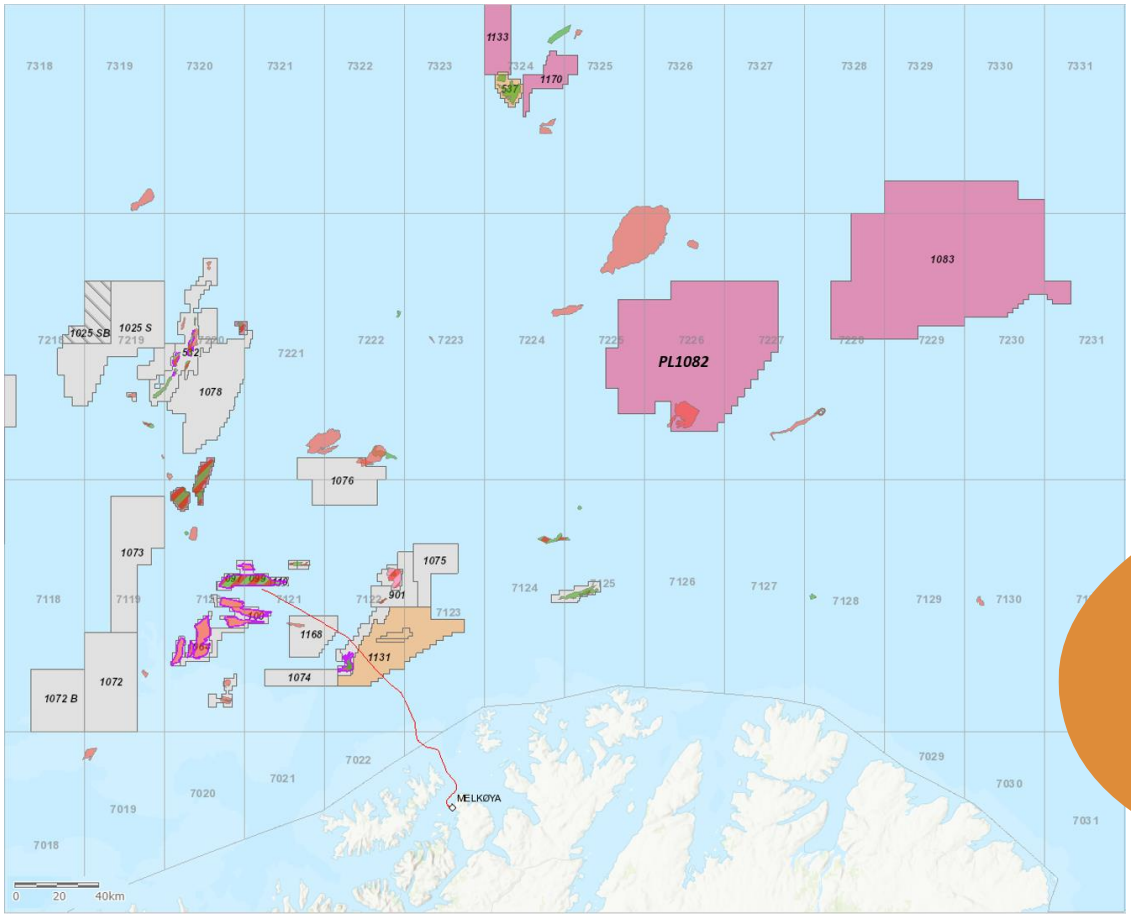
PL1082
Relinquishment report



1 License history

Production license PL1082 (Fig. 1.1) was awarded during APA 2019 the 14th of February 2020. Licensees are Aker BP ASA (previously Lundin Norway AS) and Sval Energi AS (previously Spirit Energy Norway AS) with 50 percent each. The work commitment included acquisition and reprocessing of 3D seismic, and geological and geophysical studies with a drill/drop decision within three years.

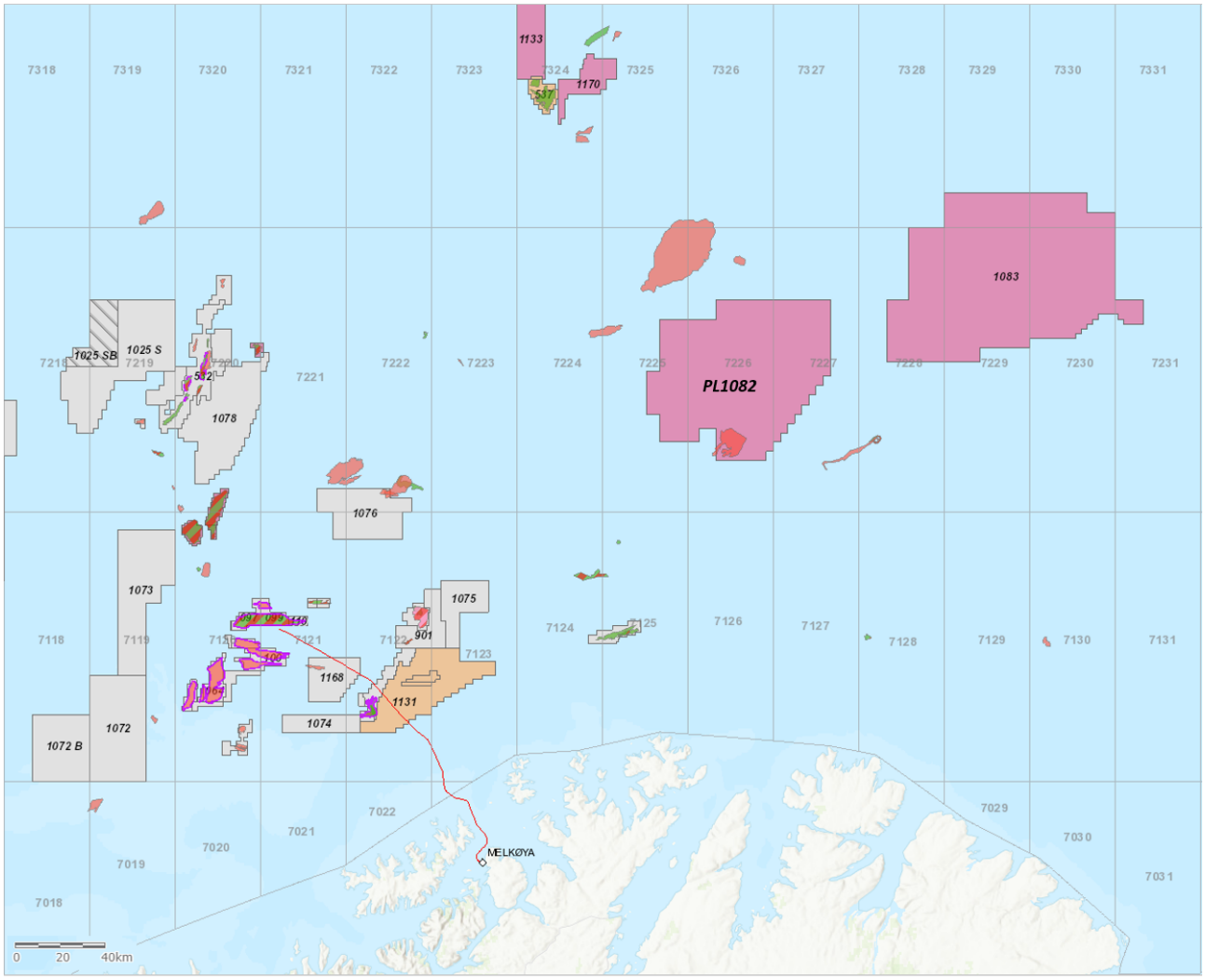


Fig. 1.1 Location of Production License 1082 in the Barents Sea

Table 1.1 PL1082 meetings

Date	Committee	Number/Type
22.04.2020	EC/MC	#1
03.11.2020	EC/MC	#2
25.11.2021	EC/MC	#3
16.02.2022	EC	work meeting
21.06.2022	EC	work meeting
17.11.2022	EC/MC	#4

2 Database

The license common database for PL1082 encompassed released wells and 2D seismic data. In addition a single 2D seismic line and the 3D seismic survey NSH17 was licensed. No CSEM data was included in the common database.

2.1 Seismic data

Common database

The license relied mainly on released 2D seismic and the NBR12-3466 seismic line (Fig. 2.1), a line which was further reprocessed. To better evaluate prospectivity in the main structural closures the license acquired 500 km^2 of the 3D seismic survey NSH17. The survey is a merge between the surveys SPE17003 and NSH12 (Table 2.1).

Table 2.1 Common seismic database PL1082

Name	NPD ID	2D/3D	Company	Total length (cdp km)	Released Yes/No	Vendor
SPE17003	8473	3D	Spectrum ASA	32808	N	TGS
NSH12	7629	3D	Fugro Multi Client Services AS	92605	N	TGS
NBR12-4436	7579	2D	Fugro Multi Client Services AS/TGS	50	N	TGS
Various 2D seismic lines		2D	Various	-	Y	-

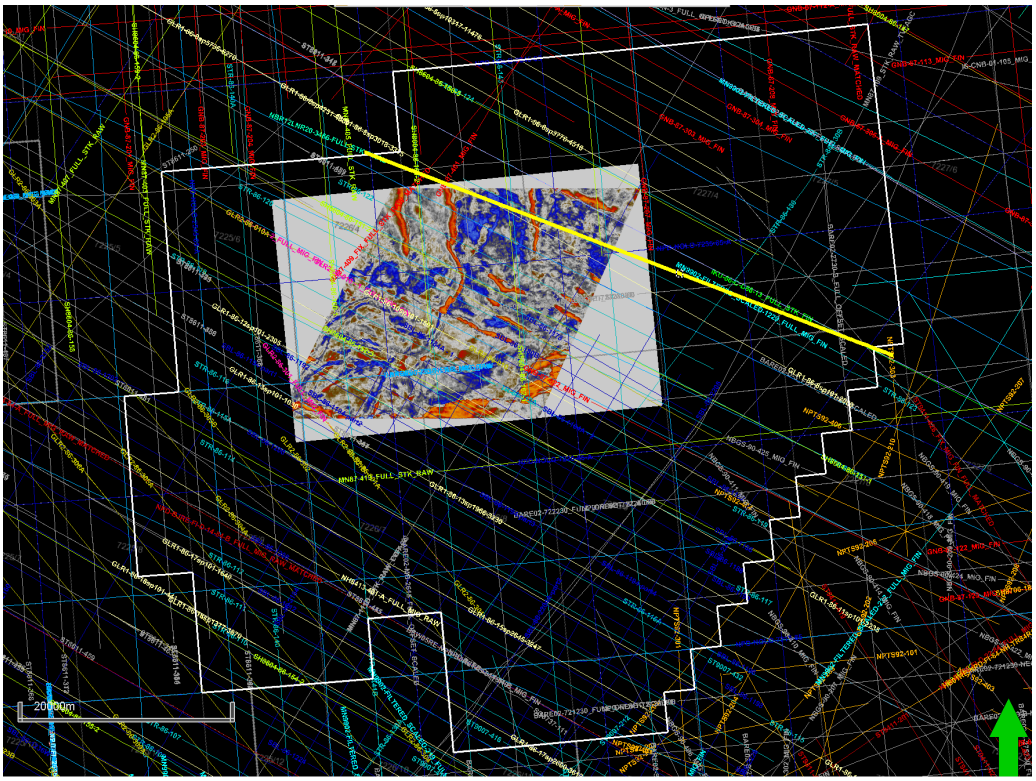


Fig. 2.1 PL1082 seismic database. *White fully drawn line marks the license boundary of PL1082. A time slice of the 500 km2 3D seismic over the crest of the faulted dome is shown for reference. The heavy drawn yellow line crossing the NE portion of the license is the reprocessed NBR12-3466 line.*

2.2 Well Data

Wells used for seismic tie, geological input regarding reservoir and source rock properties, and sampled for geochemical analysis are listed in Table 2.2 and displayed in Fig. 2.2.

Table 2.2 Released wells in PL1082 common database

Well	NPDID	Operator	Year	Content	TD MD (m RKB)	TD Formation
7124/3-1	1066	Saga	1987	OIL/GAS	4730	Ørn
7125/1-1	1350	Saga	1988	OIL/GAS	2200	Kobbe
7224/6-1	5835	Statoil Hydro	2008	GAS	2338	Kobbe
7224/7-1	1245	Statoil	1988	SHOWS	3067	Havert
7225/3-1	6587	Total	2011	GAS	4150	Isbjørn
7225/3-2	7149	Total	2013	GAS	2210	Klappmyss
7226/2-1	5807	StatoilHydro	2008	GAS	2992	Havert
7226/11-1	1177	Statoil	1988	GAS	5200	Basement
7228/1-1	6820	Noreco	2012	DRY	1714	Kobbe

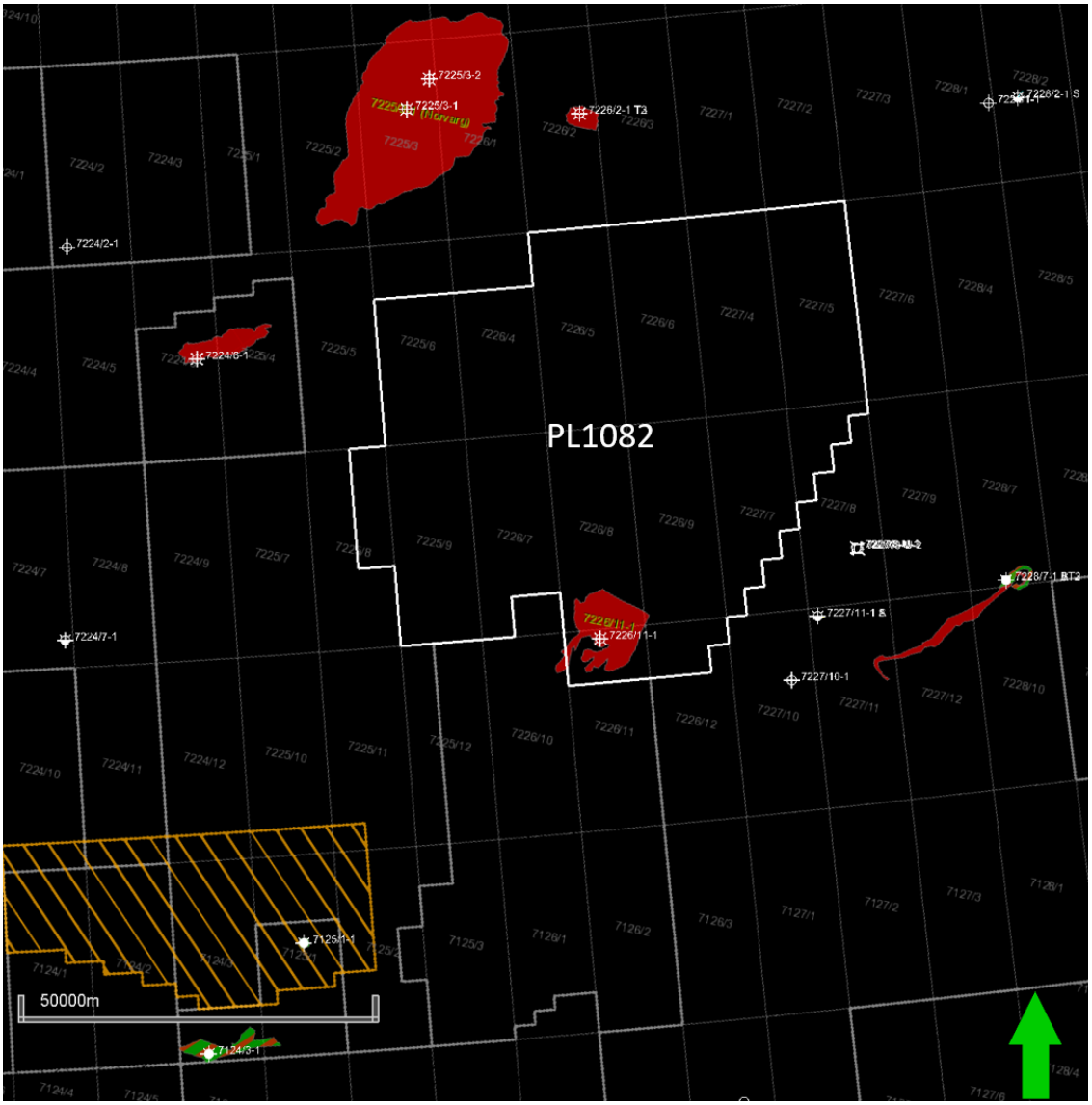


Fig. 2.2 Well location map, PL1082

3 Geological and geophysical studies

The application for the Jurassic Aestas Prospect and the PL1082 acreage was based on 2D seismic data of varying vintages and quality. While potential direct hydrocarbon indicators could be identified on a few lines - there was no coherent picture that was truly conform with structure. This can partly be attributed to the varying quality and difficulties in obtaining a coherent seismic dataset balanced with regard to both phase, time and amplitude.

2D seismic reprocessing

In order to investigate if reprocessing of 2D seismic could mitigate the limitations, a test-reprocessing was initiated. Reprocessing of seismic line NBR12-3466 within the license boundary provided much improved seismic resolution and definition, and direct hydrocarbon indicators were seen in the Aestas East Prospect. However, for most other 2D seismic lines one cannot expect as much uplift with reprocessing as those surveys lack recorded source signatures. This precluded reprocessing of further lines, and instead 500 km^2 of the 3D NSH17 was licensed.

Fluid replacement modelling

Fluid replacement modelling was performed on wells with regard to Realgrunnen Subgroup and Snadd Formation reservoirs, this work showed that seismic fluid responses are to be expected in case reservoirs are filled with oil or gas. However, distinguishing between oil and gas may be more difficult than separating hydrocarbons and brine away from wells.

Seismic modelling

As the top Stø Formation reflection may change polarity and character depending on the presence and thickness of the overlying Fuglen Formation - wedge modelling of cap rock and reservoir was performed. Released high resolution tie-lines between wells 7226/2-1 and 7226/11-1 were interpreted and synthetically modelled with properties from the wells and with/without hydrocarbon fill in the structural closures in the Aestas prospects to evaluate how well various scenarios conformed to that observed on the seismic. Where Fuglen is thick (e.g. Well 7226/2-1) the top Stø reflection is a trough and further softening with hydrocarbon fill. Where Fuglen Formation is thin or absent (e.g. Well 7226/11-1) Hekkingen Formation instead overlies the Stø Formation and the top Stø is a hard event dimming with hydrocarbon fill.

3D seismic reprocessing

The data improvement potential of the NSH17 was deemed modest with regard to a full reprocessing work flow and therefore a more limited scope was chosen (Fig. 3.1) including:

- Pre stack de-striping / Footprint attenuation
- Gather de-noise and residual flattening
- Structural / anisotropic diffusion filter on common offsets
- Gather output and angle stacks

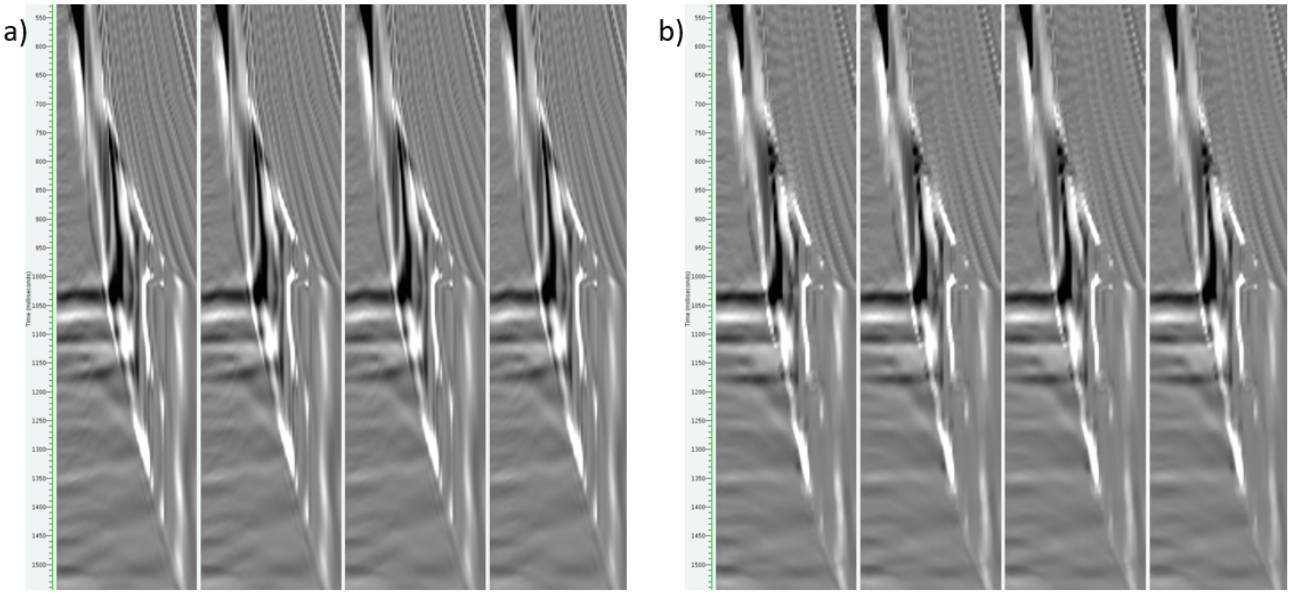


Fig. 3.1 NSH17 gathers during selected reprosessing steps *a) Gathers after destriping, note remaining noise and imperfect gather flatness, b) Gathers after denoise and residual flattening.*

Pcube+ inversion

A Pcube+ inversion study was performed with the purpose to better understand top reservoir polarity and seismic pick, and to enhance fluid effects indicating the presence of trapped hydrocarbons. The inversion results in particular helped delineating thickness variations of the Fuglen Formation and constrained fluid contact inputs in the prospect evaluations.

CSEM feasibility study

Feasibility studies for CSEM data have been performed. The studies showed that for large hydrocarbon accumulations CSEM may be sensitive but as nearby wells have highly conductive saline brines, existing CSEM data is unlikely to yield conclusive results in the absence of a strongly resistive anomaly.

Geochemistry

Sampling of reservoir sections for geochemical analysis and fingerprinting of migrated hydrocarbons was performed for wells 7124/3-1, 7125/1-1, 7224/6-1, 7224/7-1 and 7225/3-1, all wells suggesting vertically migrated contribution of liquids from Early-Middle Triassic source rocks in the extracted samples.

4 Prospect update

The work within the license has gradually focussed on the Jurassic prospectivity (Fig. 4.1) as clear depth-conform amplitude anomalies reflecting hydrocarbons were revealed in both the Aestas Main and the Aestas East prospects through reprocessing the 3D seismic. Conversely, interest in the Carnian prospectivity has degraded as no depth-conform amplitude shut-off has been observed in any sizeable channel body despite the fact that fluid replacement modelling infers such anomalies are to be expected in the presence of hydrocarbons given good reservoir properties. A large Carnian channel meander in the southern part of the 3D continues down-flank towards Well 7226/11-1 where the corresponding sand interval was brine saturated. This meander can be followed on single 2D seismic lines between the 3D and Well 7226/11-1, no variation in amplitude that could relate to a hydrocarbon induced depth conform amplitude shut-off could be observed. Thus, explaining a decreasing interest in Carnian prospectivity in the license as data have improved. Admittedly, 500km^2 3D seismic data is too little to fully evaluate the Carnian potential within the whole licence area. Deeper potential prospectivity in the Kobbe Formation suffers from lack of areally significant closures and anticipated poor reservoir development. Also, interest in the Carboniferous McFly Lead dwindled with the negative results of recent wells testing this play.

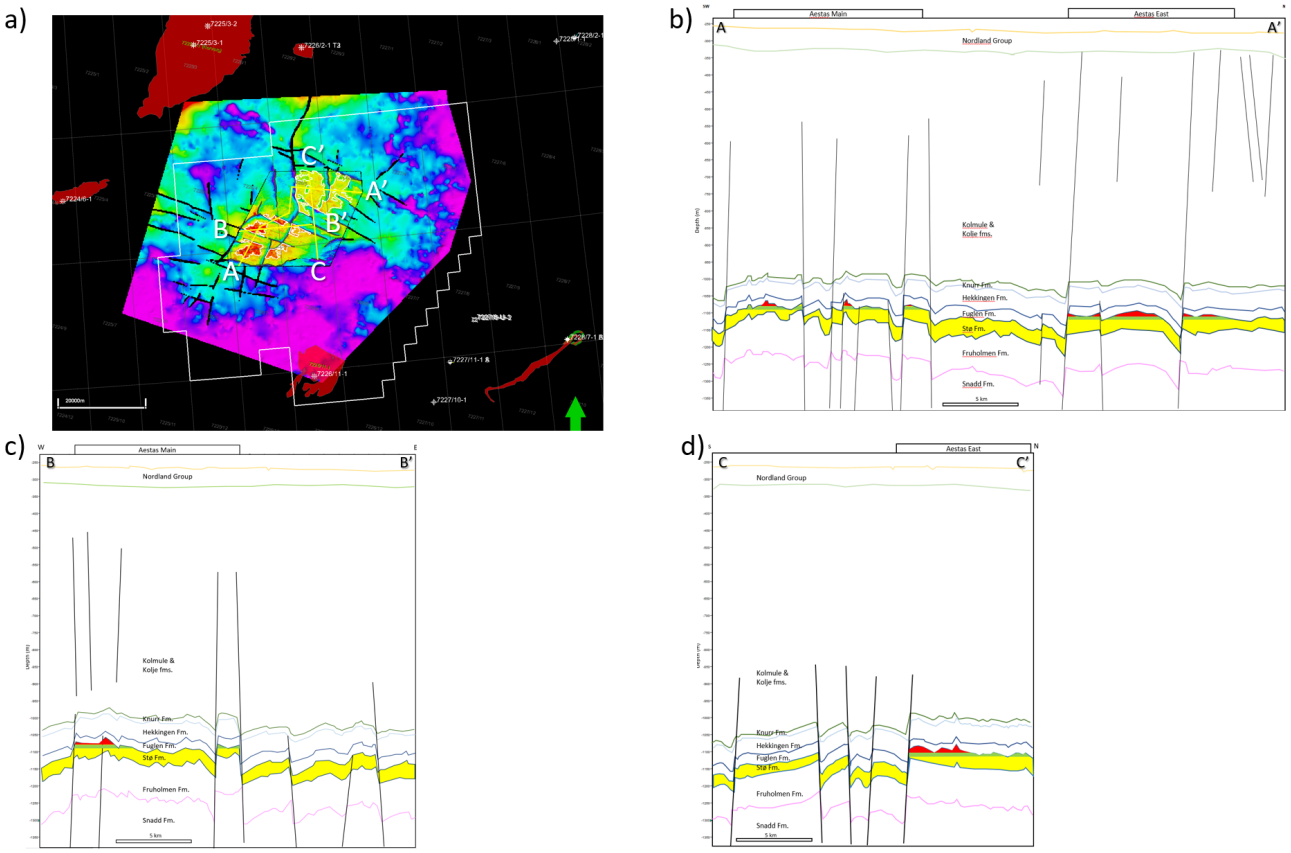


Fig. 4.1 Geoseismic sections through Aeastas Main and East prospects *a) depth map with mean hydrocarbon-water contacts marked by white outlines. b) random line through Aestas Main and East prospects. c) x-line through Aestas Main Prospect. d) inline through Aestas East Prospect.*

Below, the Jurassic prospectivity (Aestas Main and Aestas East prospects) is updated based on the NSH17 3D seismic survey, for possible deeper prospectivity we refer to the original license application with the change that also the Carnian closure is downgraded to lead status in the absence of any observable direct hydrocarbon indicators.

Aestas Jurassic prospects

The main change to the prospects volumetric evaluation is to the containers as 3D seismic data now provide better constraint. Also fluid contacts have been constrained by the 3D seismic. Previously, on 2D no coherent depth conform direct hydrocarbon indicators could be observed. A separate resource table is now presented for Aestas East as such a table was included in the application only for the Aestas Main Prospect.

Aestas Main

Aestas Main (Fig. 4.2) is evaluated as a gas and oil (Table 4.1) prospect, the segments are underfilled with regard to internal spill points. The contacts ranges were guided based on observations on the reprocessed and inverted 3D seismic data. Note the anticipated limited thickness of the mean oil column of only 13 metres this may prohibit or limit recovery and may thus warrant truncation of the probability for discovery to avoid technically unfeasible outcomes in any future re-evaluation.

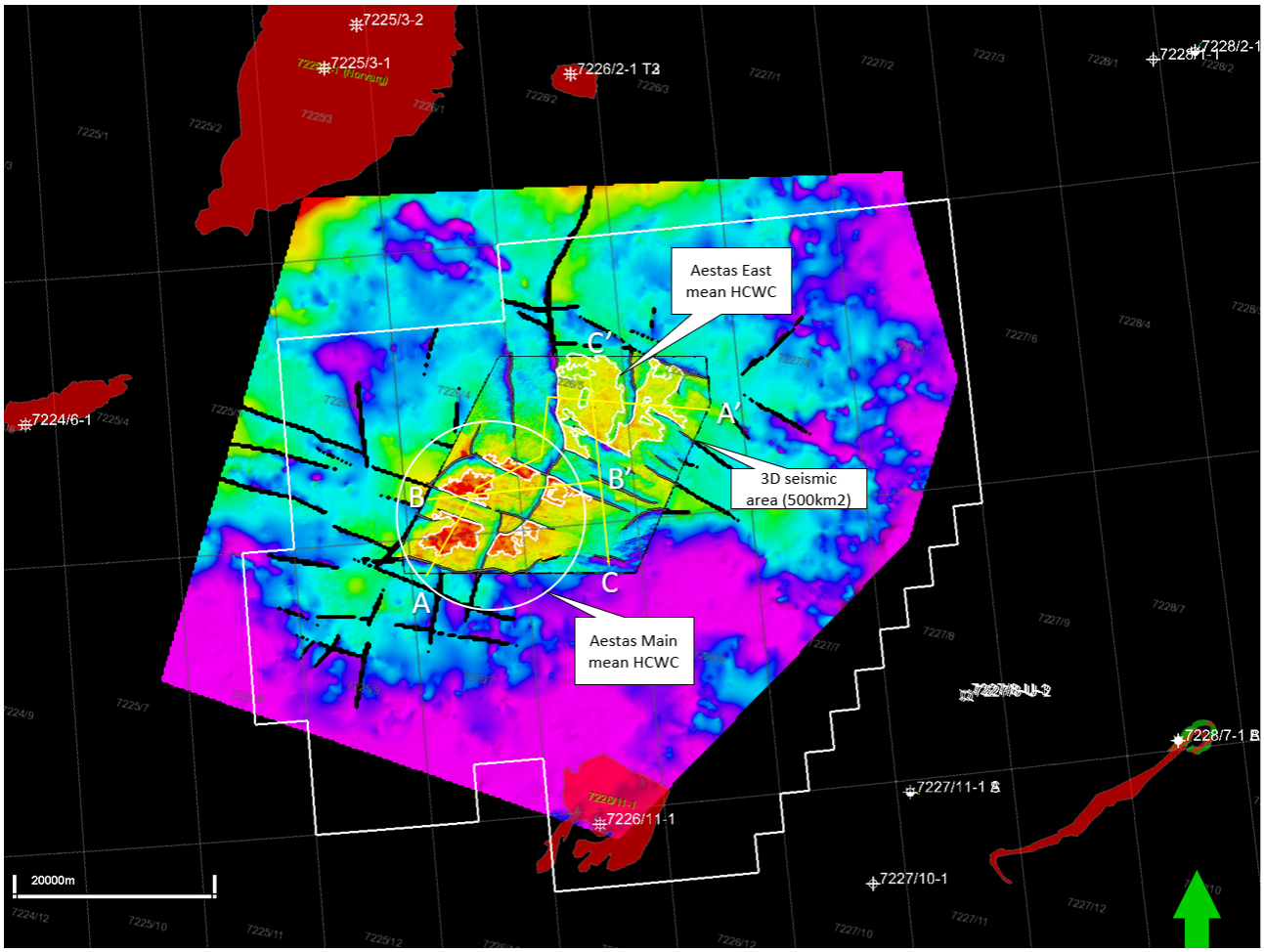


Fig. 4.2 Top Stø Formation depth structure map with prospect outlines. *Note area covered by 3D seismic and surrounding areas mapped on released 2D seismic. A slight disparity exists between the grids as different depth models were used for 2D vs. 3D seismic areas. Mean hydrocarbon-water contacts (HCWC) are marked in white outlines. Locations of geoseismic profiles in Fig. 4.1 are marked in yellow.*

Table 4.1 Aestas Main Jurassic Oil & Gas case resource sheet

Table 4: Discovery and Prospect data (Enclose map)

Block	7226/4	Prospect name	Aestas Main	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&Gas	Reported by company	AkerBP	Reference document				Assessment year	2023
This is case no.:	1 of 1	Structural element	Bjarmeland Platform	Type of trap	Faulted four-way	Water depth [m MSL] (>0)	270	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)	13,40	20,80	31,30	52,10	0,69	1,02	1,63	2,71
	Gas [10^9 Sm^3] (>0.00)	0,16	1,02	1,63	2,71	0,00	0,00	0,00	0,01
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	3,39	4,20	11,10	20,20	0,18	0,28	0,57	1,03
	Gas [10^9 Sm^3] (>0.00)	0,06	0,08	0,70	1,82	0,00	0,00	0,00	0,00
Reservoir Chrono (from)	Middle Jurassic	Reservoir litho (from)	Stø Fm	Source Rock, chrono primary	Lower Triassic	Source Rock, litho primary	Steinkobbe Fm	Seal, Chrono	Upper Jurassic
Reservoir Chrono (to)	Upper Triassic	Reservoir litho (to)	Tubåen Fm	Source Rock, chrono secondary	Carnian	Source Rock, litho secondary	Snadd Fm	Seal, Litho	Fuglen Fm
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,28	Oil case (0.00-1.00)	0,00	Gas case (0.00-1.00)	0,00	Oil & Gas case (0.00-1.00)	1,00		
Reservoir (P1) (0.00-1.00)	1,00	Trap (P2) (0.00-1.00)	1,00	Charge (P3) (0.00-1.00)	0,70	Retention (P4) (0.00-1.00)	0,40		

Parametres:	Low (P90)	Base	High (P10)
Depth to top of prospect [m MSL] (> 0)		1058	
Area of closure [km^2] (> 0.0)	25,0	36,0	53,0
Reservoir thickness [m] (> 0)	27	48	69
HC column in prospect [m] (> 0)	29	33	37
Gross rock vol. [10^9 m^3] (> 0.000)	2,170	2,770	3,340
Net / Gross [fraction] (0.00-1.00)	0,75	0,83	0,90
Porosity [fraction] (0.00-1.00)	0,21	0,23	0,25
Permeability [mD] (> 0.0)	140,9	308,7	458,1
Water Saturation [fraction] (0.00-1.00)	0,22	0,26	0,28
Bg [Rm3/Sm3] (< 1.0000)	0,0087	0,0091	0,0095
1/Bo [Sm3/Rm3] (< 1.00)	0,84	0,86	0,87
GOR, free gas [Sm^3/Sm^3] (> 0)	671140	500000	398400
GOR, oil [Sm^3/Sm^3] (> 0)	47	52	57
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,25	0,32	0,40
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,25	0,32	0,40
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,32	0,40	0,48
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,32	0,40	0,48

Temperature, top res [°C] (>0)	29			For NPD use:					
Pressure, top res [bar] (>0)	111			Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
Cut off criteria for N/G calculation	1. 10% porosity	2.50 % Vshale	3.	Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
								Kart nr	NPD will insert value

Aestas East

The Aestas East Prospect (Fig. 4.2) is evaluated as a gas and oil (Table 4.2) prospect, the two fault blocks are connected by a spill point within the range of possible hydrocarbon columns. The contacts ranges were guided based on observations on the reprocessed and inverted 3D seismic data. Of special notice is the anticipated limited thickness of the mean oil column of only 7 metres. The thin oil column may prohibit or limit recovery and may thus warrant truncation of the probability for discovery to avoid technically unfeasible outcomes in any future re-evaluation.

Table 4.2 Aestas East Jurassic Oil & Gas case resource sheet

Table 4: Discovery and Prospect data (Enclose map)

Block	7226/4	Prospect name	Aestas East Jurassic	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	AkerBP	Reference document				Assessment year	2023
This is case no.:	1 of 1	Structural element	Bjarmeland Platform	Type of trap	Faulted four-way	Water depth [m MSL] (>0)	270	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)	14,90	36,80	45,00	79,70	0,78	1,95	2,34	4,16
	Gas [10^9 Sm^3] (>0.00)	1,18	1,93	2,34	5,68	0,00	0,00	0,01	0,01
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	2,04	3,99	8,41	17,10	0,11	0,19	0,43	0,89
	Gas [10^9 Sm^3] (>0.00)	0,46	0,79	1,29	2,33	0,00	0,00	0,00	0,00
Reservoir Chrono (from)	Middle Jurassic	Reservoir litho (from)	Stø Fm	Source Rock, chrono primary	Lower Triassic	Source Rock, litho primary	Steinkobbe Fm	Seal, Chrono	Upper Jurassic
Reservoir Chrono (to)	Upper Triassic	Reservoir litho (to)	Tubåen Fm	Source Rock, chrono secondary	Carnian	Source Rock, litho secondary	Snadd Fm	Seal, Litho	Fuglen Fm
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,32	Oil case (0.00-1.00)	0,00	Gas case (0.00-1.00)	0,00	Oil & Gas case (0.00-1.00)	0,32		
Reservoir (P1) (0.00-1.00)	1,00	Trap (P2) (0.00-1.00)	1,00	Charge (P3) (0.00-1.00)	0,70	Retention (P4) (0.00-1.00)	0,45		
Parametres:	Low (P90)	Base	High (P10)	*Not releveant case after evaluating 3D seismic*					
Depth to top of prospect [m MSL] (> 0)		1082							
Area of closure [km^2] (> 0.0)	51,0	62,0	75,0						
Reservoir thickness [m] (> 0)	22	39	59						
HC column in prospect [m] (> 0)	30	33	37						
Gross rock vol. [10^9 m^3] (> 0.000)	1,138	1,355	1,571						
Net / Gross [fraction] (0.00-1.00)	0,76	0,83	0,90						
Porosity [fraction] (0.00-1.00)	0,21	0,23	0,25						
Permeability [mD] (> 0.0)	140,0	300,0	460,0						
Water Saturation [fraction] (0.00-1.00)	0,20	0,24	0,28						
Bg [Rm3/Sm3] (< 1.0000)	0,0087	0,0091	0,0095						
1/Bo [Sm3/Rm3] (< 1.00)	0,84	0,86	0,87						
GOR, free gas [Sm^3/Sm^3] (> 0)	671140	500000	398400						
GOR, oil [Sm^3/Sm^3] (> 0)	47	52	57						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,12	0,17	0,22						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,12	0,17	0,22						
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,32	0,40	0,48						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,32	0,40	0,48	For NPD use:					
Temperature, top res [°C] (>0)	29			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)	111			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. 10% porosity	2.50 % Vshale	3.					Kart nr	NPD will insert value

5 Technical evaluation

As no prospect of sufficient volume potential for a stand-alone development has been defined and since current and future developments are too distant to make smaller oil volumes economically feasible this section is intentionally left blank.

6 Conclusion

Jurassic prospectivity in PL1082 has been evaluated through purchase and reprocessing of 500 km^2 3D seismic data over the two largest structures identified from 2D seismic in the APA 2019 application. The seismic show evidence of both gas and oil in both the Aestas Main and the Aestas East prospects. However, the modest estimated oil volumes are insufficient for a stand-alone development and likely future tie-in infrastructure is too distant to be feasible.

Carnian prospectivity has been downgraded to lead-status because of lack of expected direct hydrocarbon indicators within the 3D seismic area.

Paleozoic prospectivity remain as lead(s) and given disappointing results in the two most recent wells targeting this play in the Barents Sea, neither does these opportunities warrant a drill decision.

Based on the outcome of work outlined above the partners in PL1082 have unanimously decided to relinquish the license in its entirety.