PL 831 Lapse Report

Part of Blocks 6407/10 & 6307/1

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Table of Contents

1 History of the production licence 1
2 Database overviews 3
2.1 Seismic data 3
2.2 Well data 5
2.3 Special Studies 5
3 Results from geological and geophysical studies 6
4 Prospect update report 8
5 Technical evaluation 18
6 Conclusions 19

List of Figures

1.1 PL 831 Location map 1
2.1 PL 831 common database map 3
4.1 Revised prospectivity in PL 831 8
4.2 Tranmelr trap definition 9
4.3 Seismic southwest-northeast profile 10
4.4 Seismic north-south profile 11
4.5 Chronostratigraphic scheme 12
4.6 A cartoon illustration of the Tectonostratigraphic framework 13
4.7 Depth map of Top Tranmelr 15

List of Tables

2.1 PL831 Common seismic database 4
2.2 PL 831 Common well database. 5
2.3 PL 831 special studies in the common database 5
4.1 Revised prospect data, NPD table 5 16

1 History of the production licence

Summary

PL 831 (Figure 1.1) was awarded as part of the APA 2015 licence round for predefined areas on the 5th of February 2016. The initial period was set to 8 years (3+2+2+1), of which the first decision, Decision to Drill, is due on February 5th 2019.

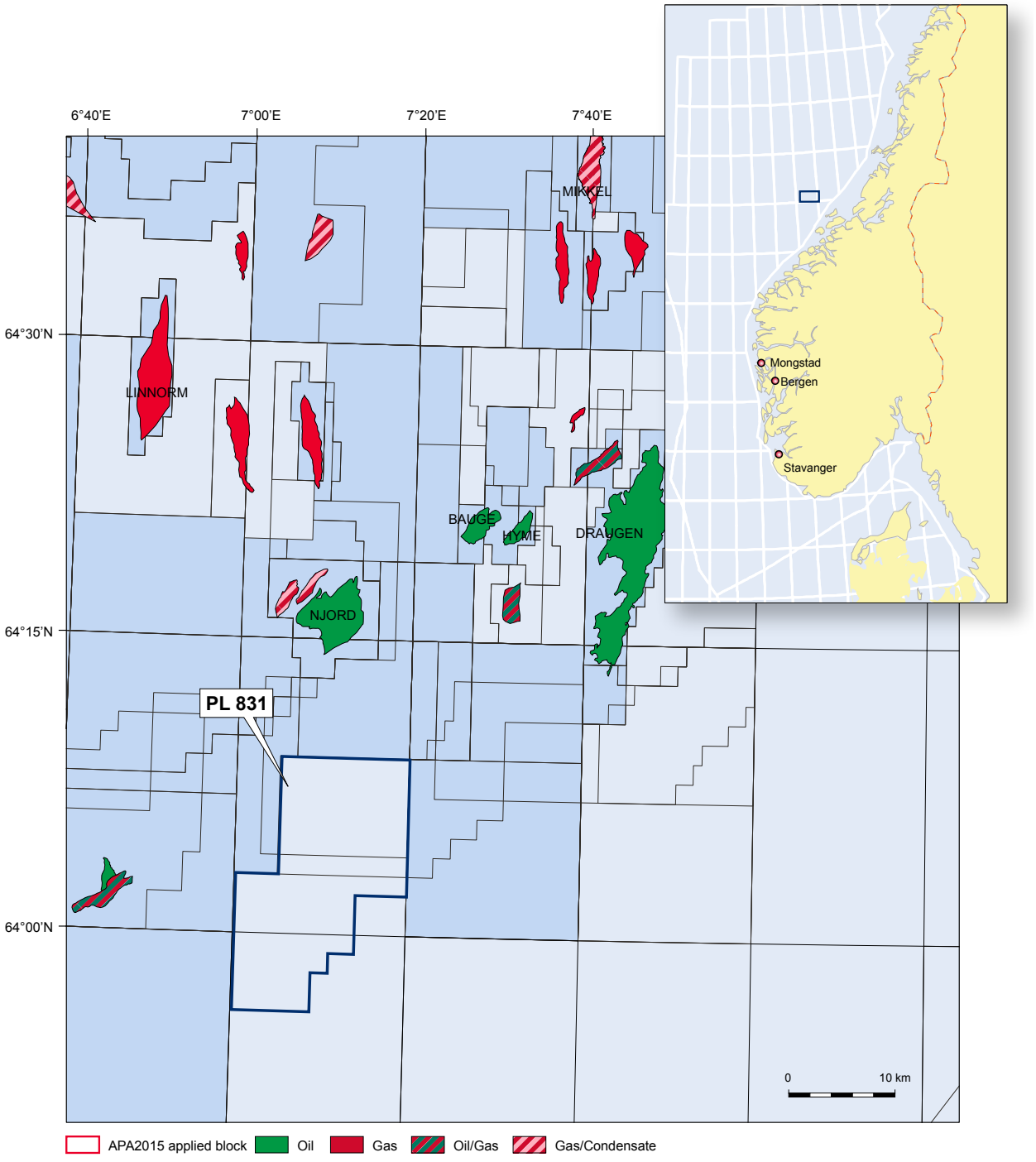

Figure 1.1 *PL 831 Location map*
Parts of block 6407/10 and 6307/1 in the Norwegian Sea.

Participants

Suncor Energy Norge AS is the operator (40%), with partners Lundin Norway AS, VNG Norge AS (Neptune E&P Norge AS) and Petoro, each holding a 20% equity.

Work Commitment

The work commitment of reprocessing 3D seismic has been fulfilled (2017).

Meetings held

MC meetings were held at least once a year as agreed by the licence group at the first EC/MC meeting on April 7th 2016, in accordance with JOA article 2.1.

Meetings held during the licence term are listed below:

1. ECMC start-up meeting on 07/04/2016 at Suncor offices in Stavanger
2. ECMC meeting on 10/11/2016 at Suncor offices in Stavanger
3. CGG reprocessing start-up meeting 09/01/2017 at CGG offices in Crawley, UK
4. Special studies work meeting 09/02/2017 at Suncor offices in Stavanger
5. CGG reprocessing onsite meeting 23/03/2017 at CGG offices in Crawley, UK
6. CGG reprocessing onsite meeting 03/05/2017 at CGG offices in Crawley, UK
7. Tectonostratigraphic work meeting 14/11/2017 at Weatherford Laboratories in Stavanger
8. ECMC meeting on 15/11/2017 at Suncor offices in Stavanger
9. Tectonostratigraphic work meeting 03/05/2018 at Weatherford Laboratories in Stavanger
10. Seismic interpretation work meeting 20/09/2018 at Suncor offices in Stavanger
11. ECMC meeting on 07/11/2018 at Suncor offices in Stavanger

Reasons for licence lapse

The main prospect Ursa, identified by the Operator, is degraded to a lead based on the re-evaluation of the reprocessed seismic and the integration of the studies performed during the licence period. The Tranmelr prospect, identified by VNG, is therefore brought forward as the main prospect by the licence group.

Re-evaluation of the Tranmelr prospect, based on the varies studies performed, led to an increased prospect risk. The geological chance of success is 9% mainly due to the lack of efficient top and lateral seals. The expected reservoir has poor reservoir quality not good enough to secure sufficient flow-rates. Production of hydrocarbons from such a poor reservoir is expected to be very difficult. The combination of these factors is the main driver for the decision to lapse PL 831.

2 Database overviews

2.1 Seismic data

The common database for PL 831 includes PGS14005SUNR17 (Figure 2.1), which is a 3D PSDM broadband reprocessing done as part of the work programme. A subset of the larger PGS14005 survey is reprocessed for the licence by the CGG office in Crawley, UK. Due to data quality issues related to remnant peg-leg multiple energy, two versions of the dataset are generated. One with a fairly standard processing flow and one with an extra pass of Targeted Multiple Attenuation (TMA) applied. In addition, a post migration pre stack gather conditioning is done by Sharp Reflections in 2018 due to the persistent remaining multiple energy, which particularly affects the definition of the Ursa prospect. This dataset, the PGS14005SUNR18, is also included in the common database (see Table 2.1).

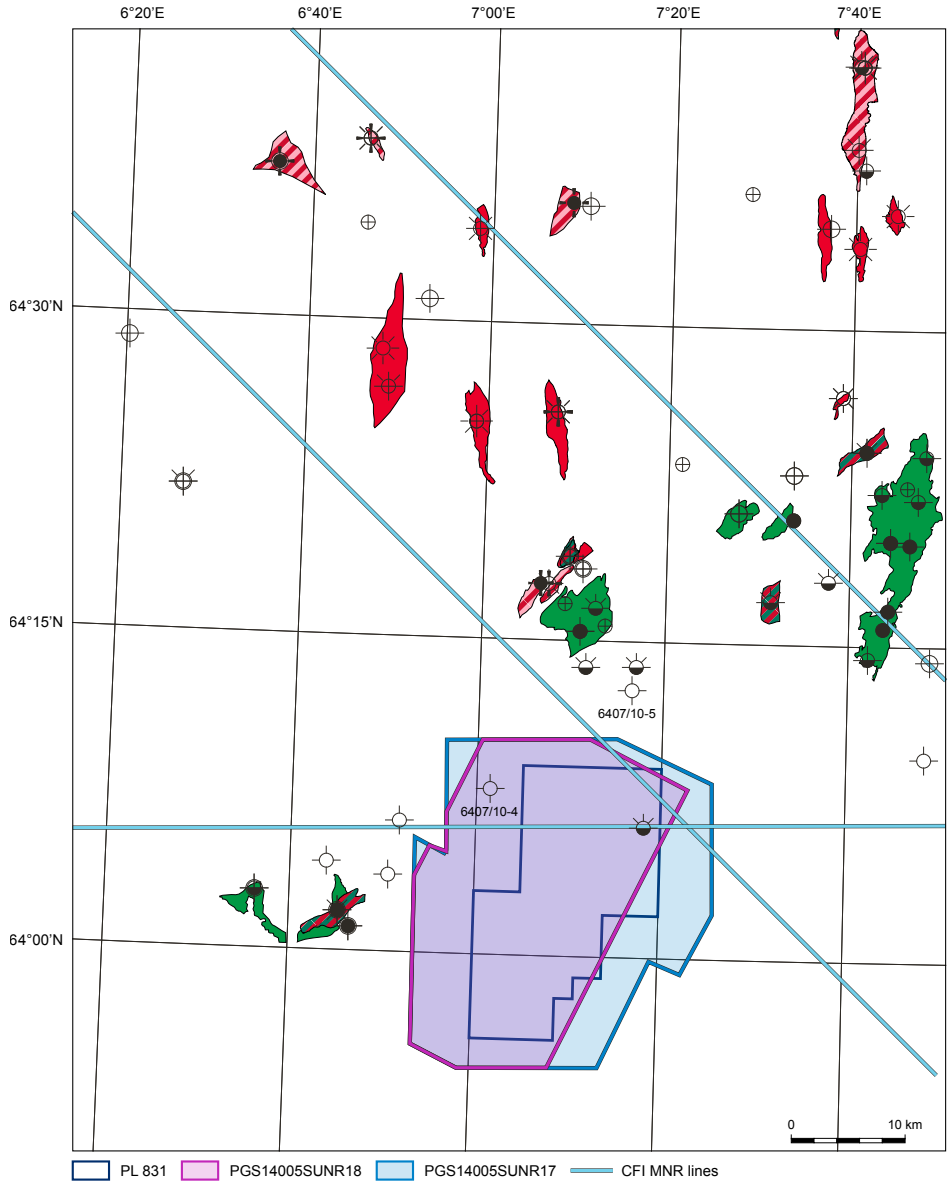

Figure 2.1 ***PL 831 common database map***
Two reprocessed 3D seismic datasets are included in the common database, along with three regional 2D lines. The two wells, 6407/10-4 and 6407/10-5, are also included.

3 clarify processed MNR 2D lines are part of the database, used as input to a structural reconstruction study.

Table 2.1 lists details of all seismic data included in the common seismic database.

Table 2.1 ***PL831 Common seismic database***

Seismic Survey	NPDID	Survey Type	Survey Year	Status	Commens
PGS14005SUNR17	8054	3D	2017	Licence owned	CGG PSDM reprocessing from PGS legacy data for licence group.
PGS14005SUNR18	8054	3D	2018	Licence owned	Post mig, pre stack gather conditioning processing from CGG gathers (PGS14005SUNR17) for licence group.
CFI-MNR-06	4364	2D	2006	Multi client	TGS Clarify processing of MNR 2D line; CFI-MNR06-7110 [Shotpoint range: 14011-19250].
CFI-MNR-11	7389	2D	2011	Multi client	TGS Clarify processing of MNR 2D line; CFI-MNR011-90446 [Shotpoint range: 25157-29861] and CFI-MNR11-90471 [Shotpoint range: 23737-29622].

2.2 Well data

Two wells are included in the common well database (Figure 2.1), listed in Table 2.2. Raw data from both wells are available to the licence group.

Table 2.2 ***PL 831 Common well database.***

Well	NPDID
6407/10-4	7699
6407/10-5	7763

2.3 Special Studies

All partners have extensive experience in this area, from both regional and licence work. It was decided to build on each others knowledge and to use existing special studies as input to the common database. Some of the proprietary studies done for PL 751 and PL 700 are therefore included. These are listed in Table 2.3.

Table 2.3 ***PL 831 special studies in the common database***

Study	Provider	Year complete	Owner
Frøya High & Froan Basin, Mid Norway – 2D and 3D backstripping for prediction of palaeobathymetry and palaeostructure.	Badleys	2016	PL 751
Petroleum system analysis of the PL751 area offshore Mid Norway.	Torena AS	2016	PL 751
Stratigraphic and Depositional Modelling of the Jurassic interval for PL751.	Ichron	2016	PL 751
APT well 6407/10-4 Routine geochemical analysis.	APT	2016	PL 700
Hot shot' sedimentological description and petrography of the cored interval and detailed petrographic study of selective sidewall core samples, Norwegian Sea. Ichron report no. ECR 5339.	Ichron RPS	2016	PL 700
Norwegian Sea. Automated mineralogy (QEMSCAN) and biostratigraphic analysis of selective cores and sidewall cores, Norwegian Sea. Report QE 278.	Robertson CGG	2016	PL 700
Well 6407/10-4. SpecCam Mineral logging report (core and cuttings).	Spectral. Map and Weatherfords	2016	PL 700
Routine Biostratigraphy and XRF of well 6407/10-4. APT report APT16-4492.	APT	2016	PL 700
Fluid inclusions study for well 6407/10-3.	FIT	2016	PL 700
Fluid inclusions study for well 6407/10-4.	FIT	2016	PL 700
Well 6407/10-4 report – Geological interpretation from FMI borehole images.	The Eiriksfjord	2016	PL 700
Well 6407/10-4: Automated mineralogy (QEMSCAN) and biostratigraphic analysis of selective cores and sidewall cores. Report QE278.	Roberson CGG	2016	PL 700

3 Results from geological and geophysical studies

Several studies are proprietarily performed to evaluate the prospectivity in PL 831.

Seismic reprocessing (2016-17, CGG)

- Broadband PSDM reprocessing improved imaging throughout the section, and in particularly from BCU and below. Reduction in the overall random and linear noise levels, removal of multiple energy (waterbed and peg-legs), enhanced frequency content and improved fault imaging are the key improvements on the data quality compared to the legacy dataset.

Seismic reprocessing (2018, Sharp Reflection)

- Based on the improved data quality from the CGG reprocessing, post migration gather conditioning is done in an attempt to further improve the data quality focused on the BCU level. The main scope was to amend the quality of the seismic data to make it possible to map the trap for the Ursa prospect with higher confidence. Noise levels in general are to a large degree reduced. However, the remaining peg-leg multiple persists in masking the primary energy making it impossible to define the Ursa trap with any confidence.

Rock physics and forward AVO modelling (2018, G&G Resources)

- A comprehensive rock physics study is carried out to derive depth-dependant elastic rock property trends for various lithologies and provide a quantitative interpretation (QI) model. The study includes examination of lithology and oil/brine discrimination, expected interface reflectivity, AVA responses and wedge modelling. The study focuses on both the Upper Jurassic Rogn Fm target (Ursa) and 4 different plausible Triassic reservoir facies (lake facies, braided facies, aeolian facies and alluvial facies).

PL 831 Stratigraphic and sedimentological analysis of the Triassic and Jurassic (2017-18, Skolithos Limited)

- The stratigraphic and depositional modelling study done for PL 751 covers the Jurassic interval for the Frøya High area. This study has later been modified by the operator to include the PL 831 area, and is by the licence group considered sufficient for the evaluation of the potential Rogn Fm reservoir. The proprietary PL 831 study is therefore mainly focused on assessing the Triassic prospectivity in Blocks 6407/10 and 6307/1. This study concentrates on the sedimentology/ stratigraphic aspects of the possible reservoir and seal facies, their distribution and quality.

Frøya High: Tectonic evolution, subsidence, uplift and erosion assessment (2017-18, Terractiva)

- Both 2D and 3D reconstruction is done to evaluate the tectonic evolution of the Frøya High through time; from the Permo-Triassic rifting to the Cenozoic inversion and uplift. The study focuses on creating a consistent structural framework and to link it to the depositional setting for both Triassic and Upper Jurassic reservoirs. The reconstructed surfaces are additionally used as input for the petroleum system analysis, evaluating the migration of hydrocarbons in to the prospectivity identified in PL 831.

Petroleum system analysis for the Frøya High (2018, Torena AS)

- The study is executed to understand the basin development, deposition of source rocks, fetch areas and migration pathways for the prospectivity in the licence. A review of an oil correlation study performed by APT is included. The basin modelling results are integrated with the reconstructed surfaces provided by the operator.

The reprocessed seismic data generally increases the confidence in the seismic interpretation. However, it did not enable a valid definition of the Ursa trap which led to the downgrade from a prospect to a lead. A high confidence interpretation of the Tranmelr prospect trap is on the other hand possible on the new seismic data. The geophysical studies performed increased the understanding of the expected seismic response of both the Upper Jurassic and Triassic reservoirs. However, remaining data quality issues mask the primary signal of seismic events underlying the strong BCU reflector, which made it difficult to apply the geophysical results in an evaluation of Ursa. Further, the Triassic rocks are considered to be quite 'stiff' and AVA is therefore considered quite difficult.

The close 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 Triassic section is found to comprise alluvial fans and fluvial plain infill sediments, which is considered not to be compatible with the presence of a high quality reservoir. 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 slightly different view of the prospectivity within PL 831. It was decided to mature two identified prospects towards the drill/drop decision; the Upper Jurassic Ursa and the Triassic Tranmelr prospects. During this evaluation the Ursa prospect is downgraded to a lead, leaving the Tranmelr prospect as the main focus of this report. The outlines of the evaluated Tranmelr prospect, along with the original Ursa prospect, are illustrated by Figure 4.1.

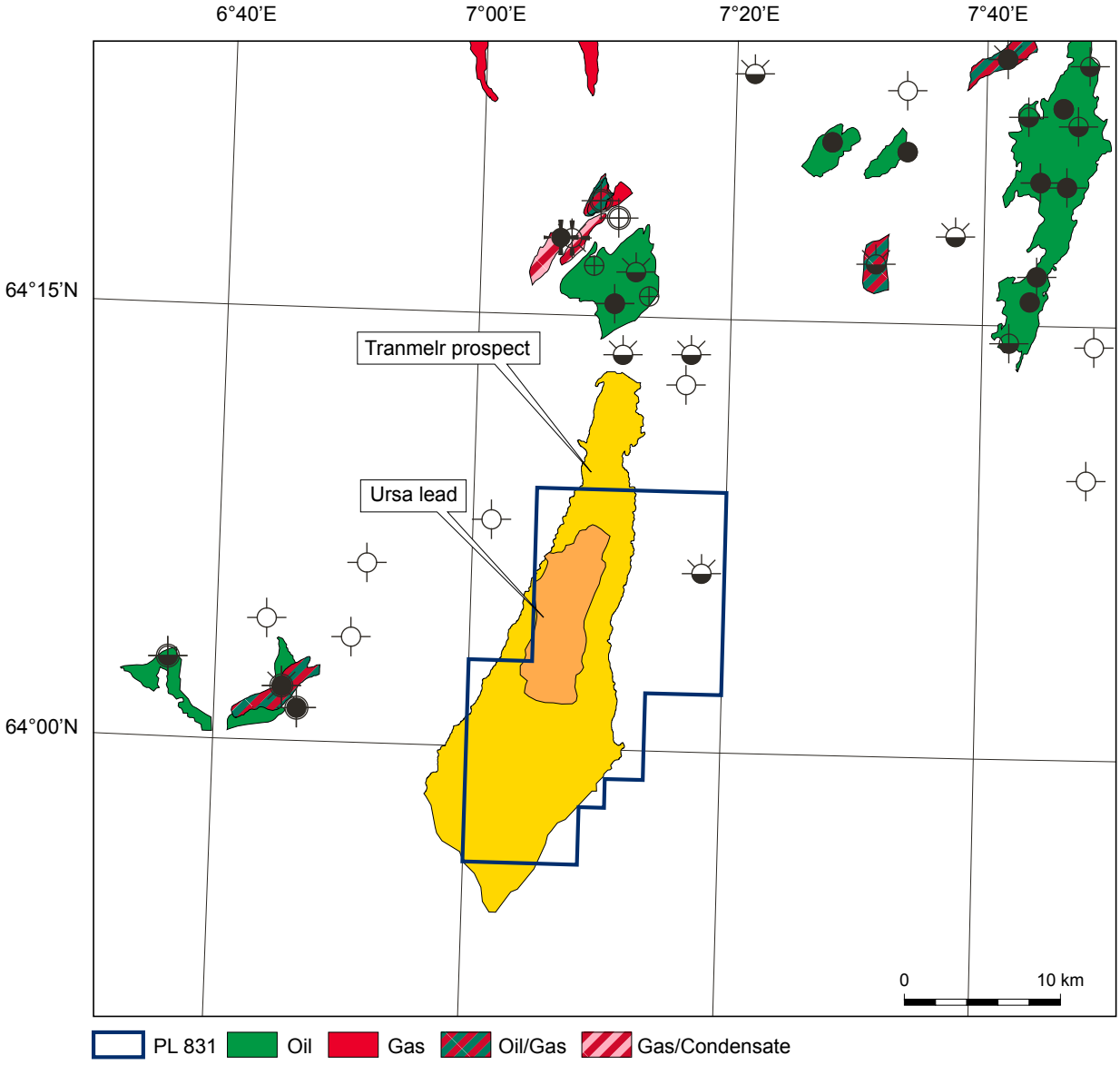

Figure 4.1 ***Revised prospectivity in PL 831***
The revised outlines of the Tranmelr prospect and the Ursa lead

The Tranmelr prospect

The Tranmelr prospect was originally identified by VNG (Neptune Energy) as a structural truncation trap, fault bounded to the south, with Triassic 'Red Beds' as reservoir rocks. Retention was at the time of application identified as the key risk.

The re-interpreted Tranmelr prospect is a combined structural and stratigraphic trap comprising alluvial/ fluvial reservoir of Triassic age. The trap is complex consisting of several components (Figure 4.2). The stratigraphic components are related to the interaction between the Base Cretaceous Unconformity (BCU) and the Intra Triassic Unconformity (ITU) defining the western and eastern part of the trap, respectively. The truncation of the ITU by the BCU forms the main element of the Tranmelr trap geometry (Figure 4.3). The crest of the structure is located to the south where the trap is defined by major faults towards the Froan Basin to the southeast (Figure 4.4). To the southwest the Tranmelr prospect is limited by basement being truncated by the BCU leaving no space for Triassic sediments. Finally, the northern part the prospect is bounded by a large fault towards the Gimsan Basin.

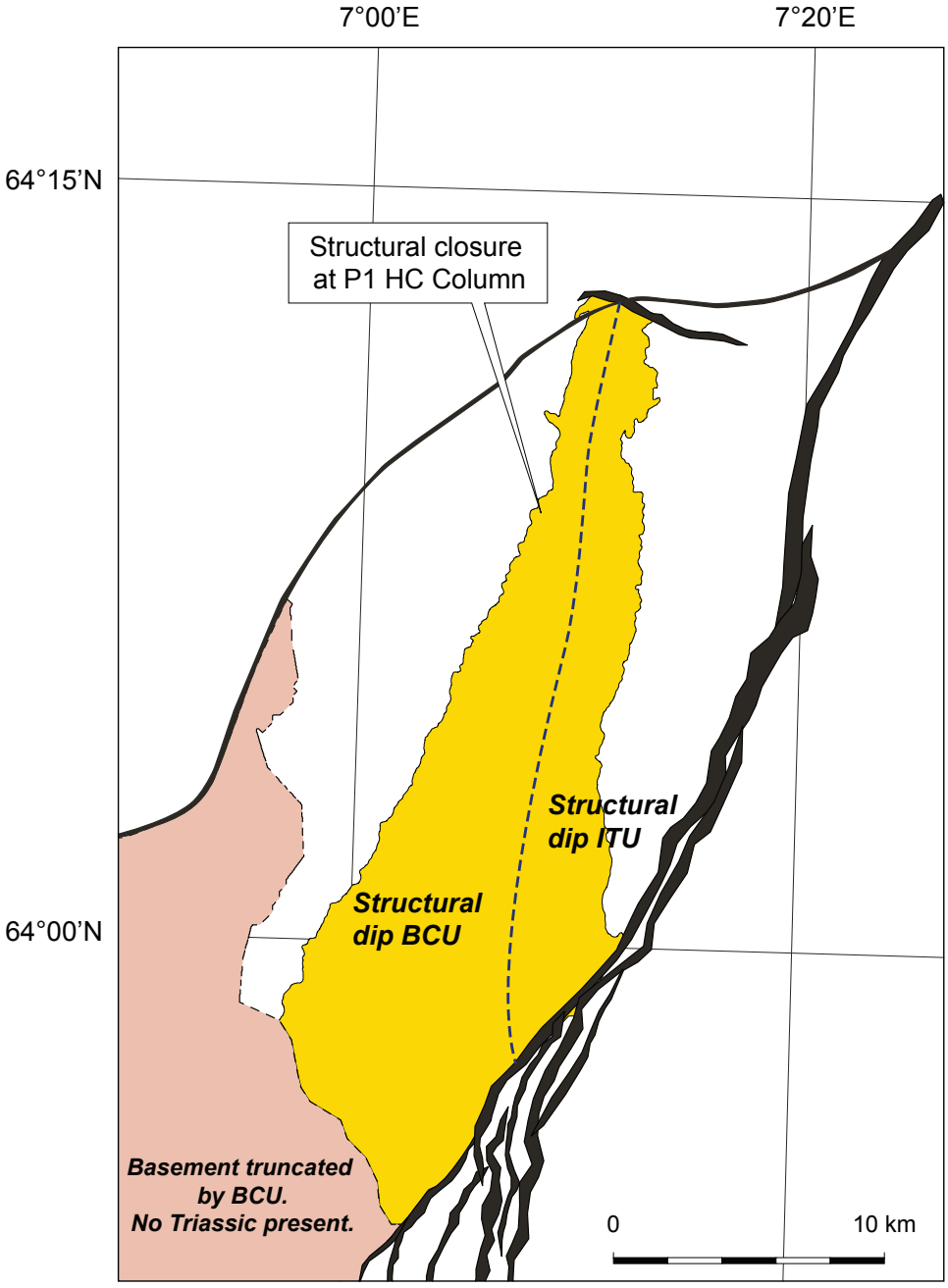

Figure 4.2 ***Tranmelr trap definition***
A conceptual illustration of the trap for the Tranmelr prospect. As illustrated this is a complex trap, comprising several key elements. The stipple line in the middle of the prospect illustrates the intersection point where BCU truncates ITU.

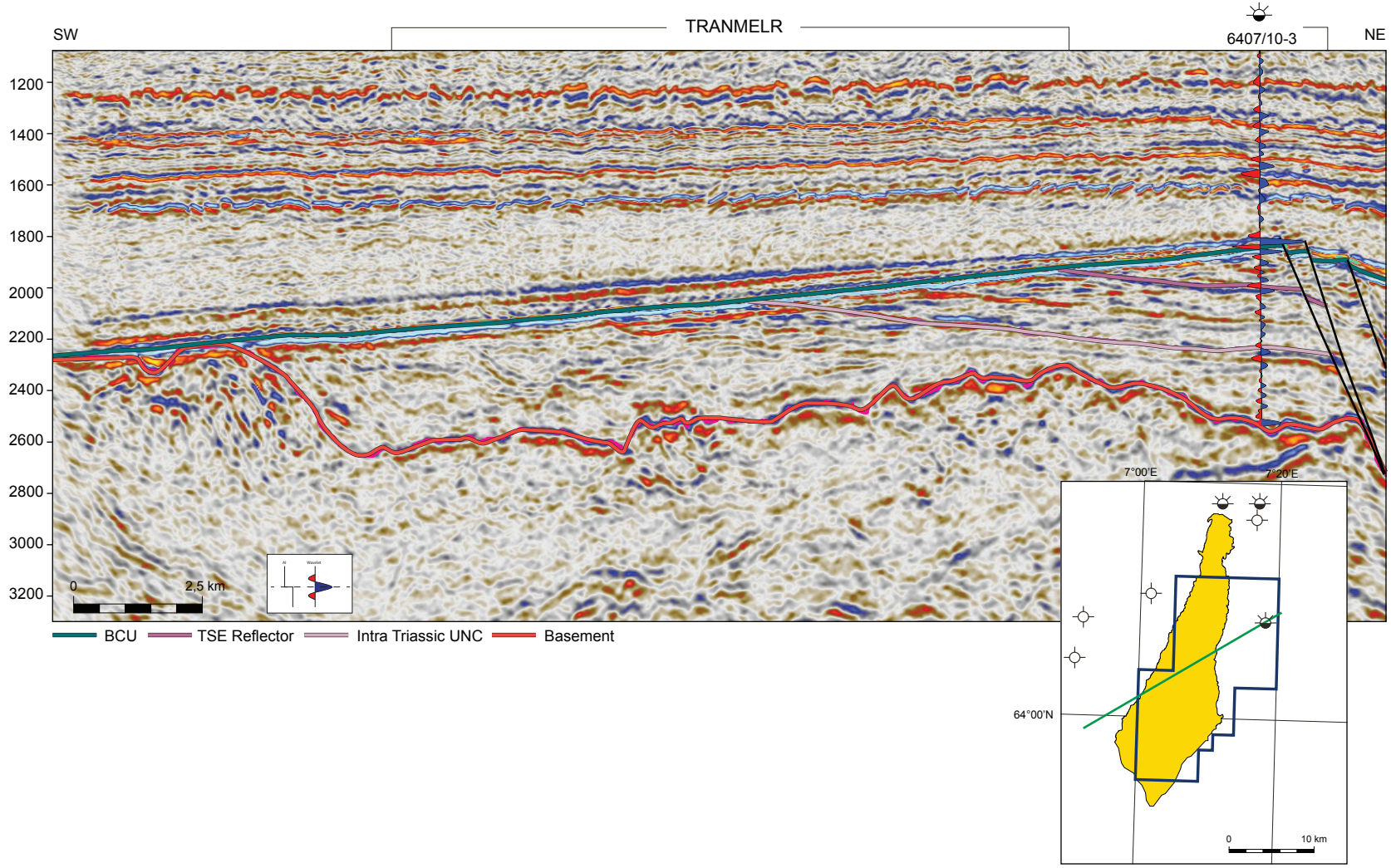

Figure 4.3 ***Seismic southwest-northeast profile***

The figure shows a seismic section in a dip direction through the Tranmelr prospect. The trap geometry is defined by the ITU getting truncated by the BCU. The age equivalent reflector of the top salt present in the 6507/12-2 well on the Trøndelag Platform (Top Salt Equivalent) is mapped on seismic regionally. This is done to ensure a consistent interpretation of the age of the Triassic sequences present on the Frøya High. The TSE reflector can be seen on this seismic section.

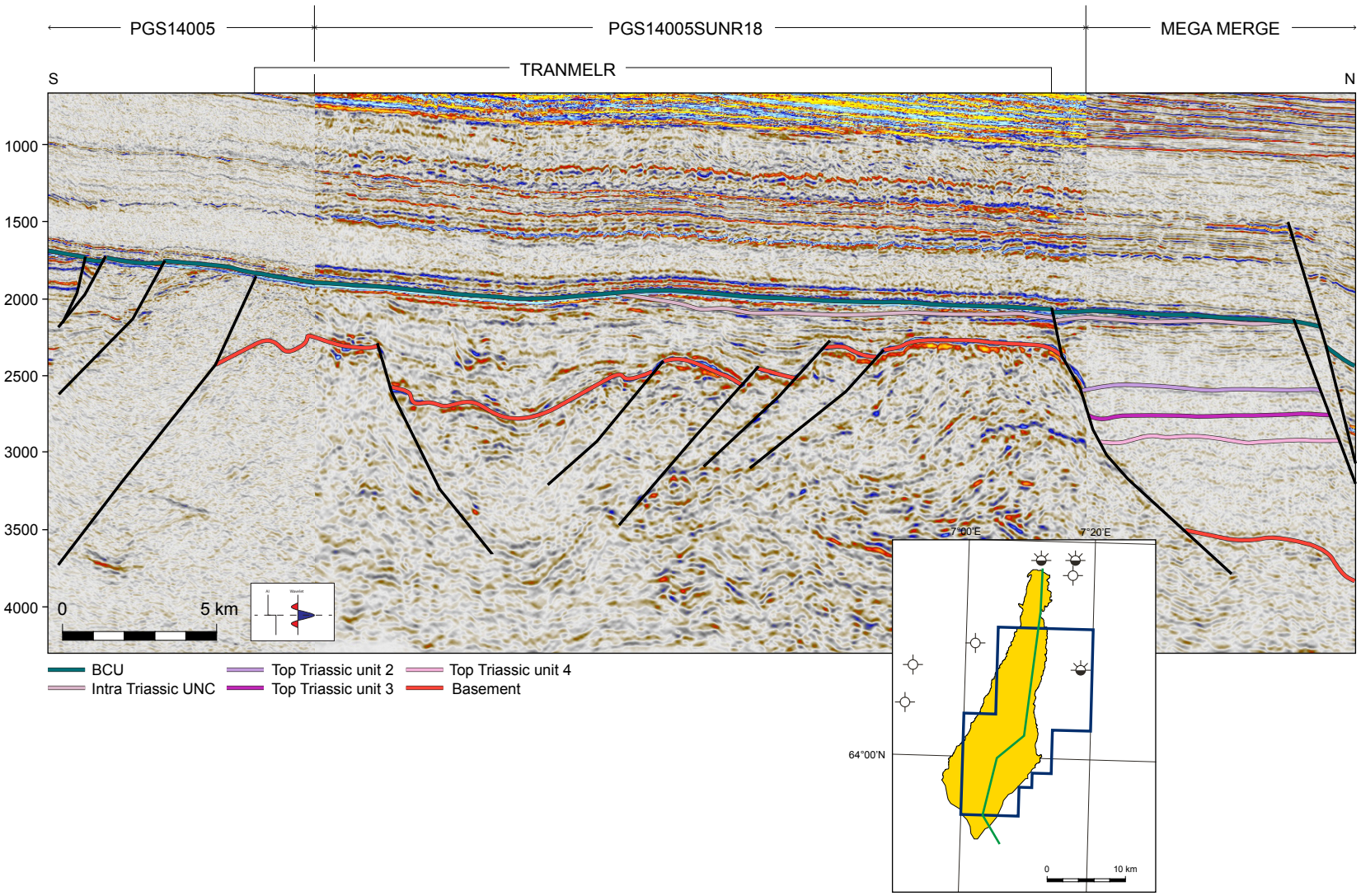

Figure 4.4 ***Seismic north-south profile***

The figure shows a seismic section in a strike direction through the Tranmelr prospect. The trap is bounded to the southeast by a large fault. This fault is part of the fault complex separating the Frøya High from the Froan Basin. The bounding fault towards the Gimsan Basin can be observed to the north.

The seal comprises intra Triassic shales, Upper Jurassic Spekk Fm and Cretaceous shales as well as fault seal in the south and north. Intra Triassic shales immediately overlying the Intra Triassic Unconformity is regarded as the most critical of the seal elements. Detailed analysis of the Triassic succession in the 6407/10-3 well situated down-dip and east of the prospect concluded that the overall Triassic section is relatively sandy, without a laterally extensive thick mudrock to act as top seal for parts of the prospect. Top seal on the eastern flank of the prospect is hence considered very high risk. The faults at the crestal area to the southeast towards the Froan Basin, where the juxtaposed stratigraphy is likely to be sandy intervals of Middle Triassic age, exert an additional risk. The lateral sealing capacity of the basement to the southwest is also unknown. Presence of possible Upper Jurassic thief sands within the Spekk Fm top seal at BCU adds to the total seal risk.

The reservoir for the Tranmelr prospect is interpreted to be alluvial fan deposits being part of the Permo-Triassic synrift infill (syn-rift 1 in Figure 4.5 and mega-sequence M1A in Figure 4.6a). The stratigraphic analysis shows that this sequence (intersected by both wells) represents deposition of proximal alluvial fans. The source areas for these deposits are likely to be related to nearby foot-wall erosion. Figure 4.6b is an illustration of the gross depositional setting during this time period. The quality of the assumed reservoir is very low with permeabilities in the 1-100 md range as inferred from the nearby wells.

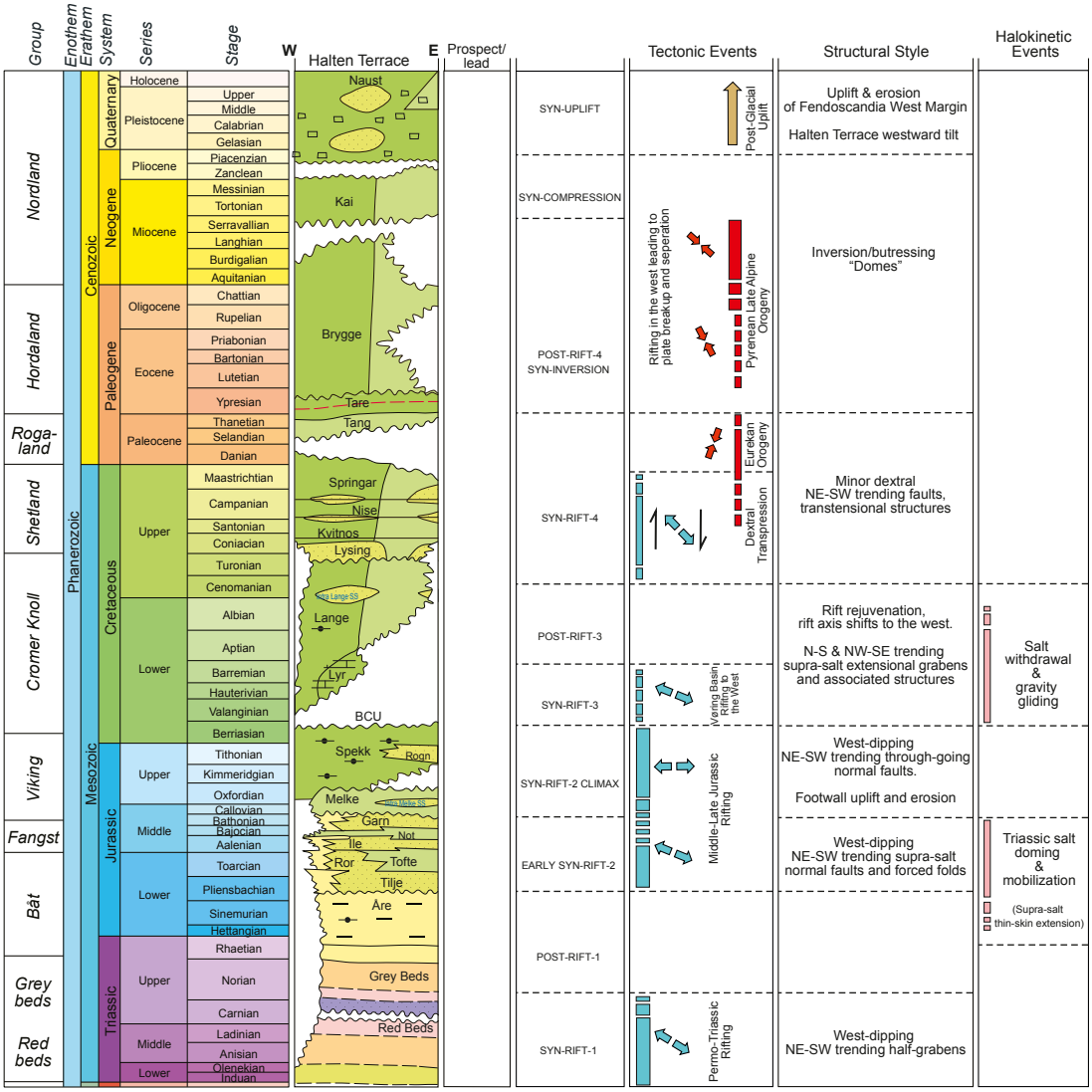

Figure 4.5 *Chronostratigraphic scheme*
Tectonostratigraphic summary for the Frøya High, Norwegian Sea.

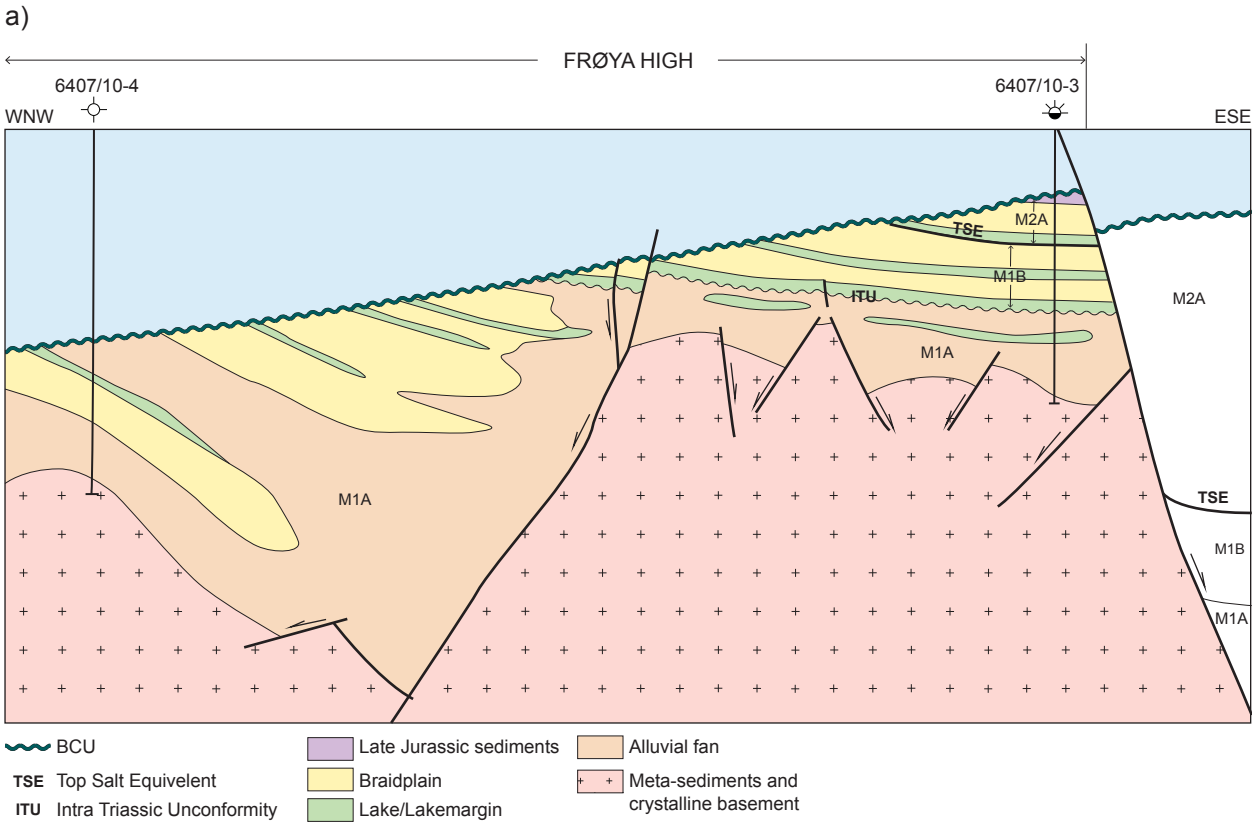

Figure 4.6 ***A cartoon illustration of the Tectonostratigraphic framework***

Figure a) Geological profile across the Frøya High, intersecting both 6407/10-3 and 6407/10-4. It shows the three Permo-Triassic mega-sequences identified by the study of the structural evolution. The associated depositional environment for each sequence is illustrated on the figure.

Figure b) Plausible scenario for the deposition of the Triassic section on the Frøya High.

The hydrocarbon fetch area for the Tranmelr prospect is situated in the Halten Terrace to the west of the Frøya High. Huge volumes of both oil and gas have been expelled from Jurassic source rocks, proven by the many discoveries in the area. Both the 6407/10-3 and 6407/10-4 wells have shows in the Triassic sections. The geochemical data for the oil stains in these wells are similar to each other and are also consistent with generation from the Spekk Fm source rock. These oil stains prove the migration from the kitchen onto the Frøya High across the major Klakk Fault Complex.

For the risk assessment of Tranmelr, the geological and geophysical studies performed during the licence term have been important. Seal remains the key risk factor, with reservoir quality as a secondary issue. Figure 4.7 shows a depth map of the Tranmelr prospect, with the estimated P90, P50 and P10 OWC ranges displayed. Although the estimated Pmean recoverable resources are reasonable (Table 4.1), the combination of the high geological risk and the assumed poor producibility of the reservoir led the licence group to a negative decision to continue further work.

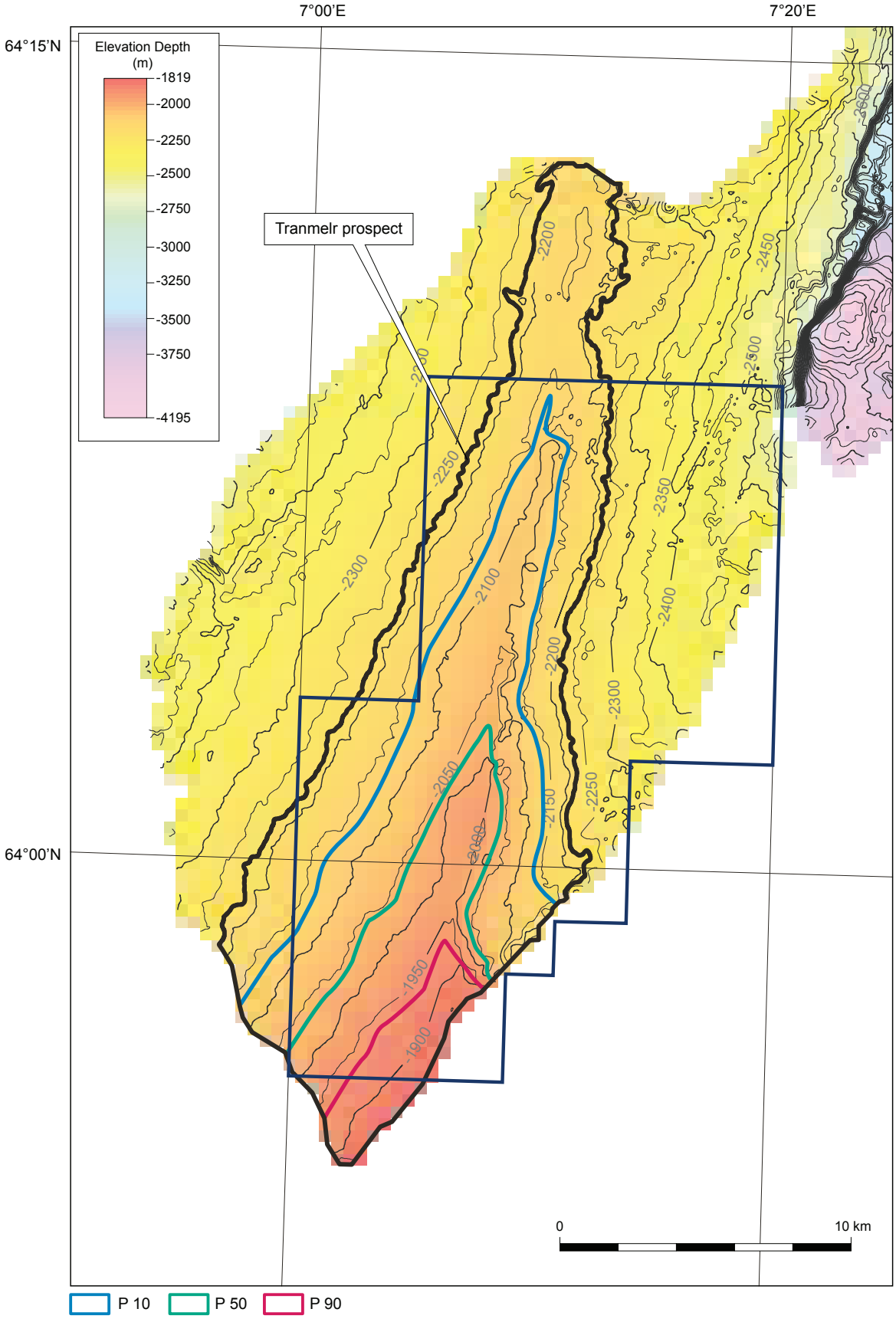

Figure 4.7 ***Depth map of Top Tranmelr***
Outline of the Tranmelr prospect with the estimated P90, P50 and P10 OWC range displayed.

Table 4.1 *Revised prospect data, NPD table 5*

Block	6307/1 & 6407/10	Prospect name	Tranmelr	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	Suncor Energy Norg	Reference document	PL 831 Lapse Report			Assessment year	2018
This is case no.:	1 of 1	Structural element	Frøya High	Type of trap	Structural	Water depth [m MSL] (>0)	330	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)	6.83	1.92	69.74	164.40				
	Gas [10^9 Sm^3] (>0.00)								
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	1.19	0.16	15.52	37.18				
	Gas [10^9 Sm^3] (>0.00)					0.19	0.02	3.14	7.66
Reservoir Chrono (from)	Carnian	Reservoir litho (from)	"Red Beds"	Source Rock, chrono primary	Tithonian-Oxfordian	Source Rock, litho primary	Spekk Fm	Seal, Chrono	Tithonian-Oxfordian & Car
Reservoir Chrono (to)	Induan	Reservoir litho (to)	"Red Beds"	Source Rock, chrono secondary	Callovian	Source Rock, litho secondary	Melke Fm	Seal, Litho	Spekk Fm & "Red Beds"
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0.09	Oil case (0.00-1.00)	1.00	Gas case (0.00-1.00)	0.00	Oil & Gas case (0.00-1.00)	0.00		
Reservoir (P1) (0.00-1.00)	0.80	Trap (P2) (0.00-1.00)	0.70	Charge (P3) (0.00-1.00)	0.80	Retention (P4) (0.00-1.00)	0.20		

Parametres:	Low (P90)	Base	High (P10)	*Comments*
Depth to top of prospect [m MSL] (> 0)	1819	1819	1819	
Area of closure [km^2] (> 0.0)	13.5	43.9	111.4	*Base parameters: P50 values*
Reservoir thickness [m] (> 0)	400	748	1400	
HC column in prospect [m] (> 0)	115	212	313	
Gross rock vol. [10^9 m^3] (> 0.000)	0.522	3.155	10.773	
Net / Gross [fraction] (0.00-1.00)	0.15	0.25	0.35	
Porosity [fraction] (0.00-1.00)	0.12	0.14	0.16	
Permeability [mD] (> 0.0)	5.0	10.0	100.0	
Water Saturation [fraction] (0.00-1.00)	0.45	0.35	0.25	
Bg [Rm3/Sm3] (< 1.0000)				
1/Bo [Sm3/Rm3] (< 1.00)	0.77	0.63	0.53	
GOR, free gas [Sm^3/Sm^3] (> 0)				
GOR, oil [Sm^3/Sm^3] (> 0)	300	200	100	
Recov. factor, oil main phase [fraction] (0.00-1.00)	0.10	0.20	0.40	
Recov. factor, gas ass. phase [fraction] (0.00-1.00)				
Recov. factor, gas main phase [fraction] (0.00-1.00)				
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:

Temperature, top res [°C] (>0)	70			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)	250			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.Vshale<=0,40	2.Porosity>=0,10	3.					Kart nr	NPD will insert value

The Ursa lead

The Ursa lead was originally the main prospect in this licence. It was defined as a stratigraphic trap with Upper Jurassic delta deposit reservoir, encased in Spekk Fm shales. The reprocessing of the PGS14005 survey focused on improving the trap definition for this prospect. However, even after two passes of reprocessing it proves to be very difficult to remove the persistent peg-leg multiple just below BCU. These remaining multiples make it impossible to map a trap with the necessary confidence. The geological model for the deposition of Upper Jurassic sands on top of the highly eroded Frøya High is also dependant on the presence of older fault geometries creating necessary accommodation space. The updated seismic interpretation does not support this model which makes it unlikely that the Ursa reservoir is present. It is therefore not possible to define a gross rock volume for Ursa and the prospect is hence downgraded to a lead. The remnant peg-leg multiple can easily be observed on Figure 4.3 as the red, soft seismic events that runs approximately 50 ms below the BCU.

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 the Tranmelr prospect.

6 Conclusions

The Tranmelr prospect and the Ursa lead are re-evaluated based on interpretation of the reprocessed seismic data, along with the integration of the geological and geophysical studies performed during the licence period.

The geological chance of success for the Tranmelr prospect is 9%, which is regarded too low to justify a Drill decision by the partnership. Very high risk on top and lateral seal is identified as the key risk element. Additionally, presence of a good quality reservoir is also regarded unlikely. The low permeability of the expected Triassic reservoir within the prospect leads to the application of low recovery rates in the volume calculations, giving a P90-P10 range for recoverable volumes of 9-281 mmboe.

The partnership is aligned that no more technical work can be done on the existing data to further de-risk the Tranmelr prospect.

The trap for Ursa is not mappable on the available seismic data and thus the trap is conceptual. The geological model for deposition of sand is no longer valid due to lack of accommodation space. Ursa is therefore downgraded to a lead.

No further upside potential is recognised in the licence.

Due to the low probability of geological success, combined with moderate recoverable volumes for the Tranmelr prospect, the partnership is aligned on a negative drill decision in PL 831. Hence the area is fully relinquished to the authorities.