

PL762 Relinquishment Report

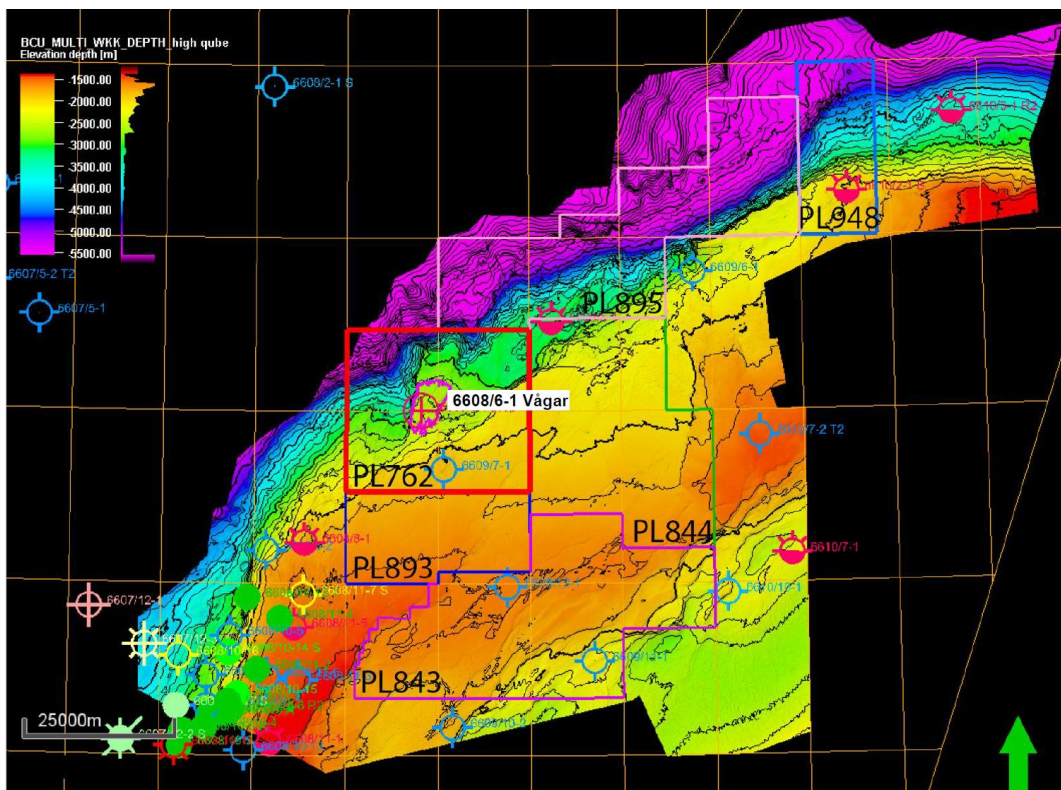


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1 Introduction

1.1 License Owners

- Aker BP ASA (20%), Operator
- Equinor Energy AS (60%)
- Petoro (20%)

1.2 Award and Work Program

PL762 is situated on the Rødøy High, Northern Nordland Ridge (Fig. 1.1). The license covers an area of 273 km² involving parts of blocks 6608/6, 6608/9, 6609/4 and 6609/7. Although other plays are possible, most of the focus in the license has been on the Permian Carbonate Play. Fig. 1.2

shows the drilled and remaining structures of this play as shown by a 3D visualization of the Upper Permian Unconformity (UPU) at the Rødøy High.

The license was awarded to Noreco as Operator (20 %) and North Energy (20%), Fortis Petroleum (20%), Lime Petroleum (20%) and Petoro 20% as partners on 7th February 2014 following the APA2013 Licensing Round. The initial period had a Drill or Drop Decision (DoD) within three years (7th February 2022). The DoD decision was later extended one year to 2018 due to change in operatorship after Aker BP took over Noreco's assets in the Norwegian Sea in 2016.

Fortis Petroleum acquired North Energy's assets in the license in 2016 and two years later Equinor Energy took over Fortis' and Lime Petroleum's assets in the license.

The primary work obligation was 3D seismic acquisition within 3 years. This was fulfilled by the acquisition of survey NO14001, with subsequent multi azimuth co-processing of the GNNR99 data.

In February 2018 the partnership decided to drill the 6608/6-1 Vågar well. The well was drilled during summer 2019 with Odfjell's Deep Sea Stavanger semi-sub rig. The well was dry.

Fig. 1.1

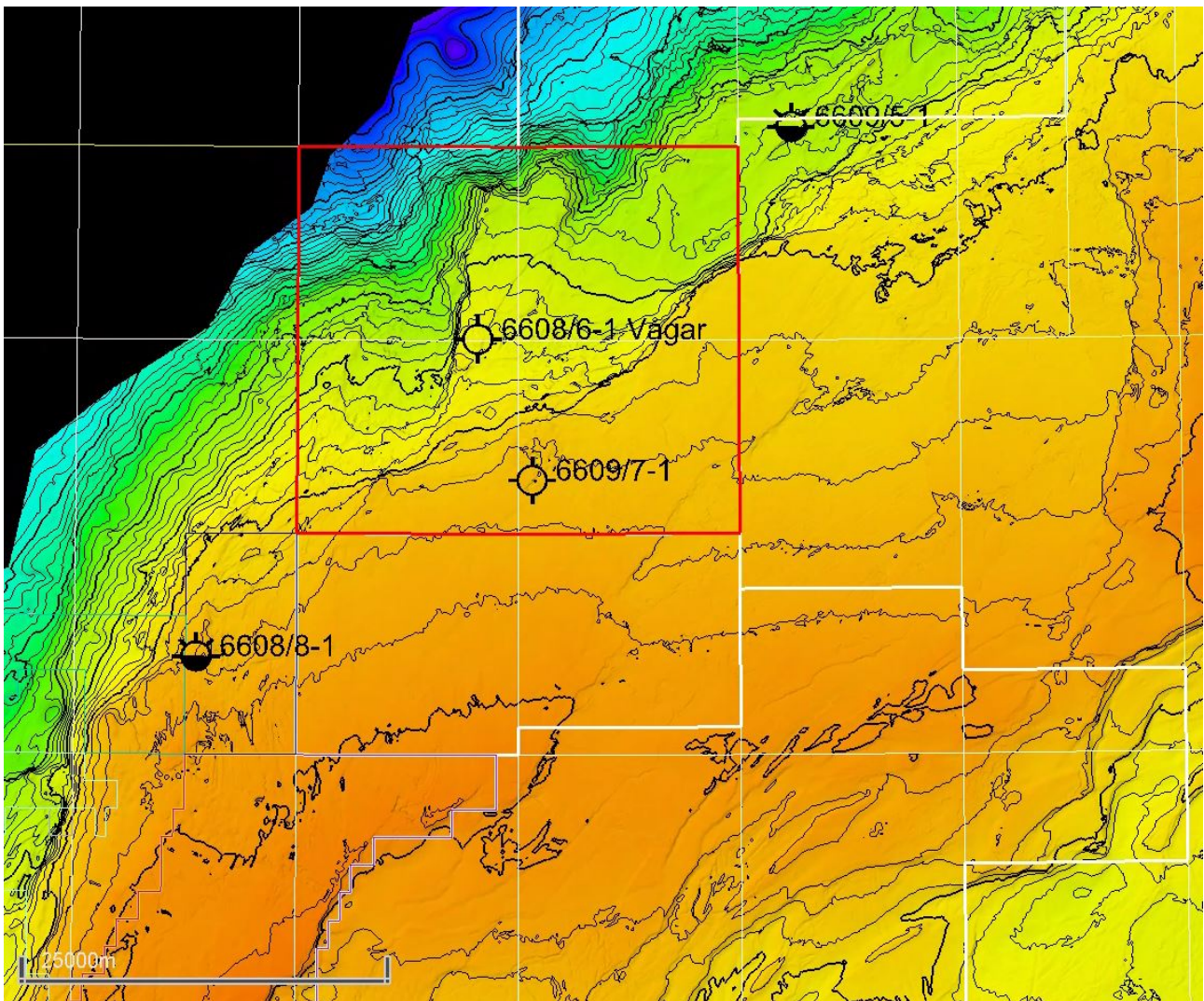


Fig. 1.1 Position of PL 762
 BCU time map of the Rødøy High With position of the closest relevant Exploration Wells (6608/6-1 Vågar, 6609/7-1, 6609/5-1 and 6608/8-1)

Fig. 1.2

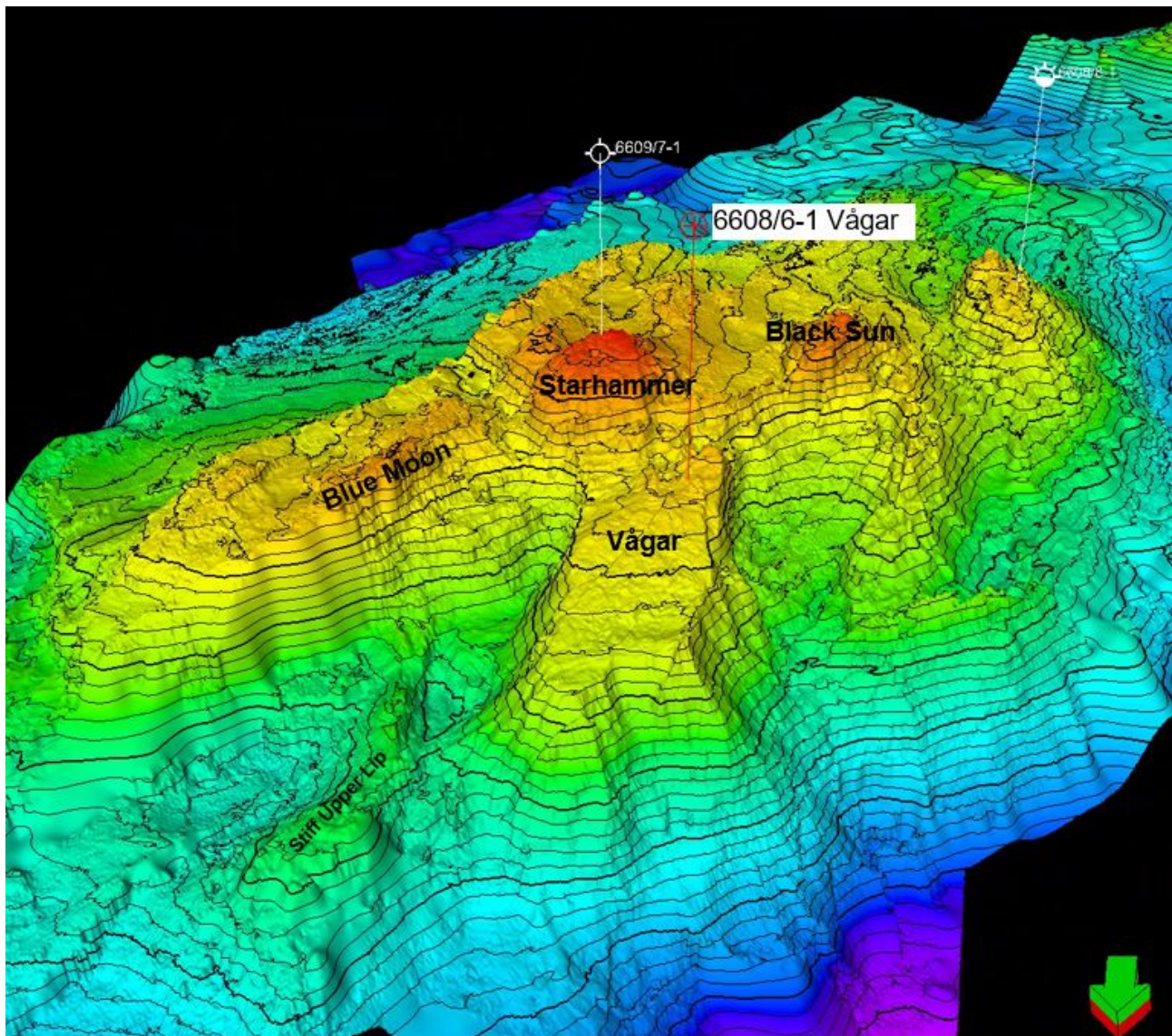


Fig. 1.2 Upper Permian Unconformity (UPU) at the Rødøy High

The image shows already drilled Permian structures and the remaining potential. The drilled structures are Starhammer (6609/7-1), 6608/8-1 and the recent 6608/6-1 Vågar. The largest remaining structures are Blue Moon and Black Sun.

1.3 Identified Prospectivity

The present status on identified and remaining prospectivity in PL762 is shown in Fig. 1.3.

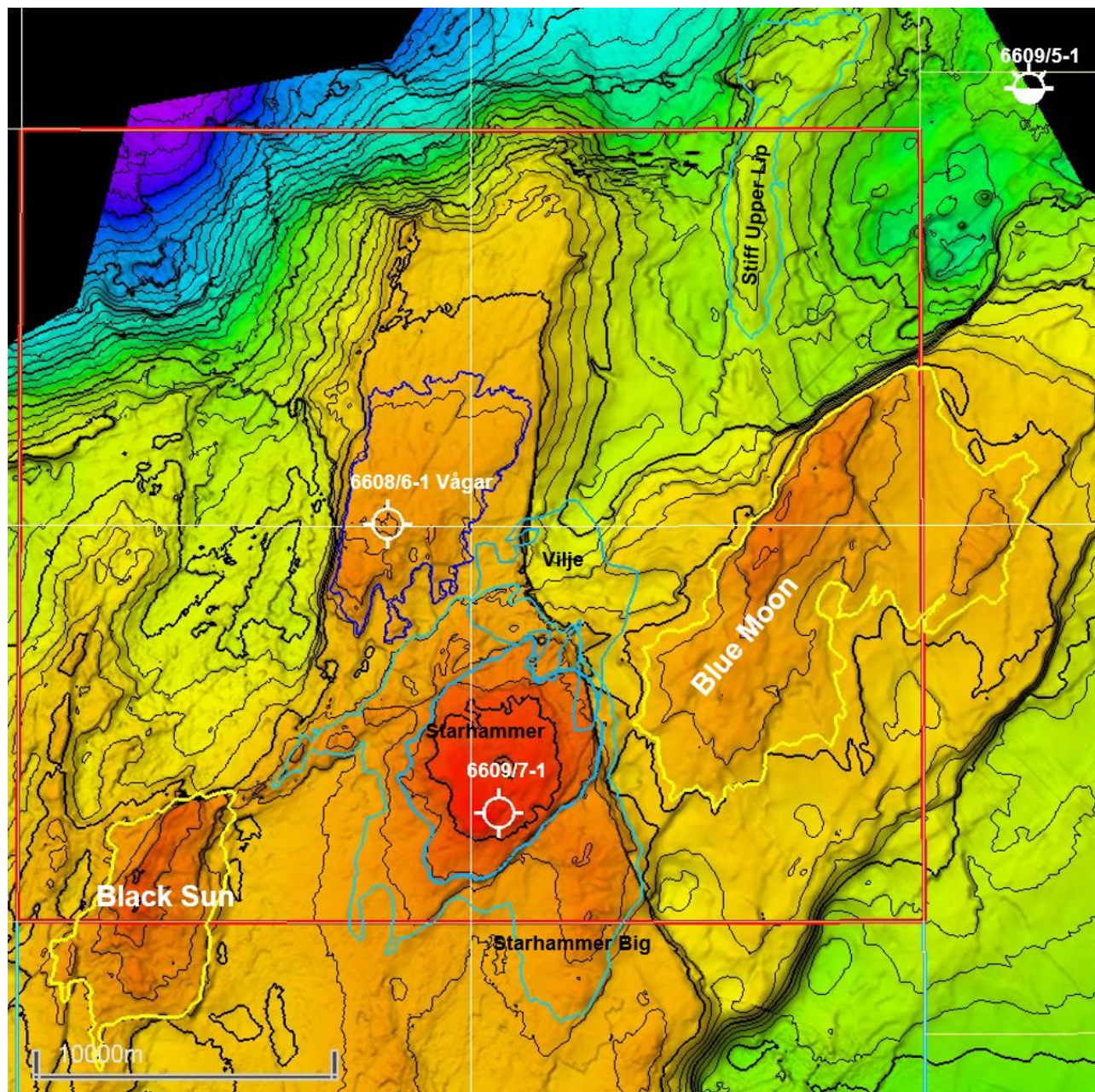


Fig. 1.3 Identified prospectivity PL 762

The identified, but high risk, Permian Carbonate Play prospects Black Sun and Blue Moon are shown in yellow outline, whereas the Permian leads Starhammer, Starhammer Big and Stiff Upper Lip are shown in light blue outline. The Vilje lead contained in the Naust N or Kai Fm is also shown in light blue. The old Vågar prospect polygon (dark blue) is shown as a Reference.

The Permian Carbonate Play has received the highest focus in this license and in the summer of 2019 the license drilled the 6608/6-1 Vågar well (Aker BP 2019 & Aker BP 2020). The well targeted the Vågar Prospect which was seen as the most attractive container, and it was hoped that the structure could have acted as a Play Opener for the Permian Carbonate Play in the Norwegian Sea if success.

Unfortunately, the reservoir section was shown to be tight (Fig. 1.4) due to destructive diagenetic processes. It could also be concluded from the Vågar well that the hydrocarbon system was not effective for the Permian section as the mudgas data showed hundred times decrease in HC content relative to the Cretaceous section (Fig. 1.5). Also, a substantial part of THCG from cuttings and mudgas consisted of CO₂, particularly in the Permian section (Aker BP 2020 and APT 2020).

Vågar 6608/6-1 CPI net res. and pay summary																
Preliminary (2019-08-15)																
Well	Zones	Flag Name	Top (m MD)	Bottom (m MD)	Top (m TVDSS)	Bottom (m TVDSS)	Gross (m TVT)	Net (m TVT)	Not Net (m TVT)	Net to Gross	HCPT (m TVT)	PHIT (v/v)	PERM (mD)	VCL (v/v)	SWT (v/v)	
6608_6-1	ZECHSTEIN GP	GROSS ROCK	2468,30	2750,90	2438,10	2719,75	281,65	281,65	0,00	1,00		0,03	0,50	0,01	0,99	
		Net. RES						4,42	242,72	0,02	-	0,17	30,71	0,05	0,72	
		Net. PAY						0,00	247,14	0,00	-	-	-	-	-	

Fig. 1.4 6608/6-1 Vågar Net Reservoir and Pay

The average porosity of the Vågar reservoir section was only 3%. Only 4,4m of net reservoir was encountered in uppermost parts of the Zechstein sequence.

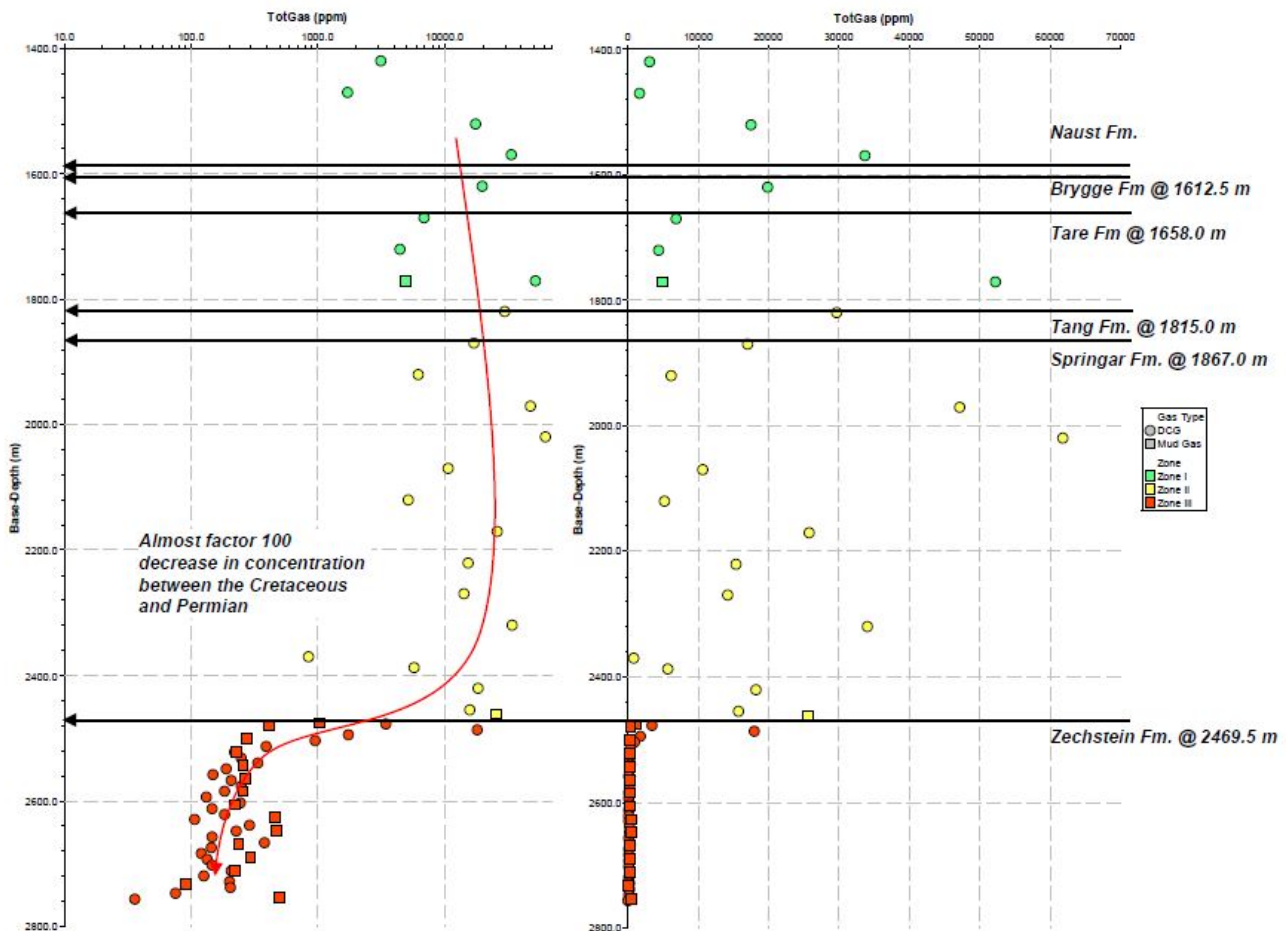


Fig. 1.5 6608/6-1 THCG concentration (ppm)

On entering the Zechstein reservoir at 2469,5m MD there is a sudden decrease by a factor of 100 in total hydrocarbon gas concentration

On this background it is assumed that the remaining Permian prospects in PL762 have a very low chance of success, with main risks on reservoir quality and working hydrocarbon system.

This certainly affects the two largest Permian structures which presently are undrilled and contain most of the possible upside in the license, respectively named Black Sun and Blue Moon. Both prospects are rotated fault blocks with Permian reservoir and Triassic top and lateral seal. Strictly speaking, both the Black Sun and Blue Moon structures could have been classified as leads, since both now are considered to have less than 5% COS.

Black Sun straddles the border to PL 893 and the prospect polygon area is divided roughly 50/50 within each license but with apex of the structure within PL 762. Blue Moon is contained mostly within PL 762, but if filled to spill, volumes could also be found in open area towards the East.

Starhammer, drilled in 1983 (6609/7-1, Phillips 1983) and Starhammer Big including downfaulted segments on the north and south side, respectively, were earlier classified as high risk Permian Carbonate prospects. In the new evaluation both are classified as high risk leads. Although not having been re-risked, they are considered to have a lower COS than Black Sun and Blue Moon.

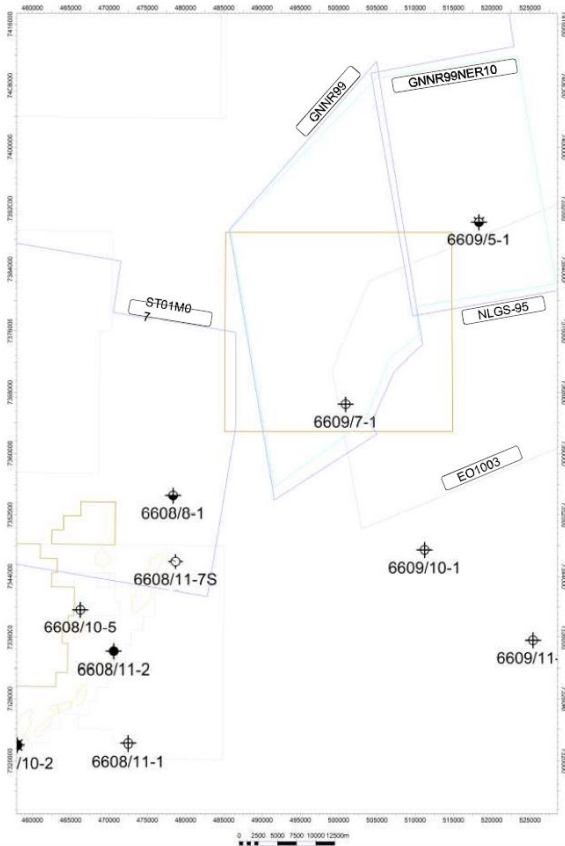
In the APA 2013 application, Noreco classified the Vilje amplitude anomaly as a gas prospect and considered the soft amplitude anomaly to occur in the Kai Fm (Noreco 2013). Aker BP's view, following interpretation of the PGS16005 data, is that the Vilje anomaly belongs to the lower parts of the Naust Formation and is no longer a valid prospect.

The identified Prospects and Leads are described in 3 Remaining Prospectivity.

2 Database

2.1 Seismic Database

From the onset, the common seismic database (Fig. 2.1) consisted of all released 2D seismic data as well as the 3D's GNNR99, NLGS-95, EO1003 and ST01M07. Later, Noreco acquired the NO14001, which subsequently was co-processed with the GNNR99, with final result NO15M02.



3D seismic survey	Acquired	reprocessed
GNNR99NER10		2010/North Energy
GNNR99	1999/GECO	
NLGS-95	1995/Statoil	
EO1003	2010/E.On	
ST01M07	2001/Statoil	

Common 2D seismic data
All released 2D seismic

Fig. 2.1 Original common seismic database

Since there were severe quality issues with the NO15M02, this volume was subsequently taken out of the seismic database and replaced by the PGS16005 3D survey (outline seen in Fig. 2.2).

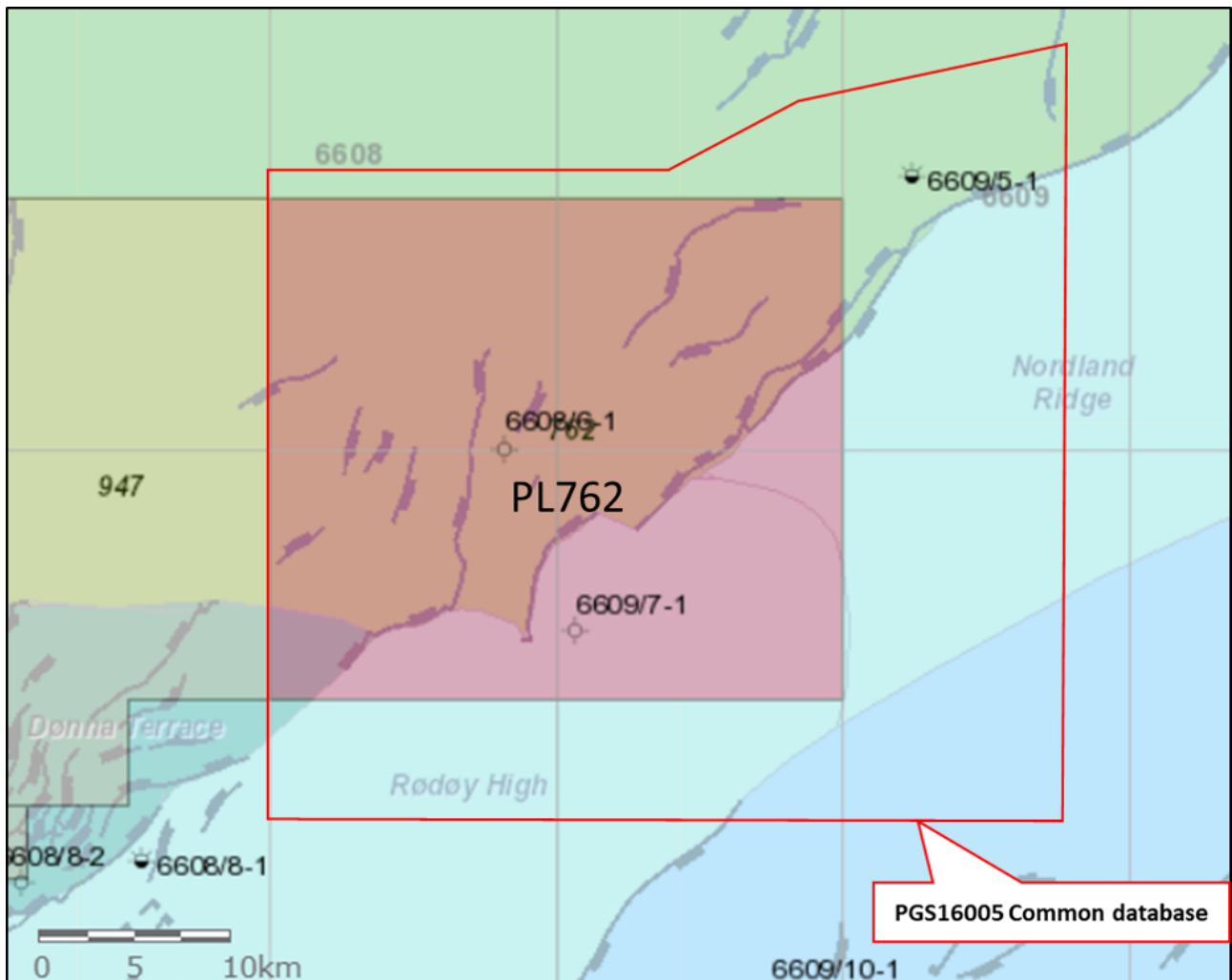


Fig. 2.2 Common seismic database - PGS16005 Coverage of PGS geostreamer data approved as common seismic database in PL762

2.1.1 Seismic reprocessing

In 2015, ION performed a bi-azimuth Pre Stack Depth Migration reprocessing for the PL762 involving the 3D surveys NO14001 and GNNR-99, with final output named NO15M02. The main objectives of the reprocessing were to provide high resolution image of the Vågar spur and the 6609/7-1 well, with large bandwidth in order to resolve fractured and karstified carbonates and clear definition of faults, and to enhance signal to noise. The final NO15M02 processed volume was not of optimal quality, and it was later taken out of the seismic common database, being replaced by the superior quality 3D geostreamer data PGS16005 (Fig. 2.2).

2.2 Well Data

The common well database (Fig. 2.3) consists of all relevant exploration wells on the northern Nordland Ridge and adjacent basinal areas. Key wells are the 6609/7-1, 6608/8-1 and 6609/5-1.

Well	Operator	Year	Status	TD	Age/Formation at	Age/Formation with Hydrocarbons	Cored Formation
6507/6-1'	Saga	1986	P&A	4040	Lower Triassic/ Red Beds	gas shows in Lower Jurassic Åre	Åre Fm
6507/12-2'	Saga	1981	P&A	5008	Middle Triassic/ Red Beds	HC shows in Triassic	Red Beds
6508/5-1'	NorskeShell	1987	P&A	2586	Late Triassic/ Red Beds	none	lle Fm
6608/8-1'	Statoil	1997	P&A	3013	Upper Permian/ Dolomites	oil shows in Triassic/ Red Beds	Red Beds & Dolomites
6608/10-2'	Statoil	1992	P&A	3678	Upper Triassic/ Åre	Oil discovery in Middle-Lower Jurassic Fangst and Båt groups	Fangst, Båt groups
6608/10-5'	Statoil	1995	P&A	3200	Lower Jurassic/ Åre	none	
6608/11-1'	Statoil	1986	P&A	1620	Upper Triassic/ Red Beds	none	Grey Beds
6608/11-2'	Statoil	2000	P&A	2215	Upper Triassic/ Grey Beds	Oil discovery in Lower Jurassic/ Åre	Åre Fm
6609/5-1'	Statoil	1985	P&A	3600	Lower Triassic/ Red Beds	HC shows in Triassic Red Beds, Cretaceous/ Lange	Lange, lle fm
6609/6-1'	Statoil	2007	P&A	2733	Triassic	No data available	
6609/7-1'	Phillips	1983	P&A	1969	Pre-Devonian/ Basement	none	Basement
6609/10-1'	Saga	1983	P&A	2167	Upper Triassic/ Red Beds	none	Tilje, Åre fm's
6609/11-1'	Statoil	1986	P&A	1620	Upper Triassic/ Red Beds	none	Red Beds
6610/2-1'	Statoil	1996	P&A	2673	Triassic/ Red Beds	Shows at top Upper Cret/ Lysing Fm; Shows Lower-Middle Jurassic/ Tare, Tilje, År	Lysing Fm, Åre Fm
6610/3-1R	Statoil	1996	P&A	4200	Upper Triassic/ Red Beds	Shows in Cretaceous Lange Fm	Lange Fm, lle fm
6610/7-1'	Statoil	1983	P&A	3333	Upper Triassic/ Red Beds	Oil shows in Lower Jurassic sandstones	Lange, lle, For fm's
6610/7-2'	Statoil	1984	P&A	4215	Lower Triassic/ Grey Beds	Dry	Tilje Fm, Grey Beds
6710/10-1'	Statoil	2000	P&A	2267	Upper Cretaceous/ Springar Fm	Upper Cretaceous/ Springar Fm	Tang Fm
6608/11-7S	Rocksourc	2011	P&A	2216	Red Beds	Dry	

Fig. 2.3 Common database wells

2.3 Special Studies

After Aker BP became operator for PL762, a geochemical subsurface leakage study with abundant seabed sampling was performed by ORG in the summer of 2017 (ORG Geophysical 2017a and 2017b). This covered the larger parts of the Rødøy High. The grid of sampling points focused mainly on obtaining geochemical and microbial samples of the seabed directly over the identified Permian structures within PL 762 and 893. The rationale for the study was the assumption that alle hydrocarbon filled structures to a certain degree leak hydrocarbons by microseepage. It was hoped that this study could help de-risk the hydrocarbon system of the Grønøy High and as a best outcome point to specific structures that could have hydrocarbon potential.

The sampling programme did show a small cluster of micro seepage anomalies related to oil over the apex of the Blue Moon structure, but it is unclear what the statistical significance of this is (Fig. 2.4). In general there are more hydrocarbon indicators northwards towards the Træna Basin than southwards towards the Helgeland Basin (e.g. Fig. 2.5).

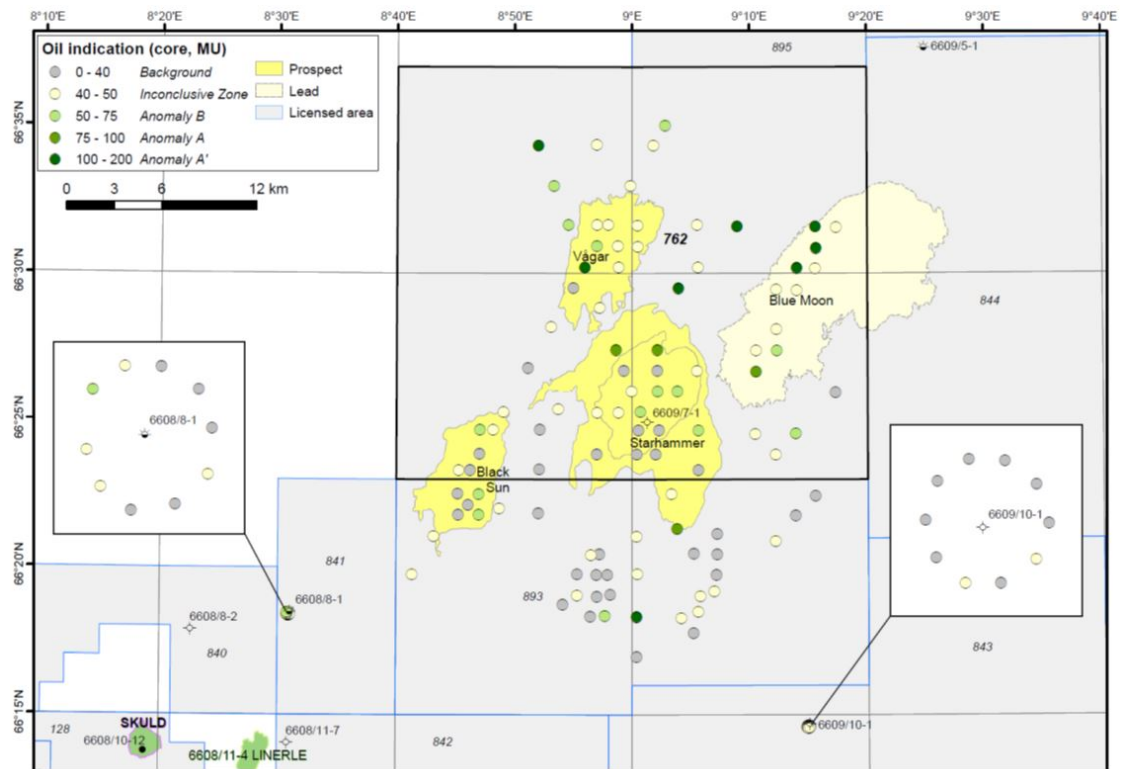


Fig. 2.4 Oil indications from cored samples
Blue Moon: A mini-cluster of Three Points indicating anomalously high oil content relative to background samples occurs over the apex area of the structure.

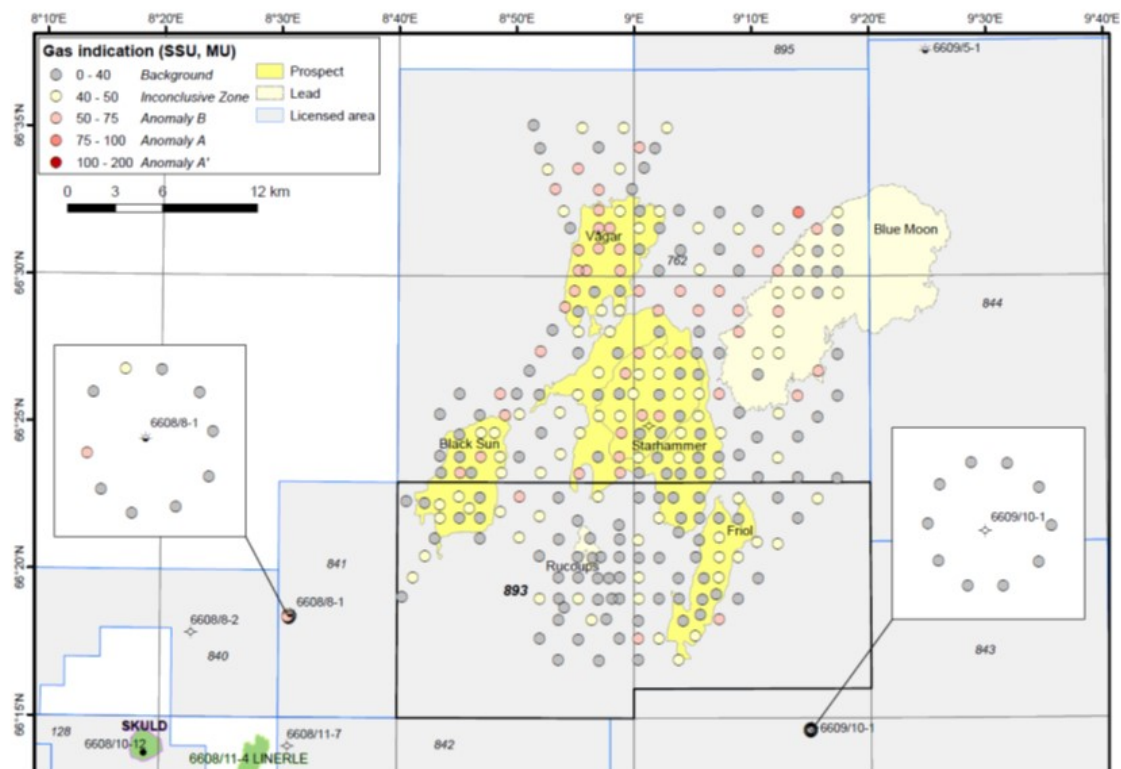


Fig. 2.5 ORG survey Gas indications Gas indications (SSU samples), Rødøy High. In general, the ORG study indicates a higher density of anomalous samples towards the Træna Basin than towards the Helgeland Basin that is closest to PL 893

Other than this the following special studies and reports were either performed for the license, or bought by the license:

- IP-survey (ORG Geophysical 2015). Three survey lines were acquired over PL 762 and 893; Vågar-Starhammer-Frioul, Black Sun-Vågar and Black Sun-Frioul. Chargeability anomalies were recorded over Black Sun and in the area between Vågar and Starhammer. No anomalies were detected over Vågar and Frioul.
- CGG radar slicks study for PL 762. This macro seepage study detected class 3 slicks (possible oil related slicks, but other explanations cannot be ruled out) over one of the back basins in PL 893.
- Lønøy hypogene karst and fractured reservoir study (Lønøy Geoconsulting 2016). Based on observation from the 6608/8-1 well this study claims that the most probable type of karstification at Vågar would be related to hypogene processes. Actual results from the Vågar well does not seem to support this hypothesis since the observed mud losses most probably were related to epi-genetic karstification in and close to the surface proximal limestone pavement/lapiaz/karrenfeld.
- Cambridge Carbonates report with appendix (Garland et al. 2016a & b). This report with appendix was bought by the license from PL841 and is a comprehensive review of all wells with relevance for the Permian Carbonate Play in the Norwegian Sea.
- Mud gas reports (Geoprovider 2016a, b & c). The license bought the following mud gas reports; 6608/8-1, 6609/7-1 and 6507/6-4A. All have relevance for the Permian Carbonate Play.
- FIT reports (FIT 2008a & b). The chemistry and fluid inclusion reports for wells 6608/8-1 and 6609/7-1 were bought by the license.
- APT Geochemical analysis of extracts from the SWC in the 6608/6-1 Vågar well. This study showed traces of a Cretaceous migrated oil in fluid extracts from the SWCs
- PRS 2020, Petrographic and facies analysis of side wall cores, Permian Zechstein, Well 6608/6-1 Vågar

3 Remaining Prospectivity

The identified remaining prospectivity in the Permian Carbonate Play is considered very high risk and even the earlier identified structural prospects, Black Sun and Blue Moon, are now considered to have a COS of less than 5%. In a stricter sense the mentioned structures qualify more to be classified as leads rather than prospects.

The other prospect possibilities (leads) in the license such as Stiff Upper Lip (Permian), Starhammer and Starhammer Big (Permian) and Vilje (Naust N or Kai anomaly) are regarded as having an even lower COS and are not likely to become exploration targets within the foreseeable future. The present prospect and lead inventory is shown in (Fig. 1.3).

3.1 Black Sun

Black Sun is a large and well defined rotated Permian fault block. Karstified carbonates constitute the reservoir, with most likely Triassic shales as top seal. Faults may have compromised the seal as they are observed above the crest and also on BCU level. Possible vent features are observed on the seismic above the Black Sun structure. Black Sun could be sourced by Spekk Fm and/or a lean Cretaceous source rock. The apex is within PL 762 but the structure is straddling the border with PL893 (Fig. 1.3, Fig. 3.1). Detailed calculations on the distribution of volumes within PL 893 and PL 762, respectively, have not been performed, but based on area the split is close to 50/50.

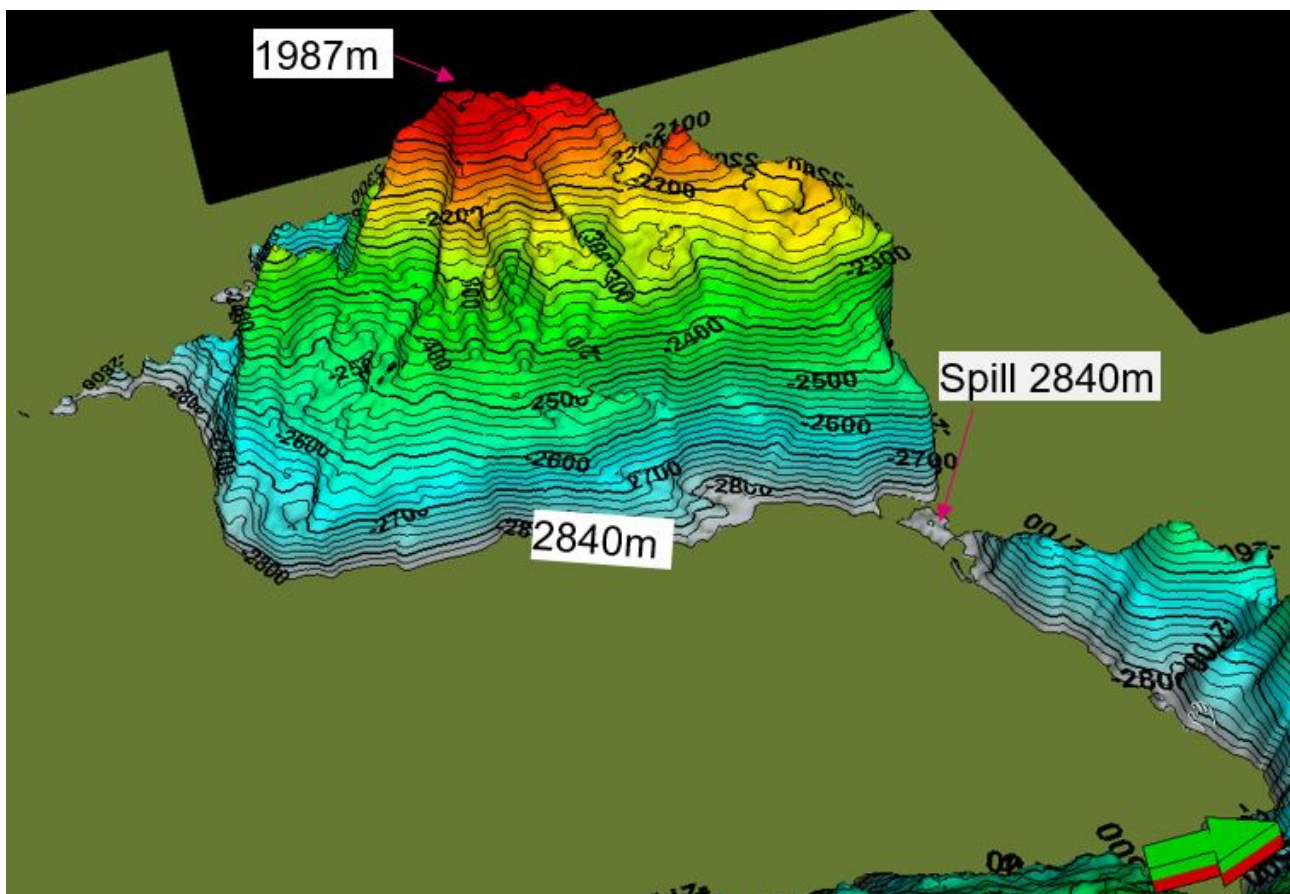


Fig. 3.1 The Black Sun container

The Black Sun structure seen from a vantage point to the East. The apex is at 1987m and spill is at 2840m.

Before drilling of the Vågar structure a quite optimistic filling model (filled to spill +/- 10m) was used in the volume estimate for Black Sun. This, together with optimistic petrophysical parameters, gave large in-place and recoverable P(50) total volumes, respectively 51.6 and 22.6 (10^6Sm^3 OE). Since the apex of Black Sun is at a depth of 1987m and the spill contour at 2840m the old filling model would imply a HC-column of 853m and this is now considered to be unrealistic because of likely column restrictions. Also, results from the 6608/6-1 Vågar well, indicates a limited hydrocarbon system for the pre-Cretaceous section, so if filled, underfilling is seen as a far more likely scenario than a filled to spill model.

Following results from the 6608/6-1 Vågar well, petrophysical parameters such as N/G and Porosity were assigned new values (Table 3.1). Furthermore, Geox simulations with a more realistic filling model with a spread of GWC's in the rock volumes gave substantially lower volumes (Table 3.2) than in the old evaluation. P50 In-place and P50 recoverable total volumes are now considered to be, respectively, 5.49 and 2.42 (10^6Sm^3 OE).

Additionally, Black Sun risking was revised after results came in for the 6608/6-1 Vågar well. In the old evaluation, Black Sun was estimated to have a COS of 14%. Following harder risking of factors like reservoir quality, seal presence and migration/timing Black Sun's COS is now estimated at only 4% (Table 3.3).

Consequently, Black Sun is presently not seen as an attractive drilling target.

Table 3.1 Black Sun revised petrophysical parameters and GWC's

Parameter	Min	Mode	Max
N/G	0.02	0.10	0.30
Porosity	0.03	0.10	0.20
Gas saturation	0.65	0.75	0.85
Rec.factor Non assoc.gas	0.25	0.45	0.65
Rec.factor condensate	0.15	0.40	0.60
GWC	2271	2555	2840

Table 3.2 Black Sun revised volumes

In-place and recoverable volumes	P90	P50	Mean	P10
In-place total volumes (10^6Sm^3 OE)	2.02	5.49	6.78	13.2
In-place Non Associated Gas (10^9Sm^3)	1.91	5.18	6.4	12.4
In-place Condensate (10^6Sm^3)	0.09	0.30	0.39	0.8
Recoverable total volumes (10^6Sm^3 OE)	0.87	2.42	3.02	5.91
Recoverable Non Associated Gas (10^9Sm^3)	0.82	2.29	2.87	5.62
Recoverable Condensate (10^6Sm^3)	0.03	0.11	0.15	0.32

Table 3.3 Black Sun revised risk

Risk factor	P(Play)	P(segment)
Reservoir	1.0	
Trap	0.8	
Source	0.9	
Reservoir presence		1.0
Reservoir quality		0.4
Seal presence		0.5
Trap geometry		1.0
Source presence		1.0
Migration and timing		0.3
Marginal Play probability	0.72	
Conditional segment probability		0.06
Unconditional probability		0.04
Dry hole risk		0.96

3.2 Blue Moon

Blue Moon is the largest remaining prospect within PL 762 and if substantially filled it extends eastwards into open area (Fig. 3.2). If filled to spill towards the Starhammer structure, this would imply a total column of the order of 750m (Fig. 3.2). As for the filling model, this divides the rock volume in increments of three, giving the following case: Min 2440m, Mode 2690m and Max (spill towards Starhammer) at 2940m (Table 3.4). The filling model for Blue Moon has therefore not been changed from earlier.

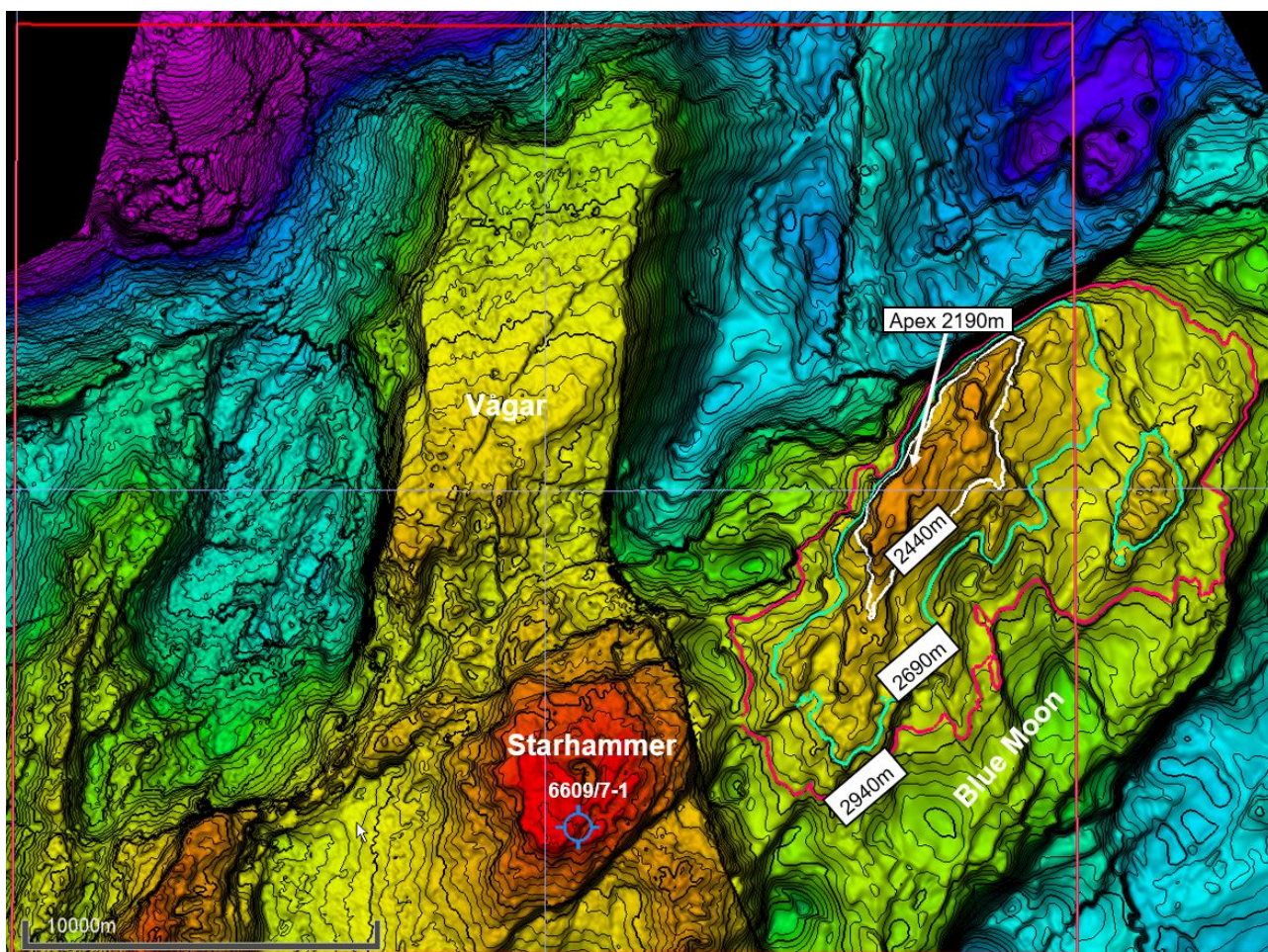


Fig. 3.2 Blue Moon filling model

UPU Depth map of the Blue Moon structure showing filling cases: Min: 2440m, Mode: 2690m and Max: 2940m involving spill towards Starhammer.

The reservoir is believed to be karstified Permian Carbonates, like in Black Sun and Vågar, with Triassic top and lateral seal. For Blue Moon a combined oil and gas case has been evaluated as the base case model in Geox. The reason for this is that the ORG microseep study (ORG Geophysical 2017a & b) indicated a small cluster of oil related anomalous samples and measurements directly over the apex area of the structure. The significance of this clustering of oil related points is not clear, and it is not by any means proven that it has statistical significance.

However, basin modelling shows that if the Spekk Fm exists on the downfaulted terrace between Vågar and Blue Moon, then it would be at the right depth to generate oil which migrate into the Blue Moon structure. Also, seismic interpretation of PGS 16005, and other seismic data, shows

that the area in question is eroded deeply into the Triassic section due to the strong footwall uplift of the Rødøy High, concomitant with the hyperextension of the Træna Basin and adjacent Vøring area giving little chance for the occurrence of Viking Grp sediments on the terrace.

The pre-Vågar volumetric evaluation gave large in-place and recoverable P50 total volumes, respectively 42.7 and 17.8 (10^6Sm^3 OE).

Following results from the 6608/6-1 Vågar well, petrophysical parameters such as N/G and Porosity were assigned new and lower values (Table 3.4), and the most recent Geox model gives P50 total in-place and recoverable volumes of, respectively, 17.7 and 7.16 (10^6Sm^3 OE) (Table 3.5).

Additionally, Blue Moon risking was revised after results came in for the 6608/6-1 Vågar well. In the old evaluation, Blue Moon was estimated to have a COS of 18%. Following harder risking of factors like reservoir quality, seal presence and migration/timing, Black Sun's CoS is now estimated at only 3% (Table 3.6).

Consequently, Black Sun is presently not seen as an attractive drilling target.

Table 3.4 Blue Moon revised petrophysical parameters and GWC's

Parameter	Min	Mode	Max
N/G	0.02	0.20	0.40
Porosity	0.03	0.10	0.20
Gas saturation	0.65	0.75	0.85
Rec.factor Non assoc.gas	0.25	0.45	0.65
Rec.factor condensate	0.15	0.40	0.60
GWC/OWC	2440	2690	2940

Table 3.5 Blue Moon revised volumes

In-place and recoverable volumes	P90	P50	Mean	P10
In-place total volumes (10^6Sm^3 OE)	5.08	17.7	28.2	64.4
In-place Non Associated Gas (10^9Sm^3)	3.39	9.85	12.5	25.1
In-place Oil (10^6Sm^3)	2.57	17.4	26.9	62.7
Recoverable total volumes (10^6Sm^3 OE)	2.11	7.16	10.6	23.2
Recoverable Non Associated Gas (10^9Sm^3)	1.45	4.38	5.63	11.4
Recoverable Oil (10^6Sm^3)	0.769	5.18	8.31	19.8

Table 3.6 Blue Moon revised risk

Risk factor	P(Play)	P(segment)
Reservoir	1.0	
Trap	0.8	
Source	0.9	
Reservoir presence		0.7
Reservoir quality		0.5
Seal presence		0.5
Trap geometry		0.9
Source presence		1.0
Migration and timing		0.3
Marginal Play probability	0.72	
Conditional segment probability		0.05
Unconditional probability		0.03
Dry hole risk		0.97

3.3 Leads

Most of the license work in PL762 has targeted exploring the unproven Permian play. Some seismic anomalies have been identified in the shallower stratigraphy in the PL762 (Fig. 3.3), however these have been seen as high risk and less attractive.

Fig. 3.3

Seismic section over the Vilje, Hedda Kai and Hedda Paleocene leads on PGS16005

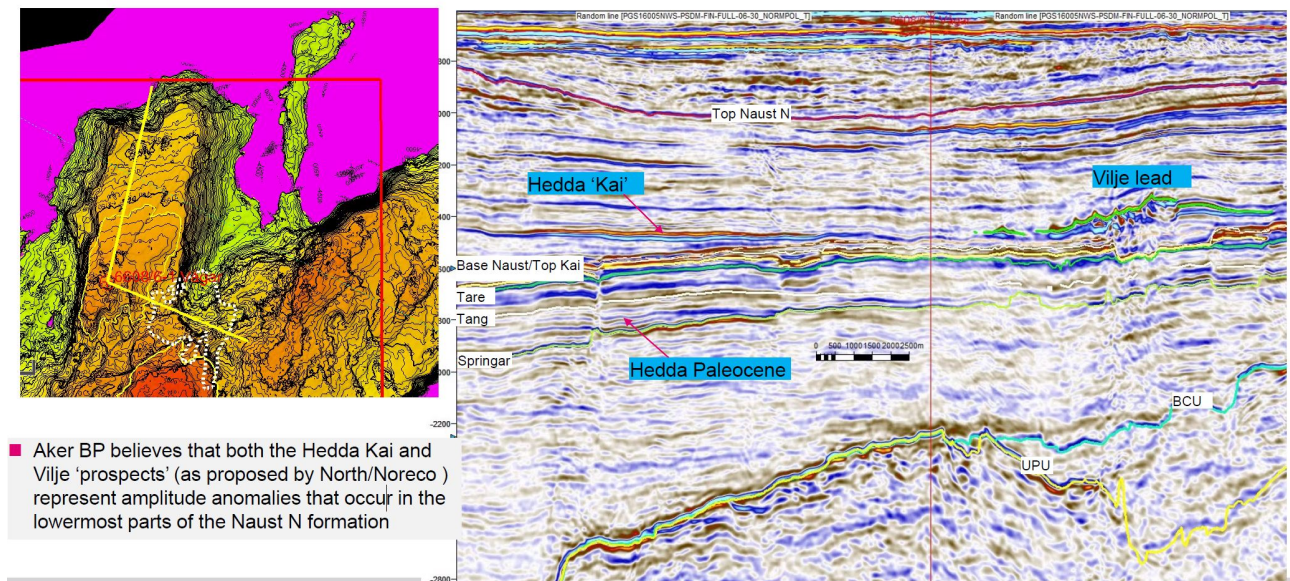


Fig. 3.3 Leads PL762 Top Permian map and seismic x-section. the narrow structure towards the north is the permian Stiff upper lip lead.

4 Conclusion

From the onset, the Permian Carbonate Play at the Rødøy High, including both the 762 and 893 licenses, seemed to represent a substantial volumetric potential. It was hoped that Vågar, the most attractive container, would act as a play opener and later enabling the exploration and drilling of the Black Sun and Blue Moon structures.

However, the 6608/6-1 well showed that the Permian carbonate reservoir, in spite of showing well developed epi-karst with substantial mud-loss close to the lapiaz surface, was not functional because of diagenetic minerals filling the pore spaces (RPS, 2020). Also, despite showing indications of minor oil traces in extracts (APT, 2020), the hydrocarbon system for the Permian section is not very prolific with observed THCG in the low ppm range and with high CO₂ content observed in the Vågar well (Aker BP, 2020).

Post Vågar re-definition of filling model (Black Sun) and petrophysical parameters for both structures shows that the upside for the remaining Permian structures is not as attractive as previously envisaged, and re-risking downgrades both structures giving them a CoS in order of 3-4%. Also, all untested Permian structures extend outside the PL762 license boundaries.

Without a discovery in the license, the JV will not be able to fulfill a BoK commitment. Since the leads are considered to have even downgraded chance of success there is not an attractive drilling target in the license at current stage. As such the recommendation is to relinquish the PL762 acreage. The work programme in the license has been fulfilled through seismic reprocessing, G&G studies and drilling of the 6608/6-1 Vågar well.

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