

RWE Dea Norge

PL582 RELINQUISHMENT REPORT

R-020115

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1 INTRODUCTION

Production licence 582, blocks 6204/10 and 11 in the Norwegian Sea, was awarded 4th February 2011 with drill or drop decision within 4th February 2013. The licensees were RWE Dea Norge AS (operator) 40%, Marathon Petroleum Norge AS 30% and GDF SUEZ E&P Norge AS 30%. The work commitment for the initial term of the licence according to article 4, letter a) and b) in the licence agreement was: Merge and reprocess 3D seismic and to Perform G&G Studies. This was fulfilled within time, but although positive indications, more studies were needed in order to decide on drilling. Hence the licensees applied for one year extension of the drill or drop deadline to 4th February 2014. This was granted in a letter of 20th December 2012 from the Ministry.

2 SUMMARY

At the time of the application, based on vintage 3D seismic data, one prospect (named Pan) and one main lead (named Apollon) needed to be further matured to be possible drilling prospects.

According to the work commitment the 3D seismic data was merged and reprocessed. The G&G studies including seismic AVO & inversion as well as acquisition of seabed samples for microbiology and geochemical analysis were performed resulting in thorough evaluation of all potential prospective levels in the late Jurassic and Cretaceous. All the seismic work indicated the thickness of the Lysing sandstone in Pan to be very limited. This combined with negative results from the microbiological study downgraded the Pan prospect from a potential drillable prospect. For the Apollon lead the conclusion from the performed studies showed that significant risk exists with respect to trap validity/retention to make it into a drillable prospect.

Based on the performed work the licensees decided not to drill a well in PL582. The Ministry was informed of this decision in a relinquishment letter of 16th January 2014. This report summarizes the status of the relinquished area as required in the licence agreement, article 4, letter i).

3 DATABASE

The primary seismic dataset in the area is the RD12M01 survey which was a merge and reprocessing of 3 legacy datasets. The merge and reprocessing was undertaken as part of the PL582 work commitment. . In addition to this, a number of other 2D and 3D seismic surveys were used for the APA 2010 application and license mapping.. The main 3D and 2D surveys used are listed in Tables 2.1 and 2.2 respectively. The 3D seismic data were of different vintages and various degrees of quality.

RD12M01: merge & reprocessing

In order to improve the imaging and achieve more detailed analysis of the stratigraphic plays and detailed seismic mapping in general and of individual lobes in the Apollon lead in particular, the 3D seismic data (ST9202, ST9704 and ST9804) were merged and reprocessed into RD12M01 between Q4 2011-Q3 2012. Hence this has been the main dataset used for mapping the prospectivity in the licence.

Table 3.1: 3D seismic survey

Survey	Data quality	Vintage
RD12M01 (merge and reprocessing of ST9202, ST9704 & ST9804)	Good reflector continuity. Good noise and multiple suppression. Relative amplitude preservation, however, limited offsets.	2012
ST9202	Reasonable reflector continuity. Noisy deeper section	1992
ST9704	Reasonable reflector continuity. Noisy deeper section	1997
ST98M6	Good. Sharp wavelet. Reasonable reflector continuity	1998
MS97M	Low frequency content and noise	1997
GP3D93R02	Good to medium quality. Noisy deeper section	2002 (1993)
MC3D-Møre	Relatively high frequency and some vertical noise	

Table 3.2: 2D seismic surveys

2D seismic		
MM95	MS99	FTDE-91
ST8620	ST8408	MM90
ST8503	SG9009	GE8901-RE91
GMS191	ST9703	

A total of 13 wells in the area were included in the database of which 5 were considered as key wells. The key wells are listed in Table 2.3. These were used for petrophysical evaluation, seismic to well tie, depth conversion, and facies maps.

Table 3.3: Key wells

Lysing Fm	TD (m)	Oldest age	Petrophysics	Biostrat	HC	Age w/HC	# cores
6204/10-1	2709	Basement	Yes	Yes	No		4
6204/10-2 A	2051	E. Cretaceous	Yes	Yes	No		1
6204/10-2 S	2092	Basement	Yes	Yes	Gas	E. Cretaceous	2
6204/11-1	2962	Triassic	Yes	Yes	Gas	L. Jur/L. Cret	6
6204/11-2	2919	L. Jurassic	Yes	Yes	No		0

4 TECHNICAL WORK, STUDIES AND MEETINGS IN THE LICENCE

The 3D seismic merge and reprocessing of the three surveys ST9202, ST9704 and ST9804 took place in the autumn of 2011. The new set of data, RD12M01 was ready for interpretation in April 2012. The key stages of the reprocessing workflow are listed below:

- Linear denoise in shot/receiver
- Tau-P mute/decon in shot/receiver
- 2D SRME
- Radon
- Binning (12.5 m x 25 m), regularisation, merge and interpolation (12.5 m x 12.5 m)
- Kirchhoff PSTM
- 2nd Radon and denoise
- Stacking: full (0-35 deg), near (5-15), mid (15-25) and far (25-35)

The reprocessing achieved better imaging and reflector continuity in the target levels (Early/Mid Cretaceous and Mid/Late Jurassic) through improved noise and multiple suppression. Figure 4.1 illustrates the uplift in seismic quality.

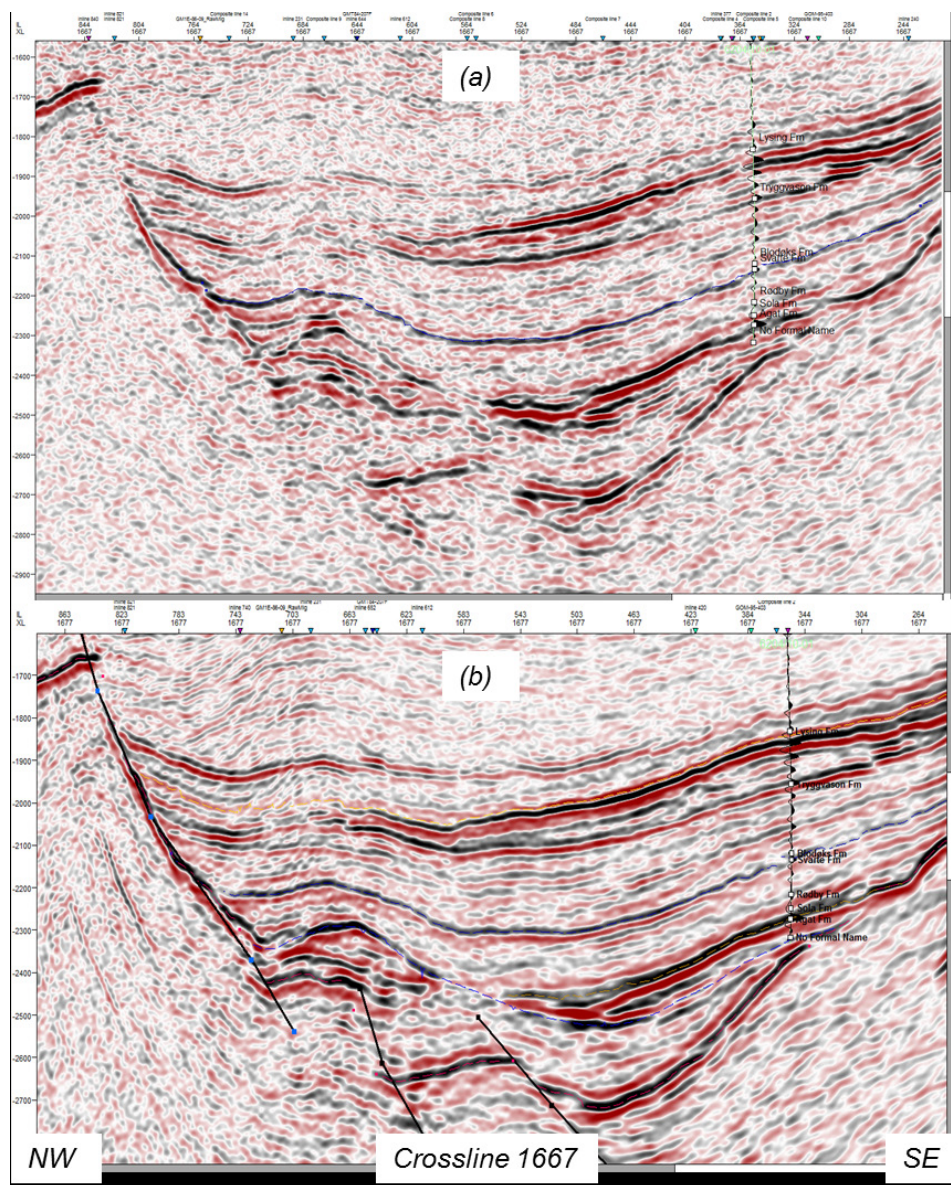


Figure 4.1. Reprocessed seismic data shows better imaging and reflector continuity (a) compared to the original seismic data (b)

Additional geological and geophysical studies carried out includes:

- Structural, stratigraphic and prospect mapping
- Core interpretation and depositional facies mapping
- Rock physics, AVO and Seismic inversion study
- Fluid Inclusion analysis and basin modelling
- Geochemical seabed sampling including recognizing seep in seabed

Management and Exploration committee meetings held in the license:

EC/MC meeting 30/03/2011
EC/MC meeting 24/11/2011
EC/MC meeting 11/09/2012 (additional Workmeeting 07/10/2012)
EC/MC meeting 06/11/2012
EC/MC meeting 20/11/2013

5 PROSPECTIVITY

The identified prospectivity within PL582 comprises of the Apollon prospect, the Pan and Zeus leads and the Pax discovery. The prospectivity is summarised in Figure 5.1 and Table 5.1

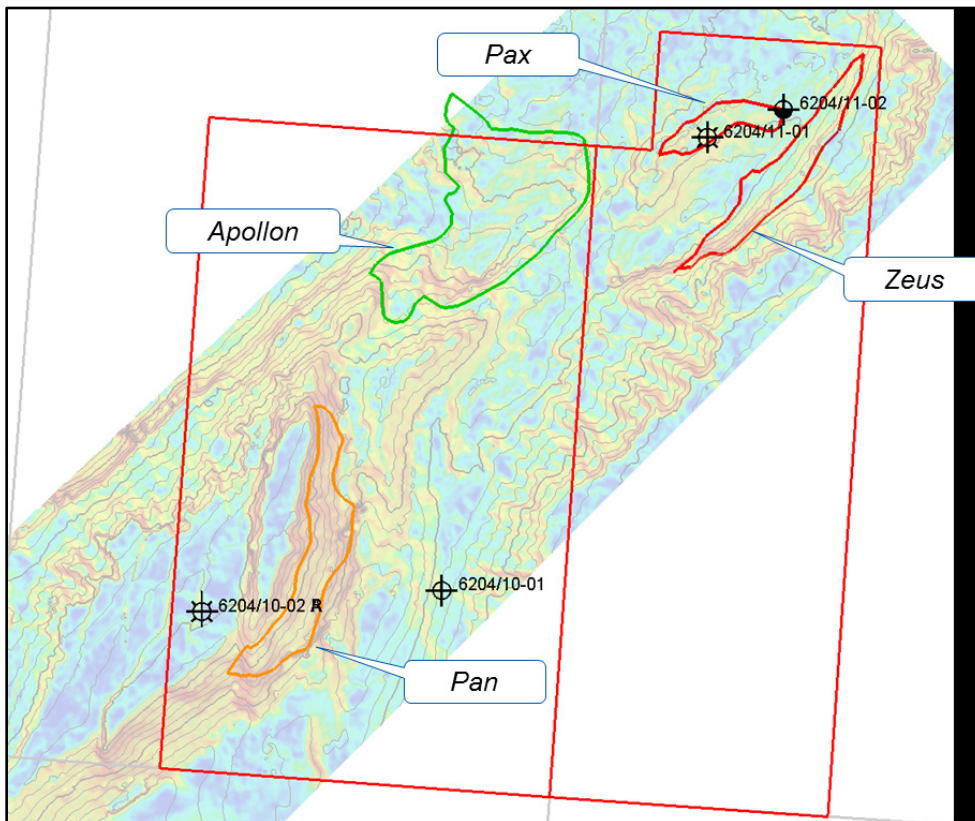


Figure 5.1. PL582 prospectivity displayed on top of basement topography.

Table 5.1. Summary of PL582 prospectivity

Prospect	Target	Volume (x10 ⁶ Sm ³ oil recoverable)			POF (%)	Comments
		P90	P50	P10		
Apollon	Cretaceous Agat Fm	4.2	20	58	16	Main risk is trap validity

Lead	Target	Comments
Pan	Cretaceous Lysing Fm	Reprocessed seismic data demonstrated poor reservoir sandstone potential. Microbiology results negative. Pan downgraded from a prospect to a lead.
Zeus	Jurassic	Unknown/risky reservoir interval. Small volume potential.

Discovery	Reservoir	Volume (x10 ⁹ Sm ³ gas recoverable)	Comments
Pax	Jurassic Sognefjord Fm	3.5	

Apollon Prospect

At the time of the application the Apollon lead (figure 4.2) was identified and describe as a stratigraphic pinchout trap with the reservoir comprising of Lower Cretaceous Agat Fm. turbitite sands. The main objectives of the work program were to improve the seismic image to define and de-risk the trap, model seismic DHI responses and de-risk the petroleum system through microbiology analysis. During the technical work Apollon was upgraded to a prospect but with a significant risk with respect to trap validity/retention.

A coloured inversion of the seismic data showed the Top Agat Fm going from a hard seismic kick, tied to the top of a hard conglomeratic package in the 6204/10-1 well, to a soft seismic kick where it was interpreted the sandstones were deposited in a more distal topographic low (Figure 5.2). This was a key observation in the mapping and definition of this stratigraphic prospect.

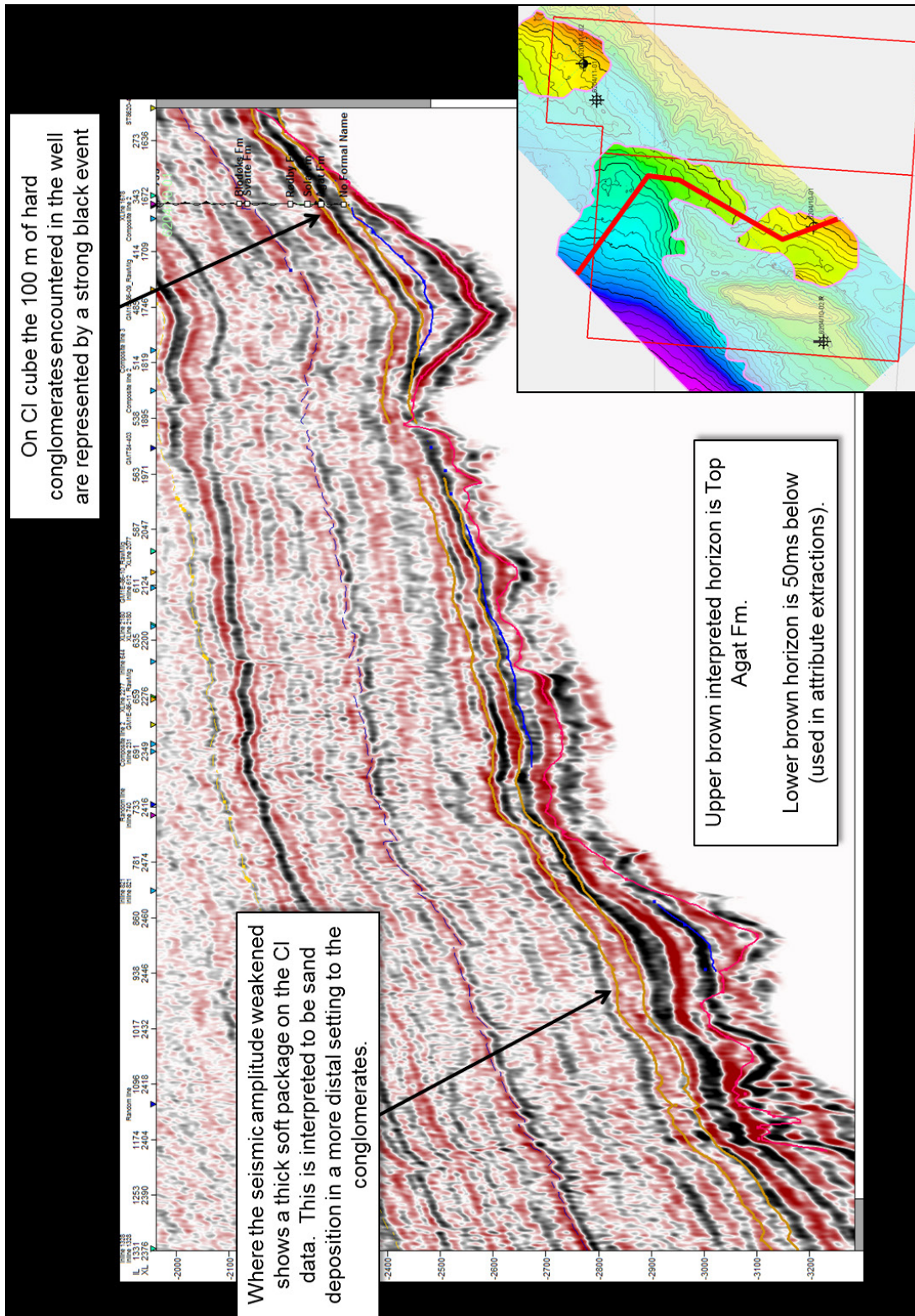


Figure 5.2. Change in character of coloured inversion defining the interpreted soft sands in Apollon.

As part of the license work commitment the licence performed a Microbiology and Geochemical seabed survey operated by RWE Dea in June 2012. The results from the survey were very encouraging but were not sufficient to be conclusively used in the prospect analysis. Due to the inconclusive nature of the microbiology results a denser grid of seabed samples was desired in order to try and decrease the uncertainty in the results. This additional work program formed the basis for the one year extension of the license drill-or-drop decision. The dense grid on samples used for microbiology analysis gave us a good understanding of the hydrocarbon phase and migration story de-risking these elements in the prospect evaluation. Since the results are showing multiple elements of the subsurface hydrocarbon system we were not able to apply the results directly as a DHI uplift in the risking for the prospect specific risk.

Instead we used the indications for de-risking the total HC system on the presence for oil on the play level. The data collected over Apollon (Fig 5.4 A&B). is indicating a more oil prone province with respect to the reference wells in Agat in PL 270, that are gas prone (Fig 5.4 B). Based on seismic interpretation and seismic inversion studies in combination with the geological model of the Agat Fm sandstones, the interpretation of the Apollon prospect was multiple sand packages within a thick gross turbidite package (Figure 5.3). As a consequence of the Neogene uplift event it is unlikely these individual sand bodies will have independent contacts. Therefore, in the volumetric assessment the most likely scenario of multiple sand layers with a common contact was considered with an up-side potential of individual sand bodies having independent contacts. Trap validity is the major risk for the Apollon prospect because there remains significant uncertainty in the interpretation of a sand bypass zone and/or pinchout in the up-dip part of the trap.

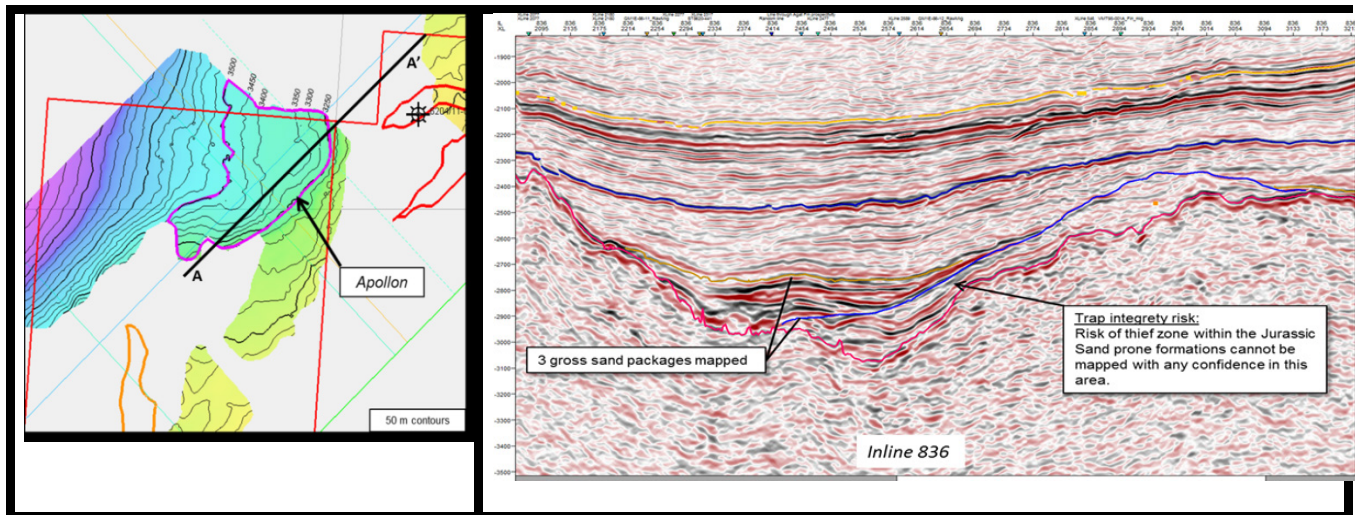


Figure 5.3 Apollon prospect and seismic cross section

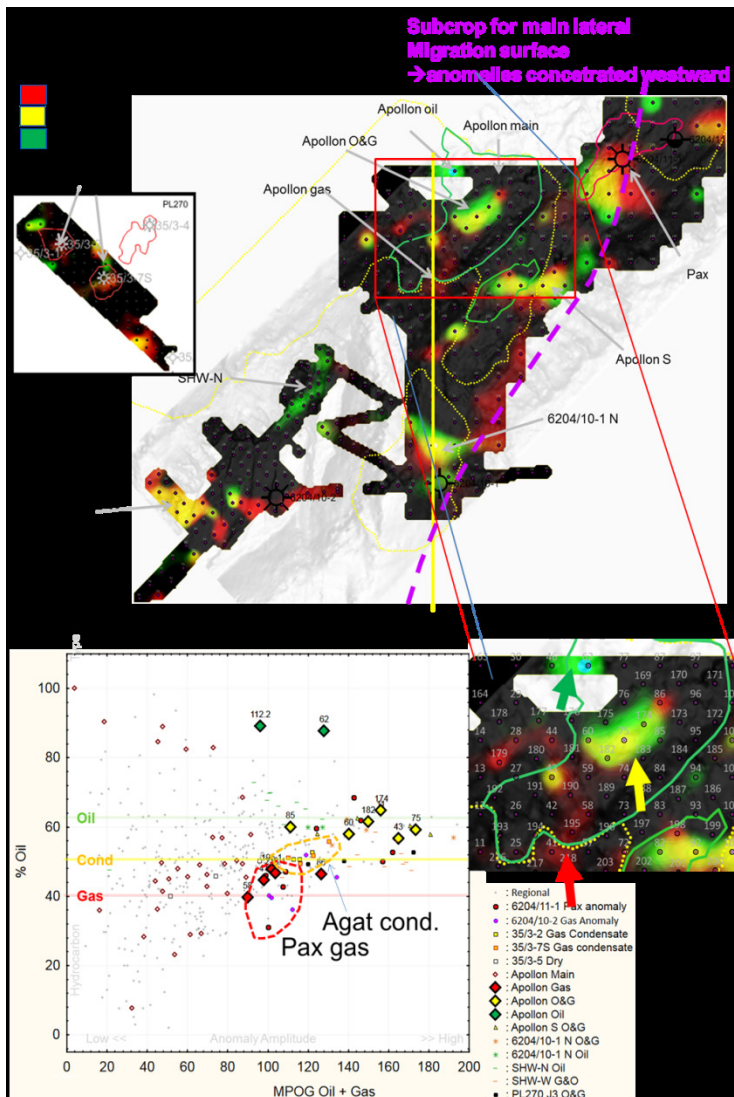


Figure 5.4 A) Overview of MPOG anomalies, including Agat; B) Apollon Anomaly Characterisation; MPOG Scatter plot including reference data

Pan lead

In the application the prospect (named Pan) was defined as a three way structural closure against the Selje basement high. The Pan prospect was assessed to comprise of late Cretaceous Coniacian age slope- and basin floor fan turbidites, which is the distal part of the Upper Lysing Fm. This depositional system was proved to exist in the well 6204/10-1, (1995 in PL175) just 3 km to the east.

The merged and reprocessed seismic data demonstrated poor reservoir sandstone potential as illustrated in the map extraction and results from neural network prediction given in figure 5.5. From this there was virtually no seismic evidence of sand at the Pan location in contrast to the Lysing sand proved in well 6204/10-1. Further to this, the results from the microbiology turned out to give a negative response for the Pan structure. Based on this it was decided to downgrade Pan from a prospect to a lead.

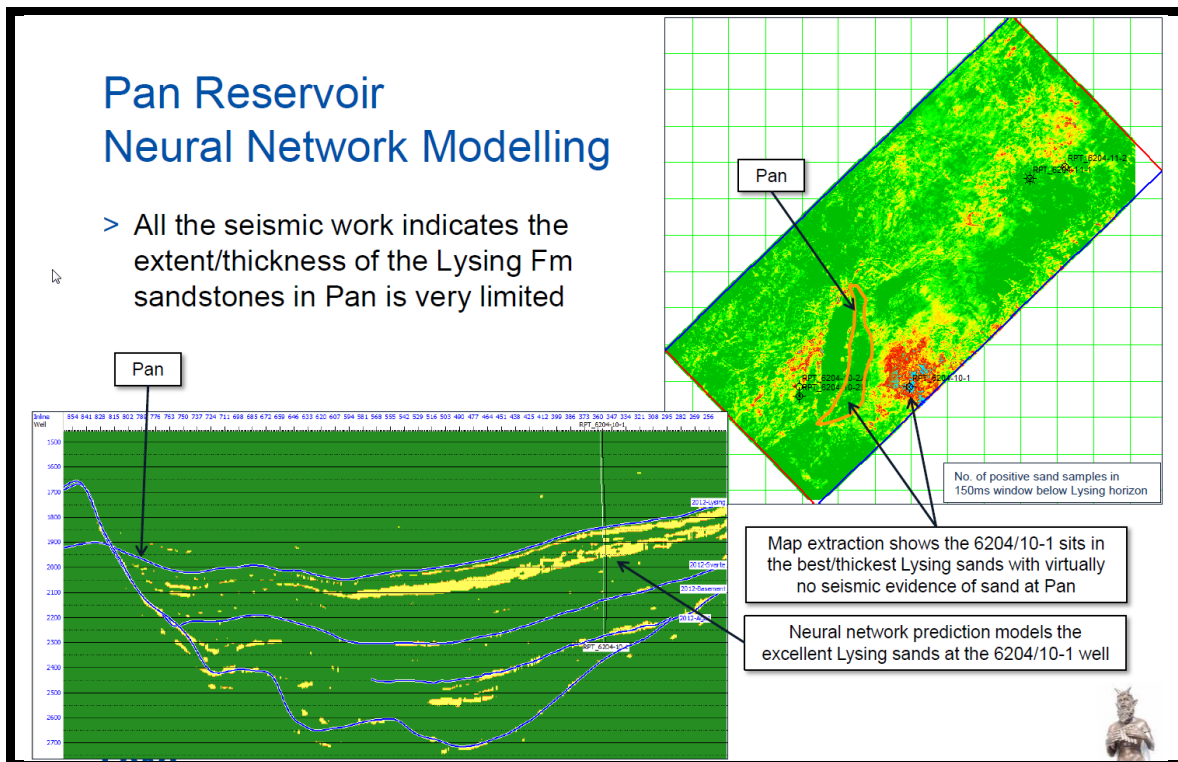


Figure 5.5 Pan prospect downgraded to lead

Zeus lead

A smaller lead, named Zeus was identified in the licence. It is defined as a Jurassic pinchout against basement updip and to the east of the small gas discovery proved in the 6204/11-1 well drilled in 1994. The interpretation of the merged and reprocessed seismic data indicated only limited potential for Sognefjord Fm. reservoir within the BCU pinchout closure. Also at this location the microbiological results turned out to be negative.

Pax discovery

The Pax discovery (well 6204/11-1) proved a working hydrocarbon system in the area with a small gas volume in the late Jurassic Sognefjord Fm. This could be regarded as additional potential to be considered in possible development plans if an economic discovery was made in the licence.

Conclusion

The comprehensive work program including seismic reprocessing and seabed sampling for microbiology analysis was unable to significantly de-risk the prospectivity. The license partnership was unanimous in the decision to let the license expire given the very low probability of find for the prospectivity.