

Edison Norge AS Exploration PL850

Expiry Report May 2020



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1 History of the Production License

PL850 was awarded 05.02.2016 as a result of APA2015 to the partnership of Edison Norge AS (Operator) 40%, Kufpec Norway AS 20%, PGNiG Upstream International AS 20%, and Lime Petroleum Norway AS 20%. Effective from 31.10.2018 Lundin Norway AS acquired 10% of the license shares from Edison Norge AS, and from 21.12.2018 Lundin Norway AS acquired 20% from Lime Petroleum AS. The current partnership is Edison Norge AS (Operator) 30%, Lundin Norway AS 30%, Kufpec Norway 20% and PGNiG Upstream Norway AS 20%.

The license covers an area of 1028 km² within blocks 7124/6, 7125/4, 7125/5, 7125/6, 7126/1 and 7126/4, located in the Nysleppen Fault Complex in the Southern Norwegian Barents Sea, south of the Bamse Discovery (7124/3-1) and north of the Nucula Discovery (7125/4-1) (Fig. 1.1). The average water depth in the license is 300m.

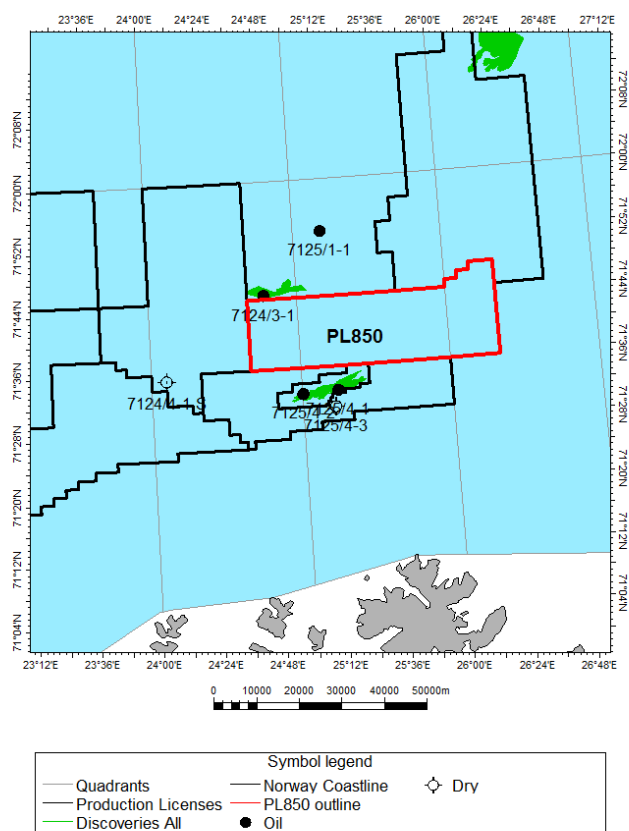


Fig. 1.1 PL850 location map.

The work commitment with stipulated time limits include a 3 years sub-period to collect new 3D seismic data, conduct G&G studies before Drill or Drop decision on 05.05.2020. Within 5 years from award, drill exploration well and decide to concretize (BoK) or drop on 05.05.2022. Within 7 years from the award, perform conceptual studies and decide on continuation (BoV) or drop before 05.02.2024. Within 8 years from award, prepare development plan and decide to submit PDO or drop before 05.02.2025.

Two license extensions has been awarded following the Operators request. Nine (9) months license extension was granted to allow time to include a reprocessing feasibility study in the work programme. Additionally, 6 months license extension was granted, due to a delay in the decision process caused by the ongoing sales process of Edison Norge AS.

The PL850 JV was formally established following a start-up meeting held on 17.03.2016. A total of 10 formal meetings including 6 EC/MC and 4 work meetings have been organized by the operator, and all the minutes of meetings have been posted and approved by the partners on L2S. Additionally one coreworkshop has been arranged by the operator.

The main exploration potential of the license is represented by the Elg Prospect, a crestal collapse structure combined with erosional truncation of the Realgrunnen SubGp. reservoir. Three (3) leads has been identified within the Snadd and Kobbe Fms. (Fig. 1.2).

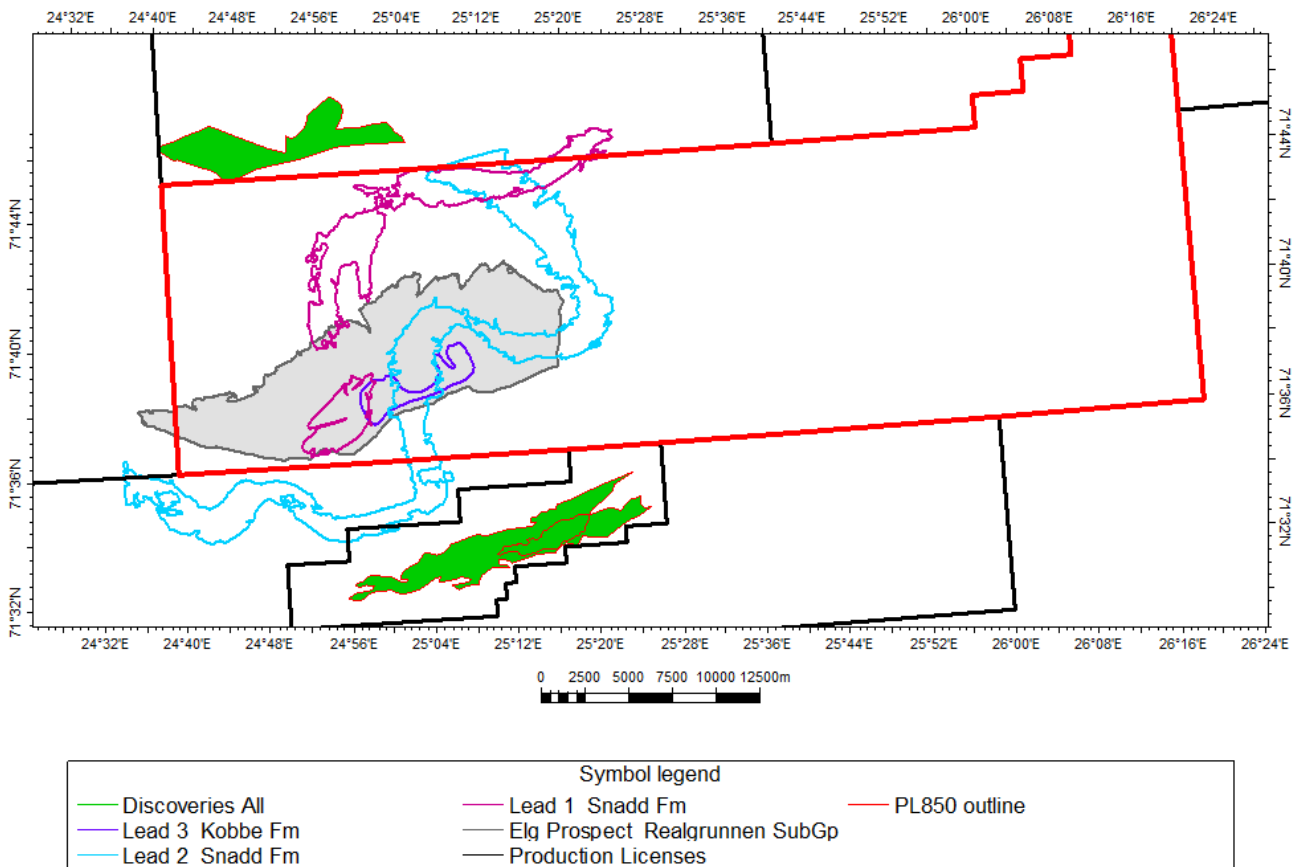


Fig. 1.2 PL850 prospectivity

The potential hydrocarbon volumes and associated risk of the Elg Prospect have been addressed by a work program of comprehensive geological and advanced geophysical work. The revised exploration potential of the license led to a high risk, low reward economy, and the Operator recommended the partners to surrender the license. The decision was supported unanimously by the three partners in the joint venture.

2 Database Overview

2.1 Seismic Data

Public available 2D seismic lines, the most important survey being the BSS01 survey, was used in the prospect assessment for APA2015. Additionally, a selection of 2D lines of the multicient SSSH1101 dataset has been included in the common database. As part of the work programme, the PL850 JV collected a new 3D seismic dataset (ED16001) covering 1530 km². The seismic data used in the evaluation of PL850 is listed in Table 2.1 and Fig. 2.1.

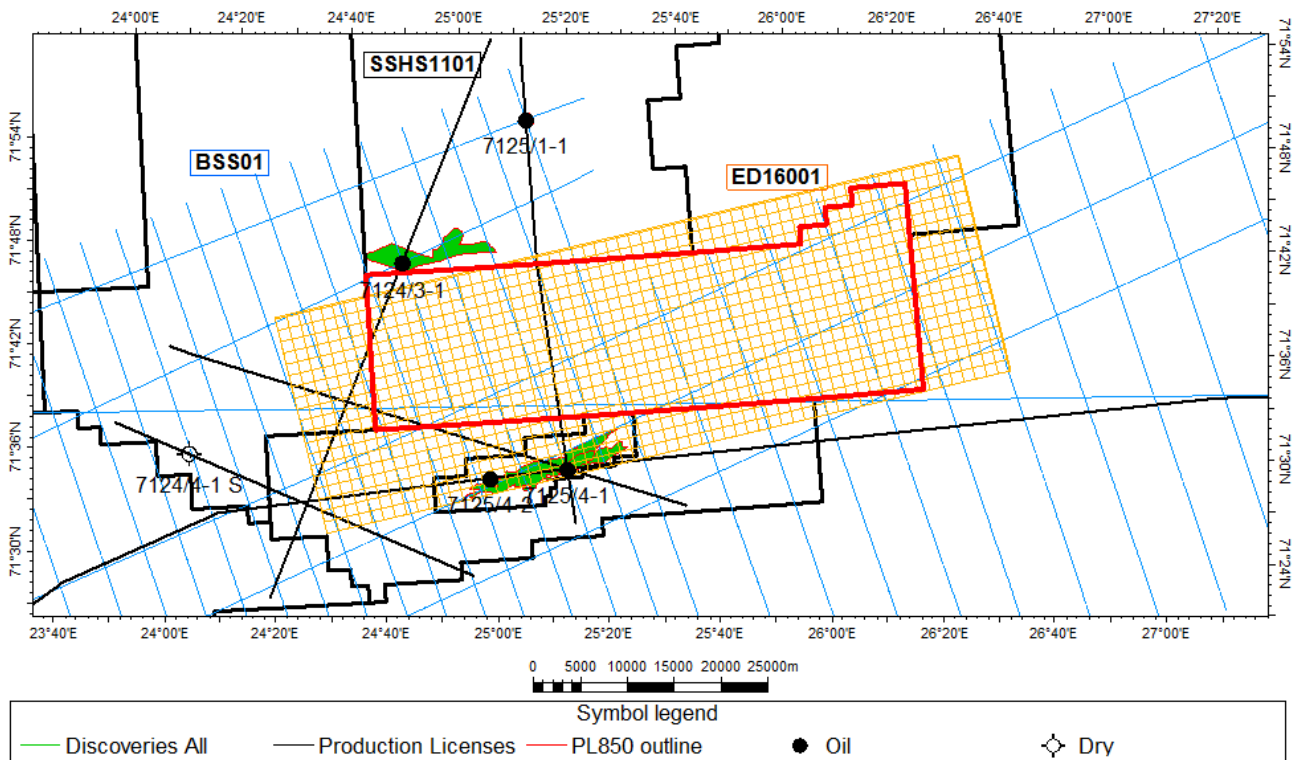


Fig. 2.1 Database

Table 2.1 Seismic database

Survey name		NPDID	Availability
3D			
ED16001		8368	PL850 proprietary
2D			
SSHS1101	line 119, 123, 444, 452 and 996	7431	Multicient (Searcher Seismic)
BSS01		4091	Public available

2.2 Well Data

No wells are included in the common database. Data from five released wells including their cores has been used in the license evaluation (Table 2.2 and Fig. 2.1). Fluid inclusion reports from the five key wells has been included in the common database. Multicient studies from Ichron provided lithostratigraphic information for the key wells, used for well correlation and prediction of reservoir development.

Table 2.2 Well database

Wellbore	NPDID	Status
7124/3-1	1066	Released
7124/4-1S	6678	Released
7125/1-1	1350	Released
7125/4-1	5450	Released
7125/4-2	5944	Released

3 Results of Geological and Geophysical Studies

The work obligations for PL850 included acquisition of minimum 1000km² of 3D seismic data and an EM feasibility study. In addition, several de-risking activities (in house and externally) has been carried out as part of the G&G work programme.

Seismic acquisition (Polarcus)

3D seismic survey (ED16001), covering approximately 1530km² was acquired in 2016 by Polarcus, on behalf of the PL850 partnership. The ED16001 survey was acquired by Polarcus Naila vessel, using triple source configuration (Flip-Flop-Flap) and 12 x 6150m (6000m active length) streamers with 75m separation. The goal of the survey acquisition was to provide high quality structural imaging, particularly at Jurassic to Permian level. Interval of interest was placed between 800 and 3600 milliseconds (top Realgrunnen SubGp. and top Kobbe Fm).

Seismic processing (DUG)

The seismic data was processed from SEG-D field tapes and started from de-blending of overlapping shots. A broadband, PreStack Time Migration processing flow aimed to preserve the amplitude response in terms of AVO, effectively remove multiple energy and maximise vertical and lateral resolution to counter erosional and pinching out character of the main prospects. Strong, direct arrival noise present in the data, limited the ability to achieve all the objectives at satisfactory level.

Structural study and Fault Seal Analysis (Badley)

Prospect bounding faults were identified and interpreted by Edison and passed to Badley for QC of throw displacement and geological validation. Fault seal analysis was performed by Badley on re-interpreted faults, and attributes including shale gauge ratio and hc column heights were calculated.

Result: Overall, the key faults show a high sealing potential. A relay ramp was identified in the easternmost part of the Elg Prospect (Compartment B), creating a spill point at Realgrunnen SubGp. reservoir level and impacting the potential trapped volumes of hydrocarbons. Furthermore, three areas of structurally weak points with potential fluid flow between compartments were identified (Fig. 3.1). The abovementioned findings lead to a re-definition of the Elg Prospect.

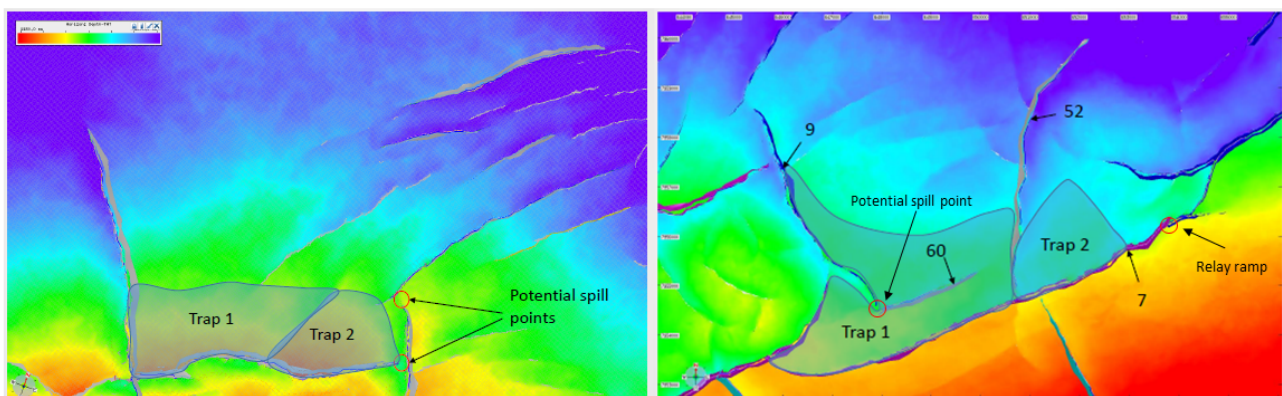


Fig. 3.1 Structural study Identification of four critical areas of importance for the definition of the Elg Prospect.

Joint Impedance and Facies Inversion - JiFi (IKON)

The main objective of the study was to determine lithology distribution and fluid type to de-risk the identified prospects and leads at Triassic and Jurassic levels. Well data from 15 offset wells were analysed, and 4 wells were used for rock physics modelling and fluid substitution (7125/4-2, 7124/4-1S, 7122/7-3, 7122/6-2).

Results: Overall, the facies classification down to the Top Kobbe Fm. is of good quality, broadly matching the known distribution of lithologies and hydrocarbons within the survey area. The interpretation supports the current geological model for the area, producing geometries for reservoir facies consistent with the relevant stratigraphy. The location of the pinchout line of the Realgrunnen SubGp. was constrained based on the results of the JiFi study. In the Kobbe Fm. and below, the interpretation is less reliable, and the uncertainty in the interpretation increases with stratigraphic age.

Basin modeling and Geochemistry (IGI)

The aim of the study was to increase the understanding of the migration mechanism within PL850, located between the Bamse & Nucula discoveries in the Måsøy Fault Complex and Finnmark Platform. Specifically, hydrocarbon charge to the Jurassic Realgrunnen SubGp sands of the Elg Prospect is deemed to be a critical exploration risk.

Results: Charge relies on spillage from the Bamse Discovery, ca. 13 km to the North, and results from the Basin Modeling study show that the Elg Prospect is charged most readily when multiple source rocks are present, including a Paleozoic source (e.g. Ørn Fm.), Havert, (Stein)Kobbe and the Hekkingen Fms.

Petroleum system (Sverre Ohm (consultant) and in-house)

A semi regional source rock evaluation study was carried to support the basin modeling study.

Results: The geochemistry of the oil accumulations in the Nysleppen&Måsøy Fault Complex, and the Hammerfest & Nordkapp Basins indicate an eastward long distance migration within a Jurassic petroleum system (Tornerose-Binne). Similarities in the oils found in the Bamse and the Nucula accumulations indicate a north-south migration route. Additionally, charge from an unknown Triassic petroleum system and a pre-Triassic petroleum system are inferred by isotopically light values in samples from the Nysleppen/Måsøy Fault Complex.

Update of petrophysics

Edisons pre-award evaluation of the key wells was based on stratigraphic information from NPD FactPages. A re-evaluation of petrophysical properties of prospective intervals (Realgrunnen SubGp, Snadd and Kobbe Fms) was carried out based on the stratigraphic information from Ichron multiclient reports which are included in the common database.

Core workshop (Ichron)

The purpose of the core workshop was to address the stratigraphic uncertainty of the Snadd-Hekkingen interval, and to discuss the relevance for the Realgrunnen SubGp. prospectivity in the PL850 license area. Cores from the 7124/3-1, 7125/1-1, and 7125/4-1 wells were displayed.

CSEM feasibility study

A CSEM feasibility study was performed on the Ulv Prospect, defined in the pre-award evaluation. The background resistivity model was build using 4 nearby wells (7124/3-1, 7125/1-1, 7125/4-1 and 7125/4-2). Information on the anisotropy ratio was taken from the nearby CSEM inversion work performed in previous Edison operated PL770 license.

Results: The 2.5D modelling shows that CSEM is sensitive to a prospect with average resistivity of 15 Ω m and above. Frequencies above 1 Hz and offsets above 4 km are needed in order to be sensitive to the 15 Ω m case.

Re-processing feasibility study

A seismic re-processing feasibility study of the ED16001 dataset was carried out to adress data quality issues related to 1) direct arrival energy 2) vertical resolution and lateral continuity 3) acquisition footprint and 4) remnant multiple higher frequency imprint. A processing flow similar to the MFZ02LNR18 re-processing (PL952), partly overlapping the ED16001 survey, was utilized in the feasibility study.

Results: The feasibility study indicated good potential to improve the data quality for interpretation, and to estimate reservoir properties from elastic parameters with more accuracy.

4 Prospect Update Report

The pre award evaluation of the area resulted in identification of one prospect and one lead; the Ulv Prospect and the Lirype Lead, both truncational traps with main reservoir in the Realgrunnen SubGp. (Fig. 4.1). The prospectivity was originally defined on available 2D seismic and a few multiclient 2D lines covering the area (2.1 Seismic Data). The data coverage was relatively poor and large uncertainty was connected to the trap existence. The newly acquired 3D ED16001 dataset was used to assess the Ulv Prospect and to evaluate the remaining potential of the license area. The Ulv trap proved to be open both towards the east and the west, and the prospect was downgraded and is not regraded as attractive for the license.

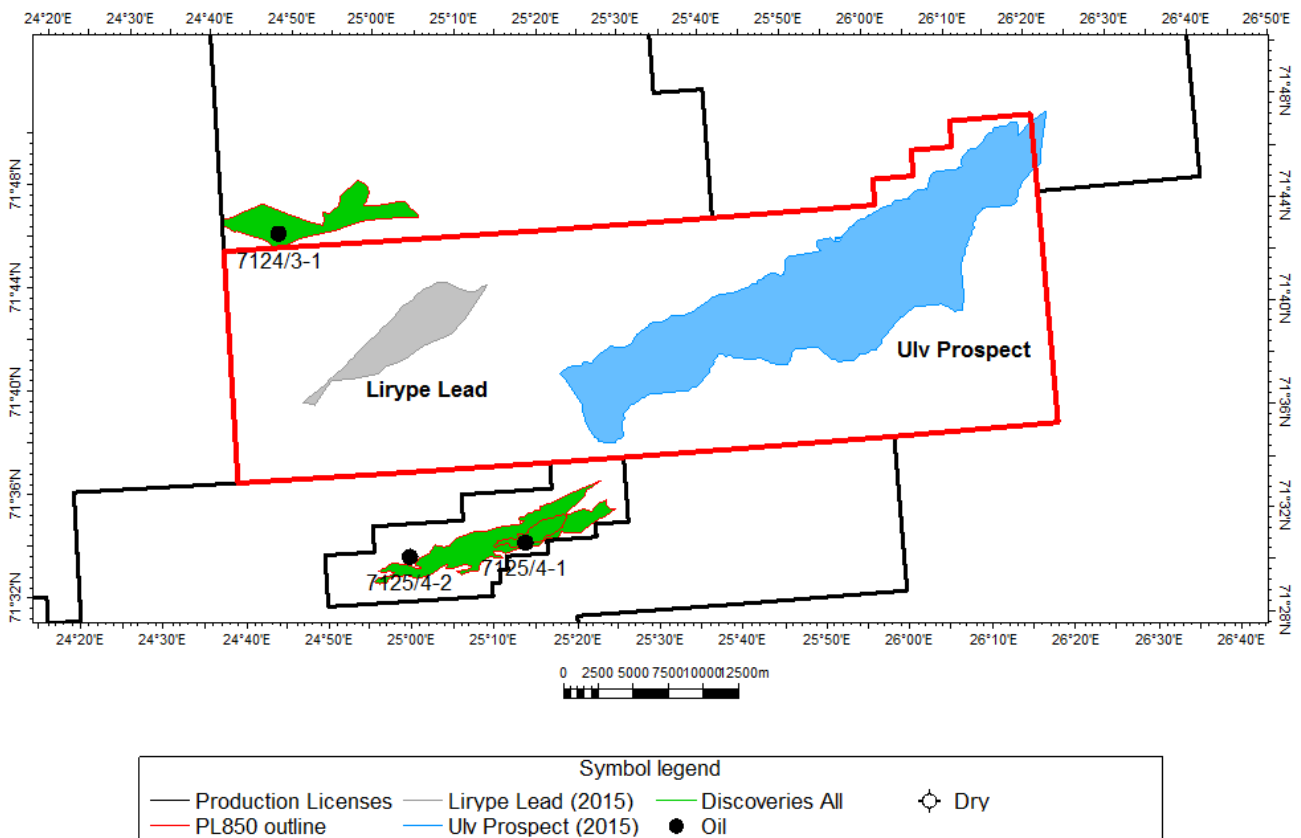


Fig. 4.1 APA2015 prospectivity

Detailed seismic mapping of the ED16001 dataset resulted in identification of the Elg Prospect (Fig. 4.2). The trap is defined as a crestal collapse structure in a complex structural setting, covering an area of 128km². Crest of the structure is at 1160m, and spillpoint is defined by position of faulttip of westernmost bounding fault at 1363m.

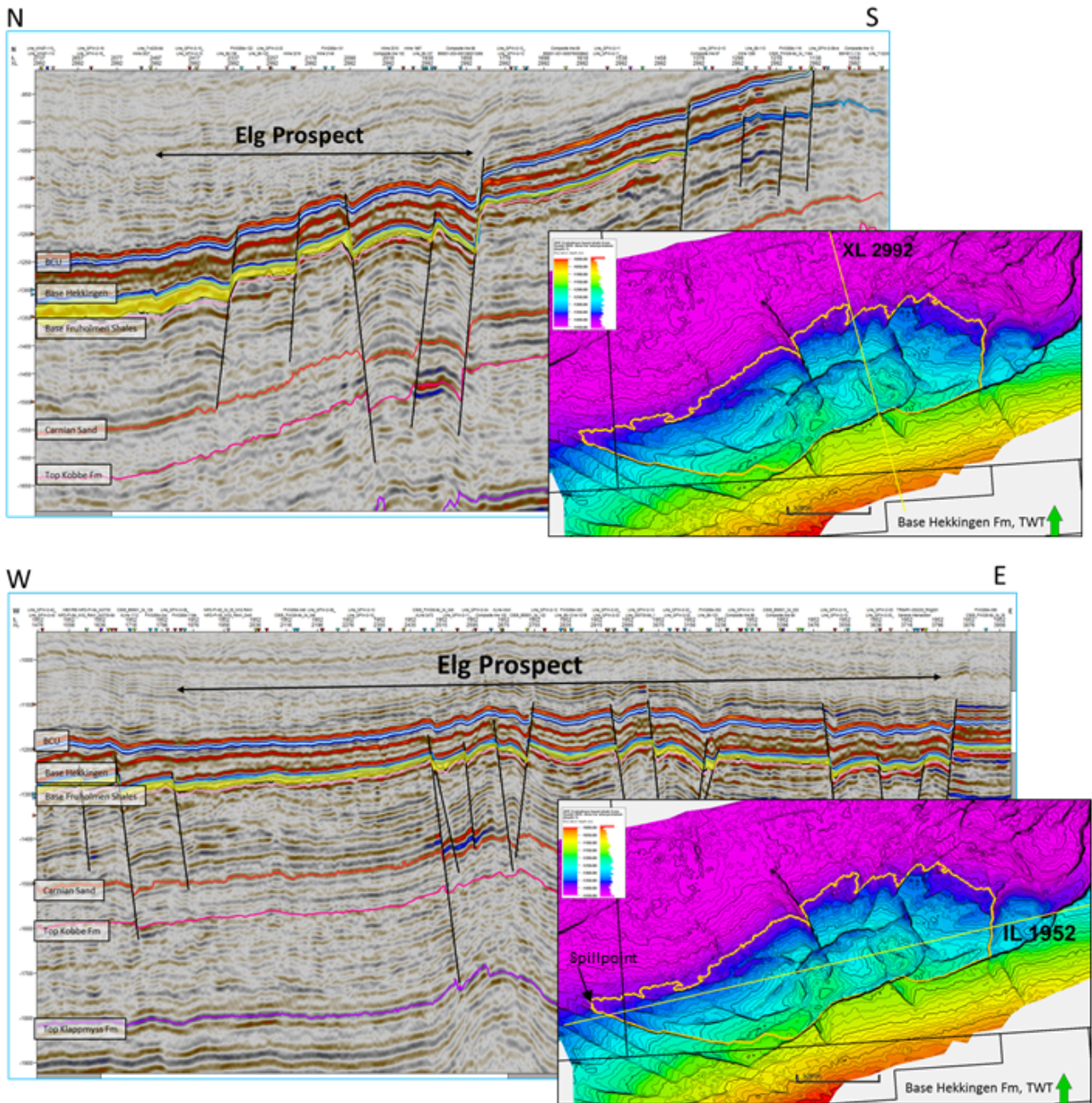


Fig. 4.2 Elg Prospect Seismic sections through the Elg Prospect.

Main reservoir is the Realgrunnen SubGp. (Stø and Fruholmen Fm) comprising clean sands of excellent reservoir properties. The top seal is provided by the laterally extensive Hekkingen/Fuglen shales, and the Base Fruholmen shales, proven by 7124/3-1, 7125/1-1 and 7124/4-1S wells, provide the base seal. A uniform thickness of the base seal of 12-17meters (~8ms) are found in the wells (Fig. 4.3).

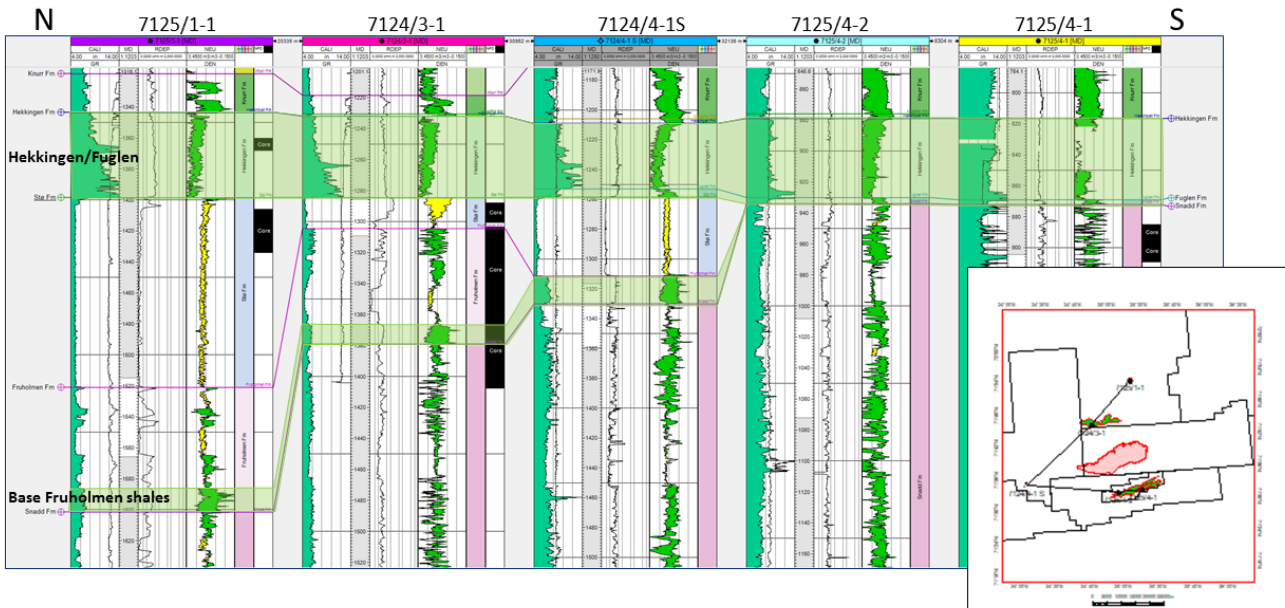


Fig. 4.3 Well correlation illustrating the assumed top and base seal for the Elg prospect.

Based on the depth structure map the Elg structure can be divided into 3 compartments; A, B and C (Fig. 4.4). The Lirype Lead, defined in the pre award evaluation, is partly equivalent to Compartment A. While Compartment A and B are fully fault dependent, Compartment C also relies on pinch out of the Realgrunnen SubGp. reservoir in the updip part. Main risks for the Elg Prospect are 1) sand distribution 2) position of the truncation line and 3) fault seal.

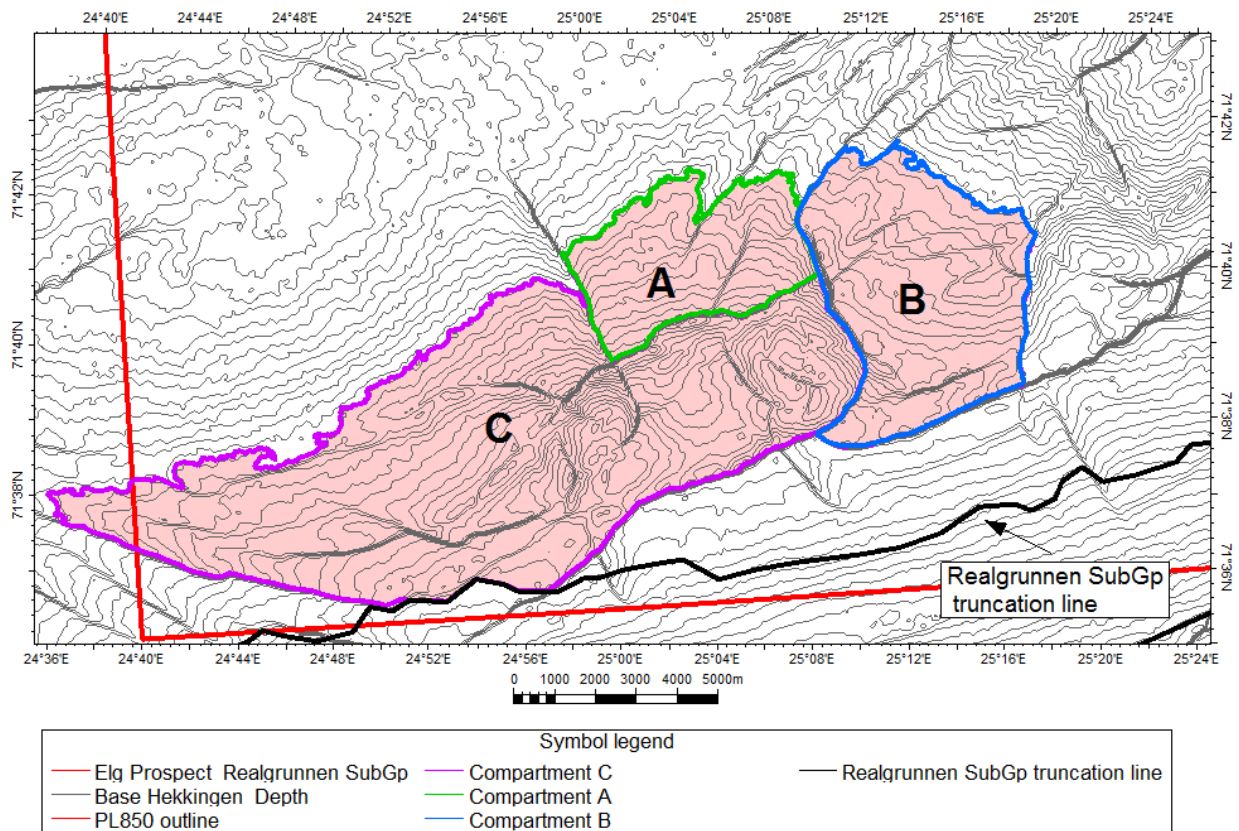


Fig. 4.4 Compartmentalization of the Elg Prospect Compartmentalization is regarded as a significant risk factor. The Elg structure comprise three compartments (A, B and C). Areas of potential fluid flow has been identified by the structural study.

A manual interpretation of the base reservoir of the Realgrunnen SubGp. is very challenging due to the lateral facies variations of the Fruholmen Fm, and the presence of multiple erosional surfaces across the area. Furthermore, areas of thin Realgrunnen are challenging for interpretation of the Fruholmen Basal Shale due to interference with Base Hekkingen (Top Realgrunnen). A model approach to the Base reservoir interpretation were considered to be more accurate, and a base reservoir surface was generated by running a bulk shift (+8ms) of the top Snadd surface. Inverted facies from the JiFi study identified Realgrunnen sandstones below Base Hekkingen, and confirmed the interpretation that these sands are thinning out towards Nuclua appraisal well 7125/4-2, as predicted by initial geological model (Fig. 4.5).

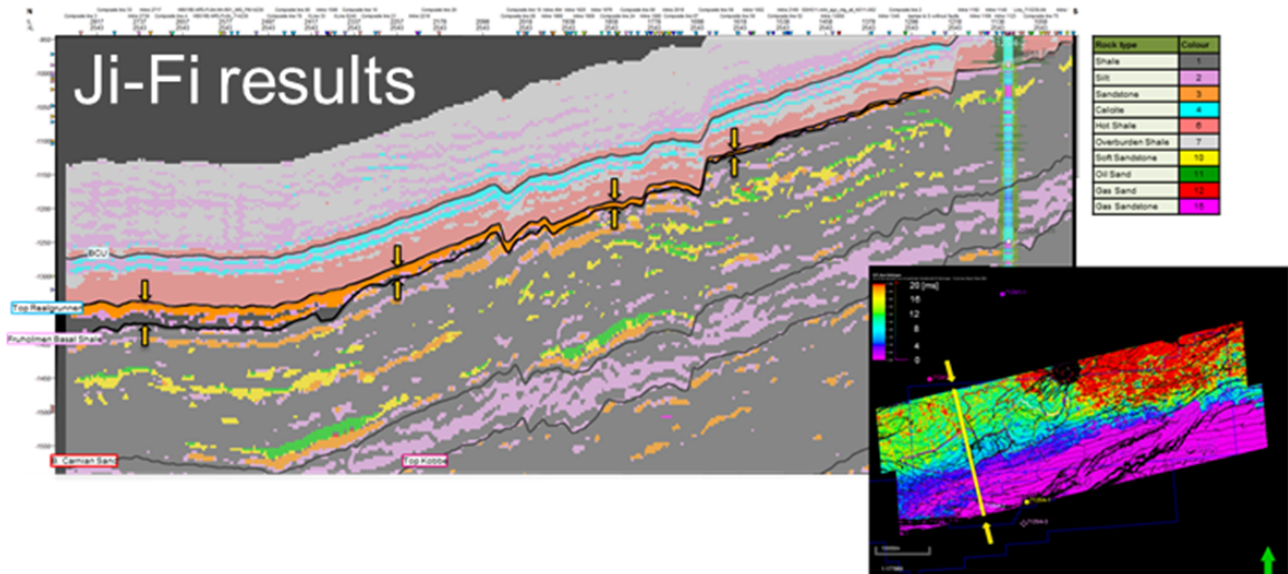


Fig. 4.5 JiFi lithofacies Xline illustrating the thinning of the sandstone lithofacies in the Realgrunnen interval (marked by arrows). Insert picture show the position of the XL and the thickness variation of this interval across the ED16001 survey.

As in the rest of the SW Barents Sea, fault throws are relatively small, and sealing capacity is an issue. Detailed fault interpretation and the structural and fault seal studies were used to evaluate the sealing capacity of the prospect bounding faults.

The Structural Study and Fault Seal Analysis highlighted areas of potential communication between B&C, A&C and A&B (Fig. 3.1). Assuming the structurally weak points are open for fluid flow, a single compartment case was used for the volumetric calculation and for the following Tech Ec evaluation.

Final assessment of the Elg prospect found in place total resources of P90 57.9MSm³, P50 127.1MSm³ and P10 261.4MSm³, with a COS of 21%.

Additional prospectivity has been defined within the Snadd and Kobbe Fms.

Well defined southwest-northeast oriented Snadd channels of significant size are evident in two stratigraphic levels.

The upper Snadd channels are evident as high amplitude seismic anomalies, and the inverted facies from the JiFi study identified the channels as oil sands (Fig. 4.6). The highest risk associated to the prospectivity in the Snadd Fm is the reservoir quality, and the stratigraphic trapping mechanism. Amplitude maps show medium to poor amplitude conformance with structure, and there is a high risk on presence of their sands.

Highest risk related to the Kobbe prospectivity is associated with the structural closure of the trap. Potential development of relay-ramps along western key bounding fault and lack of fault intersection between the two key faults are the main risk. Consequently, the structure seems to be open towards the west, and the potential is limited to the two minor 4-way closures corresponding to the brighting in amplitudes.

The prospectivity of the Snadd and Kobbe Fms. is after the final evaluation considered not to be attractive.

5 Technical Evaluations

The Nysleppen/Måsøy Fault Complex in the Norwegian Barents Sea is generally underexplored, with few exploration wells. The exploration activity in the region has led to several smaller discoveries since the 7124/3-1 well was drilled in 1987, but no discoveries of significant size, leading to a field development have been made. Hence, there are no infrastructure in place to facilitate a relatively fast development of a future discovery and development. The technical and economical evaluation of the Elg Prospect in PL850 is thus considering a stand alone development with an FPSO.

Development scenarios were assessed for both the multi compartment and single compartment cases of Elg Prospect, considering only an oil phase.

The multi compartment case provided negative economical result. The single compartment case, considered little probable and too risky provided positive economical result.

6 Conclusions

The evaluation of the acquired ED16001 seismic survey in combination with geophysical analysis and geological data from offset wells, has led to the identification of the Elg Prospect and several leads in the Snadd and Kobbe Fms (Fig. 1.2).

The estimated volumes in secondary targets (Snadd and Kobbe Fms.) are regarded as negligible, and associated with high risks.

The Elg Prospect is economic according to Edison's evaluation considering a single trap with full communication.

However, large uncertainties are related to possible compartmentalization which will have a negative impact on the economics for the Elg Prospect.

The risk of finding sub-commercial volumes are considered to be too high to support a positive drill decision.

The PL850 partnership has unanimously decided to relinquish the license.