PL 987 & 987 B Lapse report

Part of blocks 30/7, 8, 10 & 11

Lundin
Norway

vår energi

DNO
EST - 1971

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1 History of the production licence

Summary

PL987 (Figure 1.1) was awarded as part of APA 2018 licence round on the 1st of March 2019. The initial period was set to 7 years (2+2+2+1), of which the first decision, drill or drop, is due on the 1st of March 2021.

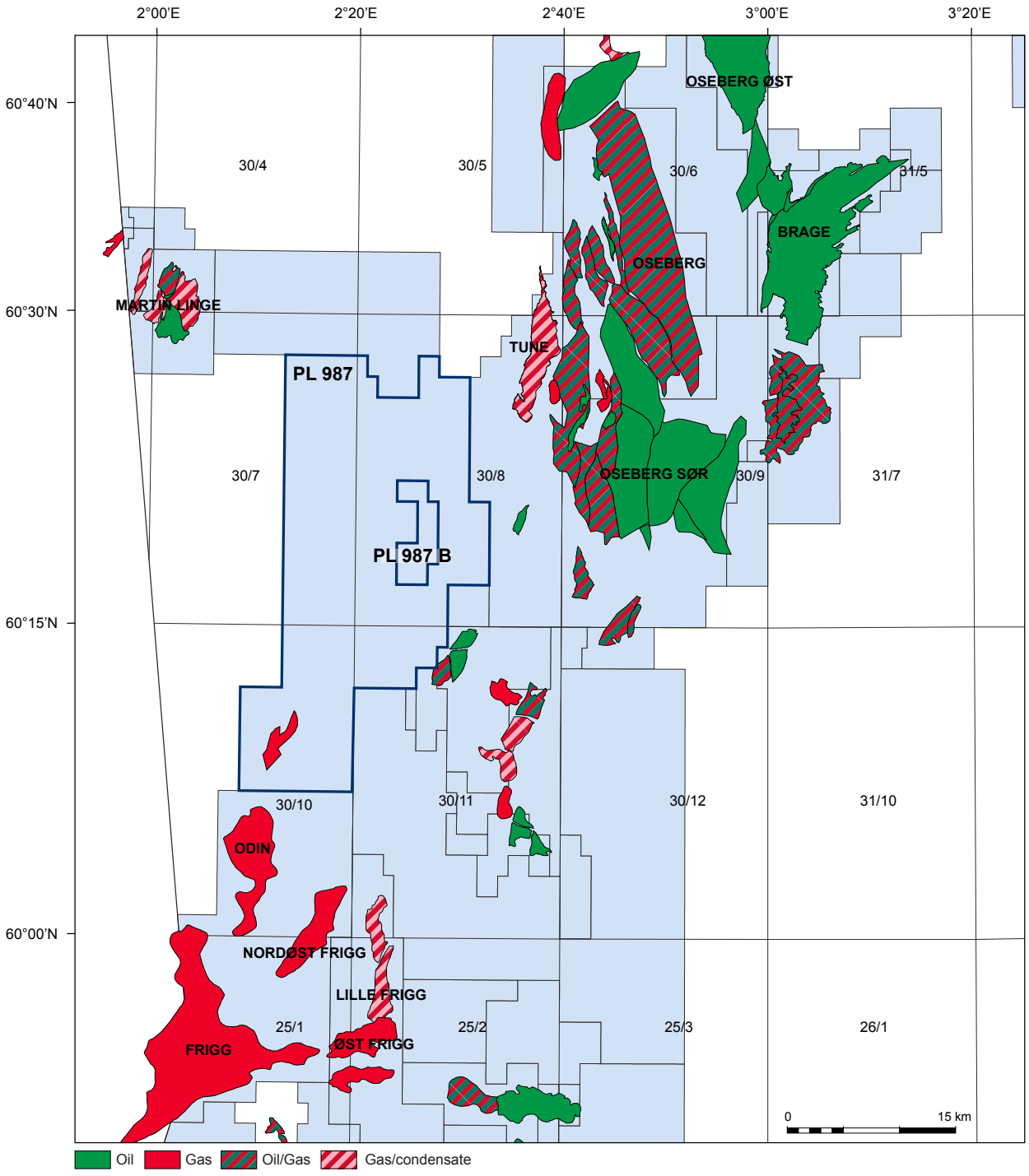

Figure 1.1 ***PL 987 and Pl 987 B location map***
Part of block 30/7, 30/8, 3010 and 30/11 in the North Sea.

Additional acreage, PL987 B, was awarded as a part of the APA 2019 licence round on the 14th of February 2020. The work programme and the associated periods were the same as for PL 987.

Based on license work the prospectivity in the licence has been interpreted to be of high risk.

Participants

Suncor Energy Norge AS, with 40% equity, is operator of the licence. Vår Energi AS, DNO Norge AS and Lundin Energy Norway AS are partners with 20 % equity each.

Work Commitment

The work commitment was initial purchase and reprocessing of 3D seismic. Email from NPD confirmed that work programme already is fulfilled by purchasing parts of the multiclient CGG18M01, if data quality is good enough and no technical reasons to reprocess.

Meetings

MC meetings were held at least once and EC meetings twice a year, in accordance with JOA article 2.1. These meetings were combined ECMC meetings and in addition several EC work sessions have been organized. Below is a list of the meetings held during the licence term:

1. ECMC start-up meeting on 28th of March 2019 at Suncor office Stavanger

2. ECMC meeting the 12th of December 2019 at Suncor office Stavanger

3. EC meeting the 16th of June 2020, Virtual meeting

4. ECMC meeting the 22th of October 2020, Virtual meeting

5. EC workshop the 14th of December 2020, Virtual meeting

Reasons for licence lapse

The main prospectivity in the Jurassic has been re-evaluated based on the CGG18M01 seismic and geological and geophysical studies. Reservoir quality and trap definition were initially seen as the main uncertainties for the prospectivity. The special studies indicates that reservoir quality is poor for reservoirs within the Jurassic. Re-mapping on the new seismic changed the trap outline/concept.

Secondary prospectivity in the Cretaceous and Paleocene also show high risk on reservoir presence and quality according to the stratigraphic study.

Based on the above it was decided to lapse PL987 and PL987 B.

2 Database overviews

2.1 Seismic data

The common seismic database consists of parts of CGG's multiclient 3D survey CGG18M01. The dataset is a broadband acquisition from 2016, and was processed with the most modern and advanced processing techniques in 2018. The seismic quality has been investigated and found sufficient to evaluate the prospectivity of the licence.

Owners agreed to purchase a full licence to a large enough area to properly evaluate the prospects, i.e. including offset wells and several discoveries and fields east of the licence, resulting in ~1700 km^2 of data. Final migrated full stack, angle stacks, gathers and seismic velocities of the survey area are purchased.

Seismic common database is shown in Figure 2.1 and a list of seismic surveys Table 2.1

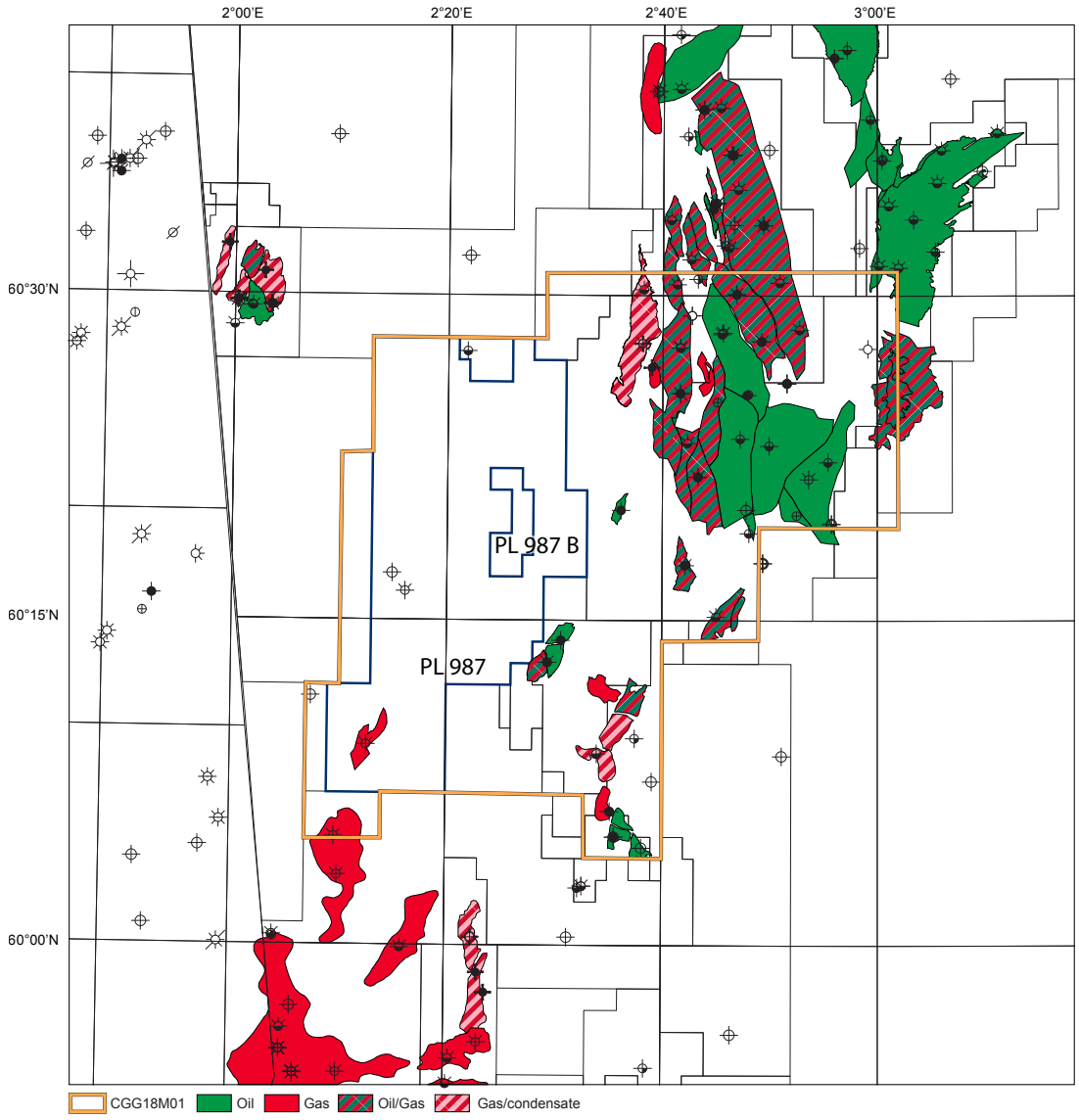

Figure 2.1 ***Seismic common database***

Table 2.1 ***Seismic survey details***

Seismic Survey	Merged surveys within AOI	NPDID	Survey Type	Processing Company	Processing	Status	Availble data
CGG18M01	CGG16001	8332	3D	CGG	PSDM	Multi-client	Full stack, angle stacks, gathers and velocities.

2.2 Well data

All well data in the vicinity of the licence, both in the UK and Norwegian sector, have been released and therefore no wells needed to be purchased/traded for the common database.

Wellbores that have been used in the evaluation of the licence prospectivity are listed in Table 2.2.

Table 2.2 ***PL 987 and PL 987 B well database***

Sector	well	NPDID
NO	25/2-12	1290
NO	25/2-4	356
NO	29/6-1	375
NO	29/9-1	31
NO	30/4-1	377
NO	30/4-2	378
NO	30/4-3 S	7961
NO	30/4-D-1 H	6228
NO	30/4-D-1 AH	6229
NO	30/5-2	2886
NO	30/6-1	380
NO	30/6-2	381
NO	30/6-3	382
NO	30/6-4	383
NO	30/6-6	39
NO	30/6-7	73
NO	30/6-8	77
NO	30/6-9	83
NO	30/6-10	92
NO	30/6-13	7
NO	30/6-14	53
NO	30/6-15	110
NO	30/6-16	333
NO	30/6-17R	849
NO	30/6-18	488
NO	30/6-20	892
NO	30/6-25 S	3578
NO	30/6-26	4416
NO	30/6-27	4425
NO	30/6-29 S	7801
NO	30/7-6 R	507
NO	30/7-7	390
NO	30/7-8	216
NO	30/7-8 R	506
NO	30/8-1 S	2430
NO	30/8-3	3246
NO	30/8-4 S	5974
NO	30/9-1	65
NO	30/9-2	11
NO	30/9-3	55
NO	30/9-4S	452
NO	30/9-5 S	478
NO	30/9-6	1027
NO	30/9-7	1306
NO	30/9-8 R	1461
NO	30/9-9	1442

Sector	well	NPDID
NO	30/9-10	1514
NO	30/9-11	1673
NO	30/9-12 A	1770
NO	30/9-13 S	1811
NO	30/9-14	2076
NO	30/9-15	2223
NO	30/9-16	2361
NO	30/9-18	2552
NO	30/9-19	3561
NO	30/9-20 S	4463
NO	30/9-21 A	5805
NO	30/9-21 S	5800
NO	30/9-22	6034
NO	30/9-23	6182
NO	30/9-24	6210
NO	30/9-25	7249
NO	30/9-26 S	7491
NO	30/9-27 S	7522
NO	30/9-28 S	7869
NO	30/10-5	395
NO	30/10-6	1816
NO	30/11-10	7595
NO	30/11-10 A	7602
NO	30/11-11 S	7896
NO	30/11-12 S	7921
NO	30/11-13	7948
NO	30/11-14	7982
NO	30/11-3	62
NO	30/11-4	98
NO	30/11-5	2986
NO	30/11-6 S	4950
NO	30/11-7	5919
NO	30/11-7 A	6085
NO	30/11-8 A	6611
NO	30/11-8 S	6540
NO	30/11-9 A	7281
NO	30/11-9 ST	7280
NO	30/12-1	2248
NO	30/12-2	8850
NO	31/4-2	401
NO	31/4-6	43
NO	31/4-7	235
NO	31/4-8	312
NO	31/7-1	7954
NO	31/7-2 S	8174

Sector	Well
UK	3/14d-18
UK	3/14A-19Z
UK	3/15-4
UK	3/15-9 A
UK	3/15-9 Z
UK	3/15-10
UK	3/15-11
UK	3/15-12
UK	3/15a-14
UK	3/15a-15
UK	3/15a-16 Y
UK	3/15a-16 Z
UK	3/20a-3
UK	3/25b-5

Well data have been used for:

- Seismic-well ties
- Sedimentology and stratigraphy study for reservoir presence and quality
- Structural reconstruction

3 Results from geological and geophysical studies

Several proprietary studies have been performed as part of the licence work to evaluate the prospectivity in PL 987 and 987 B. The studies are described below with the integration of the findings at the end.

- **Integrated stratigraphic and depositional study of the Middle to Upper Jurassic succession (Skolithos 2019-2020)**

Review of the Middle to Upper Jurassic in 48 selected wells adjacent to the licence where both cores and log data were studied to interpret facies associations.

The study concludes in general that the reservoir potential of the Middle Jurassic to lowermost Cretaceous succession within the PL987 is low. The intervals with proven sandstones (Hugin, Tarbert and Ness fms) have already been tested by wells 30/7-7 and 30/10-6 where they were proven to be tight as a consequence of deep burial (c. 4.7 – 5.0 km TVDSS). The evidence for potential reservoir sandstones hosted within mudrocks of the Heather and Draupne fms is weak.

- **Structural Reconstruction of the Fensal Sub-basin (Terractiva 2019-2020)**

A tectonostratigraphic study with special emphasis on the Middle to Late Jurassic in order to de-risk trap and reservoir presence. A 2D reconstruction and a 3D back stripping from present day to Middle Jurassic times done to evaluate the tectonic evaluation in the Fensal Sub Basin. The study focuses on creating a consistent structural framework and to link it to the depositional setting for the Upper Jurassic reservoirs.

The study concludes that main uplift and erosion of the Oseberg Rift shoulders happened in Late Oxfordian, which resulted in sediment transportation from the rift shoulder into the mini-basin just down dip from the Oseberg and not out in the centre of the PL987 licence.

- **Reprocessing feasibility study (RPS 2020)**

Review of the 2016-2018 CGG multiclient processing to investigate the potential uplift through reprocessing.The study concluded that there is nothing inherently wrong with the existing data (CGG18M01) and that significant improvements through reprocessing is unlikely.

The integration between the studies done by Skolithos and Terractiva, resulted in a solid and consistent tectonostratigraphic evaluation of the prospective intervals within the licence. The Upper Jurassic section has high risk on both reservoir presence and effectiveness. In addition seismic re-mapping changed the trap outline/concept. This work has been crucial in the complete prospect evaluations performed.

4 Prospect update report

When the licence was established it became clear that the partnership had different view of the prospectivity within the licence. It was decided to mature all identified opportunities towards the drill/ drop
decision with main focus on the Middle Jurassic Storhaug (Suncor) and the Upper Jurassic Dinnet (Lundin, Vår and DNO) prospects. Figure 4.1 illustrates the original (a) and updated (b) prospectivity in the licence.

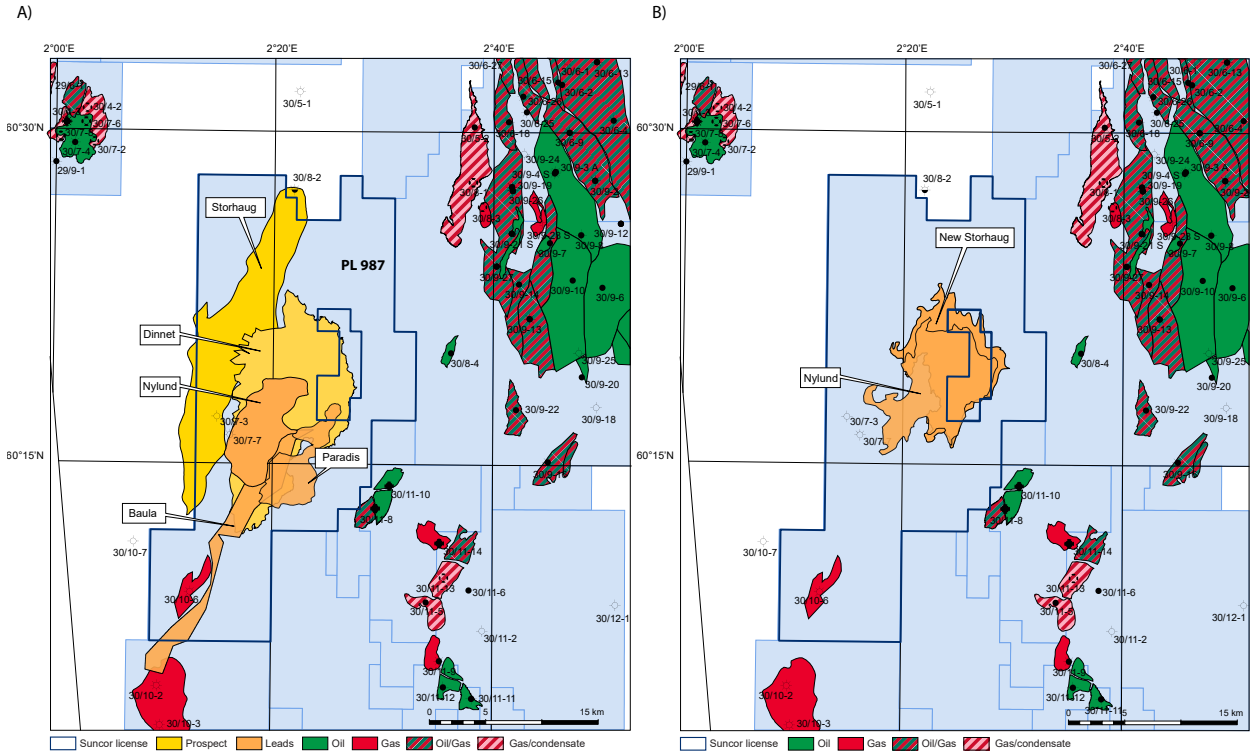

Figure 4.1 ***Original vs updated propsectivity in PL 987 and PL 987 B***
A) Original propsectivity at time of apllication. The prospects Storhaug (Suncor), Dinnet (Lundin, Vår Energi and DNO) and the leads Nylund (Suncor), Paradis (Suncor) and Baula (Lundin) was identified in connection with APA 2018. B) Prospectivity within the licence at the time of drop. New Storhaug was identified on the CGG18M01 seismic by Suncor.

The Storhaug Prospect

The Storhaug prospect was identified by Suncor as a structural trap, bounded to the east by a large fault and inferred missed by the dry well 30/7-7. Reservoir was believed to be the upper part of the Tarbert Fm, with the informal name Balta sand with possible similar porosity preservations mechanism as seen in the Martin Linge Field. The Heather Fm shale was considered top and lateral seal, proven by the nearby well 30/7-7. The Storhaug prospect was located in a favourable position to receive hydrocarbons from the downdip Fensal Sub-basin. Reservoir effectiveness and trap definition was considered the main risks due to burial depth and poor seismic quality.

New seismic revealed that the original Storhaug trap was not valid. A second structure on Top Brent level was identified to the east of the original Storhaug and named the New Storhaug (Figure 4.2). New Storhaug is a 4 way dip closure with spill point towards the east, with apex 500m deeper than the original Storhaug prospect. The Upper Tarbert Fm is considered reservoir and Heather Fm shales top seal. The crest of the 4-way is at 4500m depth TVD with lowest closing conture at 4930 m TVD.

Petrophysical evaluation in the area shows that reservoirs at this depth, have low porosity and permeability values. Two nearby wells, 30/7-7 and 30/10-6, ran DST tests in HC zones within the Tarbert Fm at comparable depth and found very low producible reservoirs.

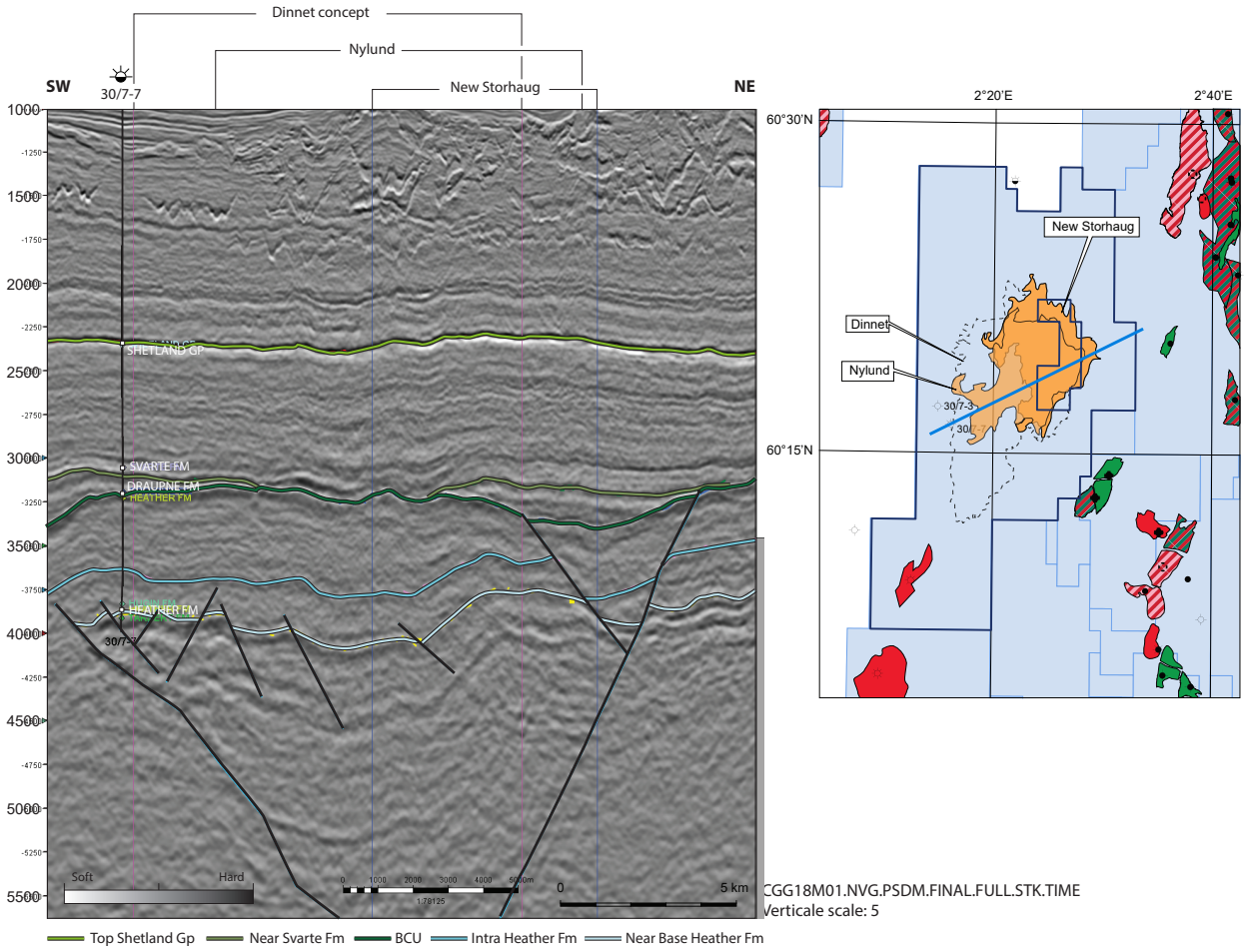

Figure 4.2 ***Seismic profile crossing New Storhaug lead and Dinnet concept***
Top reservoir at New Storhaug lead is defined by the Base Heather Fm interpretation. The mapping confidence is considered good, although the seismic quality is fair due to the chaotic overburden in this area.

Due to the high risk on reservoir quality, New Storhaug is downgraded to a lead.

Dinnet Prospect

The Dinnet prospect located east of the dry 30/7-7 well (Figure 4.2) was based on an seismic amplitude anomaly at BCU level. The conceptual depositional model for the Dinnet prospect was based on observed erosion of Middle Jurassic and Triassic sediments on the Oseberg-Huldra rift shoulders. The erosion occurred during Callovian to Early Cretaceous and sandy gravity flows could be deposited as basin floor fans within the Draupne shales during Tithonian times in the Dinnet area. No wells have encountered Intra Draupne sandstones within the basin, but both Intra Draupne and Intra Heather sandstones have been deposited on the rift shoulder to the east.

In-house investigation of the BCU amplitudes on the CGG18M01 seismic has changed the understanding of anomaly. Dinnet trap outline (towards west) is most likely caused by amplitudes and frequency changes set up by the Cretaceous onlap to BCU rather than geology within the Draupne or Heather fms (Figure 4.3). Observations made on amplitude and frequency blending maps fit well with seismic wedge modelling and isochrone map.

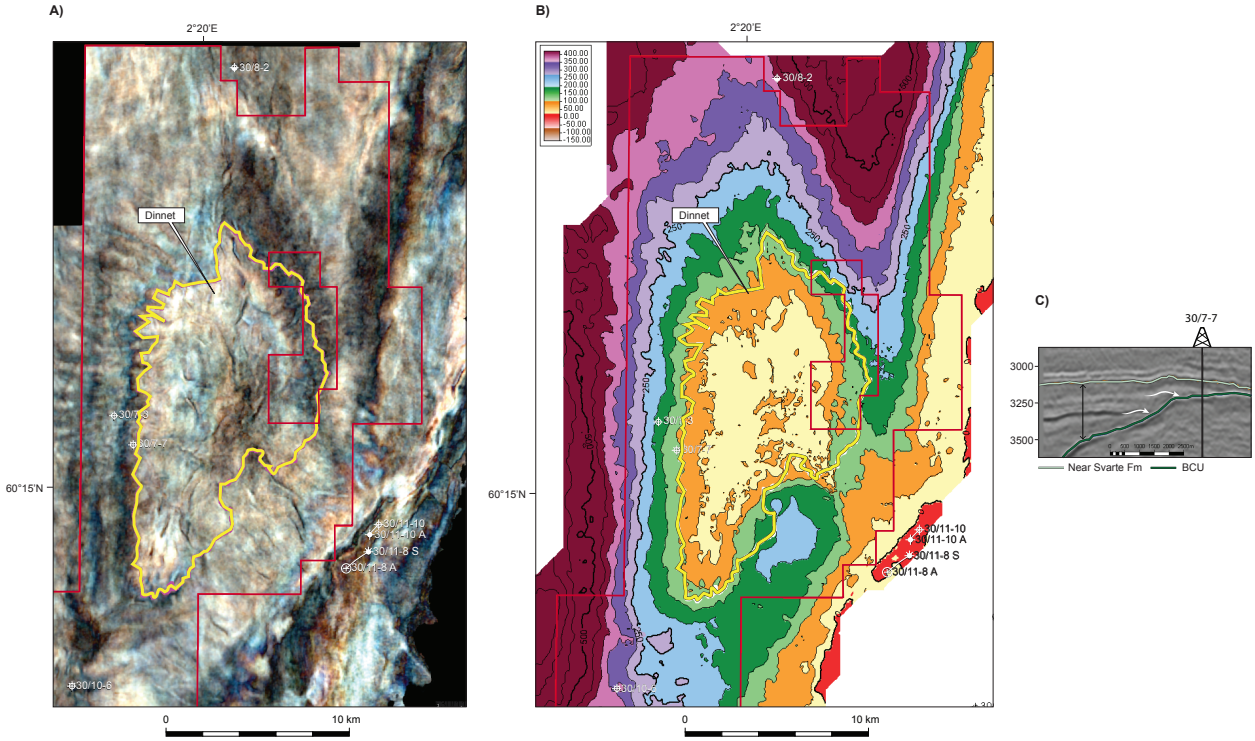

Figure 4.3 ***Trap on Dinnet concept***
Amplitudes and frequency changes on Dinnet, which was basis for the trap definition originally, are likely caused by onlap of Cretaceous strata to BCU. a) Frequency blend b) Isochrone map between Near Svarte Fm and BCU c) Seismic section illustrating Cretaceous onlap to BCU and ischrone interval

A reconstruction of a selected 2D line and further 3D back stripping over the licence was preformed to determine if the Dinnet outline is within a depo-center for erosion products from the Oseberg rift shoulder. The study showed that smaller parts (eastern part) of the Dinnet prospect could have accommodation space during Callovian/Oxfordian time, but not through Tithonian time. Any deposits from Oseberg area would have to fill the larger eastern sub-graben before spilling to the west and deposit in the Dinnet area, reservoir presence is therefore unlikely.

An in-house investigating of the wells on the Oseberg Field revealed that only a few wells had encountered Intra Draupne sandstone and most of the Oseberg Field had the older Heather shales deposited above the Brent Gp. An erosion during Tithonian times would simply results in depositioning of shaly sediments in the Dinnet area. Reservoir presence and quality is therefore considered as high risk.

The stratigraphic study done by Skolithos supported the in-house investigating that any sediments within the licence area mostly is dominated by argillaceous facies. Sediment gravity flows originating from the Oseberg Fault block are likely to have transported sediment through relay ramps into the mini-basins to the east of the 30/7-7 structural high, but these are anticipated to be predominantly mud-prone.

Due to the high risk on trap and reservoir, Dinnet is downgraded to a concept.

Nylund Lead

The Nylund lead had a conceptual reservoir model in Upper Jurassic similar to Dinnet without defined trap. The anticipated reservoir age for Nylund was intra Heather sst. A trap with a crest around 4200 m TVD is identified using the new seismic (Figure 4.2). All though a trap is identified, the Nylund lead remains a lead due to high risk on reservoir presence and quality.

Paradis

The lead is defined by a Cretaceous marker (top reservoir) and BCU (base reservoir), and forms a 4-way dip closure. Unproven reservoir in the area, and the structural study does not indicate any hinterland exposed in nearby area, hence very high risk on reservoir presence.

Baula

Hugin Fm lead in the down-faulted area east of 30/10-6 discovery. Reservoir depth is at 5500m TVD, hence very high risk on reservoir effectiveness.

Paleogen and Neogene

The shallow section within the licence is effected by what looks like mud volcanoes and injectites. A feasibility study presented by emgs showed that the disturbed section was highly conductive and therefore most likely not charged by hydrocarbons. Only minor resistive injectites was identified. The shallow section is therefore not believed to be prospective.

5 Technical evaluation

A complete technical evaluation regarding economical value and possible development solution is not performed due to the low chance of success for New Storhaug and Nylund caused by deep burial depth and hence poor reservoir effectiveness. The Dinnet is conceptional, and no trap is observed on seismic and in addition likelihood of reservoir presence/effectiveness is considered low.

6 Conclusion

The prospects and leads within the licence have been re-evaluated based on the purchased 3D seismic data and thorough geological and geophysical studies.

The evaluation of New Storhaug concluded that the geological chance of success for the prospect is very low, and therefore not a valid candidate for a drill decision. The main risk is effective reservoir, due to great burial depth. The reservoir will most likely be tight and not producible.

Evaluation of Dinnet showed that the original trap definition is not valid. The geological studies concluded that the chance of having reservoir presence and quality within the Dinnet area is very low to absent. Dinnet is therfore downgraded to a concept.

Nylund was originally a concept very simlar to Dinnet without a trap defined. A trap has been defined on the new seismic, but the geological studies have concluded very low likelyhood for reservoir precense and quality in the area. This lead is therfore not concidered to be a drilling candidate.

The remaining prospectivity within the licence showed very low potential and the partnership is aligned on a negative drill decision in PL 987 and PL 987 B. Hence the area is fully relinquished to the authorities.