

Edison Norge AS

PL727

Expiry Status Report 2018



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1 History of the Production License

The Production License 727 was awarded on 7th February 2014 as result of the APA2013 round. It covered the blocks 3/5, 3/6, 3/8 and 3/9 of the southern Norwegian North Sea for a total of 821 km². The area is located north of the prolific Siri Fairway in Denmark, where multiple fields can be found in the Danish sector (i.e. Siri, Connie, Cecilie and Nina). The sandstones in the Siri Fairway were deposited as turbidites and/or gravity slides in the Late Paleocene, and consist of stacked interfingering sandstone lobes which are encased to varying degrees in fine-grained sediments. The application comprised of 4 play types and with a total of 7 leads of Paleocene, Cretaceous, Jurassic and Triassic ages. The PL727 was operated by Edison Norge AS (Edison) and the licensees are reported in the Table 1.1.

Table 1.1 Licensees and interests in PL727

Licensees at award	Interest at award	Licensees at relinquishment	Interest at relinquishment
Edison International Norway Branch S.p.A (Op.)	40%	Edison Norge AS (Op.)	40%
Concedo ASA	30%	Concedo ASA	30%
Skagen44 AS	30%	Skagen44 AS	30%

Upon the award, the initial period extended until the 7th February 2016, Table 1.2. In the fall of 2016, the operator and partners applied for a 24 months extension to mature new Carboniferous play in the license. The license group was awarded with 18 months extension by the NPD/MPE of all terms in April 2016 and new drill or drop gate was set to 7th August 2017. The main goal with the extension was to perform a PSDM reprocessing of the MC3D-NDB2013 survey for the western side of the license where Edison has highlighted the most interesting prospectivity in the Carboniferous and Paleocene. In June 2017, a second application of extension was sent to NPD to conduct maturation of Garnet prospect and the joint venture(JV) applied for 6 additional months to complete the remaining G&G work in the license due to late arrival of seismic reprocessing deliveries. In beginning of September 2017, the license group was awarded with additional 6 months of Drill or Drop terms, new DoD gate was set the 7th February 2018. As a result of this extension, a comprehensive work program has been conducted to mature full prospectivity of the license, in particular the Paleocene and Carboniferous prospectivity.

Table 1.2 Work-program for PL727

Work Program Task	Original deadline	1st Extension	2nd Extension	Results
Acquire new 3D Seismic / Re-process 3D Seismic	-	-	-	Fulfilled
Decision to drill an exploration well	07.02.2016	07.08.2017	07.02.2018	Not continue
Decision to concretize (Bok)	07.02.2018	07.08.2019	07.08.2019	-
Decision to continue (BoV)	07.02.2019	07.08.2020	07.08.2020	-
Decision to submit a PDO	07.02.2020	07.08.2021	07.08.2021	-

From the award in 2014, Edison had regular meetings with the partners in the license, and worked actively to inform NPD about any changes in the work-program and timeline. Before applying for the extensions, Edison initiated meetings with NPD to inform about the reasons for license extensions, Table 1.3.

Table 1.3 Meetings held in PL727

Meetings	Date
Kick-off Meeting	21.03.2014
EC & MC	19.11.2014
Workshop	23.06.2015
EC	19.10.2015
EC & MC	03.11.2015
NPD	19.11.2015
EC & MC	25.04.2016
EC & MC	03.11.2016
Workshop	24.04.2017
NPD	08.06.2017
EC & MC	20.06.2017
EC & MC	24.11.2017

Over the last 4 years, Edison tried to de-risk prospectivity as much as possible, but still the risk associated with the outlined prospectivity proved insufficient to warrant a continued activity for the license. Therefore, the majority of the JV in PL727, decided to relinquish the license.

2 Database Overview

2.1 Seismic Data

The 3D seismic data used by the license group is shown on Fig. 2.1 together with the 20 seismic lines purchased from GEUS in the Danish sector. In Table 2.1 and Table 2.2, all the 3D and 2D surveys are listed respectively.

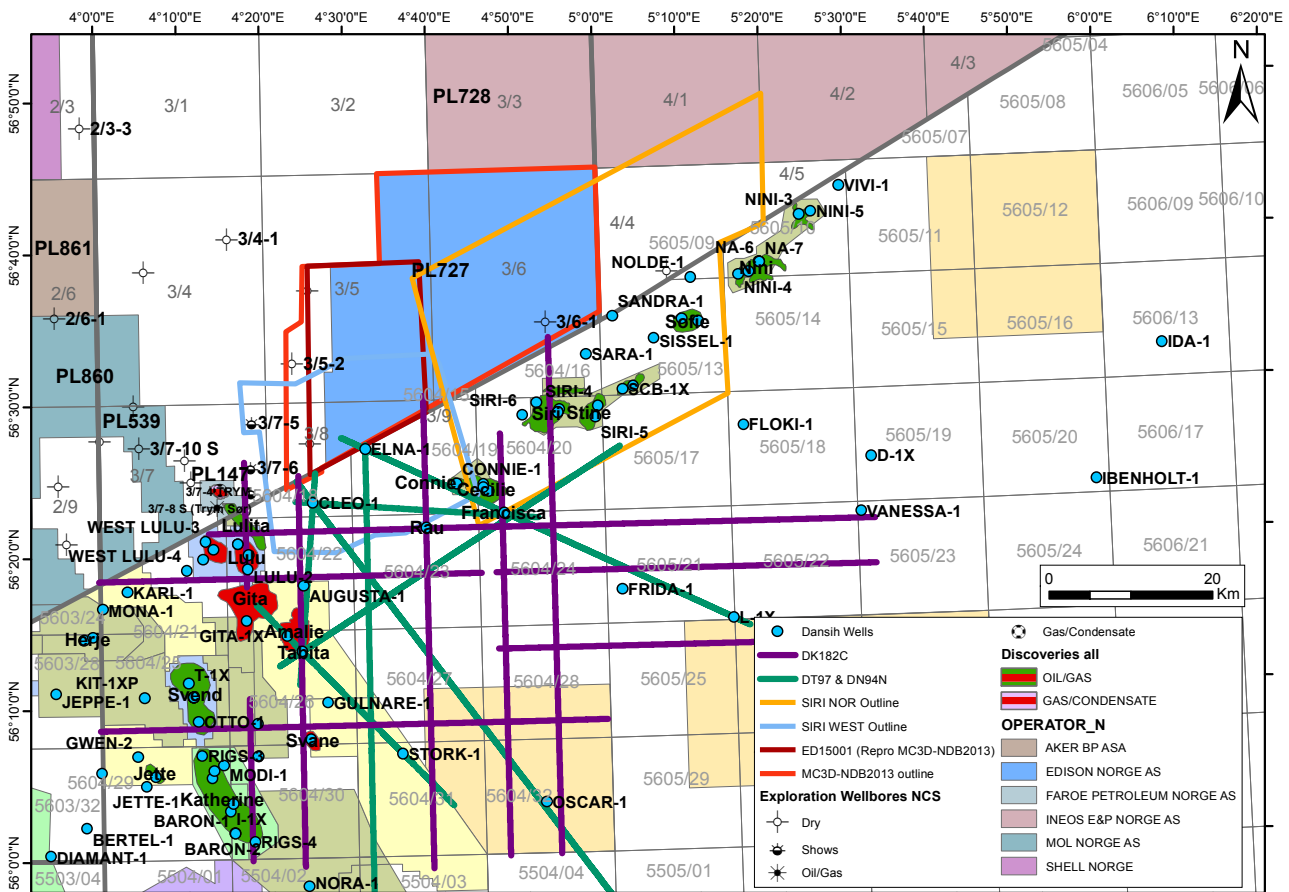


Fig. 2.1 Map of seismic database in PL727 Relevant 3D surveys are marked with colours and additional 2D lines from Danish sector (purchased from Geus) are highlighted.

- MC3D-NDB2013, 3D seismic dataset acquired in 2013 by PGS and purchased by JV in 2014, to fulfill seismic commitments. ED15M01, 3D dataset reprocessed of MC3D-NDB2013 by PGS in 2016
- Additional 3D public seismic datasets: SiriWest, SiriNor and DNO0601(for regional purposes)
- Additional 2D public datasets: MN9604, NDBE96, ANO78-2R93, MN9206, CGME96, CAST-90, SH8709R91, ST8716R91 and ST8630
- Additional 2D datasets in Danish sector purchased from GEUS: DT97C, DK182C and DN94N

Table 2.1 List of 3D Seismic Surveys for PL727

3D Seismic Survey	NPDID	Acquired/Reprocessed/ Procured/Merged	Market available
MC3D-NDB2013	7922	Procured	Yes
ST9602 / SiriNor-96	3829 / GEUS (Denmark)	Procured	Yes
G-9603 / SiriWest-96	3763 / GEUS (Denmark)	Procured	Yes
ED15M01	7922, 3829 & 3763 (MC3D-NDB2013, ST9602 & G-9603)	Merged	Yes
ED17M01	7922 (MC3D-NDB2013)	Reprocessed	No
DNO0601	4341	Procured	Yes

Table 2.2 List of 2D Seismic Surveys for PL727

2D Seismic Survey	NPDID	Acquired/Reprocessed/ Procured/Merged	Market available
MN9604	3776	Procured	Yes
NDBRE96	3781	Procured	Yes
CGME96	3758	Procured	Yes
ANO78-2R93	2263 (ANO78-2)	Procured	Yes
MN9206	3521	Procured	Yes
SH8709R91	3040 (SH8709)	Procured	Yes
ST8716R91	3059 (ST8716)	Procured	Yes
CAST-90	3309	Procured	Yes
ST8630	2913	Procured	Yes
DT97C	GEUS (Denmark)	Procured	Yes
DK182C	GEUS (Denmark)	Procured	Yes
DN94N	GEUS (Denmark)	Procured	Yes

2.2 Well Data

The well data used by the license group consisted of all released public data in and around the license area. Along with the Norwegian wells, the JV purchased multiple wells from GEUS to extend the common database into the Danish sector with the following wells: Elna-1, Cleo-1, Amalie-1, Tabita-1, Svane-1, P-1X, Gert-2 and Gert-3. See Fig. 2.1 for well locations. The JV consisted of the same partnership from the former license, PL541, and therefore had access to other Danish wells in the Siri Fairway (i.e. Siri, Nini fields).

Table 2.3 Key well database in PL727

Wellbore name	NPDID
3/5-1	290
3/5-2	291
3/6-1	4117
3/8-1	6476
4/4-1	7270
Elna-1	Denmark
Cleo-1	Denmark
Amalie-1	Denmark
Tabita-1	Denmark
Svane-1	Denmark
P-1X	Denmark
Gert-2	Denmark
Gert-3	Denmark

3 Results of Geological and Geophysical Studies

Reprocessing of MC3D-NDB2013 (PGS)

Reprocessing of MC3D-NDB2013 was performed by PGS of a total area of 318 km² on the western part of the license. The focus of the reprocessing was to increase the resolution below Base Cretaceous Unconformity (BCU). The quality was greatly improved with a more accurate interval velocity modelling below BCU for the stratigraphic intervals which provided a better base for interpretation.

Mega-merged survey (MC3D-NDB2013, SiriWest, SiriNor) (qaGeo)

Merging of three surveys to create a seamless survey in the area to help the interpretation work on one seismic cube.

Geophysical studies (Edison in-house)

1. Well-ties and synthetic seismograms were created to have good correlation between wells and seismic.
2. Tuning thickness study for Paleocene was an exercise to test the seismic resolution for possible tuning effect in Paleocene target.
3. AVO studies were performed in the license on all key prospects.

Spectral decomposition (ffA GeoTeric) (Edison in-house)

Spectral decomposition study was aimed to highlight the sedimentological model for the Norwegian Siri Fairway to understand the sand distribution of the Paleocene intervals for the main prospect, Trollgaren. It has also been conducted on all interesting stratigraphic levels.

Low-frequency study (JV study)

A low frequency (ISA - Instantaneous Spectral Analysis) study was conducted on the license by partner Skagen44, on SiriNor and MC3D-NDB2013 3D cubes, using different low frequencies. No interesting features were distinguished or recognized by this method.

Biostratigraphical study (RPS Ichron)

The study focused on the bio/litho-stratigraphic framework and zonation schemes on a dataset of 24 wells around and within the production license 727. The goal was to obtain a local and consistent biostratigraphic and lithostratigraphic scheme applied to all important wells in the area which helped to distinguish the different formations and members across NCS and Danish sector.

Fairway mapping and reservoir quality evaluation (RPS Ichron)

After the stratigraphic study discussed above, the same dataset was used to investigate the sedimentology and reservoir quality of both the Paleocene and Carboniferous intervals. The project was designed to provide a composite paleogeographic and depositional model for the area, along with reservoir quality indications for main targets.

Geo-Structural studies (Edison in-house)

This study aimed to reduce the uncertainties on the definition of the structural architecture, to provide a structurally sound template for the interpretation of deep areas with poor data quality, to improve the understanding of the timing of deformation and its implications on the effectiveness of the petroleum system, to try to further validate the interpreted fault geometries, linkage and segmentation pattern and finally to predict the sealing potential of prospect bounding faults. Improving the understanding of the rotated fault blocks of Paleozoic age, and further de-risk the prospectivity.

Petrophysics study (Edison in-house)

To support the seismic interpretation and prospect assessment processes, petrophysical work was performed on the key wells in the area in order to investigate reservoir properties and parameters, and main fluid contacts.

Geochemistry & Basin Modelling study (IGI):

The focus of the study was to geochemically-constrain the source rock potential of Mesozoic and Paleozoic sources within the PL727 area and surrounding area (Tail-end Graben (DK) and Søgne Basin), to address the understanding of the petroleum system(s) and de-risk uncertainties related to both source rock presence and effectiveness.

The studies listed were primarily used as a de-risking method for the prospectivity and were mostly focused on the Paleocene and Carboniferous, the main targets for the license. The biostratigraphical study done by Ichron increased the understanding for the Trollgaren prospect and helped to better define the stratigraphy for the key wells. Several papers have been published on the Siri Fairway describing the channel system extending from northwest to southeast. The spectral decomposition technique, iso-proportional slicing performed by Edison for Paleocene interval, highlight that Trollgaren prospect was a part of the Siri Fairway. Also, it confirms the outline of the prospect interpretation carried out independently, Fig. 4.3. The petrophysics study helped to better define the stratigraphy in order to distinguish between sands and shales.

For the Carboniferous target, Garnet prospect, the PSDM reprocessing gave an increased uplift of the seismic data quality. Achieved results were good enough to allow Edison to perform a more reliable seismic interpretation and to better understand the pre-Cretaceous structural architecture and traps identification, see Fig. 3.1 for comparison. Geo-structural studies performed along with seismic interpretation, contributed to the understanding of the relationship between the unconformities and faults, an increased the confidence for Garnet prospect mapping.

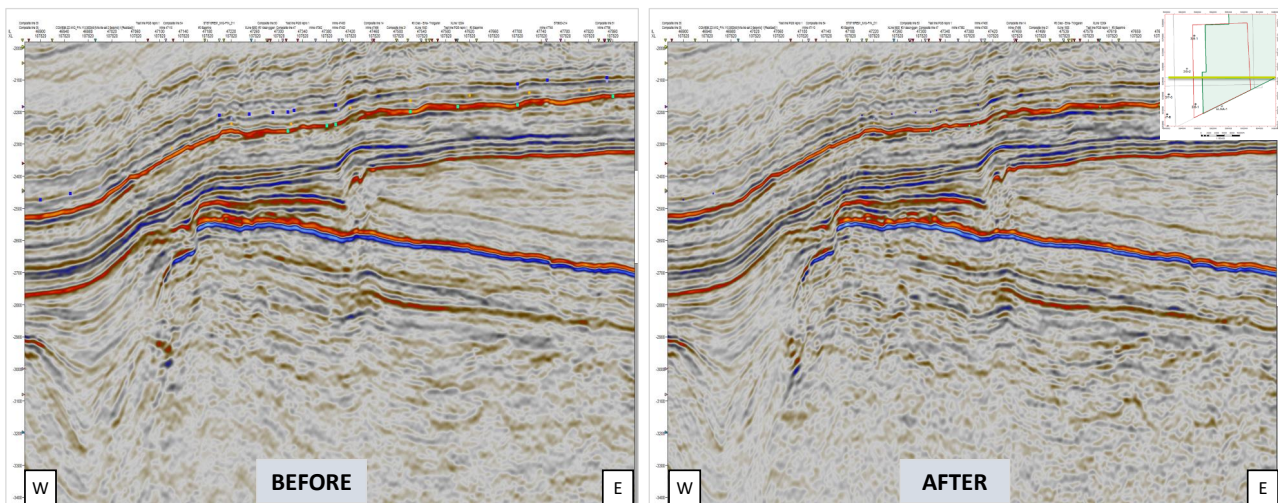


Fig. 3.1 Seismic crossline IL107820 (ms) Comparison between mega-merged cube (2015) and new reprocessed PSDM, stretched back to time (2017)

Basin modelling and geochemistry studies were important to understand the source potential in the basin and to model migration routes to the prospects. Some of the prospects around 3/6-1 well, were proven to be difficult to charge and therefore the risk was increased. Fairway mapping and reservoir quality studies were run for Paleocene and Carboniferous intervals, it proved the deposition model for Paleocene and confirmed reservoir properties used for volumetric calculation. For the Carboniferous, the lack of well controls made it difficult to prove the depositional model for the area and predicted reservoir presence and properties.

4 Prospect Update Report

The prospectivity outlined in APA2013 application, included three leads in the Paleocene (Revtangen, Børaunen and Trollgaren), two in the Cretaceous (Riskaholmen and Tingholmen), one in Jurassic (Vassryggen) and one in Triassic (Ternaholmen). Revtangen, Børaunen, Riskaholmen and Tingholmen leads were not pursued any further, due to a lack of DHI and/or closure associated with them. In addition, Low frequency study also showed no interesting features associated with these leads. The main focus was given to the Paleocene target (Trollgaren), Jurassic (Vassryggen lead) and the potential up-dip of the salt diapir of well 3/6-1. After awards and new 3D seismic data was purchased in the area, focus was directed at the underexplored Paleozoic targets (Carboniferous new play). Updated map with outlines of all leads and prospects is shown on Fig. 4.1.

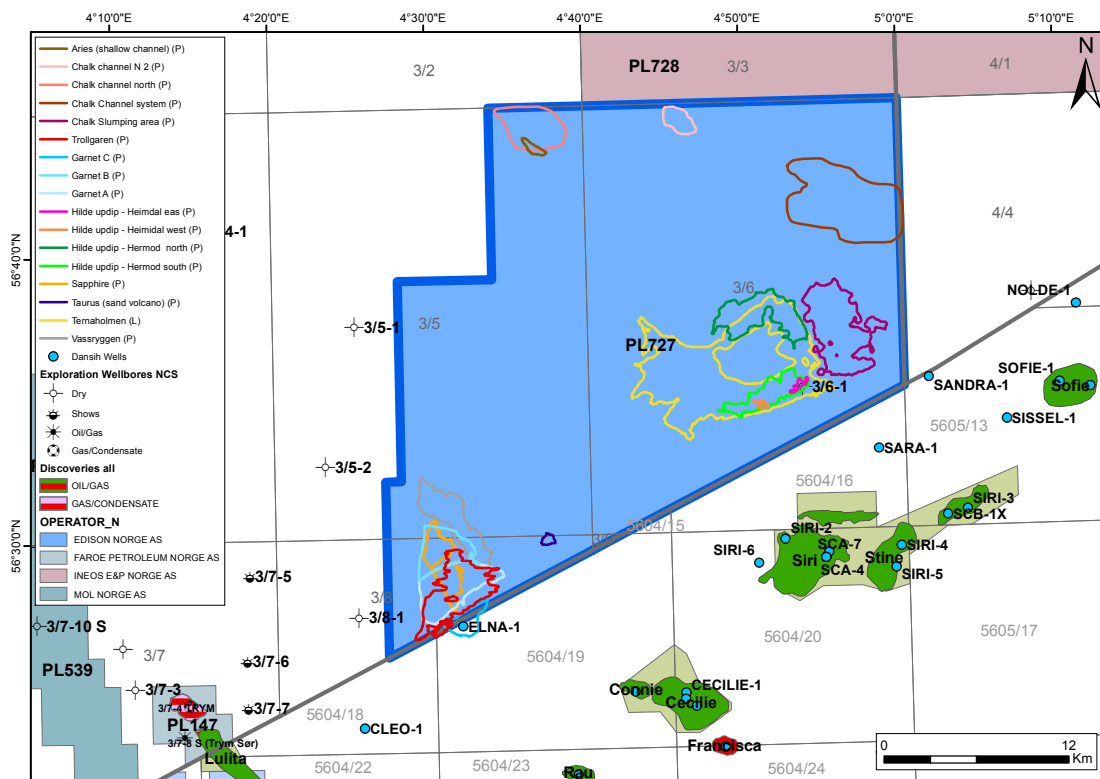


Fig. 4.1 Basemap with prospectivity outlined in PL727

Trollgaren prospect was a stratigraphic trap and interpreted as a deposition side-lobe of the main Siri fairway and was structurally located above the Coffee Soil Fault (CSF). The reservoir consisted of turbidites deposited sands, Ty Mb (T10.2), of late Paleocene Våle Fm. Trollgaren was first interpreted on the MC3D-NDB2013, which was then merged with SiriWest and SiriNor cubes. The prospect cover the southern corner of the license area and the mega-merged cube helped to perform the regional interpretation. However, one of the risks when mapping the prospect, was that the three surveys used, had a large difference in resolution which made it challenging to understand if the sands were ending/truncating towards the seismic boundary. Therefore, the main risk in Trollgaren was retention (lateral sealing). The secondary risk was reservoir presence updip of Trollgaren closure due to the fact that presence of thin sands below seismic resolution could not be ruled out. To de-risk this aspect, the license group performed a sedimentology study and used spectral decomposition to understand the distribution of the sands in the Siri Fairway. Iso-proportional slicing from top Lista Fm down to top Ekofisk Fm with Geoteric, helped to prove the presence of channel systems in the area, and gave an excellent correlation between the traditional seismic interpretation and Geoteric result of a sand fan outline. Biostratigraphic study from Ichron on the key wells made it possible to distinguish

between different sand Mbs associated with Sele, Lista and Våle formations. Source rock and migration were not considered to be key risks, since PL727 was seated close to a proven source in the Søgne Basin and the more mature Tail-End Graben. When mapping out the top seal for the prospect, provided by shales of Våle Fm. in the up-dip portion of the prospect, it was not possible to distinguish a clear reflector in the seismic. The seismic resolution at this depth was around 13 meters, but it was still possible to have a thinner unit of shales up-dip, although with an increasing risk related to trapping mechanism. Therefore the risk of leaking up-dip was present and it was challenging to evaluate if the prospect was connected to the main Siri Fairway or spilling towards the northeast, where 3/6-1 is located. The biostratigraphic study divided the Ty Mb into two units, T22.1 and T10.2, where T10.2 is the oldest sand Mb. Well 3/8-1 has only T10.2 sands and Elna-1 has T.22.1 and Cleo-1 has both T22.1 and T10.2, see Fig. 4.2 and Fig. 4.3. Total resources calculated for Trollgaren prospect for the mean case were 23,5 MSm³ OE, with total recoverable resources estimated at 8,21 MSm³ OE. Chance of success was assumed to be 27%.

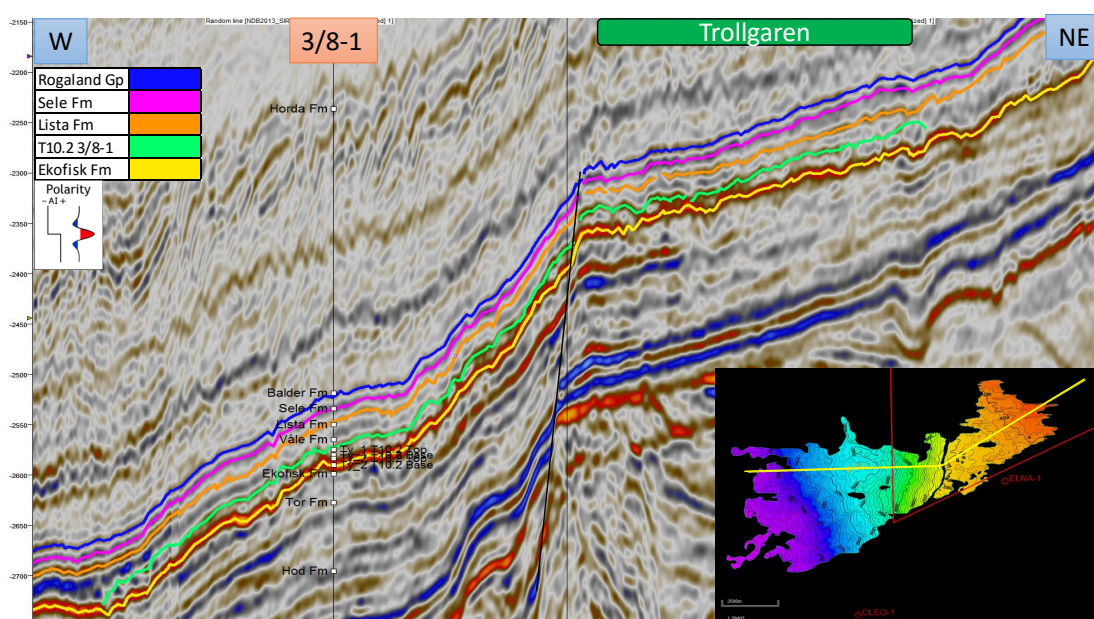


Fig. 4.2 Trollgaren Prospect W-NE seismic line across Trollgaren prospect and key well 3/8-1.

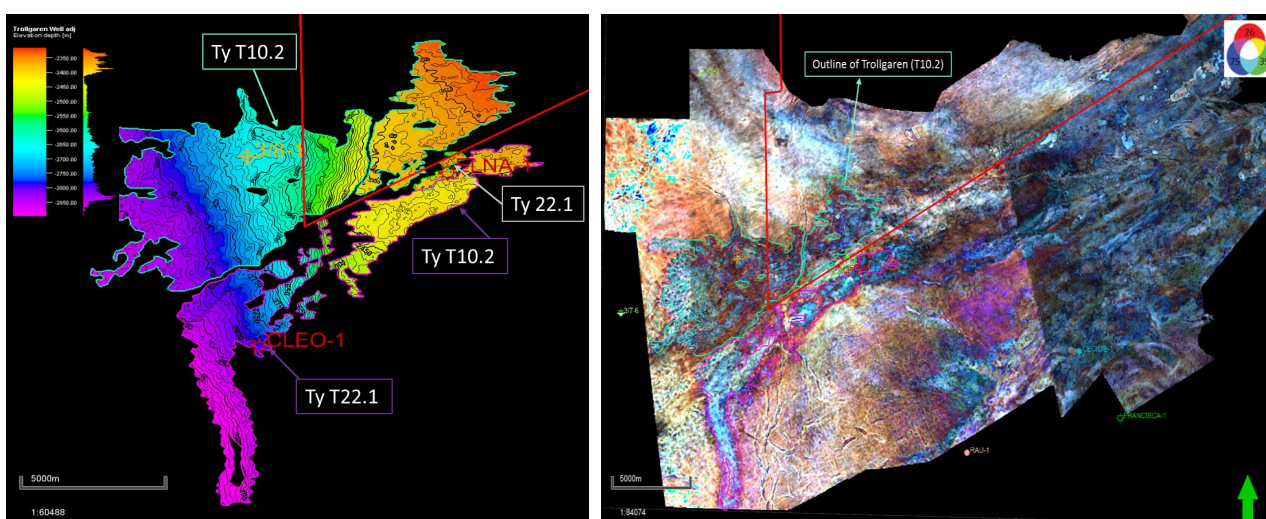


Fig. 4.3 Trollgaren Prospect map and colour blending using ffA GeoTeric On the left figure the depth map of Paleocene Ty Mb (m) shows the outline of the Trollgaren prospect which is supported by results from GeoTeric (Iso-proportional slicing technique) on the right figure.

Garnet prospect was first interpreted on the original MC3D-NDB2013, but after receiving the newly reprocessed cubes from PGS, Fig. 4.4, the quality of seismic data were drastically increased beneath Rotliegendes Formation. It was now possible to map out the rotated fault blocks of Paleozoic age in this area with greater confidence. This new understanding gave an increased confidence on the prospectivity. Edison observed that these blocks were segmented into different compartments, named Garnet A, B and C. The lack of wells nearby that had drilled deep enough to test similar prospects makes the reservoir presence and quality difficult to predict. In addition, it would need to rely on a source rock that has not been proven in the area. The JV purchased the well reports of Danish wells, P-1X, Gert-2 & -3 in order to improve the knowledge on the play and to better understand the reservoir quality and distribution of Namurian-Visean intervals. In addition, Edison tried to improve the understanding with several G&G studies, but still the knowledge of this play remains low. Garnet A rely on top seal of Carboniferous interval, for Garnet B would be more risky due the fact that the top seal depend partially on Base Rotliegendes Fm. However, despite the high risk, the potential for Garnet prospect was believed to be very interesting. In fact, volumetric run for segment Garnet A, mean case, total resources were estimated at 92,1 MSm³ OE and total recoverable resources were 55,3 MSm³ OE with a play risk of 77% and chance of success for the prospect 11% with the highest risk set for reservoir and source presence. Total chance of success was set for Garnet A to 8%.

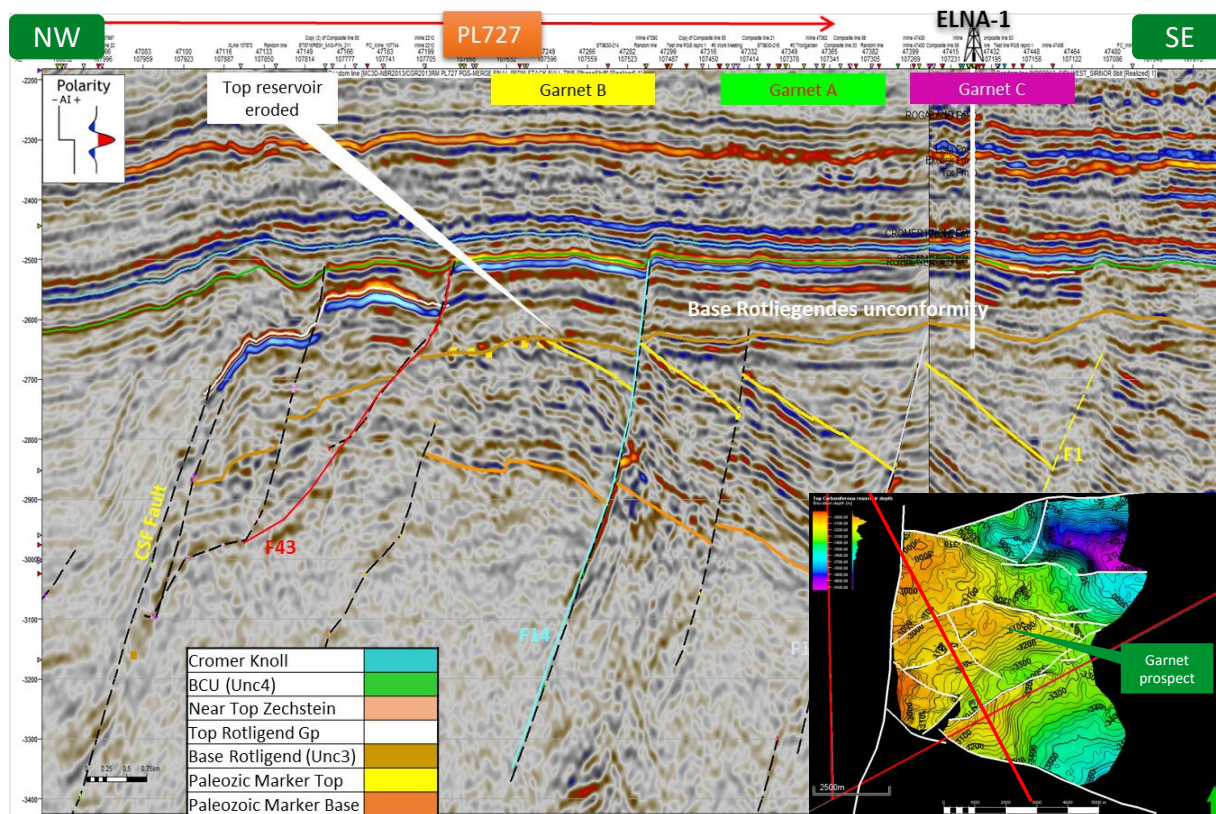


Fig. 4.4 Seismic line across Garnet Prospects NW-SE seismic line across Garnet prospects, highlighting the Paleozoic rotated fault blocks structures.

Sapphire prospect was a stratigraphic/structural trap with Rotliegendes sands up-dip from Elna-1. Elna-1 well was a reference well which found water in Rotliegendes sands. Sapphire has an erosional zone/fault separating this compartment towards the Elna-1 which was visible in the seismic as an erosional truncation over BCU. The prospect has a positive AVO response. Chance of success was assumed to be 20%, but the volumes were not interesting enough to be considered as a stand alone prospect. Since mean total resources were 1,6 MSm³ OE. Sapphire can be an attractive upside potential since it can be tested by one exploration well targeting the more interesting prospects, Trollgaren and Garnet A.

Vassryggen was a combined stratigraphic and structural trap, above a salt collapse graben area. Play model developed expects Upper Jurassic sands (Ula Fm.) laterally controlled by small scale faults and lateral erosion played by BCU unconformity and top Rotliegendes reflector. The prospect has relative minor volumes and medium/high risk, chance of success was 11%. Mean case, total resources were 4,9 MSm³ OE and total recoverable resources 3,4 MSm³ OE. The outline of the prospect was just outside the outline of Trollgaren and Garnet A which makes it difficult to be tested together with the other prospectivity in the license.

The prospectivity around the Hilde salt diapir, where 3/6-1 well was drilled, has been carefully studied for Hermod Mb. (Sele Fm.) and Heimdal Mb. (Lista Fm.) sands. The well was dry, but it might be considered that the well was drilled down flank of a potential hydrocarbon accumulation. Using the well tops as contact, some leads were outlined around the salt diapir. However, they were considered to be too high of a risk to be an interesting target. Around the 3/6-1 well, a lead called Ternaholmen of Triassic age, was first described in the application in 2013. Big uncertainties were related to reservoir presence and effectiveness. In addition, the lead rely on long distance migration, and would need an untested Lower Carboniferous source rock. Therefore, it was never upgraded to a prospect level.

Prospects were outlined in younger stratigraphic levels in Tertiary, Aries and Taures, but it was considered to have too small volumes potential and was isolated from the other prospects in the license. Also, several prospects were detected in the Cretaceous, which were related to chalk channels and slumping features. The main risk was related to charge and it was decided not to investigate them further.

5 Technical Evaluations

The production license 727 was situated in proximity to nearby infrastructures in Danish sector. Given a discovery for Trollgaren prospect, a subsea tie back into already existing facility was considered as the best option. In particular the possible Trollgaren prospect development scenario (Paleocene target case only) considered a subsea tie-back to DK Harald field (approximately 22 km southwest). The Harald platform is a good potential candidate and is already working as a hub for the Trym field.

Nine producers and three injectors is required for P50 case with three 4-slots templates connected with an manifold in order to recover the final resources of 116 MBOE (Tech.Ec 2016) for Trollgaren target with 15 years production time.

Technical evaluation was performed on Trollgaren stand alone case to see if the prospect is economically viable. Trollgaren and upside potential in Sapphire and Garnet A scenario was not conducted, but can be tested by the same exploration well and would increase the economic for the license.

6 Conclusions

Since the award in 2014, Edison Norge has worked extensively in the last 4 years on behalf of the PL727 JV, carrying out several de-risking geological and geophysical studies for relevant stratigraphic intervals, reprocessing of the seismic and trying to mature a drillable prospect. This understanding has enabled JV to map out several leads and prospects with good confidence.

Moreover, in the southern corner of the license three prospects (Trollgaren, Sapphire and Garnet A) have been outlined with interesting potential/volumes and eventually with the possibility to be tested with one exploration well. This could have given JV the possibility to test at the same time a mature-medium size Paleocene play (Trollgaren prospect) together with high risk-high reward, but poorly explored/known Carboniferous play (Garnet prospect).

Edison currently believes that PL727 prospectivity is attractive, but also recognizes that, despite the comprehensive G&G studies performed, the uncertainties led the PL727 JV to drop the license at ECMC meeting 24.11.2017.