

# PL557 & PL557 B



## Relinquishment Report



PL557 & PL557B Relinquishment Report

# Table of Contents

1 Key license history .....	1
2 Database .....	3
3 Review of geological framework .....	6
4 Prospect update .....	10
5 Technical evaluations.....	13
6 Conclusions .....	14

## List of Tables

2.1 Seismic Database - 3D.....	3
2.2 Well Database.....	4
4.1 Zeus prospect data sheet (NPD).....	11
4.2 Ramborg prospect data sheet (NPD).....	12

## List of Figures

1.1 PL557 and PL557B Area Map.....	2
2.1 Well and Seismic Database .....	5
3.1 OMV1003 Lambda Rho.....	7
3.2 P-impedance volume OMV1003.....	8
3.3 Norwegian Sea Stratigraphy Chart.....	9

# 1 Key license history

The PL557 was awarded to OMV (Norge) AS (Operator - 50%), Repsol (40%) and Skagen44 (10%) on 19th of February 2010 as part of the APA2009 licensing round (TFO2009). The license was granted for an initial period of 7 years valid to 19th of February 2017. Furthermore, in the APA2011 licensing round (TFO2011), the PL557 Partnership was awarded with an extension license named PL557B. The license was awarded on 3rd February 2012, and the license was granted with the same initial period as PL557. The licenses PL557 and PL557B can be seen in Figure 1.1.

The work program set by the authorities in the initial period was as follows:

- Phase 1 - 3 years - acquire seismic data, G&G studies, drill or drop decision (DoD),
- Phase 2 - 2 years - drill one exploration well, concretize or drop decision (BoK), perform conceptual studies, continuation or drop decision (BoV),
- Phase 3 - 2 years - prepare development plan, decision to submit PDO or drop.

An application for a 2 years extension for phases 1-3 was submitted to the Ministry of Petroleum and Energy in a letter dated November 19th 2012. The licence extension was approved by the Ministry on 6th February 2013. The new date for DoD decision was set to 19th February 2015.

Licence meetings overview:

- EC Meeting - 03.03.2010
- EC Meeting - 10.05.2010
- EC / MC Meeting - 04.11.2010
- EC Work Meeting - 28.04.2011
- EC Work Meeting - 07.06.2011
- EC Work Meeting - 05.08.2011
- EC / MC Meeting - 09.11.2011
- EC Work Meeting - 05.11.2012
- MC Meeting - 30.11.2012
- EC Work Meeting - 24.06.2013
- EC / MC Meeting - 21.11.2013
- EC Work Meeting - 11.07.2014
- EC Work Meeting - 17.10.2014
- EC / MC Meeting - 05.12.2014
- MC Meeting - 29.01.2015

The license work program obligation has been fulfilled by the acquisition of 3D seismic data and completion of several G&G studies. Based on the results from the external studies and extensive internal analysis of identified prospects, the volume potential recognized within the PL557/557B licence area is not sufficient for a drill decision. The licence Management Committee has concluded to relinquish the licence.

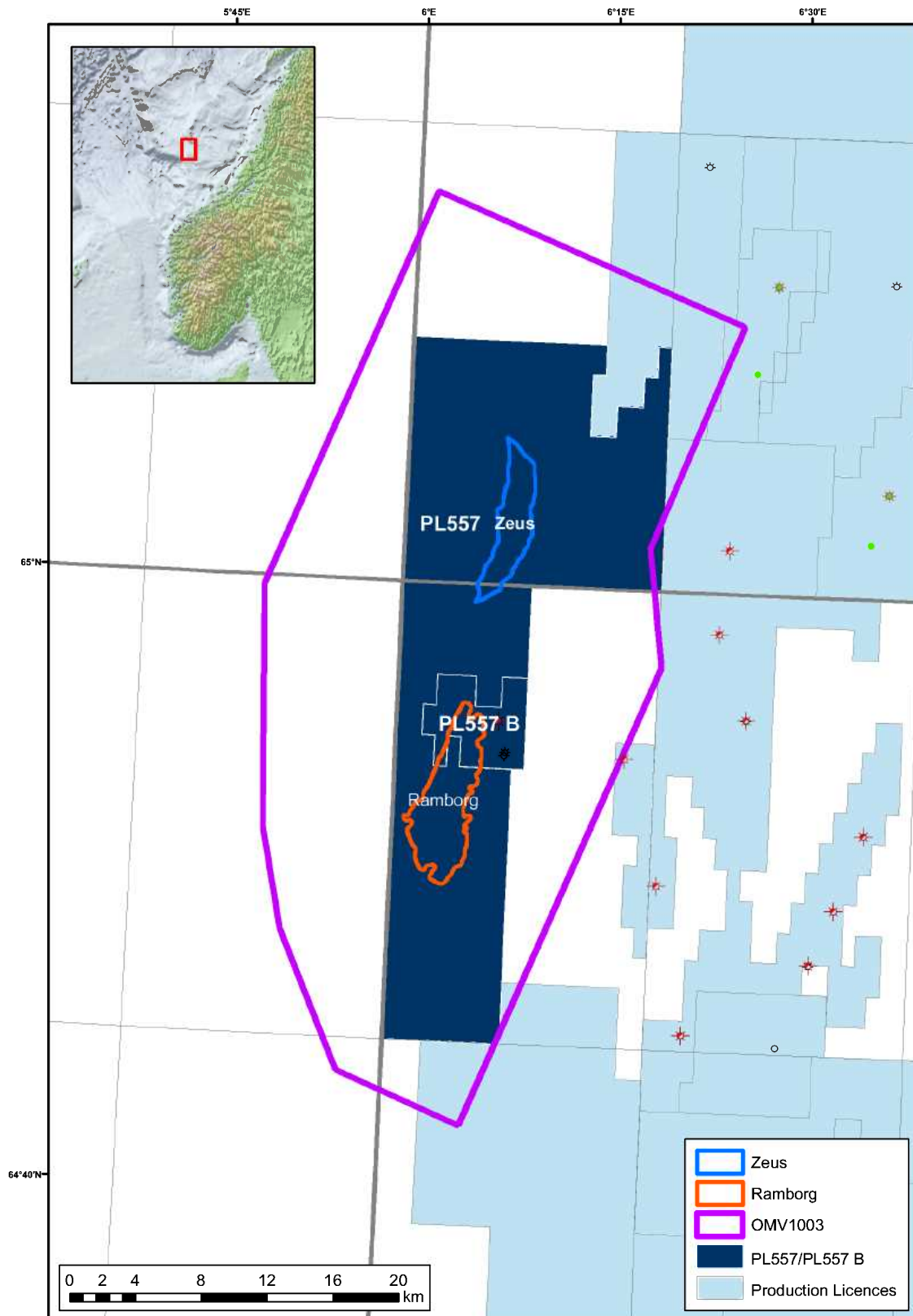


Figure 1.1 PL557 and PL557B Area Map

Area map outlining PL557 and PL557B, as well as the two prospects identified, namely Zeus (blue outline) and Ramborg (red outline). The purple polygon outlines OMV1003, which is a 3D seismic survey acquired by the Joint Venture in 2010.

## 2 Database

The seismic database consists of a number of proprietary and public 2D and 3D data, the main 3D seismic data utilized is listed in Table 2.1 and also illustrated in Figure 2.1. In 2010 the PL557/557B Joint Venture (JV) acquired the OMV1003 3D seismic survey as part of the approved license work programme. The survey covers most of the license area, with a total area of 803 km<sup>2</sup> of full fold data. As part of the same survey campaign, three 2D lines (OMV1006) were acquired tying key wells in the vicinity of PL557 and PL557B. The main objective for acquiring the data was to generate a high quality dataset with optimal imaging for performing detailed interpretation and analysis of the prospects in the license area.

Table 2.1 Seismic Database - 3D

Seismic Database - 3D			
Survey	Vintage	Area (km <sup>2</sup> )	Quality
OMV1003	2010	803	Excellent to good
HWM94	1987 - 1994	1660	Moderate to poor
SKH96	1996	755	Moderate to poor

PSTM processing for the OMV1003 survey was completed in 2011. The OMV1003 survey was also used for creating pre-stack inversion volumes and conducting AVO analysis. The latest mapping and prospectivity evaluation for the licence was predominantly based on these datasets.

The well database (Table 2.2) includes key wells within a semi-regional area of the deposited Lange Formation sandstones, however only few of the wells had Lange Formation sandstones as primary target. Most of the same wells were relevant also for the analysis of the Jurassic play (Ramborg), as they typically have a primary target in the Jurassic. The wells have been incorporated in a number of studies during the prospect evaluation, as described in a later section (3 Review of geological framework). Some of the wells were added to the well database during the licence work, and incorporated into the ongoing studies for better understanding of the Cretaceous Lange sedimentary systems in particular.



Table 2.2 Well Database

Well Database					
Well	Spud Year	Field/Discovery	Hydrocarbons	HC Formation	TD Formation
6406/1-1	2001	Erlend North	Gas/Condensate	Tofte	Åre
6406/1-2	2003	6406/1-2	Gas/Condensate	Lange	Red Beds
6406/1-3R	2005	6406/1-2			Lange
6406/1-4	2005	6406/1-2			Åre
6406/2-1R	1995	Lavrans	Gas/Condensate	Fangst, Båt	Åre
6406/2-2	1995	Lavrans	Gas/Condensate	Tofte, Ile	Åre
6406/2-3	1996		Gas/Condensate		
6406/2-4	1997	Lavrans	Shows	Garn, Tofte, Tilje	Melke
6406/2-5A	1997	Kristin	Gas/Condensate	Garn, Ile	Ror
6406/2-6A	2000	Ragnfrid	Gas/Condensate	Tofte	Tofte
6406/2-7	1999	Erlend	Gas/Condensate	Garn, Ile	Tilje
6406/3-4	1987	Trestakk	Shows	Fangst, Båt	Tilje
6406/3-5	1988		Shows	Garn	Tilje
6406/5-1	2001	6406/5-1	Gas/Condensate	Garn	Tilje
6506/11-1	1987		Gas shows	Lysing, Lange	Åre
6506/11-2	1991	6506/11-2 Lange	Oil/Gas	Ile, Tilje, Lange	Åre
6506/11-3	1992		Shows	Lysing, Garn	Not
6506/11-4S	1996	Åsgard/Smøbukkk	Oil	Åre, Ile, Lange	Åre
6506/11-5S	1996	Åsgard/Smøbukkk	Oil/Gas	Åre, Ile, Lange	Åre
6506/11-6	1998	Kristin	Gas/Condensate	Garn, Ile	Åre
6506/11-7	2001	Morvin	Oil/Gas	Fangst, Båt	Åre
6506/11-8	2006	Morvin	Oil	Garn, Tofte	Tilje
6506/12-1	1985	Åsgard/Smøbukkk	Gas/Condensate	Fangst, Båt	Åre
6506/12-7	1987	Åsgard/Smøbukkk	Gas/Condensate	Fangst, Båt	Tilje
6507/11-7	2007				Lange

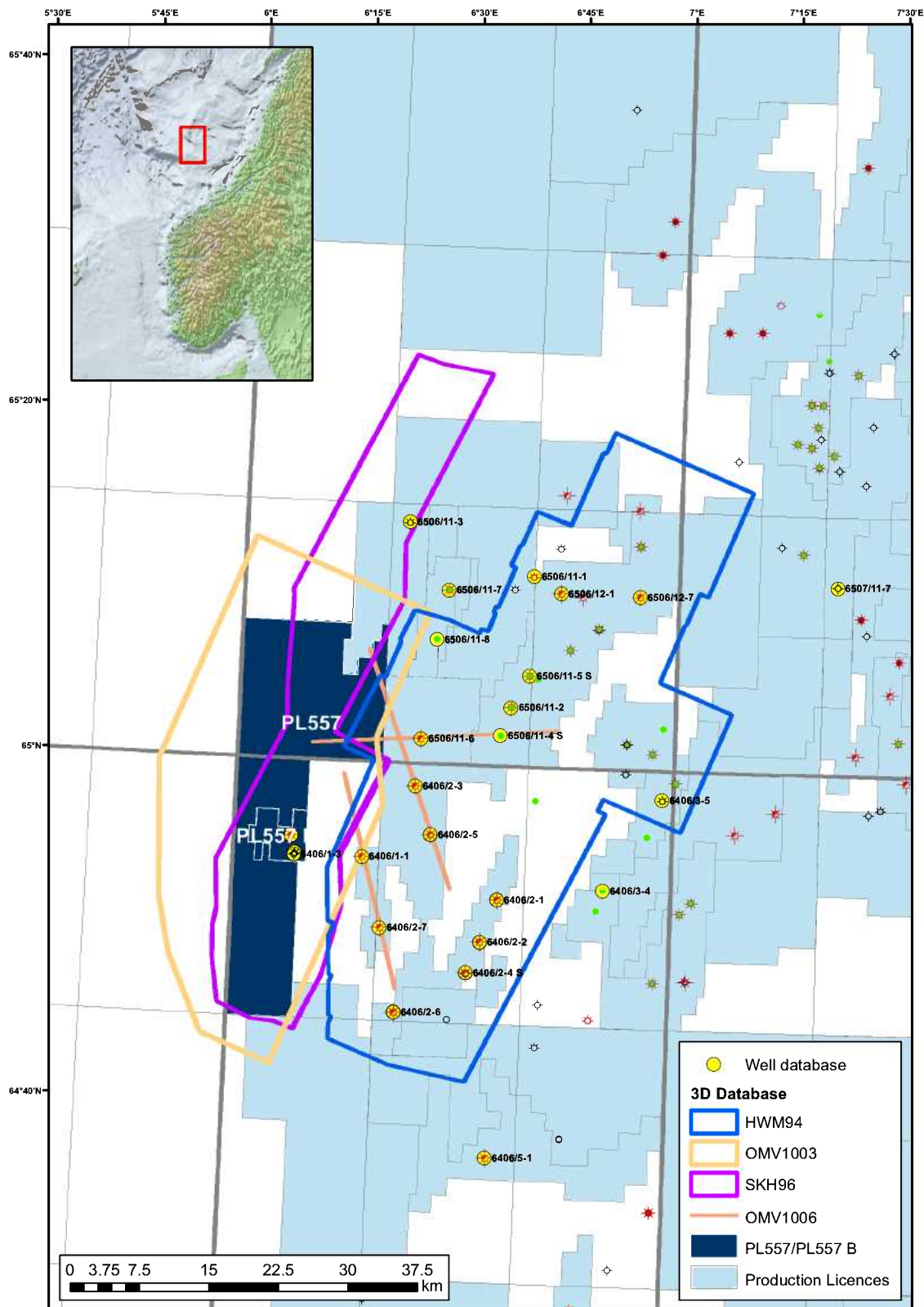


Figure 2.1 Well and Seismic Database

Overview of the main seismic and well data utilized during the license work programme. OMV1003 and OMV1006 was acquired by the Joint Venture in 2010, as part of the approved license work programme.

## 3 Review of geological framework

The main prospect identified in the licence area was the Zeus prospect in the Lange Fm. The work on the licence was primarily directed towards evaluation of this prospect. The Zeus prospect belongs to NHKL-2 play; it is a part of the depositional system extending from Nordland Ridge to the North-East to the Ytreholmen Fault Zone to the South-West. It covers sandstones of the Lyr and Lange Formations of Berriasian to Turonian age. This section summarizes the main results of the geological and geophysical work and special studies carried out on the licence period.

### Seismic interpretation

The main regionally interpreted reflectors were the Seabed, Top Kai Fm., Base Tertiary (Lower Tertiary Unconformity), Top Shetland, Top Cromer Knoll, BCU, Base Viking Gp. and Top Åre coal. A detailed interpretation was carried out at the prospect levels based on the OMV1003 seismic dataset.

Isopach maps and amplitude maps support the model of Cretaceous sediment input from the North-East, deposited by low density turbidites. The deposition of these sediments were influenced by the paleo-structural highs of the Sklinna Ridge.

### External studies

In 2011, a conventional petrophysical evaluation of 12 wells situated in the area of PL557 / PL557B was performed by Senergy. The main focus of the study was to determine the basic petrophysical properties (clay volume and net reservoir in particular) of the Cretaceous Lange Formation, in addition to other units with reservoir potential in the Jurassic and Triassic intervals.

Also in 2011, the JV purchased the Ichron Haltenbanken Stratigraphic Database study, in order to establish a robust and reliable stratigraphic framework for the license. This study incorporated data from 15 wells, 8 of them were from an Ichron non-proprietary study, with additional 7 wells added on proprietary basis for the JV. The integration of the additional wells resulted in a small number of minor sequence edits to the original non-proprietary study, and involved the evaluation of palynological and micropalaeontological distribution charts, wellsite charts, logging sheets and summary logs. Furthermore, Ichron performed a sedimentological and reservoir quality study of three wells in the vicinity of PL557 / PL557B, with available core in Lange Formation sandstones. The key results from this study were that the reservoir quality of the studied intervals is predominantly very low to low. Most of the sandstone samples contain high silt and clay content, are significantly to pervasively cemented and moderately to strongly compacted, hence the main control on reservoir quality is sandstone texture and clay content (i.e. grain size, sorting and optically non-resolvable clay content). Post-compactional calcite cements downgrade reservoir quality. However, minor developments of clean, medium grained, cross-stratified sandstones deposited within channels are present locally, displaying permeability of up to 753mD.

In 2012 the JV commissioned a seismic inversion study on the OMV1003 dataset from Rock Solid Images (RSI), with the aim of trying to derisk the Zeus prospect. Analysis of the seismic inversion volumes did not support a hydrocarbon accumulation at Zeus (Figure 3.1 and

Figure 3.2). Anomalies attributed to low poisson ratio and lambda-rho were observed over the top of the ridge between the Sklinna highs, however the study was unable to distinguish these from lithological changes.

### Internal studies

Basin modelling and geochemical data indicate that the Spekk, Melke and Åre have a high source rock potential where present in the vicinity of PL557 and PL557B. The modelling indicates that Spekk is gas prone in the outboard areas to the South-West and North of the Sklinna Ridge, and oil to gas prone in the areas to the East (Halten Terrace).

Integration of results from the Ichron stratigraphic framework study and regional seismic facies mapping, led to a more detailed breakdown and correlation of sandstone units within the Lange Formation. An updated petrophysical evaluation was performed, in order to capture the reservoir properties of the intervals of interest. A Norwegian Sea stratigraphic chart is embedded in Figure 3.3, illustrating the incorporation of the Ichron stratigraphic framework and the adoption of Norlex naming nomenclature of the Cretaceous Lithostratigraphy.

AVO and Rock Physics studies indicate that the Turonian sandstones, as encountered in the offset wells, exhibit a class II AVO response with an increase in hydrocarbon saturation resulting in a decrease in acoustic impedance and Vp/Vs ratio. However this thickness of the observed reservoirs within the Cretaceous are below the seismic resolution of the OMV1003 dataset.

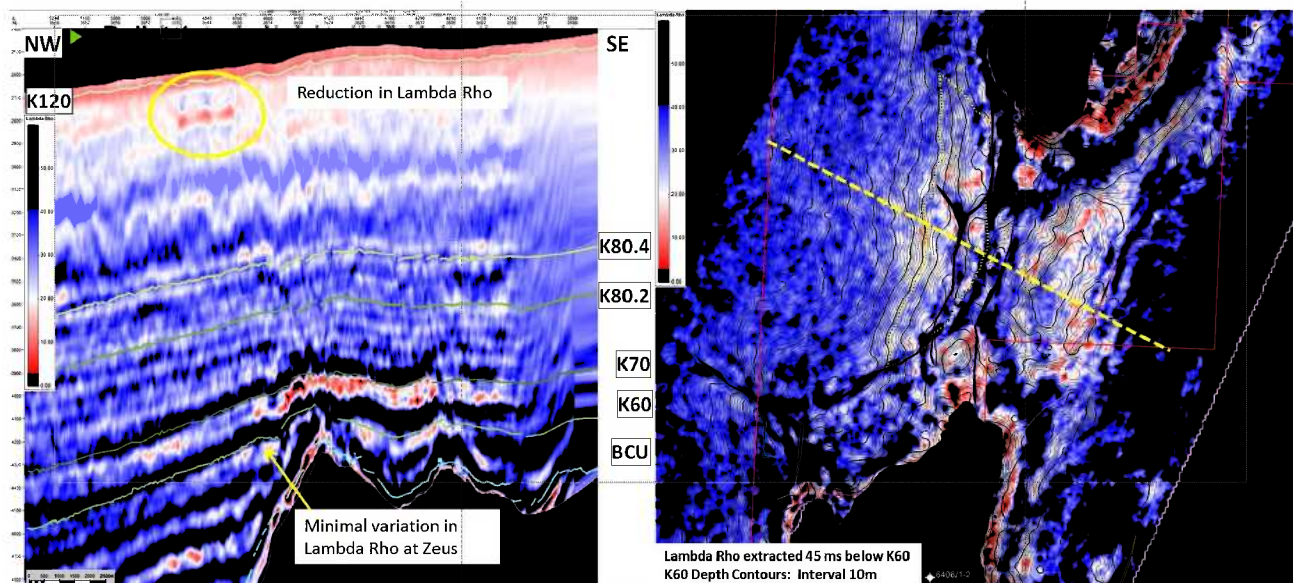


Figure 3.1 OMV1003 Lambda Rho  
OMV1003: Lambda Rho

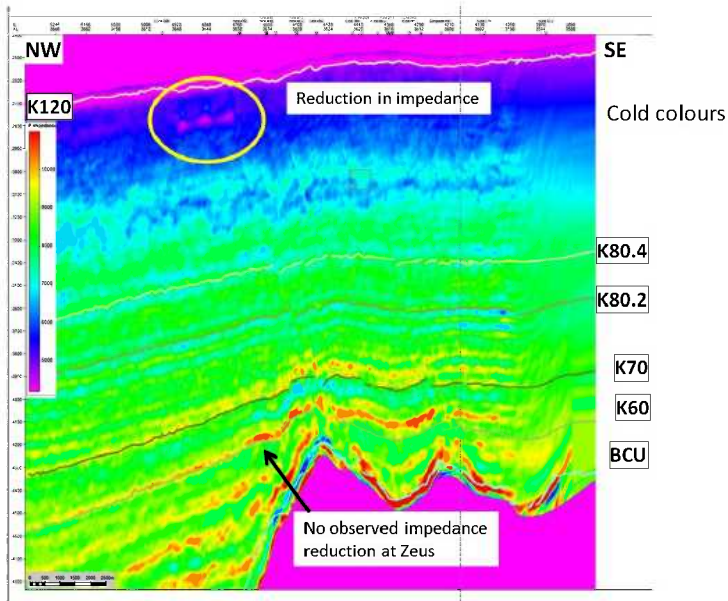
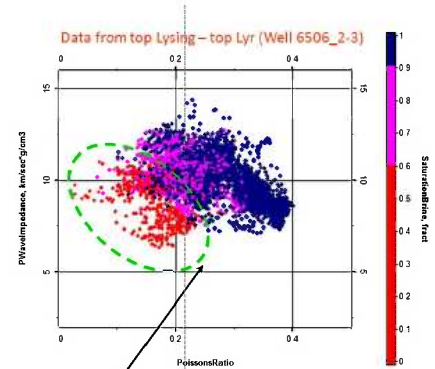


Figure 3.2 P-impedance volume OMV1003  
P-impedance volume through Zeus Prospect



- Cross-plot suggests hydrocarbon filled rocks would have lower P-impedance values with corresponding lower Poisson's Ratio values while brine filled rocks would have higher values

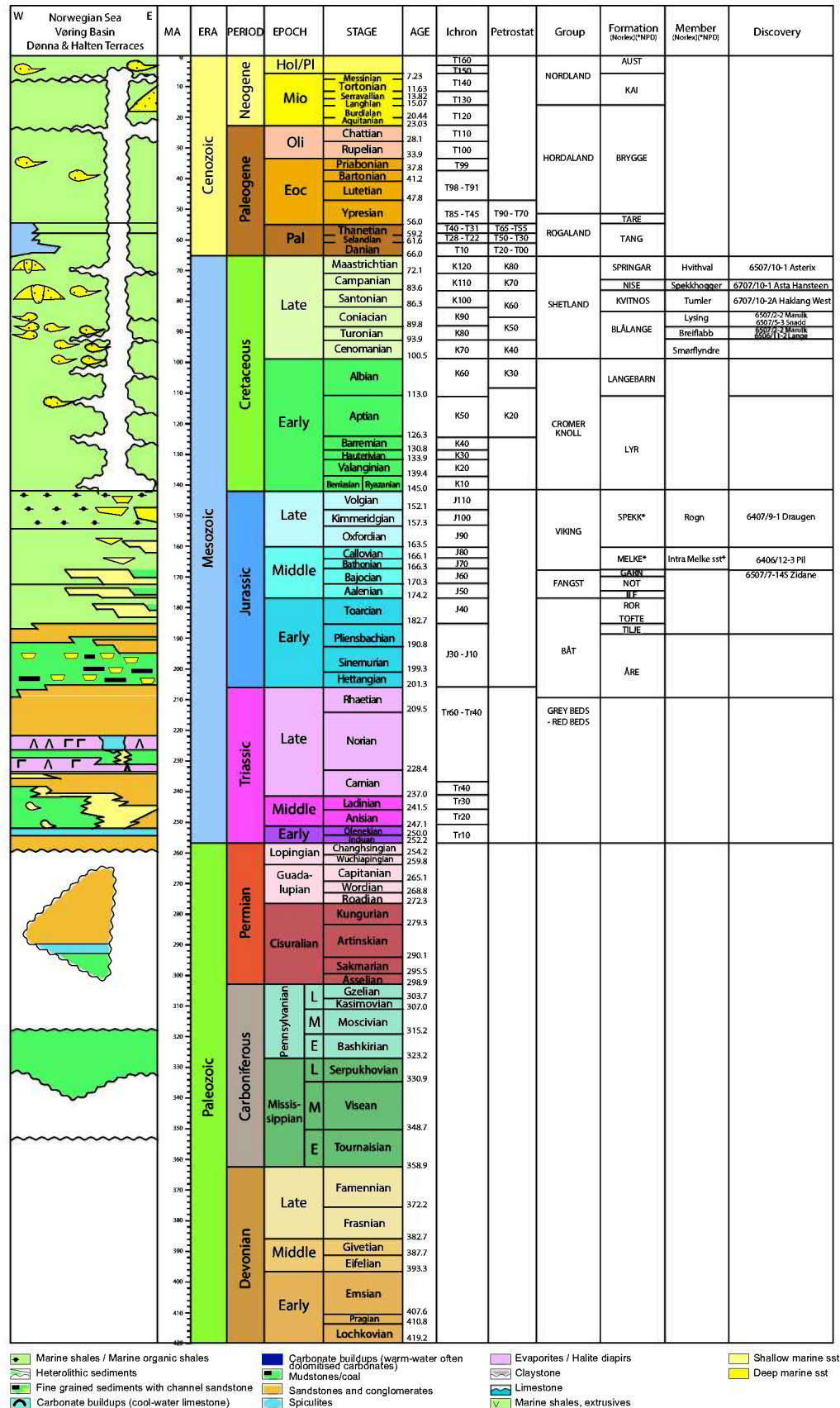


Figure 3.3 Norwegian Sea Stratigraphy Chart

## 4 Prospect update

### **Zeus Prospect**

Zeus was the main lead identified in the APA 2009 application (Figure 1.1). The prospect was defined as a pinch-out/detachment trap in the Lange Formation located on the outboard slope of the Sklinna Ridge. The main play type was anticipated to be deep marine turbidite sandstones sourced from the East. The main risks were considered to be trap geometry and reservoir presence.

The work effort focused on reducing the prospect risks through acquisition and processing of new 3D seismic in the licence and G&G studies. The new seismic survey enabled to map and analyze the prospect in more detail compared to the initial description in the APA application. The seismic inversion study provided information regarding the reservoir properties and hydrocarbon saturation. Partial stacks analysis, pre-stack AVO and seismic inversion study showed no convincing evidence of gas saturation in the prospect area. The results of the assessment led to negative conclusions and downgrading of the Zeus prospect.

The prospective volumes are presented in Table 4.1.

### **Ramborg Prospect**

The Ramborg prospect was identified by Skagen44 and Repsol in the APA2009 application (Figure 1.1). The prospect was defined as a stratigraphic trap containing sediments of inferred Jurassic age. The main play type was anticipated to be shallow marine sandstones, similar to the prolific Middle Jurassic play of the Halten Terrace. The main risks were considered to be presence of reservoir and retention. The remaining updip part of Ramborg prospect was applied for in the APA2011 application, and awarded as PL557 B.

The work effort focused on reducing the prospect risks through detailed mapping and analysis of the new 3D seismic and G&G studies. The results of the assessment led to an increased risk placed on reservoir and retention, and a reduction in the estimated recoverable resources.

The prospective volumes are presented in Table 4.2.

Table 4.1 Zeus prospect data sheet (NPD)

Table 5: Prospect data (Enclose map)										
Block	Block E&G/1	Prospect name	Zeus	Discovery/Prospect Lead	Prospect	Prospect ID (or New)	NPD approved (Y/N)	NPD will insert value	Assessment year	NPD will insert value
Play name	Block E&G/1	Reported by company	OMV (Norge) AS	Reference document	No	PL557/PL557B	Reinforcement Report	450	2014	3D
Oil, Gas or O&G case:	Gas	Structural element	Skinna Ridge	Type of trap	Stratigraphic	Water depth [m MSL] (>0)				Seismic database (2D/3D)
This is case no.:	1 of 1	Main phase	Associated phase							
Resources IN PLACE and RECOVERABLE	Volumes, this case	Low (P90)	Base, Mean	High (P10)	Low (P90)	Base, Mean	High (P10)	Base, Mode	High (P10)	High (P10)
In place resources	Oil [10 <sup>8</sup> Sm <sup>3</sup> ] (>0.00)	1.01	6.95	14.80	0.13	0.67	1.83	0.89	1.93	1.93
Recoverable resources	Gas [10 <sup>3</sup> Sm <sup>3</sup> ] (>0.00)	0.63	4.50	9.68	0.06	0.32	1.03	0.45	1.03	1.03
Reservoir Chrono (from)	Turonian	Reservoir litho (from)	Oxfordian	Source Rock, chrono primary	Source Rock, litho primary	Speck	Turonian	Seal, Chrono	Seal, Chrono	Seal, Chrono
Reservoir Chrono (to)	Albian	Reservoir litho (to)	Lange	Source Rock, chrono secondary	Source Rock, litho secondary	Meike	Lange	Seal, Litho	Seal, Litho	Lange
Probability /fraction		Oil case (0.00-1.00)	Gas case (0.00-1.00)	Charge (P3) (0.00-1.00)	Retention (P4) (0.00-1.00)	Oil & Gas case (0.00-1.00)	Retention (P4) (0.00-1.00)	Oil & Gas case (0.00-1.00)	Retention (P4) (0.00-1.00)	Oil & Gas case (0.00-1.00)
Total (oil + gas + oil & gas case)	1.00	0.35	0.50	0.50	0.90	0.90	0.90	0.40	0.40	0.40
Parameters:	Low (P90)	High (P10)	Comments							
Depth to top of prospect [m MSL] (>0)	4580	4580								
Area of closure [km <sup>2</sup> ] (>0.0)	1.9	6.9								
Reservoir thickness [m] (>0)	49	172								
HC column in prospect [m] (>0)	55	113								
Gross rock vol. [10 <sup>6</sup> m <sup>3</sup> ] (>0.000)	0.651	0.881								
Nat / Gross [fraction] (0.00-1.00)	0.50	0.60								
Porosity [fraction] (0.00-1.00)	0.13	0.54								
Permeability [mD] (>0.0)	10.0	30.0								
Water Saturation [fraction] (0.00-1.00)	0.35	0.30								
Bg [Rm <sup>3</sup> /Sm <sup>3</sup> ] (<1.00000)	0.0020	0.0030								
GOR, free gas [Sm <sup>3</sup> /Sm <sup>3</sup> ] (>0)	115	128								
GOR, oil [Sm <sup>3</sup> /Sm <sup>3</sup> ] (<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)										
Temperature, top res [°C] (>0)	160									
Pressure, top res [bar] (>0)	81.0									
Cut off criteria for NVE calculation	0.1	0.2	0.3							
				For NPD use:	Register - pit:	Register Date:	For NPD use:	Register - pit:	Register Date:	For NPD use:
				Date:	Date:	Date:	Date:	Date:	Date:	Date:
				NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value
				NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value	NPD will insert value
				Kart nr	Kart nr	Kart nr	Kart nr	Kart nr	Kart nr	Kart nr





## 5 Technical evaluations

A technical evaluation and an economic analysis were performed for the Zeus and Ramborg prospects. In-place volumes were generated in GeoX, permeability range was populated from petrophysical analysis of offset wells. PVT characteristic was based on properties of the Gas / Condensate proven within the Lange Formation in the 6406/1 wells, and also of the Gas / Condensate proven in the Middle Jurassic formations in the 6406/2 wells.

A development scenario assumed a tie-in to the Kristin Field. Results of the economic analysis showed negative economic value of the project (EMV). The key elements leading to negative value are reduced CoS, estimated recoverable volumes, assumed high pressure drilling environment for the exploration well and decrease of market oil prices.

## 6 Conclusions

The evaluation of the licence area has contributed to increased understanding of the Lange Formation depositional system and sand distribution. The analysis showed that turbidity sediments are most likely present in the prospect area, however not likely in the target interval of Zeus.

The reasons for relinquishment:

### **Zeus prospect:**

- Lack of evidence for reservoir presence and quality of the interpreted target interval.
- Lack of convincing evidence of gas saturation from pre-stack AVO / seismic inversion study.
- A significant risk for trap definition - fault continuity is uncertain, fault sealing properties are uncertain, probable continuity of sandy sediments with no lithological sealing.
- Identified recoverable volumes are regarded non-commercial and hence not sufficient to support a drill decision.

### **Ramborg prospect:**

- Lack of evidence for reservoir presence and quality of the interpreted target interval.
- A significant risk for lateral seal definition.
- Identified recoverable volumes are regarded non-commercial and hence not sufficient to support a drill decision.