

PL945

Surrendering Report

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1 KEY LICENSE HISTORY

Production License (PL) 945, is located in the Vøring Basin, Norwegian Sea and comprise parts of blocks 6605/6, 6605/9, 6606/4, 6606/5, 6606/7 and 6606/8 (Figure 1.1). The license was awarded on March 2nd, 2018, as a part of the Awards in Predefined Areas (APA) 2017. The Drill-or-Drop (DoD) decision deadline was by March 2nd, 2020.

The license partnership consisted of OMV (Norge) AS (Operator) and Equinor Energy AS. The license interest between the companies was as follows:

- ▶ OMV (Norge) AS - 60%
- ▶ Equinor Energy AS - 40%

The initial work programme to evaluate the license was as follows:

- ▶ Phase 1 - Within two years (by March 2nd 2020) re-process 3D seismic data and make drill or drop decision.
- ▶ Phase 2 - Within four years (by March 2nd 2022) drill one exploration well & decide to Concretize (BoK) or drop.

The work programme for the initial phase of the license was fulfilled by the merge and reprocessing of the Vøring Basin Tile 1 (VBT-1) and NH0202 3D seismic surveys and performing prospectivity evaluation studies. The approximately 1444 km² final reprocessed PSDM 3D seismic survey, OMV19M02, covers the observed license prospectivity and the two Stetind wells (6605/8-1 and 6605/8-2). The reprocessing was specifically focusing on improving the structural definition, fault imaging and at the same time preserving the amplitude content.

During the life cycle of PL945 a number of meetings were held between the licensees. A list of these meetings are provided below:

- ▶ 06.04.2018 - EC/MC meeting
- ▶ 09.05.2018 - EC work meeting
- ▶ 03.10.2018 - EC work meeting
- ▶ 08.11.2018 - EC/MC meeting
- ▶ 15.02.2019 - EC work meeting
- ▶ 28.02.2019 - EC work meeting
- ▶ 22.05.2019 - EC work meeting
- ▶ 01.10.2019 - EC work meeting
- ▶ 27.11.2019 - EC/MC meeting

The initial phase of the work programme was completed by creating a high quality 3D seismic survey through reprocessing and merge of the VBT-1 and NH0202 3D seismic surveys. The Operator has also conducted several G&G studies on behalf of the partnership, including: fault seal analysis, regional depositional and tectonic studies and seismic modelling through fluid substitution. Three prospects and four leads were identified and assessed within the license, however, the volume potential currently recognized within the PL945 is not sufficient for a positive drill decision within the license. The license Management Committee has therefore concluded to surrender the license.

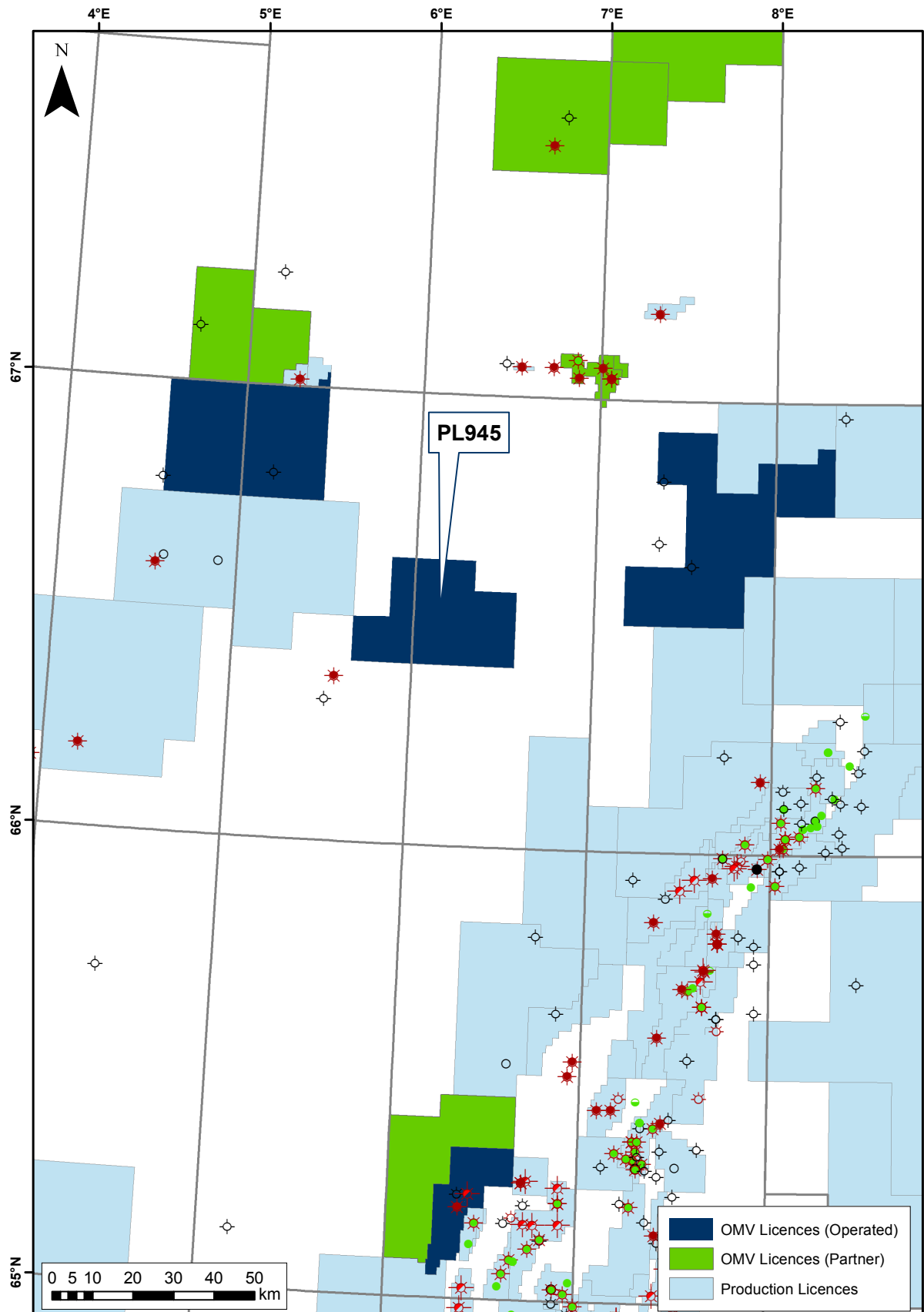


Figure 1.1 Overview Map Norwegian Sea

2 DATABASE

The common seismic and well database was approved April 2018. The complete list of seismic surveys in the common database can be found in Table 2.1 and the location of the surveys in Figure 2.2. The key dataset is the reprocessed OMV19M02, the data quality is considered to be good to excellent. The OMV19M02 covers an area of approximately 1444 km². The input survey for the reprocessing was the VBT-1 and NH0202 3D seismic surveys. The common seismic database includes an approximately 1025 km² cropped version of the VBT-1 survey, the released NH0202 survey (Figure 2.2) and all public released and available 2D seismic surveys.

The well database is summarized in Table 2.2 with the locations in Figure 2.1. Several wells were essential to understand the stratigraphy in the area, in particular 6707/10-1 (Luva), 6607/5-2 (Amundsen II), 6605/8-1 (Stetind I) and 6605/8-2 (Stetind II) were key for understanding the prospectivity in the license, and key in constraining the geophysical studies carried out in the license such as seismic modelling and AVO analysis.

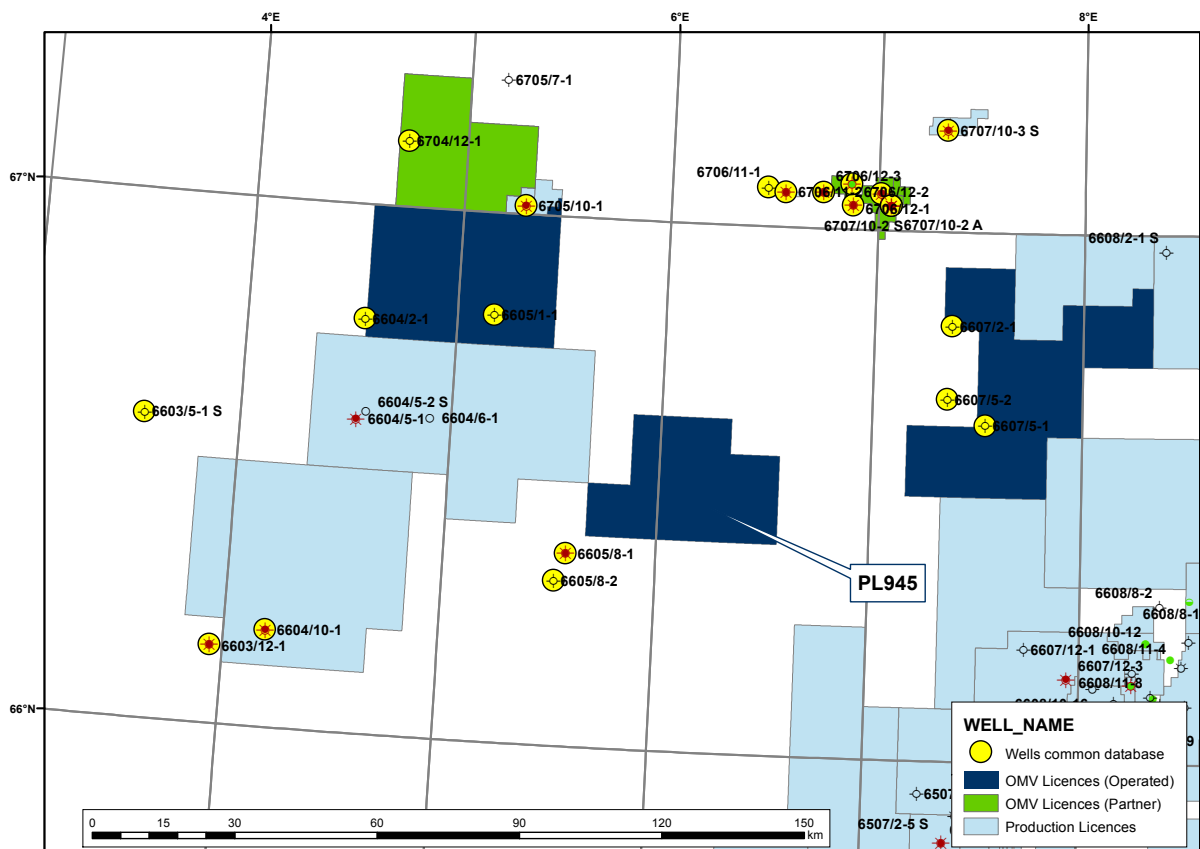


Figure 2.1 Wells Common Database Location Map

Table 2.1 Seismic Database

Survey	Survey Input	NPDID	Market Availability	Vintage	Area/Length	Quality
3D - OMV19M02	VBT-1, NH0202	7196, 4177	License Owned	2019	1444 km ²	Good - Very Good
3D - VBT-1	-	7196	Multiclient	2011	1025 km ²	Good
3D - NH0202	-	4177	Released	2002	2620 km ²	Fair - Good

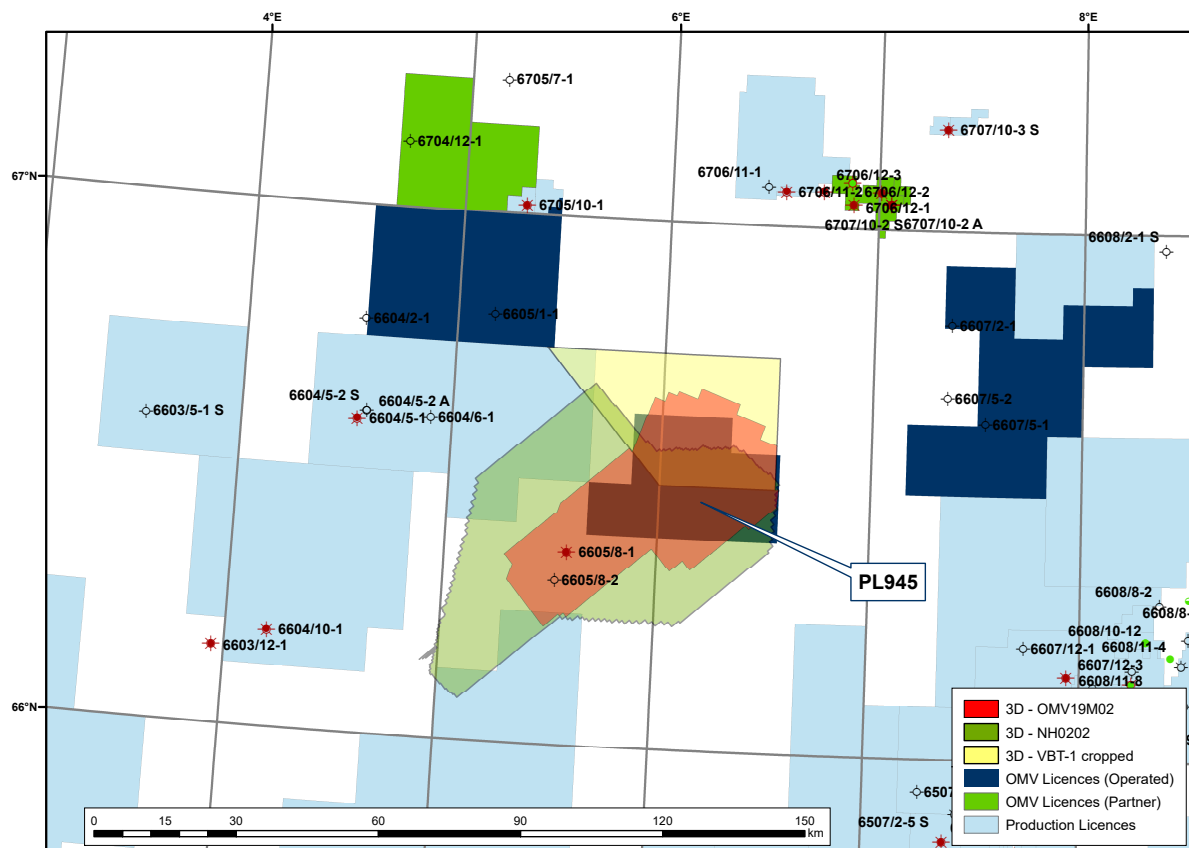


Figure 2.2 Seismic Common Database Location Map

Table 2.2 Well Database

Well Name	NPDID	Prospect Name	Drilled	TD TVD m RKB	Oldest Penetrated Formation	Oldest Penetrated Age	Hydrocarbons	Operator
6603/12-1	5985	Gro II	2009	3830	Springar Formation	Late Cretaceous	Gas	A/S Norske Shell
6603/5-1 S	6348	Dalsnuten	2010	5068	Lange Formation	Late Cretaceous	Dry	A/S Norske Shell
6604/10-1	6356	Gro I	2010	3715	Springar Formation	Late Cretaceous	Gas	A/S Norske Shell
6604/2-1	6568	Gullris	2011	3551	Springar Formation	Late Cretaceous	Dry	BG Norge AS
6605/1-1	5979	Obelix	2008	3944.5	Nise Formation	Late Cretaceous	Dry	StatoilHydro
6605/8-1	4984	Stetind I	2005	4508	Lange Formation	Late Cretaceous	Gas	Norsk Hydro
6605/8-2	5812	Stetind II	2008	4196	Lange Formation	Late Cretaceous	Dry	StatoilHydro
6607/5-1	1064	Amundsen I	1987	3805	Lange Formation	Late Cretaceous	Dry	Esso E&P Norway
6607/5-2	1789	Amundsen II	1991	4666	Kvitnos Formation	Late Cretaceous	Dry	Esso E&P Norway
6607/2-1	5471	Cygnus	2007	3526	Springar Formation	Late Cretaceous	Dry	Eni Norge
6704/12-1	3759	Gjallar	1999	4094	Nise Formation	Late Cretaceous	Dry	Saga Petroleum
6705/10-1	6044	Asterix	2009	3775	Lange Formation	Late Cretaceous	Gas	StatoilHydro
6706/6-1	4705	Hvitveis	2003	3450	Springar Formation	Late Cretaceous	Gas	Esso E&P Norway
6706/11-1	3202	Vema/Egir	1997	4306	Lange Formation	Late Cretaceous	Dry	Den norske stats oljeselskap
6706/11-2	7709	Gymir	2015	2596	Nise Formation	Late Cretaceous	Gas	Statoil Petroleum
6706/12-1	5867	Snefrid Sør	2008	3949	Kvitnos Formation	Late Cretaceous	Gas	StatoilHydro
6706/12-2	7651	Snefrid Nord	2015	2754	Nise Formation	Late Cretaceous	Gas	Statoil Petroleum
6706/12-3	7666	Roald Rygg	2015	3335	Kvitnos Formation	Late Cretaceous	Gas	Statoil Petroleum
6707/10-1	3075	Luva	1997	5026.5	Kvitnos Formation	Late Cretaceous	Gas	BP Norway
6707/10-2 A	5931	Haklang	2008	4325	Kvitnos Formation	Late Cretaceous	Gas	StatoilHydro
6707/10-3 S	7550	Ivory	2014	4301	Kvitnos Formation	Late Cretaceous	Gas	Centrica (Norge) AS

3 REVIEW OF GEOLOGICAL AND GEOPHYSICAL STUDIES

Prospect and lead definition within PL945 was largely driven by one of two key factors, observed seismic amplitude anomalies or structural delineation. Consequently, the main focus of the seismic merge and reprocessing was on improving the structural imaging and at the same time preserve the seismic amplitude content. Utilizing this reprocessed data set several studies were undertaken, including; fault seal analysis, semi-regional reservoir depositional and structural studies, rock physics modelling, seismic attribute generation, AVO and fluid substitution modelling. The regional geological framework and basin modelling for PL945 is described in the application.

New geological and geophysical studies consist of re-interpretation on new PSDM 3D reprocessed seismic data (OMV19M02), a semi-regional structural and depositional studies. New interpretation work includes seismic horizon interpretation, quantitative geophysical analysis and structural mapping (fault mapping) of the Hoffmann prospects, the Albrechtsbereger and Kuglhorn leads. Data quality of the reprocessed seismic is regarded as good to very good and an improvement, especially on structural imaging covered by the NH0202 3D seismic survey.

Reservoir and retention are seen as the main risks for the Hoffmann prospects. In an effort to evaluate the likelihood of having good quality reservoir sands deposited within the PL945 license a structural and reservoir deposition study was initiated. The structural and depositional studies consisted of backstripping and decompaction of overburden, restoration of paleo basin geometries, estimation of accommodation space at key stratigraphic levels, facies association descriptions from core, petrography, proximal-to-distal comparison and trend analysis of grain size, grain sorting and clay content, assessment of reservoir quality constraints and reservoir distribution based on both well and seismic data. The results from the regional structural and depositional study concludes that there is a high likelihood of having Late Cretaceous reservoir sands deposited in the license area, however the license area is interpreted to be located in a distal depositional position, giving rise to uncertainty in reservoir quality distribution.

A 3D fault seal study was carried out to derisk the the fault component of the traps by addressing the sealing capacity. Well 6607/5-2 (Amundsen II) was applied in the modelling study (Allan diagram). This study concluded that the fault seal is not critical for the Hoffmann prospects. However, main uncertainty is the lithology variations as the distance to the offset well applied in the study is approximately 50 km from the identified prospects.

Prestack seismic data from OMV19M02 were applied across the Hoffman prospect for analysis and interpretation of thickness tuning and amplitude response (Figure 3.1). Results from the prestack seismic wedge model from well 6607/5-2, shows that the geophysical anomaly in the Hoffman prospect is mainly dominated by a 25-40 m thick sand interbedded with shale (Figure 3.2). Thus, the synthetic model is in agreement with the seismic data.

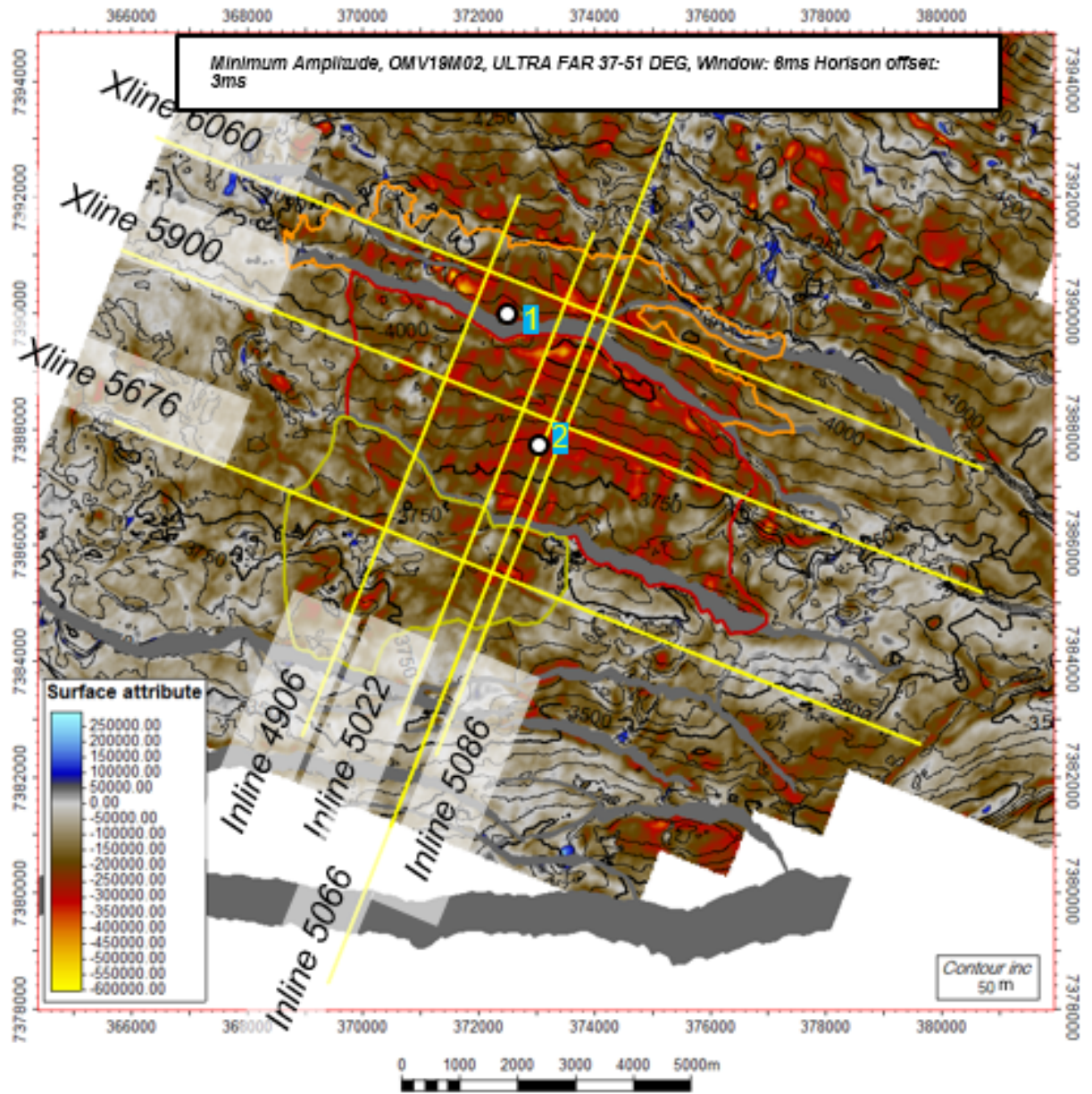


Figure 3.1 Hoffmann prospect with prestack seismic example locations
Hoffmann prospect with outline of seismic lines and prestack seismic locations.

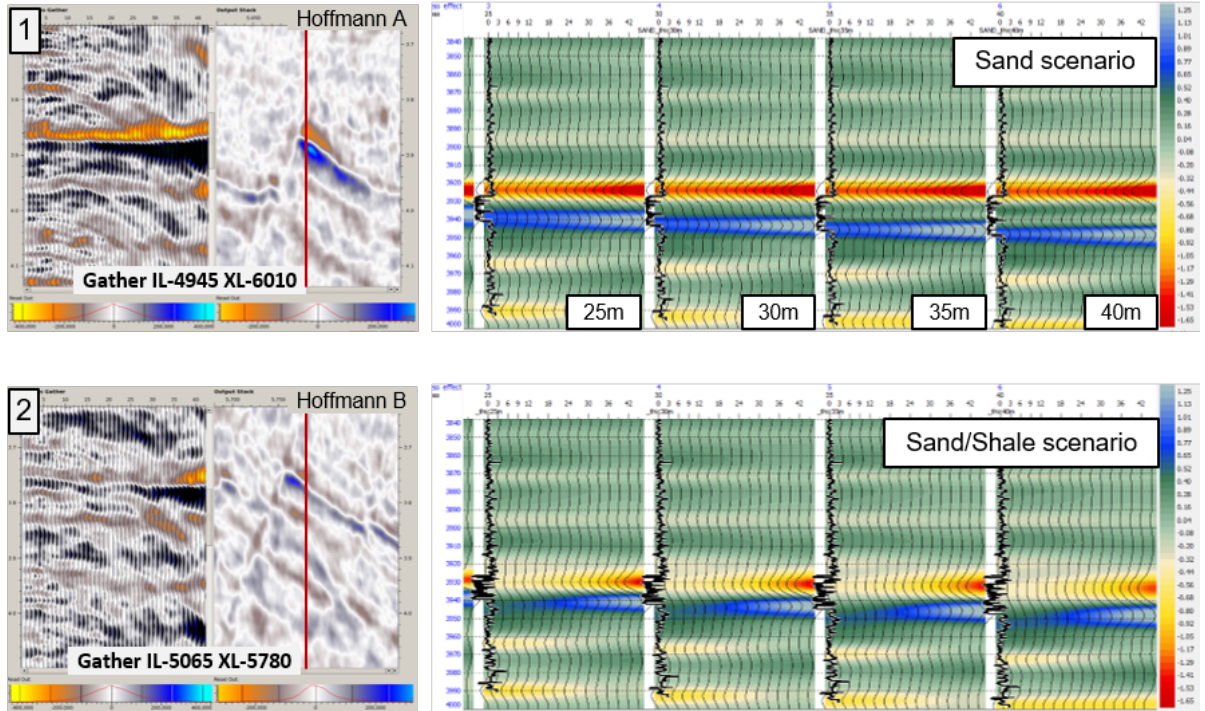


Figure 3.2 Prestack Seismic Analysis

The gathers picked at different locations within the Hoffmann prospect corresponds with the 1D modelling results from the prestack wedge.

4 PROSPECT UPDATE

One prospect and seven leads were identified at the time of the APA 2017 application. The Hoffmann prospect was the main prospect within the application area and the basis for the application. Figure 4.1 shows the application area and the prospect and lead outlines at the time of application. The Hoffmann prospect was observed as a clear amplitude increase with increasing offsets (Figure 4.2). The Hoffmann prospect is located in the Vøring Basin approximately 35 km north-east of the Stetind I gas discovery and 65 km south-west of the Aasta Hansteen Field (OMV (Norge) AS holds 15% equity in PL218/ PL218B).

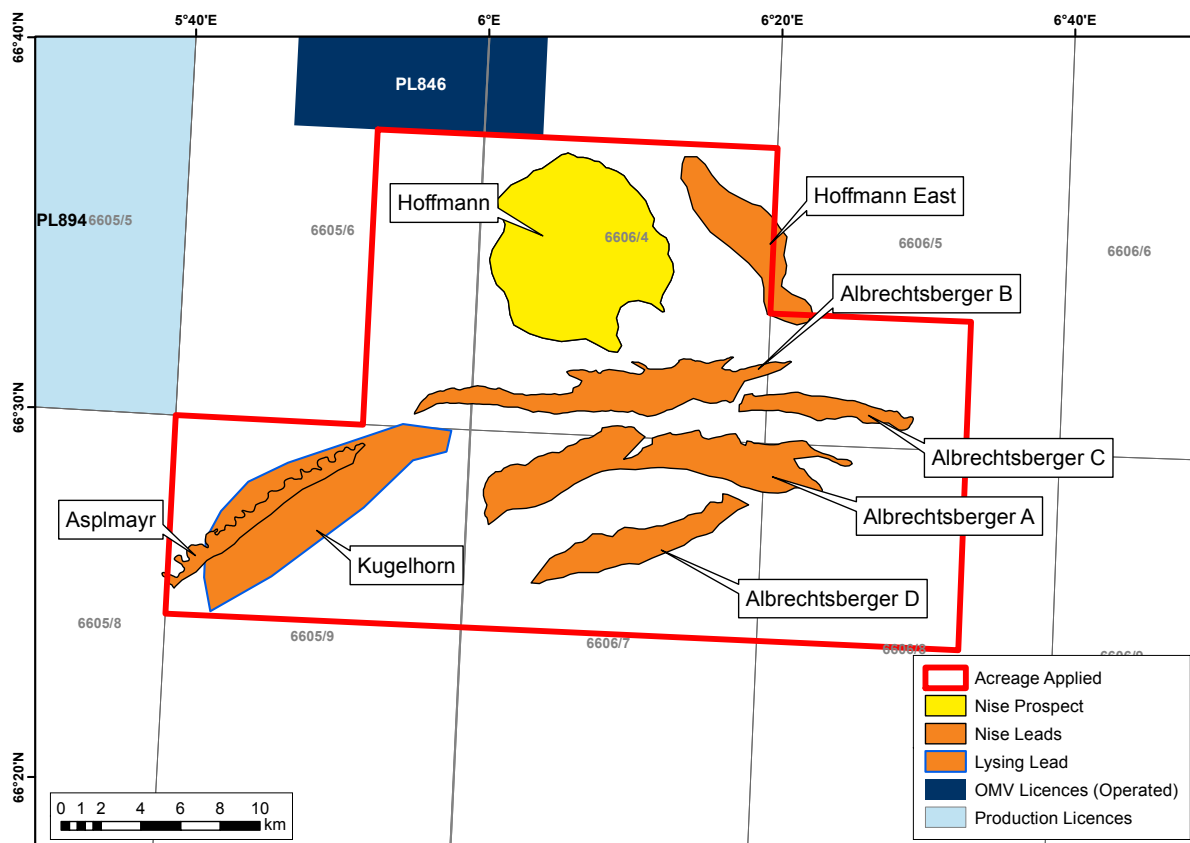


Figure 4.1 APA2017 application area

APA2017 application area and identified prospect and lead outlines

The Hoffmann prospect is defined as containing an Upper Cretaceous Nise Formation sandstone reservoir with a combination of stratigraphic/structural trap, mappable on 3D seismic data. As a result of the remapping on the reprocessed PSDM seismic survey and prospect evaluation studies performed, it became clear that the Hoffmann prospect is compartmentalized in three individual prospects, Hoffmann A, Hoffmann B and Hoffmann C (Figure 4.3 and Figure 4.4). Subsequent the redefinition of the Hoffmann prospects the trapping mechanism for Hoffmann A change from a combination stratigraphic/structural trap to a pure structural trap, three way dip-closure towards a fault. The trapping mechanism for Hoffmann A and Hoffmann B prospects stayed as a combination of stratigraphic/structural trap. The reprocessed 3D seismic dataset has improved the seismic imaging at the prospect level, ensuring a higher confidence in fault definition and prospect definition. The outcome of the prospect evaluation process is that there is a good likelihood of having Late Cretaceous reservoir sands deposited in the license acreage, however the license area is interpreted to be located in a distal depositional

position, giving rise to uncertainty in reservoir quality distribution and preservation. Reservoir and retention are still seen as the main risks for the Hoffmann prospects (Table 4.1, Table 4.2 and Table 4.3).

Through the G&G evaluation for the PL945 acreage, three of the additional leads from the 2017 APA license application have discarded, Hoffmann East, Asplmayr and Albrechtsberger D. In addition to the Hoffmann prospects four leads are still considered part of the remaining license prospectivity, Albrechtsberger A, Alberchtsberger B, Albrechtsberger C and Kuglhorn (Figure 4.4, Table 4.4, Table 4.5, Table 4.6 and Table 4.7).

The Albrechtsberger A, Albrechtsberger B, Albrechtsberger C and Kuglhorn leads all have in common that they are defined as pure structural traps, three way dip-closure towards a fault. The Albrechtsberger leads are interpreted to possibly contain an Upper Cretaceous Nise Formation sandstone reservoir, while the Kuglhorn lead shares a number of similarities with the Stetind I (6605/8-1) gas discovery, located approximately 10 km to the south-west, and is interpreted to be an extension of the Upper Cretaceous Lysing Formation play along the same major bounding fault proven by the Stetind I discovery. The key risk for the Albrechtsberger leads are considered to be reservoir, both presence and quality, situated on a very distal part of the depositional fair way for Nise Formation sands. Similarly reservoir quality is considered the key risk for the Kuglhorn lead, with the Stetind I discovery in close proximity, trap, charge and retention is considered to be at lower risk for the Kuglhorn lead, however the well results showed very low mobility for the Lysing Formation reservoir which reflects the high risk on reservoir.

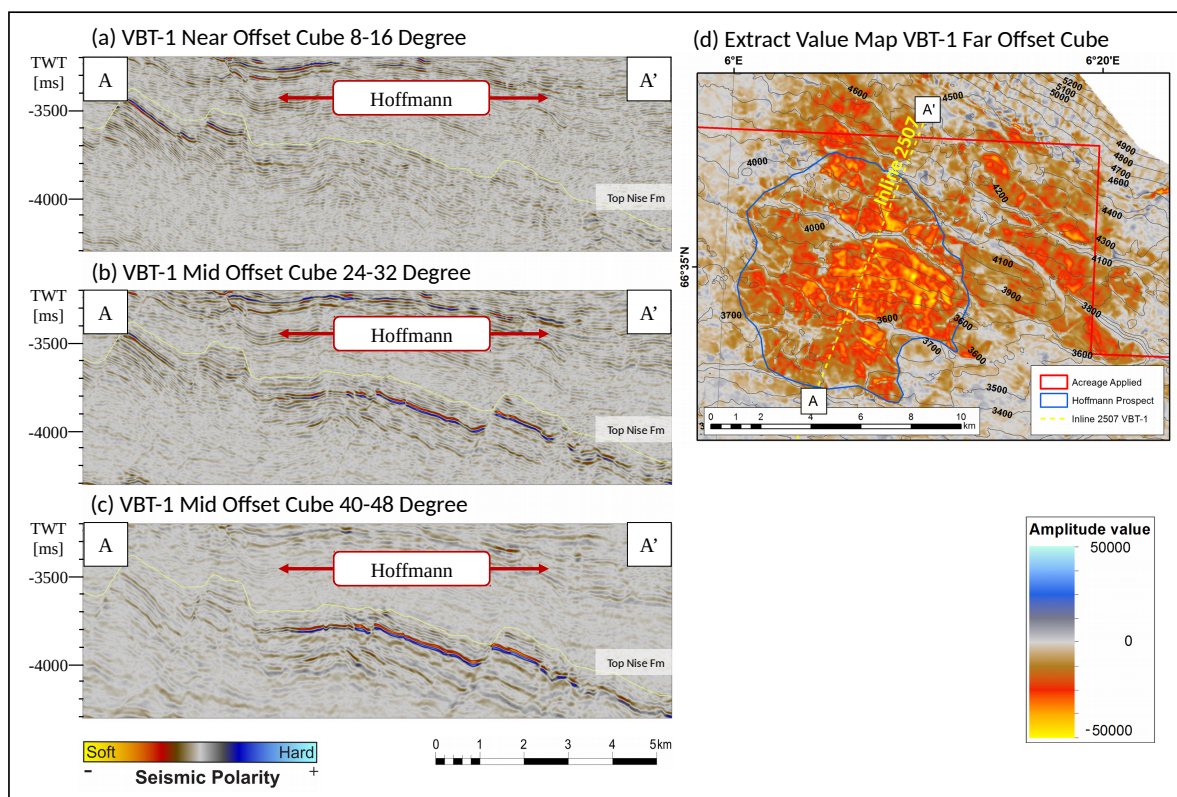


Figure 4.2 Hoffmann prospect at application (APA 2017)

(a) Hoffmann prospect on VBT-1 Near Offset Cube inline 2507

(b) Hoffmann prospect on VBT-1 Mid Offset Cube inline 2507

(c) Hoffmann prospect on VBT-1 Far Offset Cube inline 2507

(d) Extracted amplitude from Top Hoffmann Reservoir horizon, 0 ms search window for amplitude extraction. Contour interval 100 m

Table 4.3 Hoffmann C Prospect Data Sheet (NPD)

Table 4: Discovery and Prospect data (Enclose map)		Block 6606/4		Hoffmann C		Discovery/Prospect/Lead		Prospect		Prospect ID (or New)		NPD approved (Y/N)	
Oil, Gas or O&G case:	Play name	Prospect name	New Play (Y/N)	Outside play (Y/N)	Reference document	Combination	Water depth [m (MSL)] (>0)	Assessment year	Assessment year	Seismic database (2D/3D)	Base, Mean	High (P10)	NPD will insert value
This is case no.:	1 of 1	Reported by company	OMV Norge AS	OMV Norge AS	Type of trap	High (P10)	Low (P90)	850	2019	3D	Base, Mode	High (P10)	NPD will insert value
Resources IN PLACE and RECOVERABLE													
Volumes, this case													
In place resources	Oil [10 ⁹ Sm ³] (>0.00)	1.88	7.69	6.17	Base, Mean	14.80	0.05	0.19	0.22	0.42	0.19	0.42	
Recoverable resources	Gas [10 ⁹ Sm ³] (>0.00)	1.12	4.56	4.96	Base, Mode	9.35	0.02	0.09	0.10	0.19	0.09	0.19	
Reservoir Chrono (from)	Campanian	Reservoir litho (from)	Nise Formation	Source Rock, chrono primary	Reservoir litho (to)	Turonian	Source Rock, litho primary	Blalange Formation	Seal, Chrono	Campanian	Seal, Litho	Nise Formation	
Reservoir Chrono (to)	Campanian	Reservoir litho (to)	Nise Formation	Source Rock, chrono secondary	Reservoir litho (to)	Nise Formation	Source Rock, litho secondary	Blalange Formation	Seal, Litho	Nise Formation	Seal, Litho	Nise Formation	
Probability [fraction]													
Total (oil + gas + oil & gas case) (0.00-1.00)	0.53	Oil case (0.00-1.00)	0.60	Gas case (0.00-1.00)	Charge (P3) (0.00-1.00)	0.75	Oil & Gas case (0.00-1.00)	Retention (P4) (0.00-1.00)	0.50				
Reservoir (P1) (0.00-1.00)	Low (P90)	Trap (P2) (0.00-1.00)	High (P10)	Comments									
Parameters:	3675	3675	3675										
Depth to top of prospect [m (MSL)] (> 0)	4.2	10.0	12.9										
Area of closure [km ²] (> 0.0)	30	40	50										
Reservoir thickness [m] (> 0)	170	350	530										
HC column in prospect [m] (> 0)	0.356	0.481	0.608										
Gross rock vol. [10 ⁹ m ³] (> 0.000)	0.72	0.79	0.85										
Net / Gross [fraction] (0.00-1.00)	0.15	0.19	0.23										
Porosity [fraction] (0.00-1.00)	10.0	100.0	600.0										
Permeability [mD] (> 0.0)	0.35	0.29	0.20										
Water Saturation [fraction] (0.00-1.00)	0.0036	0.0038	0.0040										
Bq [Rm ³ /Sm ³] (< 1.00000)													
1/Bo [Sm ³ /Rm ³] (< 1.00)													
GOR, free gas [Sm ³ /Sm ³] (< 0)													
GOR, oil [Sm ³ /Sm ³] (< 0)													
Recov. factor, oil main phase [fraction] (0.00-1.00)													
Recov. factor, gas ass. phase [fraction] (0.00-1.00)													
Recov. factor, gas main phase [fraction] (0.00-1.00)													
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0.55	0.60	0.65										
Recov. factor, top res [FC] (>0)	0.42	0.45	0.48										
Temperature, top res [bar] (>0)	123												
Pressure, top res [bar] (>0)	367												
Cut off criteria for N/G calculation	PHI >=0.11	Vsh <=0.4											

5 TECHNICAL EVALUATIONS

A technical evaluation and an economic analysis was performed for the Hoffmann prospects. A development scenario with a subsea tie-back to the producing Aasta Hansteen field was considered for the Hoffmann prospects. The results of the economic analysis for the Hoffmann prospects was negative. The negative outcome is related to the compartmentalization between the Hoffmann segments, giving rise to a high number of wells, both in exploration and production stage, high uncertainty in seal potential and reservoir quality in combination with marginal resource potential in the Hoffmann prospects.

6 CONCLUSIONS

The PL945 partnership has placed considerable effort in evaluating the prospectivity of the license. As a consequence of the work programme, the license stakeholders now have a much greater understanding of the prospectivity in the license. The PSDM 3D seismic merge and reprocessing of the multiclient (VBT-1) survey and the NH0202 has improved the amplitude preservation, structural imaging and the delineation assessment of the prospects and leads.

All license commitments have been fulfilled. The main reasons for surrendering the license are listed below:

The G&G studies performed in the license were not able to de-risk the trapping/seal and reservoir quality in the main identified prospects to an acceptable level. Through the interpretation of the OMV19M02 dataset and prospect evaluation studies, it has become clear that the resource potential of the identified prospectivity in the license is not viable to take the license to a positive drill decision. The license partnership mutually agree to surrender the production license. Figure 6.1 depicts the prospect and lead for the license.

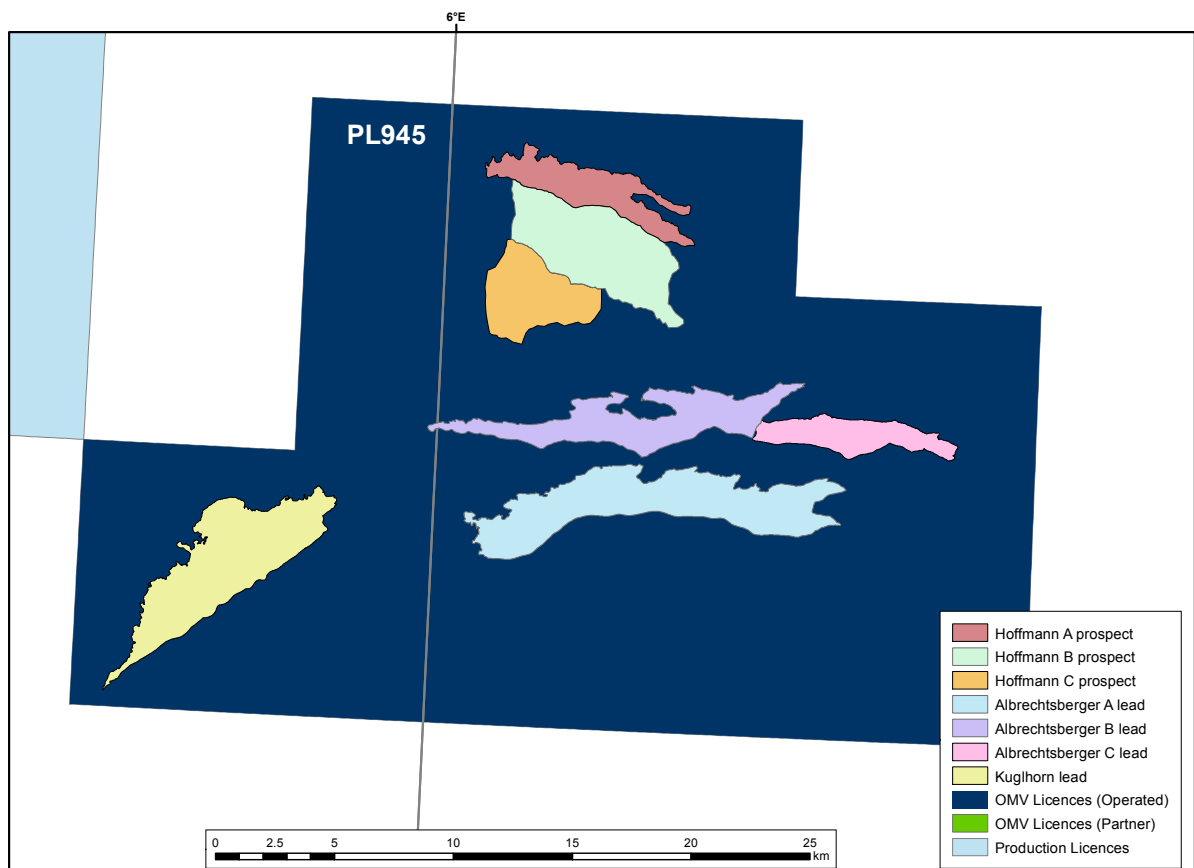


Figure 6.1 PL945 Prospectivity