Relinquisment report
PL 902 / 902B

Lundin Energy Norway

In cooperation with Lundin Energy Norway

AkerBP DNO petoro

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1 License history

Award and work program

Lundin Norway AS (now Lundin Energy AS), was awarded the PL902 (block 7120/1,2,3,4,5,6) as operator together with Petoro and Aker BP ASA as partners the 10th of February 2017. PL902 B (block 7120/1,2) was awarded as an extension of the license to the north the 1st of March 2019. The license group was then including DNO Norge AS which had come into the license group in November 2018.

The work program was to acquire and/or re-process 3D seismic within three years from award with a drill or drop (DD) decision within the same period. Within five years from award, the licensees should consider to make a "Decision to Concretize" (BOK) and within seven years make a "Decision to Continue" (BOV). An application for extension of the deadlines for one year was approved in February 2020.

In 2017, PL902 was part of the TopSeis campaign covering the licenses in the southern part of the Loppa High.

Table 1.1 License deadlines

Action	Date	New date after extension
Award	10/2-2017	
Acquire and/or re-process 3D seismic	10/2-2020	
DD	10/2-2020	10/2-2021
BOK	10/2-2022	10/2-2023
BOV	10/2-2024	10/2-2025
PDO	10/2-2025	

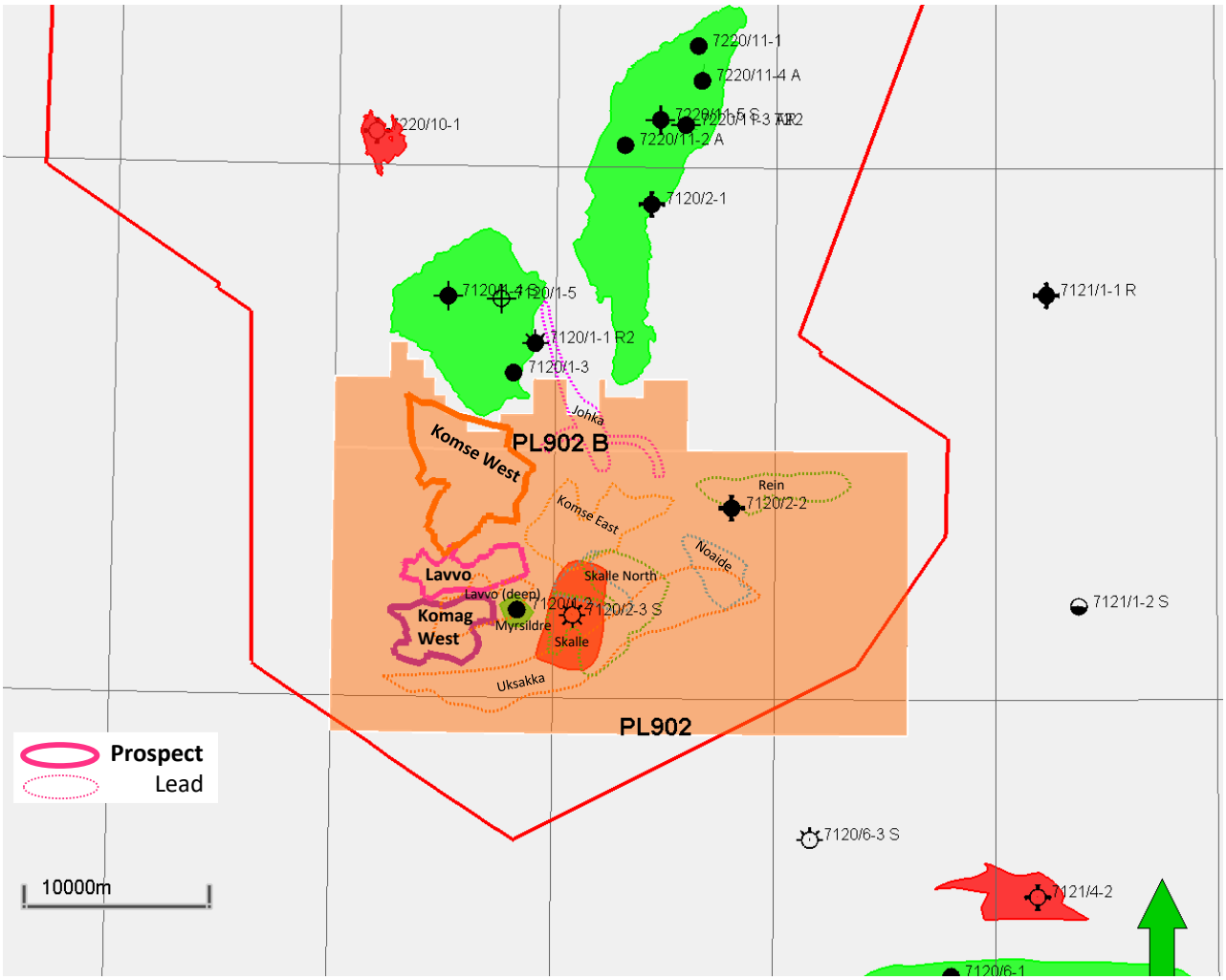

Fig. 1.1 Map showing the location of PL902 and PL902B

PL902 and PL902B are located south of the Gohta and Alta discoveries. Komse West, Lavvo and Komag West are prospects that have been evaluated in the license. The two discoveries Skalle and Myrsildre are situated inside the license area. Leads are indicated with dashed lines. The red polygon is the outline of the LN17001 TopSeis survey

License meetings

Exploration Committee (EC) and/or Management Committee meetings (MC) were held on the following dates. In addition two separate work meetings (WM) were held.

Table 1.2 License meetings

Date of meeting	Type of meeting
10/3-2017	MC no1
20/11-2017	EC/MC
22/11-2018	EC/MC
10/4-2019	EC/MC
20/9-2019	EC/MC
12/10-2020	EC/MC
14/1-2021	EC/MC
10/2-2020	WM
4/5-2020	WM

Reason for relinquishment

For Komse West, new assessment of the reservoir properties and redefinition of the prospect outline gave a reduction in the volumetric potential. A fault sealing analysis study gave an increase in the risk of fault leakage. The prospect therefore became too small and the risk too high.

The Lavvo prospect had a high risk on reservoir and only parts of the structure seemed to have seismic amplitudes which could be related to reservoir.

The Komag West prospect was difficult to map even on the new seismic. This lead to a high uncertainty on definition of the trap.

After evaluation, the economic and volumetric potential of the ranked prospects in PL902 and PL902B were too small and the risk too high both for a standalone and a tie in solution.

2 Data base overview

2.1 Seismic data

At the initialization of the license, the survey LN15M01 – Including the background surveys LN0801, NH9605 and SH9301 - was the seismic database for the license (see Fig. 2.1). In 2017 the license was a part of the TopSeis survey LN17001. The survey covers most of the license and this survey became the basis for the seismic interpretation when it was finished. The red polygon in Fig. 1.1 shows the outline of LN17001 in PL902 and PL902B area

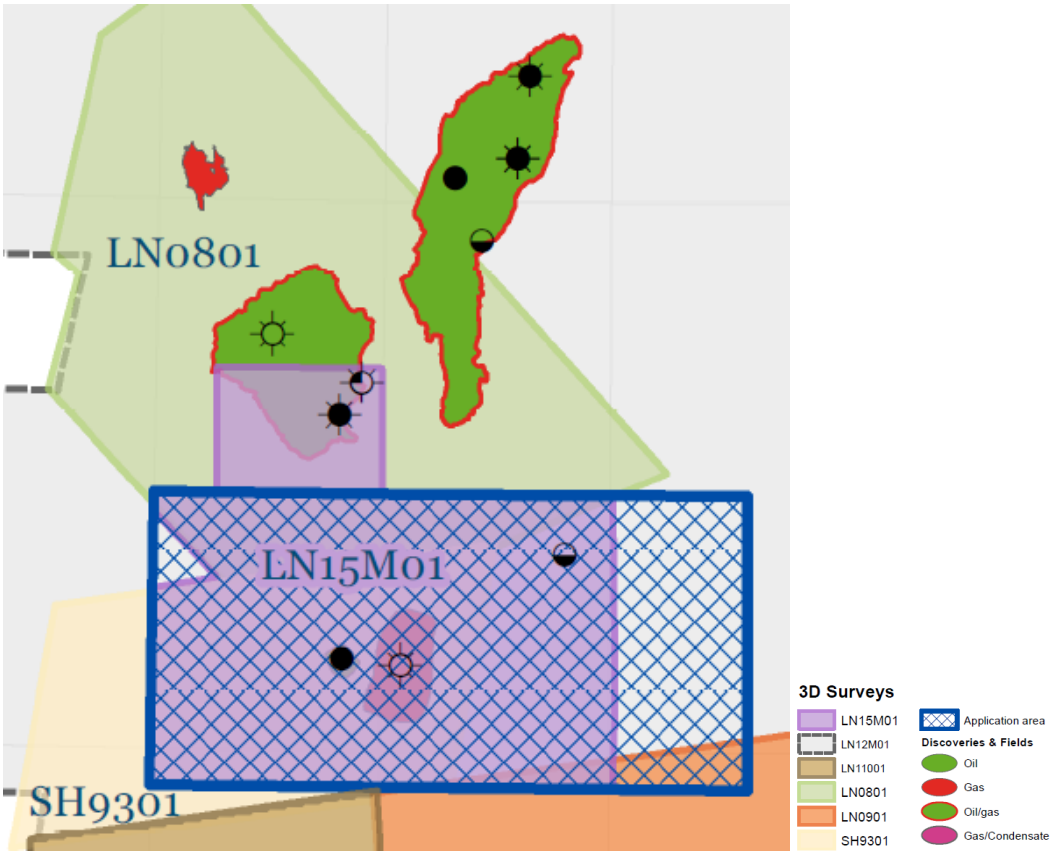

Fig. 2.1 Seismic data base prior to LN17001 Top Seis
The three surveys covering the license area LN0801, NH9605 and SH9301. The purple-filled area is the outline of the reprocessing LN15M01. This survey was the license seismic database at the initialization of the license.

The relevant vintage seismic surveys and the new TopSeis survey are listed in

Table 2.1 Seismic database

SURVEY	TYPE	OPERATOR	YEAR	NPDID
LN15M01	3D merge	Lundin	2015	
UNDERLYING SURVEYS OF THE MERGE:				
LN0801	3D survey	Lundin	2008	4556
SH9301	3D survey	Shell	1993	3620
NH9605	3D survey	Statoil	1996	3787
LN17001	3D survey	Lundin	2017	8477

2.2 Well data

The following wells were actual for the license.

Table 2.2 Actual wells for the license

Well	Common database	OPERATOR	YEAR	NPDID
7120/1-2	no	A/S Norske Shell	1989	1366
7120/2-3S	yes	Lundin Norway AS	2011	6592
7120/2-2	no	Norsk Hydro Produksjon AS	1991	1690
7120/1-1R2	no	A/S Norske Shell	1986	897
7120/1-3	yes	Lundin Norway AS	2013	7210
7120/1-4S	yes	Lundin Norway AS	2014	7429
7120/2-1	no	Norsk Hydro Produksjon AS	1985	473
7220/11-3	yes	Lundin Norway AS	2015	7714
7220/11-3AR	yes	Lundin Norway AS	2016	7959

3 Geological and geophysical studies and results

Studies
The following studies were carried out in PL902 and PL902B:

- Acquisition and processing of LN17001 including several versions of PSDM
- Seismic interpretation
- Pre-stack inversion of LN17001
- Geochemical analysis
- Reservoirs properties assessment
- Fault seal analysis

Results
The TopSeis seismic survey gave a good uplift in quality compared to the vintage seismic in the area. This facilitated an improved seismic interpretation including fault interpretation which was important for the main prospect, Komse West. The geochemical analysis gave important information about potential HC source rocks in the vicinity of the license.

The updated seismic horizons were together with an updated assessment of reservoir parameters used in calculating HC volume potential in the prospects. For the main prospect, Komse West, this resulted in reduced volume potential compared to earlier calculations. This was mainly due to a reduction in the assumed reservoir quality for the carbonates.

The fault analysis study on Komse West included fault seal analysis and juxtaposition analysis. Generally the analysis showed that the risk for leakage was larger for the Røye Fm part of the reservoir than the Ørn Fm part.

4 Prospect update report

Resource summary from the application

The three prospects Komse West, Lavvo and Komag West were defined in the application. The location of these prospects can be seen in Fig. 4.1.

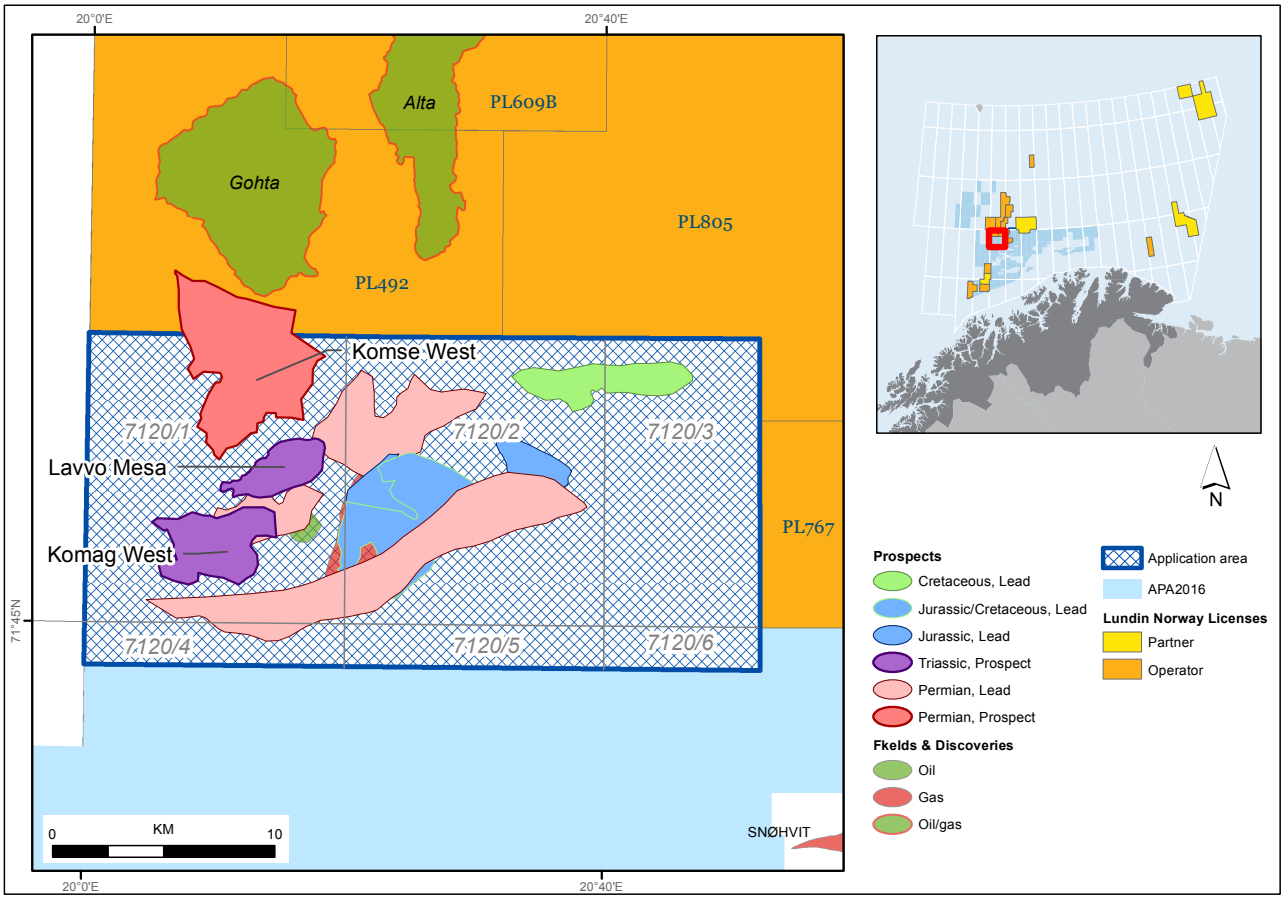

Fig. 4.1 Application area with prospects and leads

Table 4.1 shows a summary of the resource potential of the three prospects from the application.

Table 4.1 Resource potential (NPD Table 2) from the application

Table 2: Resource Potential

Discovery/ Prospect/ Lead name [1]	D/ P/ L [2]	Case (Oil/ Gas/ Oil&Gas) [3]	Unrisked recoverable resources [4]						Probability of discovery [5] (0.00 - 1.00)	Resources in acreage applied for [%] [6] (0.0 - 100.0)	Reservoir		Nearest relevant infrastructure [8]	
			Oil [10^6Sm^3] (>0.00)			Gas [10^9Sm^3] (>0.00)					Litho-/ Chrono-stratigraphic level [7]	Reservoir depth [m MSL] (>0)	Name	Km (>0)
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)						
Komse West	P	Oil&Gas	10,90	22,40	38,20	3,50	6,89	21,01	0,21	60,0	Havert-Ørn Fms/ Triassic- Carbon.	2700	Snøhvit	30
Komag West	P	Oil	8,90	16,40	26,90				0,18	100,0	Realgrunnen Gp/ Jurassic-Triassic	1600	Snøhvit	30
Lavvo	P	Oil&Gas	8,10	19,00	35,00	1,30	2,92	5,40	0,19	100,0	Snadd Fm/ Triassic	1100	Snøhvit	30

Komse West

In the application the Komse West prospect was defined as the continuation of the Gohta structure south of the Komse Fault. The Komse West prospect was the down faulted part of the structure, situated about 500 m deeper than Gohta. A strong unconformity could be observed near the base

of the Triassic indicating deep erosion of the Palaeozoic. Subaerial exposure of the Permian and Carboniferous in early Triassic times may have generated reservoir possibilities both in the form of karstification of carbonates and in the form of deposition of locally generated erosion products such as coarse sandstones and conglomerates. The lower Snadd shales were expected to act as seal. The trap was dependent on fault sealing towards north, either by juxtaposition of reservoir against non reservoir or by tight fault smearing material. Another risk was that the fault zone could be a relay ramp so that hydrocarbons may leak into the Gohta discovery. A seismic shadow below a shallow gas anomaly complicated the mapping in the fault zone.

Fig. 4.2 shows a geosection over the Komse West prospect with the different formations tilting towards east resulting in older and older formations being exposed westwards in the truncated area at the Base Triassic time.

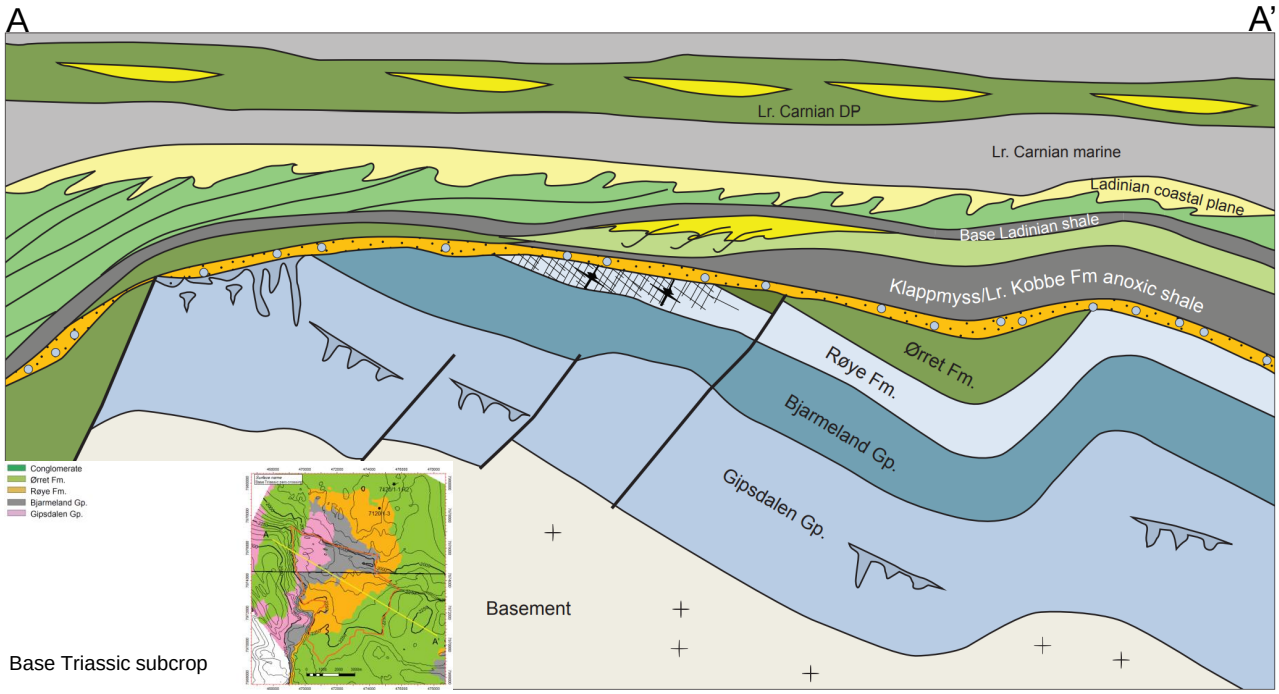

Fig. 4.2 Geosection over the Komse West prospect

In the license period, several geological and geophysical methods have been applied in order to investigate the uncertainties defined in the application. The new seismic was used in the definition of the prospect. Fault interpretation and fault seal analysis indicated that a Røye-Røye Fm juxtaposition would have a large chance of leaking. An Ørn-Ørn juxtaposition would in this study hold a larger HC-column. Since the Ørn Fm part of the reservoir is located to the west, and if we consider the Bjarmeland Gp to be tight, an "Ørn-only" prospect in the western part of Komse West was considered further in the volumetric and technical-economical analysis. This more compact "Ørn Fm-only" solution had on beforehand also shown to be more benefitial economically due to the number of development wells. Updated reservoir properties from the Alta discovery were used in the volumetric calculations. The main reasons for the reduction in the calculated resource potential from the application to the relinquishment is the change in reservoir parameters and the shift from Havert Fm, Conglomerate, Ørn Fm and Røye Fm reservoir to "Ørn Fm-only" reservoir. The reduction in chance of success (CoS) results mainly from an increased risk in Trap. Table 4.2 shows the resource volume for the Komse West prospect.

Table 4.2 Komse West prospect data

Table 5: Prospect data (Enclose map)									
Block		Prospect name	Komse West Ørn	Discovery/Prosp/Lead		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:		Reported by company		Reference document				Assessment year	
This is case no.:		Structural element		Type of trap		Water depth [m MSL] (>0)		Seismic database (2D/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)	14,422	23,196	32,11	53,545	0,066	0,107	0,115	0,173
	Gas [10^9 Sm^3] (>0.00)	0,291	0,467	0,488	0,714	2,686	5,119	5,93	9,887
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	5,593	13,192	14,606	26,182	0,036	0,048	0,077	0,129
	Gas [10^9 Sm^3] (>0.00)	0,158	0,264	0,328	0,531	1,044	1,605	2,698	4,827
Reservoir Chrono (from)		Reservoir litho (from)		Source Rock, chrono primary		Source Rock, litho primary		Seal, Chrono	
Reservoir Chrono (to)		Reservoir litho (to)		Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,14	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)	0,80	Trap (P2) (0.00-1.00)	0,40	Charge (P3) (0.00-1.00)	0,75	Retention (P4) (0.00-1.00)	0,60		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)									
Area of closure [km^2] (> 0.0)									
Reservoir thickness [m] (> 0)									
HC column in prospect [m] (> 0)									
Gross rock vol. [10^6 m^3] (> 0.000)	0,528	0,821	1,344						
Net / Gross [fraction] (0.00-1.00)	0,56	0,7	0,84						
Porosity [fraction] (0.00-1.00)	0,08	0,1	0,12						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0,25	0,2	0,15						
Bg [Rm3/Sm3] (< 1.0000)	0,00542	0,00434	0,00362						
1/Bo [Sm3/Rm3] (< 1.00)	0,508	0,635	0,762						
GOR, free gas [Sm^3/Sm^3] (> 0)	3000	5600	6000						
GOR, oil [Sm^3/Sm^3] (> 0)	180	185	190						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,352	0,44	0,528						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,352	0,44	0,528						
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,52	0,65	0,78						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,52	0,65	0,78	For NPD use:					
Temperature, top res [°C] (>0)				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)				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

Lavvo

The Lavvo prospect was in the application defined as an erosion remnant (a mesa structure) at the BCU level. The possible reservoir was interpreted to be in the upper part of the Snadd formation. In the application, the HC-volumes for the high case were calculated including a fault which helped giving a deeper than spill filling of the structure. The main risk for the Lavvo prospect was seen to be reservoir presence.

The Lavvo prospect did not change much after updating on the new seismic. Fig. 4.3 shows a Top Lavvo depth map with possible oil water contacts used in the volumetric calculation. Fig. 4.4 shows a section over the Lavvo prospect with two zones "Upper" and "Lower" which have been given different reservoir properties in the volumetric calculation. Table 4.3 shows the resource volume for the Lavvo prospect. The prospect volumetric calculations are more conservative compared to the application. The high case now is close to spill at BCU and is not depending on a potential fault sealing towards north which gave deeper than spill filling as it was in the application.

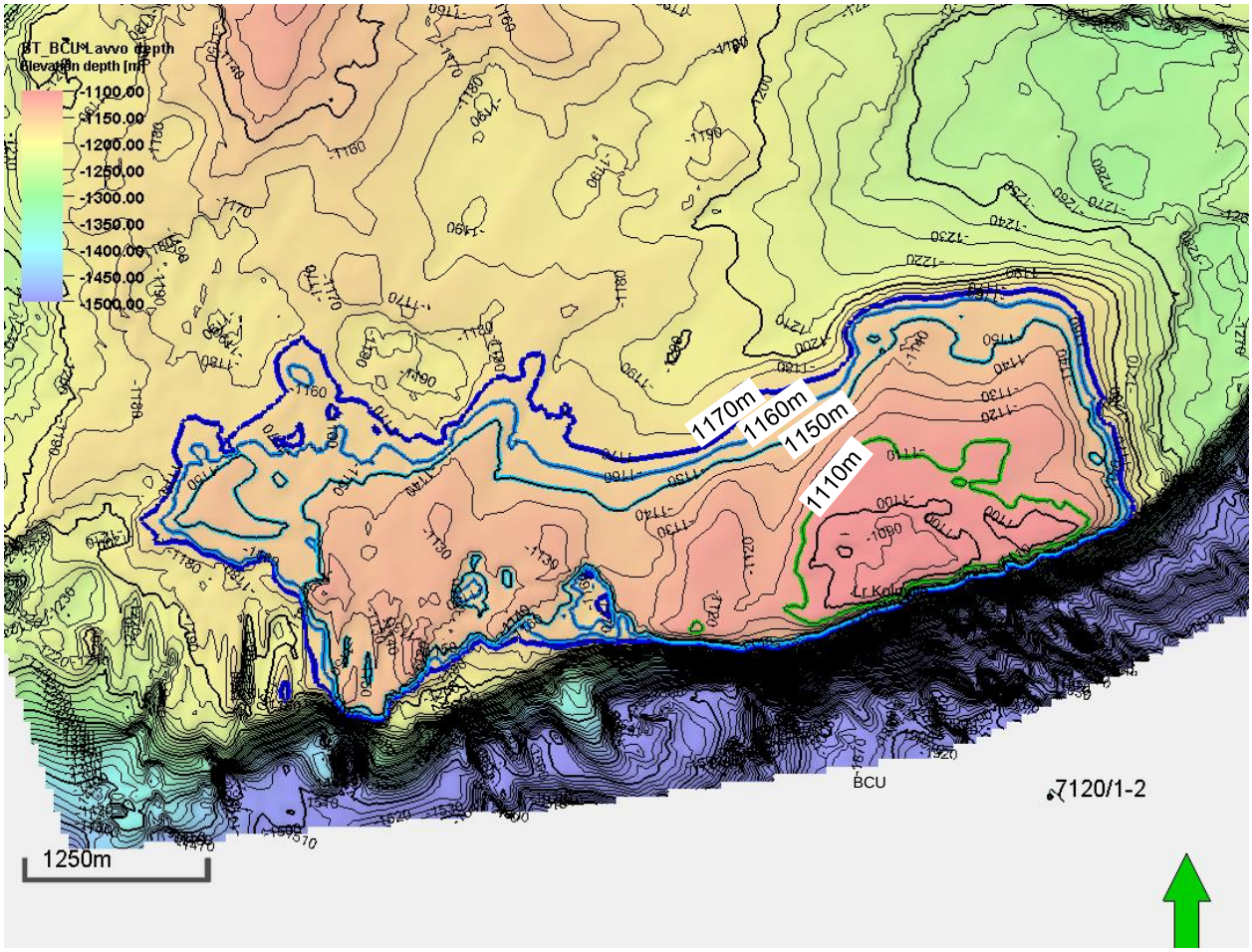

Fig. 4.3 Top Lavvo depth map

Top Lavvo depth map (BCU). Showing possible low, medium and high contacts

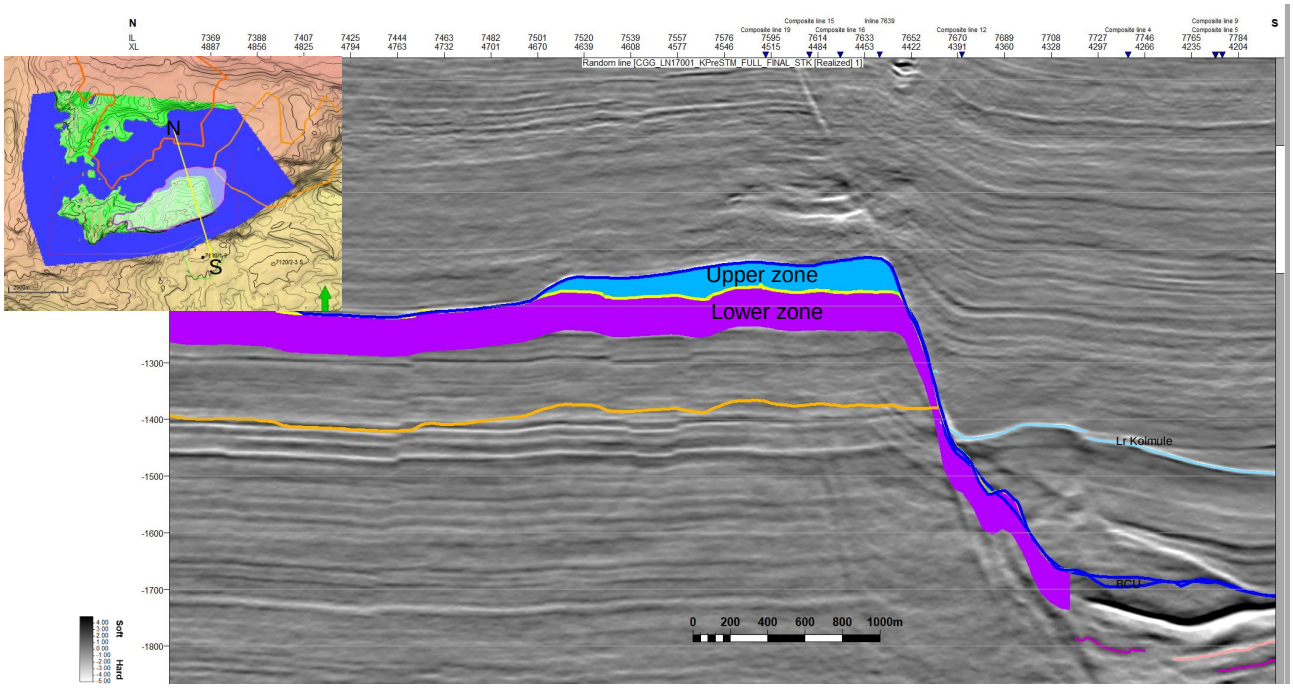

Fig. 4.4 North-south section over the Lavvo prospect

Table 4.3 Lavvo prospect data

Table 5: Prospect data (Enclose map)

Block		Prospect name	Lavvo	Discovery/Prosp/Lead		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:		Reported by company		Reference document				Assessment year	
This is case no.:		Structural element		Type of trap		Water depth [m MSL] (>0)		Seismic database (2D/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)	10,794	16,101	19,194	27,524	0,025	0,049	0,044	0,064
	Gas [10^9 Sm^3] (>0.00)	0,116	0,208	0,184	0,251	0,386	0,794	0,952	1,605
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	4,445	5,108	8,507	12,871	0,016	0,035	0,029	0,044
	Gas [10^9 Sm^3] (>0.00)	0,07	0,106	0,121	0,172	0,161	0,302	0,422	0,729
Reservoir Chrono (from)		Reservoir litho (from)		Source Rock, chrono primary		Source Rock, litho primary		Seal, Chrono	
Reservoir Chrono (to)		Reservoir litho (to)		Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,14	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)	0,40	Trap (P2) (0.00-1.00)	0,90	Charge (P3) (0.00-1.00)	0,75	Retention (P4) (0.00-1.00)	0,50		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)									
Area of closure [km^2] (> 0.0)									
Reservoir thickness [m] (> 0)									
HC column in prospect [m] (> 0)									
Gross rock vol. [10^6 m^3] (> 0.000)	0,158990859	0,239922821	0,326816245						
Net / Gross [fraction] (0.00-1.00)	0,46600486	0,614001337	0,734609388						
Porosity [fraction] (0.00-1.00)	0,214626853	0,235539599	0,255571111						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0,339276473	0,278095477	0,220706749						
Bg [Rm3/Sm3] (< 1.0000)	0,01112	0,01	0,00909						
1/Bo [Sm3/Rm3] (< 1.00)	0,804	0,82	0,836						
GOR, free gas [Sm^3/Sm^3] (> 0)	2999,136	4325,121	6020,057						
GOR, oil [Sm^3/Sm^3] (> 0)	25,91792495	50,04462372	74,23110243						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,394289735	0,437597438	0,481333303						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,394289735	0,437597438	0,481333303						
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,600061665	0,649977436	0,699980228						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,600061665	0,649977436	0,699980228	For NPD use:					
Temperature, top res [°C] (>0)				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)				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

The new TopSeis seismic dataset over the prospect gave an uplift in the interpretability of the prospect, but it did not reduce the risk of reservoir not being present. If anything, the new dataset indicated that it could be that only parts of mesa structure is reservoir. The Trap on Lavvo seems to be well defined. The reduction in CoS compared to the application mainly reflects a reduction in probability of Retention, Reservoir and Charge.

Komag West

In the application, the Komag West prospect was located south of the Asterias fault on the Skalle terrace (well 7120/2-3S). Fig. 4.5 shows a depth map over the Komag West prospect. Possible oil water contacts are indicated. Fig. 4.6 shows a geological section going through the Myrsildre well (7120/1-2). The map to the left shows where the various formations sub-crop BCU. Table 4.4 shows resource volumes for the Komag West prospect. The seismic in the area is noisy and the trap is difficult to define accurately. The reduction of volumes compared to the application mainly comes from reduction of the potential column heights for the high, medium and low cases in addition to the inclusion of a gas cap in the calculations. The difficult mapping and it being a down faulted prospect gave high risk on Trap.

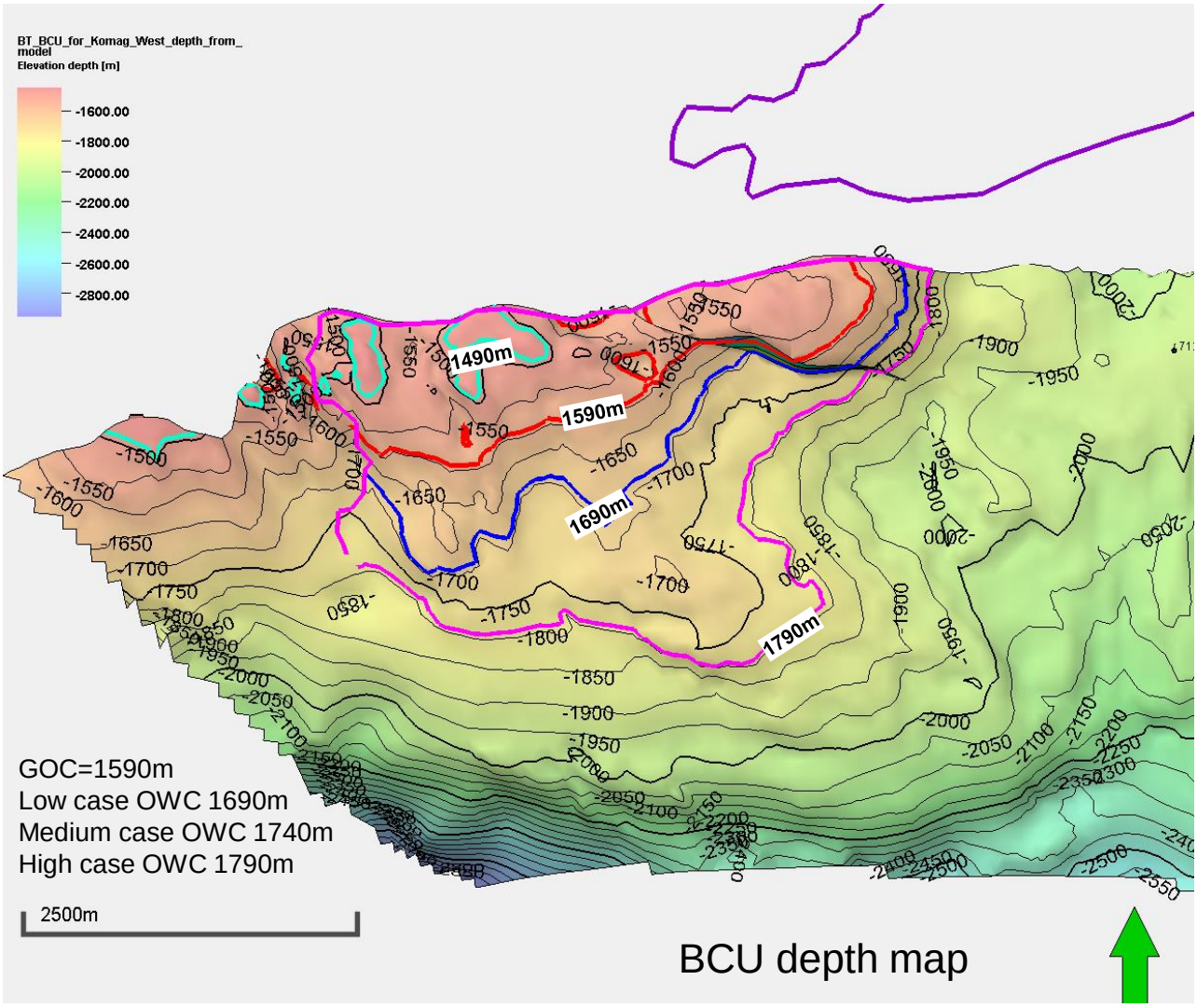

Fig. 4.5 Komag West top reservoir map

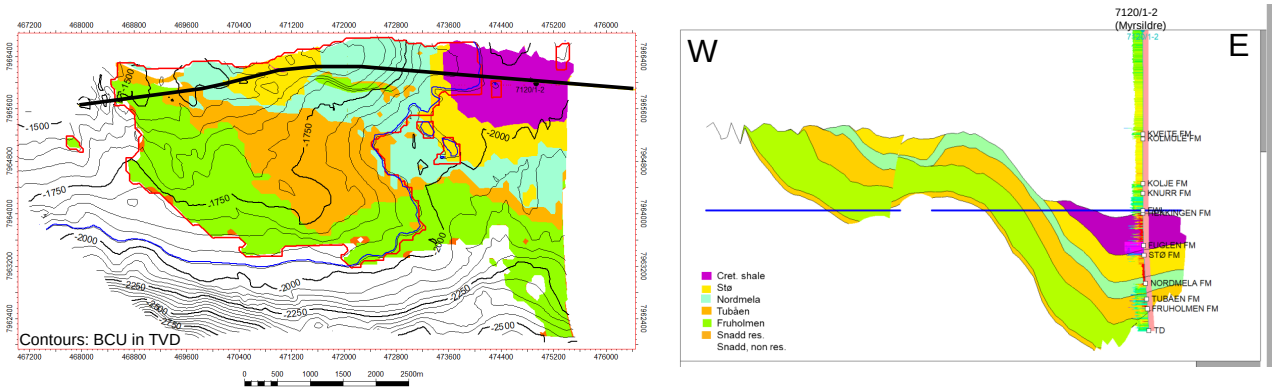

Fig. 4.6 Komag West geosection

Komag West geological section and sub-crop of BCU map. The section is going from the Myrsildre well (7120/1-2).

Table 4.4 Komag West prospect data

Table 5: Prospect data (Enclose map)

Block		Prospect name	Komag West	Discovery/Prosp/Lead		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:		Reported by company		Reference document				Assessment year	
This is case no.:		Structural element		Type of trap		Water depth [m MSL] (>0)		Seismic database (2D/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)	12,142	19,471	24,419	38,456	0,194	0,215	0,251	0,312
	Gas [10^9 Sm^3] (>0.00)	0,845	1,131	1,065	1,283	0,645	1,014	1,444	2,48
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	5,075	6,318	10,739	17,848	0,124	0,142	0,165	0,209
	Gas [10^9 Sm^3] (>0.00)	0,541	0,645	0,7	0,871	0,28	0,642	0,635	1,119
Reservoir Chrono (from)		Reservoir litho (from)		Source Rock, chrono primary		Source Rock, litho primary		Seal, Chrono	
Reservoir Chrono (to)		Reservoir litho (to)		Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,15	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)	0,70	Trap (P2) (0.00-1.00)	0,40	Charge (P3) (0.00-1.00)	0,90	Retention (P4) (0.00-1.00)	0,60		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)									
Area of closure [km^2] (> 0.0)									
Reservoir thickness [m] (> 0)									
HC column in prospect [m] (> 0)									
Gross rock vol. [10^6 m^3] (> 0.000)	0,4877	0,7594	1,0583						
Net / Gross [fraction] (0.00-1.00)	0,3070	0,3647	0,4179						
Porosity [fraction] (0.00-1.00)	0,1618	0,1836	0,2046						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0,3089	0,2645	0,2195						
Bg [Rm3/Sm3] (< 1.0000)	0,0084	0,0077	0,0071						
1/Bo [Sm3/Rm3] (< 1.00)	0,7690	0,8010	0,8290						
GOR, free gas [Sm^3/Sm^3] (> 0)	3527,0940	4255,6470	5111,5590						
GOR, oil [Sm^3/Sm^3] (> 0)	41,0107	60,1073	77,6705						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,3918	0,4332	0,4804						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,3918	0,4332	0,4804						
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,6289	0,6557	0,6816						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,6289	0,6557	0,6816	For NPD use:					
Temperature, top res [°C] (>0)				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)				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

Table 4.5 Additional prospectivity (Leads)

Lead	Description	Comment
Rein	Cretaceous (and possibly Jurassic) amplitudes south of Asterias Fault	Amplitudes in the Cretaceous indicating sandy facies south of the Asterias Fault. Kolmule Fm Knurr Fm. Possibly also in Stø Fm (Jurassic)
Uksakka	Possible closure at Base Triassic with Palaeozoic carbonate reservoir below	The possible closure at the Base Triassic is difficult to map
Skalle North	Possible continuation of the Skalle discovery. Kolmule, Knurr and Stø Fms	
Lavvo (deep)	Possible closure at Base Triassic with Palaeozoic carbonate reservoir below	
Komse East	Palaeozoic carbonates south of Komse Fault	Possibly less subaerially exposed than Komse West
Noaide	Jurassic Stø Fm	Amplitude anomaly
Johka	Snadd amplitude anomaly	

5 Technical evaluation

Technical-economical evaluation was performed, but the results were negative for a development.

6 Conclusion

Although PL902 and PL902 B is situated in an area with hydrocarbon potential and several identified leads and prospects, no leads or prospects were found to be drillable. The main arguments for this is the limited volume potential in each prospect and the risks identified with the prospects. The license group voted unanimously to relinquish the license in February 2021.