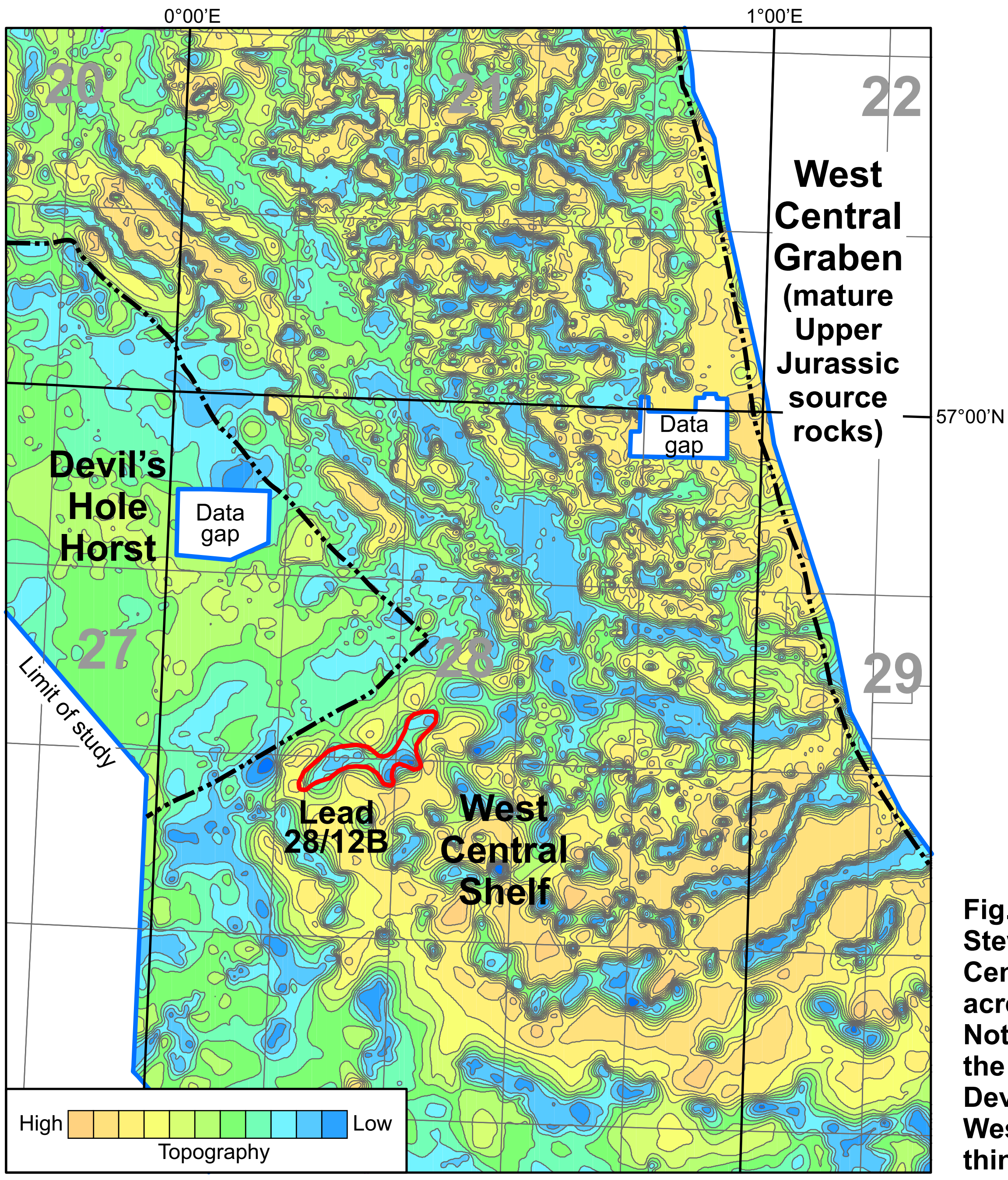


Fig. 15 Seismic line across a combination trap associated with a salt diapir (Lead 28/12A, see Fig. 16). Stratigraphic pinchout / facies change across the palaeo-low formed by salt dissolution defines the limit of the trap.

Mapping of pseudo topography as described by Stewart *et al*. (1999) offers a good insight into the location of potentially attractive leads in the West Central Shelf Fulmar Formation play (Fig. 16).

Go to: **Lead 28/12B**



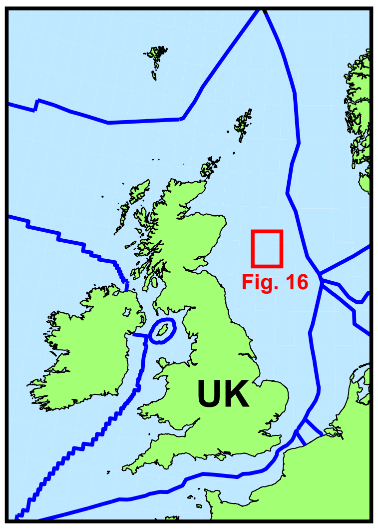


Fig. 16 Pseudo topography of pre-Late Jurassic (cf. Stewart *et al*. 1999, their Fig. 19) across the West Central Shelf showing the lead located in unlicensed acreage and featuring on this Promote UK CD-ROM. Note that the apparent low topography is an artifact of the pseudo topography generation method across the Devil's Hole Horst, and the south-western part of the West Central Shelf where the Zechstein comprises a thin, stable platform-type section.

Upper Jurassic shallow-marine references:

Fraser, SI, Robinson, AM, Johnson, HD, Underhill, JR, Kadolsky, DGA, Connel, R, Johannessen, P & Ravnas, R. 2003. Upper Jurassic. In: Evans, D, Graham, C, Armour, A, and Bathurst, P (eds), *The Millennium Atlas: petroleum geology of the central and northern North Sea*. Geological Society, London, 157-189.

Stewart, SA & Clark, JA. 1999. Impact of salt on the structure of the Central North Sea hydrocarbon fairways. In: Fleet, AJ & Boldy, SAR (eds) *Petroleum Geology of Northwest Europe: Proceedings of the 5th Conference*, Geological Society, London, 179-200.

Stewart, SA, Fraser, SI, Cartwight, JA, Clark, JA & Johnson, HD. 1999. Controls on Upper Jurassic sediment distribution in the Durward-Dauntless area, UK Blocks 21/11, 21/16. In: Fleet, AJ & Boldy, SAR (eds) *Petroleum Geology of Northwest Europe: Proceedings of the 5th Conference*, Geological Society, London, 879-896.

Palaeozoic stratigraphic plays

Permian

Nearly all of the Rotliegend (Lower Permian) fields and discoveries in the UKCS are entirely structural in trap configuration due to the sheet-like aspect of the Leman Sandstone Formation. The potential for stratigraphic pinch-out traps around the basin margins is demonstrated by the cross-section and block diagram in Figures 22 and 23. To date, only the Ravenspurn North Field in the Southern North Sea Gas Basin documents the success of the stratigraphic pinch-out play, with entrapment a combination of faulting, dip, and reservoir pinch-out to the north-west (Ketter 1991). Reduced reservoir thickness and quality is a significant risk in such basin-margin pinch-out plays.

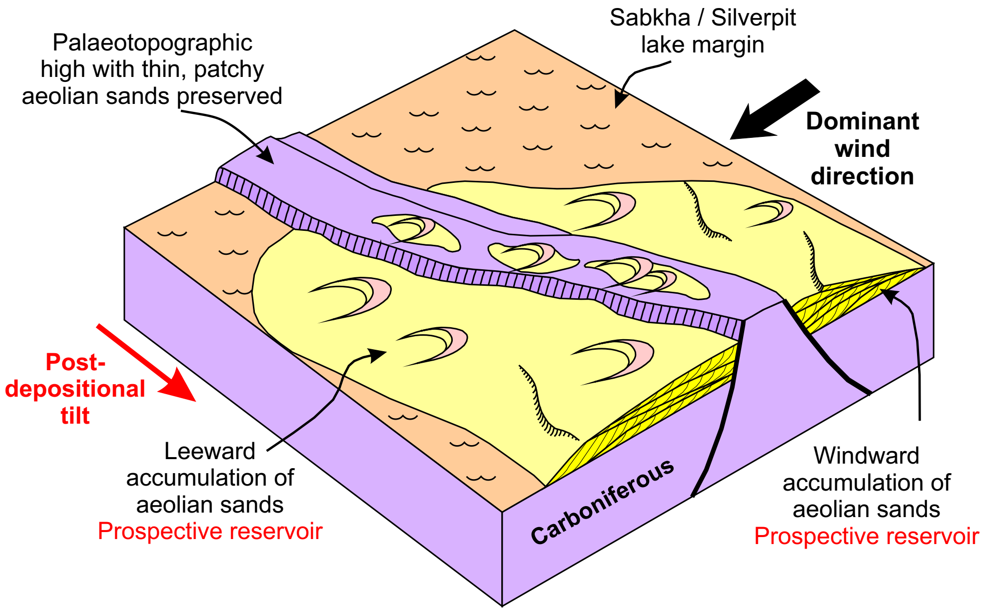


Fig. 18 Schematic diagram to illustrate structural control on Leman Sandstone stratigraphic pinch-out trap (after Munns *et al*. 2005)

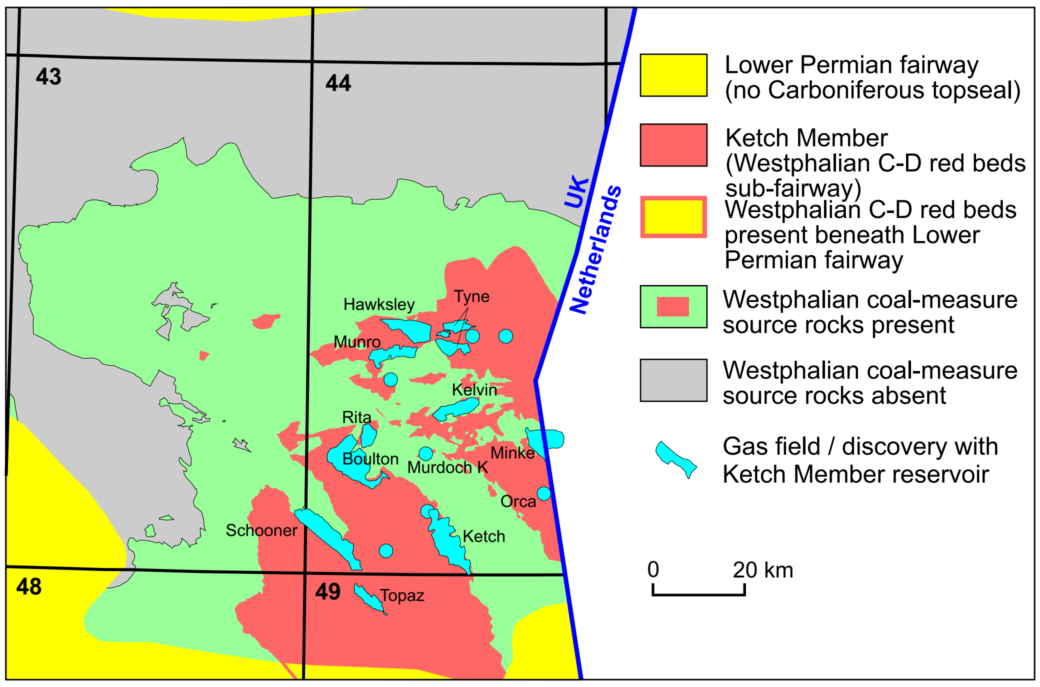


Fig. 19 Ketch Member (Late Westphalian, Carboniferous) play fairway, Southern North Sea Gas Basin (after Cameron *et al*. 2005)

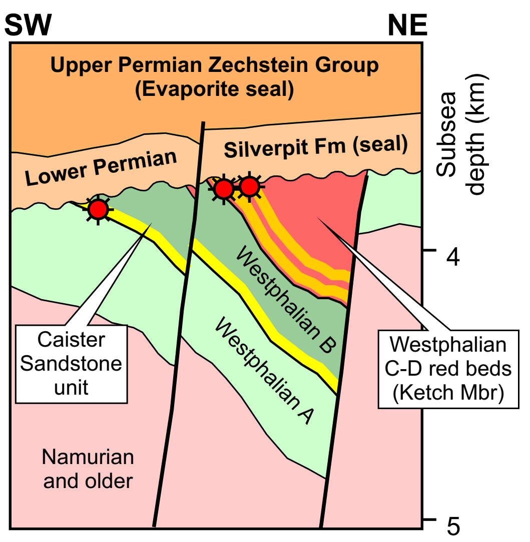


Fig. 20 Potential erosional truncation stratigraphic traps (no structural closure at base Permian unconformity). Modified after Cameron *et al*. (2005)

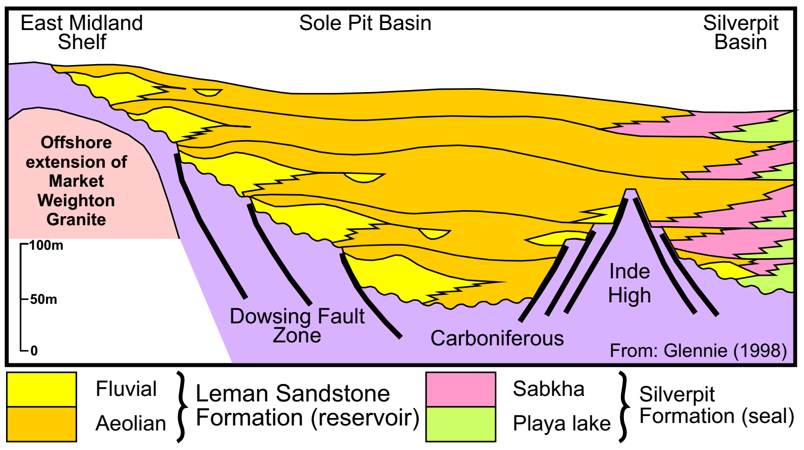


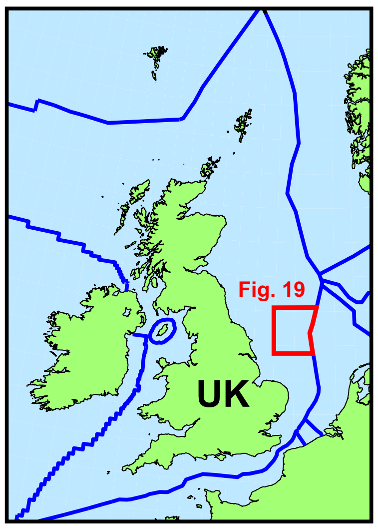
Fig. 17 Rotliegend Group: schematic facies development, Southern North Sea Gas Basin

Permian references:

Glennie, KW. 1998. Lower Permian - Rotliegend. 137-173 in: Glennie, KW (ed.) Petroleum Geology of the North Sea: basic concepts and recent advances. Blackwell Science Ltd, Oxford.

Ketter, FJ. 1991. The Ravenspurn North Field, Blocks 42/30, 43/26a, UK North Sea. In: Abbotts, IL. (ed.) *United Kingdom Oil and Gas Fields, 25 Years Commemorative Volume*, Geological Society Memoir 14, pp. 459-467.

Munns, J.W., Gray, J.C., Stoker, S.J., Andrews, I.J. & Cameron, T.D.J. 2005. The remaining hydrocarbon potential of the UK Continental Shelf. In: Doré, AG & Vining, BA (eds) *Petroleum Geology: North-West Europe and Global Perspectives-Proceedings of the 6th Petroleum Geology Conference*, Geological Society, London, 41-54.



Carboniferous

Most of the UKCS Carboniferous fields and discoveries are in structural traps top-sealed by unconformably-overlying Permian strata. However, at the Tyne gas field complex in the Southern Gas Basin, the trap is a combination of dip and erosional truncation beneath the base Permian unconformity. Where such combination traps have no associated structural closure on the base Permian, intraformational seals are required. In the example in Figure 20, the Carboniferous reservoirs dip in the opposite direction to the base of the Permian, and only an intra-Carboniferous top seal is needed. If the base Permian and Carboniferous beds dip in the same direction, an intraformational bottom seal would be required.

Much of the Westphalian B interval is mud-prone, and offers good sealing capacity. The upper part of the Ketch Member (Fig. 19) is at least locally mud-prone, and likewise a good potential seal (Fig. 20). Intraformational seals within the Upper Namurian and Westphalian A are not well-developed, so the Ketch Member and Caister Sandstone unit remain the most attractive Carboniferous targets for erosional truncation traps. The heavily fault-compartmentalised configuration of the Carboniferous means that the majority of Carboniferous traps will rely to some extent upon fault seal also.

Carboniferous reference:

Cameron, TDJ, Munns, JR, and Stoker, SJ. 2005. Remaining exploration potential of the Carboniferous fairway, UK Southern North Sea. In: Collinson, JD, Evans, DJ, Holliday, DW & Jones, NS. (eds) *Carboniferous hydrocarbon resources: the southern North Sea and surrounding areas.* Occasional Publication, **7**, Yorkshire Geological Society. 209-224.

Stratigraphic plays of the UKCS

Summary

- Stratigraphic and combination traps account for only 18% of existing fields and discoveries. Many of the stratigraphic traps have been found entirely by chance whilst drilling towards other targets
- Few substantial undrilled structural traps remain in the UK North Sea
- Upper Jurassic syn-rift and Cretaceous to Paleogene post-rift deep-water plays offer the greatest potential for stratigraphic entrapment
- Pre-rift plays offer little stratigraphic potential, focused mainly in Carboniferous plays
- Deep-water sandstones with limited lateral distribution constitute the principal reservoir in stratigraphic plays. Well-grounded conceptual models for reservoir distribution are required for trap prediction. Seismic data may not adequately resolve the stratigraphic trap at the exploration phase
- Around 50% of the UK's undiscovered resources are predicted to lie in stratigraphic or combination traps

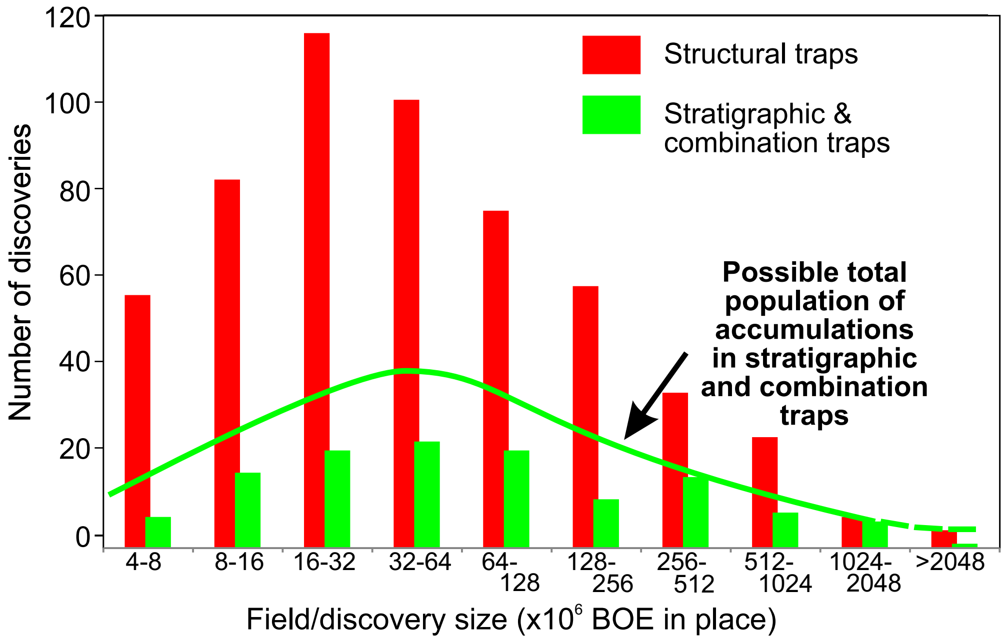
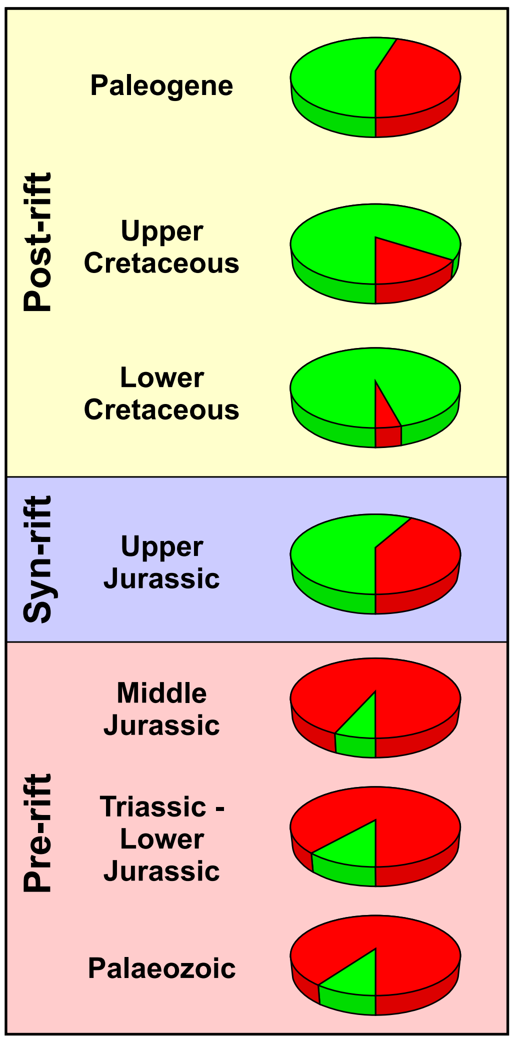


Fig. 21 Field size distribution chart for UKCS fields and discoveries in structural traps, and in stratigraphic and combination traps (as of end 2012).

A speculative curve shows a possible total population of accumulations within stratigraphic and combination traps, and indicates the potential field size distribution of the undiscovered resources in such traps.

Modified after Stoker *et al*. 2006.

Estimated % of total Yet-Find in stratigraphic and combination traps



Post-rift **71%**

Syn-rift **58%**

Pre-rift **10%**

Fig. 22 Summary of proportion of trap types in UKCS fields and discoveries and estimated proportion of total yet-to-find resources in stratigraphic and combination traps.

Trap types within fields and discoveries, discovery curves and geological models for each gross play have been considered as a means of estimating the proportion of stratigraphic and combination traps in the undiscovered resource population.

Modified after Stoker *et al*. 2006.

Structural traps
Stratigraphic & combination traps

Reference:

Stoker, SJ, Gray, JC, Haile, P, Andrews, IJ & Cameron, TDJ. 2006. The importance of stratigraphic plays in the undiscovered resources of the UK Continental Shelf. In: Allen, MR, Goffey, GP, Morgan, RK & Walker, IM (eds). *The deliberate search for the stratigraphic trap.* Geological Society, London, Special Publications, **254,** 153-167.

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