Licence P2045
Relinquishment Report
February 2015
Relinquishment report

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1 Key Licence History

Licence Details
Licence P.2045 (Glenfarclas) was awarded to Faroe Petroleum (Operator, 33.34% equity) on 1st January 2013, with joint venture partners Eon E&P UK Limited (33.33%) and First Oil and Gas Limited (33.33%). The Initial Term of the licence was 4 years, but with a Drill-or-drop decision to be made at the end of Year 2 (1st January 2015).

The licence comprised blocks 208/21, 208/26 & 214/30d, shown in Fig. 1.1

![Fig. 1.1 P.2045 Location Map. Map showing the location of P.2045 (Blocks 208/21, 208/26 & 214/30d), within the Faroe-Shetland Basin.](image)

Work Programme
The work programme commitments, completed within the first 2 years comprised:
Firm commitments

- Reprocess 300km² of 3D seismic data to PSTM.
- Carry out rock physics, basin modelling and migration studies.

Drill-or-drop

- Drill one well to 2600m or Base Tertiary, whichever is shallower, or relinquish the licence after 2 years.

Relinquishment

Following completion of the technical evaluation, P.2045 was relinquished on 31st December 2014.

2 Database

Seismic data

500km² of newly reprocessed 3D data formed the basis for the evaluation of P.2045. Fig. 2.1. The PSTM reprocessing project was carried out by CGG, with the processing completed in January 2014. The underlying data was acquired in 1996 by Geco on behalf of Shell. The main objectives of better noise and multiple suppression were achieved, and these data have increased confidence in the interpretation. Availability of offset angle volumes and gather data allowed evaluation of the AVO response at the Glenfarclas Prospect.

Well Data

Faroe Petroleum had full access to all available well data regionally.
3 Geological Overview

P.2045 was located in the Faroe-Shetland Basin, immediately north-east of the Glenlivet gas discovery. Analogous to Glenlivet, prospectivity at the application stage was observed within sandstones of the Palaeocene Vaila Formation, with the primary focus being a large structural and stratigraphic trap, named the Glenfarclas Prospect.

This licence area was situated within a Cenozoic basin and slope setting, with the Rona Ridge structural high located to the south-west, and the Faroe-Shetland Basin depositional axis to the north-west.

Mature source rocks of the Kimmeridge Clay Formation are believed to be present in the immediate vicinity of the prospect and towards the north-west, with migration into Palaeocene stratigraphy proven by several nearby gas discoveries (e.g. Laxford and Glenlivet) Fig. 3.1
Prospectivity

Glenfarclas Prospect
The Glenfarclas Prospect is a large structural and stratigraphic trap of Palaeocene age, located around 12km north-east of the Glenlivet gas discovery. Mean recoverable resources of 394Bcf were calculated, with P90 of 26Bcf and P10 of 940Bcf.

Risk is distributed between trap, reservoir and seal, with the overall geological risk considered to be high. This view is largely driven by the rock physics study, which concluded that the seismic response observed at the Glenfarclas Prospect is inconsistent with what would be expected if hydrocarbon bearing sandstones were present within the trap.

Trap
A large structural and stratigraphic trap was mapped at the top of the Vaila V2 equivalent section, on the good quality reprocessed dataset. On three flanks the Prospect can be defined by structural dip closure, however a stratigraphic pinch-out of reservoir sands updip to the east is required to complete the trap. This
is also the area of poorest data quality. A 4 way dip component exists but this was not considered for the purpose of risking as it is very small (<0.1km²). See Fig. 4.1

Reservoir
The reservoir is a Palaeocene-aged, Vaila Formation sandstone. An isopach thick can be clearly mapped within this interval, and a model invoking sands deposited within a localised intra-slope depocentre, analogous to Glenlivet, is proposed. However, mapping on the reprocessed seismic volume indicated the thickened interval, the proposed reservoir section at Glenfarclas, to be of Vaila V1 to V2 age, making it older than the hydrocarbon bearing sands of both the Glenlivet and Laxford discoveries. While the mapped isopach indicates potential for reservoir deposition at Glenfarclas, this is not substantiated by the surrounding wells, which are largely dominated by non-reservoir sections within the Vaila V1 and V2 age.

Seal
Stratigraphic pinch-out and / or fault seal is required to be effective along the east of the Prospect. Updip well 208/22-1 penetrated an entirely shale dominated Vaila V1 / V2 section where drilled outside of the mapped isopach thick. A seismically reflective Vaila V3 section, sitting above the top Glenfarclas event and potentially down-cutting into the Glenfarclas top seal, is considered a risk.
Charge
The Upper Jurassic Kimmeridge Clay is generally considered the most likely source rock to be present within the region. Basin modelling predicted that it sits within the gas window at present day, in the area immediately below the Glenfarclas Prospect. This kitchen was modelled to have expelled prolific volumes of oil and gas, and modelling predicted the Glenfarclas Prospect would be filled with gas. Migration up into the Palaeocene section regionally was proven by several hydrocarbon discoveries, notably nearby Glenfarclas.

Other Prospectivity
Prospectivity was evaluated within both the Cretaceous Commodore Formation (Albian to Turonian interval) and younger sandstones within the Flett Formation (late-Palaeocene to Earl

Commodore Formation
A small hanging-wall closure was mapped at the Commodore Formation equivalent level. Sandstones of this age (Cenomanian to Turonian) have been penetrated in wells 206/3-1 and 206/4-1, 45km to the south-west but are poorly developed in updip well 208/26-1. Amplitude response at this level appeared to be related to lithology, with the response being similar to those at the 208/26-1 well location. Risk on reservoir presence and quality, the requirement for fault seal in the hanging-wall trap, combined with the small area of structural closure made this lead unattractive.

Flett Formation
No structural closures were mapped within P.2045 at this stratigraphic level. Reservoir quality sands were penetrated in the Glenlivet well but were water-bearing. Amplitude response in these sands over the licence area showed a similar response to those encountered in the Glenlivet well.

5 Technical evaluation

Seismic Interpretation
Significant uplift in seismic data quality was observed on delivery of the CGG reprocessed 3D dataset in January 2014. Interpretation of the dataset confirmed the presence of the combined structural and stratigraphic trap at Glenfarclas. However, the proposed reservoir section, identified by an isopach thick, was interpreted to be of Vaila V2 age, older than the excellent quality gas bearing sands of the nearby Glenlivet discovery. See Fig. 5.1.

Rock Physics
A rock physics study was carried out to understand the seismic response at the Glenfarclas Prospect, and how the response compared to the data over the Glenlivet gas discovery. The Glenlivet discovery was clearly visible as a strong amplitude anomaly with a Class III to IV AVO response, while the Laxford gas discovery also exhibited a Class III response, but weaker than observed at Glenlivet.

Analysis of the PreSTM CDP gathers at Glenfarclas showed a soft response on near offsets, however this dimmed with offset. The gradient and intercept cross plots showed that data extracted from both inside and outside the trap area overlaid each other, a response inconsistent with a hydrocarbon filled structure being present at Glenfarclas.
Fig. 5.1 South-west to north-east seismic line from Glenlivet Discovery to Glenfarclas Prospect. This line shows the location of the Glenfarclas Prospect in relation to the Glenlivet discovery, illustrating that the top Glenfarclas reservoir (pink pick) is older than the Glenlivet reservoir. The Glenlivet discovery also has significantly brighter amplitudes on this full offset seismic line than those seen at the Glenfarclas Prospect. Data Courtesy of Robertson GeoSpec a CGG company.

Basin Modelling and Migration
This was carried out in-house using basin modelling software, and results indicated that the proposed Kimmeridge Clay source rocks are located within the gas window at present day, immediately below the Glenfarclas Prospect. This kitchen was modelled to have expelled prolific volumes of oil and gas, and modelling predicted the Glenfarclas Prospect would be filled with gas.

Core Study
A core study was undertaken to better understand facies and cementation controls on reservoir quality in Vaila Formation reservoirs. The Vaila V3 was interpreted to form a series of sandy intra-slope turbidite systems marginal to the Rona Ridge.

The core study defined two main facies architectures:

- Channelised facies characterised by thinner bedded upward fining pebbly sandstones with sharp erosional bases.
- Thick bedded amalgamated turbidite sand bodies interbedded with thick hemipelagic shales, interpreted to represent the localised fill of topography on a (terraced?) slope. Localised accommodation mainly controlled by faulting which may be subseismic in scale.
The potential exists for high net:gross reservoir sandstone preservation, but the lateral extent of sand bodies are uncertain and defined by (subseismic?) localised topography. Reservoir quality is strongly depth controlled, but high porosity sandstones are preserved at depth where chlorite clay rims have inhibited quartz cementation.

6 Conclusions

The Glenfarclas Prospect has mean resources of 394Bcf, but the risk was considered to high to commit to drilling an exploration well. The results of the rock physics study significantly increased the risk, with the AVO response inconsistent to what would be expected if hydrocarbon bearing sands were present within the closure.

As a result the decision was made to relinquish licence P.2045.

7 Clearance

Faroe Petroleum as operator has approved this relinquishment report for publication by the DECC.