wintershall dea

RELINQUISHMENT REPORT
PL804

concedo

AkerBP

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1 Key License History

Production License 804 was awarded in APA 2014 to Wintershall Norway as operator (40%), Concedo ASA (30%), and Det norske oljeselskap ASA (30%) and became effective on 06.02.2015. The license was located in blocks 7121/10, 7121/11 and 7121/12 with the total area of 313 km2 (Fig. 1.1). The decision to drill an exploration well was scheduled for 07.02.2017.

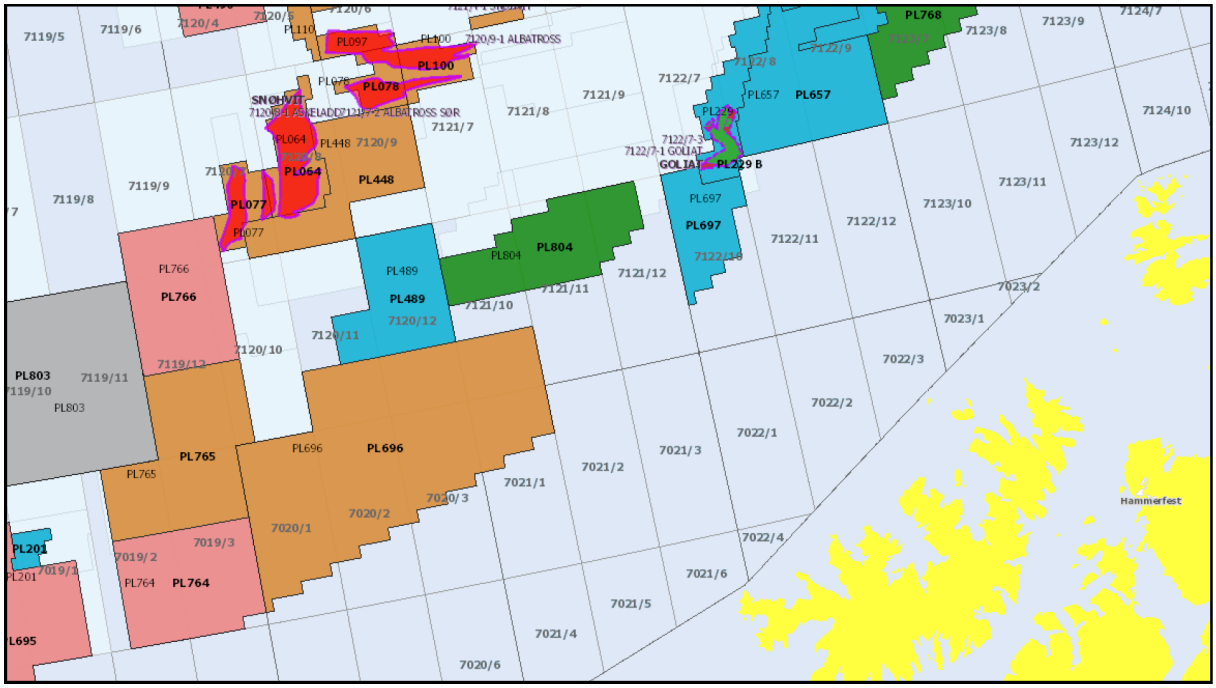

Fig. 1.1 PL804 license area

The initial work commitment included reprocessing of 3D seismic and the execution of G&G studies. An extensive G&G work program was planned and performed for PL 804 license to define and evaluate prospectivity in the Permian play, and to assess all the associated risk elements. The application for the area was based on the Størekorsnes prospect of Permian age

DG0902 3D seismic survey of 500 km^2 was jointly Pre-SDM reprocessed with three BSS01 2D lines (203, 108,103) of 285 km of the total length by CGG in 2015 and delivered in September 2016.

The Storekorsnes prospect is a combined stratigraphic/structural trap at Upper Permian Ørret Formation level. The prospect is dependent upon reservoir pinch-out to the west and south, and independent fault seal to the east and north (Fig. 1.2). An intraformational transgressive shale constitutes the bottom seal and shales of the Lower Triassic Havert Formation constitute the top seal.

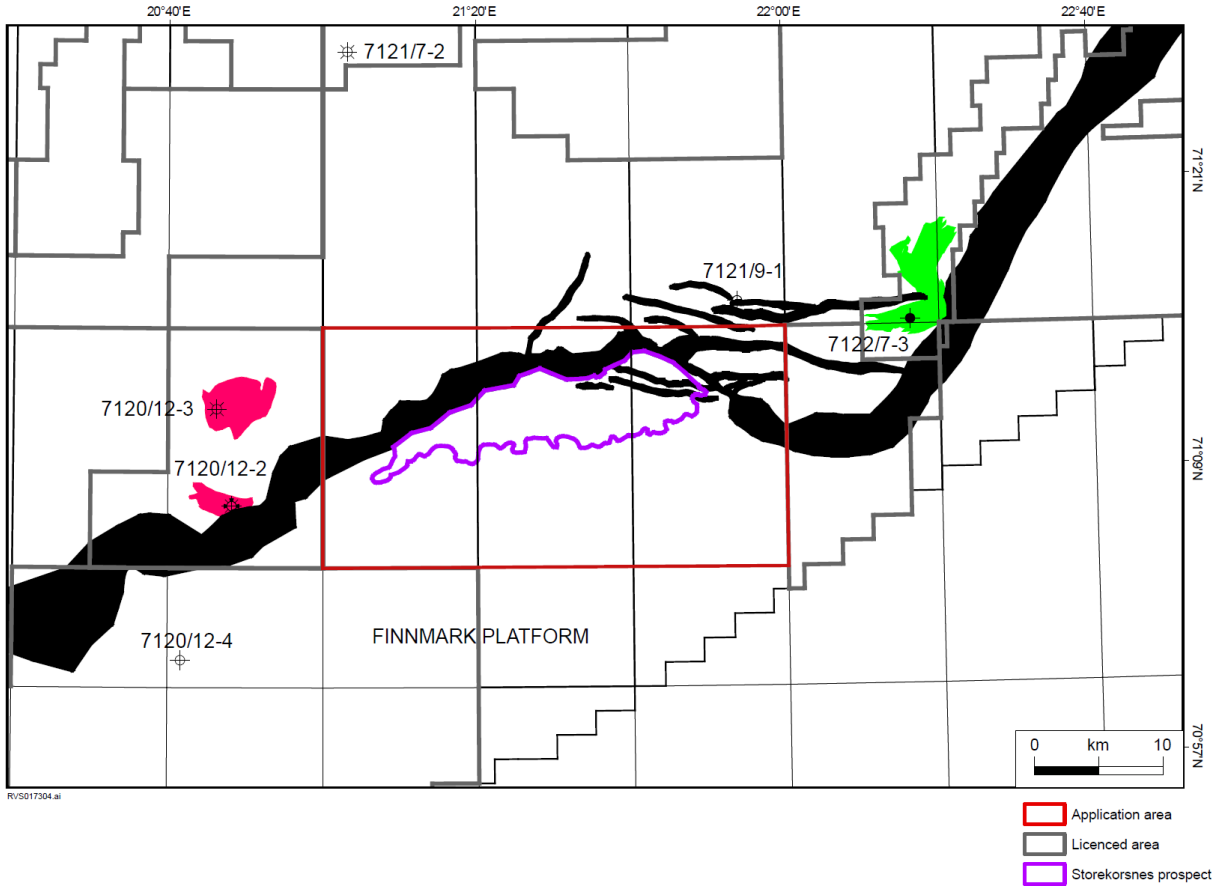

Fig. 1.2 Sorekorsnes prospect location

Underlying organic rich shales of Carboniferous age are considered to be the most likely hydrocarbon source. Charge is possible directly from the Finnmark Platform or from the Hammerfest Basin which is down flank and north of the prospect. Hydrocarbon charge from the Triassic age Steinkobbe Formation which is oil mature in the Hammerfest Basin is also possible. Oil is considered the most likely hydrocarbon phase. The crest of the structure is located in the western part of the prospect at 1380 m MSL.

Storekorsnes prospect was part of the same play that included the Andotten prospect in the nearby PL768 and PL768B license lying to the northeast awarded to Wintershall and partners in the APA 2013. The play is unproven at this stage and consequently Storekorsnes prospect risk is considered high.

2 Database

This chapter describes the databases that have been used to evaluate the greater PL 768/768 B area.

2.1 Seismic data

The common seismic database of the PL804 license used in the mapping of the prospect is shown in Fig. 2.1 and listed in Table 2.1. The evaluation of the prospect is based on the PSDM reprocessed 3D seismic survey DG0901. Full, near and far stack have all been used in the evaluation. The NA01M1 and EN0702 3D seismic surveys have been valuable in the understanding of the eastern extension of the prospect. A variety of vintages of 2D seismic data have also been used mainly for regional understanding and well calibration particularly of well 7120/12-4.

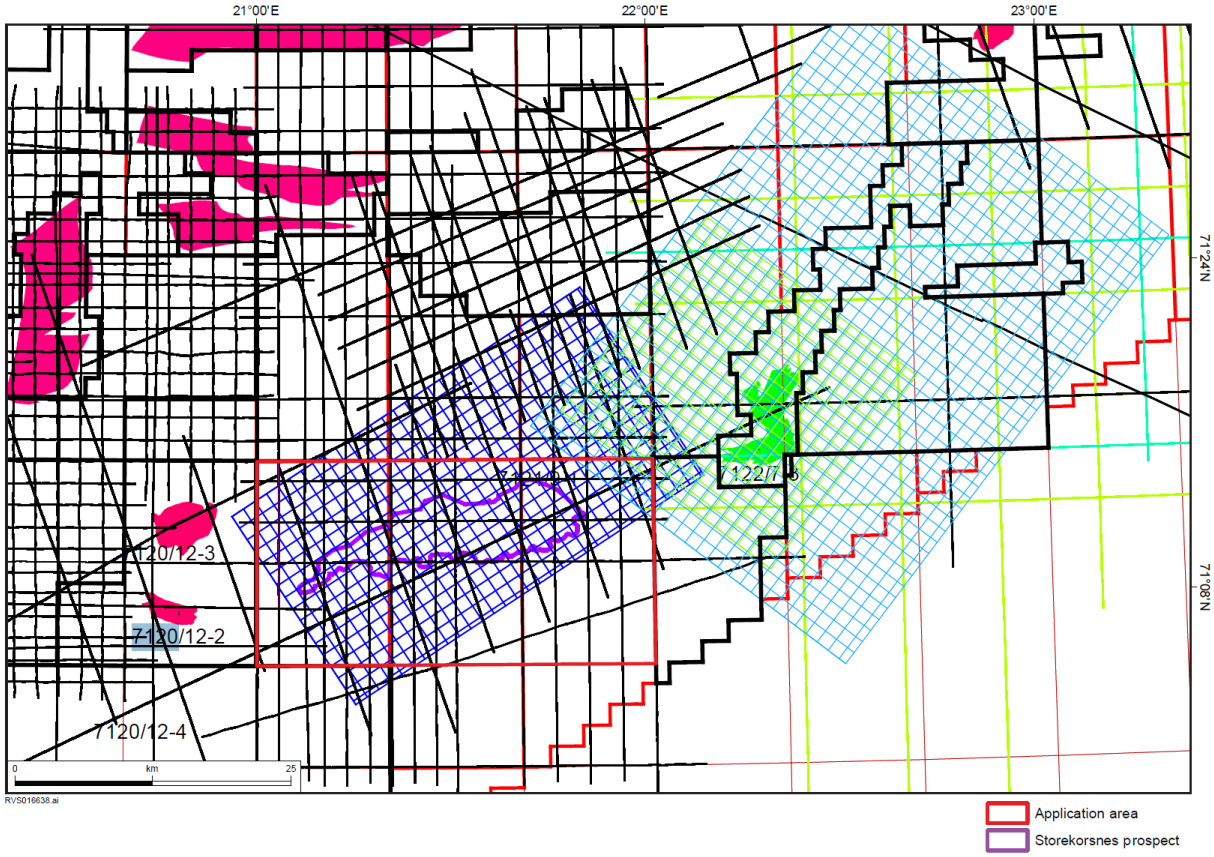

Fig. 2.1 Seismic database

Table 2.1 Seismic database

Seismic survey	3D/2D	Overall quality	Type
DG0901	3D	Moderate	Digital
EN0702, parts	3D	Good	Digital
NA01M01	3D	Good	Digital
ST8320R00	3D	Moderate to good	Digital
NPD-TR-73/NPD-TR-73-R1	2D	Moderate	Digital
NPD-TR-77/NPD-TR-77-R1	2D	Moderate	Digital
NPD-TR-79	2D	Moderate	Digital
NPD-FI-83	2D	Moderate to good	Digital
NPD-FI-84	2D	Moderate to good	Digital
ST513	2D	Moderate	Digital
BSS01	2D	Good to very good	Digital
BSSD01	2D	Good to very good	Digital
BARE05	2D	Good	Digital

2.2 Well data

The well database used in the evaluation includes 7 wells penetrating the Ørret Formation in the Hammerfest Basin and Finnmark Platform (Table 2.2). Additionally, all wells in the vicinity encountering hydrocarbon have been used to better understand the petroleum system. The key wells for understanding the Permian age clastic deposition are 7120/12-2, 7120/12-4 and 7122/7-3.

Table 2.2 Well database

Well	Year	Results	TD Formation	Status
7120/1-1	1985	Shows	Permian Ørret Formation	Released > 20 years
7120/9-2	1984	Discovery	Permian Røye Formation	Released > 20 years
7120/12-1	1980	Shows	Middle Triassic Kobbe Formation	Released > 20 years
7120/12-2	1981	Discovery	Basement	Released > 20 years
7120/12-4	1984	No shows	Carboniferous Falk Formation?	Released > 20 years
7122/6-2	2006	Discovery	Middle Triassic Kobbe Formation	Traded
7122/7-3	2006	Goliat Field	Permian Røye Formation	Released > 2 years
7124/3-1	1987	Discovery	Permian Falk Formation?	Released > 2 years
7125/1-1	1988	Discovery	Middle Triassic Kobbe Formation	Released > 2 years
7125/4-1	2007	Discovery	Early Triassic Klappmys Formation	Released > 2 years
7128/4-1	1994	Discovery	Basement	Released > 2 years
7128/6-1	1991	Shows	Basement	Released >2 years
7222/11-1	2008	Caurus	Middle Triassic Kobbe Formation	Released > 2years
7226/11-1	1987	Discovery	Basement	Released > 20 years

3 Geological and Geophysical Studies

Basin Modelling

The objective of the in-house basin analysis was to evaluate the source rock potential for hydrocarbon migration and charge into the Storekorsnes prospect. The underlying Carboniferous Tettegras Fm shales are considered as the main source rock for the prospect. The local source rocks possibly present in the half graben infill setting are mainly in the mid to late oil maturity window at present day according to basin modelling study (Fig. 3.1). Due to the burial history, erosion, uplift and isostacy, the source rocks are most likely not expelling petroleum present day. Based on the geochemical analyses of the Carboniferous source rocks in the two wells 7128/4-1 and 6-1 the initial Hydrogen Index have been around 300 mg/g TOC and TOC of 70%, which will expel both gas and oil (Fig. 3.2).

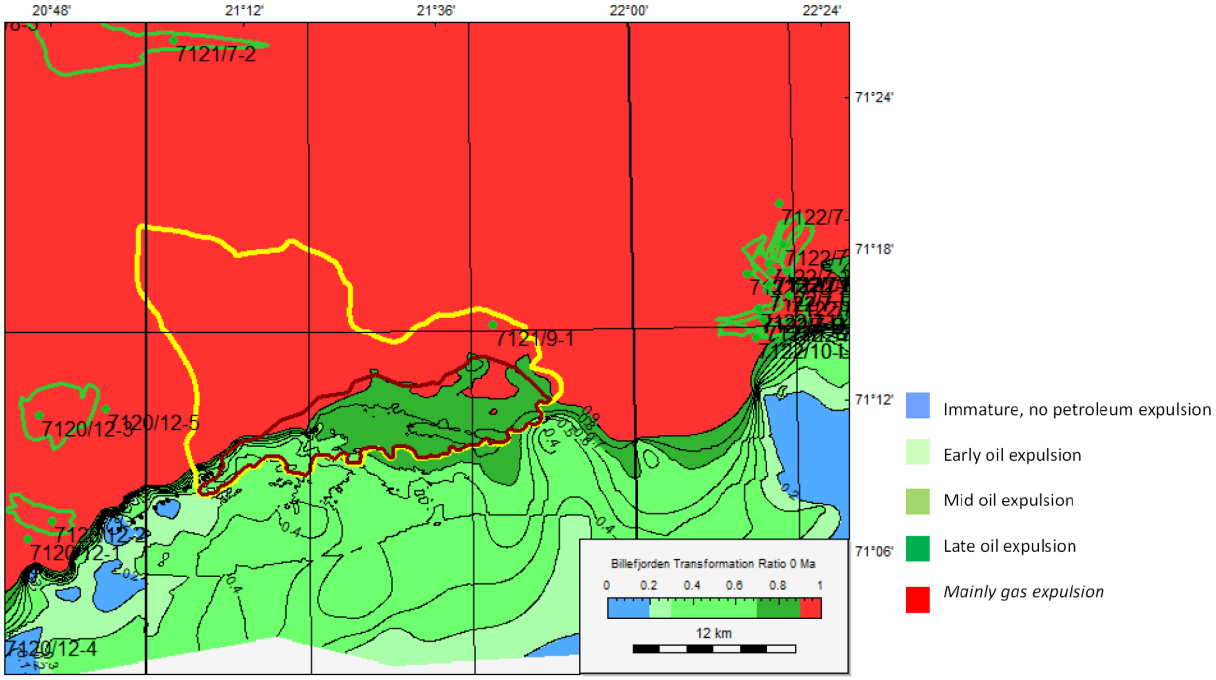

Fig. 3.1 Transformation ratio for kerogen to petroleum at Nerar Top Carboniferous level.

The expulsion of petroleum starts when the source rock reaches TR of about 0.2. The yellow polygon is the drainage area for the Storekorsnes Prospect.

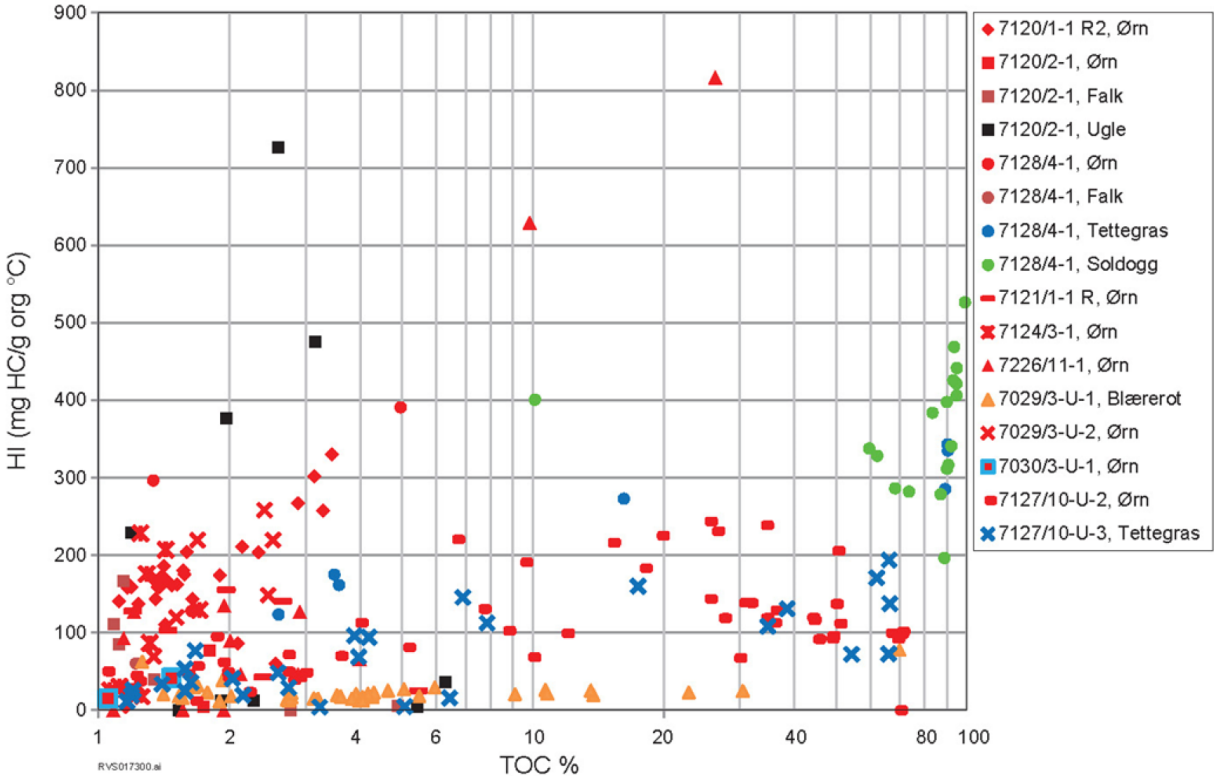

Fig. 3.2 Initial TOC and HI for Carboniferous and Permian source rocks

An alternative HC migration and charge model was evaluated that assumed the Triassic Steinkobbe Fm shales as the main source rock for the prospect. They would provide the lighter petroleum compounds confirmed by oil-prone facies in the Goliat field. The Total Organic Carbon (TOC) and Hydrogen Index (HI) measured in cuttings and core material reflect the present day potential. Based on maturity, the original source rock richness and quality for both Steinkobbe and Hekkingen Fm have been back calculated to initial TOC values. The Steinkobbe Fm of Anisian/Ladinian age is a good source rock for both oil and gas generation. The initial TOC and HI for the Steinkobbe Fm is about 3% and 300 mg HC/g TOC, respectively in the kitchen area to the east and northeast from Storekorsnes Prospect. The gross thickness of the Triassic source rocks are estimated to 200 m.

The basing modelling gave a good overview about the potential of the two different charge mechanisms.

A Regional Sequence stratigraphy and depositional model study

Well correlation and mapping of facies distribution has been carried out by Wintershall internally, with the objective to understand the greater context and connection between the proximal deltaic and shelfal facies to the distal basin floor fan setting. Well correlation and resulting geological concept model for the Ørret Fm is shown in Fig. 3.3. The late Permian mixed carbonate/clastic shelf collapsed due to the Permian rifting. Two regressive sandy sequences were separated by transgressive shales which act as bottom seal for the Storekorsnes prospect. Deposition of the early Triassic shale dominated Havert Fm formed the top seal for the prospect.

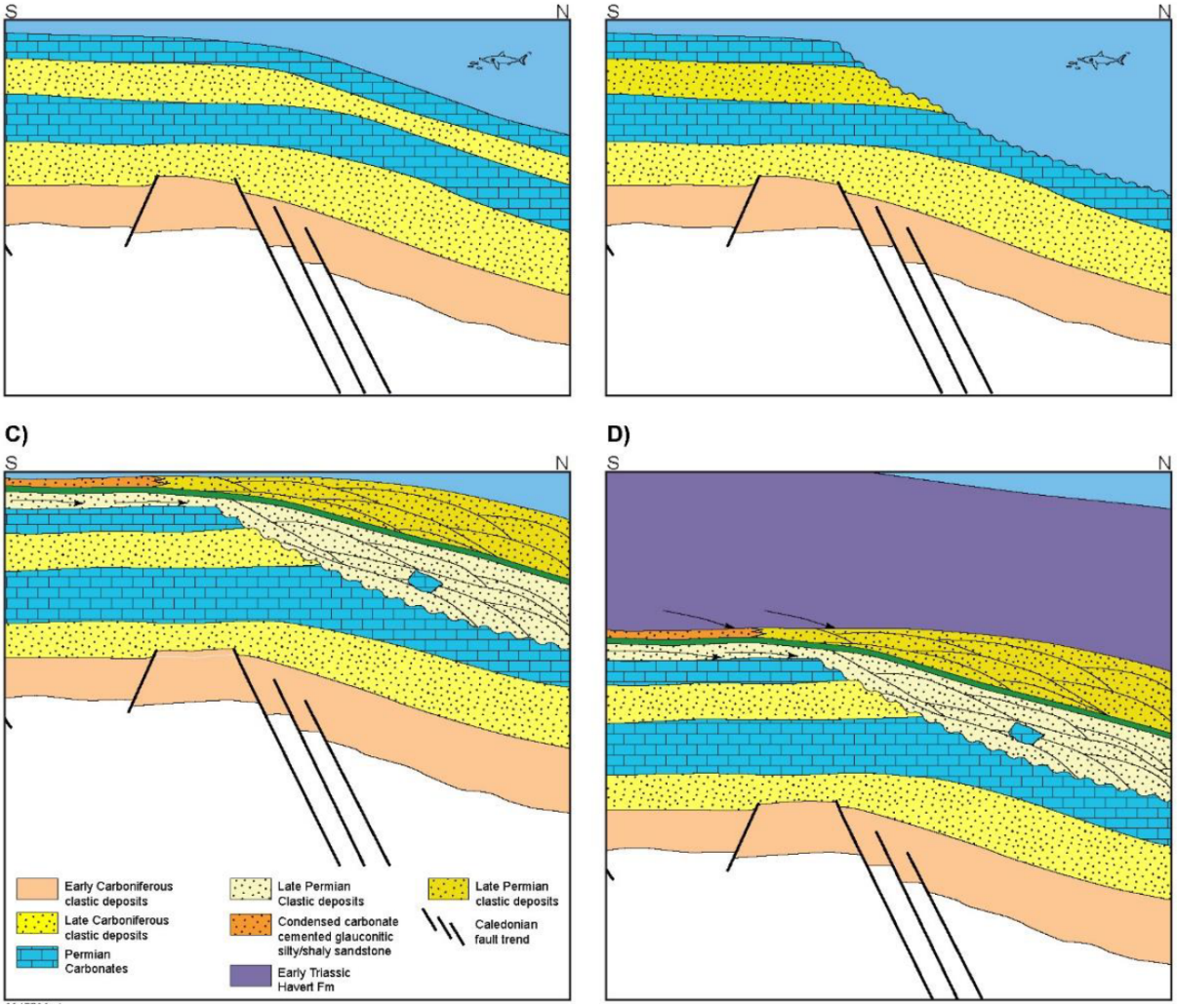

Fig. 3.3 Late Permian Ørret Fm geological model

Log Based Seismic Modelling

The study focused on the Ørret Fm interval. Well 7120/12-4 was the only good analogue for modeling as it shared similar burial history to the Storekorsnes prospect. The objective was to examine seismic amplitude sensitivity on hydrocarbon saturation. The study concluded that the Ørret Fm sandstone intervals are characterized by very weak sensitivity to pore fluid types According to the fluid substitution synthetic seismic modeling only in gas case amplitudes some change could be detectable, provided high signal-to-noise ratio seismic data is used (Fig. 3.4). After thorough analysis of the reprocessed seismic data and available angle range no direct hydrocarbon indicators nor amplitude anomalies were identified.

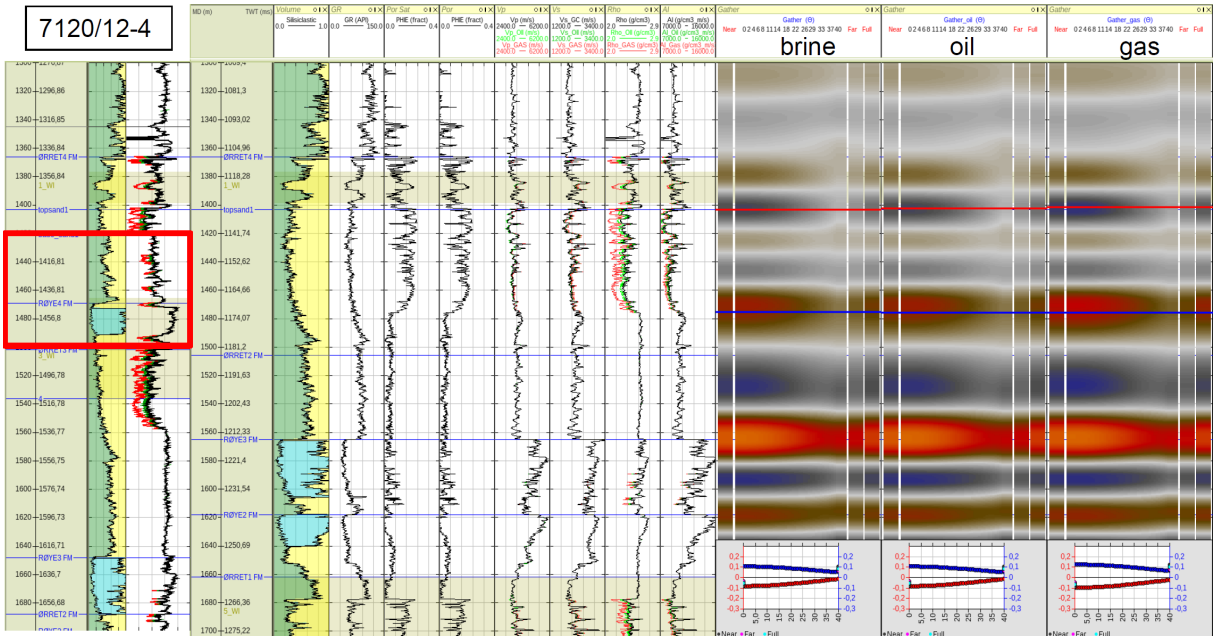

Fig. 3.4 7120/12-4 Fluid substitution modelling

4 Prospect Update report

4.1 Prospect mapping

As part of the initial license commitment in PL 804 , DG0902 3D seismic was PSDM reprocessed together with three BSS01 2D lines used for tying nearby wells. The final reprocessed data resulted in improved quality. Extensive interpretation work was carried out regionally covering the Finnmark Platform and neighboring areas eg. Hammerfest Basin. A set of regional marker horizons were interpreted on available 2D and 3D seismic and tied to offset wells (Fig. 4.1, Fig. 4.2). PSDM seismic reprocessing improved the quality of the seismic image and optimized the interpretation of the reservoir section however the limited seismic resolution didn't allow to conclude or de-risk on the trap presence. The final conclusion was that the top seal and trap effectiveness constitute a major risk for the Ørret Formation reservoir in the SW part of the prospect.

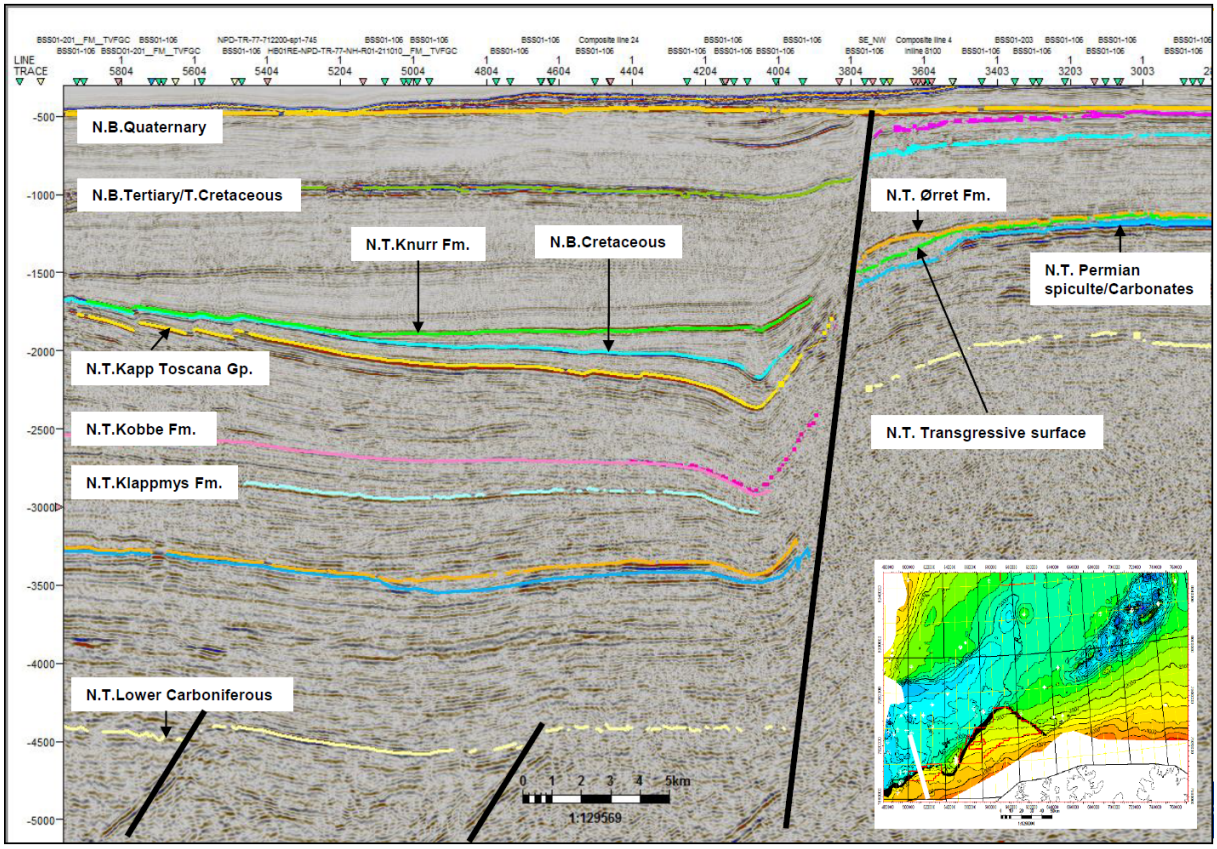

Fig. 4.1 Line BSS01-106 transecting The Storekorsnes prospect

Seismic horizons interpreted regionally

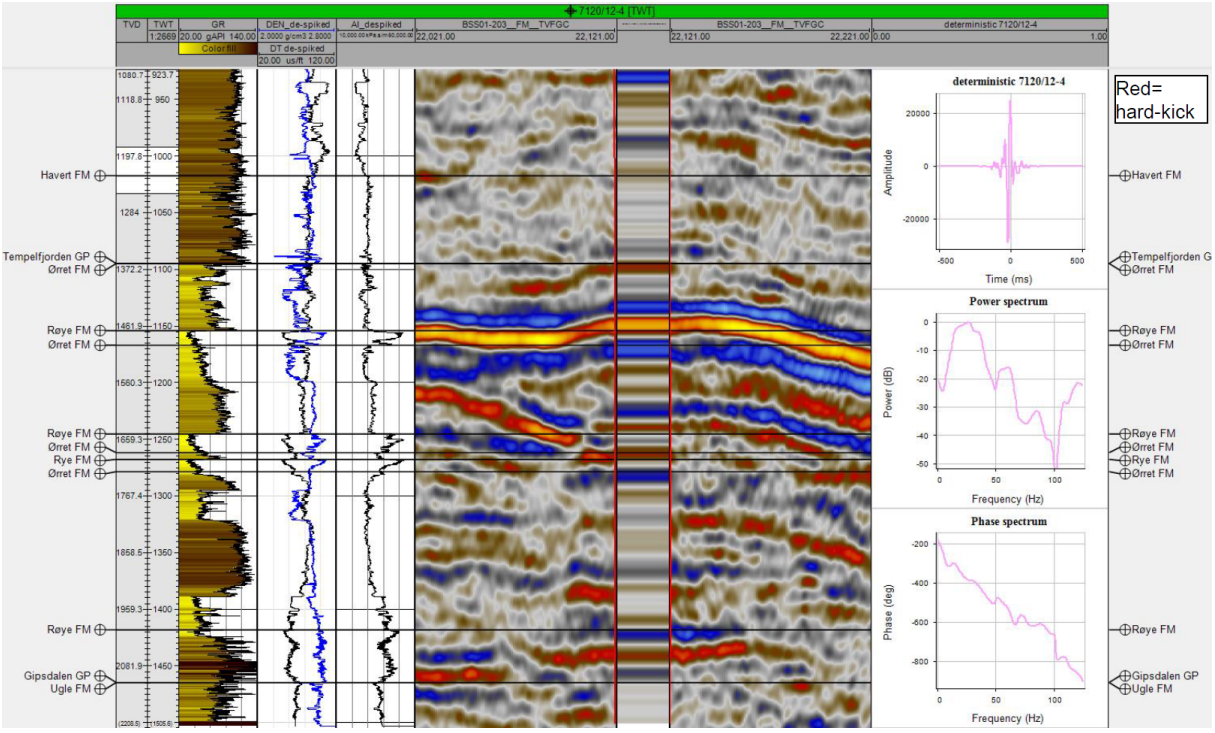

Fig. 4.2 Well 7120/12-4. Seismic to well tie

Below is a description related to the Andotten prospect elements:

Event mapping and geological model

Several events in the Permian package, from Top Ørret Fm down to the Permian-Carboniferous unconformity, were interpreted. The purpose was to look for geometries and seismic signature in the up-dip direction that could be seen as a true updip sand pinch-out against the Røye Fm platform to the South. The geological model divides the Ørret Fm Upper wedge 1 into two intervals: a lower and upper regressive sequences which are separated by transgressional shale (Fig. 4.3). Thin sandstone facies are expected to occur in the uppermost wedge interval updip at the top sets of a highly condensed section that is interpreted to continue over the platform. No valid trap is identified for this interval within the PL 804. The depth map of the Storekorsnes prospect I is shown in Fig. 4.4.

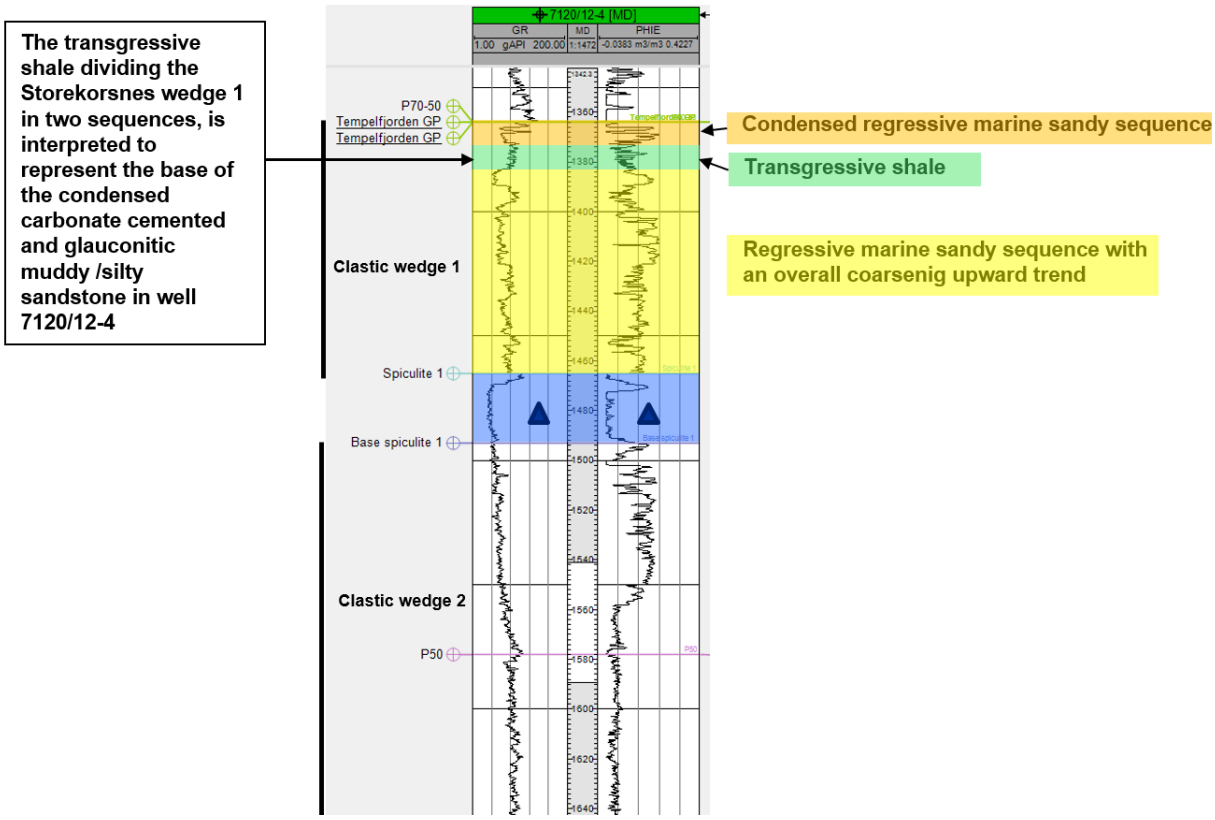

Fig. 4.3 Storekorsnes wedge geological model

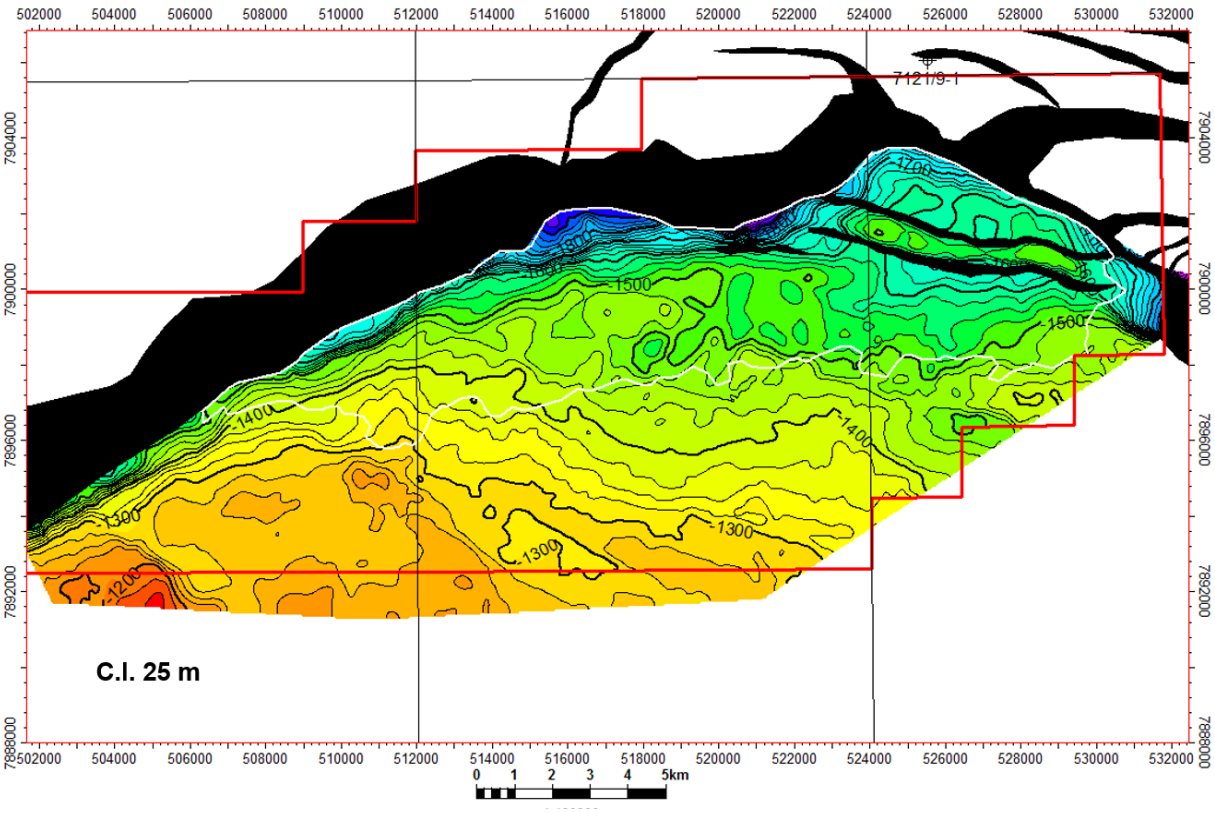

Fig. 4.4 The Storekorsnes prospect depth map.

Reservoir

The prognosed reservoir for the Storekorsnes prospect are sandstones of the Lower Ørret Formation of Late Permian age. Cored intervals in well 7120/12-2 are interpreted to represent

shallow marine to marginal marine/coastal plain deposits. In core 8 the marginal marine/coastal plain deposits are dominated by very fine to medium grained laminated to low angle cross bedded sandstone inter bedded by lamina of coal. These deposits are overlain by homogeneous massive sandstone without any sedimentary structures interpreted to be shallow marine. 7In core 7 the lower shoreface deposits are dominated by muddy bioturbated very fine to fine sandstone followed by medium to coarse grained cross bedded clean sandstone. Core 1 in well 7120/12-4 is interpreted to represent lower to middle shoreface sandstone overlain by upper shoreface clean sandstone facies. Even though the reservoir section in the Storekorsnes prospect is represented by a condensed section in well 7120/12-4, it is likely that the Late Permian regressive wedge is dominated by shallow marine deposits. However, a High Definition Frequency Decomposition cube based on GeoTeric software has been interpreted to possibly indicate channels and gravity flow deposits. Channel-like features have also been identified on seismic section in the reservoir sequence.

Seal

The Storekorsnes prospect is a combined structural / stratigraphic trap defined by a pincout of the reservoir to the south. Based on the updated interpretation on the newly reprocessed data there is still large uncertainty of the presence of the pinch-out due to limited seismic resolution and very thin Upper Permian condensed section continuing southwards over the carbonate platform. Lower to Middle Triassic sediments capping the Late Permian sand prone deposits, constitute the top seal of the play. On seismic data, these sediments are characterised by large-scale clino-therms sourced from Fennoscandia. In well 7120/12-2 and 7120/12-4, the Lower- Middle Triassic sequence is dominated by shale occationally inter bedded with thin beds of siltstone and sandstone. The base seal for the clastic wedge is provided by the Røye Formation which is dominated by tight carbonates and spiculites. The base seal for the Storekorsnes prospect (upper sequence of the clastic wedge) is provided by transgressive shales.

Source-Migration-Charge

There are two source rock scenarios evaluated for the Storekorsnes prospect. The first and main model assumes local source rock of Carboniferous age (Tettegras Fm) proven on the Finnmark Platform to the east in wells 7128/4-1 and 7128/6-1. The presence of the Carboniferous source rocks and their thickness remain a large uncertainty on the west Finmark Platform. The second scenario is a the Triassic Steinkobbe Fm through the main TFFZ fault zone from Hammerfest Basin.

4.2 Resource estimation

Mean technical recoverable oil volumes of the Storekorsnes prospect is estimated to about 253 mmbbls. The Andotten prospect is evaluated to have a GPOS of about 7.5%. The main risk elements are the Trap Effectiveness (30%), and Trap Presence (70%).

Summary of final HC volumes, selected parameter distributions used as an input and risk assesment are shown in **Table 4.1**

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Table 4.1 Prospect data

16/08/2022

Table 5: Prospect data (Enclose map)

Block	7121/10, 7121/11, 7121,	Prospect name	Storekorsnes	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	
Play name	NPD will insert value	New Play (Y/N)		Outside play (Y/N)					
Oil, Gas or O&G case:	Oil	Reported by company	Wintershall	Reference document				Assessment year	2017
This is case no.:		Structural element	Finmark Platform	Type of trap	Stratigraphic/struct.	Water depth [m MSL] (>0)	275	Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE		**Main phase**				**Associated phase**			
Volumes, this case		Low (P90)	Base, Mode	Base, Mean	High (P10)	Low (P90)	Base, Mode	Base, Mean	High (P10)
In place resources	Oil [10^6 Sm^3] (>0.00)	5.00		139.40	375.55	0.09		3.00	8.09
	Gas [10^9 Sm^3] (>0.00)								
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	1.25		39.41	108.75	0.02		0.85	2.29
	Gas [10^9 Sm^3] (>0.00)								
Reservoir Chrono (from)		Reservoir litho (from)	Ørret Fm	Source Rock, chrono primary	U. Carboniferous	Source Rock, litho primary	Kobbe Fm	Seal, Chrono	Lower Triassic
Reservoir Chrono (to)		Reservoir litho (to)	Ørret Fm	Source Rock, chrono secondary	M. Triassic	Source Rock, litho secondary	Tettegrass Fm	Seal, Litho	Havert Fm
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)	0.75	Gas case (0.00-1.00)		Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.80	Trap (P2) (0.00-1.00)	0.21	Charge (P3) (0.00-1.00)	0.64	Retention (P4) (0.00-1.00)	0.70		
Parametres:	Low (P90)	Base	High (P10)	*Drop decision taken by Feb 2017. Key issues for Storekorsnes are trap effectiveness and trap presence. No clear pinch-out seen on seismic.*					
Depth to top of prospect [m MSL] (> 0)		1299							
Area of closure [km^2] (> 0.0)	3.6	39.7	81.6						
Reservoir thickness [m] (> 0)									
HC column in prospect [m] (> 0)	83	327	400						
Gross rock vol. [10^9 m^3] (> 0.000)	8484.700	9416.600	10360.900						
Net / Gross [fraction] (0.00-1.00)	0.32	0.50	0.70						
Porosity [fraction] (0.00-1.00)	0.12	0.16	0.20						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0.39	0.28	0.19						
Bg [Rm3/Sm3] (< 1.0000)									
1/Bo [Sm3/Rm3] (< 1.00)	0.87	0.85	0.83						
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)	11	22	36						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0.16	0.28	0.40						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0.16	0.28	0.40						
Recov. factor, gas main phase [fraction] (0.00-1.00)									
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)	50			Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
Pressure, top res [bar] (>0)	180			Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
Cut off criteria for N/G calculation	1.	2.	3.					Kart nr	NPD will insert value

5 Conclusions

As a result of the work conducted it has to be stated that the main geological risks of trap effectiveness/presence and charge are high. The updated volumetric calculation for the Sorekorsnes prospect significantly decreased the resource volumes comparing to the initial evaluation.

Wintershall Norge AS recommended the drop decision inFebruary 2017 which was approved by all partners.