PL706 Relinquishment Report

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1 Key Licence History

PL706 is located in the Harstad basin in the southwestern part of the Barents Sea and comprise Blocks 7016/6, 7, 8, and 9 (Fig. 1.1).

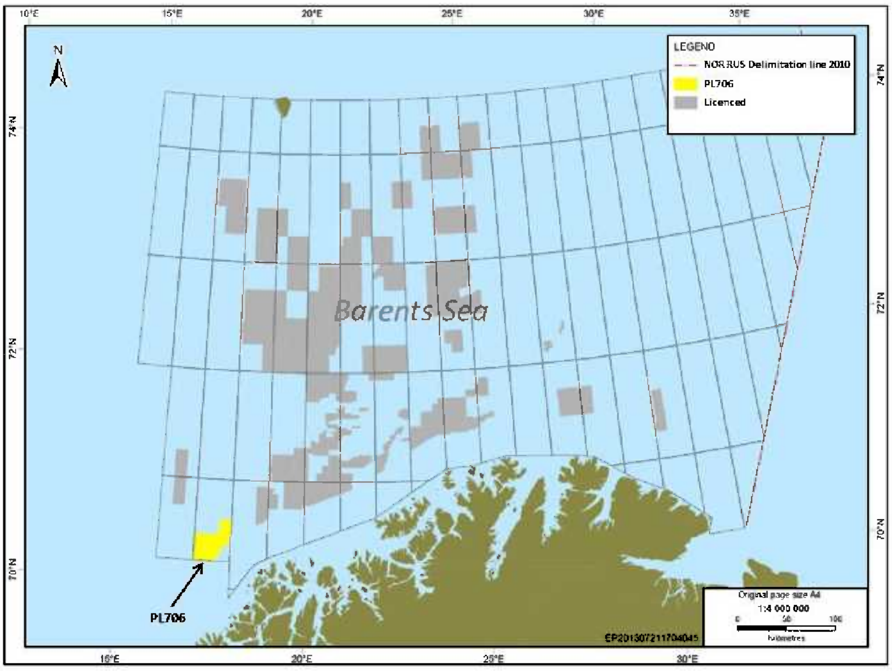

Fig. 1.1 Location map, PL706

PL706 Partnership and Work Commitment

PL706 was awarded to A/S Norske Shell (Op, 30%), BP (30%), Det Norske (20%) and Petoro AS (20%) on 21st June 2013 as part of the 22nd Licensing Round. The work program was to 1) acquire available 3D seismic, and 2) perform geological and geophysical studies within the initial two years and make a Drill or Drop decision before the license period expiry date of 21st June 2015. In the case of a drill decision, one (1) exploration well was to be drilled before 21st June 2017.

Status on Work Commitment

1) Acquire available 3D seismic: an existing 3D survey (FP12) covered most of the licence and has been purchased by all partners. To enhance the quality of the seismic it was decided to reprocess this data.

2) Perform geological and geophysical studies: to address main uncertainties a series of studies was undertaken and integrated in the evaluation of the licence. See studies overview in Table 1.1.

Table 1.1 G&G study overview

		Activities carried out to address main uncertainties						
		-Reprocessing -Reinterpretation -detailed + reliable maps -fault mapping -seismic facies & depositional history	Structural study -basin config. -BCU mapping -Timing of faults	Rock physics & QI Biostrat -QC & revised Stratigraphic intervals	Revised regional 2D interpretation SR data purchase & study Basin modelling incorporating new interpretations	Velocity model update (incl. DCAT)	CSEM feasibility & acquisition	Volcanologic screening -Sill evaluation -Heat flow modelling -CO2 presence
Uncertainties	Reservoir presence	✓	✓	✓			✓	
	Charge	✓	✓	✓	✓	✓	✓	✓
	Trap	✓	✓	✓		✓	✓	✓

In May 2015, after completing studies, the partnership unanimously agreed that a prospect of sufficient volume potential and risk profile to warrant an exploration wellbore cannot be identified in the licence. There are no remaining commitments.

Licence Meetings

Meetings have been held at a regular basis in the licence. A listing of meetings is found in the table below. Documents related to meetings can be found on Licence2Share.

Table 1.2 Meeting History

Meeting	Date
MCM/ECM #1	28 August 2013
MCM/ECM #2	29 November 2013
Work Meeting #1 (CSEM feasibility results and recommendation for survey)	21 March 2014
Work Meeting #2 (status reprocessing, DNME proposal, EM survey preparation status, budget update)	6 June 2014
MCM/ECM #3	31 October 2014
Work Meeting #3 (results G&G evaulation and agreeing way forward)	5 March 2015
MCM/ECM #4	13 May 2015

Reason for Relinquishment

The main prospect prior to the licence award was the Eiktunet prospect, characterised by a soft amplitude response in the seismic data. Several other prospects and leads were identified, see Fig. 1.2.

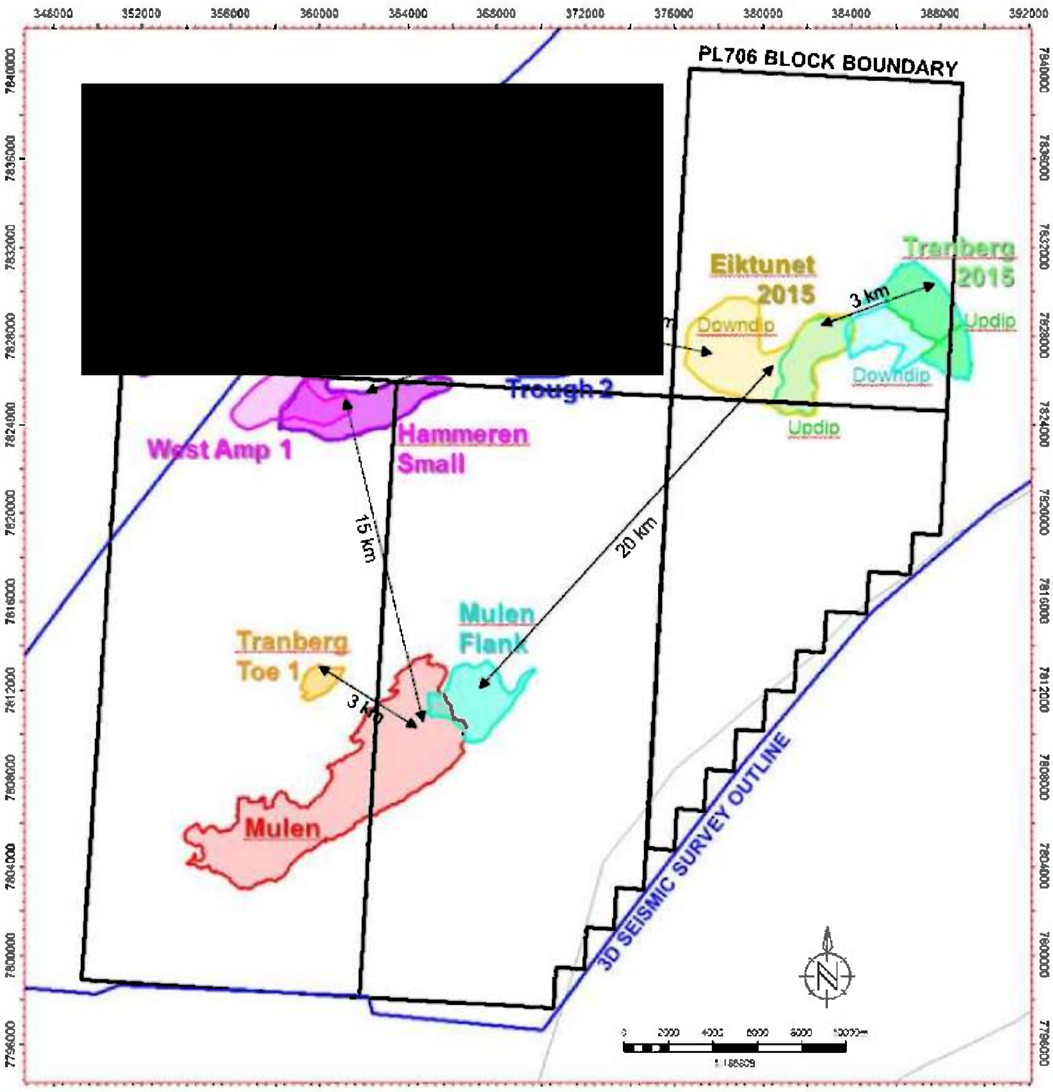

Fig. 1.2 Overview of prospects and leads

Geological and geophysical evaluations of PL706 (see short summary in Table 1.3) do not support presence of a drill-worthy opportunity in the license. A summary of the evaluations is given in table below. After source rock study the oil scenario remains high risk and give very low POS. The gas scenarios for the prospects do currently not indicate economic volumes.

Table 1.3 Technical Evaluation Overview

Name	Current Status	Outcome of Technical Evaluation
Eiktunet	Prospect	Prospect defined by seismic amplitude anomaly at the top Paleocene level, stratigraphically trapped with main risk elements related to hydrocarbon charge and retention. A hydrothermal vent penetrating the trap presents further risks related to the seal as well as non-hydrocarbon gas. The prospect is carrying a low GPOS of 4% (gas scenario) and is not seen as a drill-worthy candidate.
Tranberg	Prospect	Prospect defined by soft seismic amplitude at the base Paleocene level and amplitude shut-off across updip fault. Main risks are related to charge and retention. Hydrothermal vent penetrating reservoir layer immediately downdip of trap represents risk related to non-hydrothermal gas. It has limited volume potential and is carrying a low GPOS of 12% (gas scenario), and is not seen as a drill-worthy candidate.
Mulen	Prospect	Prospect defined by a 4-way dipping structure with a soft seismic amplitude at the base Paleocene. Main risk is related to charge and reservoir. It is interpreted to contain limited volume with a POS of 19% (gas scenario) and is not seen as a drill-worthy candidate.
Ha mmaren Small	Lead	Lead defined by a 4-way dipping sub-structure inside PL706 separated by a fault from the larger Hammaren structure located outside the PL706. The main risk is associated with quality of reservoir and is neither associated with seismic anomalies. This lead is not seen as a drill-worthy candidate
West Amp	Lead	Lead defined by a soft seismic anomaly but not conform to structure. Difficult to explain in terms of reservoir, carries limited volume and is not seen as a drill-worthy candidate

2 Database

The seismic and well database used for PL706 for prospectivity evaluation comprise regional 2D seismic data, 3D seismic data and a series of wells considered relevant for seismic ties, reservoir and rock physics properties from the western Barents Sea and the Nordland III and VI areas. In addition, a CSEM survey was acquired in the license over the Eiktunet and Tranberg prospects.

Well Database

Wells included in the common database for PL706 and used in the evaluation are listed in Table 2.1.

Table 2.1 Well database

Well name	Area	Drilled year	Type of well	Result	Water depth (m)	TD (mMD)	Age/Fm. at TD
7016/2-1	Harstad Basin	2013	Exploration	Dry	1368	4061	Late Paleocene
7019/1-1	Troms-Finnmark Fault Complex	2000	Exploration	Gas discovery	190	3003	Early Jurassic/ Tubåen Fm.
7117/9-1	Tromsø Basin/ Senja Ridge	1982	Exploration	Dry	261	3200	Early Cretaceous/ Kolmule Fm.
7117/9-2	Senja Ridge	1983	Exploration	Dry	271	5000	Early Cretaceous/ Kolmule Fm.
7119/7-1	Tromsø Basin	1983	Exploration	Dry	238	3167	Permian/ Evaporites
7216/11-1S	Sørvestsnaget Basin	2000	Exploration	Dry	361	4239	Paleocene/ Torsk Fm
7316/5-1	Vestbakken volcanic province	1992	Exploration	Gas discovery	450	4027	Late Cretaceous/ Kveite Fm.
7018/4-U-2	Troms-Finnmark Fault Complex	1990	Shallow coring	n/a	223	360	Upper Paleocene/ Torsk Fm.
7018/5-U-1	Troms-Finnmark Fault Complex	1990	Shallow coring	n/a	207	481	Late Oxfordian/ Hekkingen Fm.
7018/5-U-2	Troms-Finnmark Fault Complex	1990	Shallow coring	n/a	225	523	Bathonian/ Fuglen Fm.
7018/5-U-6	Troms-Finnmark Fault Complex	1990	Shallow coring	n/a	230	476	Toarcian/ Stø Fm.
7018/7-U-1	Troms-Finnmark Fault Complex	1990	Shallow coring	n/a	189	429	Late Barremian
Wells below added to database for inclusion in seismic QI study:							
6610/3-1	Grønøy High - Træna Basin	1992	Exploration	Dry	309	3126	Late Cretaceous
6610/3-1R	Grønøy High - Træna Basin	1996	Exploration	Dry	309	4200	Late Triassic
6610/2-1S	Grønøy High - Træna Basin	1996	Exploration	Dry	406	2673	Triassic
6710/10-1	Træna Basin	2000	Exploration	Dry	329	2267	Late Cretaceous
7122/7-3	Hammerfest Basin	2005	Exploration	Oil/Gas discovery	343	2726	Permian

Seismic Database

The PL706 seismic database is shown in Fig. 2.1.

PL 706 - 2D_3D_Seismic Database

2D Seismic Database	
Survey	Line
NBR11	215100
NBR11	310500
NBR11	311700
NBR11	431765
NBR11	313800
NBR11	315500
NBR11	317000
NBR11	437646
NH97RE08	The entire survey
3D Seismic Database	
FP12	
NA94	

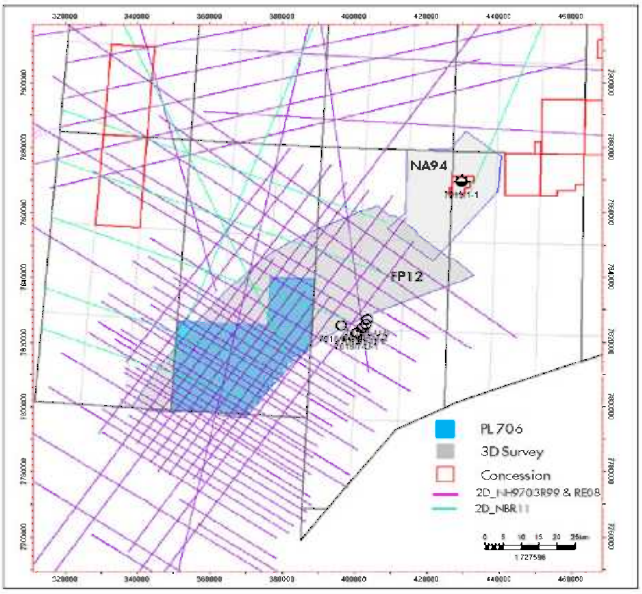

Fig. 2.1 Seismic database

Non-seismic data

EM feasibility modelling (Electromagnetic) was performed over the Eiktunet and Tranberg opportunities. Modelling demonstrated that these prospects should be detectable with EM and subsequently a CSEM survey was recommended and carried out in 2014.

External studies and reports

The East Greenland Sampling 2011 & 2012 (VBPR & TGS) was made a part of the common database in order to make available recent data on reservoir and source rocks from otherwise undrilled areas close to PL706 area (in the pre-breakup phase).

The partnership agreed to join the VMAPP project (Volcanic Margin Petroleum Prospectivity) carried out by VBPR (Volcanic Basin Petroleum Research, located in Oslo and headed by Sverre Planke). Through this project the partnership had access to core modules on a variety of volcanic related topics as well as consultancy. In addition the partnership could provide steer on timing of the research that was particularly relevant to PL706 like heat flow modelling, vent complex characteristics, potential for non-hydrocarbon gas and geometry of sill complex.

3 Review of Geological Framework

Regional mapping

2D interpretation was carried out to provide a more thorough framework for basin evolution and stratigraphy as input to a semi-regional basin model, and provide well ties into the FP12 3D data set. Key wells for tie were 7016/2-1 T2, 7019/1-1, 7117/9-1 in addition to the shallow IKU cores in block 7018 area. The interpretation of the deeper horizons carries quite some uncertainty hence two interpretation scenarios were used in the basin modelling. The new 2D interpretation in addition to using the reprocessed FP12 3D survey resulted in a better and more confident delineation of the deep seated high to the west in the PL706 in the area of the Hammaren lead (in this report informally called Hammaren High).

Structural Setting

PL706 is located in the Harstad Basin at the intersection of the Lofoten-Vesterålen Passive Margin and the Western Barents Sea Transform Margin. Prior to Early Eocene continental break-up of the northeastern Norwegian-Greenland Sea and the western Barents Sea formed a coherent geological province that was subject to episodic continental rifting. The break-up was associated with magmatism manifested locally by sills.

The PL706 area is characterised by southwesterly dipping strata in the northeast and a more centrally located graben area, bounded by the Troms-Finnmark Fault Complex (TFFC) to the east and the Hammaren high to the west. The licence area being close to the Continent-Ocean Boundary, has been subjected to a large magmatic intrusion (380 km2) located mainly within the Cretaceous strata.

A study was made to improve the understanding of the structural configuration and development of the PL706 area as well as the impact on sedimentary systems in the Upper Cretaceous and Lower Paleogene. See Fig. 3.1 for an overview map with fault generations. Late Jurassic faulting is distributed and segmented in two domains. The D1 domain is characterised by steep boundary fault along the TFFC and small scale fault blocks in the hanging wall whereas the D2 domain has a larger scale horst and graben in the hanging wall. During the Late Cretaceous to Early Paleocene the area is subjected to transtensional and transpressional deformation (leading to local anticlinal forms like the one in Mulen prospect). Domain D1 is in this interval characterised by small wavelength, east-verging half grabens that deepen southwestwards and Domain D2 with larger wavelenght, west-verging half grabens. Latest Paleocene to Eocene time the deformation is related to break-up, first order deformation is stepping westwards and shortening is contemporaneous with extensional faulting.

The E-W section shown in Fig. 3.2 shows some of the prospects and leads in relation to the eastern basin-boundary fault (TFFC) and the "Hammaren High" to the west. The large scale configuration of the PL706 part of the Hammerfest Basin is largely controlled by older structural grain. Reactivation during Cretaceous and Paleogene maintained the graben structure west of the boundary fault (TFFC). Smaller scale structuration especially during Early Paleocene affected sedimentary systems within the graben area, evident by thinning of the lower Paleocene sequence over horsts and thickening in grabens (see Fig. 3.6). There is a correlation between the lows and brighter amplitudes which suggests a lithological difference between the lows and highs.

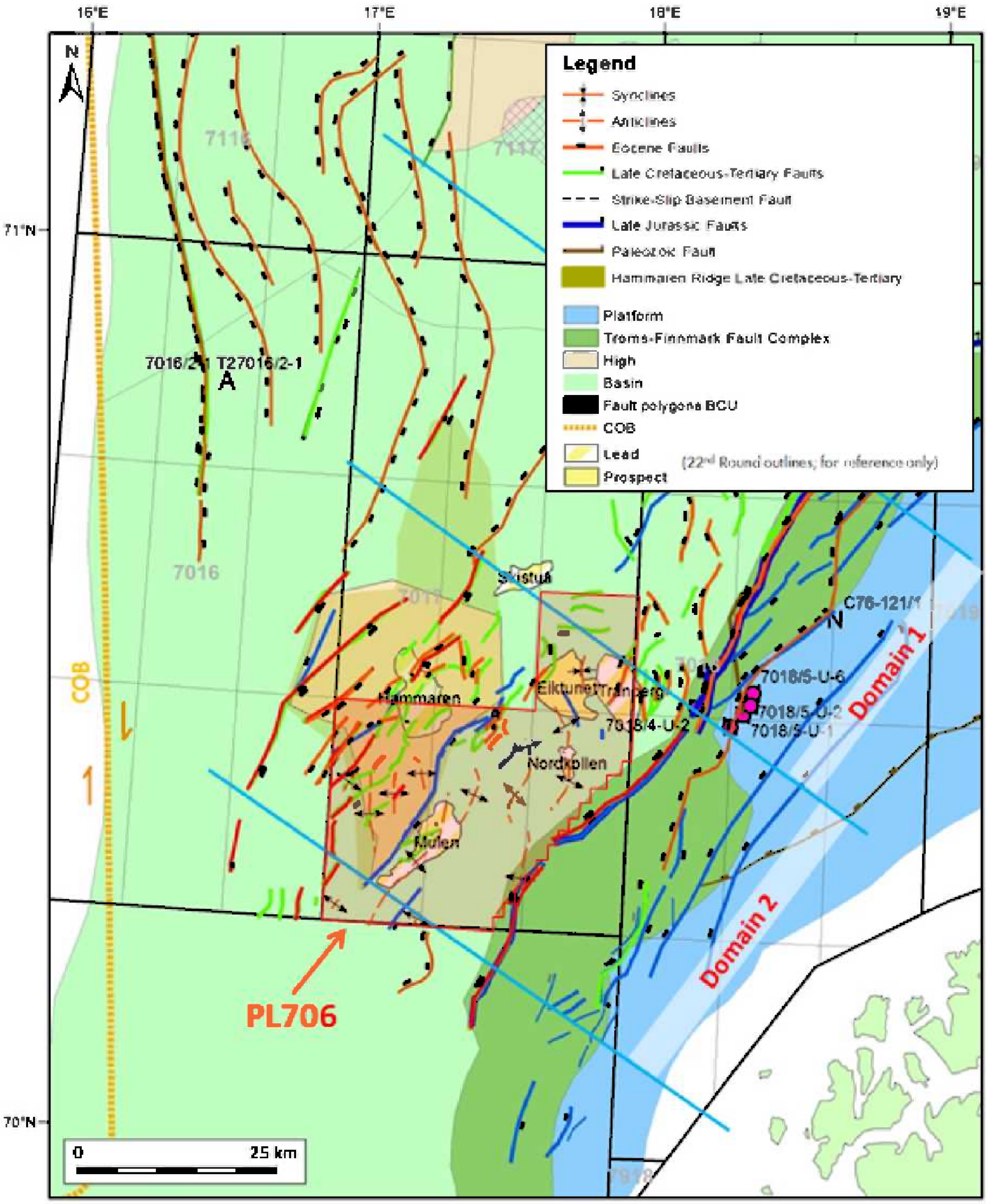

Fig. 3.1 Structural overview indicating age of faults

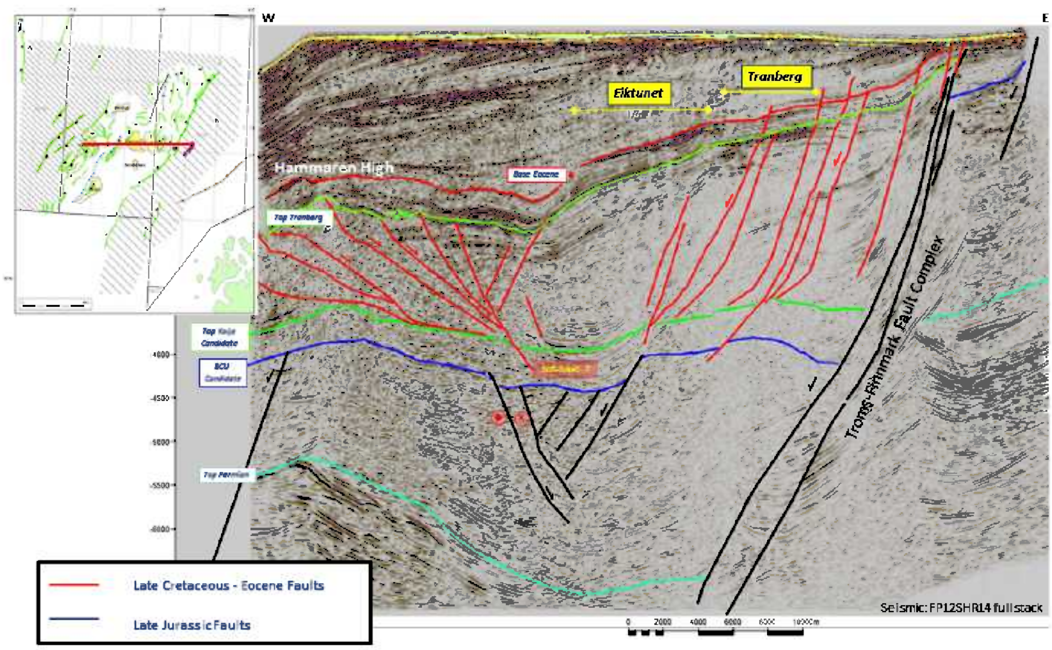

Fig. 3.2 Seismic section

The Cretaceous-Eocene fault generation providing possible migration paths from deep source rocks

Volcanological aspects

The proximity of PL706 to Continent-Ocean Boundary and the presence of a sill-complex with associated hydrothermal vents, warranted a closer look at the effects these may have on the prospectivity (Fig. 3.3). Of particular importance was heatflow due to rifting and sill presence, the sill-complex geometry as well as possible CO2 generation. The partnership agreed to join the VMAPP project to better address these aspects. The relatively large intrusive complex is likely originating from underplating which is not identified on current seismic.

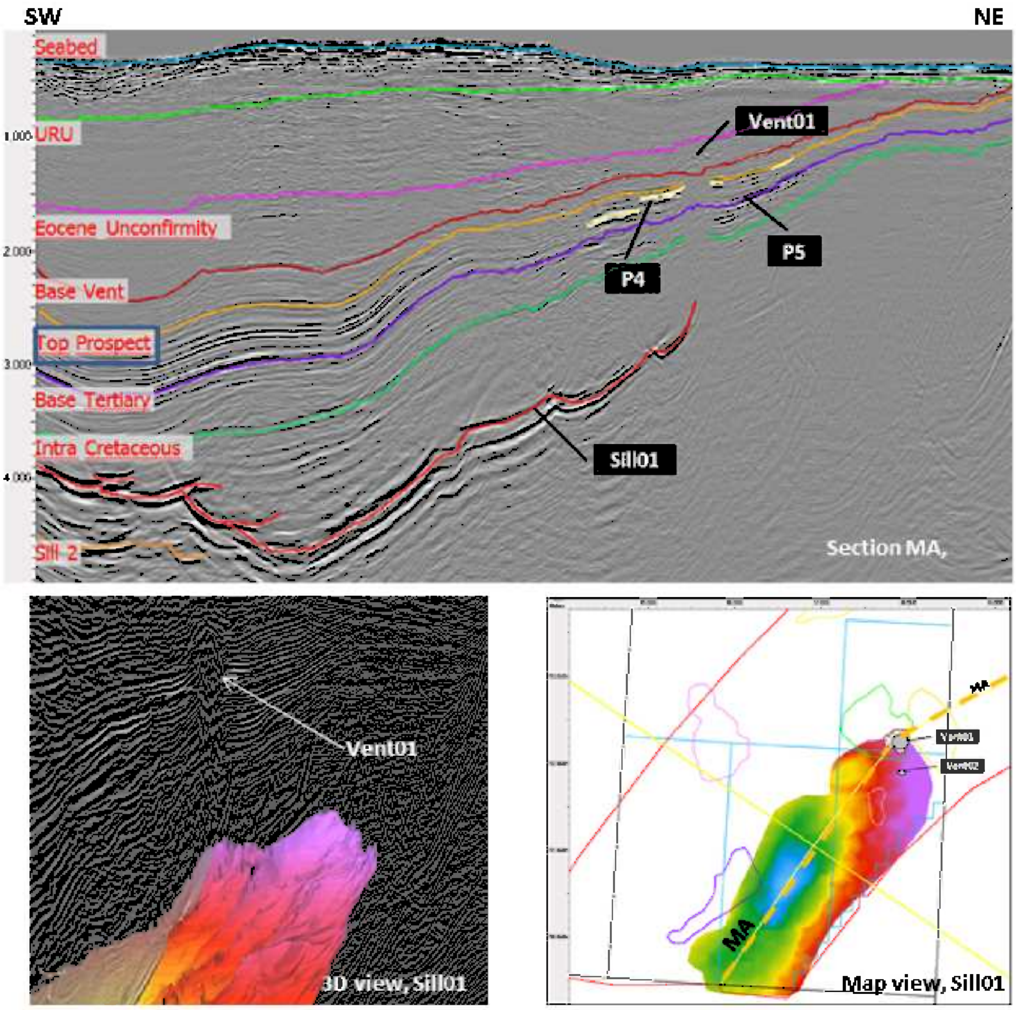

Fig. 3.3 Location of main sill and vents

P4 and P5 on seismic section represent amplitude anomalies in Eiktunet and Tranberg prospects. Location of 22nd. round prospect outlines for reference in map view. Note location of vents in relation to sill shape and location of Eiktunet and Tranberg.

-Both a narrow and wide scenario for underplating was included in the basin model to test the effect on heatflow and HC generation. Heatflow models using different software/ algorithms were used for verification.

-The sill itself can become fractured and constitute a migration pathway for hydrocarbons. The sill can also induce fractures in the surrounding rock. The shape of the sill can therefore focus migration towards particular areas, and this has been consider in PL706.

-High concentration of CO_2 was found in neighbouring well 7019/1-1 and this was considered a risk also in PL706. A large part of the CO_2 in this well has heavy carbon isotopes that is associated with magma/mantle degassing and is attributed to the wells proximity to a deep basin rooted fault system. In PL706, a prospect by prospect consideration has to be made on consideration for CO_2 presence. Anomalous concentrations of CO_2 can also originate from sill intrusion into coals or carbonates, however significant volumes of these lithologies are considered less likely in the Lower Cretaceous sediments into which the sills were emplaced in PL706.

Basin development and reservoirs

The main depocentre in PL706 is the graben structure running sub-parallel to the Troms-Finnmark Fault Complex (TFFC). This graben has likely been a long lived feature and is seen on maps from several levels (e.g. Fig. 3.4).

Fig. 3.4 Basin configuration

Top Kolmule depth map with two interpreted fan systems separated by the Hammaren High. The blue dashed line is outlining a possible fan system developed towards the west. The white dashed line outlines a fan system developed mainly in the graben structure between Hammaren High and the Troms-Finnmark Fault Complex.

The main sediment input is thought to have come from the northeast via two distinct elongated depressions, forming slope and basin floor fan complexes in a deep marine setting (see Fig. 3.5). Probable secondary influx has been line fed flows from the Finnmark Platform along the TFFC. A more westerly oriented depression is identified just north of PL706 and was possibly a conduit for sediments into another part of the Harstad Basin to the west. The gross outlines of the two feeder & fan systems are based on seismic character within structural low-lying areas. Seismic character suggests a layered lower Paleocene sequence with alternations of sandstone and claystone. The upper Paleocene is interpreted as overall mudprone. The layered lower Paleocene is thinner or absent over highs, like the Hammaren High. Fig. 3.6 illustrates the depositional model for early Paleocene with a cross section showing structuration and sediment fill at end Eocene time.

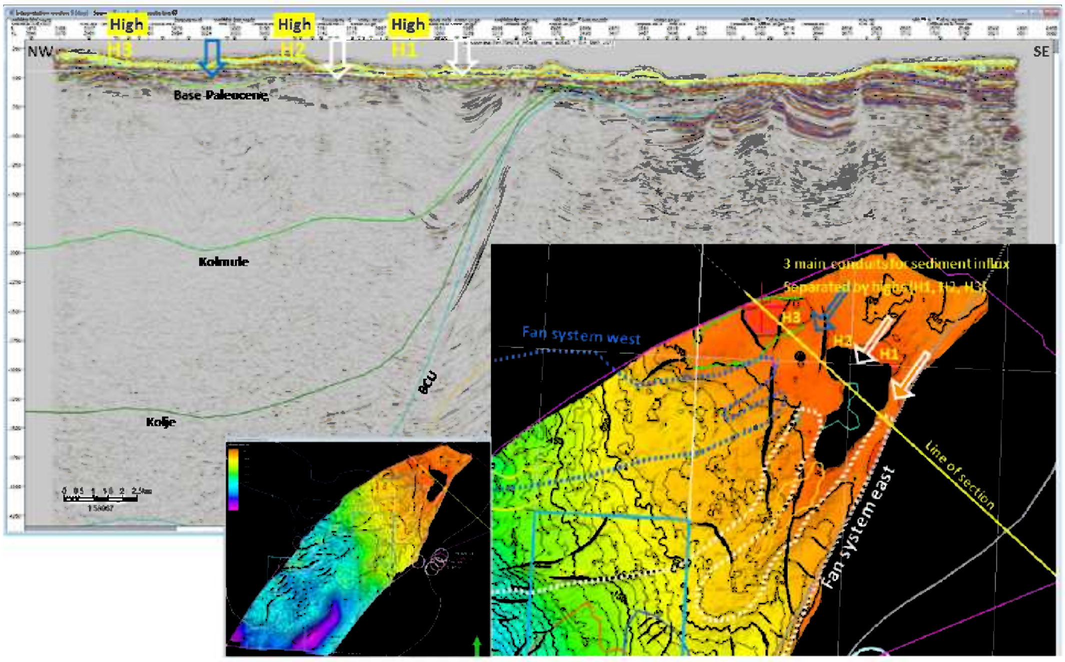

Fig. 3.5 Main sediment entry points

Maps showing Base Paleocene depth with arrows indicating conduits for sediment infux into possible western and eastern fan systems

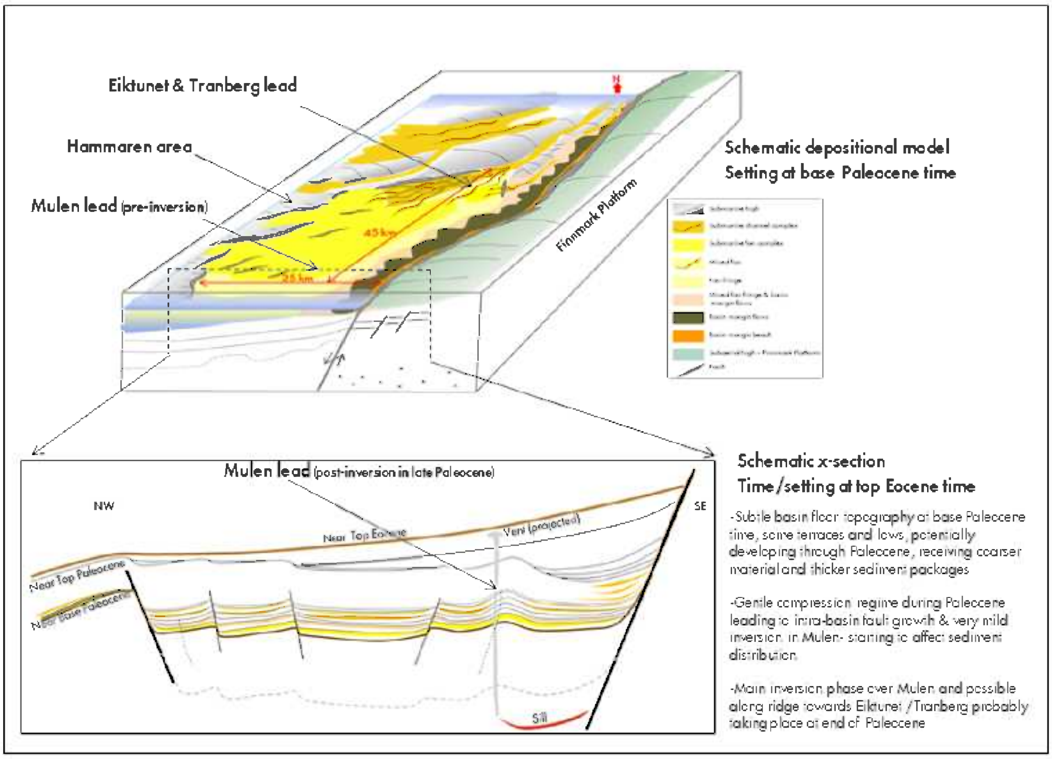

Fig. 3.6 Basin configuration and depositional model

Source rocks

Interpretation made for the 22nd Round showed the Upper Jurassic with its regional prolific source rock, Hekkingen Fm., to be deeply buried and overmature for oil and likely also for gas. The interpretation of the deep horizons (Permian, Jurassic, Lower Cretaceous) were associated with quite some uncertainty due to the long distance to calibration points. Reinterpretation of these horizons were done as part of evaluation of PL706, however the BCU remains quite deep in the base case and also in an alternative shallower interpretation. Hence the Hekkingen Fm. is likely over-mature for oil generation in areas with drainage to the PL706 prospects and leads.

It was therefore important to revisit the source rock potential of the Cretaceous interval and a study was undertaken to look in detail at results from particularly the recent East Greenland Sampling, as well as shallow IKU wells immediately east of PL706, the Barents Sea and Mid Norway. A possible Knurr-Kolje source rock, which is generally lean and with gas-generative potential, has been included in the basin model scenarios. Even if the Knurr-Kolje source had potential for oil generation it seems to be too deep in much of the fetch area for PL706 traps.

Charge model

Alternative basin models were made to test variables like deep vs shallow BCU and Kolje Fm., degree of underplating, sill thickness, source rock presence and up-dip faulting in stratigraphic traps. For a Hekkingen and Kolje source rock, oil expulsion and most of the gas, would occur too early for an effective seal to have formed. The chance of finding oil in the identified PL706 opportunities remains very low (Fig. 3.7). Fig. 4.3 and Fig. 4.5 shows sections with oil and gas windows and possible migration routes into the PL706 traps.

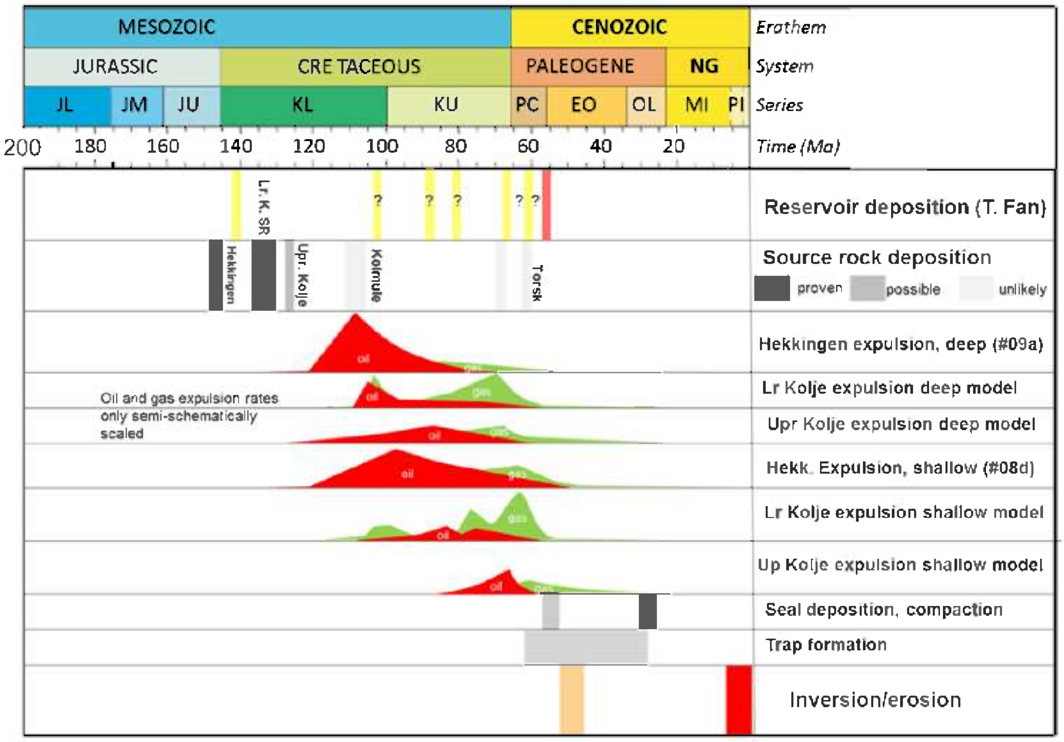

Fig. 3.7 Petroleum system

HC expulsion in different scenarios

4 Prospect Update

The main opportunities in the PL706 area has been the Eiktunet and Tranberg strat. & fault traps in the northeast and the Mulen inversion structure in the southwest of the licence. Several other amplitude based leads were investigated but discarded primarily due to size (and these were also associated with high risk) A summary of the respective volumes and risk are presented in Table 4.1, see Fig. 1.2 for location map.

Table 4.1 Volumes and risk for main prospect (gas scenario)

Prospect	Volume, BCM Recoverable (P90-P50-P10)	POS (gas)
Eiktunet	1.1 - 3.2 - 8.5	4 %
Tranberg	1.4 - 3.6 - 7.7	12 %
Mulen	1.6 - 13 - 43	19 %

Eiktunet and Tranberg prospects

The Eiktunet prospect is defined by soft amplitude anomalies on one, occasionally two seismic loops just below the top Paleocene horizon (Fig. 4.1). The trap is bounded in part by small faults but seems to require a large stratigraphic trapping element.

The Tranberg prospect is defined by one soft amplitude anomaly at base Paleocene level, potentially coupled with somewhat less bright anomalies on reflectors immediately below the top anomaly. There is an amplitude shut-off across a fault that bound the prospect to the SE. A small part of the up-dip shut-off has no seismically clear fault and a stratigraphic sealing element may be required for the trap (Fig. 4.2).

An EM feasibility study showed that both Eiktunet and Tranberg should be detectable in an hydrocarbon fill scenario and a survey was acquired in the summer of 2014. The [redacted] Reprocessing of the FP12 survey allowed a better definition of the trap and internal configuration of amplitude anomalies. The new interpretation with the addition of detailed AvO analysis resulted in a smaller lateral extent of a possible HC filled traps for both Eiktunet and Tranberg. The revised interpretations for the two traps were demonstrated to be [redacted]

Reservoir

The reservoir in Eiktunet and Tranberg are interpreted to be deep water fan complexes. The location of Eiktunet and Tranberg is close to the exit points of mapped conduits for sediments into the basin (see Fig. 3.6 for conceptual depositional model). Some of the amplitude anomalies here may in part be a lithological effects. Similarly the observed increased amplitudes in minor throughs further out in the graben are probably also lithology effects.

Charge

The formation of an effective seal to the Eiktunet and Tranberg traps was too late to trap the Hekkingen oil charge. Charging of gas could be possible if a Knurr-Kolje source rock or a lean Kolmule interval is present (Fig. 4.3) . Additional risk in this area are the effects of the underlying sill and the hydrothermal vents. One prominent hydrothermal vent penetrates the updip part of the Eiktunet trap. This vent is also immediately downdip of the Tranberg lead. There are several possible implications of this vent, 1) it can be a migration path-way for hydrocarbons into the Eiktunet and Tranberg traps, 2) it can have have destroyed the top seal of Eiktunet and formed a leak path out of this trap 3) it can have been a migration path into Eiktunet and Tranberg for non-hydrocarbon gas associated with the sill.

Seal

Eiktunet relies to a large extent on up-dip and lateral stratigraphic seal. Small faults are playing a part locally, the brightest amplitude patch in Eiktunet is bounded updip by such a small fault. The overall long-distance stratigraphic sealing element required for the larger trap to work makes lateral/up-dip seal at high risk.

Tranberg has well defined faults that could form a seal along most of the updip boundary, however there are areas where no fault throw can be identified, possible in part due to quality of the seismic. Hence the seal element is difficult to define all along the trap boundary and a stratigraphic seal component may have to be in place for the trap to work.

Top seal is represented by intraformational Paleocene and Eocene claystones. As mentioned the hydrothermal vent penetrating the Eiktunet trap may connect the reservoir to possible younger thief sands.

QI and Geophysics

A rock physics study using 13 relevant wells to the PL706 area was carried out. This formed part of the input to a quantitative rock & fluid prediction seismic study done to increase the understanding of the amplitude anomalies and aid the de-risking. Distance to well calibration and general lack of sandstone in wells suggest limited confidence.

The study suggests soft events within the leads are related to poor quality sandstone with likely presence of hydrocarbons. The brightest soft amplitudes are found up dip within the leads and display brightening with offset. A scenario with oil leg could be possible. Good conformance to structure is not observed and low saturation gas or CO_2 cannot be distinguished. Reference is made to comprehensive material presented in EC meetings and available on L2S.

Key Risks and Uncertainties

The main risks for Eiktunet and Tranberg is charge and seal.

Based on the updated evaluations of Eiktunet and Tranberg the chance for oil remains very low and the volume estimates have been reduced.

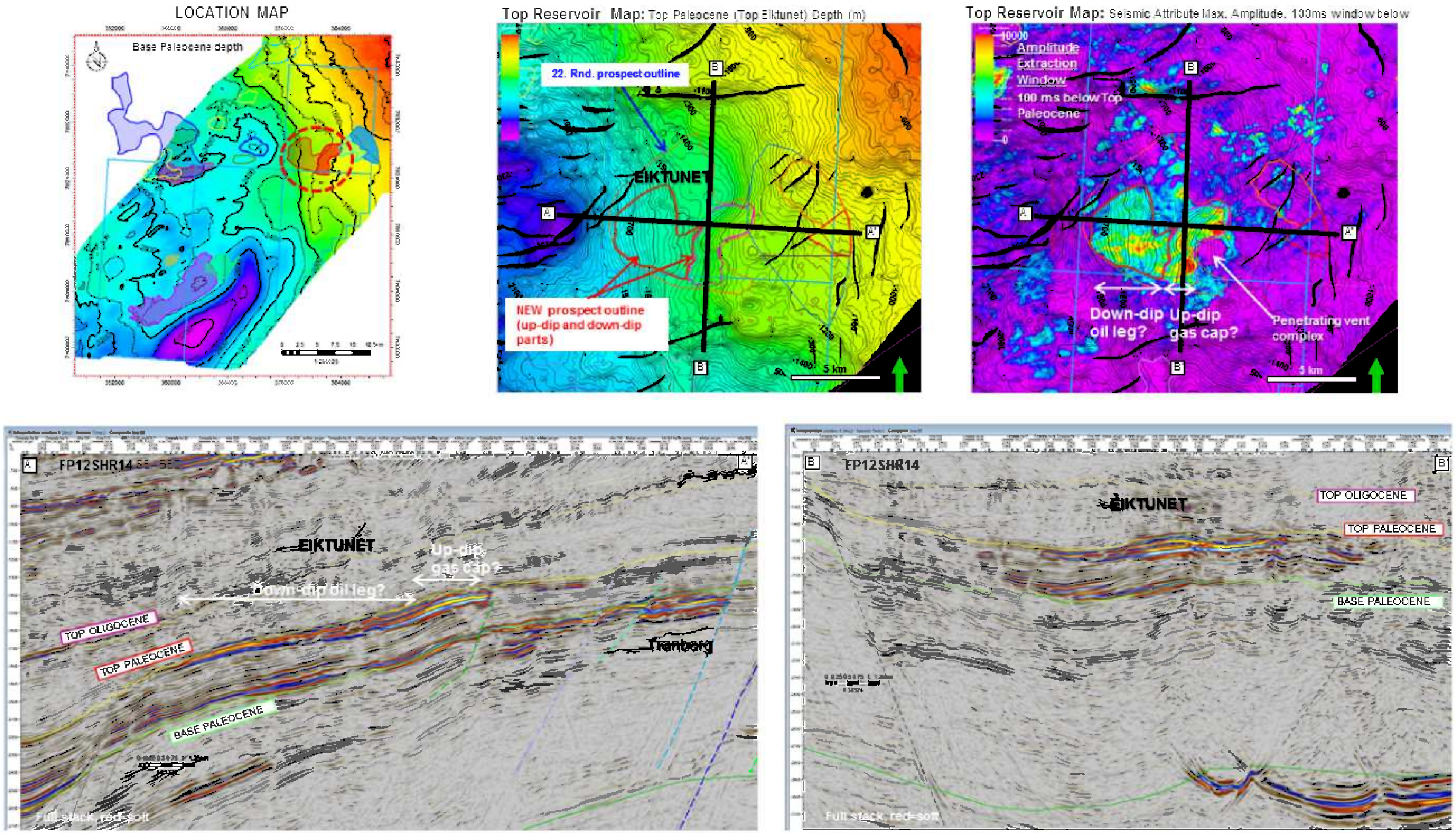

Fig. 4.1 Eiktunet

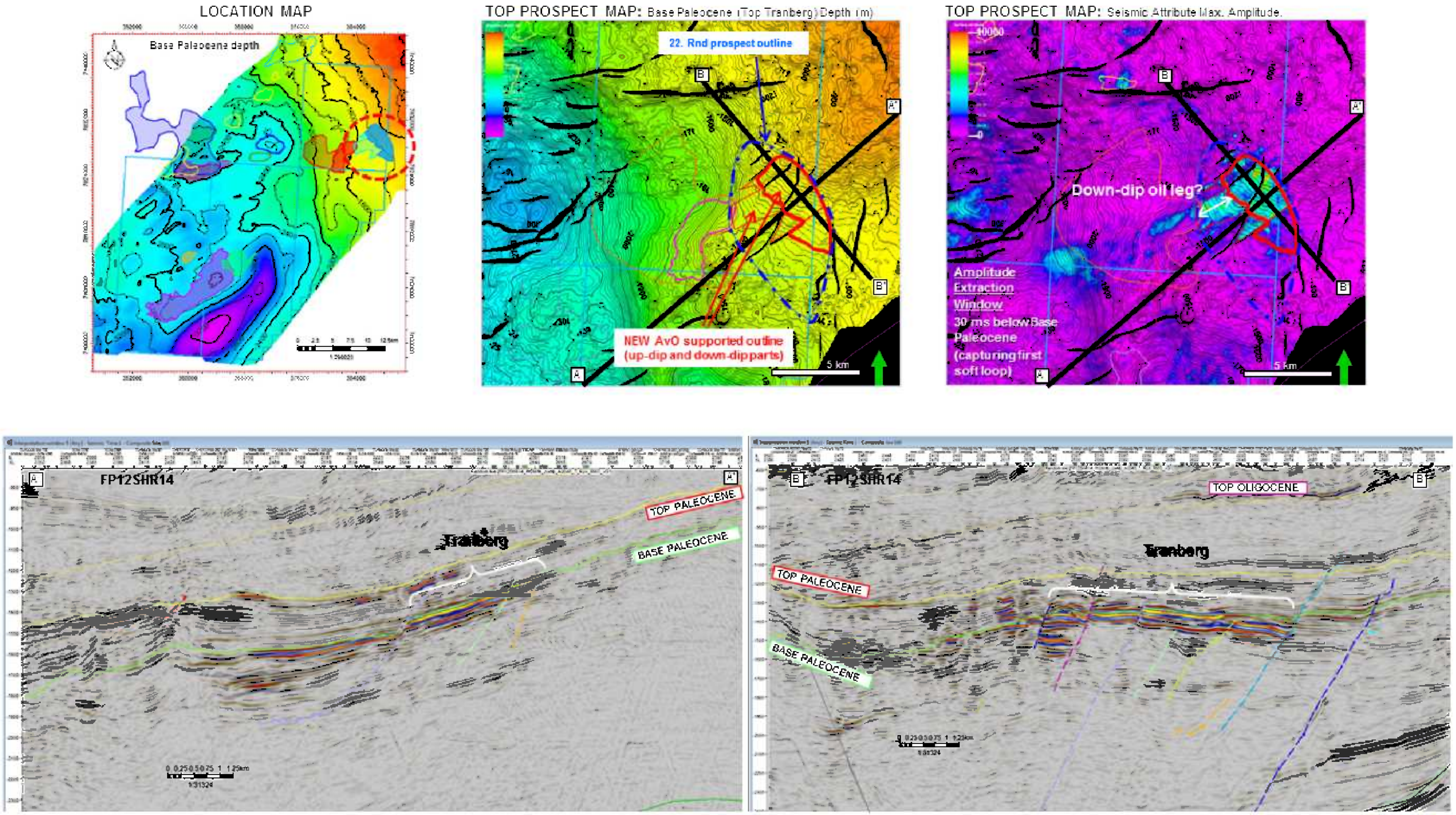

Fig. 4.2 Tranberg

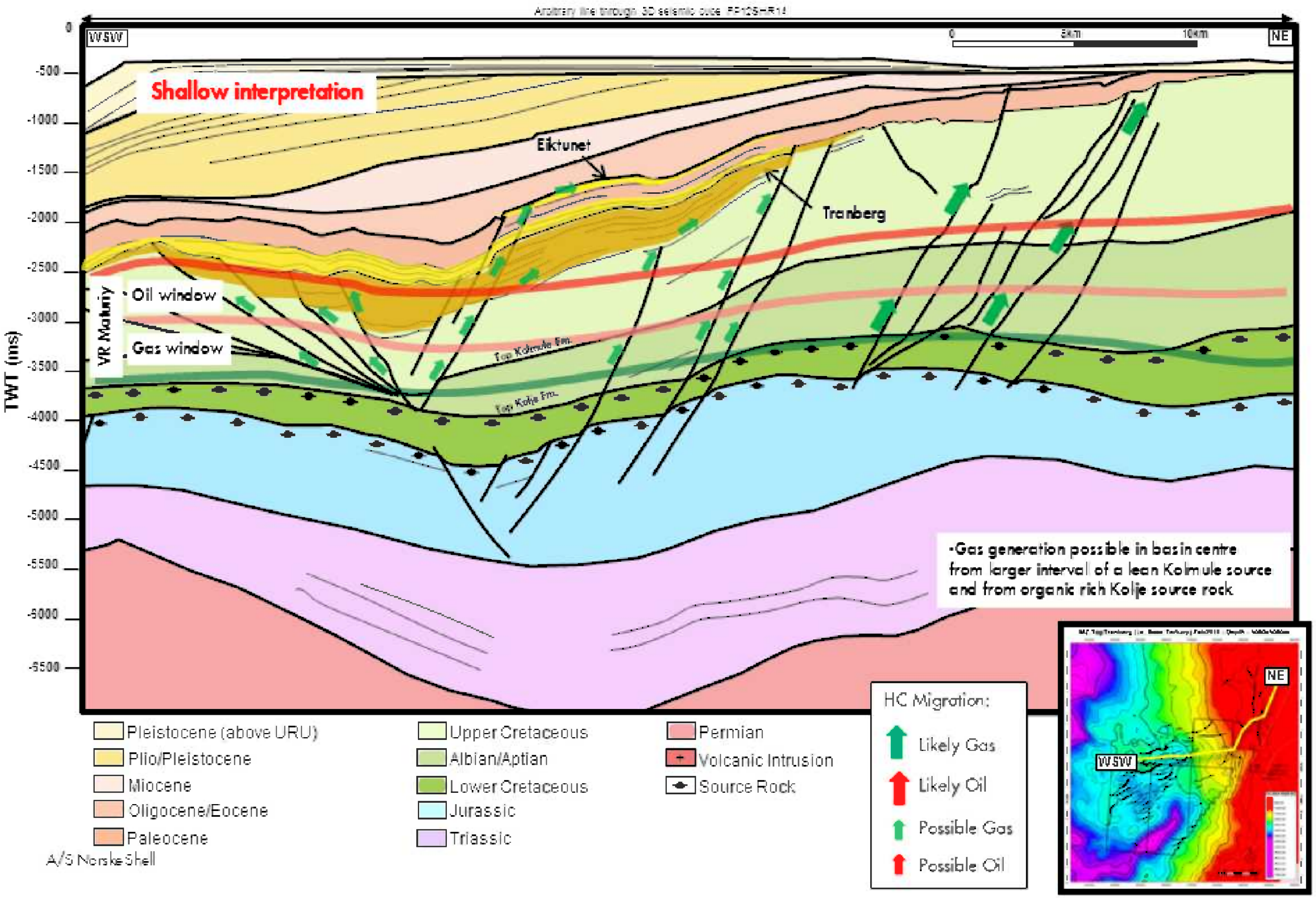

Fig. 4.3 Geosection

This figure shows the shallow interpretation of the BCU and Top Kolje. A possible Kolje source rock is only in the gas window updip of Tranberg, outside the licence boundary. Need to rely on speculative lean Kolmule source for charge.

Mulen prospect

The Mulen prospect is an inversion structure located in the southwestern part of PL706 and was initially considered to have potential for an interesting trap volume. It is mapped as a 4-way dipping structure on the base and top Paleocene level but a large part of the structure, especially the southwestern part, is suffering from poor seismic (see seismic sections in Fig. 4.4). Reservoir is believed to be represented by basin-floor fan complexes at the base of the Paleocene. Gas charge could be possible if presence of a Kolje source rock. Oil is considered less likey, see Fig. 4.5.

Two spillpoints are observed for the Mulen structure. The shallowest spillpoint (2845m) that is used for the base case volumetric estimate is represented by a saddle located in poor seismic area to the southwest, and is therefore uncertain. Another deeper structural saddle in the northeast in an area of good seismic quality, provide a spillpoint at 2880m. The soft loop that represents the Tranberg reservoir can be traced to Mulen and in the northeast of Mulen it is clearly identified some way up the flank of the structure above the 2880 m stuctural spillpoint, before the seismic quality deteriorates. The seismic QI work suggests that a hydrocarbon contact if present should be visible on seismic here. The amplitude is however of low magnitude and with flat AvO implying water-bearing reservoir. This same loop is very bright in a small patch below the structural spillpoints and could represent variation in lithology possibly with residual gas. A volume scenario was made where the downdip part of the bright patch represented a possible deeper contact of the Mulen structure at 3010m. The volume potential in this scenario had the potential to be attractive, however the POS is very low (5%) as it would require stratigraphic trapping.

The base case volume scenario (reported in Table 4.4) has the shallow spillpoint (2845m) as P50 contact but includes the deep possibility of the bright amplitude patch (3010m) as the P10 contact. Furthermore, in the base case scenario the P50 HC-bearing reservoir thickness is taken as a one seismic loop thickness, 30 m, with a two loop scenario of 60m as the P10 thickness. This scenario constrained by the structural spillpoint has higher POS (19%) but contains a volume that is regarded as too small for economic development.

Main risk for Mulen is considered to be charge and presence of reservoir.

Prospect parameters are summarised in NPD format in the following tables:Table 4.2 , Table 4.3 and Table 4.4.

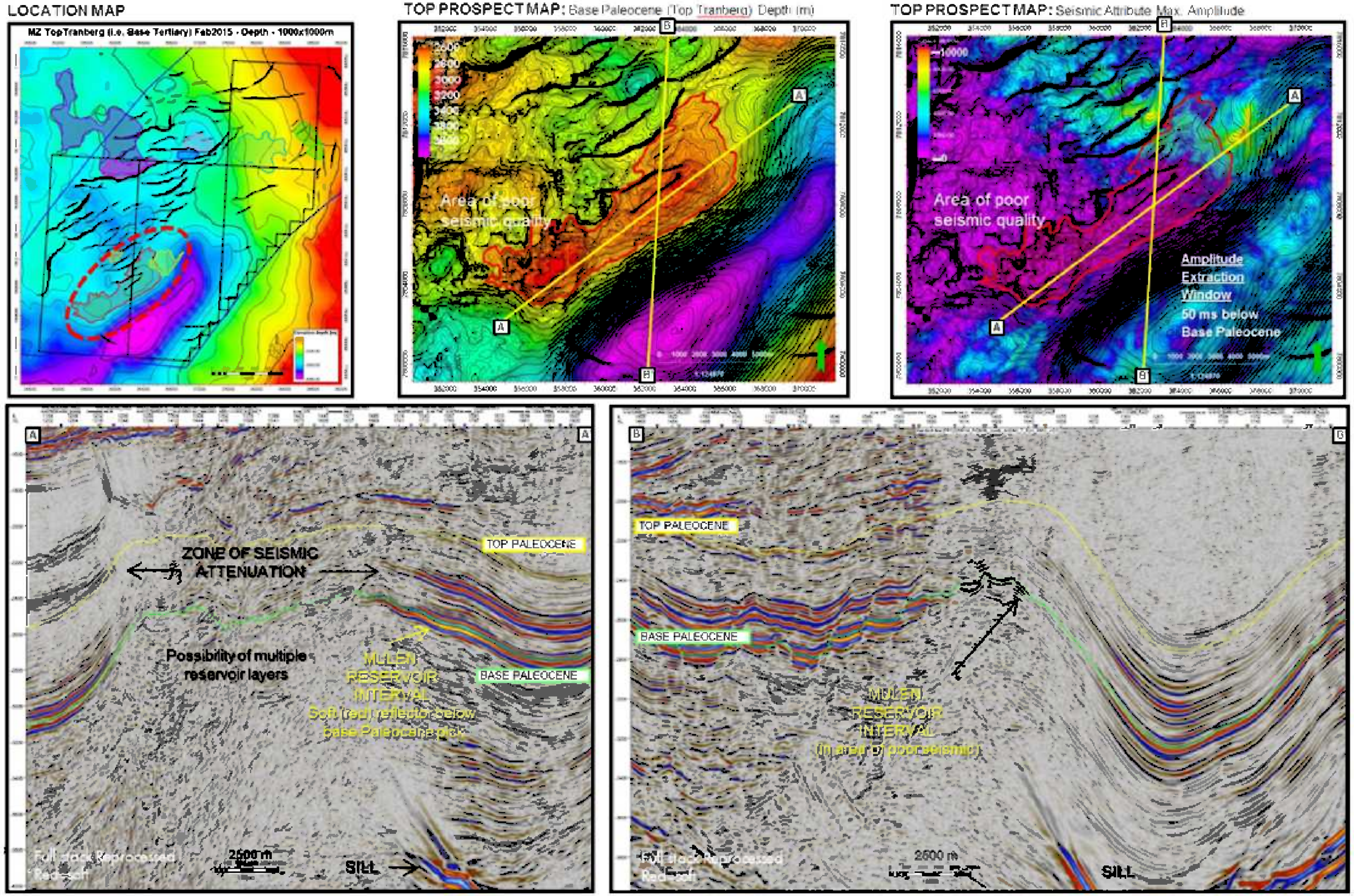
LOCATION MAP
TOP PROSPECT MAP: Base Paleocene (Top Tranberg) Depth (m)
TOP PROSPECT MAP: Seismic Attribute Max. Amplitude
Area of poor seismic quality
Area of poor seismic quality
Amplitude Extraction Window 50 ms below Base Paleocene
ZONE OF SEISMIC ATTENUATION
TOP PALEOCENE
Possibility of multiple reservoir layers
MULEN RESERVOIR INTERVAL
Soft (red) reflector below base Paleocene pick
BASE PALEOCENE
SILL
TOP PALEOCENE
BASE PALEOCENE
MULEN RESERVOIR INTERVAL
(in area of poor seismic)
SILL

Fig. 4.4 Mulen

-Phase: Likely gas if HC present
-Gas generation possible w/migration along basin margin faults and via sill related features and Mulen related Faults. Potentially need to rely on lean source in Kolmule Fm. In «warm» model, less likely gas presence.

-Possible oil if Type II SR present in Kolje Fm, which however is not present in oil window in basin in this scenario
-Oil generation probable along terrace east of basin margin in the south), migration possible along terrace towards NE.
-Unlikely oil migration westwards across syncline towards Mulen

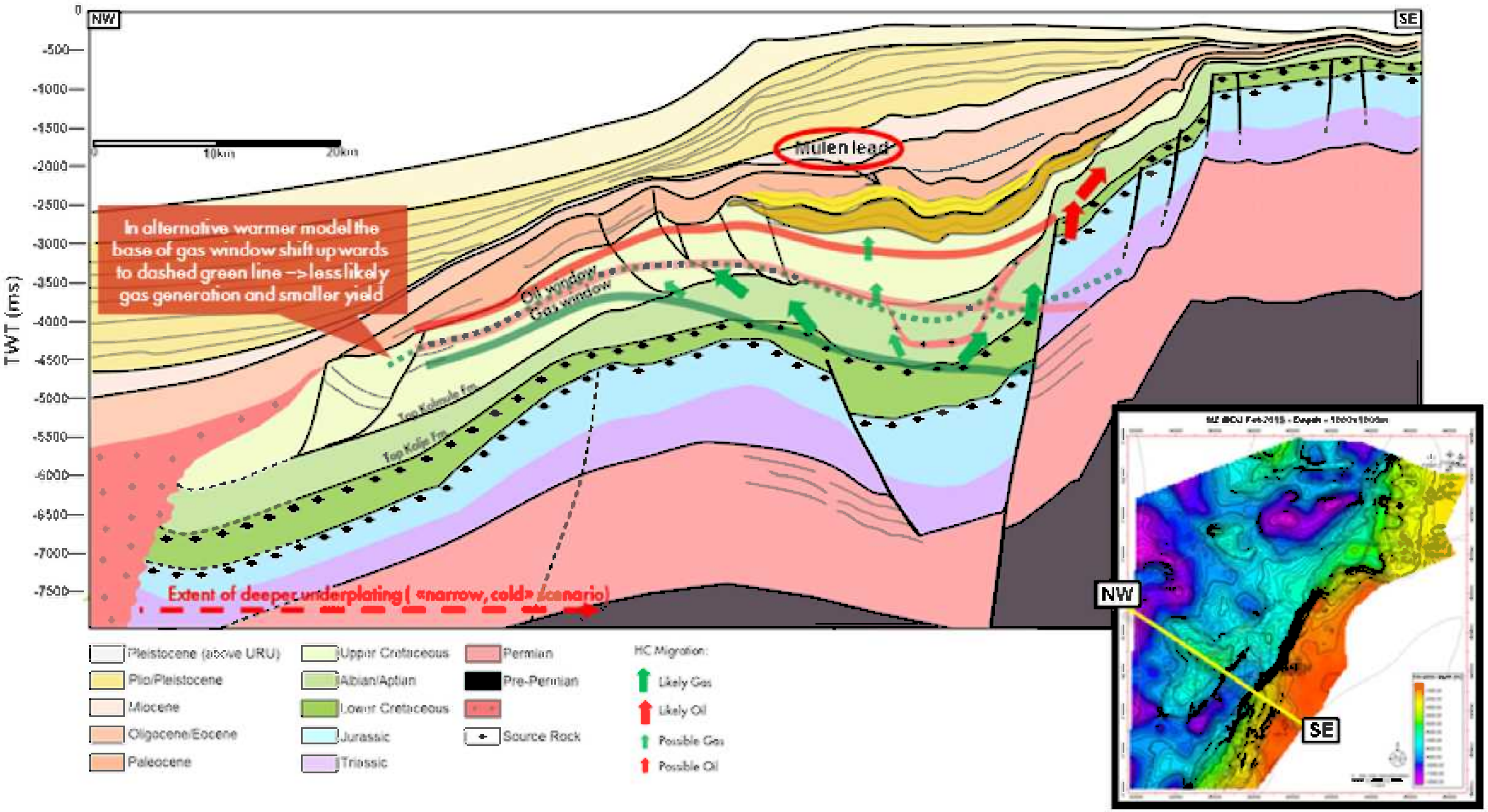

Fig. 4.5 Mulen

Note the upwards shift of oil and gas windows (green dashed line) in the case of a "warm" model which contains a more likely wider underplating.

Table 4.2 Eiktunet, NPD prospect table

Block	7017/6 & 7017/9	Prospect name	Eiktunet	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:	Gas	Reported by company	Shell	Reference document	22nd Licensing Round application			Assessment year	2015
This is case no.:	1 of 1	Structural element	Harstad Basin	Type of trap	Stratigraphic	Water depth [m MSL] (>0)	280	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)								
	Gas [10^9 Sm^3] (>0.00)	1.80	4.80	6.40	12.50				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)								
	Gas [10^9 Sm^3] (>0.00)	1.10	3.20	4.20	8.50				
Reservoir Chrono (from)	Paleocene	Reservoir litho (from)	Torsk	Source Rock, chrono primary	Albian	Source Rock, litho primary	Kolmule	Seal, Chrono	Oligocene
Reservoir Chrono (to)	Paleocene	Reservoir litho (to)	Torsk	Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Torsk
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0.04	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.50	Trap (P2) (0.00-1.00)	0.90	Charge (P3) (0.00-1.00)	0.48	Retention (P4) (0.00-1.00)	0.20		
Parametres:	Low (P90)	Base	High (P10)	*Comments:*					
Depth to top of prospect [m MSL] (> 0)		1250		*Numbers reported in column for Base Case (for Parameters and Volumes,mode) are P50 values.*					
Area of closure [km^2] (> 0.0)	3.7	8.6	20.5						
Reservoir thickness [m] (> 0)	20	27	35						
HC column in prospect [m] (> 0)	150	250	500						
Gross rock vol. [10^9 m^3] (> 0.000)	0.085	0.221	0.543						
Net / Gross [fraction] (0.00-1.00)	0.50	0.75	0.90						
Porosity [fraction] (0.00-1.00)	0.23	0.28	0.33						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0.30	0.20	0.10						
Bg [Rm3/Sm3] (< 1.0000)	0.0081	0.0071	0.0061						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)									
Recov. factor, gas ass. phase [fraction] (0.00-1.00)									
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.45	0.70	0.85						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)	43			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)	132			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	2	3					Kart nr	NPD will insert value

Table 4.3 Tranberg, NPD prospect table

Block	7017/6	Prospect name	Tranberg	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:	Gas	Reported by company	Shell	Reference document	22nd Licensing Round application			Assessment year	2015
This is case no.:	1 of 1	Structural element	Harstad Basin	Type of trap	Dip- Fault	Water depth [m MSL] (>0)	280	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)								
	Gas [10^9 Sm^3] (>0.00)	2.50	5.40	6.40	11.40				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)								
	Gas [10^9 Sm^3] (>0.00)	1.40	3.60	4.30	7.70				
Reservoir Chrono (from)	Maastrichtian/Paleocene	Reservoir litho (from)	Kveite/Torsk	Source Rock, chrono primary	Albian	Source Rock, litho primary	Kolmule	Seal, Chrono	Paleocene
Reservoir Chrono (to)	Maastrichtian/Paleocene	Reservoir litho (to)	Kveite/Torsk	Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Torsk
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0.12	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.58	Trap (P2) (0.00-1.00)	0.90	Charge (P3) (0.00-1.00)	0.48	Retention (P4) (0.00-1.00)	0.50		
Parametres:	Low (P90)	Base	High (P10)	*Comments:*					
Depth to top of prospect [m MSL] (> 0)		1115		*Numbers reported in column for Base Case (for Parameters and Volumes,mode) are P50 values.*					
Area of closure [km^2] (> 0.0)	5.3	10.0	17.0						
Reservoir thickness [m] (> 0)	20	27	35						
HC column in prospect [m] (> 0)	200	270	450						
Gross rock vol. [10^9 m^3] (> 0.000)	0.126	0.251	0.469						
Net / Gross [fraction] (0.00-1.00)	0.50	0.75	0.90						
Porosity [fraction] (0.00-1.00)	0.23	0.28	0.33						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0.30	0.20	0.10						
Bg [Rm3/Sm3] (< 1.0000)	0.0081	0.0071	0.0061						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)									
Recov. factor, gas ass. phase [fraction] (0.00-1.00)									
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.45	0.70	0.85						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)	43			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)	132			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.	2.	3.					Kart nr	NPD will insert value

Table 4.4 Mulen, NPD prospect table

Block	7017/7 & 7017/8	Prospect name	Mulen	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:	Gas	Reported by company	Shell	Reference document	22nd Licensing Round application			Assessment year	2015
This is case no.:	1 of 1	Structural element	Harstad Basin	Type of trap	4-way dip	Water depth [m MSL] (>0)	200	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)								
	Gas [10^9 Sm^3] (>0.00)	2.60	20.00	28.30	66.00				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)								
	Gas [10^9 Sm^3] (>0.00)	1.60	12.70	19.05	43.01				
Reservoir Chrono (from)	Maastrichtian/Paleocene	Reservoir litho (from)	Kveite/Torsk	Source Rock, chrono primary	Albian	Source Rock, litho primary	Kolmule	Seal, Chrono	Paleocene
Reservoir Chrono (to)	Maastrichtian/Paleocene	Reservoir litho (to)	Kveite/Torsk	Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Torsk
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0.19	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.50	Trap (P2) (0.00-1.00)	1.00	Charge (P3) (0.00-1.00)	0.48	Retention (P4) (0.00-1.00)	0.80		
Parametres:	Low (P90)	Base	High (P10)	*Comments.*					
Depth to top of prospect [m MSL] (> 0)		2570		*Numbers reported in column for Base Case (for Parameters and Volumes,mode) are P50 values.*					
Area of closure [km^2] (> 0.0)	3.3	44.0	80.5						
Reservoir thickness [m] (> 0)	15	30	60						
HC column in prospect [m] (> 0)	67	296	460						
Gross rock vol. [10^9 m^3] (> 0.000)	0.047	1.038	2.902						
Net / Gross [fraction] (0.00-1.00)	0.44	0.70	0.90						
Porosity [fraction] (0.00-1.00)	0.14	0.18	0.23						
Permeability [mD] (> 0.0)									
Water Saturation [fraction] (0.00-1.00)	0.42	0.30	0.18						
Bg [Rm3/Sm3] (< 1.0000)	0.0050	0.0044	0.0037						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)									
Recov. factor, gas ass. phase [fraction] (0.00-1.00)									
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.45	0.70	0.85						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)				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)				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.	2.	3.					Kart nr	NPD will insert value

5 Technical Evaluations

High level technical evaluations have been performed to identify likely development concepts and to assess the value of potential prospects in PL 706.

Norwegian industry benchmark data for recent and ongoing projects was used to determine the notional development cost for the ultimate recovery volumes of the PL706 leads. These recovery volumes and associated development costs were then evaluated using in-house generic economic screening charts, with standard assumptions for screening values, CAPEX phasing, income profiles, decommissioning costs etc. This approach allowed for a high level assessment of the potential value of the respective recoverable volumes. Due regard had to be taken due to the lack of local infrastructure and relatively long transport distances for any prospects identified in PL706, in comparison to the majority of the projects contained in the benchmark data set.

For the oil scenario, the benchmark data set was used to calculate a generic total cost for a typical development. A number of subsurface cases were defined from the range of identified prospects & leads. Of these, it was found that some cases could be of interest. However, these cases require for a coincident discovery of 2 or 3 prospects, and for P10 or P50 scenarios to materialize. Given the low POS for the oil cases PL706, specific development options were not made.

Possible development options for the gas scenarios were identified, and from the range of volumes it appeared that an attractive option could be a standalone FLNG concept (Fig. 5.1). This is due to the expected significant increase in cost of transporting the gas in the other development options.

Fig. 5.1 FLNG

Shell floating liquefied natural gas technology with potential to unlock energy resources offshore, without the need to lay pipelines and construct processing plants on land

For a 'Offshore Gas Processing & Gas Transport Pipeline' development concept, the possible export options identified were Hammerfest and or a future notional pipeline connecting the Barents Sea to the Åsgard pipeline. Either of these options would require a significantly long pipeline, and it is assumed this would result in a less favourable option in comparison to the FLNG concept.

For the 'Subsea Tieback to Onshore Gas Plant' development concept, there is no local or national gas infrastructure for sales gas. As such, an LNG terminal would probably be required with a potentially long subsea tieback.

The FLNG concept could represent an attractive concept based on the available information, but further evaluation would be required to substantiate the cost benefit over a traditional LNG concept. The prospects in PL706 are however currently seen as too small to make an economic case for application of Shell FLNG technology.

6 Conclusions

The prospectivity in PL706 has been evaluated and concluded based on licence specific studies.

The evaluation has resulted in the following view:

- Very low chance for oil (< 0.05) in leads within license area
- Mulen (POS = 0.19) is the only opportunity with a volume potential for stand-alone gas development but only in a P10 case
- An upside model for Mulen has been explored but this has a very low POS (0.05)
- Sub-economic gas volumes for other individual leads, would need to be combined with a Mulen upside case as a hub
- Volume potential within PL706 is regarded as insufficient to warrant further follow up data acquisition and de-risking activities.
- There could be tie-in opportunities within PL706 if a future hub is developed in the SW Barents Sea but this is unlikely to happen in the timeframe relevant to this permit.
- The PL706 license is close to shore and in an commercial fishing area with heavy boat traffic. Non Technical Risk could be significant.

Having fulfilled work commitment and based on the results from the evaluation, a drill-worthy prospect has not been identified and the partnership unanimously recommends relinquishment of PL706.

7 References

- 22 concession Round Application Document
- Hand-out material from all relevant meetings - Work meetings, Exploration Committee and Management Committee Meetings available on "Licence to Share"
- East Greenland Sampling 2011 & 2012, Polteau, S, Mazzini, M., Trulsvik, M, Planke, S. (eds), Volcanic Basin Petroleum Research AS