



## **PL840 – License status report**

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## Summary

A drill decision in PL840 was to be taken within 05.02.2019. License prospectivity was evaluated based on the PGS16005 survey, with the Ask prospect in the Jurassic Ile Fm. as the main potential. Conclusion after extensive analysis and QC has been that the Ile Fm. in Ask has a too low volume potential and too low associated probabilities to be a business driver for a drill decision. Further prospectivity is seen within the Cretaceous Lange and Lysing Fms. Unfortunately, the current 3D seismic quality of PGS16005 in these strata is too low to mature the prospects to drilling candidates.

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## 1 License history

<b><u>License:</u></b>	PL840
<b><u>Awarded:</u></b>	05.02.2016
<b><u>License period:</u></b>	Expires 06.02.2024 Initial period: 8 years
<b><u>License group:</u></b>	Equinor Energy AS (40% - Operator) Repsol Norge AS (20%) Capricorn Norge AS (20%) Skagen44 AS (20%)
<b><u>License area:</u></b>	172.47 km <sup>2</sup>
<b><u>Work programme:</u></b>	Acquire 3D seismic, fulfilled
<b><u>Meetings held:</u></b>	
11.04.2016	EC/MC startup meeting
11.02.2016	EC/MC meeting
08.11.2017	EC/MC meeting
21.06.2018	EC/MC meeting
26.09.2018	EC/MC work meeting
23.10.2018	EC/MC meeting
<b><u>Work performed:</u></b>	
2016:	License start-up PGS16005 seismic survey acquired and followed-up
2017:	Key horizons were interpreted on fast track PGS data Prioritization of Cretaceous, Jurassic and Triassic prospects
2018:	Ask prospect nominated as main drill candidate Ask prospect analysis performed incl QA/QC and Technical/Economical analysis Decision made to surrender license due to too low volume potential and probabilities

### **Reason for surrender:**

The prospectivity in PL840 has been evaluated on the PGS16005 seismic survey. Cretaceous prospectivity was challenging to assess due to poor seismic imaging. Triassic prospectivity was evaluated to have a high risk on reservoir presence and quality, and it is difficult to derisk these prospects further. Jurassic prospectivity was evaluated based on good seismic quality with the Ask prospect in the Ile Fm. as the main drill candidate. The prospect's depth however has a substantial influence on reservoir properties and related recoverable volumes, and furthermore results in low associated probabilities. NPV was assessed to be negative. In summary, no drillable prospects have been identified in the license.

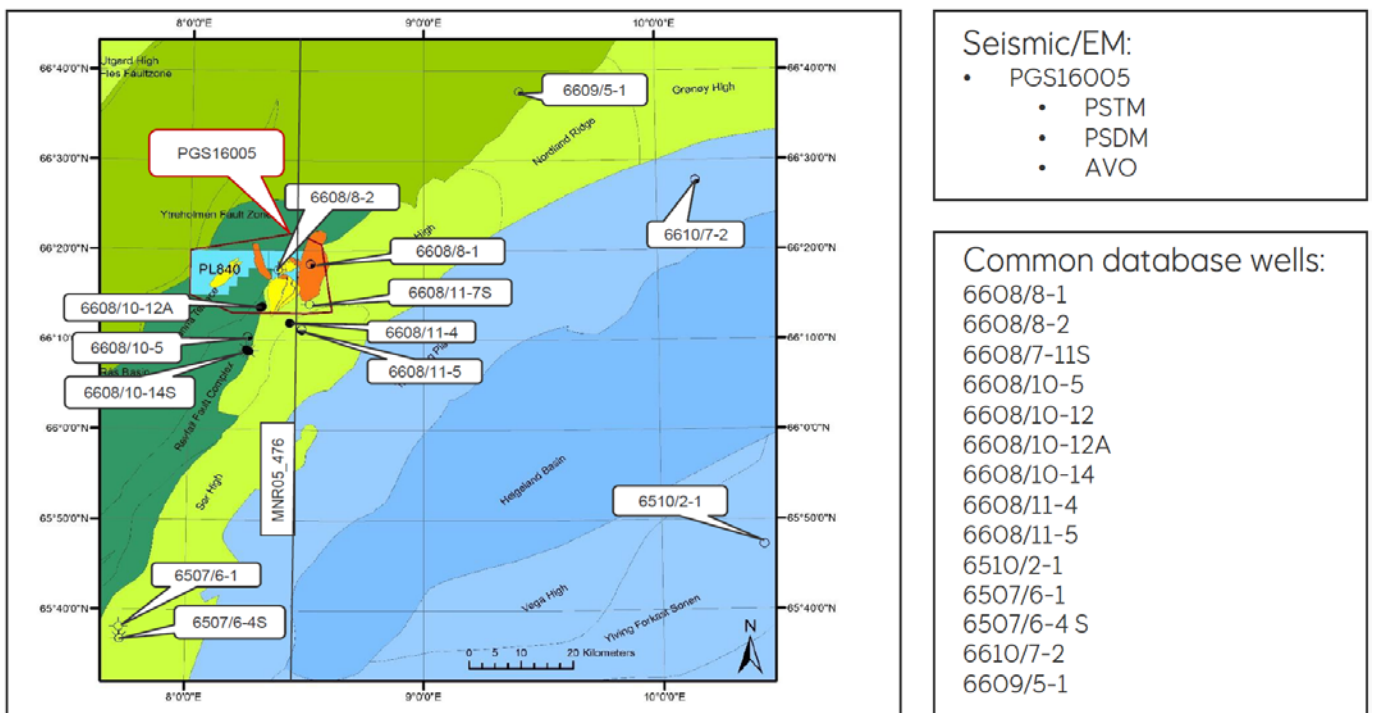
## 2 Database overviews

### 2.1 Seismic data

The common database in PL840 was approved at the MC No.1 in 2016 and included 2D seismic data MNR05\_476 shotpoint 19850 to 20600. In addition, the PGS16005 3D survey (PSTM, PSDM, AVO) was utilized in the technical evaluation of PL840.

### 2.2 Well data

The common well database is comprised of the 6608/8-1 Bjørk and 6608/8-2 Brøgger wells within the license boundary. Besides that, the following analogue wells with were analyzed in more detail with respect to reservoir potential in the Cretaceous, Jurassic and Triassic strata: 6608/7-11S, 6608/10-5, 6608/10-12, 6608/10-12A, 6608/10-14, 6608/11-4, 6608/11-5, 6510/2-1, 6507/6-1, 6507/6-4 S, 6610/7-2, 6609/5-1. The 6407/10-4 well was added in MC meeting No. 2. Released wells 6607/12-3 T2, 6608/10-16, 6608/10-1, 6608/10-15, 6608/11-2 and 6608/10-8 were also used in the evaluations, but not included in the common database.



**Figure 1 – Common database in PL840, with the license area in light blue, the PGS1005 outline in red, the main prospects and leads in yellow and orange and the reference wells both marked in the map and listed on the right-hand panel.**

### 3 Results of geological and geophysical studies

The PL840 license was awarded on the 5th of February 2016 after an application in APA2015. APA2015 had a focus on a larger area with a substantial amount of Cretaceous leads as well as some Jurassic and Triassic prospects with lower reservoir potential and chance of success (Figure 2). Only the area around these Jurassic and Triassic prospects was awarded as the PL840 license in 2016, leaving the leads in the area North of PL840 unlicensed at that stage. This area, containing the large Skywalker prospect and Yoda and R2-D2 leads has been licensed as PL947 in March 2018.

During the course of 2016, the PGS16005 seismic survey was acquired and followed-up.

In 2017, key horizons were interpreted on fast track PGS data and a prioritization of Cretaceous, Jurassic and Triassic prospects was made, with a main focus on the Cretaceous Bjørk Updip, Jurassic Ask and Triassic Teratorn prospect (Figure 2).

The Bjørk prospect was tested by well 6608/8-2 in 2007 and concluded dry. Remaining potential was based on amplitudes updip of this prospect (called 'Bjørk updip' in APA2015). These amplitudes were re-analyzed based on the PGS16005 data and ascribed to residual gas that may have migrated through the Cretaceous sands into the Nordland ridge, rather than a present-day hydrocarbon fill. Although there is uncertainty related to that explanation, the volumes in the prospect are limited and the partnership did not support maturing the Bjørk Updip prospect to a drill candidate, also considering similar amplitudes had been tested just downflanks. No further analyses were made.

The Teratorn prospect contains sub-salt strata that are highly affected by multiples and difficult to analyze with respect to internal structure and reservoir potential. The partnership therefore matured neither Bjørk Updip nor Teratorn to drill candidates.

Instead, in early 2018, the license decided the Ask prospect in the Jurassic Ile Formation contained the most potential and an extensive prospect analysis, QA/QC and Technical/Economical analysis were performed. Conclusion has however been that the Ask prospect has a too low volume potential and low associated probabilities to be a business driver for a drill decision, and the NPV was assessed to be negative.

Further area potential was seen in the Cretaceous strata, specifically in the Millennium, R2D2 South and R2D2 West leads (Figure 3) that were mapped on the final PGS16005 data during the second half of 2018. Preliminary recoverable volume estimates for the three leads are (P90/P10): 1-7 MSm<sup>3</sup> O.E. for Millennium, 0.5-3.5 MSm<sup>3</sup> O.E. for R2D2 South and 0.5-1.5 MSm<sup>3</sup> O.E. for R2D2 West. Poor seismic quality in the Cretaceous strata prohibited the leads to be further matured into prospects.

A license extension was proposed to the partners based on an ongoing regional reprocessing of the PGS16005 data with focus on Cretaceous. This reprocessing is expected to improve the seismic quality in the Cretaceous strata which may enable the license to further mature the Cretaceous leads, but the partners in PL840 voted against this reprocessing and the related license extension.

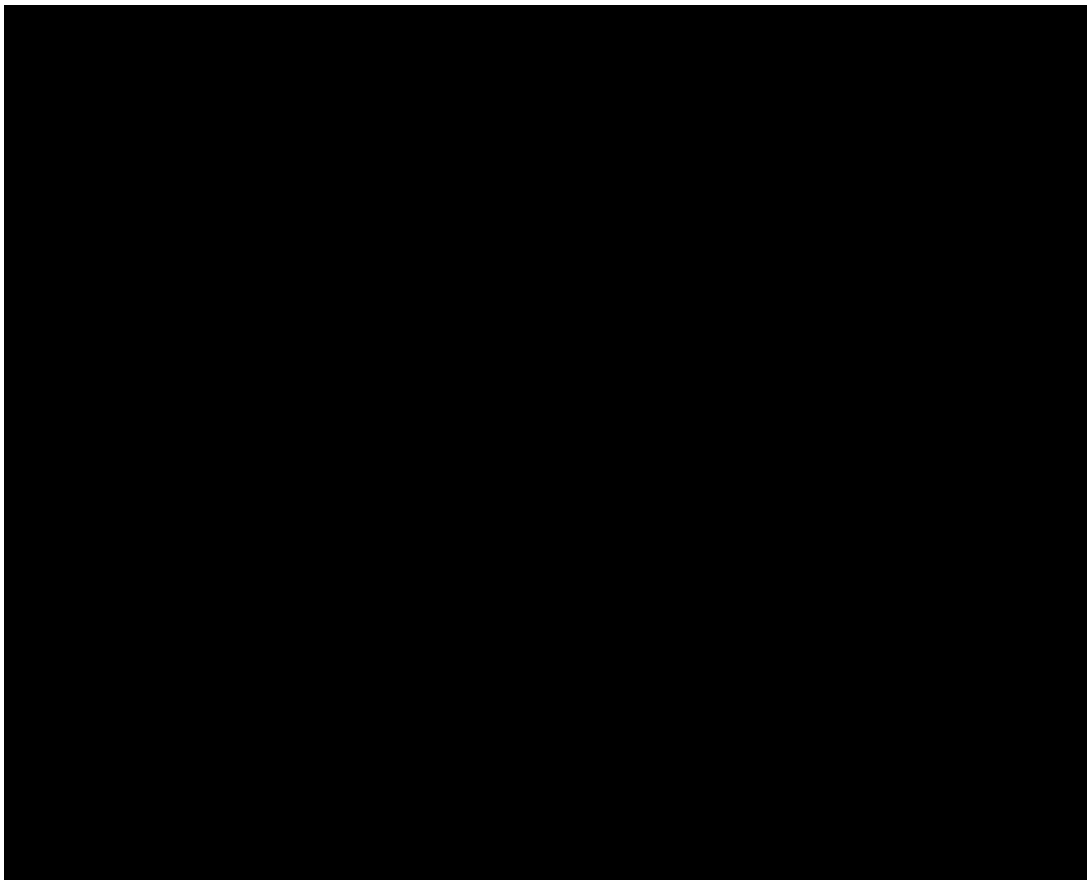


Figure 2 – Overview map of APA2015, with the PL840 awarded license in a yellow outline, and the Ask prospect, Bonzai lead, Bjørk Updip prospect, Sub-Bjørk Triassic Lead and the Teratorn Prospect depicted.

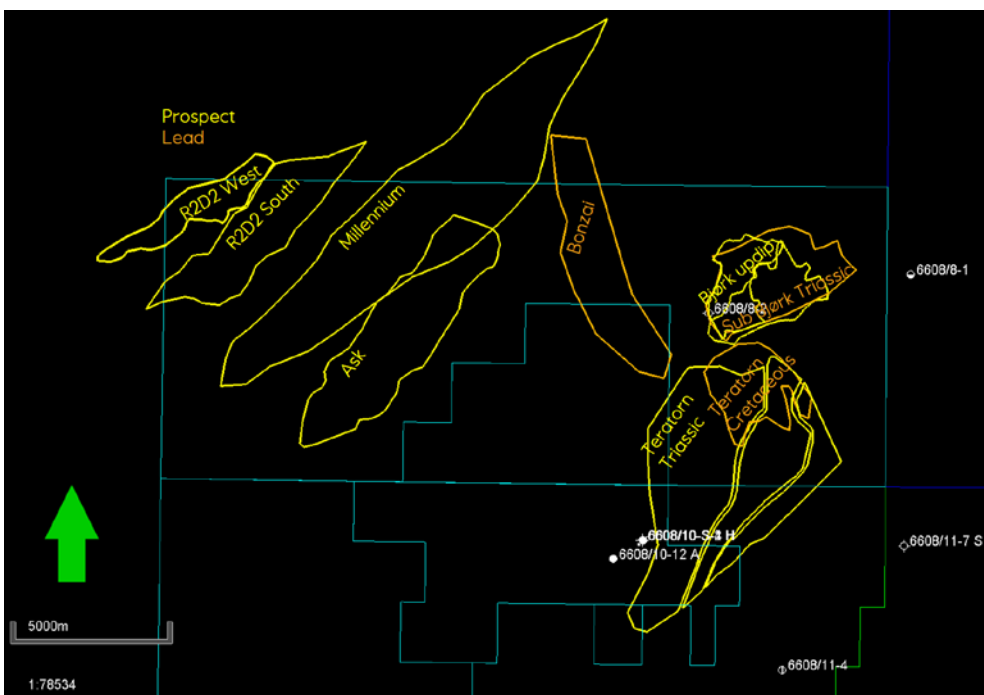


Figure 3 – License prospectivity in December 2018.

## 4 Ask prospect update report

The Ask prospect (Figure 4) is a deeply buried Lower-Middle Jurassic Ile Formation reservoir, located in a rotated fault block (Figure 5). The volumes in Ask are limited and decreased slightly post APA2016. Reservoir conditions are HPHT or near HPHT and gas is the most likely HC phase.

The key prospect risks are reservoir quality due to the burial depth and seal due to possible thief sands juxtaposed along the eastern bounding fault (Figure 4, Figure 5). The key uncertainty for the prospect is the hydrocarbon column thickness, which is estimated to be around 150m and based on amplitude response and spill point analysis.

### Reservoir model

Offset wells in the area (Figure 1) indicate that the Ile Formation consists of offshore transition zone deposits in a starved shelf setting. Porosity estimates at the reservoir depth are in the range of 6-9%, with low probability of porosities up to 12%. Given the deep burial, reservoir quality, presence and properties at 4190m TVD MSL (APEX) are the main risks for the Ask prospect. The N/G is estimate at 80% and a reservoir thickness of around 35 meters is expected.

A reservoir development similar to the proven reservoir in the 6607/12-3 T2 Jette discovery is expected. The upper part of the Ile reservoir section in Jette consists of very fine grained, low permeable reservoir with limited effective reservoir properties. Because of that the risked reservoir in Ask is based on the lower Ile reservoir interval in Jette which consists of a blocky, cleaner sandstone with slightly better reservoir properties. The improved quality here may potentially be related to a more proximal source of the sands. A cleaner and blockier reservoir is not regarded to be limited to lower Ile and could be present in the upper Ile in Ask.

The overburden thickness and temperature effect of the thick Naust Fm. in Ask is expected to be similar to the one in the Jette discovery. Base case average porosity and permeability values are on the borderline of being producible with an assumed cut-off at permeability of 0,1milliDarcy. Productivity may be enhanced by the following:

- Most likely hydrocarbon phase is gas, which makes lower porosity and permeabilities less problematic
- The reservoir is most likely overpressured (like the Jette discovery), which will have a positive effect on gas production
- The reservoir is around 200m deeper burial compared to Jette

An antimodel to the above described prognosed reservoir for the Ask base case could be formed by more proximal and coarse-grained Ile facies and/or a chlorite coating that preserved good permeabilities despite poor porosities. Such a coating is observed in Jurassic sandstones in the Halten Terrace area where producible chlorite coated reservoirs are encountered at depths greater than 4500m TVD SS. However, at this moment, no Dønna Terrace/Nordland ridge well penetrations have encountered chlorite coating.

Uncertain indications from biofacies analysis in the Jette well indicate presence of coarser grain sizes and a higher fluvial input, suggesting a more proximal sediment source may be nearby. A lack of wells to the north and northwest contributes to the uncertainty with respect to position of the shoreline. A reservoir model where chlorite coating/proximal source is a key component was therefore not used as a base case, but rather describes the upside cases for the Ask prospect.

### Source presence and maturity

There are three potential source rocks in this area: the Spekk, Melke and Åre formations.

The Spekk Formation is immature to early mature in most of the wells along the Nordland Ridge, and mid to late mature over most of the Dønna Terrace. The Spekk Formation was mapped to the northwest and east of the Ask prospect and is expected to be gas prone in that area.

The Melke Formation has approximately the same maturity as the Spekk Formation but was not mapped as the main source rock for the Ask prospect.

The Åre Formation is immature to early-middle mature along the Nordland Ridge. Åre depth increases rapidly to the west of the Nordland Ridge where Ask is located and thus source rock intervals from Åre could be gas mature.

No limitation in charge is expected, due to the small in place volumes.

### Hydrocarbon migration

The most likely pathway for hydrocarbon migration into the Ask structure is from the west, where the Upper Jurassic is juxtaposed with other porous Fangst Gp sediments.

### Pressure & Temperature

The reservoir temperature at APEX is approximately 150 degrees Celcius, while 160-165 degrees Celcius at spill. Based on the Ile Formation in the Jette well, pore pressure at APEX is expected to be approximately 600 bar, indicating a 180bar overpressure.

### Hydrocarbon phase



The hydrocarbon phase is described as either gas or oil with a distribution of 80% for gas and 20% for oil. The following observations from neighboring wells were taken into account:

6607/12-3 T2 (Jette) - main analogue:

- Not and Ile Fm present
- 4.3 m gas bearing Lange sst
- Gas proven in Ile Fm (3996.6 m), GWC at 4003 m
- Shows in Tofte Fm
- Åre had 1 m gas-bearing sst (4283m)

6608/10-1:

- Garn, Not and Ile present
- Shows in Garn and Åre Fm
- Good SR potential proven in Spekk and Åre Fm

6608/10-16:

- Garn, Not and Ile present
- Weak shows in Garn (3717-3720m) and Ile Fm (3753-3756m)

6608/10-12:

- 4m oil bearing Lysing sst and oil was proven in Åre (50 m oil column)

6608/10-5:

- Shows in Cretaceous

6608/10-14 S:

- Two reservoir levels separated by the Not shale
- Gas present in intra Melke sand
- Oil present in Ile Fm (2549-2481m) and down to the Tofte and Åre Fm (shows continued down to 2731.5 m)
- Different pressure regimes
- 6m thick Spekk

### DFI Assessment and hydrocarbon contact distribution

Revisited AVO processing and interpretation on Ask based on PSDM (raw and final PSDM data, PGS16005) show weak indications of hydrocarbon related DHI's both in Ile and Melke Formations (Figure 6, Figure 7). AVO processing was performed on the PSDM final (near, mid & far). A small DFI uplift factor was therefore applied (Pg pre-DFI uplift: 19,6%, Pg post uplift: 22,8%).

The contact distribution (see Figure 4, Figure 5) used for the prospect is based on these amplitudes, creating a mean at 4327m TVD MSL (140m column from APEX). The minimum and P90 case are based on a closure against the southeastern bounding fault at around 4270m TVD MSL. The P10 case is located at 4361m TVD MSL and depends on the same fault sealing as the P90 case.

### Volumes and probabilities

Based on the input described above, the total mean in place volumes are 2.66 MSm<sup>3</sup> O.E., where the total mean in place non-associated gas is 1,81 GSm<sup>3</sup> and the total mean in place condensate amounts to 0,2 MSm<sup>3</sup>. Oil is not considered producible due to the poor reservoir qualities and is therefore not separately reported or taken along in the Technical/Economical evaluation of the Ask prospect. The total mean recoverable resources are 0.93 MSm<sup>3</sup> O.E., with a total mean recoverable non-associated gas volume of 0,72 GSm<sup>3</sup> and a total mean recoverable condensate volume of 0,08 MSm<sup>3</sup>. This is based on a recovery factor of 20-40-60% for gas (where the high end is related to fracturing) and 15-25-40% for the condensate.

The play risk is set to 1, as there is no risk associated with the Middle Jurassic in the area. The play is proven by prolific discoveries on the Dønna Terrace. The reservoir risk is estimated to be 0.4. The reservoir has a high probability of being present, so the risk is attributed to the reservoir quality. The prospect is located at approximately 4.2 km depth posing a risk of compaction and cementation of the reservoir reducing the porosity and permeability.

The trap risk is set to 0.7 as the structure is dependent on sealing faults. Leakage might occur into Cretaceous and Jurassic sands juxtaposed to the reservoir, but this is considered low risk. The source risk is estimated to be 0.7 as well. The most likely evaluation considers the Fangst reservoir a gas case. Regional migration is considered likely. Spekk source rock is present east and northwest of the Ask prospect, but it is uncertain whether the amounts of mature Spekk are sufficient. Åre and Melke Fm. may form alternative sources for gas.

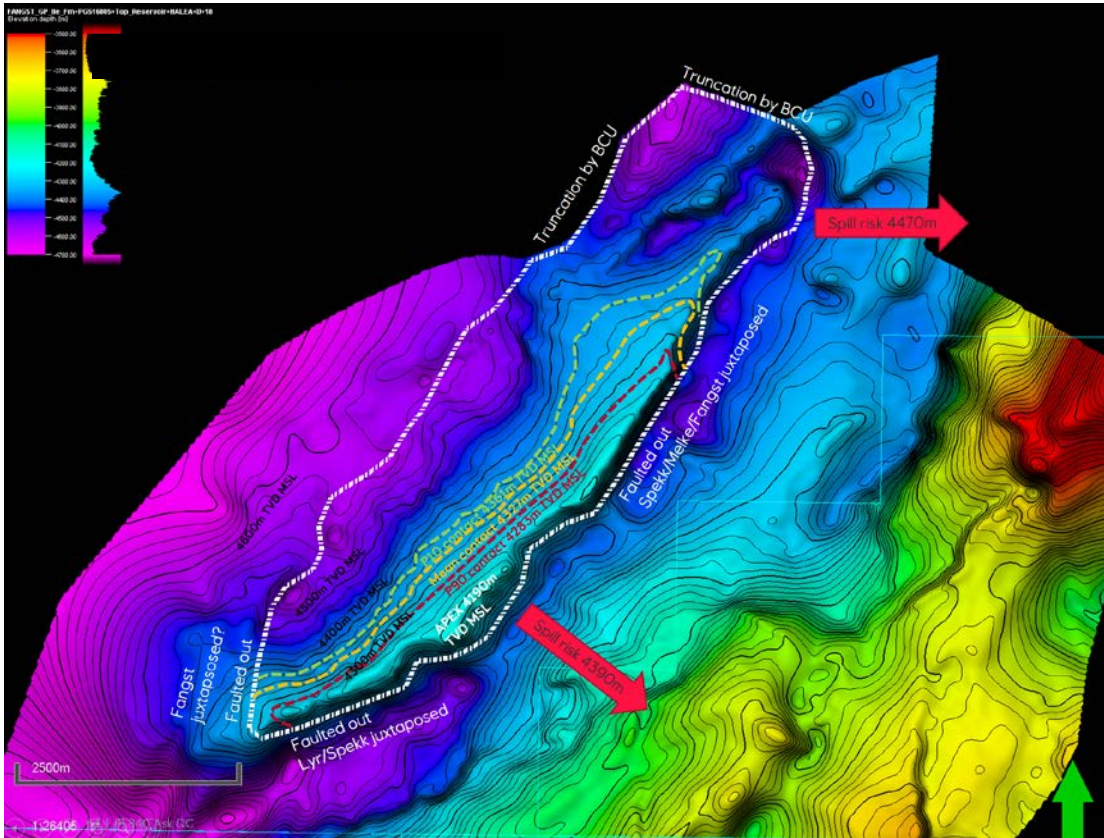


Figure 4 - Prospect definition with contact distributions and spill point.

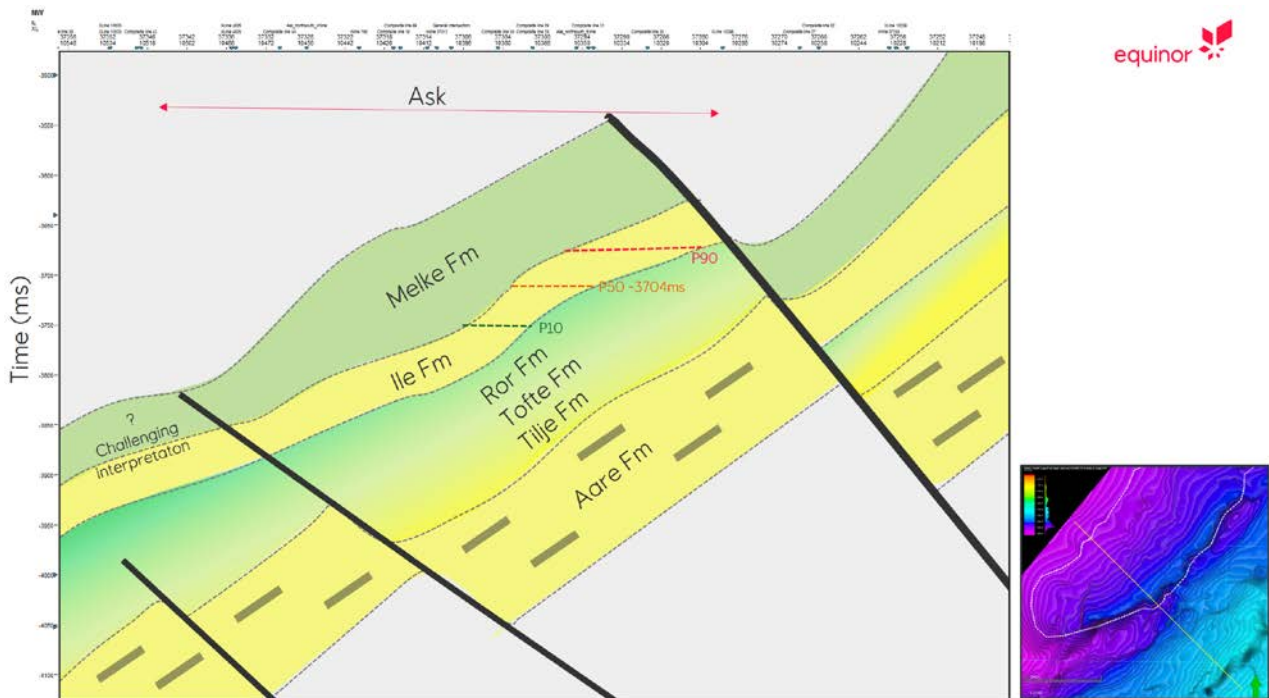


Figure 5 – Conceptual cross section of the Ask prospect with sand intervals in yellow and shale in green, including the contact distribution uncertainty

AVO (Class 2&3)  
 Minimum 5up-25ms down

Intercept (rel P-imp)  
 Minimum 5up -25ms down

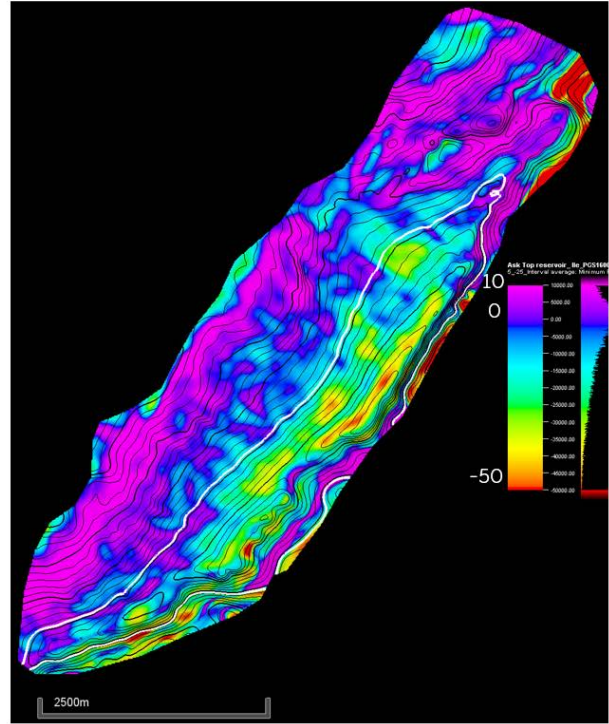
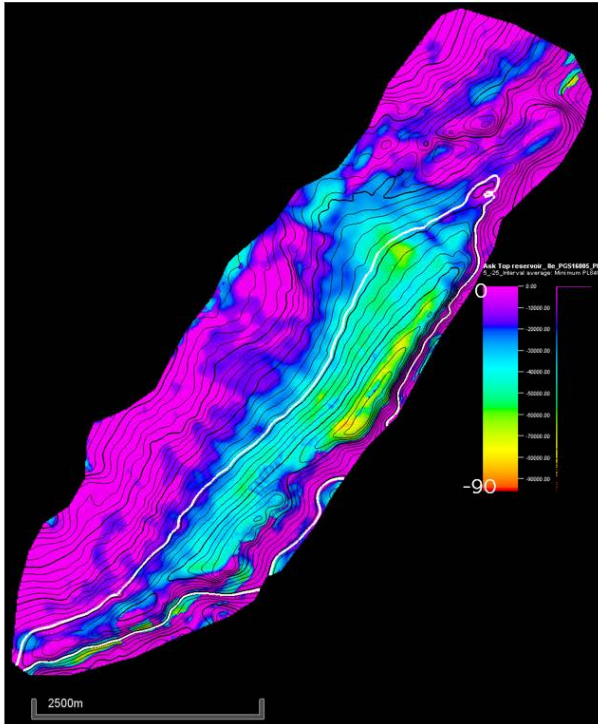


Figure 6 – PGS16005 AVO class 2&3 and intercept in an interval of 5ms up to 25ms down showing a relatively depth conform amplitude in the Ile Fm.

PGS16005 PSDM – AVO (IL 37432) : (from n,m,f as rel.imp)

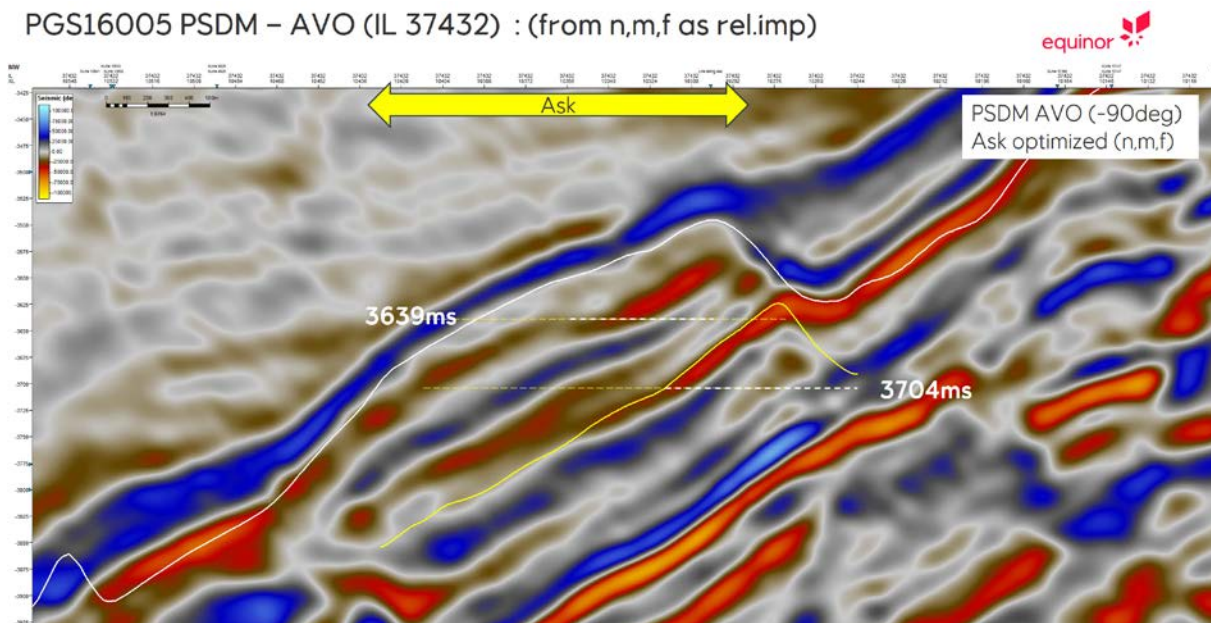


Figure 7 – Seismic cross section through the Ask prospect showing the PGS16005 PSDM AVO response with a brightening in Ile above 3704ms and a brightening in possible Melke sands above 3639ms. Volume potential in Melke sandstones was not analysed for the purpose of this work.

## 5 Technical evaluation

Considering the limited in place volumes and prospect area, the technical/economical evaluation of the Ask prospect contained a lean development solution with a single gas producer from a single-slot template with subsea tie-back to Norne.

The Net Present Value (NPV) after tax related to this development solution resulted negative, at -14,9 MUSD. The internal rate of return (IRR) is -4.6% and break-even Brent blend price ends at 229 USD/bbl.

This evaluation includes a 332 MNOK exploration discovery well cost, no appraisal wells and a production well cost of 582 MNOK a single horizontal gas producer at a depth of around 4200 m TVD MSL. Potential fracing costs were not included in these first pass estimates.

The total development costs for facilities are estimated at 1964 MNOK and the OPEX 14 MNOK/year including drilling. Permanent P&A is estimated to be 237 MNOK.

HPHT measures are not included in the well cost but are estimated to be about 110 MNOK. There furthermore is a risk related to a need for improved pipe insulation due to flow assurance issues.

The said development solution is very lean, and additional appraisal wells and producers may be needed to reach the 60% recovery factor indicated here. Please note that the 60% recovery refers to a production solution including fracing technology, while no costs for fracing were included in the economical evaluation.

When not including fracing in the evaluation, the production profile decreases substantially (Figure 2) and commerciality of the development worsens even further.

Prospect	Rec. volume (Mean GS <sub>m3</sub> Equinor share)	P <sub>g</sub>	Expected value (mUSD)	Expected B/E (USD/bbl)	Expected IRR	B/E@DG3 (USD/bbl)
Ask	0,29	18.5%	-14.9	229	-4.6%	NA

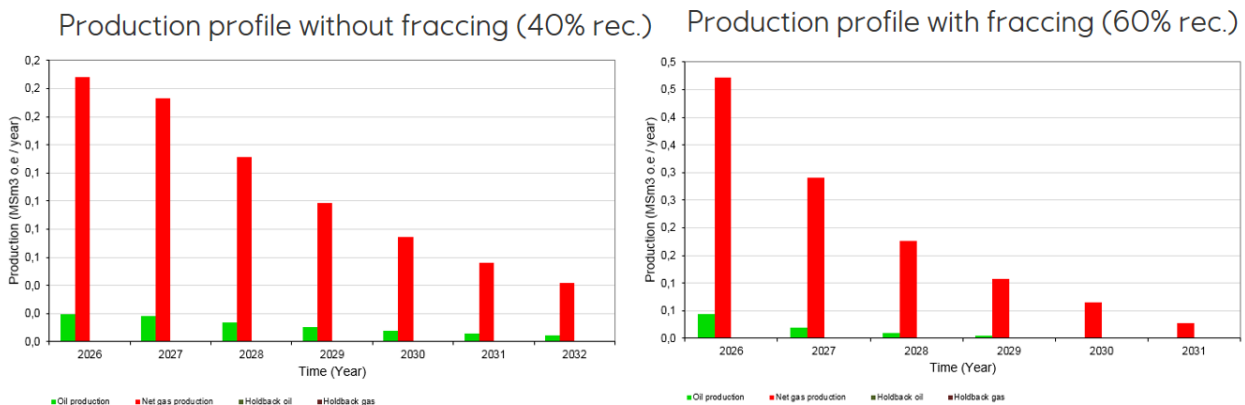


Figure 8 – Production profiles with and without fracing (note Y-axis scale difference)

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## 6 Conclusion

A drill decision in PL840 was to be taken within 05.02.2019. Licence prospectivity was evaluated based on the PGS16005 survey, that was delivered half a year later than expected - leaving limited time to do all assessments needed to take the decision to drill. Main prospectivity was evaluated to be within the Jurassic Ile Fm., with the Ask prospect as the main prospect. Conclusion after extensive analysis and QC has however been that the Ile Fm in Ask has a too low volume potential and low associated probabilities to be a business driver for a drill decision.

Further prospectivity is seen within the Cretaceous Lange and Lysing Fms. Unfortunately, the current 3D seismic quality of PGS16005 in these strata is too low to mature the prospects to drilling candidates. An ongoing regional reprocessing of the PGS16005 data with focus on Cretaceous is expected to improve the seismic quality, but the partners in PL840 voted against participation in this reprocessing and a related proposed license extension.