

Relinquishment Report



PL693 Havørn



PL693 Relinquishment Report

Table of Contents

1 Key license history	1
2 Database	3
3 Review of geological framework	7
4 Prospect update	12
5 Technical evaluations.....	14
6 Conclusions	15

List of Tables

2.1 Seismic Database.....	3
2.2 Well Database.....	4
4.1 Havørn prospect data sheet (NPD)	13

List of Figures

1.1 PL693 Area Map.....	2
2.1 Well Database.....	5
2.2 Seismic Database.....	6
3.1 OMV15M01: Inline and Crossline.....	8
3.2 OMV15M01: Intercept and Gradient.....	9
3.3 Norwegian Sea Stratigraphy Chart.....	10

1 Key license history

The Production License (PL) 693 was awarded to OMV (Norge) AS (Operator - 40%), Edison Norge AS (30%), North Energy ASA (15%) and Skagen44 (15%) on 8th of February 2013 as part of the APA2012 licensing round (TFO2012). The license was granted for an initial period of 7 years valid to 8th of February 2020. The PL693 is located in the Norwegian Sea (Figure 1.1).

The work program in the initial period was as follows:

- Phase 1 - 1 years - Purchase and reprocess 2D seismic data, G&G studies, purchase 3D seismic or drop decision,
- Phase 2 - 2 years - purchase 3D seismic, Drill or drop decision (DoD),
- Phase 3 - 1 years - drill exploration well and Concretize or drop decision (BoK),
- Phase 4 - 2 years - perform conceptual studies and decide on Continuation (BoV) or drop
- Phase 5 - 2 years - prepare development plan, decision to submit PDO or drop.

After completion of the work programme for Phase 1, PL693 joint venture partners decided to continue and enter into Phase 2 on February 4, 2014.

Licence meetings overview:

- EC Meeting - 07.03.2013
- EC Meeting - 11.10.2013
- EC / MC Meeting - 28.11.2013
- MC Meeting - 23.01.2014
- EC Meeting - 12.03.2014
- EC / MC Meeting - 27.11.2014
- EC Meeting - 03.07.2015

The license work program obligation for the Phase 1 has been fulfilled by the purchase and reprocessing of 2D seismic data and completion of several G&G studies. Equally, the license work program obligation for the Phase 2 has been fulfilled by the purchase and reprocessing of 3D seismic data. Based on the results from the external studies and extensive internal analysis of identified prospects, the volume potential recognized within the PL693 licence area is not sufficient for a drill decision. The licence Management Committee has concluded to relinquish the licence.

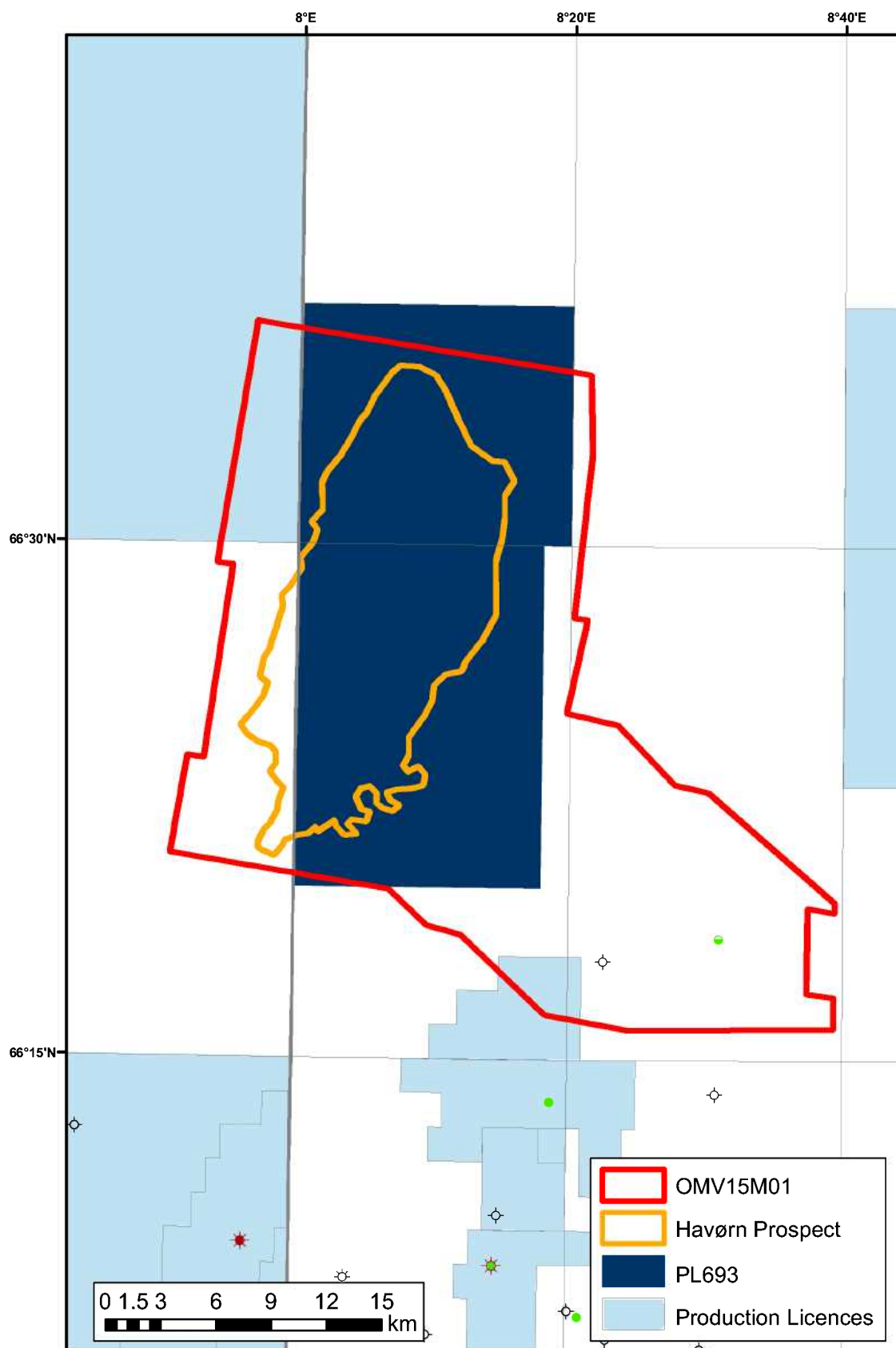


Figure 1.1 PL693 Area Map

Area map outlining PL693, as well as the Havørn prospect identified, orange polygon. The red polygon outlines OMV15M01 3D seismic survey, which the Joint Venture had re-processed in 2014.

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 2.2. In 2013, the PL693 Joint Venture (JV) purchased and reprocessed 2D seismic data as part of the approved license work programme. The 1010 km of 2D seismic data covers part of the license area as well as ties well that are key for the evaluation. The main objective for the reprocessing of the data was to generate a high quality dataset with optimal imaging for performing detailed interpretation and conducting AVO analysis of the prospect in the license area. However, this proved inconclusive and the license then agreed to continue into Phase 2. The field data for the ST0114 and ST9405 was purchased and a whole new processing was undertaken as fulfillment of the Phase 2 work program. The main objective for the reprocessing of the data was to generate a high quality dataset with optimal imaging for performing detailed interpretation and conducting AVO analysis with focus on the Paleocene prospect. The latest mapping and prospectivity evaluation for the licence was predominantly based on these datasets.

Table 2.1 Seismic Database

Seismic Database - 3D			
Survey	Vintage	Area (km ²)	Quality
OMV15M01	2015	812	Good - Excellent
ST01M07	2001	1316	Good
ST0114	2002	617	Good
ST9405	1994	735	Good

Seismic Database - 2D			
Survey	Vintage	Area (km ²)	Quality
MCG1002	2010	n.a.	Good

The well database (Table 2.2 and Figure 2.1) includes key wells within a semi-regional area, however only few of the wells had Paleogene sandstones as primary target. 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 Paleogene Tang/Tare sedimentary systems in particular.

Table 2.2 Well Database

Well Name	Drilled	TD (MDmRKB)	Formation	Well Status	Operator	CPI	Well Tie	Well Core	HC Analysis	Field/Discovery
6710/10-1	2000	2267	Springar Fm.	Dry (P&A)	Statoil	Yes		Yes		
6707/10-2 S	2008	3365	Nise Fm.	Gas (P&A)	StatoilHydro	Yes		Yes	Yes	Haklang
6707/10-2 A	2008	4850	Kvitnos Fm.	Gas (P&A)	StatoilHydro			Yes	Yes	Haklang West
6707/10-1	1997	5039	Kvitnos Fm.	Gas (P&A)	BP Norway	Yes	Yes	Yes	Yes	Aasta Hansteen
6706/12-1	2008	3950	Kvitnos Fm.	Gas (P&A)	StatoilHydro		Yes	Yes	Yes	Snefrid South
6706/6-1	2003	3451	No Formal Name	Gas (P&A)	Esso	Yes		Yes	Yes	Hvitveis
6705/10-1	2009	3775	Lange Fm.	Gas (P&A)	StatoilHydro				Yes	Asterix
6610/3-1	1993	3126	Lange Fm.	Shows (Suspended)	Statoil	Yes	Yes	Yes		
6610/2-1 S	1996	2673	Red Beds	Shows (P&A)	Statoil	Yes	Yes	Yes		
6609/7-1	1983	1969	Basement	Dry (P&A)	Philips Petroleum	Yes	Yes	Yes		
6609/5-1	1985	3600	Red Beds	Shows (P&A)	Statoil	Yes	Yes	Yes		
6608/11-7 S	2011	2435	Red Beds	Dry (P&A)	Rocksource	Yes	Yes			
6608/11-4	2004	2317	Red Beds	Oil (P&A)	Statoil	Yes	Yes	Yes	Yes	Linerle
6608/10-14 S	2010	2880	Åre Fm.	Oil/Gas (P&A)	Statoil	Yes	Yes	Yes	Yes	Skuld
6608/10-12	2008	3180	Red Beds	Oil (P&A)	StatoilHydro	Yes	Yes	Yes	Yes	Skuld
6608/10-12 A	2009	3075	Åre Fm.	Oil (P&A)	StatoilHydro	Yes			Yes	Skuld
6608/10-1	1989	3437	Åre Fm.	Dry (P&A)	Statoil	Yes	Yes	Yes		
6608/8-2	2007	2831	Red Beds	Dry (P&A)	StatoilHydro	Yes	Yes			
6608/8-1	1997	3013	Zechstein Gp.	Oil shows (P&A)	Statoil	Yes	Yes	Yes		
6607/12-1	1986	3521	Shetland Gp.	Dry (P&A)	Elf Petroleum	Yes	Yes	Yes		
6607/5-2	1991	4684	Kvitnos Fm.	Dry (P&A)	Esso	Yes	Yes	Yes		
6607/5-1	1987	3817	Lange Fm.	Dry (P&A)	Esso	Yes	Yes	Yes		
6607/2-1	2007	3526	Springar Fm.	Dry (P&A)	Eni Norge	Yes	Yes			
6605/8-1	2005	4513	Lange Fm.	Gas (P&A)	Norsk Hydro	Yes		Yes	Yes	Stetind
6507/5-3	2000	3000	Lange Fm.	Gas (P&A)	BP Amoco			Yes	Yes	Snadd
6507/2-2	1992	3958	Åre Fm.	Gas/Condensate (P&A)	Norsk Hydro		Yes	Yes	Yes	Marulk
6507/2-1	1986	4477	Åre Fm.	Shows (P&A)	Norsk Hydro					
6407/12-2	2009	1482	Lange Fm.	Dry (P&A)	GDF Suez	Yes	Yes	Yes		
6405/10-1	2007	3182	Nise Fm.	Gas (P&A)	Statoil			Yes	Yes	Midnattsol
6405/7-1	2003	4300	Lysing Fm.	Oil (P&A)	Statoil			Yes	Yes	Ellida
6305/12-1	1991	4302	Red Beds	Shows (P&A)	Norsk Hydro	Yes		Yes	Yes	

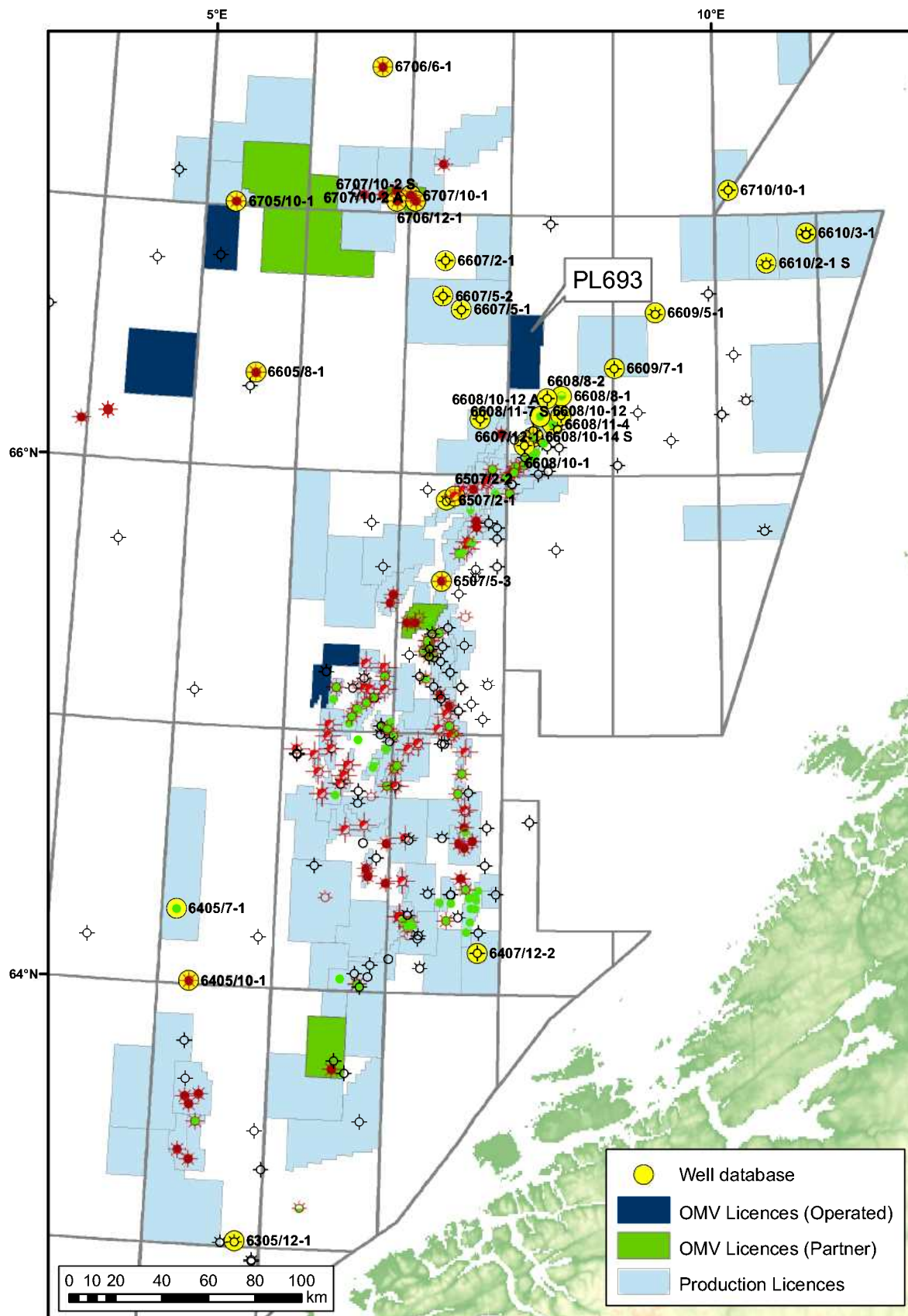


Figure 2.1 Well Database

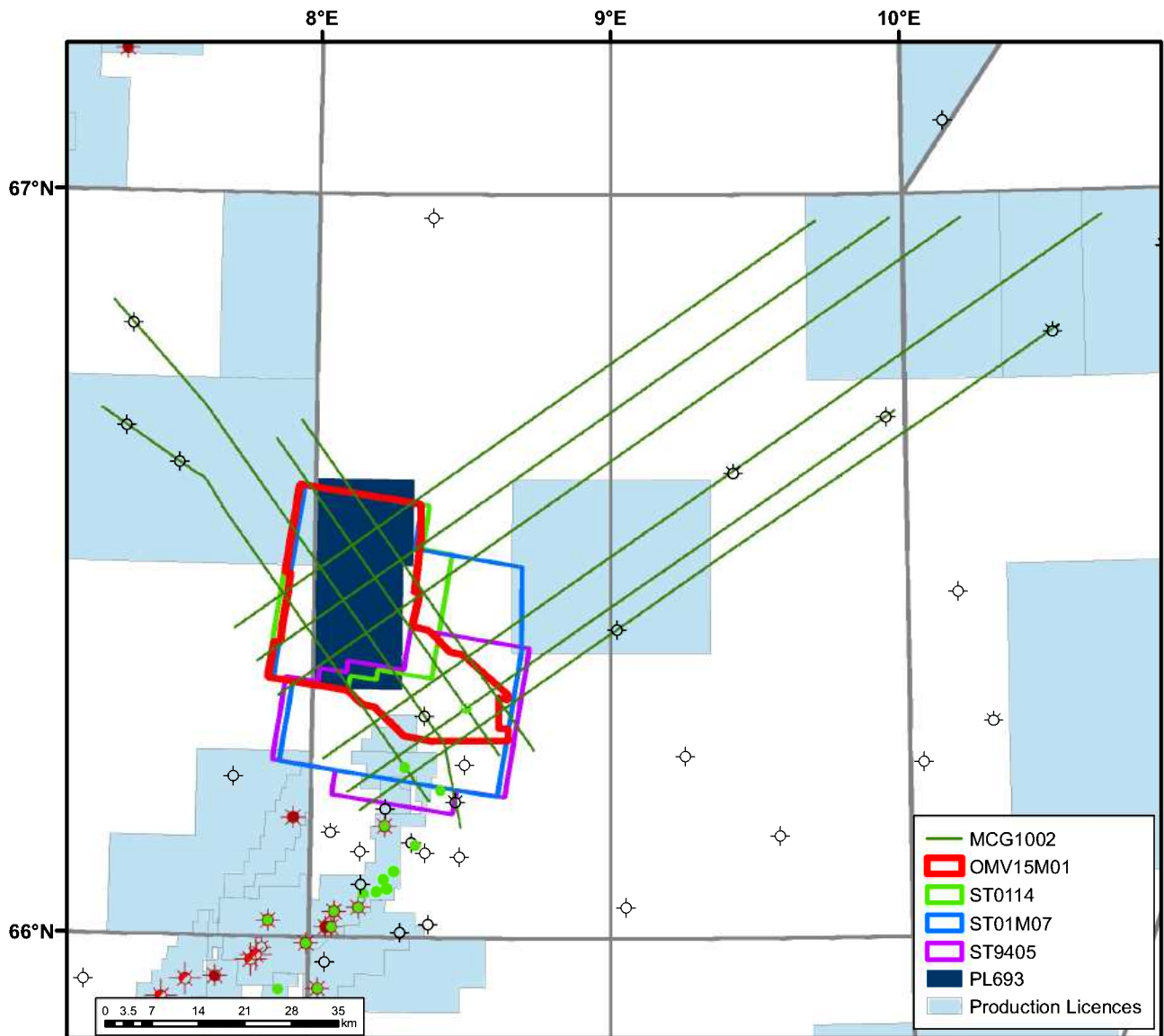


Figure 2.2 Seismic Database

3 Review of geological framework

The main prospect identified in the licence area was the Havørn prospect in the Tang/Tare Fms., Figure 3.1 The work on the licence was primarily directed towards evaluation of this prospect. The Havørn prospect belongs to nhpc-2 play; it is a part of the depositional system extending from Vestfjords Basin into the Træna Basin towards the West. It covers sandstones of the Tang Formation of Paleocene 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., Top Tare Fm., Top Tang Fm., Top Springar Fm., Top Lysing sst Member and the Base Cretaceous Unconformity. A detailed interpretation was carried out at the prospect levels based on the 812 km² OMV15M01 3D seismic dataset as well as on 1010km on the MCG1002 2D dataset.

Detailed seismic mapping in conjunction with sequence stratigraphic interpretation based on seismic and well clearly shows that the area of the PL 693 license is not sand prone; in fact, it is a deep marine setting void of sand.

G&G Studies

In 2013, an updated petrophysical evaluation of 10 wells situated in the area of PL639 was performed by OMV. The main focus of the study was to determine the basic petrophysical properties (clay volume and net reservoir in particular) of the Paleocene Tang Formation, in addition to the potential reservoir potential of the Eocene Tare Formation. The key results from this study were that there is no reservoir in the studied intervals in the vicinity of the PL 693.

A sequence stratigraphic study based on interpretation of seismic and wells was performed with intend to understand the depositional environment that prevailed during the Paleocene/Eocene. The work concluded that the area of the PL 693 is in a very distal setting, which appears to be void of thick basin floor fans. Furthermore, the study also aimed at understanding the context of the thick basin floor fan of the Tang Fm, Paleocene/Eocene in age, that was drilled in the well 6710/10-1 Hedda. A Norwegian Sea stratigraphic chart is embedded in Figure 3.3, illustrating the stratigraphic framework applied by OMV and the adoption of Norlex naming nomenclature of the Tertiary Lithostratigraphy.

AVO and Rock Physics studies indicate that the Tang /Tare Fms., as encountered in the offset wells, exhibit a class IV AVO response which is a decrease in acoustic impedance and increase of the Vp/Vs ratio Figure 3.2, which is the common response for hot shale. The modelling showed that a good reservoir should have shown an decrease in acoustic impedance and Vp/Vs ratio .

However, if reservoir is present within the Paleocene; it is then below the seismic resolution of the OMV15M01 dataset.

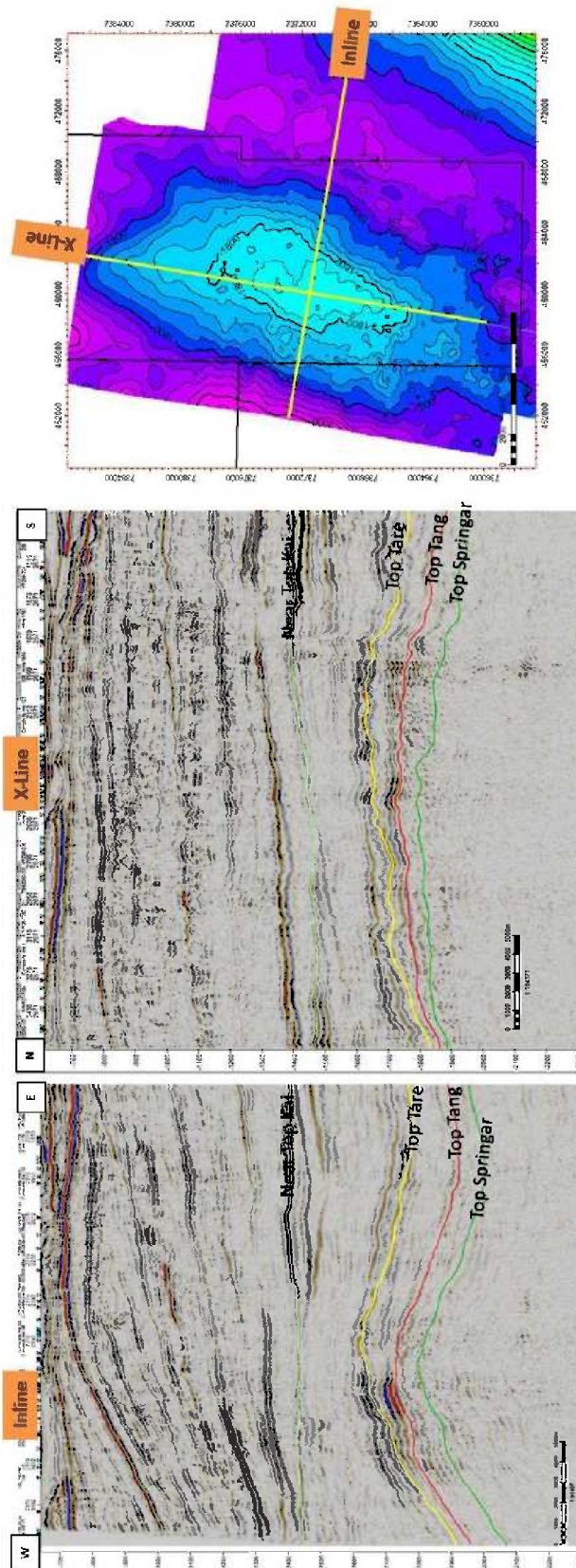


Figure 3.1 OMV15M01: Inline and Crossline
 OMV15M01: Inline and Crossline across the Havørn fourway dip-closure.

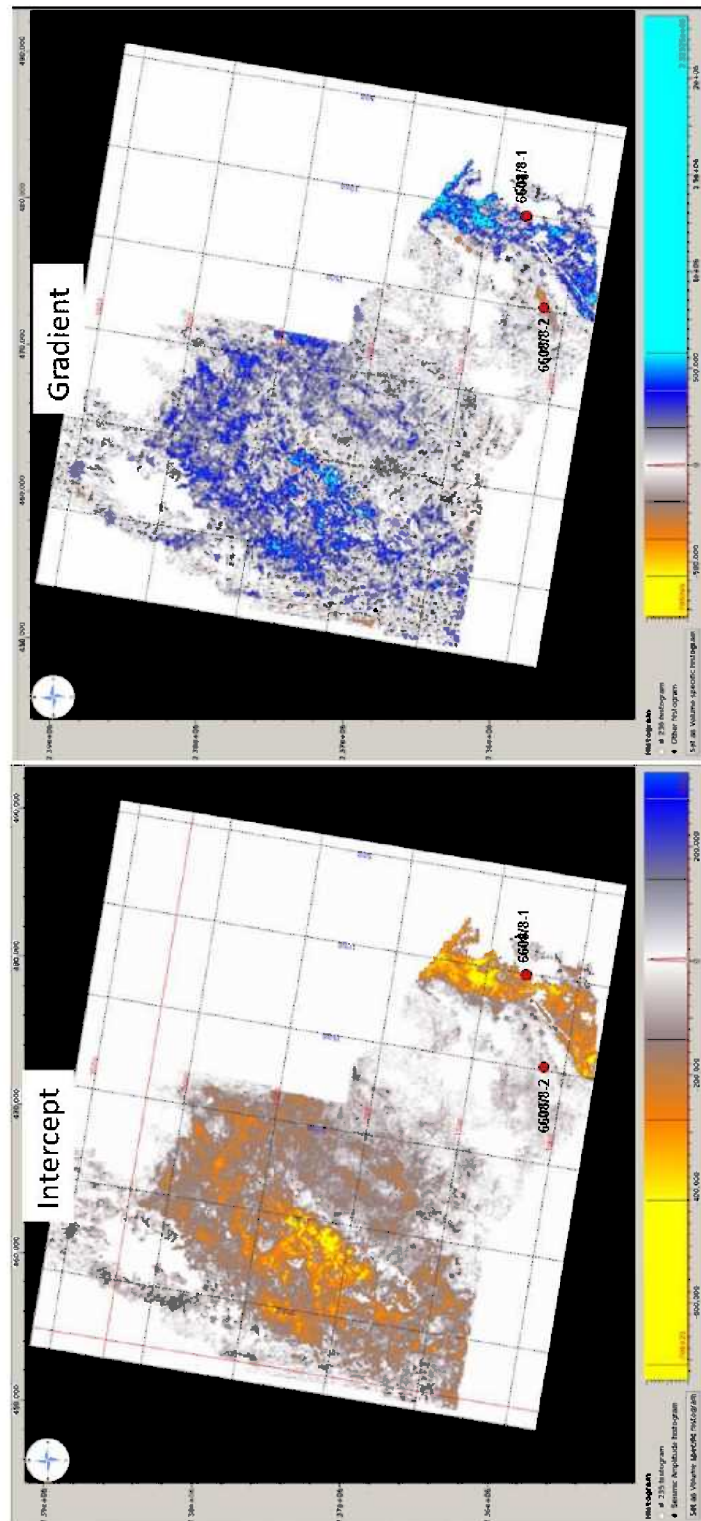


Figure 3.2 OMV15M01: Intercept and Gradient

Map view of amplitude pick analysis at selected gathers shows a negative intercept and a positive gradient for top Tare. This corresponds to class IV AVO response which is also confirmed by cross-plotting (not shown).

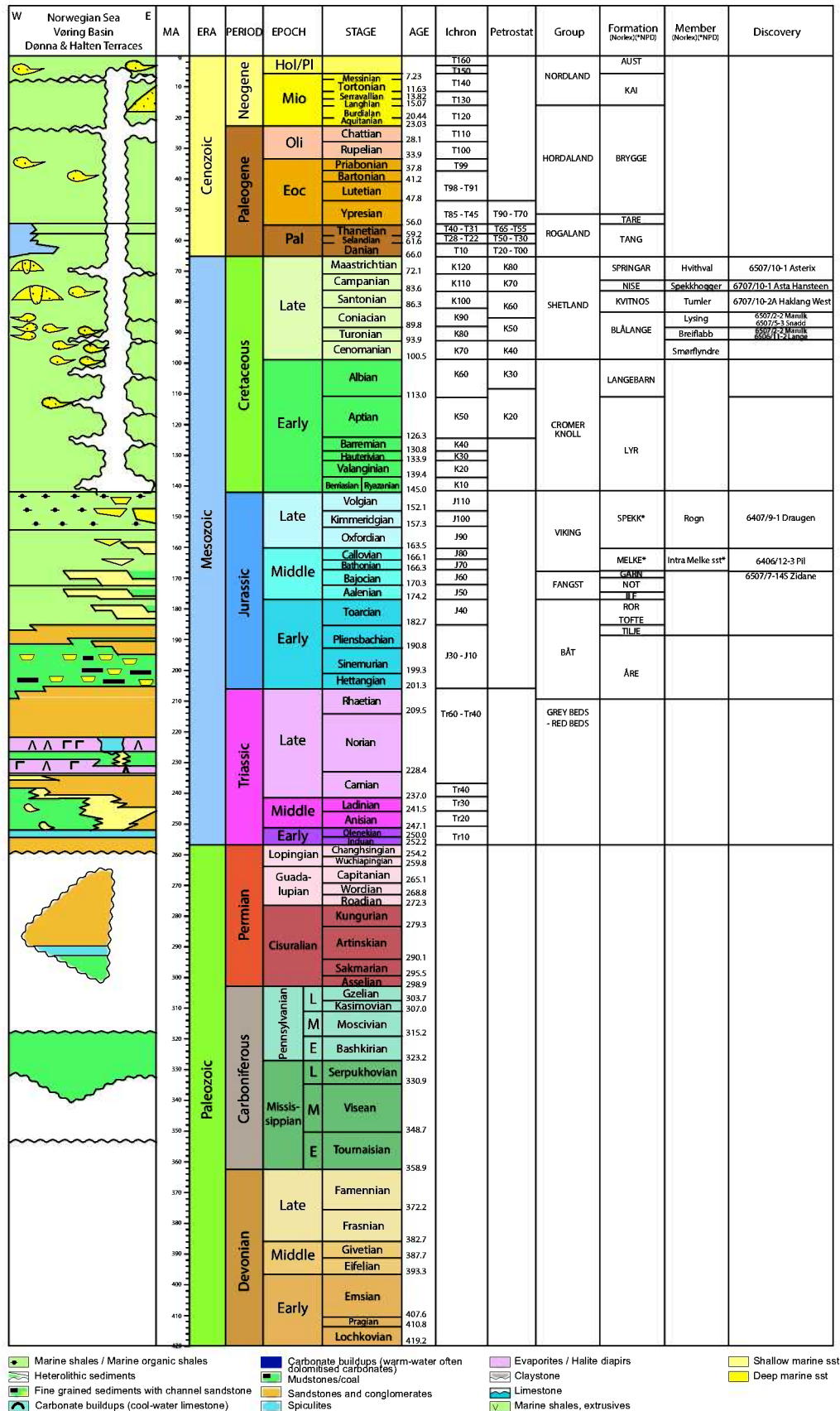


Figure 3.3 Norwegian Sea Stratigraphy Chart

In addition, the prospectivity of Early Cretaceous stratigraphic level has been evaluated. The Lower Lange Fm. sandstones (c.f. 6607/12-3) has been mapped in and around the licensed area. However, the Lower Lange Fm. sandstones onlaps the Mesozoic section in the area up-dip to the East of the block, i.e. thus there is no closure or pinch-out of the Lower Lange Fm. sandstones within the licensed area. Furthermore, all hydrocarbon is interpreted to have migrated beyond the PL693 license to the East similar to the 6607/12-3 well.

4 Prospect update

Havørn Prospect

Havørn prospect was the main prospect identified in the APA 2012 application (Figure 1.1). The prospect was defined as a four-way dip closure in the Tang /Tare Formations located in the Træna Basin of the Nordland Ridge. The main play type was anticipated to be deep marine turbidite sandstones sourced from the NorthEast, i.e. the Vestfjorden Basin. The main risks were considered to be reservoir presence.

The work effort focused on reducing the prospect risks through purchasing and re-processing of 3D seismic in the licence and G&G studies. The re-processed seismic survey enabled to map and analyse the prospect in more detail compared to the initial description in the APA application. The AVO and Rock Physics studies provided important information regarding the evaluation of the reservoir and expected reservoir properties. Analysis of partial offset stacks and pre-stack AVO study showed no evidence of reservoir presence and gas saturation in the prospect area. The results of the assessment led to negative conclusions and downgrading of the Havørn prospect.

A generic resource evaluation was performed ignoring the seismic study results for completeness. This gives the Pmean recoverable gas resources estimated to be $10.5 \times 10^9 \text{ Sm}^3$ (Table 4.1). The overall chance of success (Pg) for this case is 7% which reflects the very low chance for reservoir presence.

Table 4.1 Havørn prospect data sheet (NPD)

Block 66084 & 66087	Havørn	Prospect name	Prospect	Prospect ID (or New)	NPD approved (Y/N)	Assessment year
Play name	OMV (Norge)	Reported by company	PL 693 Reelinquishment Report	Water depth [m MSL] (>0)	Seismic database (2D/3D)	3D
Gas	Traena Basin	Structural element	Structural	360		
1 of 1	Main phase	Type of trap	Associated phase	Base, Mean	High (P10)	High (P10)
	Low (P90)	Base, Mode	Low (P90)		Base, Mode	
Oil [10 ⁶ Sm ³] (>0.00)	1.30	9.80	15.00	34.80		
Gas [10 ⁶ Sm ³] (>0.00)	0.90	6.80	10.50	24.00		
Oil [10 ⁶ Sm ³] (>0.00)	0.90	6.80	10.50	24.00	0.50	2.10
Gas [10 ⁶ Sm ³] (>0.00)	0.90	6.80	10.50	24.00	0.50	2.10
Palaeocene	Reservoir litho (from)	Tare Fm.	Source Rock, chrono primary	Spekk Fm.	Seal, Chrono	Eocene Fm.
Eocene	Reservoir litho (to)	Tang Fm.	Source Rock, chrono secondary	Callavien	Seal, Litho	Brygge Fm.
Technical (oil + gas + oil & gas case) (0.00-1.00)	0.07	Oil case (0.00-1.00)	Gas case (0.00-1.00)	Oil & Gas case (0.00-1.00)		
Reservoir (P1) (0.00-1.00)	0.20	Trap (P2) (0.00-1.00)	Charge (P3) (0.00-1.00)	Retention (P4) (0.00-1.00)		
Low (P90)	1750	Base	High (P10)	0.50		
Depth to top of prospect [m MSL] (> 0)	21.8	68.0	116.2			
Area of closure [km ²] (> 0.0)	29	43	60			
Reservoir thickness [m] (> 0)	30	65	100			
HC column in prospect [m] (< 0)	0.250	1.800	4.300			
Gross rock vol. [10 ⁶ m ³] (> 0.000)	0.09	0.22	0.49			
Net / Gross [fraction] (0.00-1.00)	0.17	0.21	0.25			
Porosity [fraction] (0.00-1.00)	10.0	30.0	50.0			
Permeability [mD] (> 0.0)	0.35	0.90	0.25			
Water Saturation [fraction] (0.00-1.00)	0.0050	0.0050	0.0040			
Bg [Rm3/Sm3] (< 1.0000)	25000	45000	90000			
1/Bg [Sm3/Rm3] (< 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)	0.60	0.70	0.80			
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.60	0.70	0.80			
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)						
Temperature, top res [°C] (>0)	47					
Pressure, top res [bar] (>0)	176					
Cut off criteria for N/G calculation	1. Porosity	2. VCL	3.			

5 Technical evaluations

No new technical and economic evaluations have been performed due to the very high geological risk of the prospect and relatively low resource potential. The mean case estimated resources are below the minimum economic field size in the area.

6 Conclusions

PL693 partnership has put considerable effort into the evaluation of prospectivity in this license. The evaluation of the PL693 area has contributed to increased understanding of the Tand /Tare Fms. depositional system and sand distribution. The analysis showed that turbidity sediments are most likely not present in the prospect area. On the contrary, the observed amplitude in the target interval of Havørn is interpreted to be associated with the presence of hot shales as drilled in the 6607/12-1 well.

The reasons for relinquishment of license are listed below:

- Lack of evidence for reservoir presence and quality of the interpreted target interval.
- Lack of convincing evidence of gas saturation from pre-stack AVO / rock physics study.
- Identified recoverable volumes are regarded non-commercial and hence not sufficient to support a drill decision. In addition, the prospect has a very high geological risk.

All licence commitments have been fulfilled.