



PL 943 Licence status report

2023-020322

Table of contents

1	History of the production licence.....	3
2	Database.....	4
2.1	Seismic data.....	4
2.2	Well data.....	5
3	Results of geological and geophysical studies.....	6
3.1	6607/12-5 Uer post well studies.....	6
3.2	Seismic reprocessing and conditioning.....	6
3.3	Structural studies.....	7
3.4	AVO inversion and 2D forward modelling.....	8
3.5	Velocity model and depth conversion.....	9
4	Prospect update report.....	10
4.1	Uer.....	11
4.2	Remaining prospectivity.....	11
5	Technical assessment.....	13
6	Conclusions.....	13

1 History of the production licence

Licence: 943

Awarded: 02.03.2018

Licence period: 7 years

Licence group:

Equinor Energy AS	30% (Operator)
DNO Norge AS	30%
Aker BP ASA	20%
Sval Energi AS	20%

Licence area: 781 km²

Work programme: Reprocess 3D seismic – 02.03.2020 (Completed)
 Decision to drill exploration well – 02.03.2021 (Completed)
 Decision to concretize – 02.09.2023

Extension of DoD 02.03.2020-02.03.2021, to evaluate reprocessed seismic
 Extension of BoK 02.03.2023-02.09.2023, to finalise post well studies from 6607/12-5

Meetings held:

09.04.2018	EC/MC meeting	15.06.2021	EC work meeting
23.05.2018	EC work meeting	29.09.2021	EC work meeting
03.12.2018	EC/MC meeting	01.10.2021	EC work meeting
20.06.2019	EC work meeting	29.10.2021	EC/MC meeting
21.08.2019	EC work meeting	17.01.2022	EC work meeting
28.11.2019	EC/MC meeting	24.05.2022	EC meeting
30.06.2020	EC meeting	17.06.2022	EC meeting
29.09.2020	EC work meeting	07.12.2022	EC/MC meeting
30.11.2020	EC/MC meeting	13.03.2023	EC work meeting
23.03.2021	EC work meeting	16.06.2023	EC work meeting

Work performed:

2018: Seismic reprocessing (EQ19M01), Framework interpretation, prospect evaluation
 2019: Seismic reprocessing (EQ19M01), prospect evaluation
 2020: Prospect evaluation
 2021: Well planning 6607/12-5
 2022: Well planning 6607/12-5, Exploration drilling 6607/12-5, post well studies 6607/12-5
 2023: Post well studies 6607/12-5, prospect evaluation

Reason for lapse: Following the dry 6607/12-5 Uer exploration well, Equinor and the PL 943 partners have not been able to identify an attractive drilling candidate in the licence. The decision to take a negative BOK decision was unanimous.

2 Database

2.1 Seismic data

The common seismic database in the licence consists of parts of the EQ19M01 3D seismic dataset which is a reprocessing of several underlying surveys (Table 2.1, figure 2.1). The data quality is generally good with a few exceptions in parts covered by the underlying DTW2000 survey (figure 2.1) which was acquired with shorter cable length compared to the other two underlying surveys. This is most noticeably observed towards the Rås Basin in the western part of the licence. EQ19M01 has been the main dataset applied for prospect evaluation and AVO studies.

3D seismic database (name, area, NPDID)

EQ19M01	2153 km ²	n/a
PSG16005	682 km ²	8321
MC3D - HVG2012	1094 km ²	7616
DTW2000	383 km ²	4034

Table 2.1 3D seismic database.

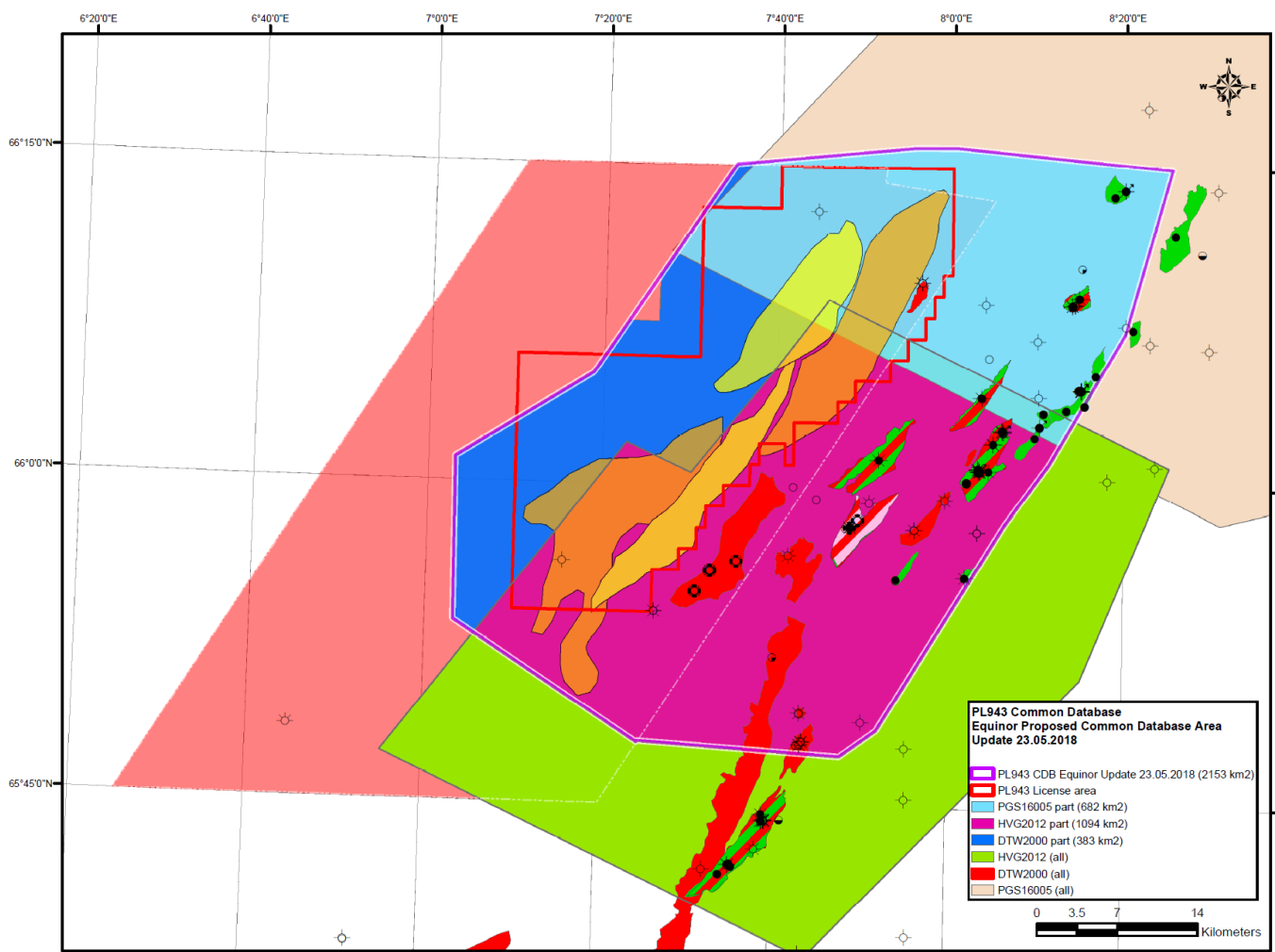


Figure 2.1 3D seismic database.

2.2 Well data

The common well database comprises data from wells listed in table 2.2. The list include well name, NPDID number, results, reservoir with encountered hydrocarbons (HC) and formation at TD.

Well	NPDID	Results	Reservoir with HC	Formation at TD
6506/3-1	4344	Dry	-	Lange Fm.
6506/6-1	4122	Gas	Fangst and Båt Gp.	Åre Fm.
6506/6-2	6960	Dry	-	Lange Fm.
6506/12-12 S	6144	Oil/Gas	Lange Fm. Fangst and Båt Gp.	Åre Fm.
6507/1-1	4955	Dry	-	Lange Fm.
6507/2-1	911	Shows	Lysing, Lange Fms, Fangst and Båt Gps.	Åre Fm.
6507/2-2	1840	Gas/Cond	Lysing and Lange Fms.	Åre Fm.
6507/2-3	2299	Shows	-	Spekk Fm.
6507/2-4	5685	Gas/Cond	Lysing Fm.	Lyr Fm.
6507/3-9 S	6951	Gas	Lysing Fm.	Lange Fm.
6507/3-5 S	5307	Gas/Cond	Ile Fm. Båt Gp.	Åre Fm.
6507/4-1	9110	Gas	Lange Fm.	Lyr Fm.
6507/5-1	3683	Oil/Gas/Cond	Lange Fm. Fangst and Båt Gp.	Åre Fm.
6507/5-3	4059	Gas	Lysing Fm.	Lange Fm.
6507/5-4	4209	Oil/Gas	Lange Fm. Garn Fm.	Åre Fm.
6507/5-6 S	6321	Gas	Lysing Fm.	Lange Fm.
6507/6-2	1520	Shows	-	Åre Fm.
6507/7-1	138	Shows	-	Tilje Fm.
6507/7-14 S	6367	Gas	Fangst Gp.	Tilje Fm.
6507/7-15 S	6730	Gas	Fangst Gp. Tilje Fm	Tilje Fm.
6607/12-1	925	Dry	-	Shetland Gp.
6607/12-2 S	6642	Oil/Gas	Lange Fm, Fangst and Båt Gp.	Åre Fm.
6607/12-3	7039	Gas	Lange, Ile and Åre Fm.	Åre Fm.
6608/8-2	2989	Dry	-	Red Beds
6608/10-12	5949	Oil	Lysing and Åre Fms.	Red Beds
6608/10-1	1391	Dry	-	Åre Fm.
6608/10-16	7404	Shows	-	Åre Fm.
6608/10-5	2578	Dry	-	Åre Fm.

Table 2.2 Well database.

3 Results of geological and geophysical studies

The following geological and geophysical studies were performed in the licence period:

- 6607/12-5 Uer post-well studies
- Seismic reprocessing and conditioning
- Structural restoration
- AVO inversion and 2D forward modelling
- Velocity modelling and depth conversion

3.1 6607/12-5 Uer post well studies

A range of studies were initiated following the completion of 6607/12-5 to resolve the properties of the reservoir and presence of fluids, which included biostratigraphy, mineralogy, geochemistry, geophysics, core analysis and PVT studies. A summary of key findings is included in this report. Post-well biostratigraphy confirmed that the cored sections contained sandstones in the Cretaceous Lysing Fm. (Early Coniacian). Some re-working was observed. Robust evidence for the Lange Fm. (Late Turonian) was also observed in the lowermost part of the cored interval, below base reservoir.

A total of three cores were acquired in the Lysing Fm. which is characterized by interbedded, dominantly fine- to medium-grained soft-sediment deformed and loaded sandstones. Water escape and soft-sediment load structures are commonly observed. The depositional environment is classified as deepwater lobe and channel complexes. The reservoir deposits in the cored section shows good examples of stacked prograding lobe and channel complexes and can be assumed to be representative for the area.

Petrographic analysis shows that the Lysing Fm. comprise quartz rich sandstones with variable volume of clay material. Some mica, plagioclase, glauconite, expanded micas and heavy minerals are also observed. The main diagenetic cements include quartz, kaolin, calcite/dolomite, siderite and pyrite. Quartz cement is regarded as the most important cement phase, which is regarded as in accordance with the burial temperature history. Overall, the reservoir quality is described as poor.

Post-well LFP and geophysical studies conclude that the observed soft seismic response on far offset angles is mainly a lithology effect (sands becoming increasingly soft with burial). Based on 2D forward modelling incorporating post-well analysis a gas (HC) filled sandstone should brighten even more than the observed seismic response.

3.2 Seismic reprocessing and conditioning

The EQ19M01 dataset covers 5051 km² in the Dønna Terrace area of the Norwegian Sea by combining the vintage HVG2012, DTW2000 and PGS16005 surveys (figure 2.1). The reprocessing was coordinated by Equinor, with multiple licences participating. The processing was performed by PGS. PL 943 included 2153 km² of the EQ19M01 survey in the licence common database.

Where previous processing efforts have been focused mainly on the Jurassic interval the main objective of the EQ19M01 reprocessing was to generate a dataset with consistent, high-quality imaging of the Cretaceous interval. The processing sequence was based on the same sequence used in the PGS16005 survey, with modifications to deghosting, denoise, demultiple and migration parameters.

3.3 Structural studies

The main prospect evaluated during the PL 943 licence period was the Cretaceous Uer prospect. The prospect is defined by a distinct amplitude anomaly observed on far offset angle stack and AVO inversion data. Structurally, the Uer prospect is located within the Ytreholmen Fault Complex (YFC) as a down-faulted, isolated, lens between the Dønna Terrace (east) and the Rås Basin (west). Due to the nature of the structural setting, confident stratigraphic tie from nearby offset wells was challenging. Significant growth is observed in Cretaceous stratigraphy across the YFC from the Dønna Terrace to the Rås Basin, attributing additional uncertainty to fault throws within the YFC. Lastly, the area underwent inversion in Paleocene with associated fault reactivation, further adding complexity to the structural interpretation.

During the licence period alternative seismic ties to the Uer prospect were discussed with reservoir in either Lysing (Coniacian) or Intra Lange (Cenomanian) formations. Structural restoration across the YFC was performed to de-risk the reservoir model (figure 3.1). Three distinct episodes of deformation was highlighted relative to select seismic marker horizons in the Aptian-Maastrichtian succession: (i) one episode of relative low fault displacement (extension) pre-Coniacian, (ii) one episode of deformation with significant displacement (extension) post-Coniacian and (iii) fault re-activation and inversion (compression) post-Maastrichtian.

With basis in the structural restoration work and detailed fault interpretation, the most likely seismic tie to the Uer prospect was the Lysing Fm. (figure 3.2) prior drilling of the 6607/12-5 well; and this theory was confirmed by the results of the post-well studies.

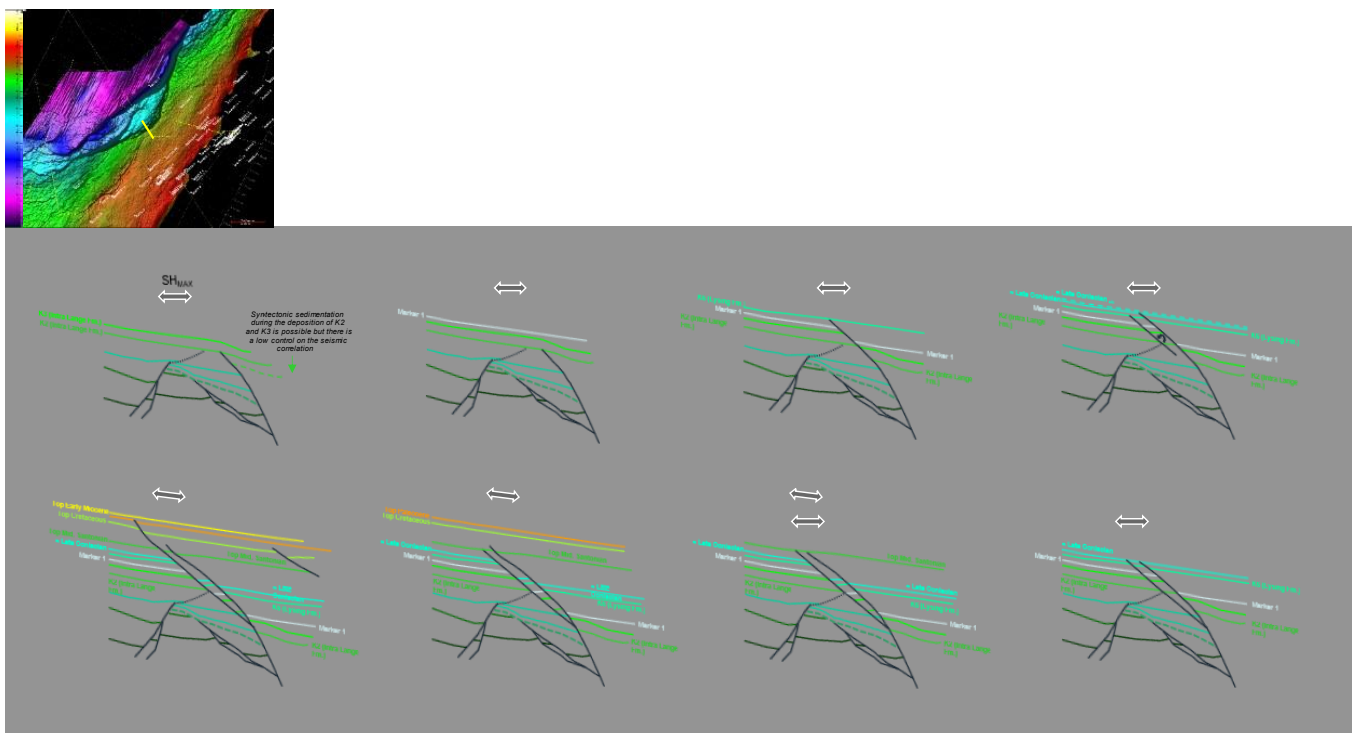


Figure 3.1 Structural restoration along the Ytreholmen Fault Complex with emphasis on Cretaceous stratigraphy.

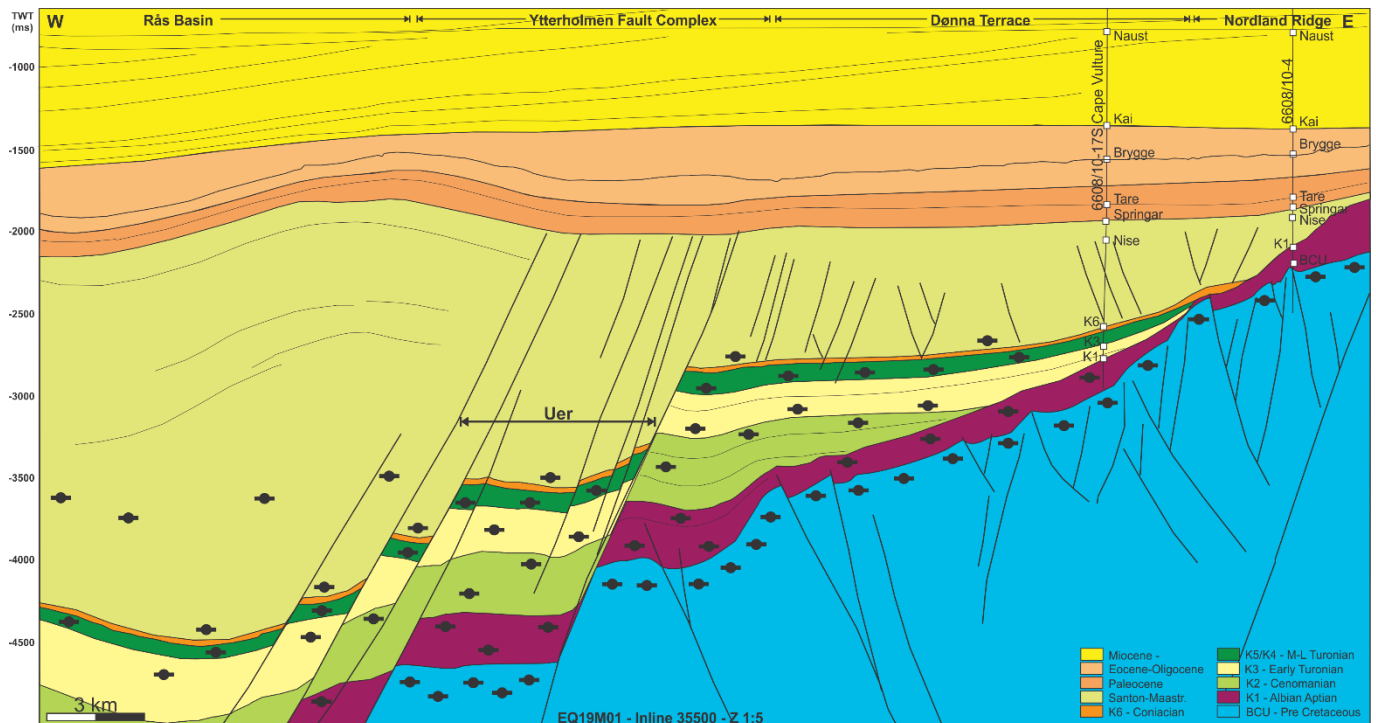


Figure 3.2 Geoseismic section from the Dønna Terrace (east) to the Rås Basin (west) across the Ytterholmen Fault Complex. The Location and structural setting of the Uer prospect is indicated.

3.4 AVO inversion and 2D forward modelling

Two main geophysical studies were conducted in the PL 943 licence period to (i) evaluate the geophysical expression of the Uer prospect to de-risk the presence of reservoir and fluid phase using offset data and AVO inversion; and (ii) investigate and de-risk the probability for presence of Intra Lange Fm. sandstones on the Dønna Terrace (Flagstone lead, Figure 4.1), juxtaposed to the Uer prospect in the East and implied additional risk on fault seal.

The geophysical evaluation of the Uer prospect concluded with support for presence of reservoir sandstone as indicated from AVO lithology attributes (V_p/V_s). Furthermore, AVO cross plotting showed that the observed amplitudes deviated from the recorded background trends (shale-shale), which could indicate presence of hydrocarbons, low or high saturation. Comparison with relevant offset wells, in particular 6507/1-1 and 6507/2-3, and modelling also gave insight into tuning effects on the reservoir amplitude expression and effect of burial.

2D forward modelling was applied to evaluate the presence of Intra Lange Fm. sandstones (AVO Class III) on the Dønna Terrace in immediate vicinity to the Uer prospect. A 2D model was built using V_p , V_p/V_s and Density to create synthetic angle stacks using angle dependent wavelets estimated from the EQ19M01 data. The modelled data was then subjected to the same AVO processing as the real data. The resulting comparison showed that the seismic modelling was able to reproduce the observed seismic event and AVO class III behavior as a pure intra shale reflection, which decreased the seal risk for the Uer prospect and stopped further evaluation of the Flagstone lead.

3.5 Velocity model and depth conversion

A study with focus on velocity model QC and depth conversion was initiated as part of the well planning of 6607/12-5. The well was targeting previously untested Cretaceous stratigraphy within the Ytreholmen Fault Complex, down-faulted from the Dønna Terrace. Due to the frontier nature of the drilling target, lack of relevant offset data in a similar structural/basin setting and pick uncertainty in the Upper Cretaceous interval, there was a high focus on depth conversion and geological prognosis in the well planning process.

A new velocity model was built for the geological prognosis in 6607/12-5 with special emphasis on depth conversion of Top Springar and Top Lysing (top reservoir). This model applied interval velocities between key formation tops as illustrated in figure 3.3.

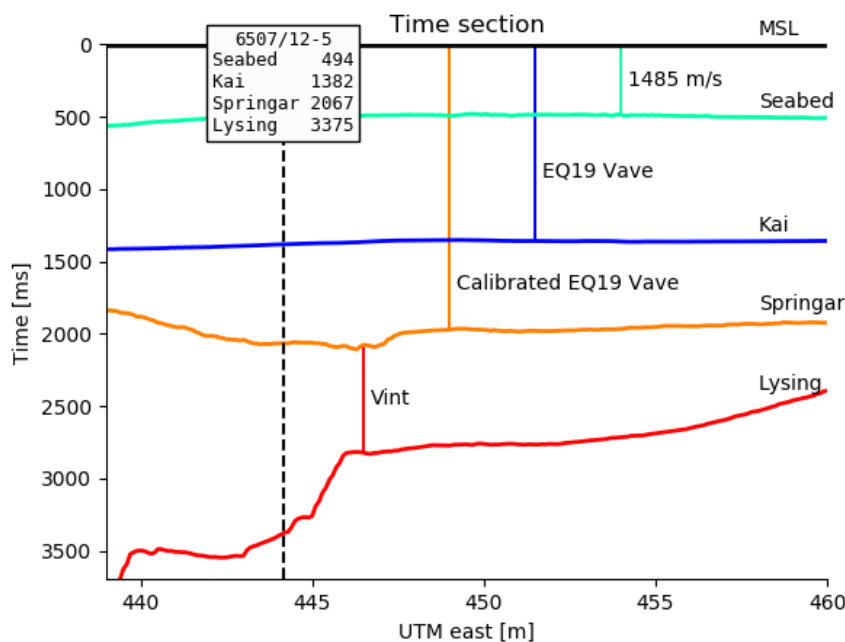


Figure 3.3 6607/12-5 Velocity model summary.

4 Prospect update report

The prospectivity in PL 943 is tied to the Cretaceous Lysing and Lange formations as both structural and stratigraphic traps on the Dønna Terrace and within the Ytreholmen Fault Complex. The evaluation of remaining prospectivity in the licence has integrated the results from the 6607/12-5 post-well studies. A summary of volume and risk from the application for award is given in table 4.1.

Discovery/ Prospect/Lead name	D/ P/ L	Case (Oil/ Gas/Oil &Gas)	Unrisked recoverable resources						Probability of discovery (0.00 - 1.00)	Reservoir	
			Oil [10^6Sm^3]			Gas [10^9Sm^3]				Litho-/ Chrono- stratigraphic level	Reservoir depth [m MLS]
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)			
Uer (Sunstone)	P	Gas	0.31	3.31	14.93	0.80	8.45	37.20	0.35	Lange Fm/Cretaceous	4100
Dalmatian (Firestone)	P	Gas	0.40	2.35	10.08	1.05	6.02	25.11	0.23	Lange Fm/Cretaceous	3650
Flagstone	L	Gas								Lange Fm/Cretaceous	3440
Capstone	L	Gas								Lange Fm/Cretaceous	2980

Table 4.1 Summary of volume and risk from the application for award. Prospect names used in the application for award is written in parenthesis.

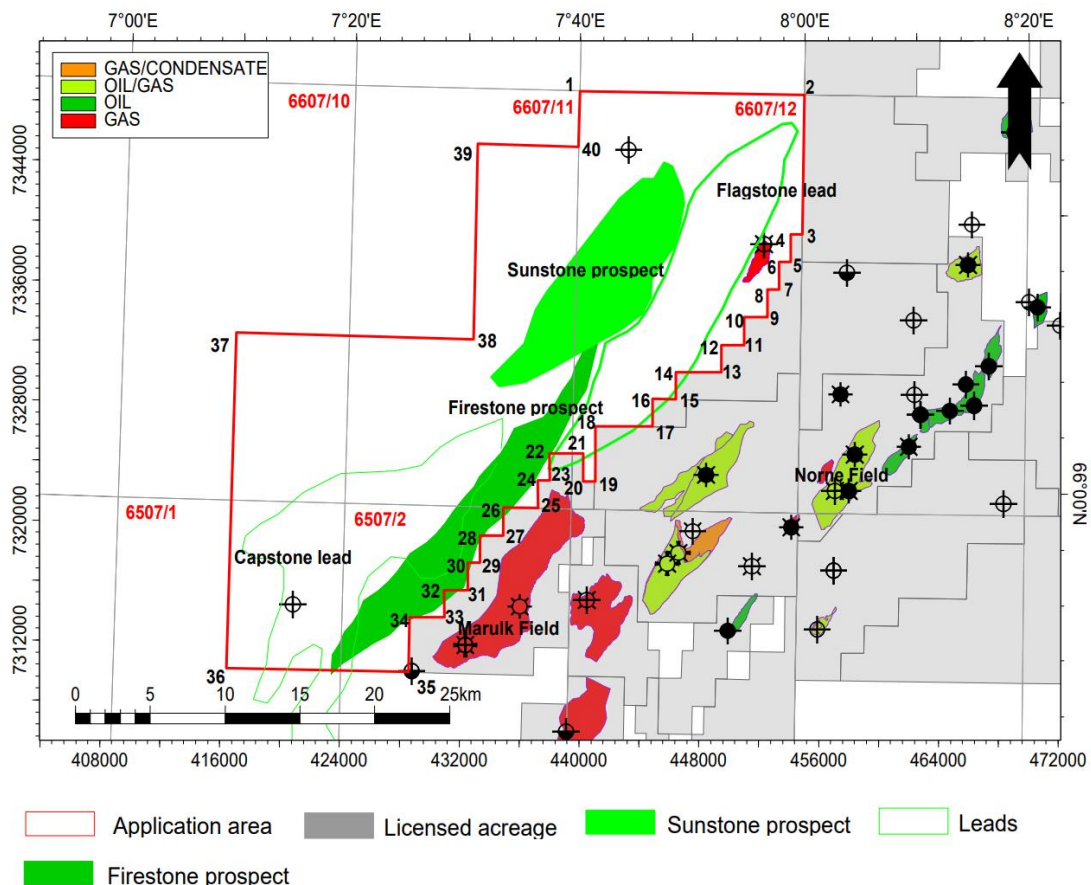


Figure 4.1 Overview map with area applied for and the main prospects and leads at time of application for award.

4.1 Uer

The Cretaceous Uer (Sunstone) prospect was the main prospect applied for and evaluated in the licence period (figure 4.1). In accordance with the licence work programme, a drill decision was taken. Well 6607/12-5 encountered water wet sandstone reservoir in the Lysing Fm. (Coniacian). Most of the measured reservoir parameters were found to be on the low-end of the pre-drill prognosis.

The well was intentionally drilled shallow on the Uer structure (figure 4.2) to avoid leaving economically interesting volumes up-dip of the well location. Following the completion of 6607/12-5 the remaining potential in the Uer structure has been evaluated, incorporating results from post-well studies. The area up-dip of 6607/12-5 is c. 2.8 km² with low probability of discovery, aligned with post well geophysical evaluations. As a result, the remaining potential up-dip of 6607/12-5 carries insignificant volume potential and very low probability of discovery.

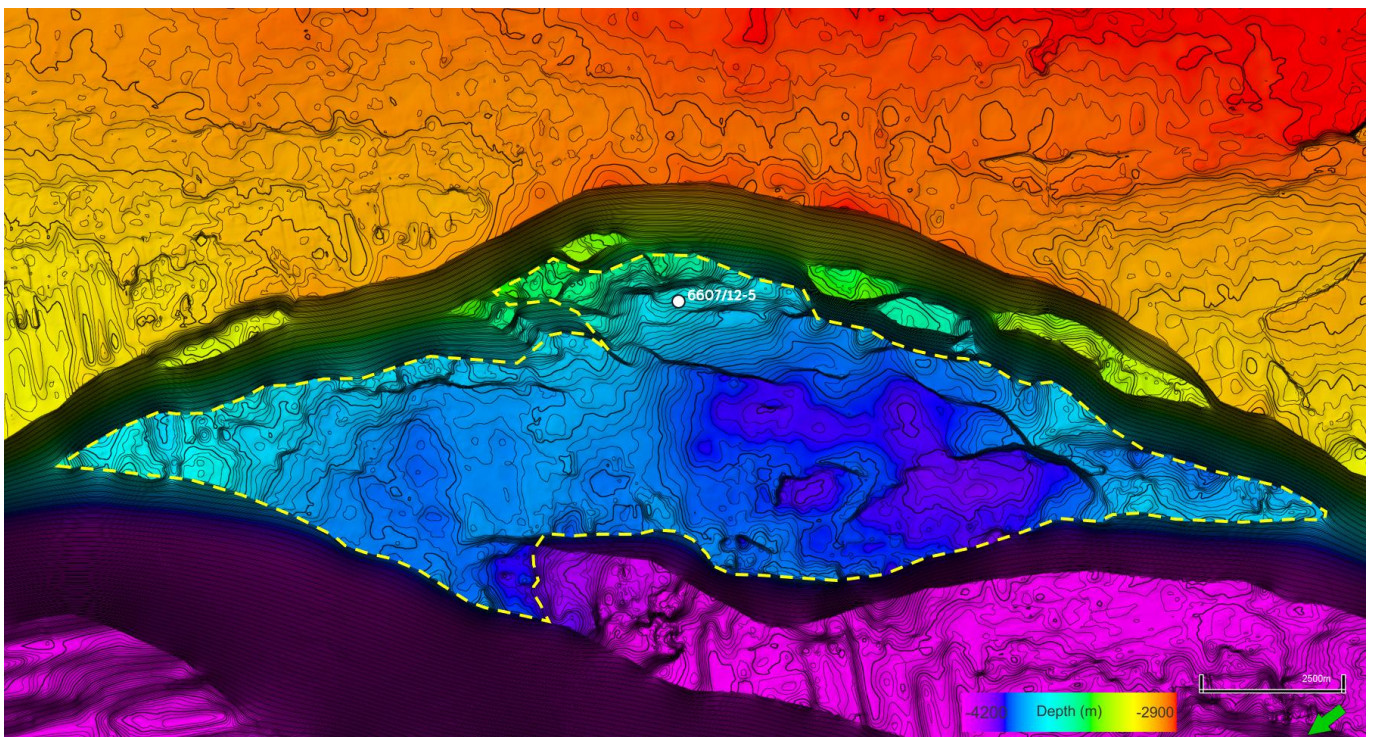


Figure 4.2 Top Lysing Fm. depth map showing the outline of the Uer prospect (yellow).

4.2 Remaining prospectivity

The Dalmatian prospect is located circa 5 km west from the Marulk field. The reservoir is tied to the Lange (Albian) Fm. The prospect was re-evaluated in the licence period following the Warka discovery, which proved producible reservoir at significant burial depth. Summary of volume and risk is given in Figure 4.2.

Trap:

The Dalmatian trap is mapped as a combined structural stratigraphic trap with both fault seal and pinch-out component. Alternative prospect models have been considered, defining the prospect container using isochore or AVO lithology attributes. The prospect outline (Figure 4.3) is a sweet-spot definition, excluding lower N/G zones from the resource calculations. Top and base seal constitutes of Lange Fm shales. The prospect is fault bounded towards the East and the North; this is defined as the critical trap element as fault throw progressively decrease northwards along-strike.

Juxtaposition of the Dalmatian reservoir towards Lange Fm. reservoir sandstones on the upper Dønna Terrace can compromise the trap integrity in Dalmatian.

Discovery/ Prospect/Lead name	D/ P/ L	Case (Oil/ Gas/Oil &Gas)	Unrisked recoverable resources						Probability of discovery (0.00 - 1.00)	Reservoir	
			Oil [10^6Sm^3]			Gas [10^9Sm^3]				Litho-/ Chrono- stratigraphic level	Reservoir depth [m MLS]
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)			
Dalmatian	P	Gas	0.17	0.80	1.60	1.19	4.79	8.35	0.20	Lange Fm/Cretaceous	4100

Table 4.2 Summary of volume and risk for remaining prospectivity.

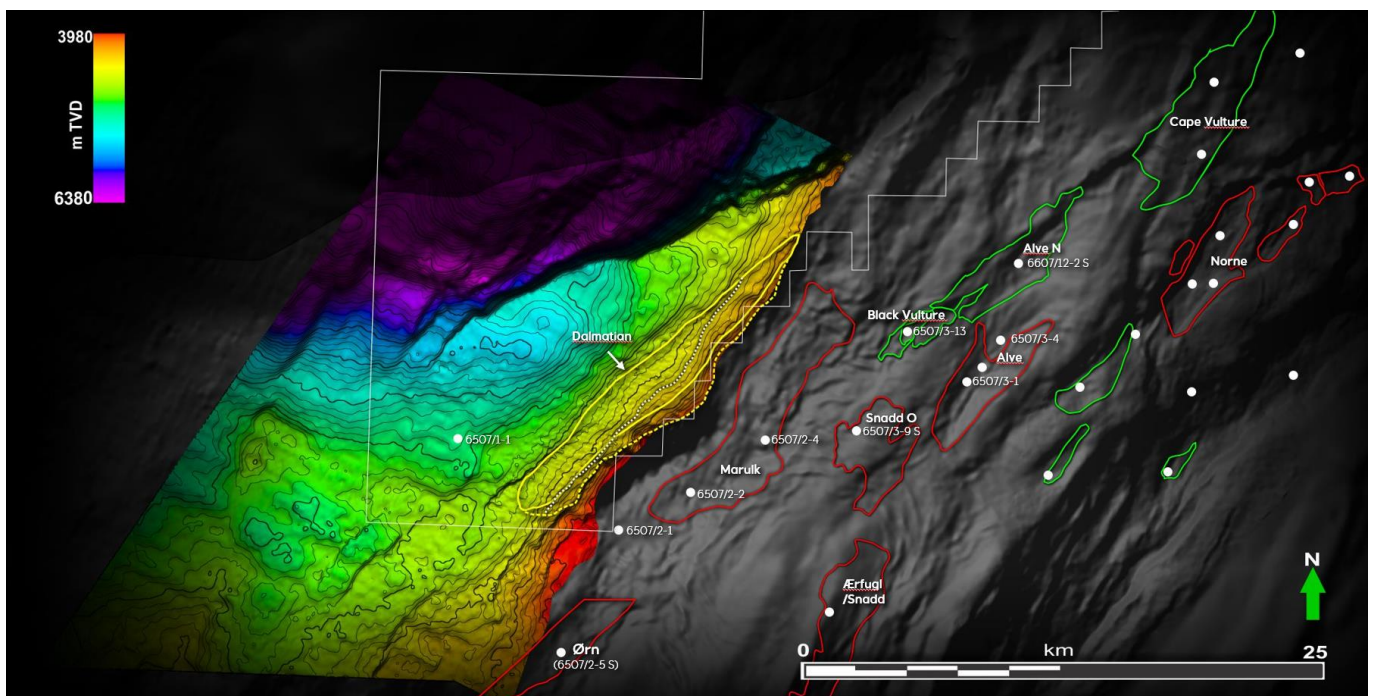


Figure 4.3 Top Intra Lange Fm. depth map showing the outline of the Dalmatian prospect (yellow).

Reservoir:

The reservoir in the Dalmatian prospect is assumed to be comprised of deep marine, channelized, turbidite deposits tied to the Lange Fm. (Albian). The reservoir apex is mapped to 4100 m TVD MSL, attributing a significant risk to producibility. A range of offset wells have been evaluated with focus on reservoir parameters, however special emphasis was put on 6507/4-1 Warka as a key analogue for the Lower Lange Fm. sandstone reservoir in Dalmatian.

Migration:

Multiple source rocks and migration scenarios have been considered for the Dalmatian prospect. The base-case scenario applied in the evaluation considers the Jurassic Spekk Fm. and lower Cretaceous Lyr/Lange Fm as potential source rocks. Within the modelled fetch area, gas is considered the most likely fluid phase with associated kitchen areas currently in gas- to post-mature window.

Seismic and AVO:

Offset seismic stacks, AVO, fluid replacement modelling and 2D seismic modelling were applied in the evaluation of the Dalmatian prospect to investigate reservoir presence, facies variations, properties, and fluid phase. The AVO evaluation support presence of reservoir, which is clearly visible on shear-impedance in line with the expected and modelled response for quartz rich sandstone deposits. Lateral and vertical facies variations are expected.

5 Technical assessment

Full technical assessment was performed prior to the drill decision on the Uer prospect, including alternative development scenarios based on expected volumes.

Technical assessment has also been performed for the Dalmatian prospect, with special emphasis on reservoir properties and drainage strategies. Marginal reservoir properties are expected with production rates significantly constrained by low permeability. Mitigating actions evaluated to compensate for low permeability include highly deviated to horizontal producers to increase production rates. High pressure and high temperature (HPHT) conditions are expected.

6 Conclusions

The well 6607/12-5 tested the best opportunity (Uer) identified in PL 943. The well was dry. The licence partnership has not been able to identify another attractive drilling candidate in the licence, and therefore, unanimously decided to drop the licence.