Relinquishment Report PL843

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1 Introduction

1.1 License Owners

- Aker BP ASA (40%), operator
- Equinor Energy AS (40%)
- Vår Energi AS (20%)

1.2 Award and Work Program

The license was awarded to Aker BP (op) with Pure E&P, Tullow and Statoil Petroleum as partners on the 5th February 2016 for an initial period of 9 years following the APA Licensing Round 2015, with a Drill or Drop decision within four years.

In 2016, Equinor acquired Tullow assets in the license and Pure E&P changed name to Point Resources and to Vår Energi in 2018.

The primary license work obligation consisted of optional acquiring 3D seismic over the entire license area. This has been fulfilled by the purchase of PGS16005 3D data.

PL 843 is situated on the Trøndelag Platform, between Northern Nordland Ridge and Helgeland Basin (Fig. 1.1). The license covers an area of 1123 km2 and covers parts of blocks 6608/12, 6609/7, 6609/8, 6609/9,6609/10, 6609/11 and 6609/12.

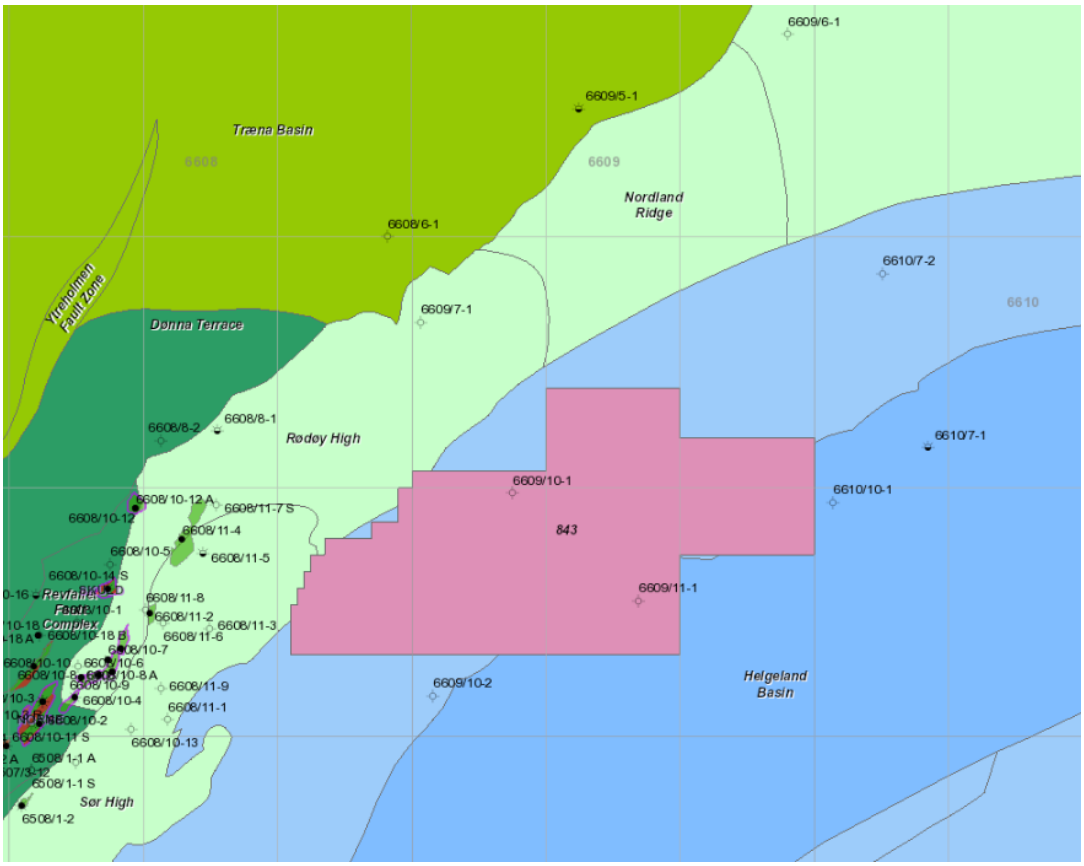

Fig. 1.1 PL843 outline, wells, discoveries and structural elements

1.3 Identified Prospectivity

The main play in the license has been the Upper Jurassic (Rogn Fm) Play with Mid-Lower Jurassic (Tilje Fm.) as secondary play.

The Upper Jurassic Play has received the main focus in this license and two prospects, Charlotte and Stina, have been defined Fig. 1.2 . The depositional setting is syn-rift graben infill with sand mainly sourced from Triassic highs. The top seal and base seals are the Spekk Fm. shales. Fig. 1.2 shows the outlines of the prospects on the Base Cretaceous Unconformity (BCU) depth map together with PL843 outline.

The recently drilled 6608/11-9 Godalen well tested the same play without encountering Rogn Fm. The 6608/6-1 Vågar well was drilled on a Permian Carbonate Play close to assumed HC source area in the Træna Basin. It was concluded from this well that an efficient hydrocarbon system in the assumed fetch area for PL843 was not likely.

The Helgeland Basin was regarded as a very challenging hydrocarbon source area in the application and was re-evaluated during the licence work, but without uplift the the potential for an efficient petroleum system.

On the background of these wells and the lack of hydrocarbon indicators from the geophysical analysis it is assumed that the Charlotte and Stina prospects in PL843 have a very low chance of success (COS), with main risks on reservoir presence and and working hydrocarbon system.

In the Mid-Lower Jurassic (Tilje Fm.) Play the Astrid prospect is evaluated. This play is tested by the wells 6609/10-1 and 6609/11-1 in the PL843 license area, both with high quality reservoirs, but waterfilled. As Astrid depends on the same petroleum system as Charlotte and Stina the chance of success is very low.

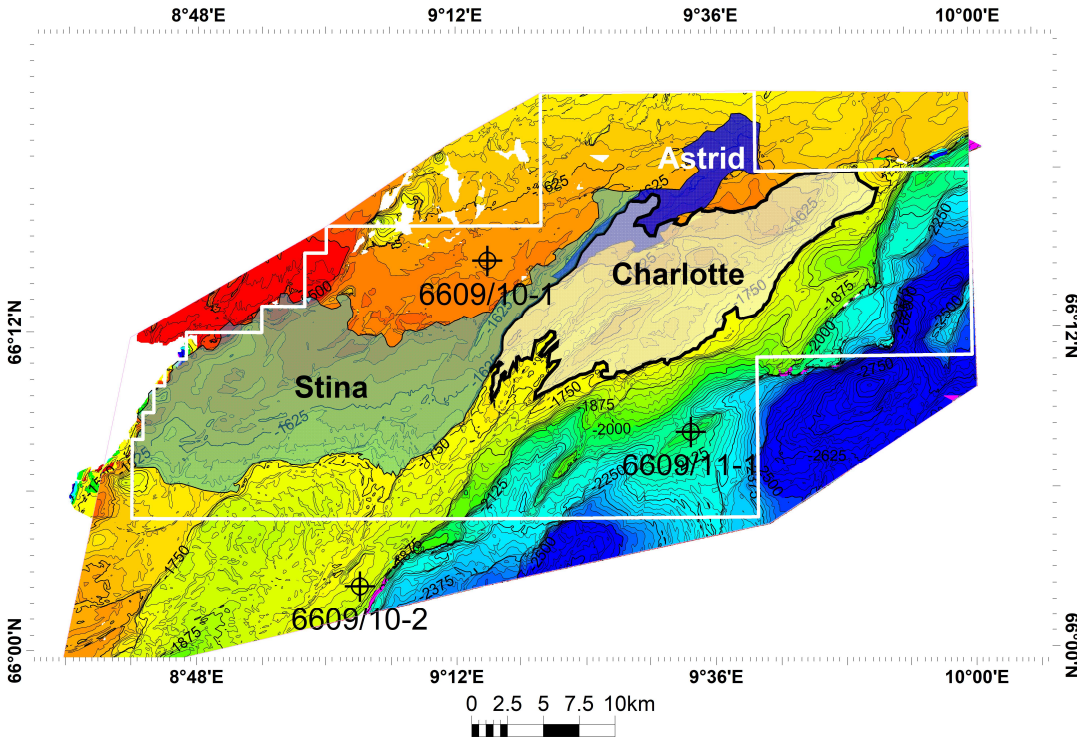

Fig. 1.2 Prospect outlines on BCU depth map

2 Database

2.1 Seismic Database

The seismic database consists of all relevant public 2D seismic that covers the license area on the Rødøy High (Table 2.1). In addition to this the following public 3D surveys are included: ST07M07 and NNE 2000. The license is covered by the PGS16005 survey, and a subset of 1706 km2 is also included in the seismic database. The coverage of the different 3D seismic datasets used and the prospects are shown in Fig. 2.1

Table 2.1 2 D Seismic database

Survey Name	Contractor
EL-8204	Elf Petroleum Norge AS/Geco
GMNR-94	Western Geco AS
GMT-84	Western Geco AS
GNRM-92	Western Geco AS
IS-HB-01	Inseis AS
MN88-2	Mobil Exploration Norway Inc.
MN9205	Mobil Exploration Norway Inc.
MNT-92	Nopec AS/CGG
N1P-94	CGG Norge AS
N2N3T96	Nopec AS/ PGS
N3RE96	Nopec AS/ Horizon
NH8102	Norsk Hydro / Geco
NH8301	Norsk Hydro / Geco
NPD-ML-73	Oljedirektoratet
NPD-ML-75	Oljedirektoratet
NPD-ML-76	Oljedirektoratet
NPD-ML-77	Oljedirektoratet
NPD-NR-83	Oljedirektoratet
NRGS84	Statoil / Geco
SG8374	Saga Petroleum / Geco
VBT-94	Nopec AS / Geoteam

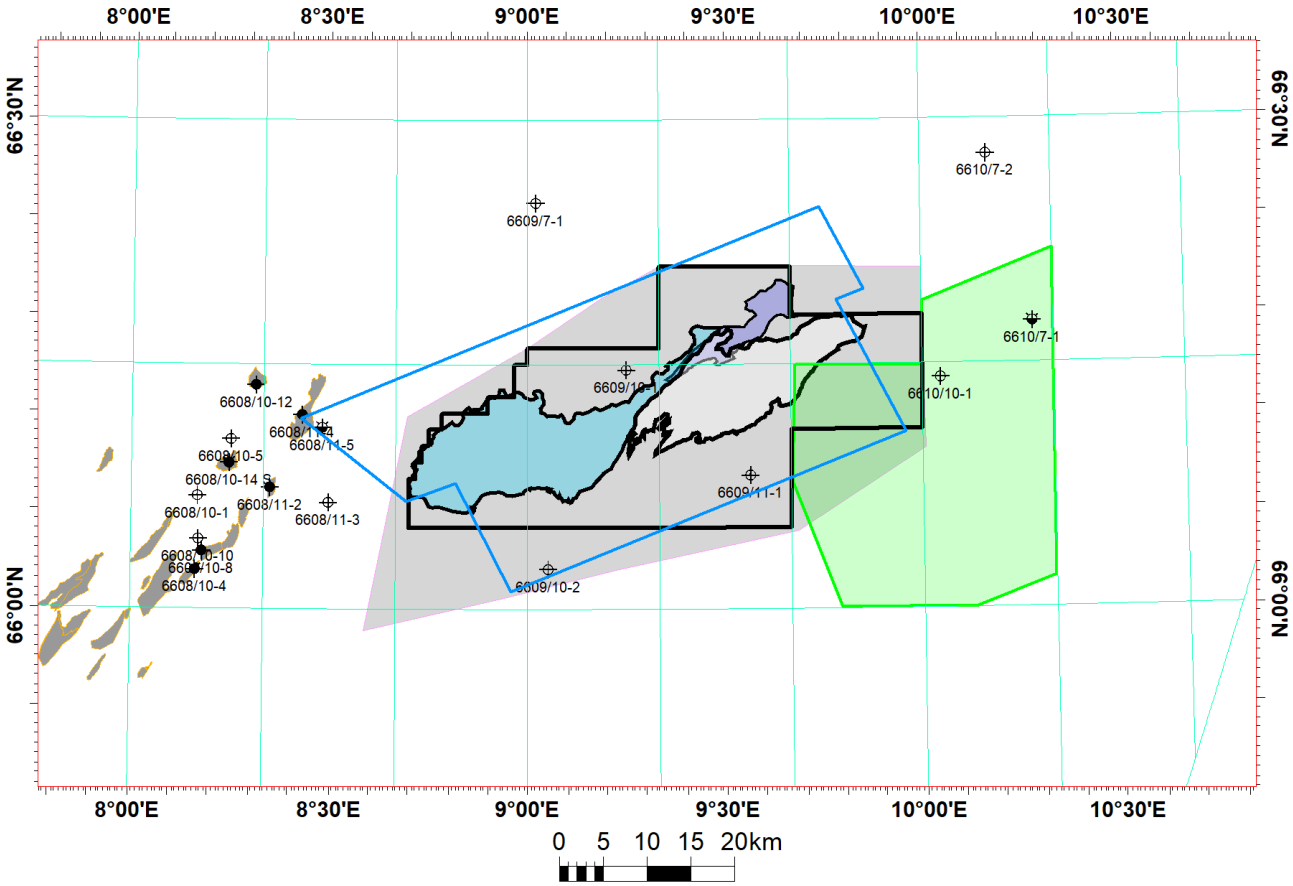

Fig. 2.1 3D Seismic database *Blue: NNE-2000, Green:. ST07M07, Grey: PGS 16005APR19*

2.1.1 Seismic reprocessing

Gather conditioning on the common database subset of PGS16005 was performed on final pre-stack time migration gathers by Sharp reflections in 2019. The subset ID is PGS16005APR19.

The objective was to improve the seismic data quality with particular focus on the Charlotte prospect in the interval between the BCU and Top Melke

Of note, the PGS16005 PSTM stacks and gathers show a series of flat events through the target interval. These events were identified as multiples which are most prominent on the nears.

Therefore, parabolic and linear Radon were key steps in the data conditioning workflow. They helped to attenuate much (though not all) of the multiple events through the target interval.

2.2 Well Data

The common well database is identical to the key wells from the APA 2015 application and shown in Table.2.1 and the map in Fig. 2.2

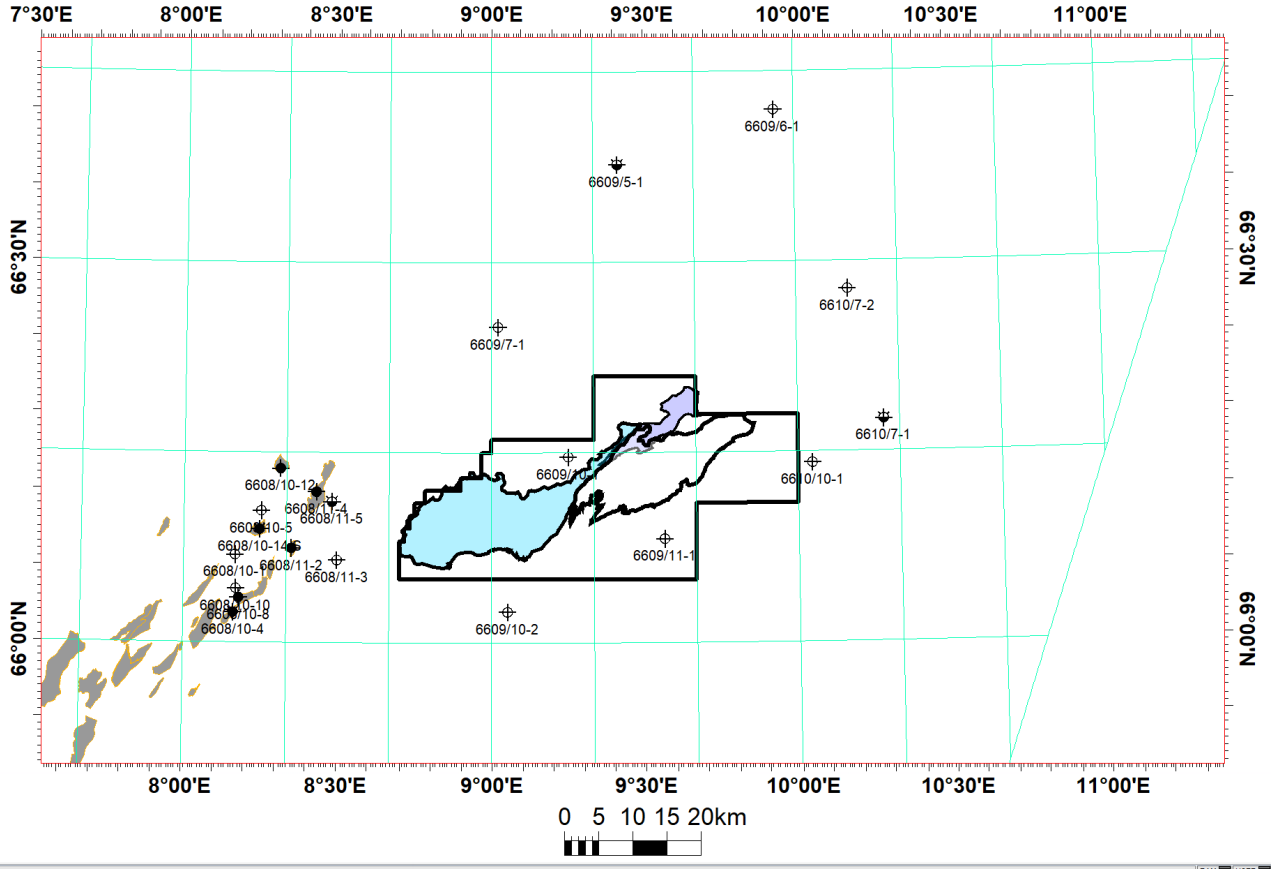

Fig. 2.2 Well locations

Table 2.2 Well database

Wells	Location (NR = Nordland Ridge)	Year (completed)	Well Logs	CPI	Seismic Well Tie	Log Correlation	Biostratigraphy	TD Formation	Comments
6608/8-1	Rødøy High (NR)	1997	x	x	x		x	Zechstein Group	
6608/8-2	Dønna Terrace	2007	x	x				Red Beds	
6608/10-1	Dønna Terrace	1989	x	x				Åre Formation	
6608/10-4	Sør High (NR)	1994	x	x				Åre Formation	Norne Northeast discovery
6608/10-5	Rødøy High (NR)	1995	x	x				Åre Formation	
6608/10-8	Dønna Terrace	2002	x	x				Åre Fm	Stær (Urd) discovery
6608/10-8 A	Dønna Terrace	2002	x					Tilje Fm	Stær (Urd) discovery
6608/10-10	Dønna Terrace	2003	x	x				Åre Formation	
6608/10-12	Dønna Terrace	2008	x	x				Red Beds	Dompap (Skuld) discovery
6608/10-12 A	Dønna Terrace	2009	x					Åre Fm	Dompap (Skuld) discovery
6608/10-14 S	Dønna Terrace	2010	x					Åre Fm	Fossekall (Skuld) discovery
6608/11-2	Sør High (NR)	2000	x					Grey Beds	Falk discovery
6608/11-3	Sør High (NR)	2002	x					Grey Beds	
6608/11-4	Sør High (NR)	2004	x	x				Red Beds	Linerle discovery
6608/11-5	Sør High (NR)	2006	x					Red Beds	
6609/5-1	Rødøy High (NR)	1985	x	x	x	x	x	Red Beds	
6609/6-1	Grønøy High (NR)	2007	x	x	x	x		Red Beds	
6609/7-1	Rødøy High (NR)	1983	x	x	x	x	x	Basement	
6609/10-1	Rødøy High (NR)	1983	x	x	x		x	Red Beds	
6609/10-2	Helgeland Basin	2009	x		x			Grey Beds	
6609/11-1	Helgeland Basin	1983	x		x		x	Åre Fm	
6610/2-1 S	Grønøy High (NR)	1996	x	x	x	x	x	Red Beds	
6610/3-1 (R)	Grønøy High (NR)	1993	x	x	x		x	Lange Fm/Red Beds	TD of 6610/3-1 in Lange Fm, while re-entry of well (6610/3-1 R) has TD in Triassic Red Beds
6610/7-1	Helgeland Basin	1983	x	x	x		x	Red Beds	
6610/7-2	Grønøy High (NR)	1984	x	x	x		x	Grey Beds	
6610/10-1	Helgeland Basin	2013	x		x		x	Grey Beds	

2.3 EM Data

The EM database consists of one CSEM 3D survey (MCPL843) covering the PL843 prospects. The receiver positions are shown in Fig. 2.3

The survey configuration was:

- Source: Deep blue 7000 A
- 189 Rx 3x3 km spacing & 22 tow-lines 3 km spacing

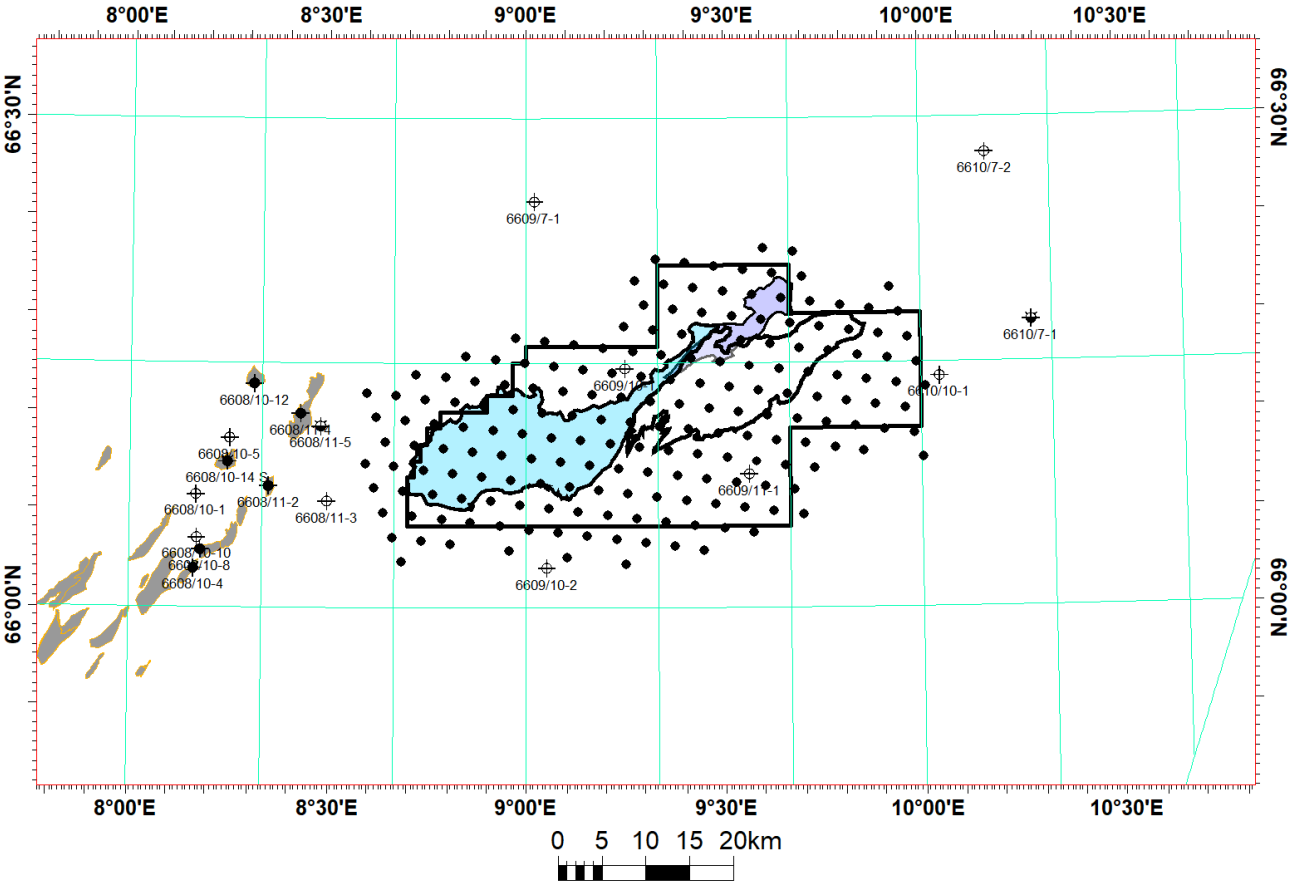

Fig. 2.3 EM database *Black dots are receiver positions*

2.4 Special Studies

The common database of special studies covering reservoir quality and stratigraphy are listed in Table 2.3.

In addition the internal special studies included:

Rock Physics and AVA modelling.

AVA screening and classification.

Bayesian inversion

EM 2D inversion

Table 2.3 Common database special studies

Study Name	Contractor	Year
Nordland Reservoir Quality Database	Ichron Limited	2010
Nordland Stratigraphic Database	Ichron Limited	2009

3 Remaining Prospectivity

The identified remaining prospectivity in the Upper Jurrassic and Mid-Early Jurassic Plays have very high risk and are now considered to have a COS of less than 10 %. In a stricter sense the mentioned structures qualify more to be classified as leads rather than prospects.

3.1 Charlotte

The Charlotte (Fig. 3.1) prospect is a Upper Jurassic wedge assumed to contain Rogn Fm. sand reservoir. In the APA 2015 application a shoreface depositional model was proposed with the sand shaling out towards the Helgeland basin (Fig. 3.2). In the license work an alternative model with syn-rift fan deposits infilling the central part of the grabens is proposed. Sand properties from Draugen field was used as analogue for the shoreface model and Rogn sand from Njord Field was used for the fan model.

Charlotte has a firm dip closure to the southeast. The trap is defined to the east partly by pinch-out and partly by dip closure, where a saddle is defined at approximately 1800 m depth. To the west, Charlotte is fault bound towards the Stina prospect. Fault offset is around 20 m at the top and 100 m at the base. The sealing properties of this fault evidently depends on the local clay fraction. A common contact of the two prospects is possible and both have a spill contour at approximately 1800 m.

In the APA 2015 application migration of hydrocarbons from the Træna Basin, via Cromer Knoll Group carrier beds, was the postulated charge model. Seismic mapping on the new dataset indicate that the most likely migration route is west of the prospects due to fault control. This observation together with the dry Vågar well proximal to the Træna basin increased the charge risk.

Top seal is provided by the draping of the soft Spekk shale and not the Shetland Group as indicated in the APA application. The main implication is reduced space for potential sands and deeper apex of 1680 m.

The Rock physics and AVA modelling used properties of the clean shoreface sand (Draugen) and the heterolithic fan sand (Njord) in combination with Spekk Fms seals from well 6609/11-1. The Njord sand (NtG=1) gave class I for all fluids and class III for gas with NtG 0.4 and porosity > 30%. The Draugen sand (NtG 1) gave class I for brine and class IIP for oil/gas. The AVA classes from PGS16005APR19 is mainly class IV and partly class III and lack contour consistency and negative as hydrocarbon indicators. Bayesian inversion indicated probability of sands, but no probability of hydrocarbons in any of the prospects. The lack of Rogn sands in the 6608/11-9 Godalen well indicates that inversion results might be optimistic. The petrophysical parameters used for volumetrics are shown in Table 3.1 and the resulting resources in Table 3.5.

The main risk in the APA application was charge. The license work combined with the dry Vågar well 6608/6-1 increased the source and migration risk and resulted in COS of 0.07 (Table 3.3).

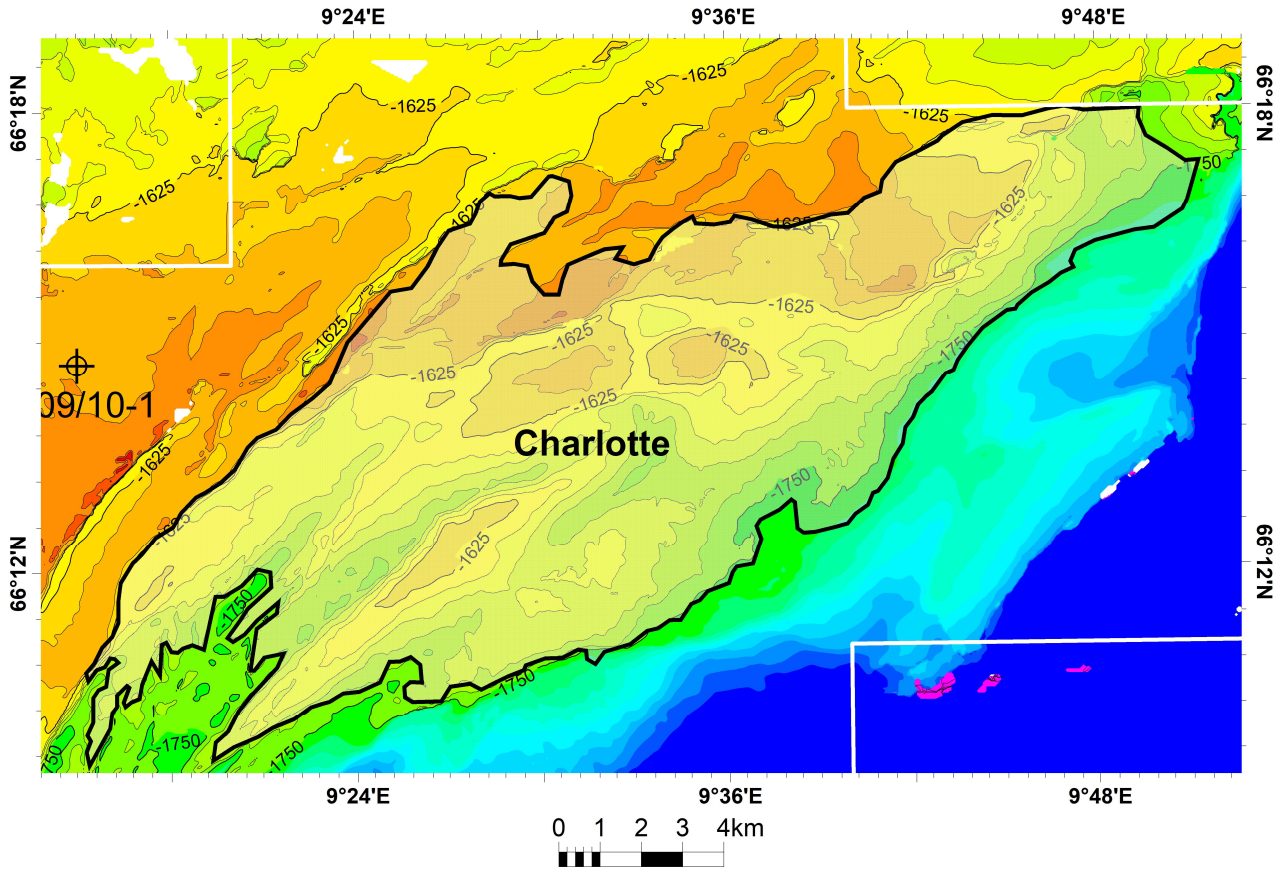

Fig. 3.1 Charlotte Prospect

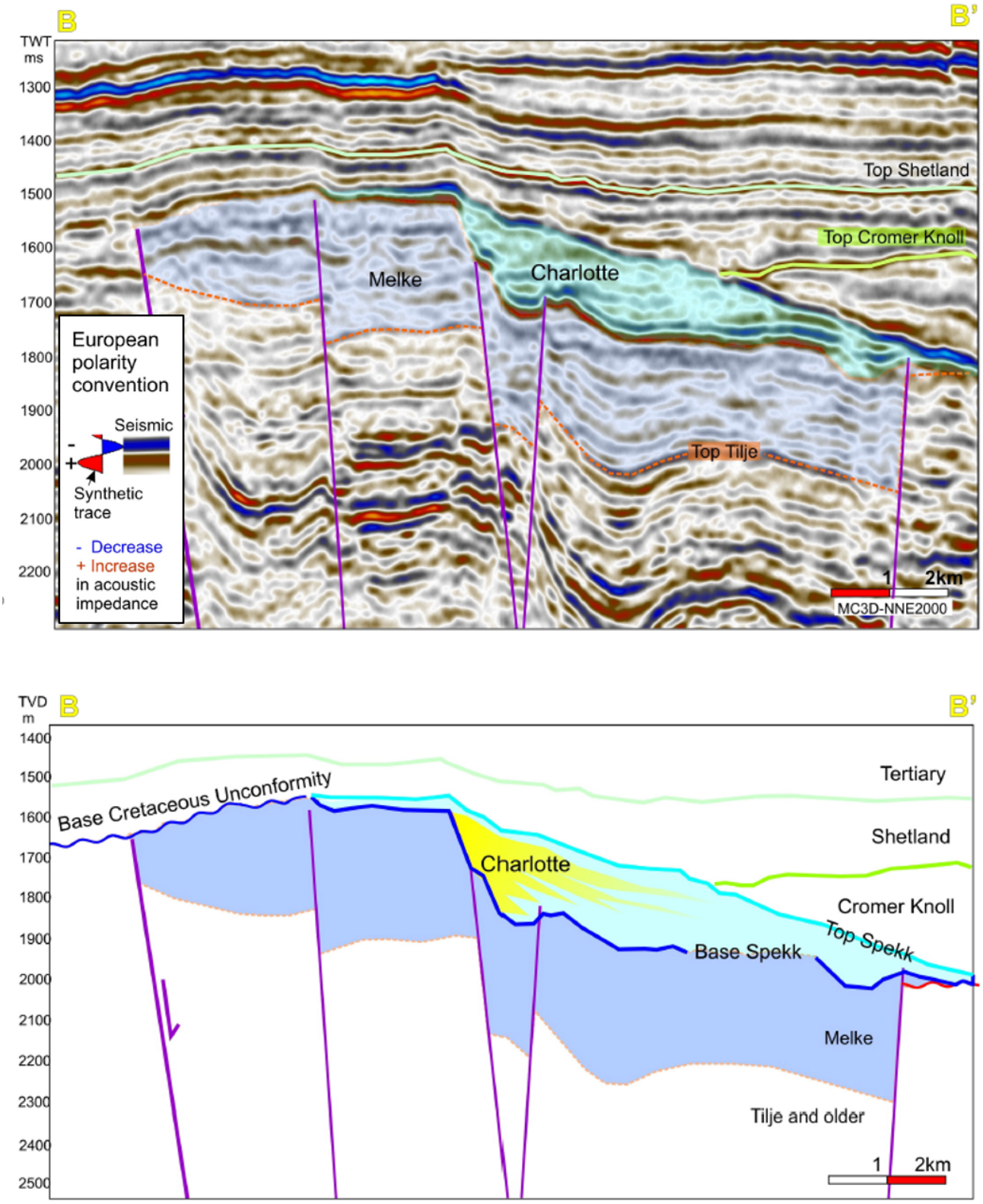

Fig. 3.2 Charlotte Prospect - seismic and geological profile *Seismic dip-line through the Charlotte prospect*

Table 3.1 Charlotte Petrophysical Parameters

	P100	Mode	P0
Net-to-Gross	0,20	0,30	0,40
Porosity	0,15	0,20	0,25
Oil saturation	0,60	0,72	0,85
Recov. factor, oil main phase	0,10	0,25	0,40

Table 3.2 Charlotte Resources

Resource Type [Units]	Mode	Mean	Std. dev.	F90
Inplace				
Accumulation size Oil [1e6 Sm3]	33.4	51.7	30.3	22.8
Accumulation size Assoc. Gas [1e9 Sm3]	0.946	1.59	1.01	0.645
Accumulation size Total Resources [1e6 Sm3 OE]	34.0	53.3	31.2	23.5
Recoverable				
Accumulation size Oil [1e6 Sm3]	7.32	13.3	9.31	4.75
Accumulation size Assoc. Gas [1e9 Sm3]	0.207	0.41	0.306	0.137
Accumulation size Total Resources [1e6 Sm3 OE]	7.48	13.7	9.59	4.9

Table 3.3 Charlotte Risk

Risk factor		Play	P(segment|play):	Overall
Reservoir		0,80		0,64
Seal		1,00		
Source		0,80		
Reservoir	Presence		0,50	0,45
	Quality		0,90	
Seal	Presence		0,90	0,81
	Trap Geometry		0,90	
Source	Presence		1,00	0,30
	Migration & timing		0,30	
Conditional Segment Probability (segment|play):			**0,11**	
Unconditional Probability, P(g):				**0,07**

3.2 Stina

The Stina prospect is located to the west of the Charlotte prospect (Fig. 3.3) and is considered to be the westward continuation of the Charlotte depositional system. It is separated from the Charlotte prospect by a potentially sealing fault. Stina has its own saddle, which is defined by a structurally deep area to the west-southwest. The depth of this saddle is approximately the same as the spill contour of Charlotte.

Seismically, it is a lens-shaped body with soft top and hard base reflections. Reservoir properties and top seal are as described for Charlotte. The trap has juxtaposition seal towards Lower Triassic sediments on the Rødøy High and this will add a slight additional risk.

The conclusions of the AVA classifications and the Bayesian inversion is the same as for Charlotte. The petrophysical parameters used for volumetrics are shown in Table 3.4 and the resulting resources in Table 3.5.

he main risk in application was charge. The license work combined with the dry Vågar well 6608/6-1 increased the source and migration risk and COS of 0.07 (Table 3.6)

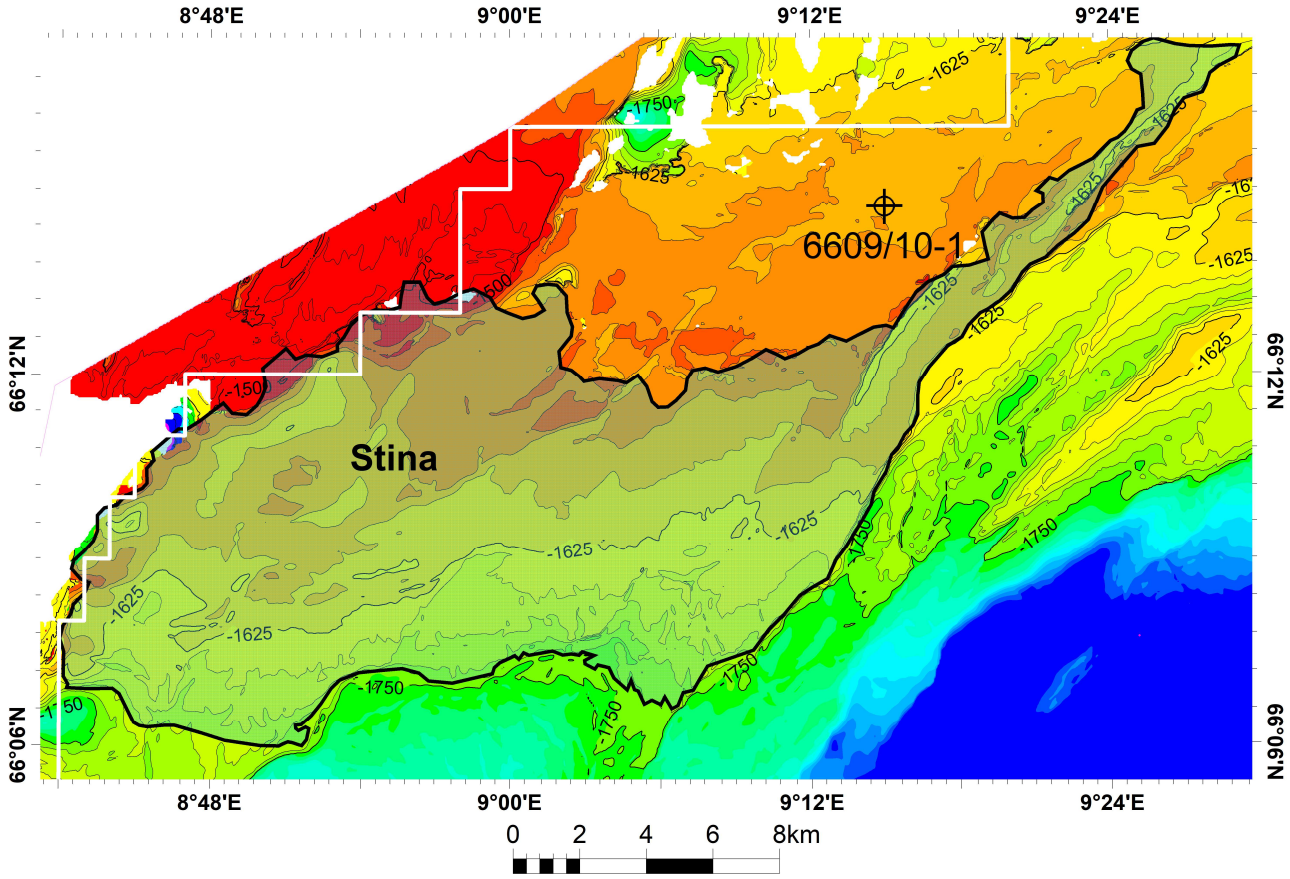

Fig. 3.3 Stina Prospect

Table 3.4 Stina Petrophysical Parmeters

	P100	Mode	P0
Net-to-Gross	0,20	0,30	0,40
Porosity	0,15	0,20	0,25
Oil saturation	0,60	0,72	0,85
Recov. factor, oil main phase	0,10	0,25	0,40

Table 3.5 Stina Resources

Resource Type [Units]	F90	F50	Mean	F10
Inplace				
Accumulation size Oil [1e6 Sm3]	55.9	144.7	147.4	242.5
Accumulation size Assoc. Gas [1e9 Sm3]	1.59	4.23	4.54	7.83
Accumulation size Total Resources [1e6 Sm3 OE]	57.6	149.2	151.9	250.1
Recoverable				
Accumulation size Oil [1e6 Sm3]	12.6	34.4	36.6	63.3
Accumulation size Assoc. Gas [1e9 Sm3]	0.368	1.02	1.13	2.05
Accumulation size Total Resources [1e6 Sm3 OE]	13.1	35.6	37.8	65.0

Table 3.6 Stina Risk

Risk factor		Play	P(segment|play):	Overall
Reservoir		0,80		0,64
Seal		1,00		
Source		0,80		
Reservoir	Presence		0,50	0,45
	Quality		0,90	
Seal	Presence		0,90	0,81
	Trap Geometry		0,90	
Source	Presence		1,00	0,30
	Migration & timing		0,30	
Conditional Segment Probability (segment|play):			**0,11**	
Unconditional Probability, P(g):				**0,07**

3.3 Astrid

Astrid is a NE-SW elongated horst (Fig. 3.4) with Tilje Fms reservoir. The Tilje Formation is approximately 150 m thick in the nearby 6609/10-1 well, where the best sand is located in the upper 100 m. The trap depends on fault seal towards Triassic strata in the east. The spill contour of Astrid at 1800 m is defined by a saddle in the north.

The petrophysical parameters (Table 3.7) of the Tilje Formation are based on the wells (i.e. wells 6608/11-4, 6609/10-1, 6609/10-2, 6609/11-1, 6610/2-1 S and 6610/10-1). The output resources in Table 3.8 are based on GRV calculated from seismic mapping of the Top and Base Tilje surfaces.

Migration is the main risk of the Astrid Prospect. Well 6609/10-1 in the west tested the play in a more optimal location related to the migration route from the Træna basin than the Astrid prospect. Similar well 6609/11-1 to the south is a better position regarding potential charge from the Helgeland basin. The final risking resulted in a COS of 0.09 (Table 3.9)

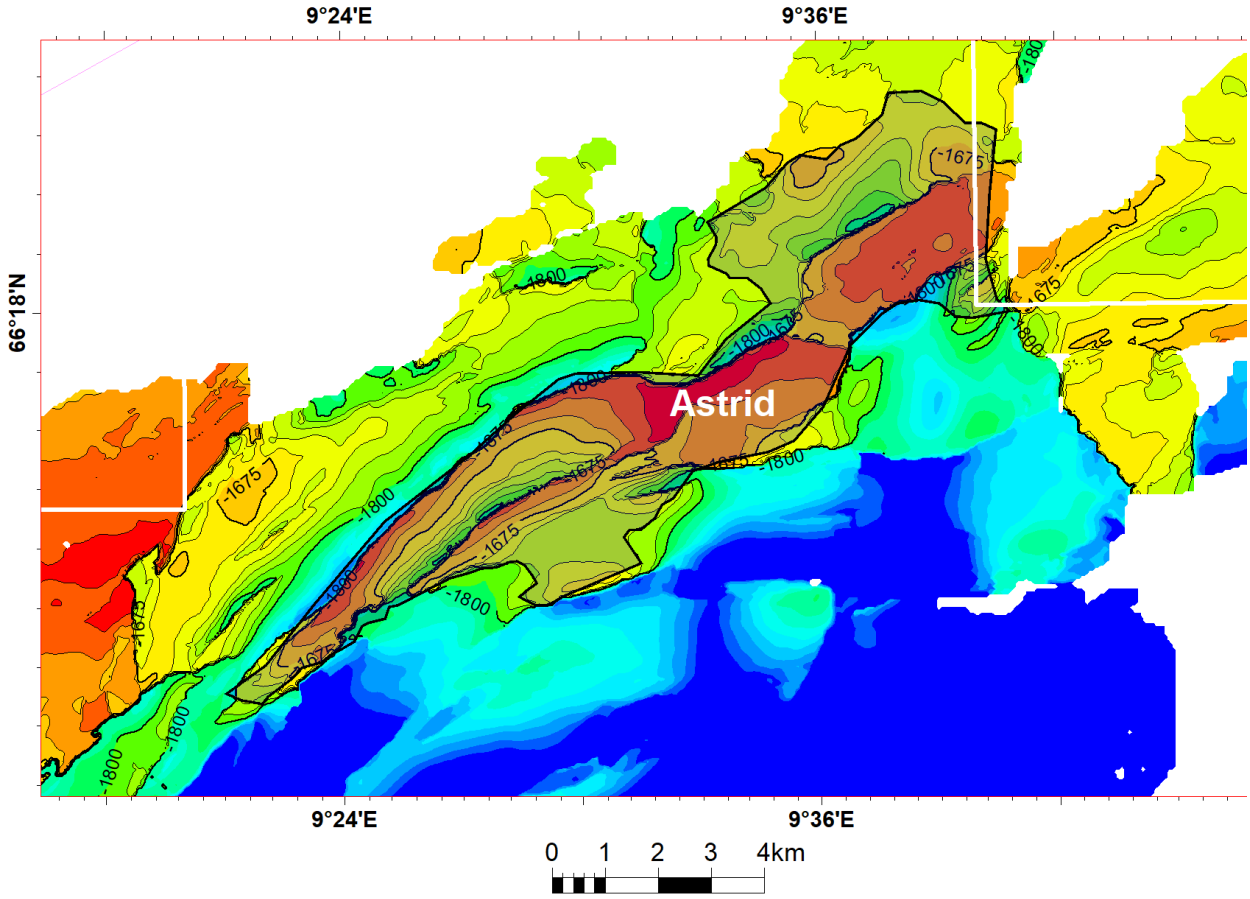

Fig. 3.4 Astrid Prospect

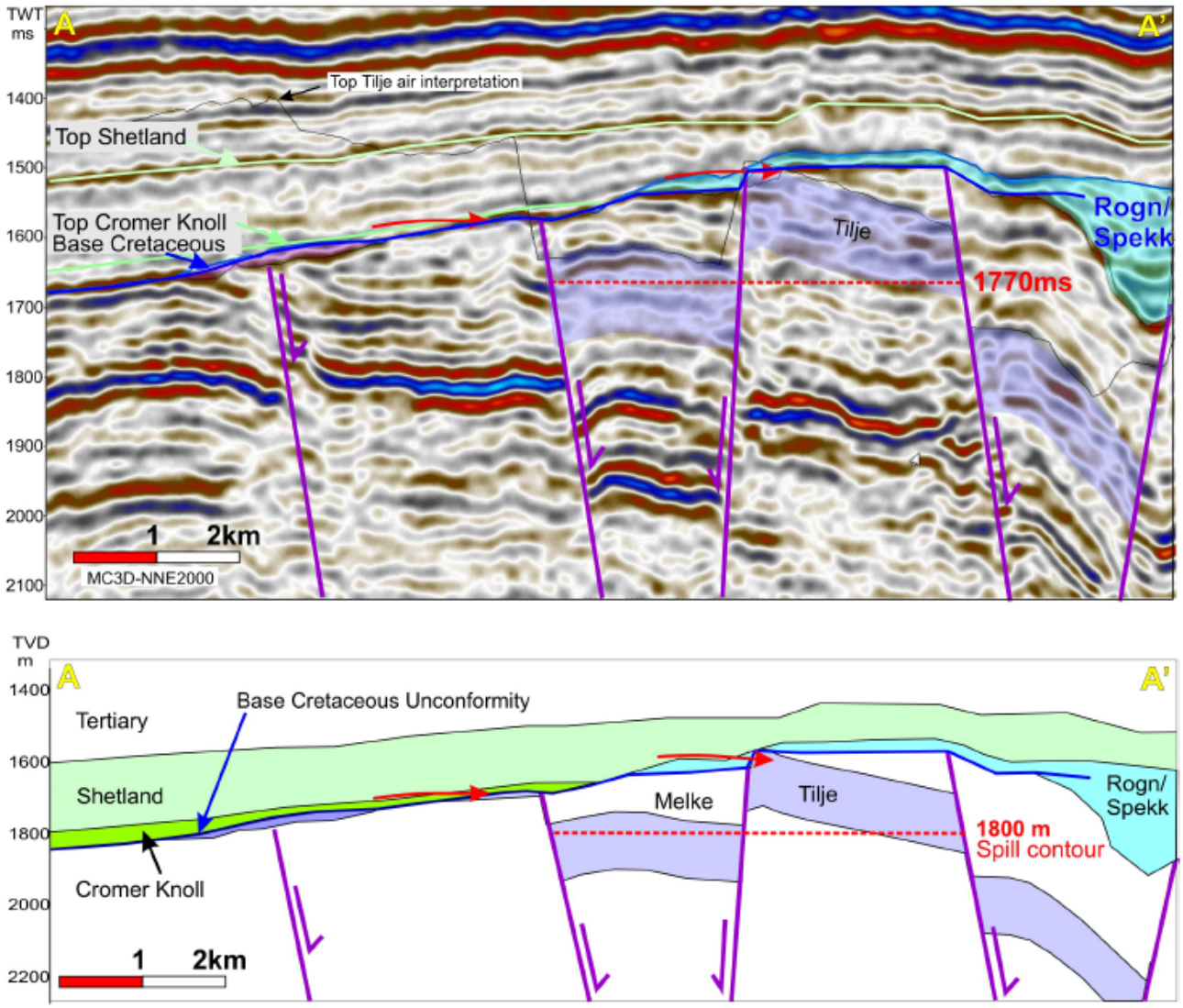

Fig. 3.5 Astrid Prospect - seismic and geological profile *Seismic dip-line through the Astrid prospect. The red arrows indicate the migration route into the Tilje Formation.*

Table 3.7 Astrid Petrophysical Parameters

	P100	Mode	P0
Net-to-Gross	0,35	0,45	0,85
Porosity	0,18	0,25	0,30
Oil saturation	0,60	0,72	0,85
Recov. factor, oil main phase	0,10	0,25	0,40

Table 3.8 Astrid Resources

Resource Type [Units]	F90	F50	Mean	F10
Inplace				
Accumulation size Oil [1e6 Sm3]	50.4	125.5	129.8	213.9
Accumulation size Assoc. Gas [1e9 Sm3]	1.45	3.72	3.98	6.87
Accumulation size Total Resources [1e6 Sm3 OE]	51.9	129.4	133.8	220.5
Recoverable				
Accumulation size Oil [1e6 Sm3]	10.6	30.0	33.5	60.7
Accumulation size Assoc. Gas [1e9 Sm3]	0.312	0.889	1.02	1.92
Accumulation size Total Resources [1e6 Sm3 OE]	11.0	30.9	34.5	62.5

Table 3.9 Astrid Risk

Risk factor		Play	P(segment|play):	Overall
Reservoir		1,00		1,00
Seal		1,00		
Source		1,00		
Reservoir	Presence		1,00	0,80
	Quality		0,80	
Seal	Presence		0,60	0,36
	Trap Geometry		0,60	
Source	Presence		1,00	0,30
	Migration & timing		0,30	
Conditional Segment Probability (segment|play):			**0,09**	
Unconditional Probability, P(g):				**0,09**

4 Conclusion

Following results from the 6608/11-9 Godalen 6608/6-1 Vågar well that were drilled summer 2019 the prospectivity of the PL843 was downgraded. The 6608/6-1 well showed that there is a very high risk on on a working hydrocarbon system sourced from the Træna basin. The well 6608/11-9 showed that there is a very high risk on efficient reservoir for the Upper Jurassic play in the PL843 area. Consequently, the Charlotte and Stina prospects have been risked to COS 7%.

The Astrid prospects is proven Early-Mid Jurassic play in the area with high quality Tilje Fm. reservoir, but because the charge risk is the same as for Charlotte and Stina the prospect is risked to COS 9%.

5 References

Sharp Reflections (2019): AkerBP, Equinor, Vår Energi Conditioning Report PL843, PGS16005 PSTM