Relinquishment Report for License PL647

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KEY LICENSE HISTORY

PL647 was awarded in the APA2011 to the licensees Maersk Oil Norway AS (operator) 40 %, Premier Oil Norge AS 30 % and RWE Dea Norge AS 30%. The targeted prospectivity was the identified Cretaceous aged turbidite deposits. These were identified on the 3D seismic datasets available at the time of application. It was expected that new 3D data would help refine the cloud of amplitudes that was the identified Sabina prospect with prospectivity at Lange Formation interval and tentative prospectivity at Lysing Formation interval.

The license work commitment for the 2 first years was to:

- Acquire necessary 3D seismic and consider reprocessing.
- Carry out relevant geological and geophysical studies.

A drill or drop decision was to be taken before 3rd February 2014.

Maersk Oil has carried out a number of studies to address key issues on the Cretaceous prospectivity:

- Acquired relevant parts of the new multiclient broadband seismic survey HVG2011.
- Reprocessed the HVG2011 survey as the original datasets (including the angle offset cubes) contained noise and multiples and where poorly aligned for AVO analysis.
- Cretaceous Lysing and Lange Fm's regional sedimentological study.
- Cretaceous section biostratigraphic study.
- Depth conversion study.
- Rock properties study.
- AVO analysis.
- Basin modeling evaluations.
- Forward modeling of reservoir quality using Touchstone software.

Numerous license partners Exploration Committee workshops, EC work meetings and formal EC and MC license meetings have been arranged, with partners represented at all meetings.

The work programme in the license has proven very effective to address the Lange and Lysing Formations prospectivity. The Sabina prospect is now better defined when compared to the evaluation done in the application evaluation. This work shows that there is limited Cretaceous prospectivity inside PL647, but interesting prospectivity is identified inside PL211. This is to a large degree based on mapping of the reprocessed HVG2011 dataset and the AVO analysis. There is a strong dependence on amplitude support for the Cretaceous prospects. No other stratigraphy prospectivity has been identified inside PL647.

The decision to drop PL647 (not committing to drill a well) is unanimous in the partnership.

DATABASE

The PL647 license partners have all acquired relevant parts of the HVG2011 muliticlient 3D seismic survey from PGS. The GeoStreamer survey was acquired in 2011 by the vessel PGS Apollo, using 10 streamers of 7000 m length. *Figure 1* shows the PL647 license outline and the HVG2011 data that is in the license data base.

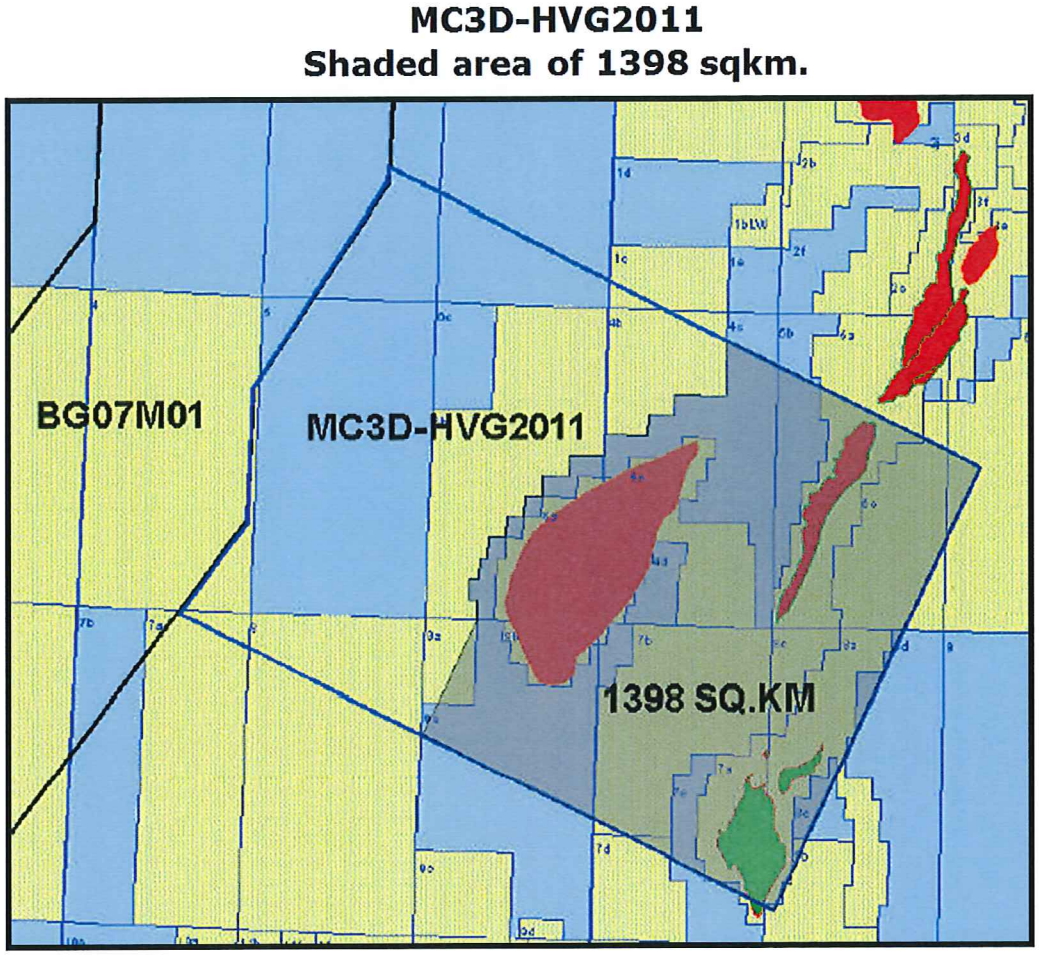


Figure 1. HVG2011 data covers most of the PL647 area. The shaded area shows the area of the HVG2011 3D in PL647 common data base. Long offset 2D seismic lines have been used to evaluate held acreage not covered by HVG2011. Cretaceous or older prospectivity has not been observed in this area.

The common well database includes wells that are considered important to understand the presence of lower Cretaceous Lange Fm sands, both in terms of reservoir presence and quality. *Table 1* lists the wells in the database, information is also presented on the presence of hydrocarbons.

Well Name	Release date	Publication Date	Discovery Info	LYLA sst in well
6506/3-1	19.08.2003	07.11.2005	dry	LY
6506/6-1	07.12.2002	18.12.2002	G disc JUR	LY la
6506/9-1	15.09.2011	28.09.2011	G disc JUR	LY la
6507/1-1	02.11.2006	15.12.2006	dry	LA
6507/2-1	29.09.1988	17.09.2007	dry w shows	LA
6507/2-2	16.03.1994	19.12.2007	GC disc CRET	LY LA
			dry w oil	
6507/2-3	05.05.1996	15.11.2001	shows	LY la
6507/2-4	19.02.2010	19.02.2010	G disc JUR	LY LA
6507/3-3	25.03.2001	15.11.2001	G disc JUR	LA silt
			OGC disc CRET	
6507/5-1	03.05.2000	15.11.2001	JUR	LA
6507/5-2	23.09.2001	11.04.2003	GC disc JUR	LA
6507/5-3	23.06.2002	18.12.2002	G dic CRET	LY
			OG disc CRET	
6507/5-4	15.04.2003	28.06.2007	JUR	LA
6507/5-5	14.02.2004	08.03.2004	OG dic JUR	LA
6507/5-6s	08.06.2010	08.06.2012	G dic CRET	LY
			dry w gas	
6507/7-1	01.12.1984	01.12.1986	shows	ly LA
6507/7-11s	14.08.1999	18.05.2004	dry	LY LA
6507/7-12	12.08.2001	11.04.2003	dry	LY
6507/7-14s	25.09.2010	25.09.2012	GC disc JUR	LY LA
6507/7-15s				LY LA
			O disc CRET	
6608/10-12	21.12.2010	23.12.2010	JUR	LY LLA

Table 1. PL 647 common well data base. The wells indicated here were also used in the biostratigraphy study and where core was available within the sedimentology study. (LY means Lysing, LA means Lange).

REVIEW OF GEOLOGICAL FRAMEWORK

The geological model for PL 647 suggests that gravity flows were generated along the western flank of the Nordland Ridge during lower Cretaceous times, but also probably during the Upper Jurassic although this is not well understood regionally in the Terrace area of Mid Norway. Erosion of significant amounts of sediment from the Nordland Ridge is believed to have been transported into isolated depocentres defined by Jurassic and Triassic rift tectonics within the Dønna and Halten Terraces.

The Sabina (Lange Formation) and Emma (Lysing Formation) prospects presented in the licence application were identified primarily by AVO response on long offset 2D seismic lines. A preliminary rock physics study (51 wells) indicated that Cretaceous aged sandstones can be imaged seismically and possess a unique response compared to mudstones (AI response). In addition, hydrocarbon and brine can be differentiated when crossplotting AI vs VpVs response. In addition, and prior to application, grounding studies on geochemistry, basin modeling, biostratigraphy, sedimentology and depth conversion were carried out to aid geological understanding of the play and improve prospect identification. Upon award of PL647 a series of G&G studies were initiated to concretize licence prospectivity.

Reservoir quality: From Maersk Oil Norway's experiences in elsewhere in Mid Norway it was known that the presence of thin low porosity and permeability sandstones was a risk. A regional reservoir quality study was initiated to understand the digenetic sequence of Cretaceous sandstones and identify the controls on poor reservoir quality. Results showed that most of the sampled sandstones were classified as minerolgically mature quartzarenite, sublitharenite or subarkose which were mechanically hard and resistant to mechanical compaction but strongly susceptible to chemical compaction, chiefly quartz cementation. Fluid inclusion studies from the Marulk Field indicated the potential for early HC filling of reservoir sandstones but suggested that markedly improved reservoir quality was an unlikely possibility. Forward modeling of reservoir quality derived from petrographic studies of the two reservoir intervals and modeling of wireline log responses at Lange and Lysing target depths was also undertaken using Touchstone software. Lange Formation PHIE Pmean 16.4%, Kair Pmean 41mD. Lysing Formation PHIE Pmean 21.5%, Kair Pmean 125mD.

Sedimentology and stratigraphy: Cored section from 14 wells from both Lange and Lysing intervals was studied which allowed a detailed deposited based facies scheme to be developed. The results of this study highlighted PL647 as being situated in a proximal setting near to the shelf slope break with the potential for sand rich deposits. This study also subdivided the Lange Formation into the Breiflabb and Smørflyndre Members whilst the Lysing Formation was renamed to Lysing Member using the Norlex scheme.

Basin Modeling: The results of this study suggested that gas or gas condensate are the likely fluid phases at target location. CGR data from the Marulk Field highlighted the potential for a condensate discovery but the proximity to the Zidane discovery suggested that a more conservative CGR

would be likely. This model is driven by the depth of the Spekk source rock in the area. Evidence of a Cretaceous source rock is known (Marulk and Ellida) but volume contribution is thought to be moderate.

Structural study: An in-house study confirmed the presence of tertiary aged basin inversion providing the mechanism of 4-way trap development.

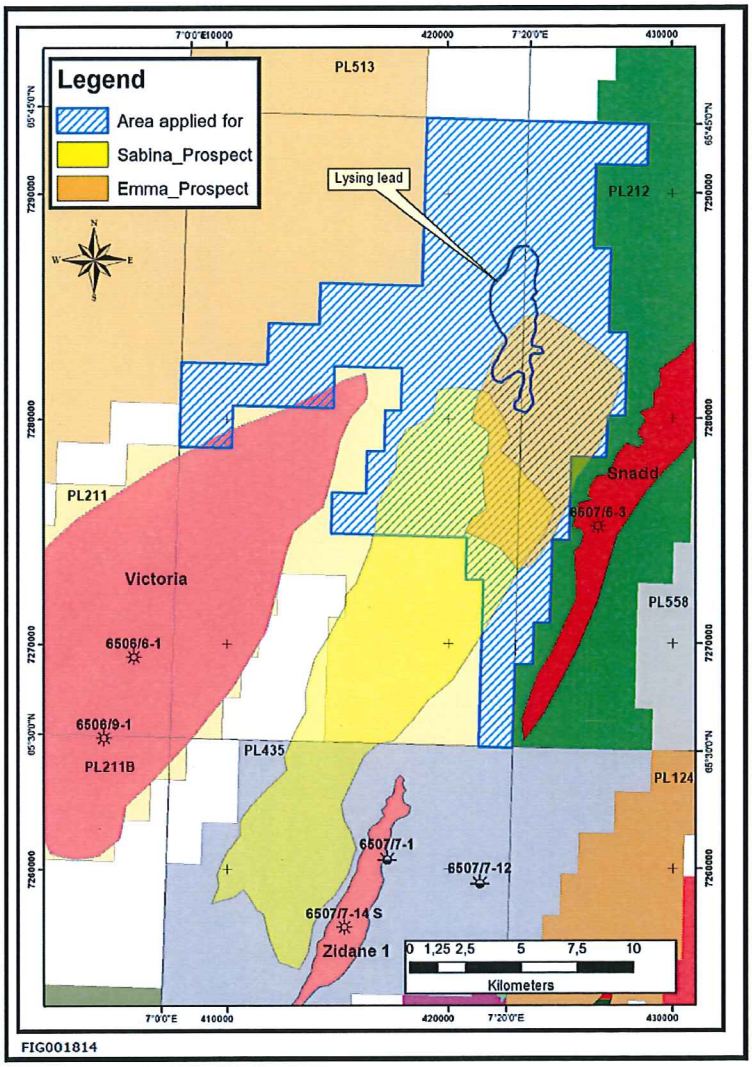
Pressure study: An in-house study indicated that reservoir sandstones of Lange Formation are normally not in vertical or lateral pressure communication, even over very short distances (less than 2km).

Rock physics study update: A sizeable study was carried out prior to application this was updated once the Zidane 2 (6507/7-15S) well was drilled in 2012. This well found condensate bearing Lange Formation sandstones. Reservoir development whilst thin (sub 25m) provided an important calibration point.

The work programme for PL647 also outlined purchase of new seismic 3D data (HVG 2011). Evaluation of this dataset highlighted the need for further seismic reprocessing carried out by Sharp Reflections. The aim was to increase signal to noise ratio through noise cancellation and demultiple filtering. A significant uplift in image quality was observed although sedimentary architecture is still ambiguous.

PROSPECT UPDATE

Pre-award techniques for prospect identification have been outlined in Section 2. Figure 2a map showing the location of the Sabina and Emma prospects from the application; Figure 2b describes the application volumes for each prospect.



Discovery/ Prospect/ Lead name	D/ P/ L	Unrisked recoverable resources						Probability of discovery	Part in acreage applied for %	Reservoir		Distance to infra-structure (km)
		Oil $10^6 Sm^3$			Gas $10^9 Sm^3$					Litho-/ Chrono-stratigraphic level	Reservoir depth (m MSL)	
		Low	Base	High	Low	Base	High					
Sabina	P	3.40	16.80	32.10	0.80	4.11	8.00	0.36	31	Lange Fm/Cenomanian	3600	8
Emma	P	0.85	3.73	7.27	0.20	0.91	1.78	0.36	100	Lange Fm/Cenomanian	3620	25

Figures 2a and b: Prospect outline and resource estimates from the APA2011 application.

Blocky AVO modeling from Well 6507/7-15S (Zidane 2) provided a geophysical framework for prospect identification (figure 3). Gas sandstones are identified with a class 2/3 AVO response at top reservoir, whereas water bearing sandstones are identified with a class 1 AVO response.

Using this technique two sandy horizons are seen at Lange Formation level in seismic cross section. Seismic mapping and amplitude extraction indicates that poor sand presence is developed within PL 647 it must be stated, though that the rock physics model is sensitive to hydrocarbon presence and less sensitive to water bearing response therefore delimiting the entirety of a sandy fan becomes less confident in the water leg.

Isopach mapping between the Cenomanian unconformity and Turonian MFS imply a basin developed within PL 647. Poor sandy development maybe the result of poor seismic imaging in the water leg, or the confined nature of the basin where mud fraction is unable to escape similar to the model described in Sinclair and Tomasso (2002). Other possible explanations include, unreworked turbidite flows within this area. Reworking of deposited gravity flows by traction ocean bottom currents has been seen within the Skarv Field to significantly winnow mud content and increase net to gross, porosity and permeabilty.

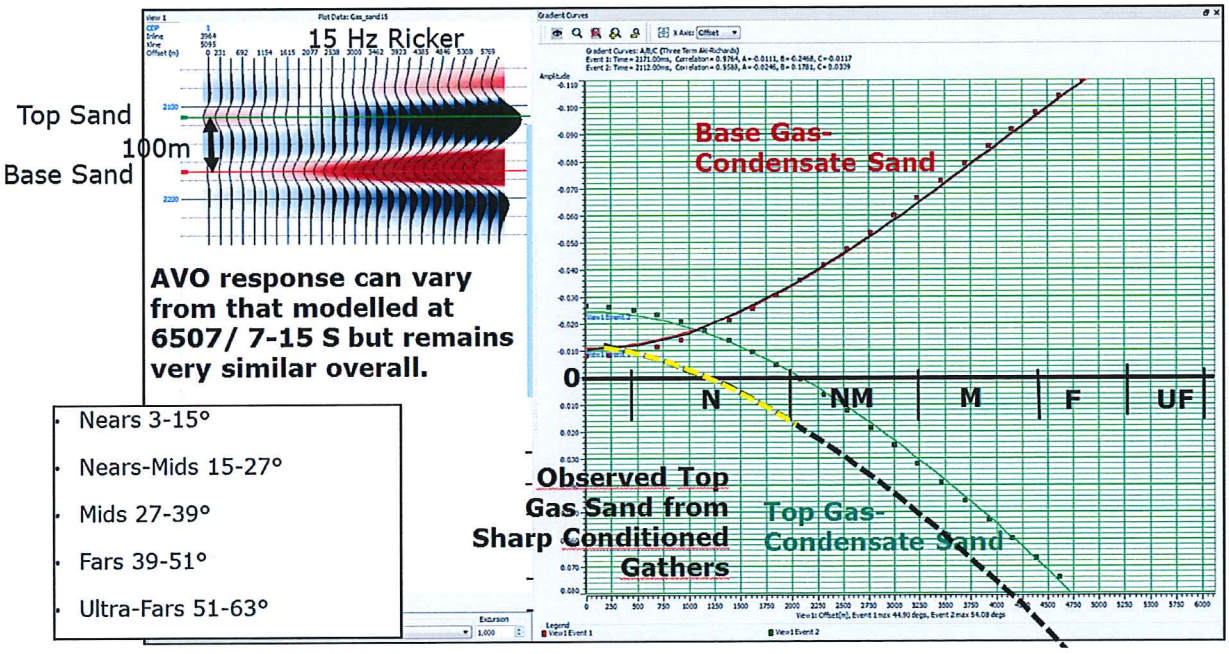


Figure 3: AVO model of seismic responses.

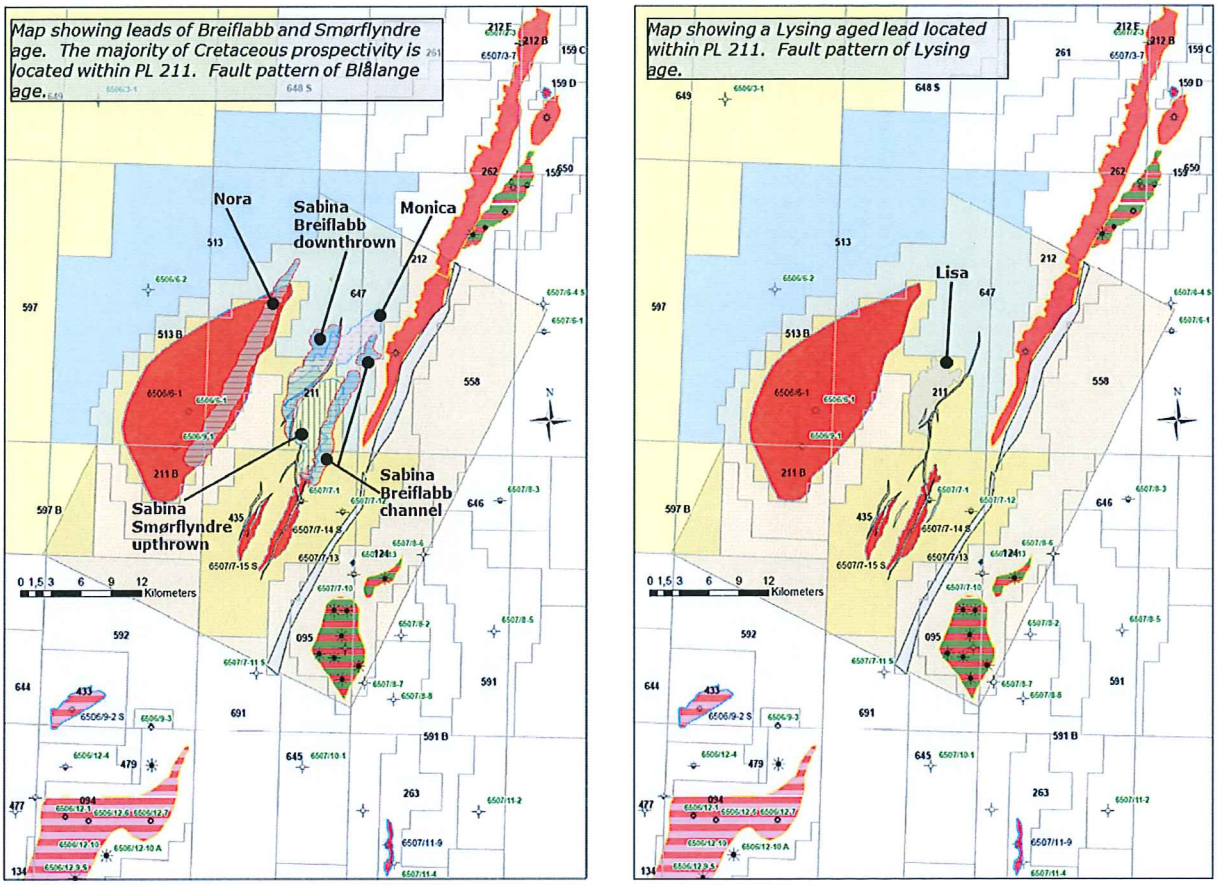


Figure 4: PL647 prospectivity.

TECHNICAL EVALUATION

The prospectivity identified inside PL647 has not required detailed development evaluations.

As part of Maersk Oil's equity positions in the area, including the PL435 Zidane development, detailed understanding of the existing infrastructure situation is available. This includes existing facilities capacity situations with cost, processing and transportation situation.

CONCLUSIONS

The PL647 work programme addressed the main uncertainties of the Sabina prospect. The resulting studies of prospectivity shows that the Cretaceous leads mainly sit within PL211/PL211 B (Fig 4) and only parts of them extends into PL647. The well core and log data interpretation, along with the improved seismic data, allows for detailed definition of the Cretaceous leads inventory. The view on prospectivity is that the PL647 parts of the leads likely only contain sub economical volumes with a high risk, inside PL647. From this it can be assumed that a more active exploration initiative from licenses PL211/PL211 B could be more attractive.

Remaining petroleum potential:

The license also contains the Monica lead (Figure 5 and Figure 6), with mounding observed in seismic cross section. Monika is stratigraphic trapped and carries the trap as the key risk element. The lead does not present a clear AVO response or other indication of DHI and is therefore regarded as high risk.

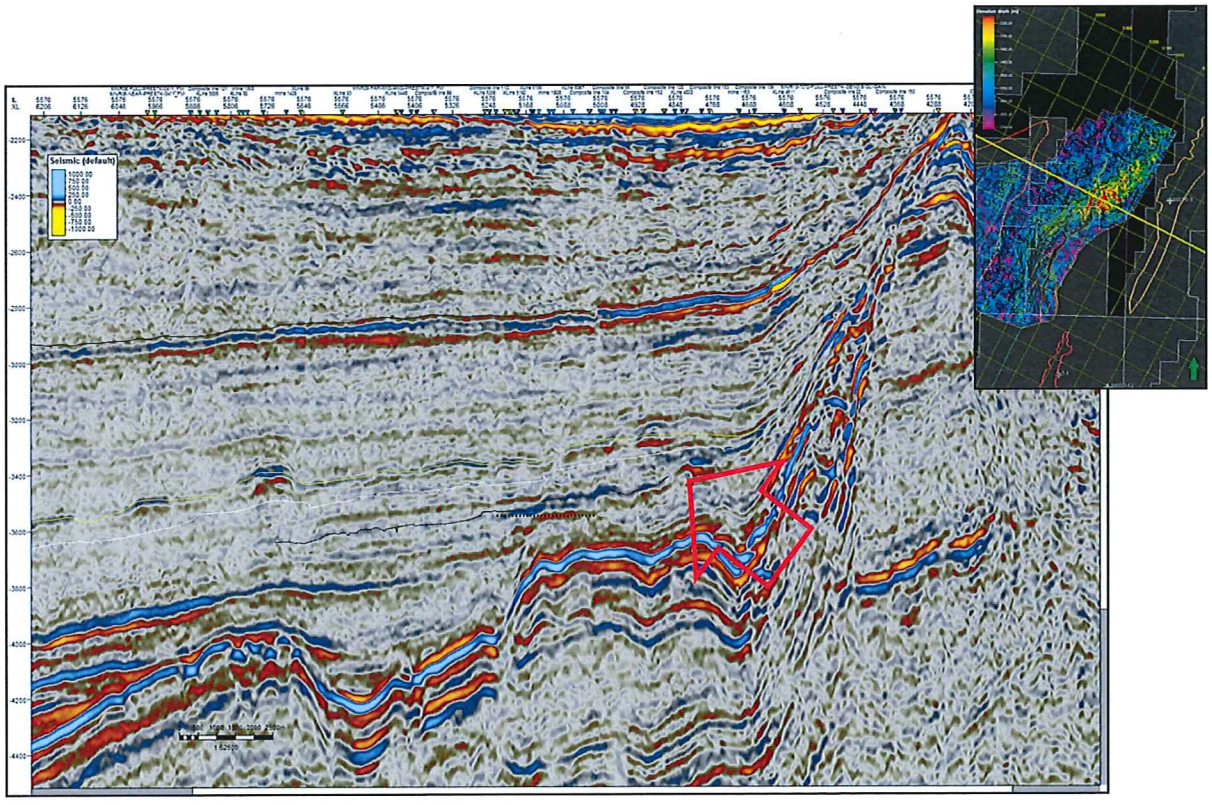


Figure 5: The Monica lead is seen as a mounded feature.

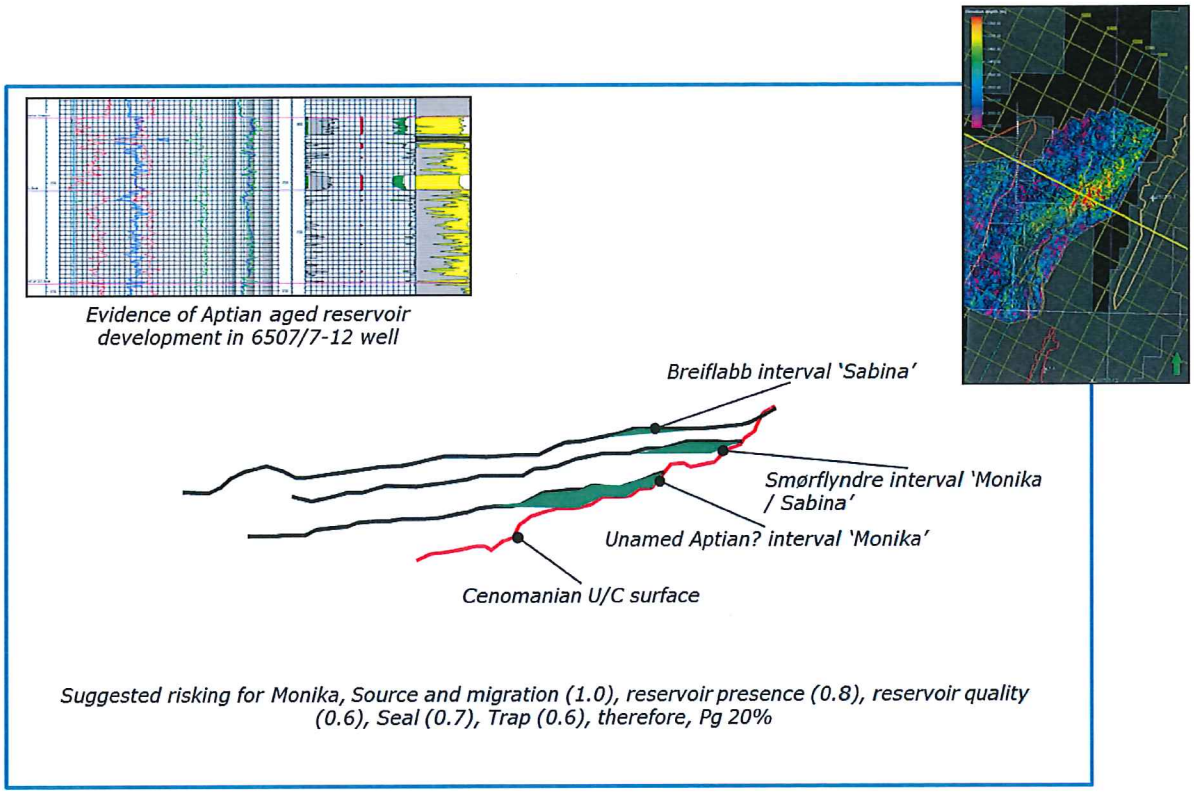


Figure 6: geoseismic section across Monica lead.

No other stratigraphic level prospectivity has been identified. Speculative potential maybe present in the Upper Jurassic. Well 6507/7-1 was drilled down flank of the Zidane 1 discovery (6507/7-14S) and tested the Upper Jurassic section. No evidence of sandstone development was observed. Amplitudes within this wedge are largely continuous and are currently thought to represent mudstones.

Prospectivity inside PL647 is most likely tested in a better position inside PL211 acreage.

Reason for relinquishment:

The license was applied for in order to mature the Lange Fm prospectivity, and to mature the identified Sabina prospect specific through detailed reservoir studies, basin modeling and detailed seismic interpretation (including AVO modeling) on new 3D data. The work programme has proven very effective and fit for purpose in the evaluation. A regional biostratigraphy study on wells has produced an integrated regional understanding of sands in wells and their relative ages. Sedimentology and rock property studies have addressed reservoir quality. The seismic study and the AVO analysis have helped to build a model where the seismic response from Lange Fm gas filled sand can be separated from water wet sand.

The studies performed in PL647 have produced detailed understanding of the Lange Fm prospectivity. The Sabina prospect seen at the time of the application has now become much better defined separated

into several separate leads and prospects. The most prospective interval now appears to be located within PL211/PL211 B stretching only partly into PL647 (Fig 4). As there are no concrete plans to drill in PL211, there is no appetite in the PL647 to take a drill decision in PL647.

The decision to relinquish the license is unanimous among the PL647 partners.