PL660 Relinquishment Report

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1 Key Licence History

Licence Details

PL660 is located in Block 1/6 in the southern part of the North Sea on the border with the UK, see Fig. 1.1. The licence was awarded to Faroe Petroleum Norge AS ('Faroe'), Maersk Oil Norway AS ('Maersk'), Petoro AS and Centrica Resources (Norge) AS ('Centrica') in 2013 as part of the APA 2012 round. The same partnership remained throughout the licence period.

The Edinburgh Prospect straddles the Norway/UK border and is split between four licences (Table 1.1). It was recognized early on by all partners in the four licences that an agreement for a joint well would be in accordance with the UK-Norway trans boundary treaty ('treaty') and the best way forward to achieve an economical project. A draft agreement between Norwegian and UK licensees was constructed. A technical drill decision was made in PL660 depending on the joint well agreement. Norwegian and UK partners have had a good cooperation and it was full agreement on the technical evaluation. All parties considered the prospect drillable, but because of other commercial issues it was not possible to have a drill decision in all licenses and hence the agreement could not be signed, this resultet in a drop decision in PL660.

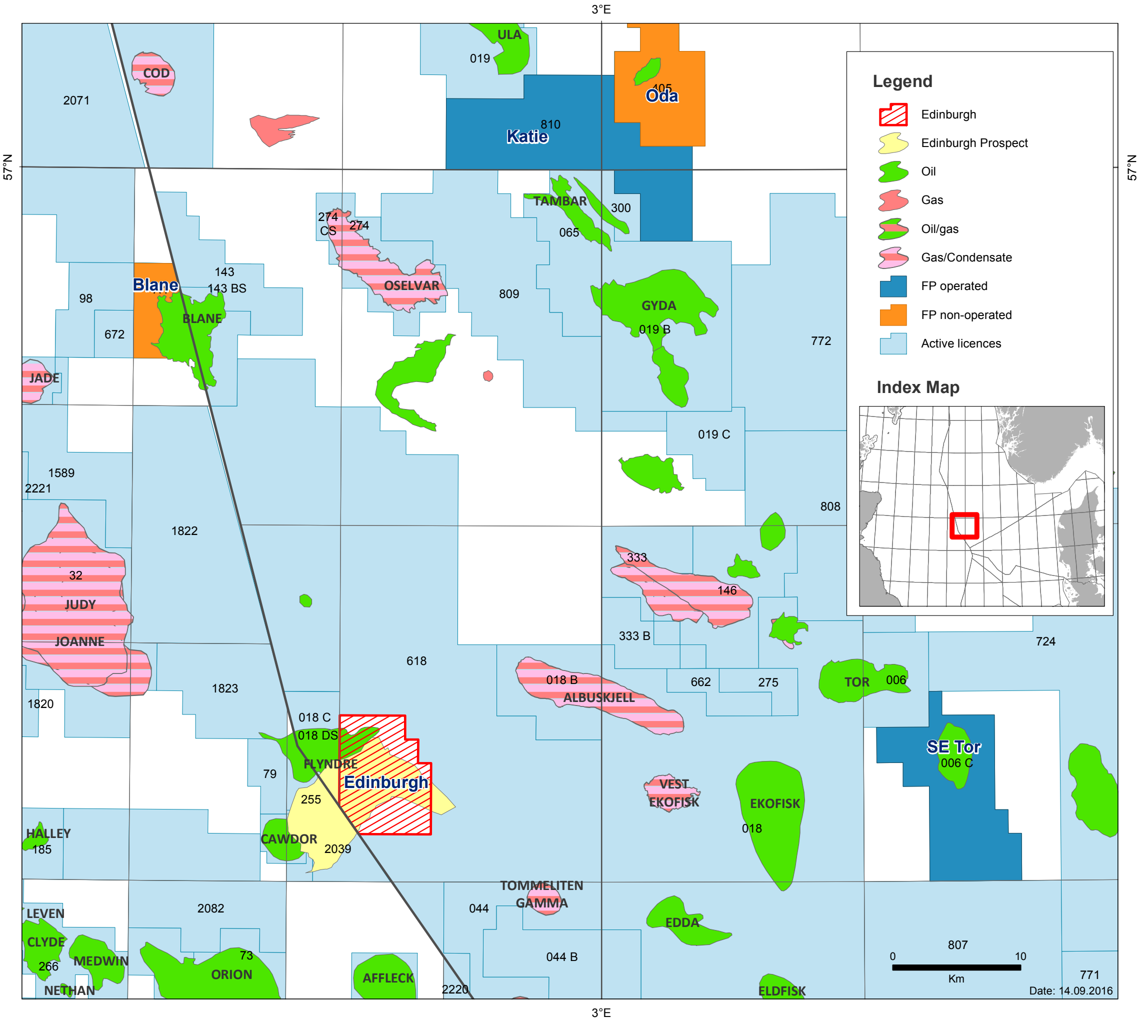

Fig. 1.1 PL660 Overview

Table 1.1 Mean volume split between the licences

PL660	PL018C	UK 30/14b	UK 30/14a
19 %	15 %	11 %	55 %

Licence Meetings

The following meetings were held in the Licence:

2013

- Exploration/Management Committee Meeting #1 14.03.2013
- Management Committee Meeting #2 13.08.2013
- Work meeting 02.10.2013
- Exploration/Management Committee Meeting #3 25.11.2013

2014

- Joint well agreement (Norway and UK) work meeting 16.10.2014
- Joint well agreement (Norway and UK) work meeting 04.11.2014
- Joint well agreement (Norway and UK) work meeting 16.12.2014

2015

- Joint well agreement (Norway) work meeting 08.01.2015
- Exploration Committee Meeting 29.01.2015
- Operator meeting with MPE 11.05.2015
- Joint well agreement (Norway and UK) work meeting 02.06.2015
- Joint well agreement (Norway and UK) work meeting 08.09.2015
- Exploration Committee Meeting 19.08.2015
- Joint well agreement (Norway and UK) work meeting 30.10.2015
- Management Committee Meeting #4 11.11.2015
- Joint well agreement (Norway and UK) work meeting 12.11.2015
- Joint well agreement (Norway and UK) work meeting 01.12.2015
- Management Committee Meeting #5 08.12.2015
- Joint well agreement (Norway and UK) work meeting 15.12.2015

2016

- Joint well agreement (Norway and UK) work meeting 23.02.2016
- Joint well agreement (Norway and UK) work meeting 17.03.2016
- Operator meeting with MPE 11.04.2016
- Joint well agreement (Norway and UK) work meeting 12.05.2016
- Management Committee Meeting #6 27.06.2016

Presentations and minutes from the licence meetings can be found on L2S. Joint well agreement meetings are not documented on L2S.

Work Programme

The licence work programme was to perform relevant geological and geophysical studies before a drill or drop decision was taken. This work programme was fulfilled with the reprocessing and interpretation of the Corner Stone PSDM data (CGG) and several relevant studies described in Chapter 3 Review of the Geological Framework. The reprocessed area covered 605 km^2 across the prospect on both the Norwegian and UK side.

The technical work in the licence was finalised before the original drill or drop decision on 8 February 2015, but due to the additional need for a joint well agreement several extensions were applied for and awarded. The operators of the licences covering the Edinburgh Prospect had an open and good communication with the Authorities during the process. The final drill or drop deadline was 8 July 2016.

Relinquishment

Following the completion of all technical work, the partnership has decided against drilling a well in the licence and hence a relinquishment letter was sent to the Ministry of Petroleum and Energy on 28 June 2016.

2 Database

Seismic Database

At the time of application the interpretation of the Edinburgh area relied on the CN193 3D seismic survey. This dataset was acquired by Geco in1993 (extent shown in Fig. 2.1). The CN193 volume is a dense, good quality 3D dataset, with 7.5 m inline and 6.25 m crossline spacing, and is processed through a conventional Pre-Stack Time Migration processing sequence. Once the licence was awarded, the partnership licensed the CGG Quad 30 survey, specifically parts of Phase 2 and Phase 5, acquired in 2003 and 2005 respectively. The area covered is shown in Fig. 2.1 The data was reprocessed in 2013-14 using a pre-stack migration algorithm with focus on getting the best possible image of the Edinburgh Prospect.

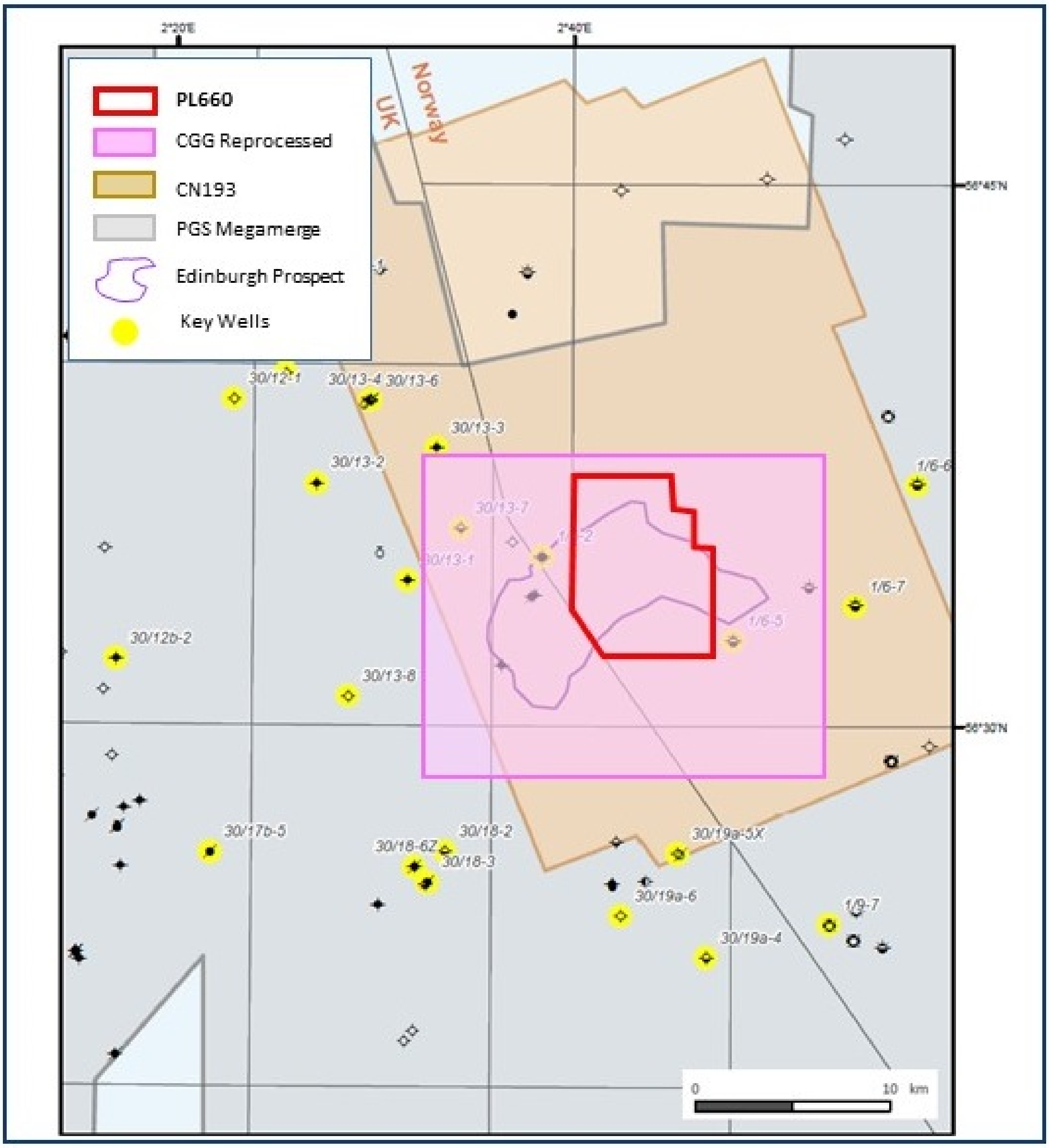

Fig. 2.1 Database Map

Map showing seismic data and wells used in the evaluation of PL660

Well Database

The license have had access to all released UKCS and Norwegian well data. This allowed for the inclusion of all the wells in the area in the evaluation of the prospectivity. Petrophysical interpretation has been performed using 'Interactive Petrophysics' software. A large number of wells were used to build up the regional picture, Table 2.1 identifies the key wells used in the detailed mapping over the evaluation area. The key wells are also highlighted in Fig. 2.1.

Table 2.1 Well Database
Wells used in the evaluation of PL660

Well	Country	Completion date	Results	Shows Formation	Petrophysical Study
30/08-1	UK	1982	PA H/C Shows	Pentland	
30/12-1	UK	1969	PA Dry		
30/08-2	UK	1995	PA G/C Discovery	Paleocene	
30/12b-2	UK	1980	PA Oil Discovery	Upper Jurassic	
30/13-1	UK	1970	PA Oil Discovery	Triassic	
30/13-2	UK	1972	PA Oil Discovery	Upper Jurassic	
30/13-3	UK	1990	PA Oil Discovery	Upper Jurassic	
30/13-4	UK	1992	SP G/C Well	Upper Jurassic	
30/13-5	UK	1996	PA Dry	Upper Jurassic	
30/13-6	UK	1996	SP Gas Shows	Upper Jurassic	
30/13-7	UK	1997	PA Oil Shows	Pentland	Yes
30/13a-8	UK	2004	PA Dry		
30/17b-5	UK	1979	PA Oil Discovery	Upper Jurassic	
30/18-2	UK	1971	PA H/C Shows	Paleocene	
30/18-3	UK	1985	PA G/C Discovery	Paleocene	
30/18-6Z	UK	1998	PA Oil Discovery	Paleocene	
30/19a-4	UK	1987	PA H/C Shows	Cretaceous	
30/19a-5X	UK	1992	PA Dry	Cretaceous	
30/19a-6	UK	1996	PA G/C Discovery	Cretaceous	
1/5-2	Norway	1974	PA H/C Shows	Paleocene	
1/6-5	Norway	1990	PA H/C Shows		
1/6-7	Norway	1992	PA H/C Shows		Yes
1/9-7	Norway	203	PA H/C Shows	Paleocene	
1/6-6	Norway	2011	PA Oil Discovery	Upper Jurassic	

3 Review of the Geological Framework

Geological Setting

PL660 is located at the south-eastern end of the Josephine Ridge (J-Ridge), an intra-basinal high within the southern part of the UK Central Graben (Fig. 3.1). The ridge trends NNW-SSE, similar to the orientation of the Forties Montrose High and the margins of the East and West Central Graben. This structural trend results from Permian and Triassic extensional phases. However, faults bounding the ridge are predominantly NW-SE trending, offset in places by NE-SW-trending faults. The two trends reflect the influence of the underlying Caledonian fabric and later SW-NE directed extension during the late Jurassic to early Cretaceous. Permian extension controlled the original thickness of Zechstein Group salt overlying the Rotliegendes Group.

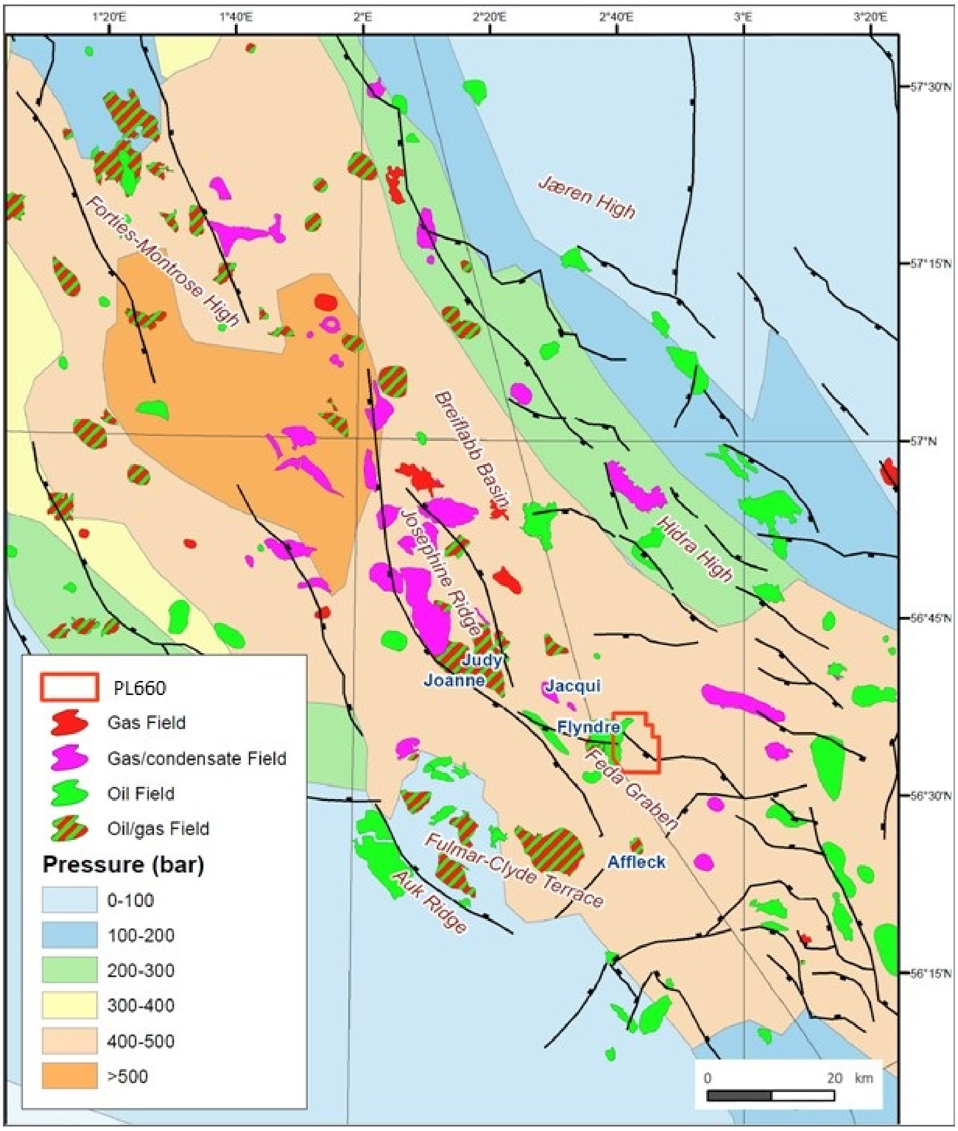

Fig. 3.1 Main Structural Elements
The map shows the main structural elements in the area of licence PL660. The licence is located at the southern end of the Josephine Ridge. The map also shows the overpressure regimes within the CNS. The licence can be seen to lie outwith the area with the highest overpressures

Extension during the Triassic led to differential loading and the initiation of halokinesis. Salt withdrawal subsequently controlled the thickness and depositional patterns of the Triassic Smith Bank and Skagerrak formations. NESW late Jurassic extension and continued salt evacuation caused the Jade horst (to the north) to ground on the Rotliegendes surface. A similar extension is invoked at the SE of the ridge to form the depocentre which controlled the overlying Triassic and Jurassic successions. As extension continued, the withdrawal of the remnant salt in the flank areas allowed relative subsidence of the northeast and southwest flank blocks. Rapid burial during the Tertiary, in the northern Quadrant 30 area, led to the development of high overpressures in the pre-Cretaceous section as a result of disequilibrium compaction and late gas charging. The focus of the work on PL660 was entirely in the Pre-Chalk section. The chronostrigraphy for this section is shown in Fig. 3.2.

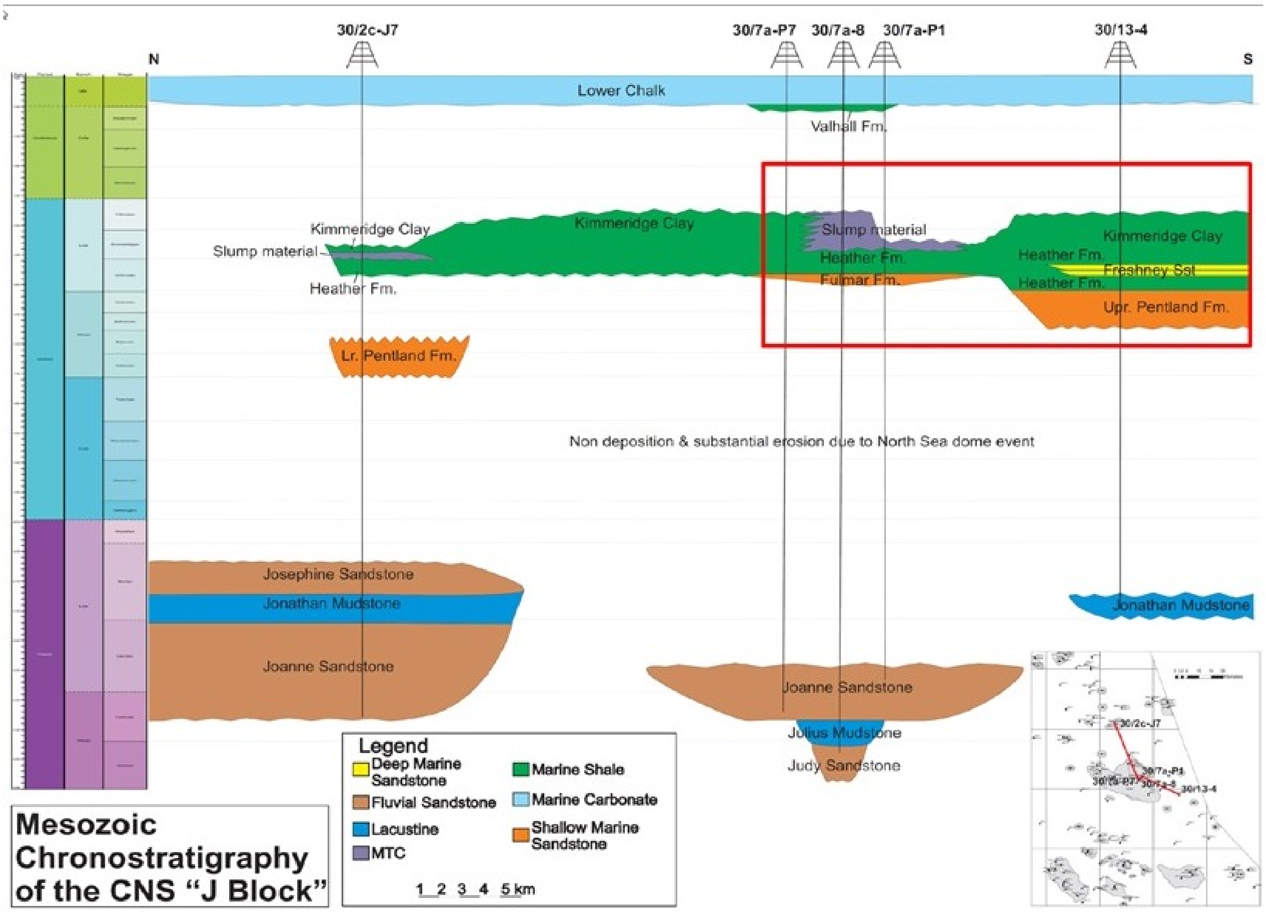

Fig. 3.2 J Ridge Chronostratigraphy
The diagram shows the chronostraigraphy of the area close to the Edinburgh prospect. It shows that there is considerable variation in the sections encountered by wells in the area.

Pressure

Maersk as operator of PL018C and the UK licenses carried out a detailed analysis of overpressure in the area of the Edinburgh Prospect. The study is summarised in Fig. 3.3. Using data from offset wells and forward modelling techniques, it was concluded that it cannot be ruled out that the Cawdor Field which sits to the southwest of Edinburgh, has been charged by hydrocarbons escaping vertically from Edinburgh. In contradiction to this it was noted that Edinburgh was probably directly connected to the Affleck structure to the south. The maximum overpressure observed in the deeper Affleck section (6000psi) would not be high enough to completely breach the Edinburgh structure. It was also observed that the overpressures seen in UK well 30/13-7, 4600psi, are substantially lower. This implies that there is a significant pressure barrier between Affleck and 30/13-7. The only significant fault between Affleck and the 30/13-7 well is the Edinburgh bounding fault. This gives added weight to the observations made on the sealing potential of the fault using Allan diagrams 4 Prospect Update.

Petrophysical Analysis

Faroe performed in-house petrophysical analyses of 11 relevant wells containing the Ula, Sandnes, Bryne, Skagerrak, Smith Bank and Rotliegend formations. The results where used in the volumetric calculations for the prospects.

Petroleum System Analysis

Faroe Petroleum carried out a basin modelling exercise for the Edinburgh Prospect. This showed that while the Mandal Formation was mature for oil directly around the Edinburgh Propsect, it was noted that the most likely fluid in the Edinburgh Prospect would be a gas condensate

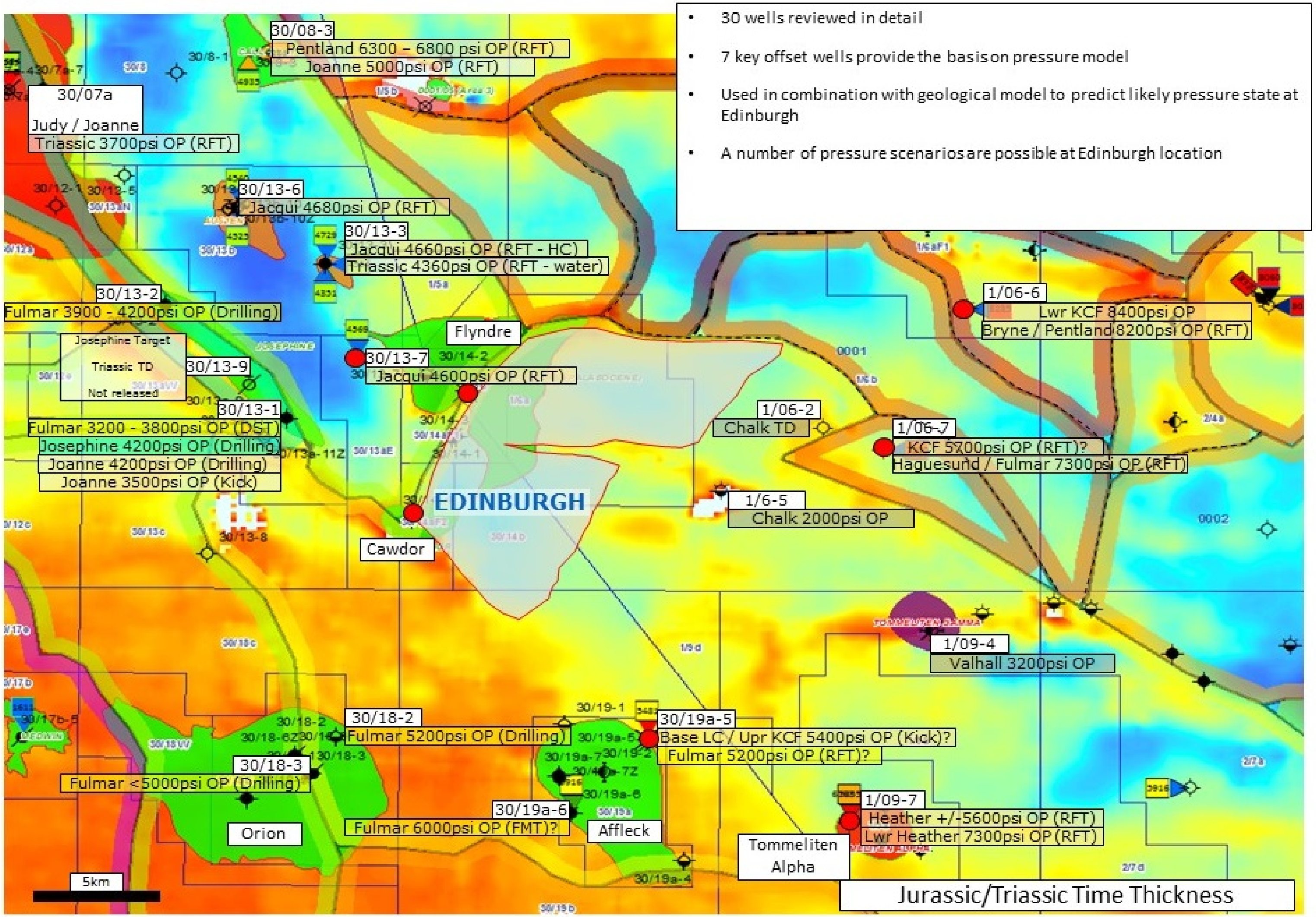

Fig. 3.3 CNS Overpressure

Map showing the overpressures encountered in the wells in the area

4 Prospect Update

The focus of the work for the PL660 licence was the Edinburgh Prospect. Detailed analysis of the reprocessed seismic data resulted in a clearer understanding of the potential of the Edinburgh Prospect.

Seismic Interpretation

Following delivery of the reprocessed seismic data, a full interpretation was carried out. Given the lack of nearby well control it is difficult to confidently identify seismic horizons with their corresponding geological events. It is possible to confidently interpret down to the BCU. A seismic line showing the tie from the nearest wells to Edinburgh is shown in Fig. 4.1. The location of the line is shown on a BCU map in Fig. 4.2. UK wells 30/13-7 and 30/13-3 test the Jurassic section to the northwest of Edinburgh. It is possible to identify a strong deeper reflector seen below the TD of the 30/13-7 well as the Julius Mudstone marker. By matching character it was possible to identify this event in the Edinburgh structure. It is very difficult to match events above the Julius Mudstone in the Edinburgh structure. As such, 2 seperate interpretations were carried through to volumetric analysis. The interpretations vary in the identification of the Top Triassic and Top Pentland picks (as seen in the seismic line). The seismic facies analysis discussed below lead to the decision that the deeper Top Pentland and top Triassic picks were more likley but did not rule out the shallower picks.

The Edinburgh Prospect is defined at both Top Heather or Top Triassic levels Fig. 4.3 and Fig. 4.4. A very small closure is present at the Base Cretaceous Unconformity level but is not volumetrically significant enough to warrant further attention. The prospect is dip closed to the south and east. To the north and west closure is provided by a combination of faults downthrowing towards the 30/13-7 well and salt walls providing side seal.

Depth Conversion

Seismic interpretation was carried out in time. A simple three layer depth conversion was used, breaking out the faster chalk interval.

Seismic Facies Analysis and Sequence Stratigraphy

The improved seismic image of the potential reservoir section allowed for a more detailed analysis of the seismic facies. When flattening on BCU a prograding sequence above the Julius Mudstone becomes apparent (Fig. 4.5). This becomes even clearer if the seismic line is flattened on the Julius Mudstone (Fig. 4.6). The sequence above the Julius mudstone is interpreted as an aggradational prograding sequence. By analogy with the rest of the basin, such a sequence would be envisaged as Upper Jurassic, however, given that Edinburgh is in the deepest part of the basin, it is possible that in this area, this package represents an older sequence. This does increase the confidence that potential reservoirs are likely to have been deposited in the Edinburgh area.

Reservoir Geology

As discussed above it is difficult to determine exactly which reservoirs could be present in the Edinburgh structures. Four potential reservoirs were identified and studied. A well section across the area is shown in Fig. 4.7.

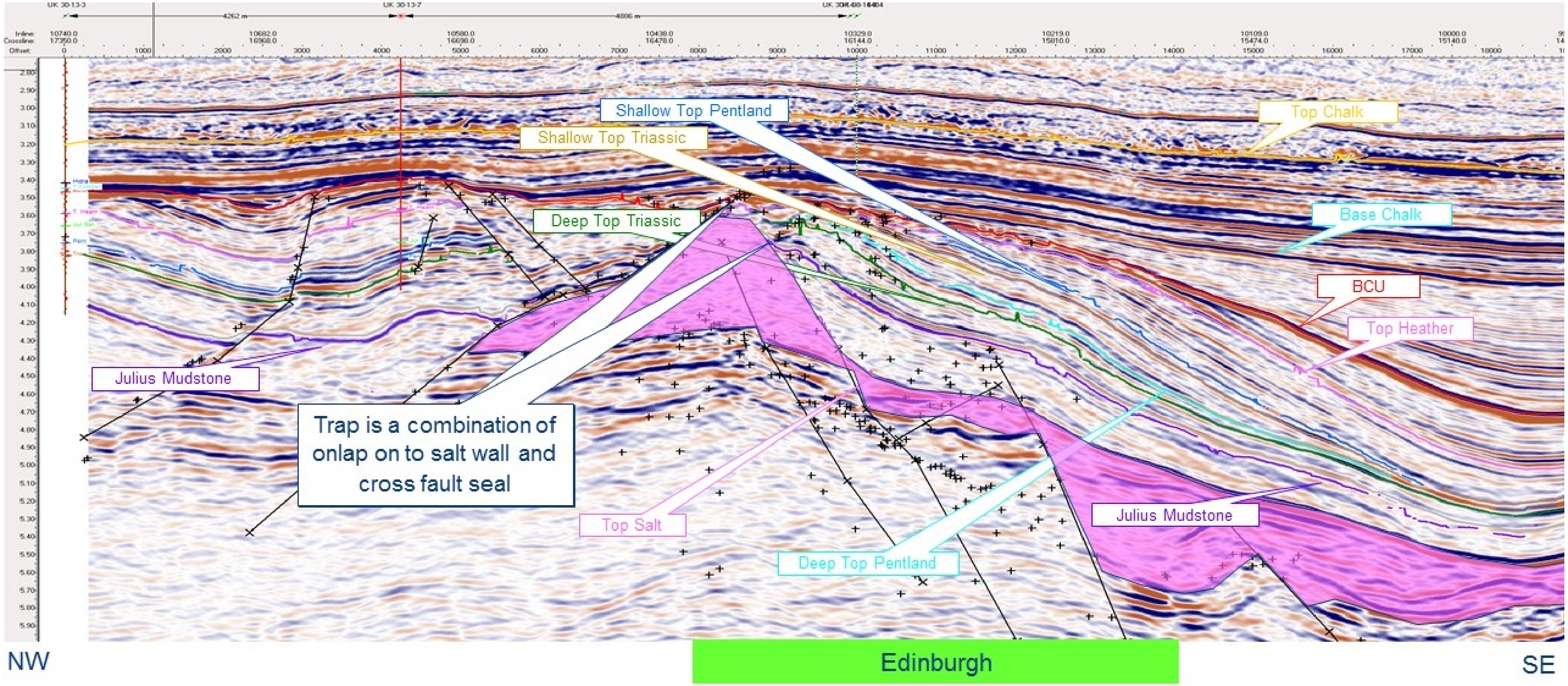

Fig. 4.1 Edinburgh Seismic Line

The seismic section shows the identification of seismic events in Edinburgh tying from wells 30/13-7 and 30/13-3

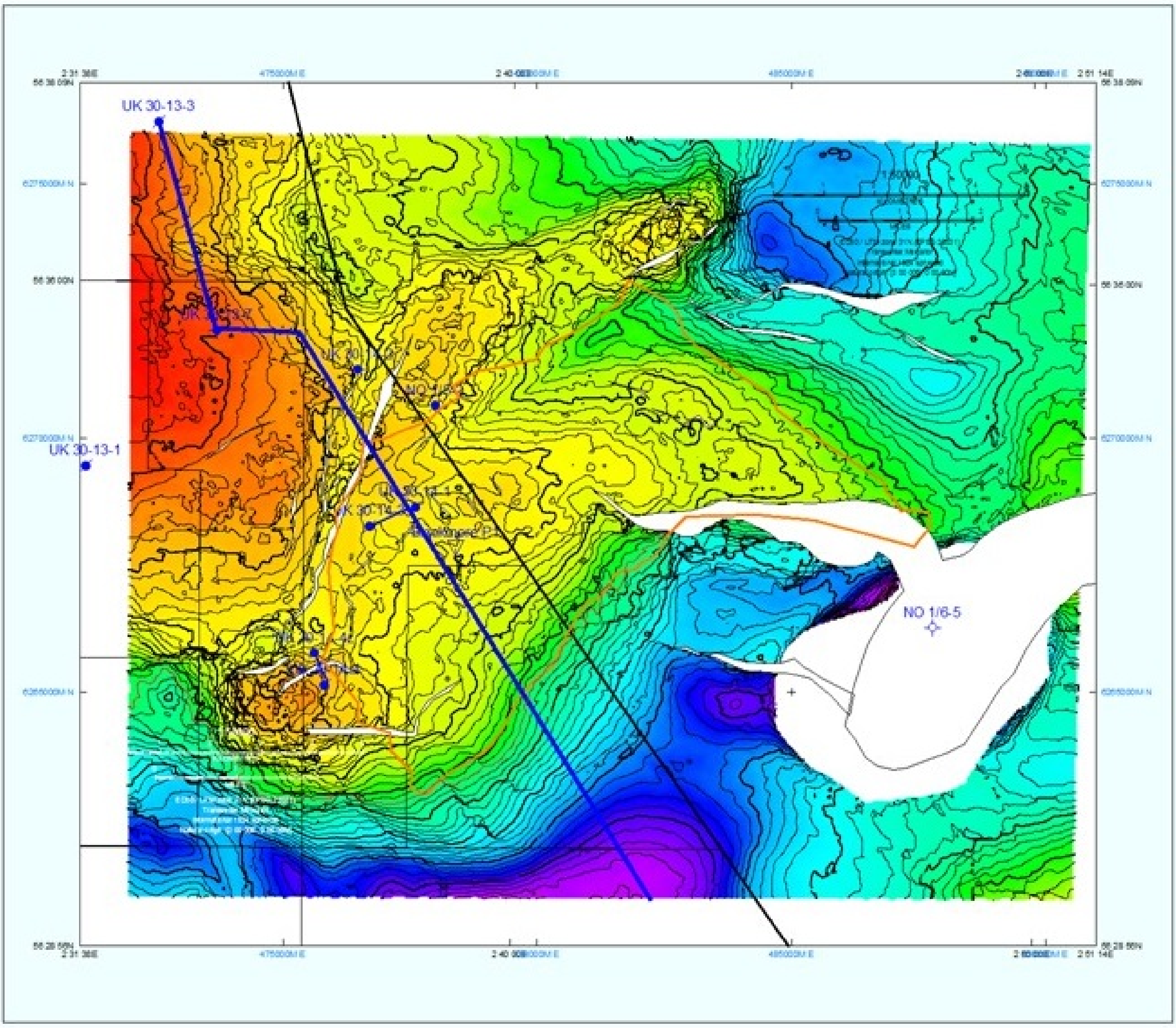

Fig. 4.2 BCU Map
The map shows depth to the Base Cretaceous Unconformity and shows the location of the seismic line discussed in the text

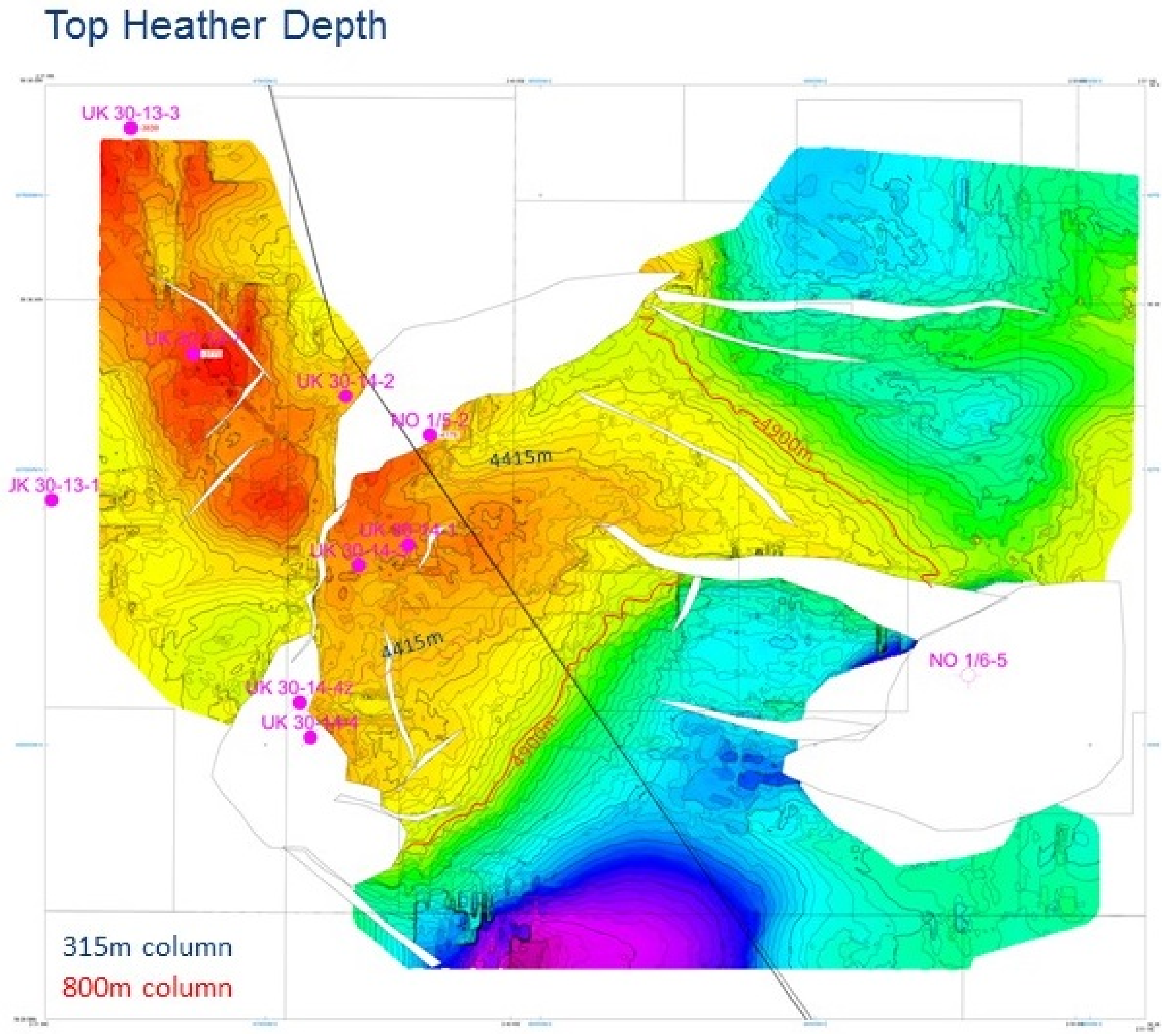

Fig. 4.3 Top Heather Depth Map
The map shows the depth to the Top Heather formation, showing potential contours for potential columns of 315m and 800m

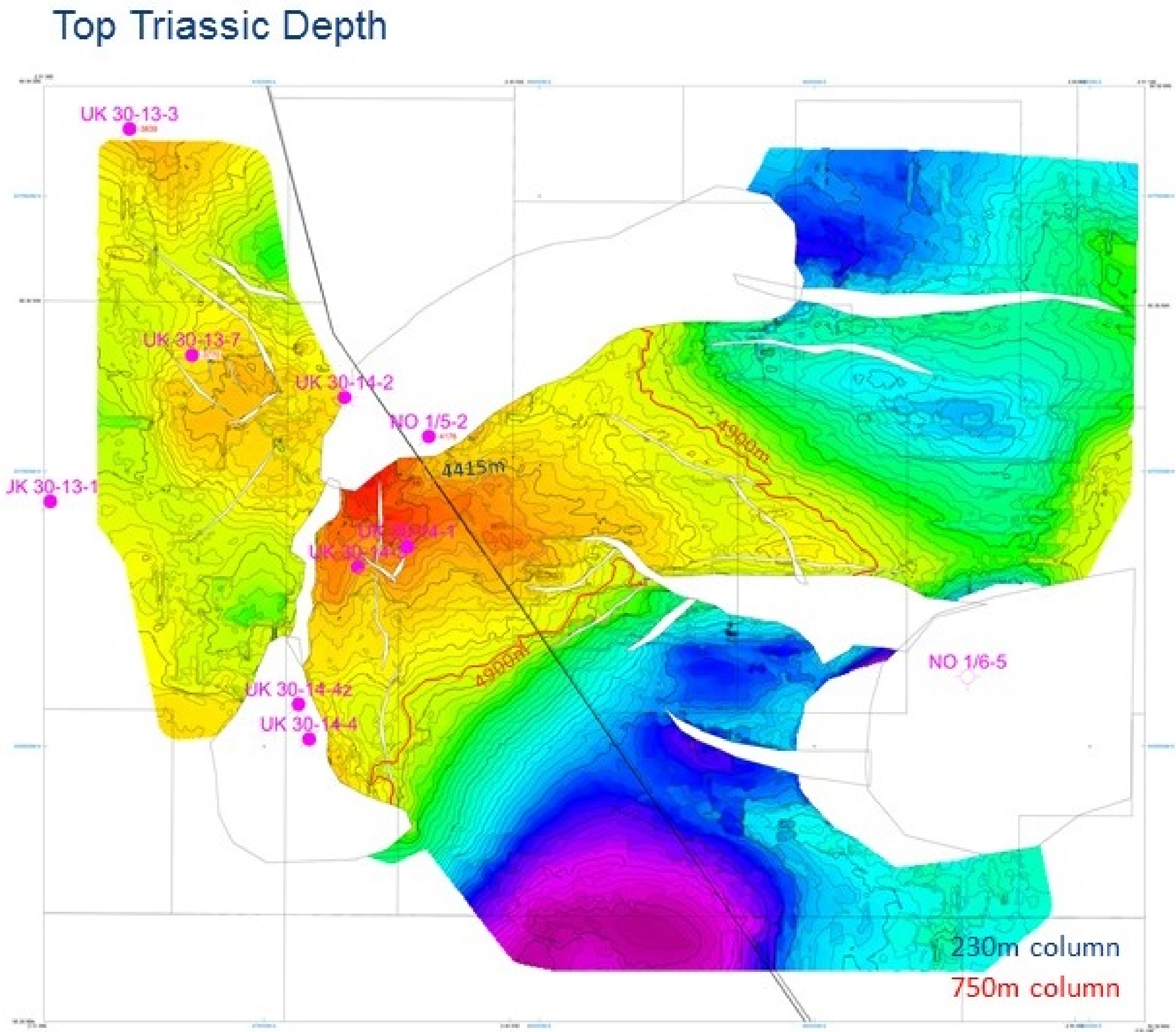

Fig. 4.4 Top Triassic Depth
The map shows the depth to the Top Triassic assuming the deeper pick made on the seismic

Upper Jurassic

- The shallow marine Fulmar sandstones
- Deep marine turbiditic Freshney sandstones

Both are excellent reservoirs. The Freshney sandstones are encountered in the wells to the north of the Edinburgh Prospect.

Middle Jurassic

- The Pentland Formation is occasionally of good reservoir quality. In the 30/13-7 well close to Edinburgh Pentland sandstones were encountered but they had poor reservoir quality. In general, the Pentland was discounted as a reservoir.

Triassic

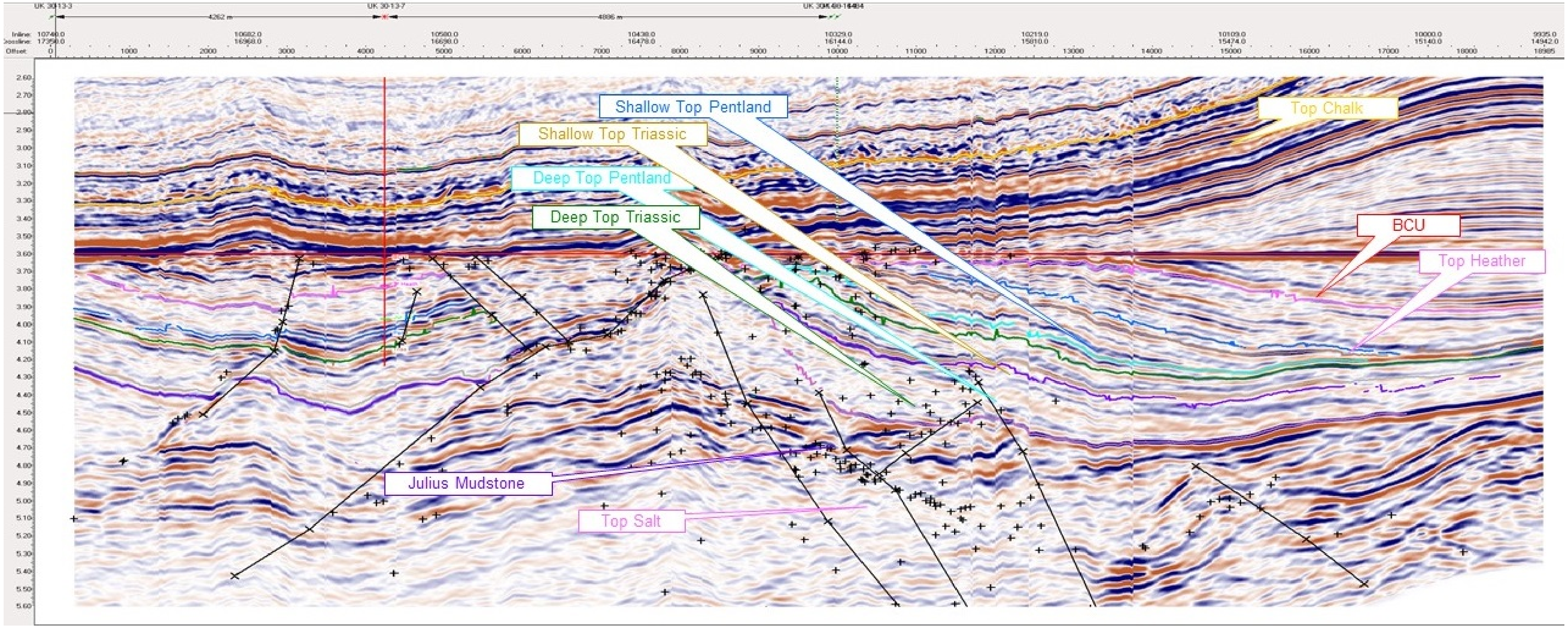

Fig. 4.5 Edinburgh Seismic Line Flattened on BCU
Seismic line flattened on the BCU event showing apparent progradation of the sequence above the Julius mudstone

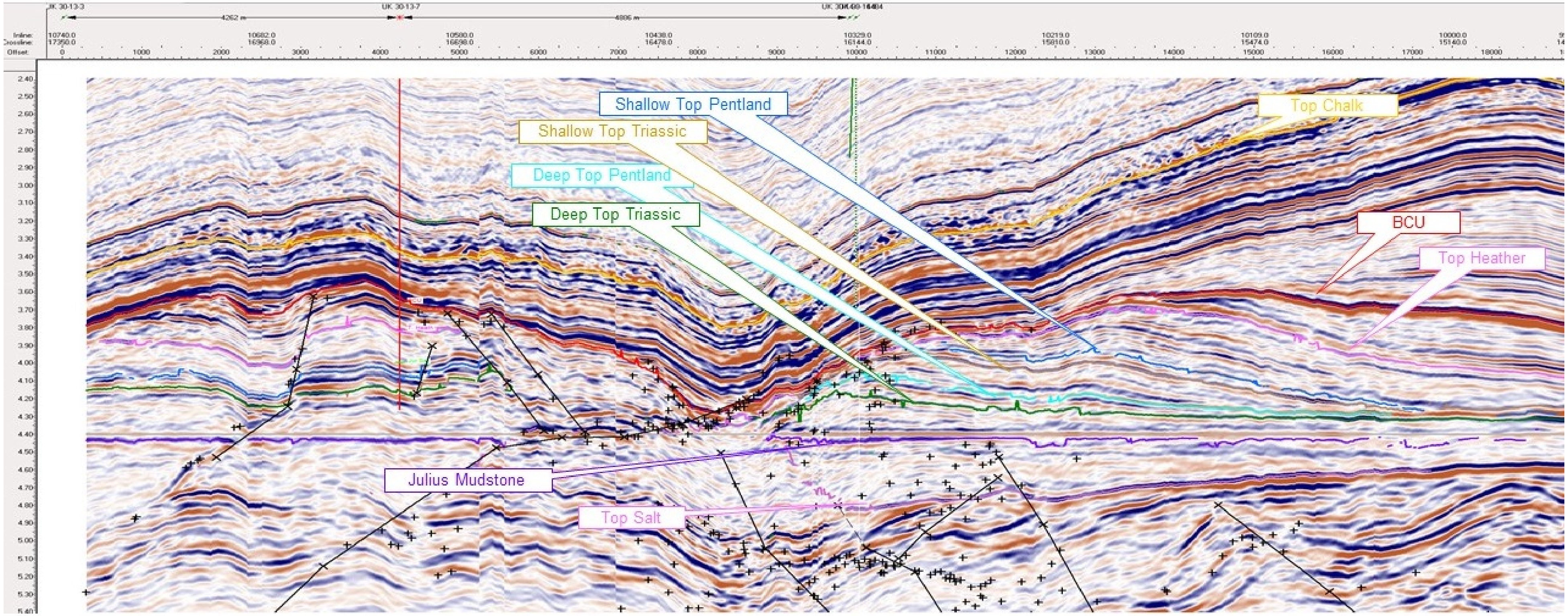

Fig. 4.6 Edinburgh Seismic Line Flattened on Julius
Seismic line flattened on the Julius Mudstone demonstrating the prograding sequence

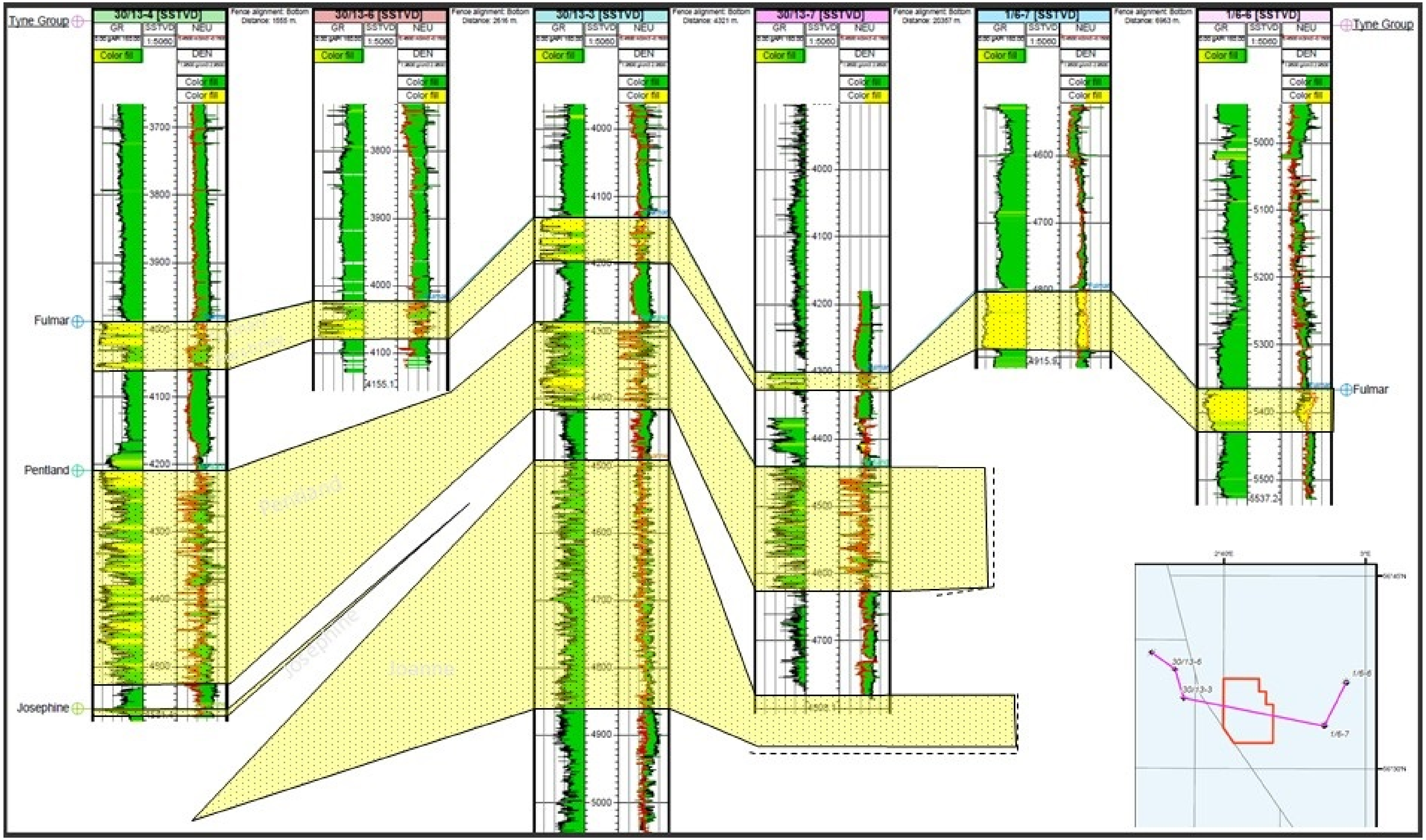

Fig. 4.7 Well Section

A well section through the wells in the area around Edinburgh, highlighting the range of reservoirs seen in the area

- The Skaggerak sandstone is subdivided into a number of sandstones seperated by shale units. The Josephine and Joanne sandstones are seen in the wells to the north of Edinburgh.

Fault Seal

The weakest point of the Edinburgh structure is the fault which seals Edinburgh off from the dry 30/13-7 well. It was decided to generate Allan diagrams to investigate the seal potential of the fault. While the 30/13-7 well gives a good tie to the hanging wall of the fault, there is considerable uncertainty on the potential lithologies in the footwall. A number of potential models were tested (Fig. 4.8).

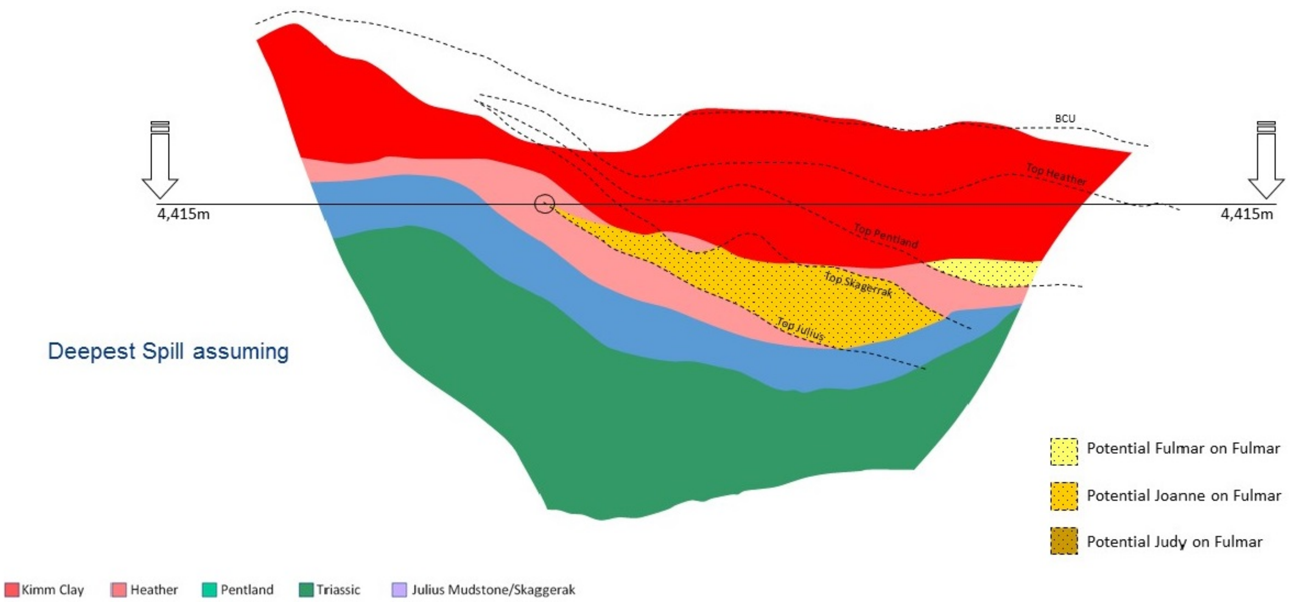

Fig. 4.8 Allan Diagram
The diagram shows the potential lithology juxtapositions across the main bounding fault for Edinburgh. The footwall lithologies modelled in this case were considered to be the most likely. Other models for the footwall geology were tried and all showed that considerable columns could held back before there was a likely sand to sand communication across the fault

Volumes and Risking Summary

An assessment of the various elements of risk for the Edinburgh Prospect is shown in Table 4.1. The potential volumes are shown graphically and tabled in Fig. 4.9 with the split of the potential reserves in Fig. 4.10.

Table 4.1 Edinburgh Risks
Assessment of the risk elements for the Edinburgh prospect. The seal across the fault and reservoir are seen as the key risks for the prospect.

Risk Element	Risk	For	Against
Trap	100%	The Blackmore structure is confidently mapped on high quality 3D PSDM data. The presence of the salt walls which define a large part of the trap is mapped with a fairly high degree of confidence although the exact edge is difficult to be certain of. The trap style is overall similar to Jasmine with a combination of fault seal and seal against a salt wall	None
Reservoir	70%	The Triassic is near universally present and if shallow in the section would provide a reservoir. A Jurassic shoreface sand is a possible alternative. Stripy seismic character points towards some sand in the section	Cannot map reservoir units from nearby wells. A Pentland section must be seen as a possibility and that would almost certainly result in failure
Seal	70%	The seal against a salt wall demonstrated on Jasmine and is clearly mapped. The part of the trap sealed by a fault is likely to have shale in the hanging wall over at least the upper part of any reservoir. Analysis of likely overpressure indicates a considerable column could be retained. Affleck being shallower could have acted as the weak point safety valve. There is a major change in pressure between Affleck and the Jacqui basin and Blackmore seems the most likely seal point. Jade and Jasmine show that faults can seal even where there is permeable units on both sides of the fault	Presence of Flyndre and Cawdor directly above Blackmore could indicate breach although no clear gas cloud can be seen as at Affleck
Charge	90%	Potential migration routes can be demonstrated on seismic data. An Upper Jurassic reservoir would be fairly simple to charge. Lack of charge is not a common failure mechanism in the area	It the reservoir is Triassic it might be separated by a number of horizons making migration difficult
Total	44%	This is higher risk than the success rate in the local area	

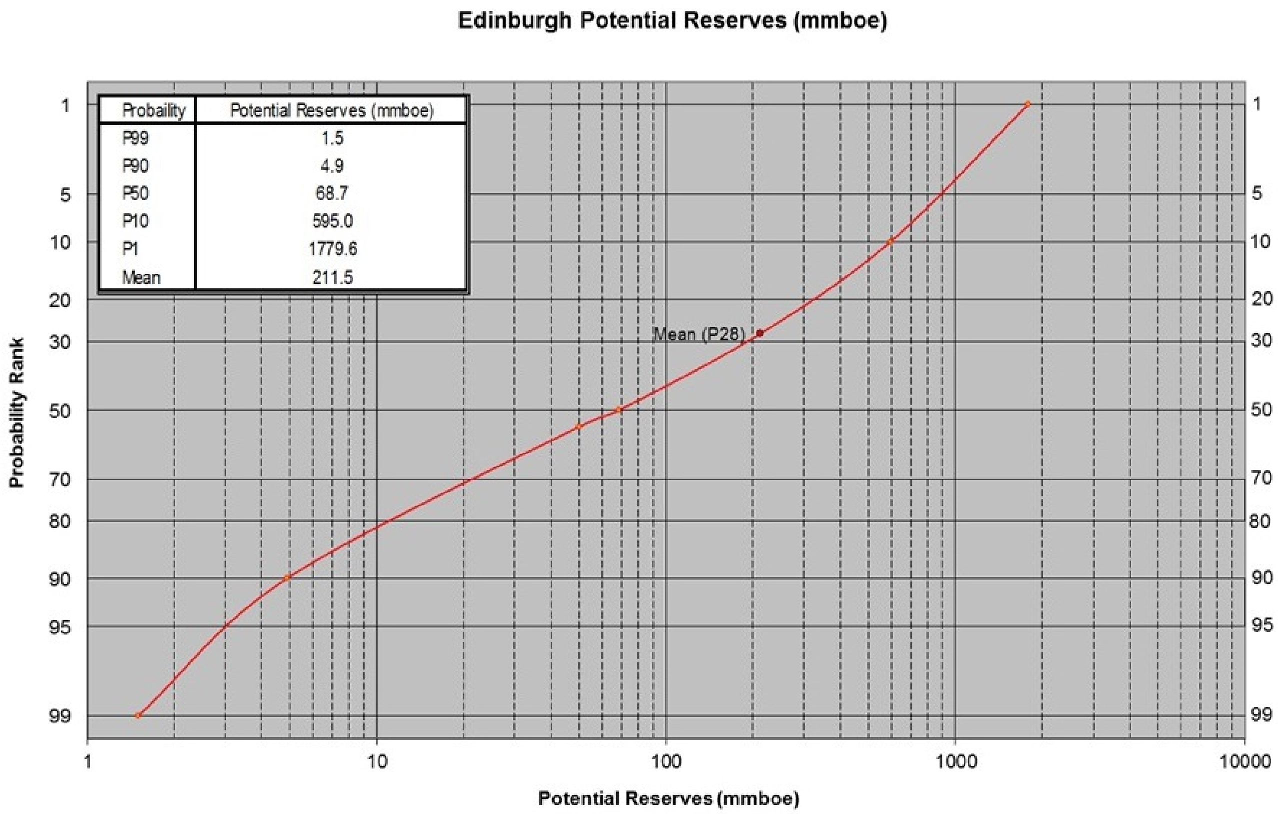

Fig. 4.9 Edinburgh Potential Reserves
Lognormal plot of potential reserves for the Edinburgh prospect

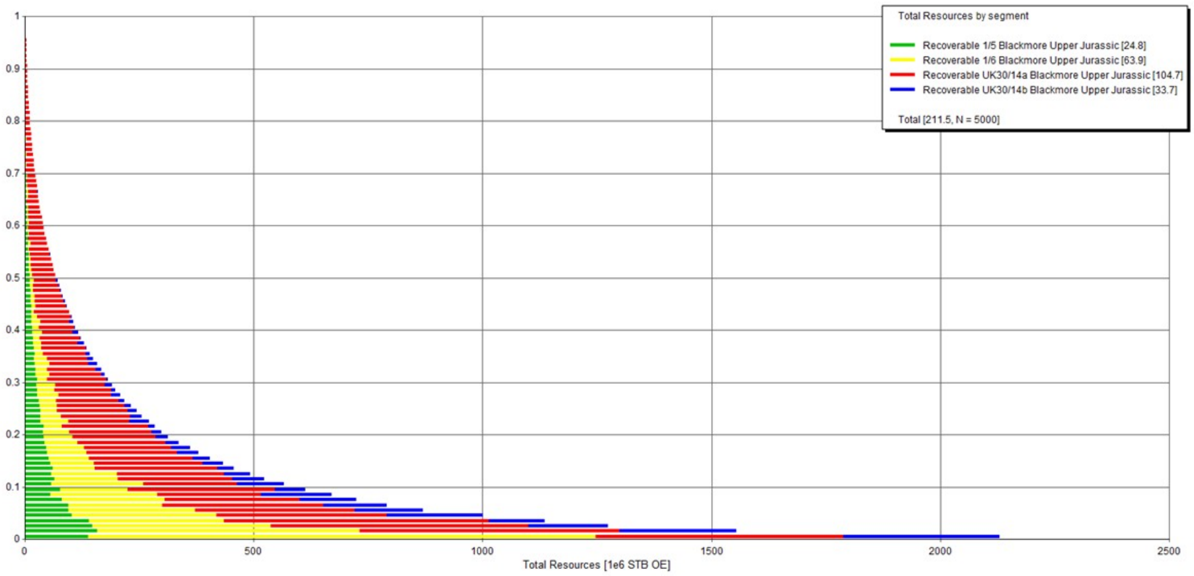

Fig. 4.10 Edinburgh Reserve Splits
The graph shows the volumes within each of the four licence blocks that cover the Edinburgh prospect.

5 Conclusions

The licence partners consider the total Edinburgh prospect a drillable prospect with viable volumetrics and Pg. However, only 22% of the mean volumes are located in PL660, and the Joint Well Agreement sharing costs between all four licences and licencees covering the structure could not be signed due to commercial difficulties. Drilling an exploration well in PL660 alone is not currently considered an economic solution by the PL660 licence and would also not be in alignement with the treaty.

Should an opportunity to drill a joint well arise, would the joint venture partners be interested to apply for the acreage in a future licensing round.