Relinquishment Report PL 893

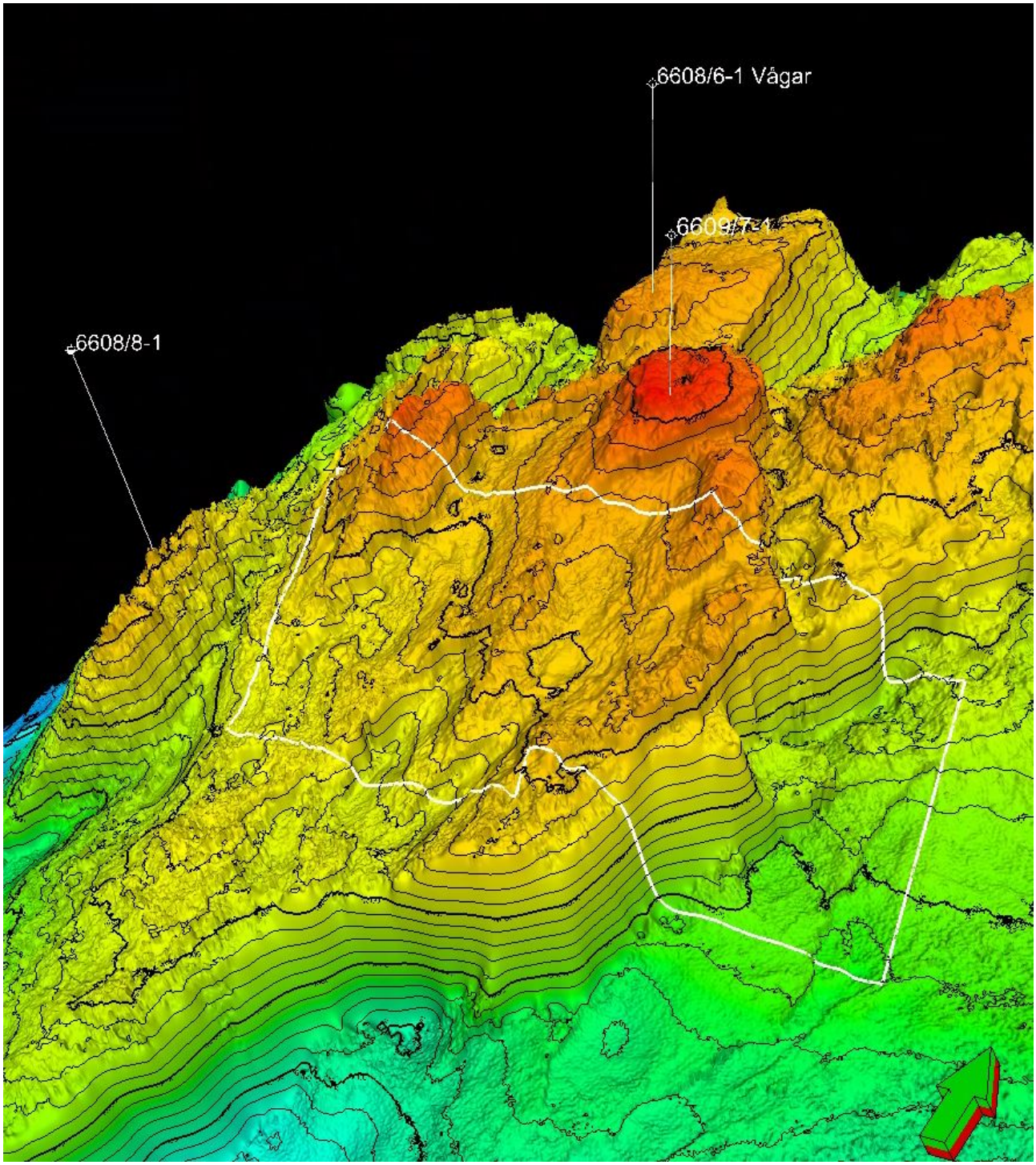

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 License Owners

- Aker BP ASA (60%), operator
- Equinor Energy AS (40%)

1.2 Award and Work Program

The license was awarded to Aker BP (operator) and Fortis on the 10th February 2017 for an initial period of 7 years following the APA Licensing Round 2016, with a Drill or Drop decision within two years. This was later extended one year to 10th February 2020 to await results from the 6608/6-1 Vågar well in PL 762.

In 2018, Equinor acquired Fortis assets in the license.

The primary license work obligation consisted of acquiring 3D seismic over the entire license area. This has been fulfilled by the purchase of PGS16005 3D data.

PL 893 is situated on the Rødøy High, Northern Nordland Ridge (Fig. 1.1). The license covers an area of 417km^2 and covers parts of blocks 6608/9 and 6609/7.

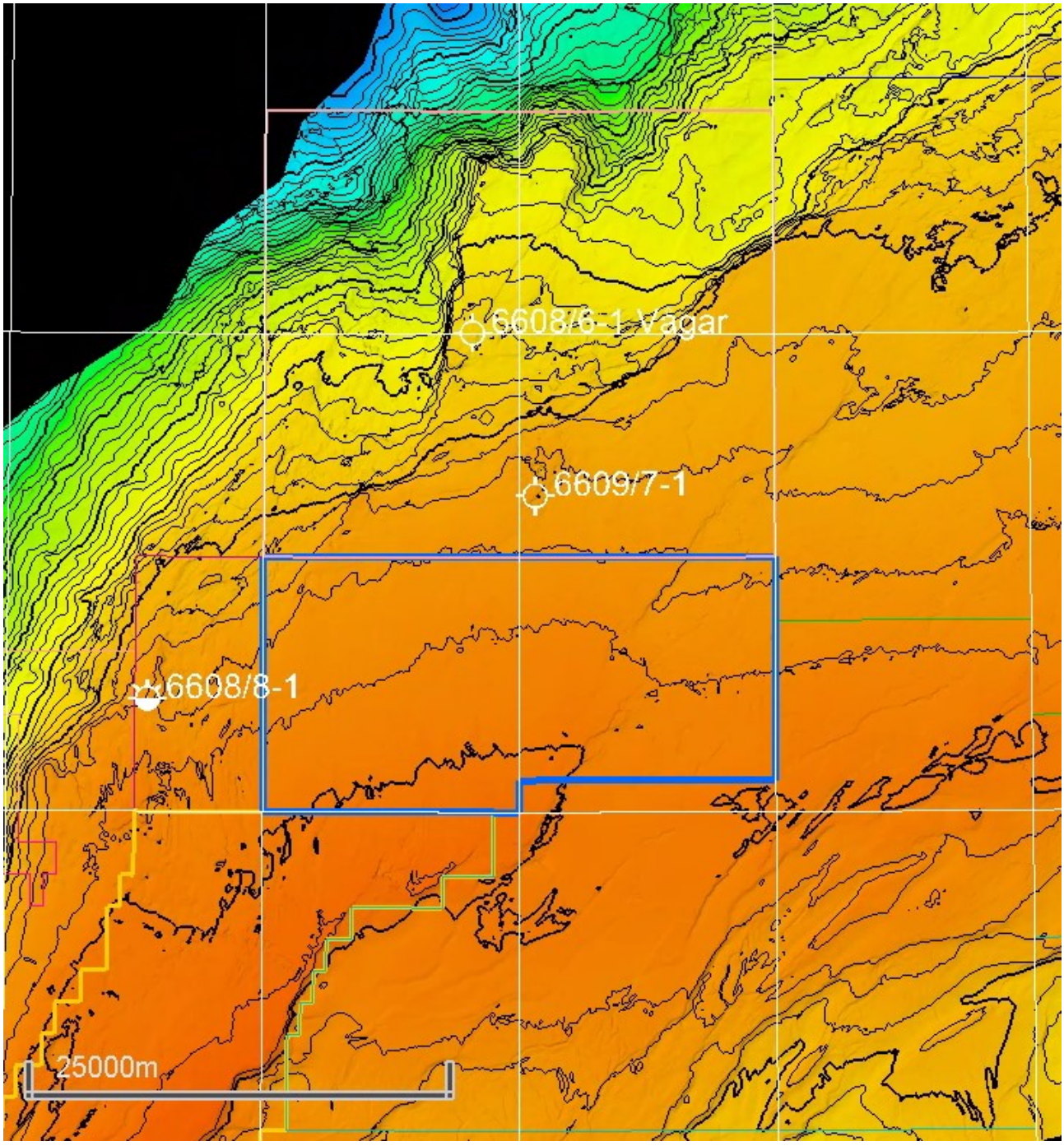

Fig. 1.1 Position of PL893 *BCU time map with position of the three most relevant Exploration wells for the Permian Play (6608/6-1 Vågar, 6609/7-1 and 6608/8-1)*

Although other plays are possible, most of the focus in the license has been on the Permian Carbonate Play. Fig. 1.2 shows a 3D visualization of the Upper Permian Unconformity (UPU) at the Rødøy High with PL893 license boundaries draped in white.

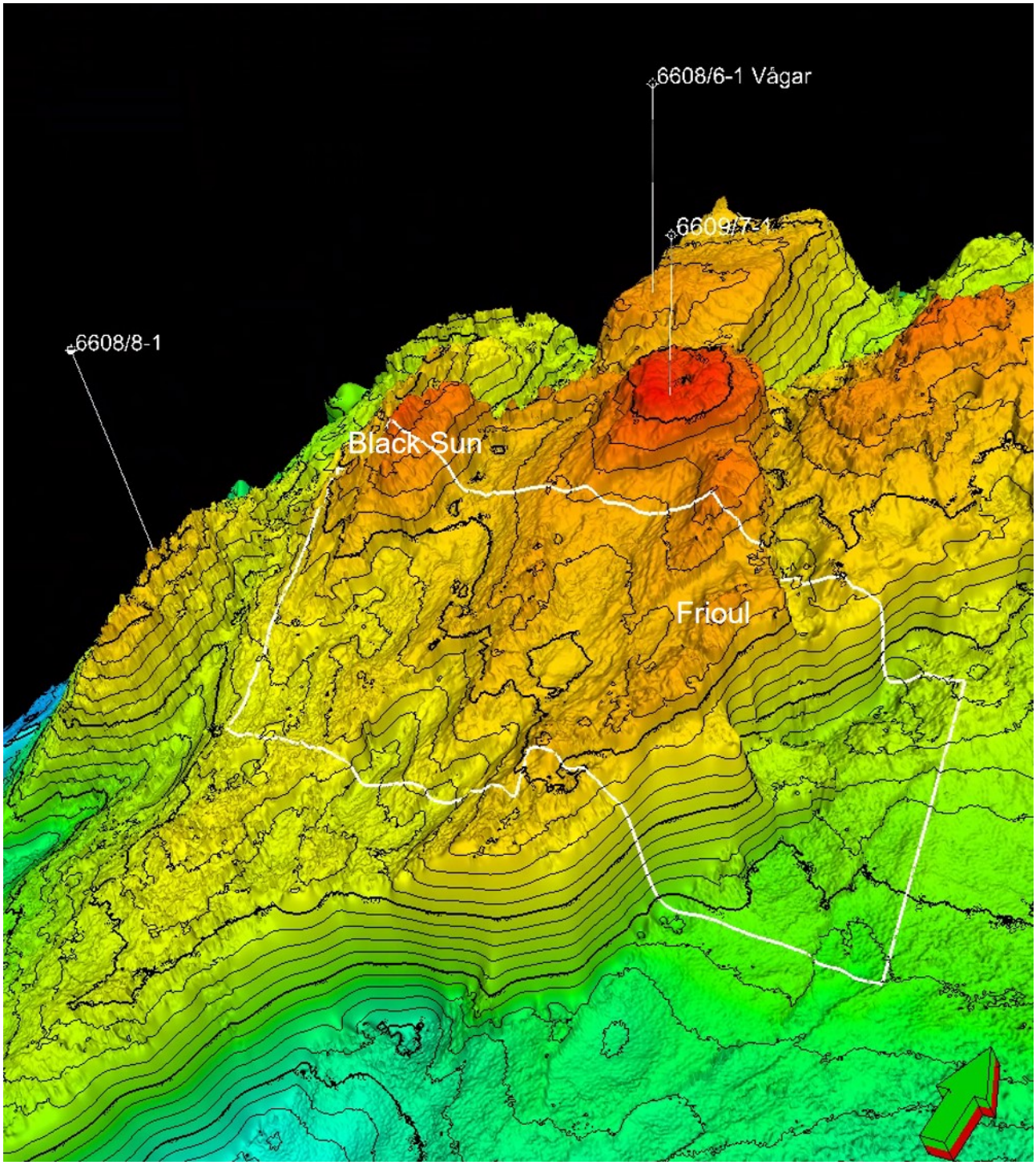

Fig. 1.2 3D view of the Rødøy High *The image shows a Depth map of the Upper Permian Unconformity (UPU) With the position of the undrilled Black Sun and Frioul structures. The white line is a drape of the PL893 License boundaries.*

1.3 Identified Prospectivity

The present status on identified and remaining prospectivity in PL893 is shown in Fig. 1.3.

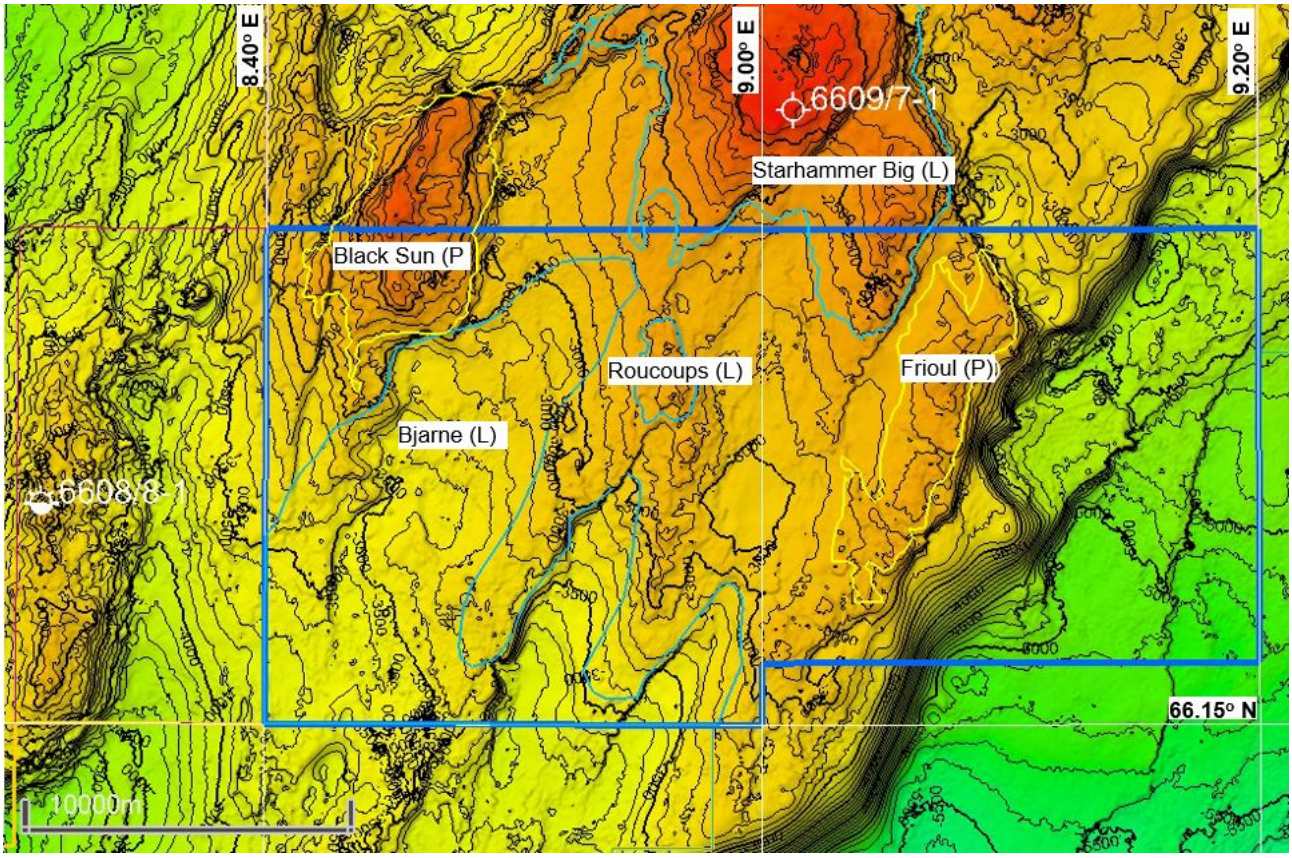

Fig. 1.3 Identified prospectivity PL 893 *The identified, but high risk, Permian Carbonate Play prospects Black Sun and Frioul are shown in yellow outline, whereas the leads Bjarne (Triassic), Starhammer Big (Permian) and Roucoups (Basement) are shown i light blue outline*

The Permian Carbonate Play has received the highest focus in this license and two prospects have been defined, respectively named Black Sun and Frioul. Both prospects are rotated fault blocks with Permian Carbonate reservoir and Triassic top and lateral seal. Black Sun straddles the border to PL 762 and the prospect polygon area is divided roughly 50/50 within each license. The apex of the structure is within PL 762 to the north.

The recently drilled 6608/6-1 Vågar well showed that a broadly similar structure in PL 762 did not have an effective reservoir 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 it showed a 100x decrease in HC content relative to the Cretaceous section. Also, a substantial part of THCG from cuttings and mudgas consisted of CO_2, particularly in the Permian section.

On this background it is assumed that the Permian prospects in PL893 have a very low chance of success, with main risks on reservoir quality and working hydrocarbon system.

The identified Prospects and Leads are described in sections 3.1 Black Sun, 3.2 Frioul and 3.3 Leads.

2 Database

2.1 Seismic Database

The seismic database consists of all relevant public 2D seismic that covers the license area on the Rødøy High. In addition to this the following public 3D surveys are included: EO1003, GNNR 99, NLGS-95, ST01M07 and NNNE 2000.

The license is covered by the PGS16005 survey, and the parts of this dataset that covers the license area of 416.668km2 is also included in the seismic database.

Initially the 3D NO15M02 was included in the database, but this data was taken out of the database together with the GNNR 99, after the inclusion of the PGS 16005 survey.

2.1.1 Seismic reprocessing

The license has not performed any reprocessing.

2.2 Well Data

The common well database is identical to the key wells from the APA 2016 application and is as shown in Fig. 2.1.

Well name	Operator	Year	Result	Field/Discovery	TD		Purpose in application				
					MD m RKB	Fm/Gp	Well tie	Depth conversion	Petrophysics	Geological model	Basin modelling
6507/6-4 A	E.ON Ruhrgas Norge AS	2011	DRY		4957	ROT LEGEND GP	X		X	X	X
6608/8-1	Den norske stats oljeselskap a.s	1997	OIL SHOWS		3013	ZECHSTEIN GP	X	X		X	X
6608/8 2	StatoilHydro ASA	2007	DRY		2831	RED BEDS (INFORMAL)	X	X		X	
6608/10-2	Den norske stats oljeselskap a.s	1991	OIL/GAS	NORNE	3678	ÅRE FM					X
6608/10-3	Den norske stats oljeselskap a.s	1993	OIL/GAS	NORNE	2921	ÅRE FM					X
6608/10-4	Den norske stats oljeselskap a.s	1993	OIL/GAS	NORNE	2800	ÅRE FM					X
6608/10-7	Den norske stats oljeselskap a.s	2001	OIL	URD	2319	ÅRE FM					X
6608/10-12	StatoilHydro ASA	2008	OIL	SKULD	3180	RED BEDS (INFORMAL)	X	X			X
6608/11-7 S	Rocksource ASA	2011	DRY		2435	RED BEDS (INFORMAL)	X	X		X	X
6608/11-6	StatoilHydro ASA	2008	DRY		1850	ÅRE FM	X	X			X
6608/11-5	Statoil ASA (old)	2006	SHOWS		2270	RED BEDS (INFORMAL)	X	X			X
6608/11-4	Statoil ASA (old)	2004	OIL	6608/11-4 LINERLE	2317	RED BEDS (INFORMAL)	X	X		X	X
6608/11-3	Statoil ASA (old)	2002	DRY		2031	GREY BEDS (INFORMAL)	X	X			X
6608/11-2	Den norske stats oljeselskap a.s	2000	OIL	6608/11-2 (Falk)	2215	GREY BEDS (INFORMAL)	X	X			X
6608/11-1	Den norske stats oljeselskap a.s	1986	DRY		1620	GREY BEDS (INFORMAL)					X
6609/5-1	Den norske stats oljeselskap a.s	1984	SHOWS		3600	RED BEDS (INFORMAL)	X	X		X	X
6609/7-1	Phillips Petroleum Company Norway	1983	DRY		1969	BASEMENT	X	X	X	X	X
6609/10-1	Saga Petroleum ASA	1983	DRY		2167	RED BEDS (INFORMAL)	X	X	X	X	X
6609/11 1	Norsk Hydro Produksjon AS	1983	DRY		3068	ÅRE FM	X	X		X	
6610/7-2	Den norske stats oljeselskap a.s	1983	DRY		4215	GREY BEDS (INFORMAL)				X	
6611/9-U-01	SINTEF Petroleum Research	1992			560					X	X
6611/9-U-02	SINTEF Petroleum Research	1992			280					X	X

Fig. 2.1 Common database wells

With relevance for the 6608/8-1 and 6609/7-1 wells, FIT (FIT 2008a and 2008b) and Mudgas reports (Geoprovider 2016a and 2016b) are included in the common database. For the 6507/6-4A & S the Mudgas report (Geoprovider 2016c) is included.

The Cambridge Carbonates report (Garland et al. 2016a & 2016b) focusing on all wells relevant for the Permian Play in the Norwegian Sea is also included in the common database.

2.3 Special Studies

In 2017 a geochemical subsurface leakage study with abundant seabed sampling was performed by ORG (ORG Geophysical 2017a and 2017b) over the larger part of the Rødøy High. The sampling points focused mainly on geochemical and microbial sampling of the seabed 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. It was hoped that this study could help derisk the hydrocarbon system of the Grønøy High and as a best outcome point to specific structures that could have hydrocarbon potential.

Unfortunately, the sampling programme did not identify micro seepage anomalies over specific structures in PL 893 and generally there are more hydrocarbon indicators towards the Træna Basin than towards the Helgeland Basin (e.g. Fig. 2.2).

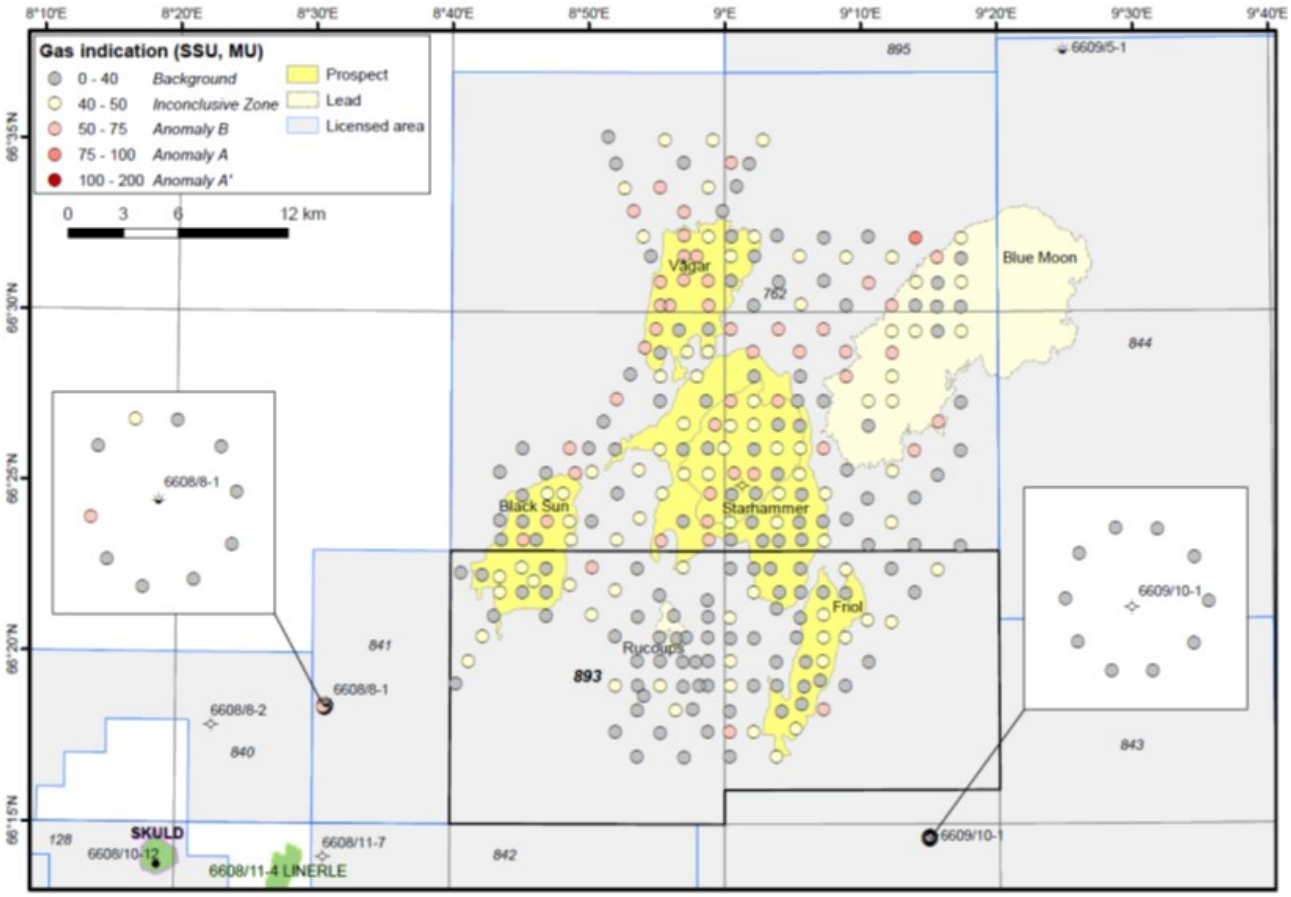

Fig. 2.2 ORG survey Gas indications *Gas indications (SSU samples), Rødøy High. In general, the ORG study indicates å higher density of anomalous samples towards the Træna Basin than towards the Helgeland Basin that is closest to PL 893*

However, the study identified interesting clusters of anomalous samples, but unfortunately outside PL893.

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 Frioul, 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 Roucoups (basement), Starhammer and Starhammer Big (Permian), Bjarne (Triassic) 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 foressable future.

3.1 Black Sun

Black Sun is the largest identified Permian Prospect in the license, but is straddling the border with PL 762 which also has the apex of the structure. Fig. 1.3, Fig. 1.2 & 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.

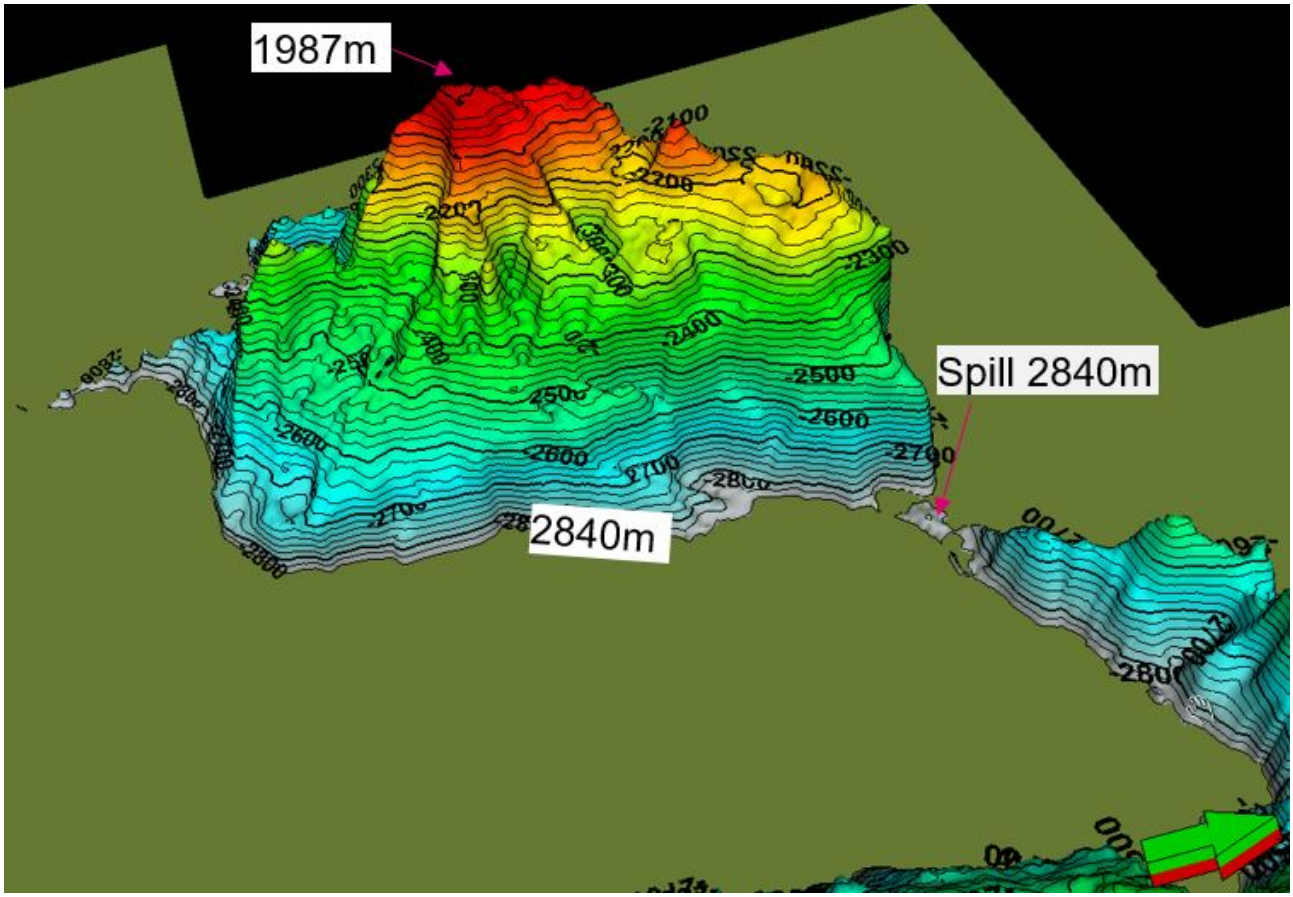

Fig. 3.1 The Black Sun container
The Black Sun structure seen from a vantage point to the East. The apex is at 1987m and spill is at 2840m.

In the previously reported evaluation of Black Sun a very optimistic filling model (filled to spill +/- 10m) was used in the Geox evaluation. This, together with pre-Vågar well optimistic petrophysical parametres, gave large hypothetical 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 way too high because of likely column restrictions. Also, results from the 6608/6-1 Vågar well, indicates a non-working hydrocarbon system for the pre-Cretaceous section, so if filled at all, 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 parametres 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 volume (Table 3.1) gave substantially lower volumes (Table 3.2) than in the old evaluation. P(50) In-place and 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 3% (Table 3.3).

Consequently, Black Sun is presently no longer seen as an attractive target.

Table 3.1 Black Sun revised petrophysical parametres 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 hypothetical volumes

In-place and recoverable volumes	P90	P50	Mean	P10
In-place total volumes (10^6 Sm^3 OE)	2.02	5.49	6.78	13.2
In-place Non Associated Gas (10^9 Sm^3)	1.91	5.18	6.4	12.4
In-place Condensate (10^6 Sm^3)	0.09	0.30	0.39	0.8
Recoverable total volumes (10^6 Sm^3 OE)	0.87	2.42	3.02	5.91
Recoverable Non Associated Gas (10^9 Sm^3)	0.82	2.29	2.87	5.62
Recoverable Condensate (10^6 Sm^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		0.2
Marginal Play probability	0.72	
Conditional segment probability		0.04
Unconditional probability		**0.03**
Dry hole risk		0.97

3.2 Frioul

Frioul is the second largest identified Permian Prospect in the license and it is located on the eastern edge of the Rødøy High, next to the Helgeland Basin. Fig. 1.3, Fig. 1.2& Fig. 3.2.

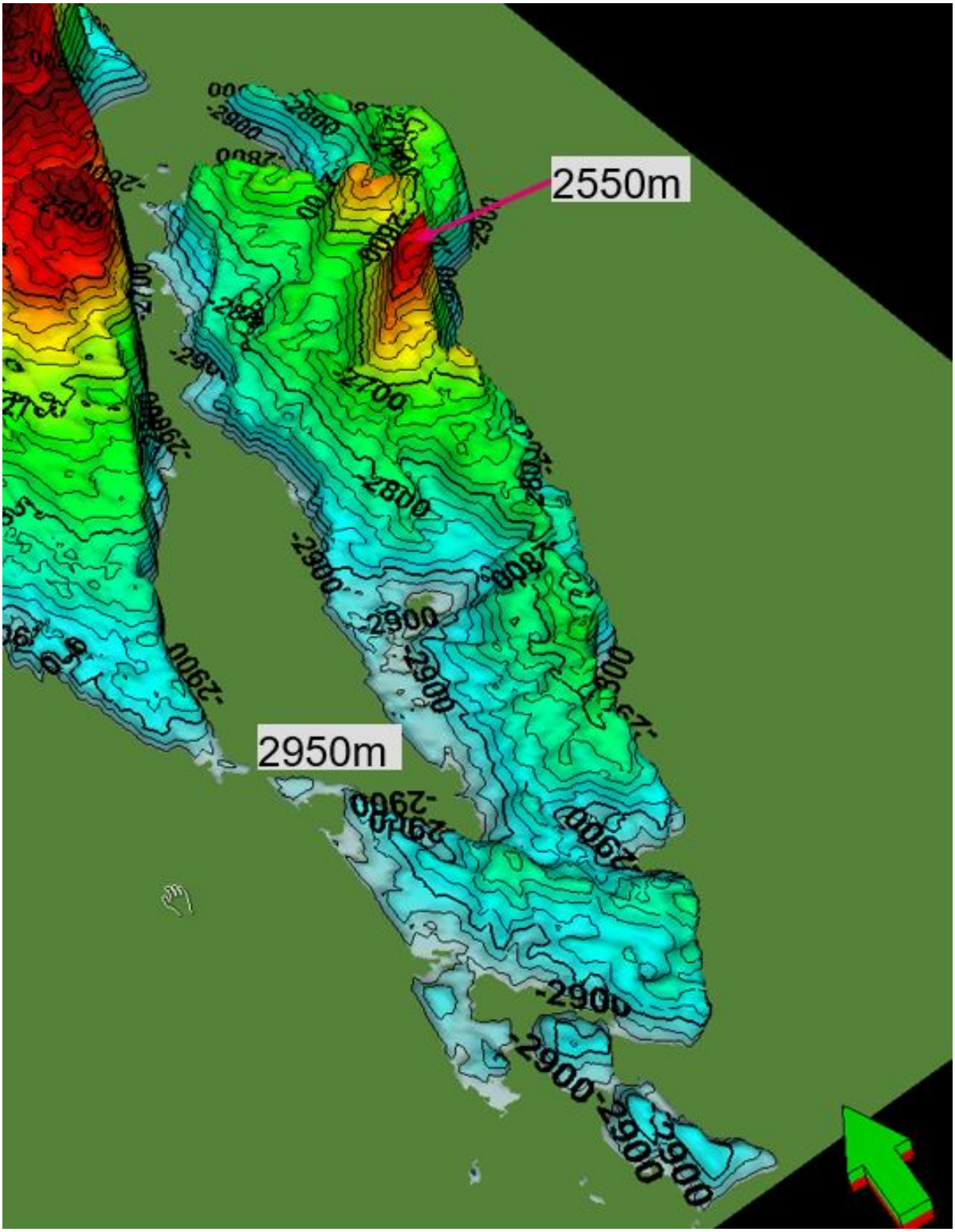

Fig. 3.2 The Frioul container *The figure shows the Frioul structure in depth, as seen from a vantage point to the south. The apex is at a depth of 2550m and the spill contour is at 2950m.*

In the previously reported evaluation of Frioul a very optimistic filling model (filled to spill +/- 10m) was used in the Geox evaluation. This, together with pre-Vågar well optimistic petrophysical parametres, gave large hypothetical in-place and recoverable P(50) total volumes, respectively 19.9 and 7.9 (10^6Sm^3 OE).

Since the apex of Frioul is at a depth of 2550 m and the spill contour at 2950m the old filling model would imply a hc column of 400m. Since Frioul sits next to the Helgeland Basin, which is not proven as a prolific hydrocarbon generating basin, underfilling is seen as a far more likely scenario than a filled to spill model, and GWC's have been changed accordingly to a more distributed spread in the rock volume.

Following results from the 6608/6-1 Vågar well, petrophysical parametres such as N/G and Porosity were assigned new values (Table 3.4). Geox simulations with the more realistic filling model mentioned above (Table 3.4) gave substantially lower volumes (Table 3.5) than in the old evaluation. P(50) In-place and recoverable total volumes are now considered to be, respectively, 1.06 and 0.47 (10^6Sm^3 OE).

Additionally, Friouls risking was revised after results came in for the 6608/6-1 Vågar well. In the old evaluation, Frioul was estimated to have a COS of 11%. Following harder risking of factors like reservoir quality, seal presence and migration/timing Frioul's COS is now estimated at only 4% (Table 3.6).

Consequently, Frioul is presently no longer seen as an attractive target.

Table 3.4 Frioul revised petrophysical parametres 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	2683	2817	2950

Table 3.5 Frioul revised hypothetical volumes

In-place and recoverable volumes	P90	P50	Mean	P10
In-place total volumes (10^6 Sm^3 OE)	0.30	1.06	1.43	3.03
In-place Non Associated Gas (10^9 Sm^3)	0.28	1.0	1.35	2.87
In-place Condensate (10^6 Sm^3)	0.01	0.05	0.08	0.18
Recoverable total volumes (10^6 Sm^3 OE)	0.13	0.47	0.64	1.36
Recoverable Non Associated Gas (10^9 Sm^3)	0.12	0.44	0.61	1.3
Recoverable Condensate (10^6 Sm^3)	0.0	0.02	0.03	0.07

Table 3.6 Frioul revised risk

Risk factor	P(Play)	P(segment)
Reservoir	1.0	
Trap	0.8	
Source	0.9	
Reservoir presence		0.9
Reservoir quality		0.4
Seal presence		0.7
Trap geometry		1.0
Source presence		1.0
Migration and timing		0.2
Marginal Play probability	0.72	
Conditional segment probability		0.0504
Unconditional probability		**0.04**
Dry hole risk		0.96

3.3 Leads

The identified leads Fig. 1.3 in the license are:

- Roucoups (Basement)
- Starhammer Big (Permian)
- Bjarne (Triassic)

With regards to the listed high risk prospect possibilities, it is considered that the Roucoups basement lead has a very high risk on reservoir quality, and that charge could also be a major problem. Additionally, the Roucoups lead polygon is only 4.2km^2, meaning that this can be classified as an unattractive high risk, low reward opportunity.

Starhammer Big shares the same risks on reservoir and hydrocarbon system as the other Permian possibilities described in 3.1 Black Sun and 3.2 Frioul.

The Starhammer structure has already been drilled by Phillips with the 6609/7-1 well (Phillips 1983) and elevated mud gas readings in connection with this well led one partner in the original partnership to speculate that Starhammer could be classified as a missed discovery. Aker BP believes that the high mud gas readings was caused by some remaing trapped gas in the seismically distinct escape vent positioned above Starhammer's apex area. However, one cannot exclude that some gas has been trapped in the smaller downfaulted blocks flanking Starhammer, such as the one extending into PL 893 (and named Maire by the original partnership in neighbouring PL 762). Being downfaulted, this segment carries a very high trap risk, and a modest volume potential.

The reservoir for the Triassic Bjarne lead would be erosional products from the apex areas of the many carbonate capped rotated fault blocks, with minor contribution from eroded basement (e.g. Roucoups). The erosional products would be onlapping the UPU in the back basins of the larger Rødøy High Fig. 1.3. The Bjarne lead is considered high risk because of stratigraphic closure updip and assumed difficulties in charging the reservoir. Reservoir quality may also be an issue.

4 Conclusion

Following results from the 6608/6-1 Vågar well that was drilled summer 2019 the prospectivity of the Rødøy High was downgraded. The 6608/6-1 well showed that there is a very high risk on efficient reservoir for the Permian structures on the Rødøy High. Also, the well showed that the Træna Basin/Rødøy High hydrocarbon system does not work for the Permian Play.

Consequently, the Black Sun and Frioul Permian structures have been risked to, respectively, COS 3% and 4%.

Possible prospectivity in other plays has been identified as leads, such as: Roucoups (basement), Starhammer Big (Permian) and Bjarne (Triassic). The exploration risk is considered to be higher for the leads than for Black Sun and Frioul structures, as there are severe issues regarding reservoir quality, charge/migration and trap for the leads in question.

5 References

FIT 2008a: A stratigraphic Reconstruction of Bulk Volatile Chemistry from Fluid Inclusions in 6608/8-1. 130pp.

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