Relinquishment Report for PL663

Document last updated 20-06-2016 16:29 CEST

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1 Key license history

PL663 was awarded to Det norske oljeselskap ASA (Operator - 30%), Bayerngas Norge AS (20%), Premier Oil Norge AS (20%), Petoro AS (20%) and Fortis Petroleum Norway AS (10%) on February 8th 2013, as part of the APA2012.

The license commitment was G&G studies and to make a drill-or-drop (DoD) decision by February 8th 2015. The initial DoD deadline was later postponed to February 8th 2016, as exploration wells drilled in PL494 (2014) and PL539 (2015) was highly relevant for a well reasoned drill decision in PL663.

During the license period, the following meetings have been held:

2013
2 ECMC meetings: 15.03 and 26.11.

2014
2 ECMC meetings: 11.06 and 17.11.
1 technical work meeting: 13.01.

2015
2 ECMC meetings: 05.06 and 05.11.
2 technical work meetings: 10.04 and 15.10.

The work obligation has been fulfilled.

Relinquishment of the license is done, due to lack of identification of a commercially attractive prospect within the license area.

2 Database

2.1 Seismic database

The common seismic database for the license consisted of both 3D and 2D datasets, shown in Fig. 2.1. Main datasets were the MC3D-CGR2010 and -CGR2013R, covering the main prospects. The quality is reasonably good, and offsets stacks have also been utilised. Other seismic datasets in the common database are of variable quality and of several vintages. 2D seismic data was utilised in the northern part of the license, for basin modeling and regional mapping purposes.

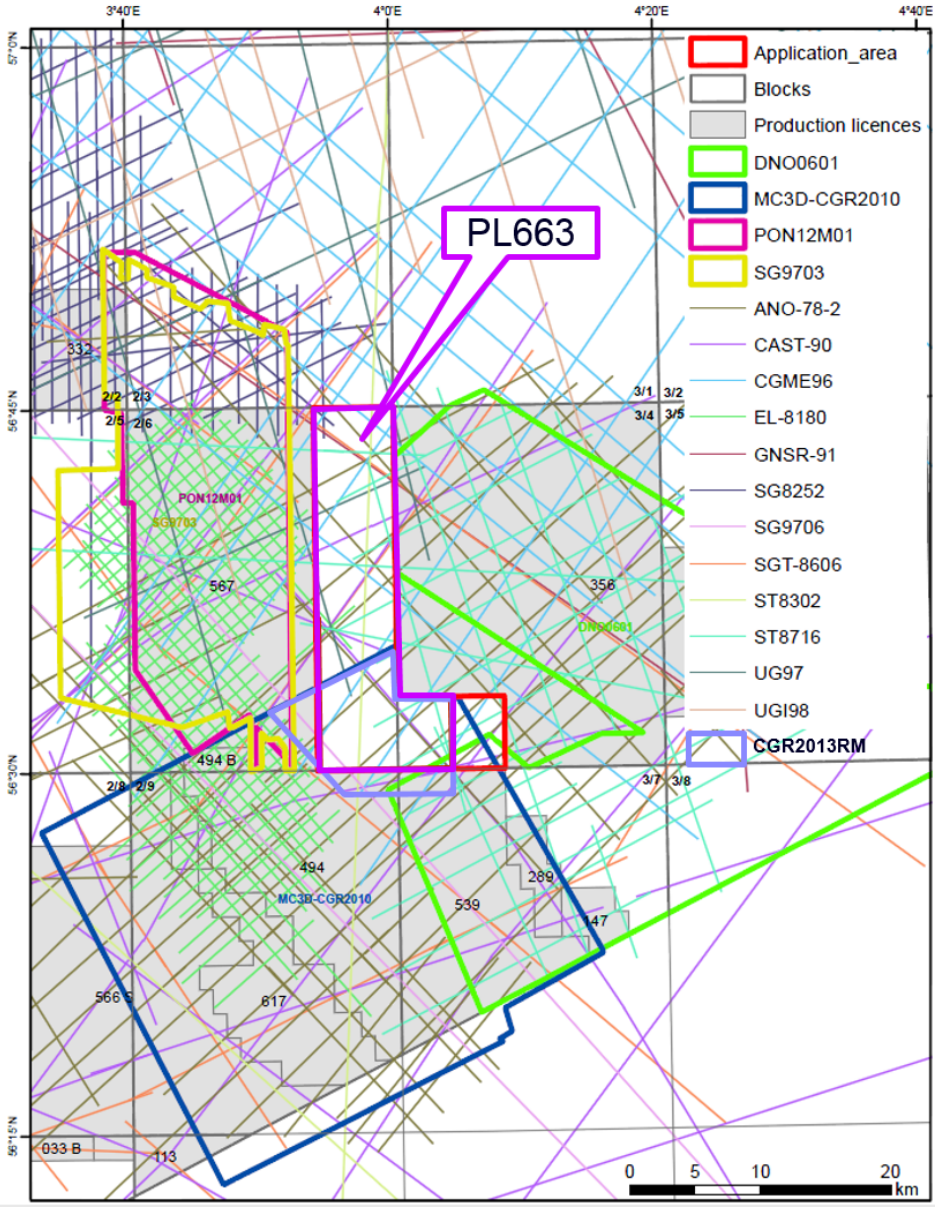


Fig. 2.1 Seismic database

2.2 Well data

A rather extensive number of wells were included in the common database, shown in Fig. 2.2 and listed in Table 2.1.

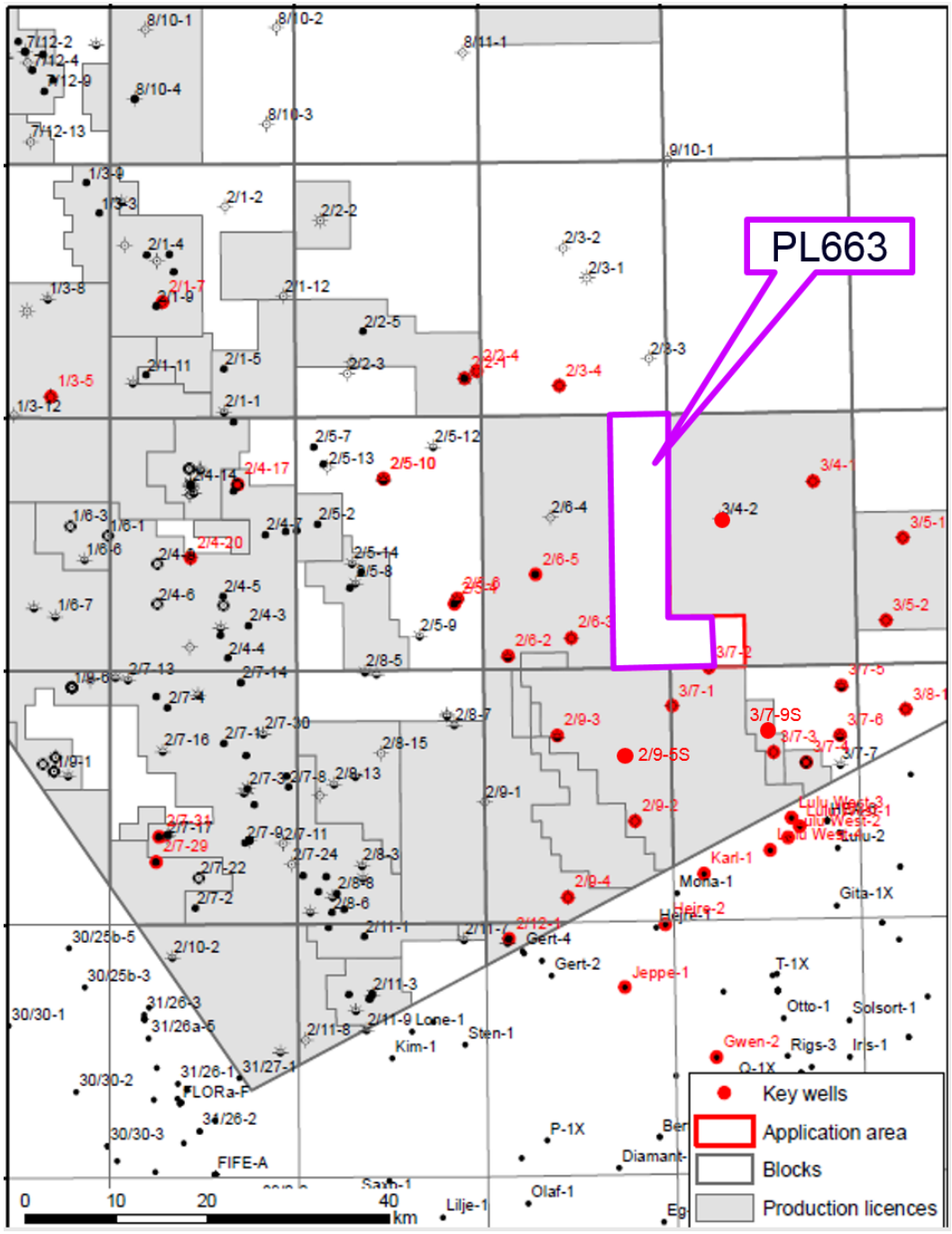


Fig. 2.2 Wells in common database

Table 2.1 List of wells in common database

Well	Status	Year P&A	TD (MD) (m)	TD stratigraphy (age)	CPI (age)	Biostratigraphy	Core description
1/3-5	dry	1985	4850	Early Permian	P	x	
1/6-7	oil shows	1992	4995	Late Jurassic	LJ		
2/12-1	oil	1987	4795	Early Permian	MJ, P	x	
2/1-7	dry	1985	5464	Early Permian	P	x	
2/2-1	oil/gas	1982	4003	Late Permian		x	
2/2-4	gas	1988	4020	Triassic		x	
2/3-4	dry	1984	3386	Late Permian	MJ	x	
2/4-17	gas/condensate	1992	5258	Early Permian	MJ, P	x	
2/4-20	dry	2008	5719	Early Permian	LJ, MJ, P	x	
2/5-4	oil	1972	3490	L. Cretaceous		x	
2/5-6	oil/gas shows	1978	4132	Triassic	LJ, MJ	x	x
2/5-10	oil shows	1993	4701	Triassic			x
2/5-10A	oil shows	1993	4715	Triassic	MJ		x
2/6-1	dry	1969	3336	Late Permian	MJ	x	x
2/6-2	oil shows	1980	4760	Late Permian	MJ	x	x
2/6-3	dry	1983	4060	Basement	MJ	x	x
2/6-4S	dry	1990	3617	Late Permian	LJ, MJ	x	x
2/6-5	oil	1997	3260	Basement	C, B	x	x
2/7-29	oil	1994	4900	Early Permian	LJ, P		
2/7-31	oil	1999	4968	Early Permian	LJ, MJ, P		
2/8-12S	oil/gas shows	1989	5300	Triassic		x	
2/9-2	dry	1979	4367	Early Permian	LJ	x	x
2/9-3	oil shows	1989	4859	Early Permian	LJ, MJ, P	x	x
2/9-4	dry	2010	5500	Early Permian		x	
2/9-5S	dry	2014	3679	Basement	LJ, P	x	
2/12-1	oil	1987	4795	Early Permian	LJ, P	x	x
3/4-1	dry	1994	3107	Late Permian	LJ	x	
3/4-2S	dry	2012	2961	Late Jurassic	LJ		
3/5-1	dry	1978	3426	Early Permian	LJ, P	x	
3/5-2	dry	1979	3825	Triassic		x	
3/7-1	dry	1973	1973	Basement		x	x
3/7-2	dry	1981	4330	Early Permian	LJ, MJ, P	x	x
3/7-3	dry	1981	3540	Late Permian	LJ	x	x
3/7-4	gas/condensate	1990	3723	Late Permian	LJ, MJ, P	x	x
3/7-5	oil shows	1992	3666	Late Permian	MJ	x	
3/7-6	oil shows	1996	4120	M. Jurassic		x	x
3/7-9S	dry	2013	3717	Triassic	MJ		
3/8-1	dry	2010	4070	Early Permian	LJ		
GWEN-2	dry	1986	4401	Triassic		x	
HERJE-2	oil	2005	5445	Pre-Jurassic		x	
JEPPE-1	residual HC	1988	5085	Permian		x	
KARL-1	oil shows	1983	4819	Permian		x	
WEST LULU-1	gas/condensate	1983	4228	Triassic			
WEST LULU-2	oil shows	1985	4054	Triassic			
WEST LULU-3	gas/condensate	1985	3857	Triassic			
WEST LULU-4	dry	1986	3850	Triassic			

2.3 Special studies

No special studies have been incorporated in the common database.

3 Review of geological framework

The relinquished area in blocks 2/6 and 3/4 is located on a terrace east of the Mandal High and west of the Søgne Basin in the Central Graben. Closest production fields are found in the Middle Jurassic Trym Field (condensate) to the south, and Tor, Ekofisk and Valhall Chalk oil fields to the west. A BCU time map with structural elements and the closest fields is shown in Fig. 3.1.

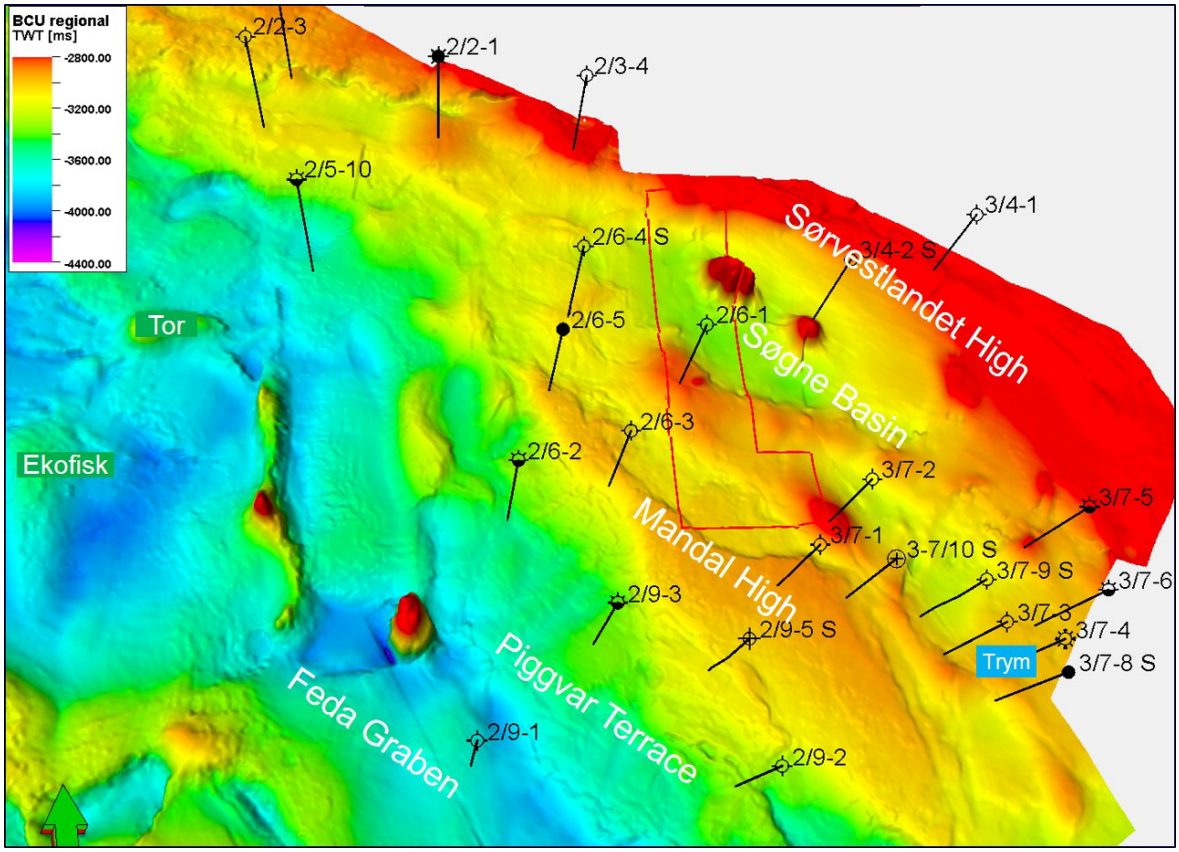


Fig. 3.1 Structural elements and fields in the PL663 area

At the time of application, Upper Jurassic was the main stratigraphic interval of interest. Additional prospectivity was mapped in leads with inferred Permian, Triassic, Middle Jurassic and Lower Cretaceous reservoirs. The main prospect, Skåla, of late Jurassic age, was expected to be part of a syn-sedimentary wedge just down-flank of the Mandal High, with a reservoir of mixed shallow marine and gravity flow sediments. Migration into the prospect was expected from the northwest, via fractured basement in the high to the west. Play concept similarities were seen between the Mandal High area and the Utsira High further to the north with respect to characteristics of the basement high, hydrocarbon migration, reservoir geometry and a concept with a regional oil-water contact.

Migration was considered the main risk, as no hydrocarbons were proven in any wells nearby and the Søgne Basin area was modelled to be in best case marginally mature. The possible migration pathway through the basement high was associated with intermediate risk and a long distance migration from the north-northwest around the Mandal High was more unlikely. So was also a migration from the south and east.

The drilling of the Myrhauk Well, 3/7-10S, provided a more confident seismic tie into the Skåla Prospect, and a post Myrhauk remapping of the reservoir resulted in a down-grading of the prospect. Deep erosion on the terrace, removing Upper Jurassic sediments seems the most likely model. The bulk of the reservoir is most likely of Triassic age, with a very high risk on both presence and quality. This Triassic part of the prospect is hence downgraded to a lead or high-risk prospect. A smaller portion of the prospect is likely a Middle Jurassic Bryne Formation reservoir, with expected reasonably good properties. However, total recoverable estimated hydrocarbon resources is considerably reduced since the earlier evaluation for the APA application. In addition, geochemichal studies on wells surrounding the Mandal High showed that the oil shows in the basement in well 2/6-5 were unique as the oil could not be correlated any of the wells in the area. It was concluded that the minor amounts of oil seen in this well did not have an origin from a source to the west of the Mandal High. This implies that the source for the oils in basement most likely is a local basin not yet proven by any well in the area. The local mini-basin just to the north of the Skåla Prospect was a likely candidate as source origin. Modeling of the potential of this small basin proved a very high risk on generating sufficient volumes to fill the prospect. In order to have an economical viable prospect, the source rock in this local basin would have to be of a far better quality than what the surrounding wells would indicate.

Drilling of well 2/9-5S, Heimdalshø, on the west flank of the Mandal High, also contributed to the down-grading of the prospectivity in PL663. This dry well did not prove any prospective reservoirs, and also the risk of the Permian Raudhammer Prospect underlying Skåla was increased with respect to presence of reservoir.

Cretaceous prospectivity in the area is high-risk, as both reservoir, trap and especially migration remains highly uncertain.

Any presence of Upper Jurassic sediments present on the "Skåla terrace" may be preserved further to the east outside of the PL663 license area.

4 Prospect update

At the time of application, three prospects (Skåla, Raudhammer and Gude) were identified by the partnership. These have since been refined by updated seismic interpretation, studies in geochemistry, basin modeling, study on seal capacity and new area knowledge obtained by the recent exploration wells; Heimdalshø (2/9-5S) and Myrhauk (3/7-10S). Skåla has persisted as the main prospect throughout the duration of the license. A map of the remaining prospectivity in PL663 is shown in Fig. 4.1 and summarised in Table 4.1.

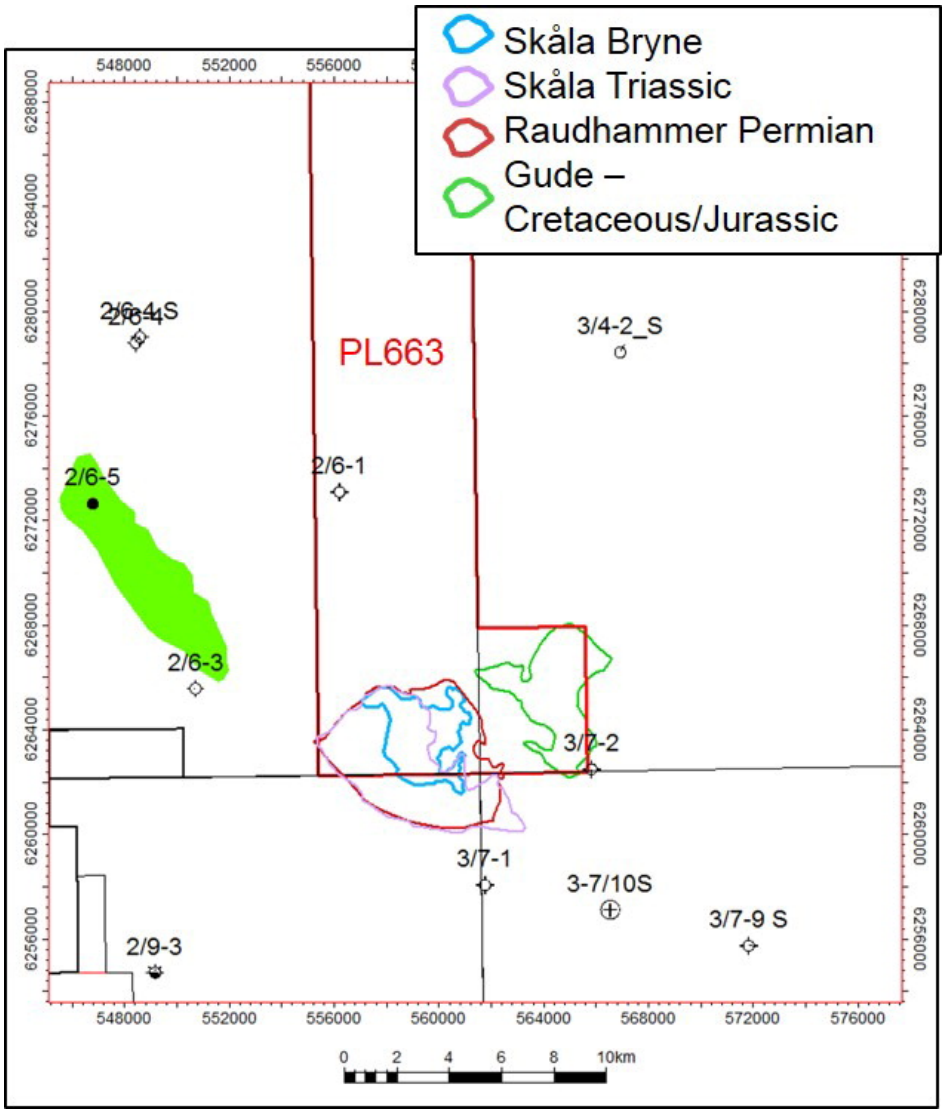


Fig. 4.1 Overview of remaining prospectivity in PL663

Table 4.1 Summary of remaining prospectivity

PL 663					GROSS RECOVERABLE RESERVES / RESOURCES					
					Low (P90)		Base (Mean)		High (P10)	
CATEGORY	RESERVOIR LEVEL	HC	RF (%)	POS (%)	Oil (MSm^3)	Gas (GSm^3)	Oil (MSm^3)	Gas (GSm^3)	Oil (MSm^3)	Gas (GSm^3)
PROSPECTS										
Skåla Bryne *)	Middle Jurassic	oil	40	15,6	1,70	0,10	3,70	0,30	6,10	0,50
Raudhammer **)	Rotliegendes/Auk Fm.	oil	48	4,0	3,40	0,17	14,30	0,70	28,50	1,39
LEADS										
Skåla Triassic***)	Triassic/Skagerrak	oil	40	6,48	5,60	0,43	15,7	1,18	23,30	2,12
Gude	Lower Cretaceous	oil	45	< 10			4,13			

* Total volumes (95% in PL 663), ** Total volumes (65% of total volumes in PL 663), *** Total volumes (45% in PL 663)

Fig. 4.2 is an updated interpretation of the Skåla Prospect. The volumes and the chance of success are considerably reduced since the time of application, due to increased understanding of the reservoir age and the petroleum system. A Bryne reservoir parameter distribution input to the resource estimate is illustrated in Fig. 4.3.

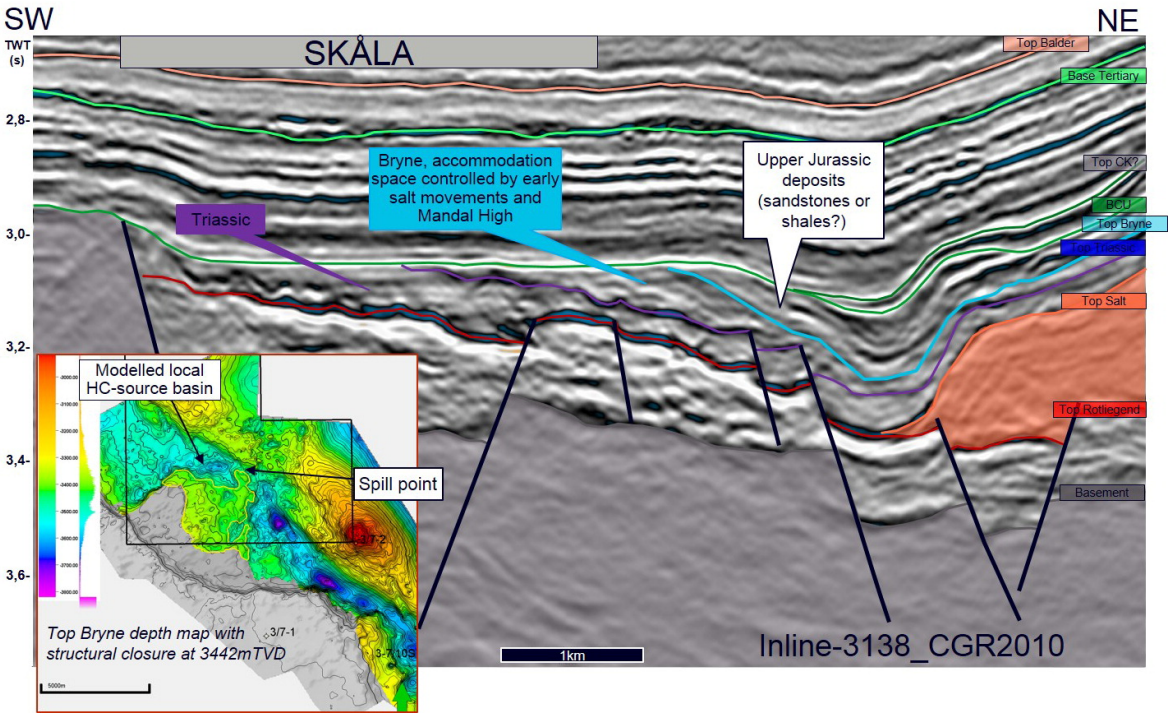


Fig. 4.2 Skåla Prospect seismic section. *Late Jurassic/Early Cretaceous erosion on the terrace, has most likely removed Upper Jurassic sediments from the Skåla Prospect*

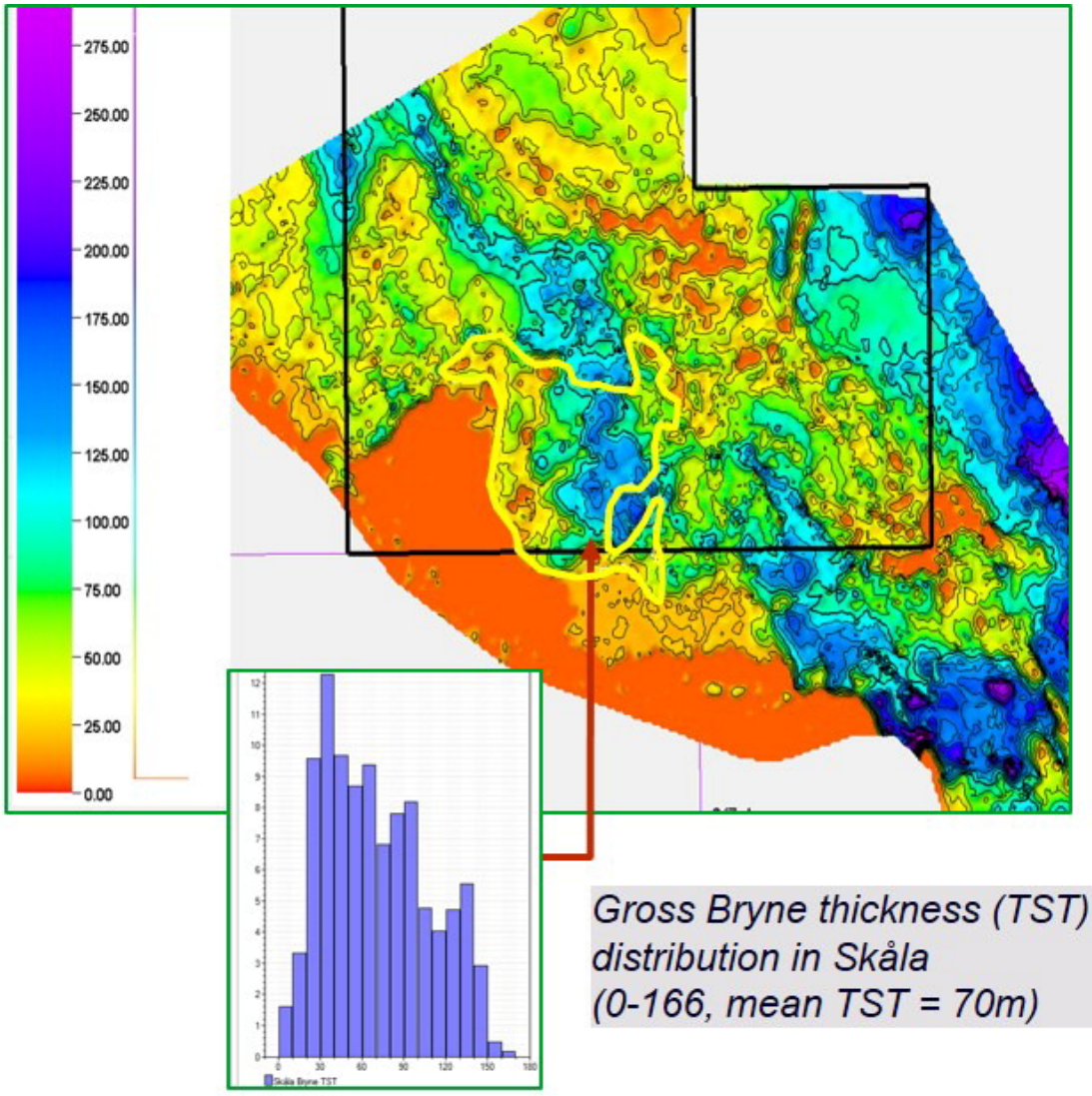


Fig. 4.3 Skåla Prospect input to volume calculations. *Bryne reservoir parameter distribution*

The Raudhammer Prospect with an inferred Permian Rotliegendes eolian sandstone reservoir, was down-graded after the drilling of the Heimdalshø Well (2/9-5S), penetrating only non-reservoir rocks in the pre-Jurassic section. The likelyhood of migration into the prospect was also reduced following the earlier mentioned update regarding geochemistry and basin modeling in the area. A seismic random line can be seen in Fig. 4.4, and reservoir and fluid parameter input to volume calculations are presented in Fig. 4.5.

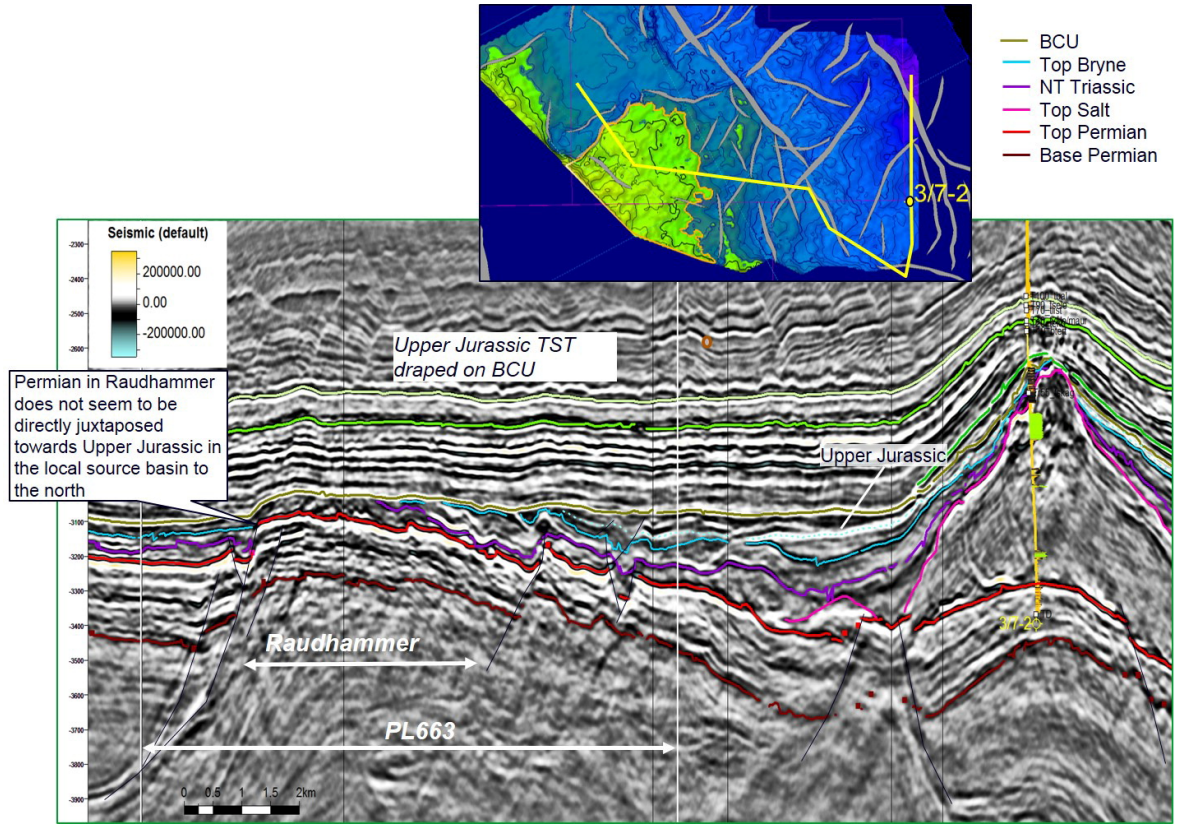
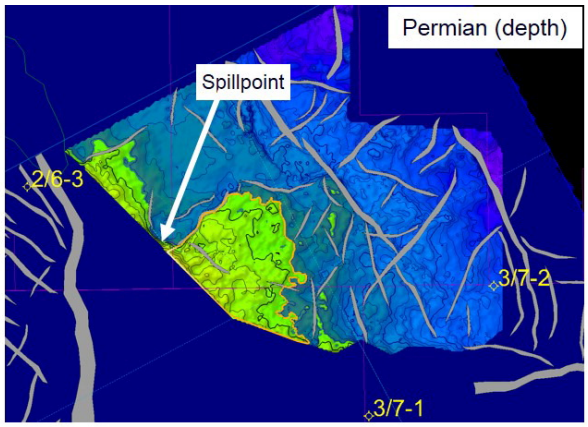


Fig. 4.4 Raudhammer Prospect seismic section. *CGR2010*



Spill point & OWC	
	Mode
Crest	3275
GOC	
GWC	
OWC	3445
Spill	3545
HC column	170

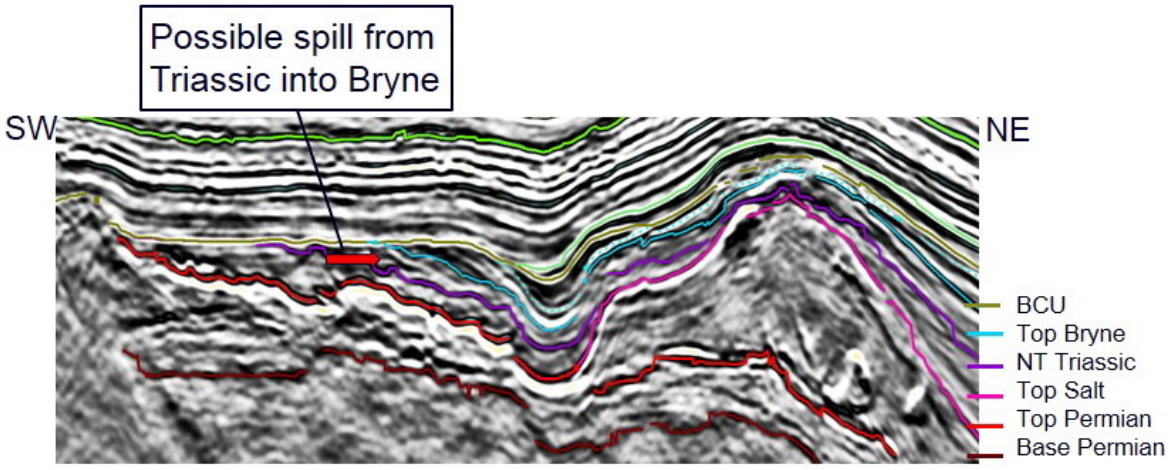
Area of max closure: 11,9 km²

Petrophysical data input	
	Mode
Porosity	0,20
N/G	0,6
So	0,7
Sg	
Gross res TST	
Net res TST	24

Fluids	
	Mode
1/Bo	0,87
GOR (Sm^3/Sm^3)	50
Rf oil+gas	0,48

Fig. 4.5 Raudhammer Prospect. *Reservoir and fluid input parameters to volume estimate*

Skåla Triassic, Fig. 4.6, has a fairly high volume potential, however, the potential oil-water contact (OWC) has a high dependency on the presence of a hydrocarbon-bearing Bryne reservoir. Given presence of a Bryne reservoir, the OWC in Triassic may be controlled by the spill-point at Bryne level, if there is pressure communication between the two reservoir levels.



There is a 70% chance there is no barrier between Triassic and Bryne.

Volumes in Triassic given a barrier between Bryne and Triassic (not likely):

Mean
16.9

Volumes in Triassic with no barrier between Bryne and Triassic:

P90	P50	P10	Mean
0.6	7.7	15.8	8.1

Fig. 4.6 Skåla Triassic Lead. *Seismic section, IL3138-CGR2010, showing the Skåla Triassic reservoir related to the Bryne Fm. reservoir*

Lower Cretaceous/Upper Jurassic Gude Lead concept, is shown in Fig. 4.7. High risk is associated with this lead, as reservoir presence, trap definition and migration is not substantiated. A full evaluation of this lead is also limited by the data coverage and quality in the area east of the license area. However, even with a better seismic coverage, the reservoir and charge risks would remain high. Of these reasons the Gude Lead has not been matured to a prospect.

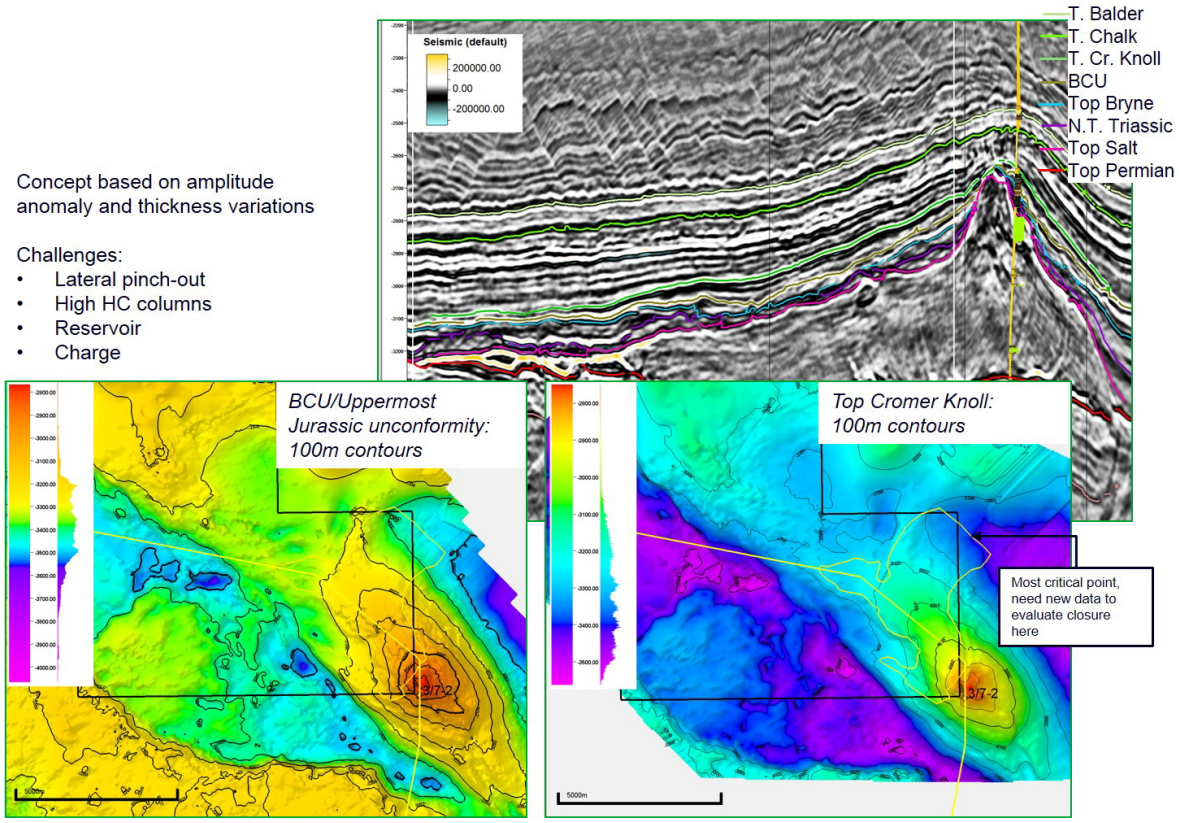


Fig. 4.7 Gude Lead concept

5 Technical evaluations

A technical-economical evaluation was carried out for the Skåla Prospect, based on the base case resources estimated for the Bryne reservoir. Subsea tie-back to the Ekofisk Field was used as the development concept (see Fig. 5.1). The evaluation, performed in December 2015, is based on:

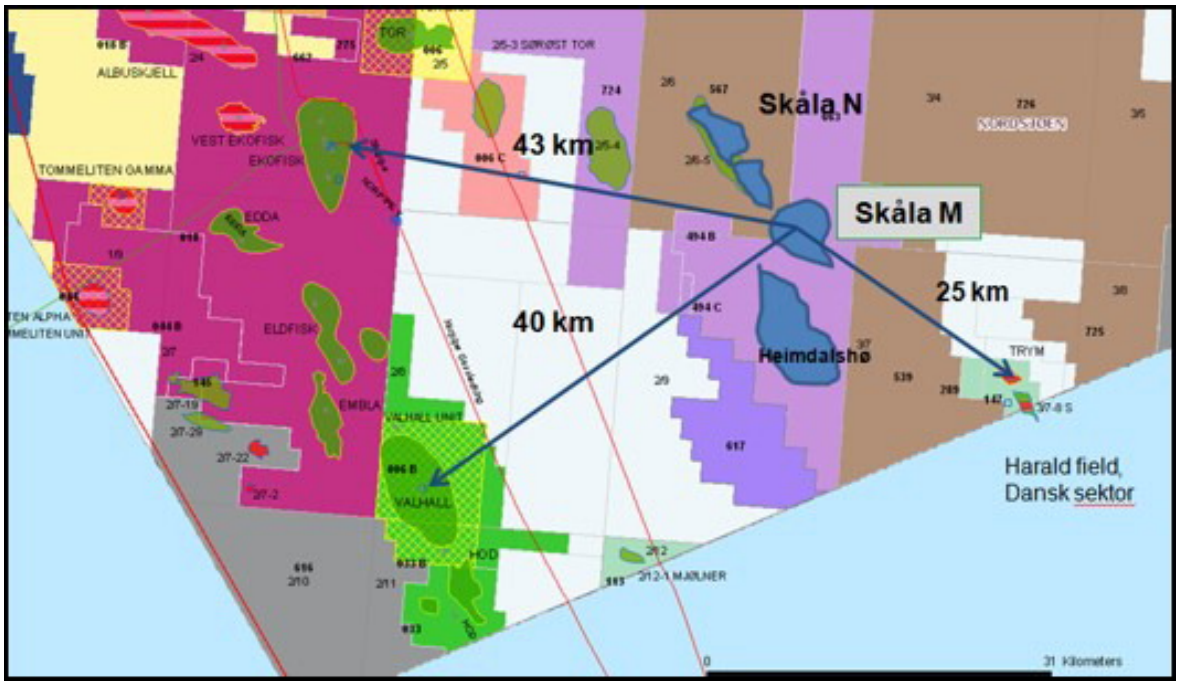


Fig. 5.1 Development concept for the Skåla Prospect. *Subsea tie-back to Ekofisk considered*

Recoverable resources: 26 MMBOE
Exploration well: 2017
First Oil: 2023
Development: Subsea Tie-back to Ekofisk (43 km)
1 no of 4 slot template o43 km Pipe-in-Pipe
1 producer wells (Rig rate: 165 000 USD/d
1 water injection wells

Some general assumptions and key figures, along with the expected net present value, ENPV, is illustrated in Fig. 5.2. The expected net present value of the Skåla Prospect is negative.

General Assumptions	Base
Oil price, $/bbl	65.00
Gas price, NOK/Sm^3	1.87
Exchange rate, NOKUSD[1]	7.50
Values:	Real 2015
Tax position:	Consolidated

Key figures, Gross 100%, (real)
Evaluation date
Rate of Return %
NPV 8% a.t, USDm
NPV/I 8%
Break Even Brent @ 8%, $/bbl
Min. ec. Volume, mmboe
EXPL. / boe
OPEX / boe
CAPEX / boe

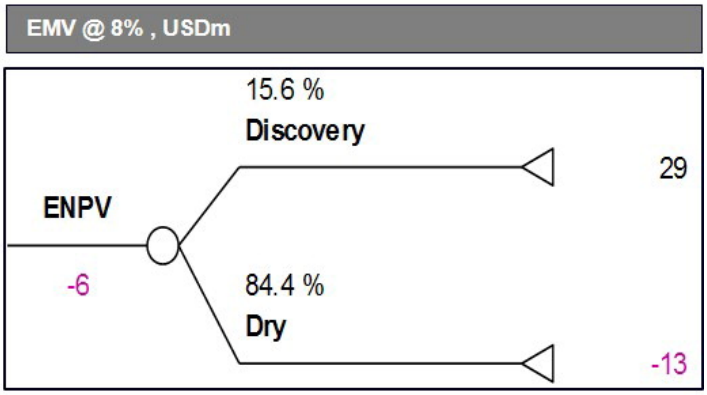


Fig. 5.2 Skåla Prospect technical-economical evaluation. *Key figures and assumptions used in the evaluation. Note that the ENPV is negative*

6 Conclusions

The partnership in PL663 has completed the license studies and evaluations. The work performed has greatly improved the understanding of the area to the east of the Mandal High. The prospectivity evaluations has not resulted in a commercially viable possibility, and the license partners have concluded to relinquish the license acreage.