



■ BASF Group

Report title:

PL575 Relinquishment Report

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1. Key License History

License PL575, covering parts of blocks 29/9 & 30/7 (Figure 1) was awarded on 4th February 2011 in the APA 2010 licensing round. The license was awarded to Wintershall Norge AS as operator (50%) and Lundin Norway AS (50%), and this remained the partnership throughout the license period.

The initial period was for 7 years with the first phase resulting in a drill-or-drop decision after two years (i.e. before 4th February 2013). The work obligation included studies and the purchase and reprocessing of 3D seismic data over the license area, the latter being fulfilled with the Q3-HILD03WIM11 data.

The license covers a small area (73 sq km) in the North Viking Graben, directly south of the Martin Linge (formerly Hild) development (Jurassic Brent Group and Eocene Frigg Member discoveries) and east of the UK Nuggets fields (Frigg Member).

The application for the area focused on the Fiona Prospect, a stratigraphic trap at Late Eocene level (later re-dated to Oligocene) defined by a localised thickening (depositional fan) interpreted with a seismic phase reversal. This is a high-risk unproven play and therefore required risk reduction to mature it to a drillable target. Unfortunately the evaluation concluded that there was no AVO or seismic attribute support for the prospect, and the chance of success was decreased to 13% and the resource volumes also reduced with the additional risk of heavy, viscous oil. In addition, no other viable prospectivity was identified.

The partnership unanimously agreed that the probability of discovery for the Fiona Prospect is too low to defend a drill decision and therefore to relinquish the license.

2. Database

At the time of application the Fiona Prospect straddled two seismic surveys, NVG05 and Q3-HILD3_TO901. These two surveys were merged and reprocessed to provide an improved and consistent data set across the entire license and prospect area (total survey area 590 sq km), including ties into the critical offset wells (Figure 2). Subsequently, this merged dataset (Q3-HILD03WIM11) was further enhanced and conditioned for AVO analysis by Sharp Reflections AS, including angle stacks and gathers.

The primary objective of the seismic work program was to allow for effective AVO analysis, and the final dataset was effective in this. In addition, PGS megamerge seismic data was used for a regional evaluation of the Eocene – Oligocene Fiona play trend across the UK & Norway, as well as mapping the pre-Cretaceous section. An extensive well database was used, with the key offset wells to the north (Martin Linge).

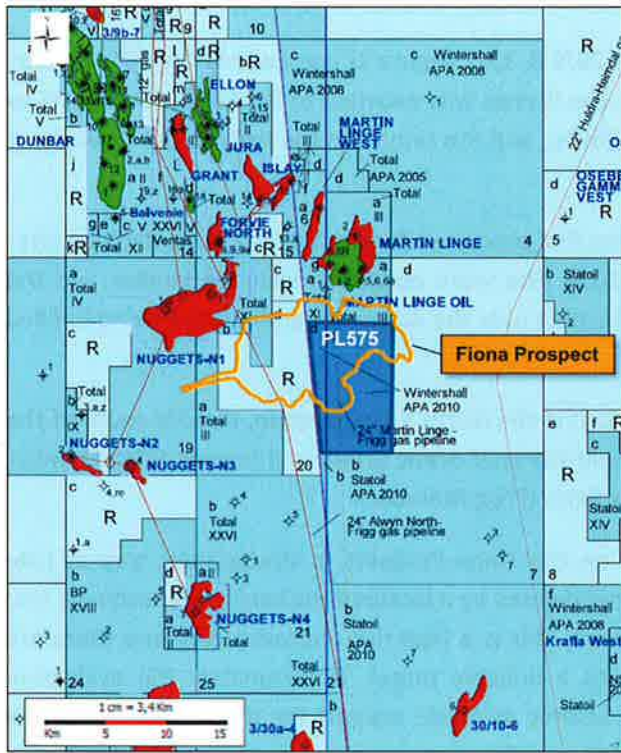


Figure 1. Location map for the PL575 license and Fiona Prospect.

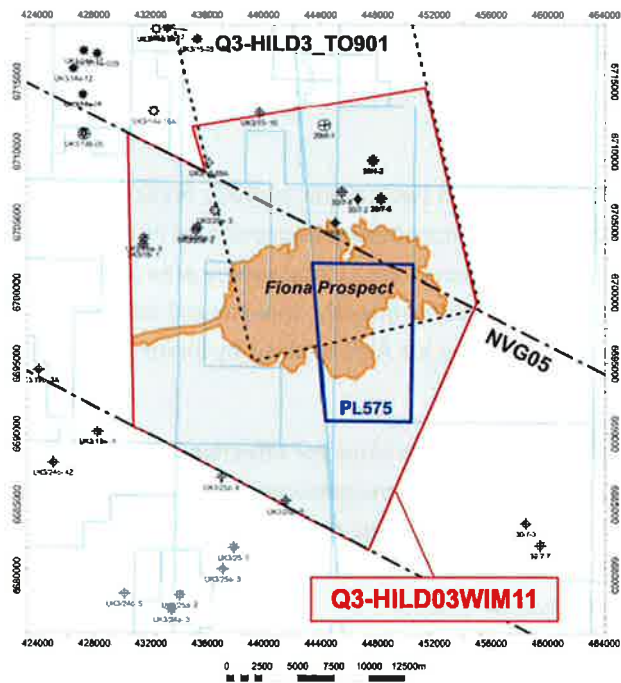


Figure 2. Location map for the merged & reprocessed Q3-HILD03WIM11 survey over the PL575 license.

3. Review of Geological Framework

The main focus was the evaluation of the Fiona Prospect, principally assessing its AVO behaviour (the most effective way to significantly de-risk the prospect) and providing a geological framework to account for the presence of a depositional package at this location.

The Q3-HILD03WIM11 survey proved effective for AVO analysis and also allowed for ties to the key offset wells to the north, west and southwest. The Cenozoic section was mapped in detail, both to provide a geological framework and to identify any other prospectivity. Since the Fiona Prospect constitutes a new play, the interpretation was extended regionally in order to provide geological context and analogues.

Additionally, all prospective horizons have been evaluated in and adjacent to the PL575 license. Incorporated into this was Wintershall's data, experience and results from nearby licenses along trend (PL507, PL509S, PL508S & PL462S).

Few additional studies were required. A 1D CSEM feasibility study was conducted for the Fiona Prospect and the results suggested that the technique may detect a hydrocarbon-charged reservoir given certain limitations. However, it was concluded that any EM results are unlikely to be sufficiently definitive to de-risk the prospect since i) the overburden is characterised by rapid lateral changes and complicated by numerous seismic hard and soft events (in part due to gas leakage from Martin Linge), ii) the Fiona package stratigraphy is uncalibrated, and iii) seismic AVO analysis should be a more reliable indicator for hydrocarbon-charged reservoir presence.

Other geological studies included a review of hydrocarbon occurrences, especially in the post-Palaeocene interval, and hydrocarbon characterisation in order to address the expected phase and assess the risk of non-commercial heavy/viscous oil.

4. Prospect Update

The application for PL575 identified only the Fiona Prospect. Following award all prospective levels have been evaluated, and the results are summarised below.

Fiona Prospect

The Fiona Prospect constitutes a new, high-risk play in this area of the North Sea. Whilst the current interpretation supports the basic concept of a discrete depositional base-of-slope fan complex, it has not proved positive for most of the prospect risk elements. The following summarises the main results and updates to the Fiona Prospect:

- Calibration to offset wells now places the Fiona Prospect as Oligocene in age (rather than Late Eocene) and hence younger than the Grid Formation, and just below the Skade Formation (Figure 3)

- The risk on trap and top seal to the Fiona Prospect remains high (Figure 4). The Fiona stratigraphic trap may not be effective due to up-dip leakage through a clearly-defined feeder channel. The top seal effectiveness and capacity is potentially compromised by younger channel systems, regional downlapping events which may be sand or silt-prone, plus proximity to the overlying thick sands of the Skade Formation (locally less than 50 m above the top of the Fiona fan)
- There also remains a high risk of hydrocarbon charge to the Fiona Prospect. A review of regional hydrocarbon shows clearly demonstrates that there are very few occurrences of hydrocarbons above the regional Hordaland shale which acts as an effective top seal to the petroleum systems below. It is also likely that the Frigg Member and Palaeocene sands over PL575 have acted to divert migrating hydrocarbons laterally up-dip and away from the PL575 area beneath this top seal
- Critically, no AVO or attribute anomaly has been identified to support a hydrocarbon-charged reservoir where such an anomaly is predicted by modeling and analogues (Figure 5). The seismic phase reversal interpreted at the time of application is no longer supported, and it was this that created the “Fiona anomaly”
- A similar seismic package (character and amplitudes) at the same stratigraphic level is interpreted along trend a short distance to the north (and may in part be connected to Fiona in PL575). This seismic package is drilled by several wells (including 29/6-1, Figure 6), and although it proves the presence of thin sands, there are no hydrocarbon shows in spite of being positioned adjacent to vertical leakage from the Martin Linge discoveries
- A significant proportion of the Fiona Prospect lies outside PL575 in UK held acreage (Figures 7 & 8). Greater than the Pmean volumes are required for material in-place resource potential to extend onto PL575
- In the very low chance of a discovery, there is a serious likelihood of any oil being severely biodegraded at this shallow depth (1000 – 1200 m), possibly to a level where it is not technically or commercially recoverable (ca. <15° API and > 400 cp)

The chance of success for the Fiona Prospect therefore remains high at 13% (Table 1), reduced from 21% at the time of application. The gross in-place resource potential remains potentially attractive but recoverable volumes (Table 2) suffer from the additional challenge of viscous oil that may not be mobile or commercially recoverable (note that gas should give a very clear AVO response and has therefore always been discounted). Moreover the crest and almost all of the P90 case lies outside PL575 (in UK held acreage) and only 27% of the Pmean case lies within license PL575.

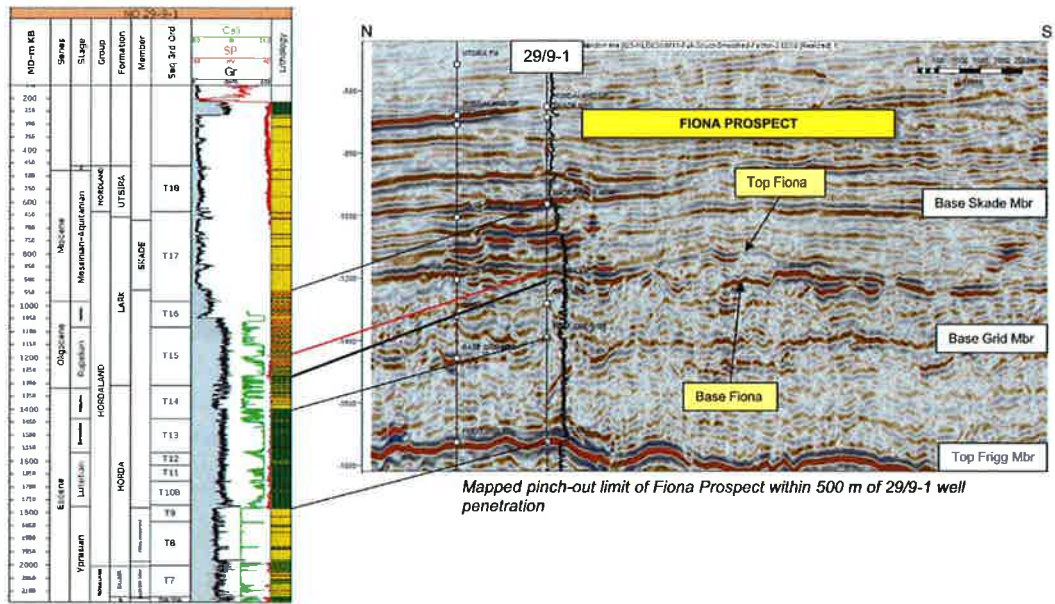


Figure 3. Seismic strike section through the Fiona Prospect including tie to the 29/9-1 well.

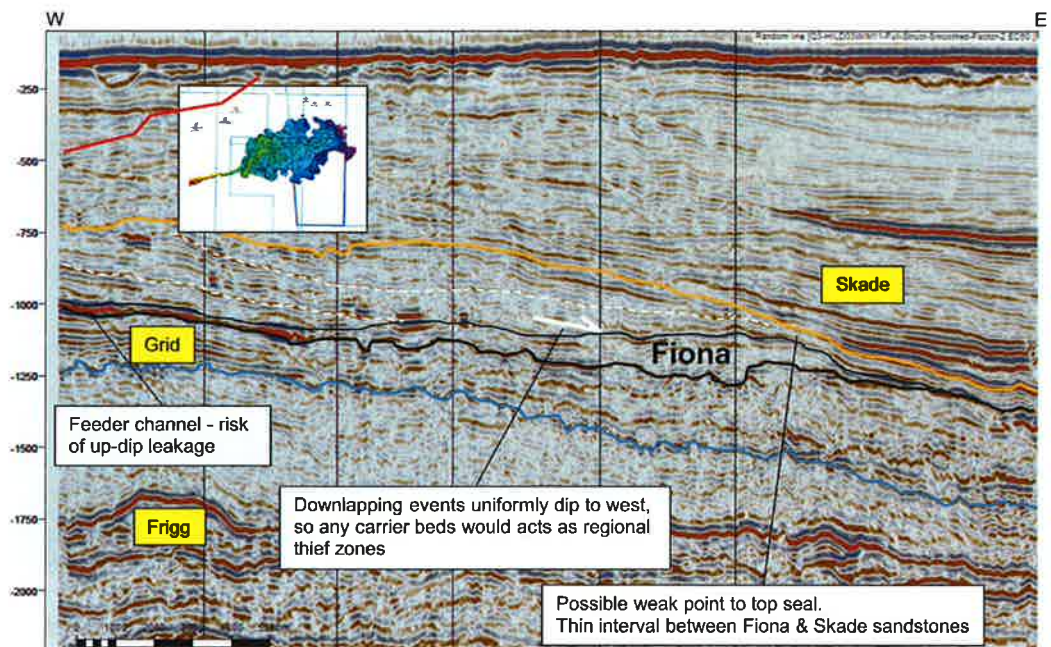


Figure 4. Seismic dip section through the Fiona Prospect illustrating the feeder channel and terminal lobe geometry, plus the primary risk elements to an effective stratigraphic trap.

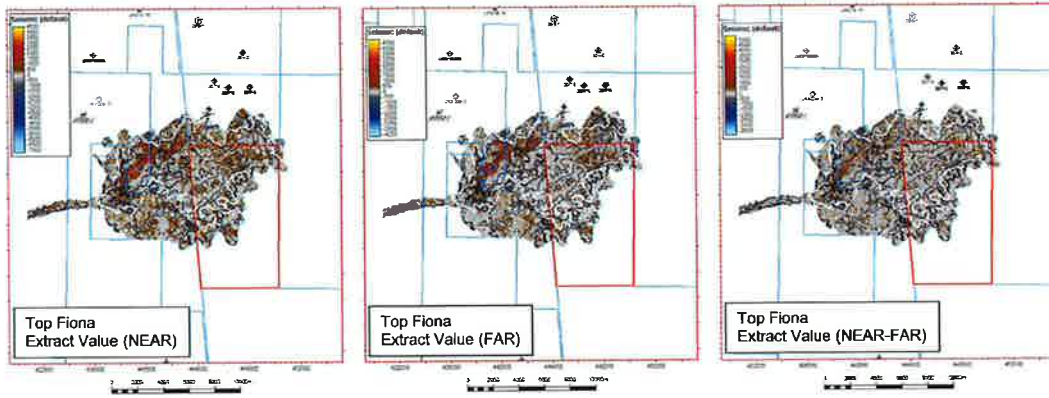


Figure 5. Seismic reflection strength vs. offset on the Top Fiona seismic pick. Note that there is no variation with offset across most of the Fiona Prospect. Similar results are achieved using a range of attributes and intervals around the Fiona Prospect.

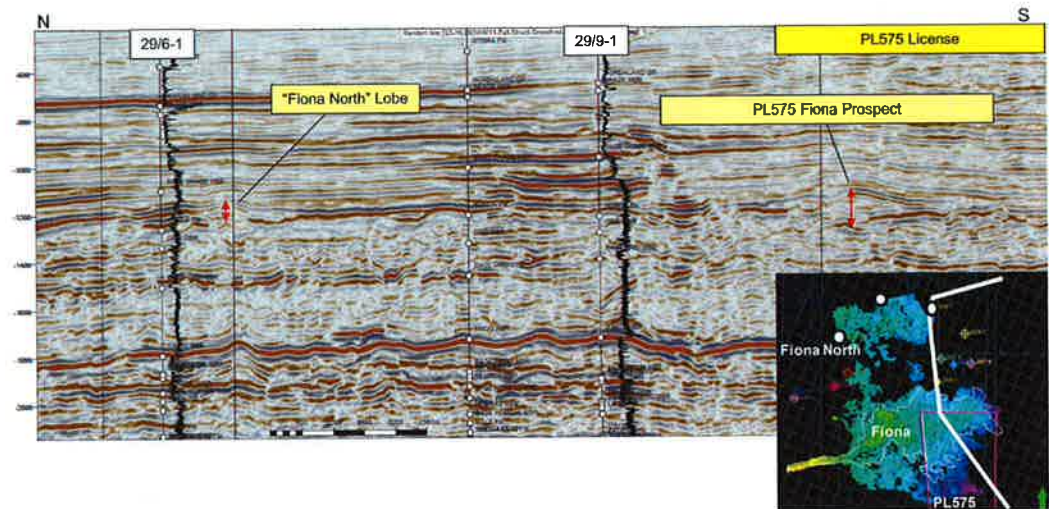


Figure 6. Seismic section through the PL575 Fiona Prospect and the similar, age-equivalent seismic (fan) package that has been drilled and proven thin, water-wet sands.

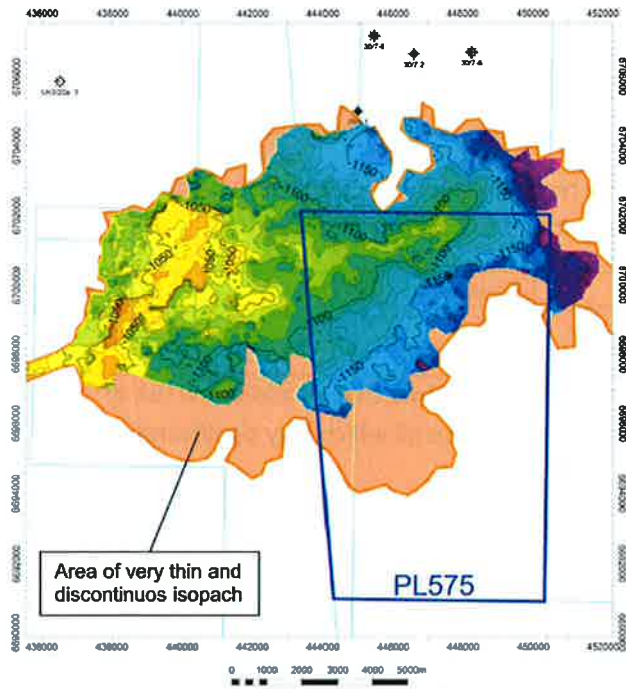


Figure 7. Fiona Prospect top structure depth map. Contour interval 10 m.

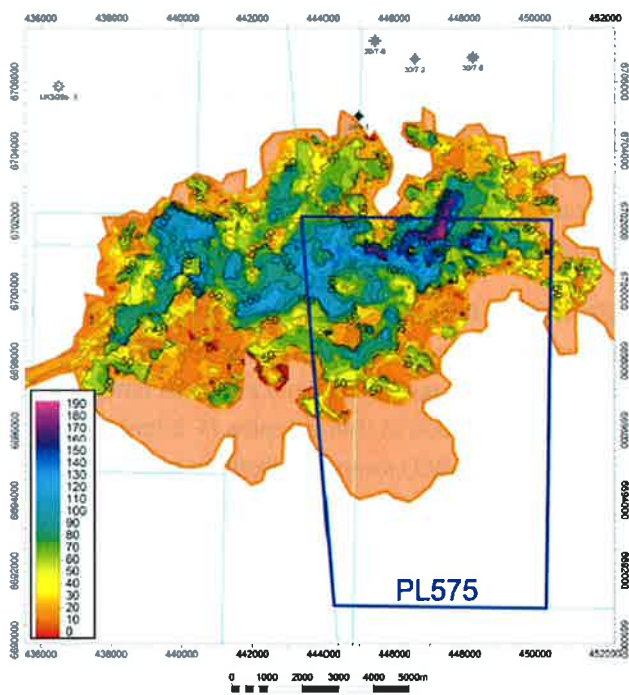


Figure 8. Fiona Prospect isochore map. Contour interval 10 m.

Gross Recoverable Resource (MMboe)	P90	P50	P10	Mean
	15.9	58.2	208.0	94.0

Table 1. Fiona Prospect gross recoverable resource volumes. Note that less than 10% of the P90 case and 27% of the Pmean case lies within the PL575 license area.

	Reservoir	Seal	Source	Trap	COS
Prospect Chance	0.70	0.50	0.75	0.50	0.13

Table 2. Fiona Prospect chance of geological success. Note that an additional risk or challenge is imposed by the likelihood of heavy, viscous oil which may significantly reduce the chance of a commercial success.

Other Prospectivity

License PL575 lies along the western margin and deep axis of the North Viking Graben. The primary post-Cretaceous play is the Frigg Member with discoveries and fields to the north (Martin Linge) and west (UK Nuggets). The Frigg Member extends over PL575, but only extremely small dip closures have been mapped and there are no significant areas with an AVO response as seen at the adjacent discoveries. No prospects have been identified at Frigg level or in the underlying Palaeocene reservoirs.

A thick Lower Cretaceous package is present, but offset wells have penetrated the entire section and proven the absence of reservoir. Moreover, the seismic does not indicate any features that may be expected to be reservoir away from the well control. Similarly, a thick Upper Jurassic package is present in the graben, but again much of the equivalent section is drilled and no reservoirs have been encountered.

The primary play in this area is the Middle Jurassic Brent Group with proven discoveries and fields to the north (e.g. Martin Linge) and northwest (e.g. Forvie & Jura in the UK). Over PL575 the Brent Group is deeply buried and poorly imaged. No significant traps have been interpreted and the risk on reservoir quality preservation at these depths (> 5 km) is very high. In addition, over the license area the entire pre-BCU interval is likely to be under HPHT conditions, with the Brent Group interval extending into the ultra-HPHT environment.

6. Conclusions

The work program and subsequent technical evaluation has provided conclusive results with regards the Fiona Prospect and other potential in the license. The chance of success at the Fiona Prospect has been reduced to a very low level, and in the absence of any other targets a drill decision could not be supported.

The decision to relinquish PL575 was agreed unanimously.