# PL1006 Licence Status Report

## Summary

PL1006 is in the Norwegian Sea on the western margin of the Halten Terrace straddling the transition from the northern part of the Sklinna Ridge into the Rås Basin. The license was awarded through APA 2018 with the Late Cretaceous Griffon Vulture prospect being the main opportunity. The prospectivity has been evaluated using good quality reprocessed seismic data, but no further derisking potential has been identified. Prospect maturation has led to a reduction in volume potential for the Griffon Vulture due to a downgrade in expected reservoir. In summary the license has failed to identify any opportunities to mature further following a drill decision, due to low volume potential and/ or low probability of success. A drop decision for PL1006 has been agreed in the license as no drilling candidate can be identified in the license at this time.

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# 1 Key License History

PL1006 is in the Norwegian Sea on the western margin of the Halten Terrace straddling the transition from the northern part of the Sklinna Ridge into the Rås Basin (Figure 1-1). The license covers 1137 km$^2$ and covers parts of blocks 6405/3, 6406/1, 6505/12 and 65006/12.

The license was awarded on 01.03.2019 following an APA2018 application with seismic reprocessing and G&G studies commitments and an initial drill or drop (DoD) decision to be taken within 01.03.2021 (1-yr extension granted until 01.03.2022).

The partners are Equinor (70%, Op) and DNO Norge AS (30%) and the focus of the application was on Cretaceous Lange Fm. prospectivity following the recent Turonian discovery of Hades in PL644. The strategy was to acquire acreage in the area south and downflank to Hades as seismic data indicated the underlying (Cenomanian) fairway to Hades (Turonian) continued further south. Additional support came from two wells drilled by ENI to the south of the Sklinna ridge, targeting a large BCU 4-way closure but made a small sub-commercial discovery in the Lange Fm.

## 1.1 License Meetings Held

**Table 1-1:** License meetings held

| Date | License Meeting |
|---|---|
| 08.05.2019 | EC-MC Meeting No. 1 |
| 26.11.2019 | EC-MC Meeting |
| 11.09.2020 | EC Work Meeting |
| 09.11.2020 | EC-MC Meeting |
| 12.11.2021 | EC-MC Meeting |
| 11.02.2022 | EC Work Meeting |

## 1.2 Reason for surrender

The prospectivity has been evaluated on good quality reprocessed seismic data. Prospect maturation has failed to identify any opportunities to mature further following a drill decision, due to low volume potential and/ or low probability of success. A drop decision for PL1006 has been agreed in the license as no drilling candidate can be identified in the license at this time.

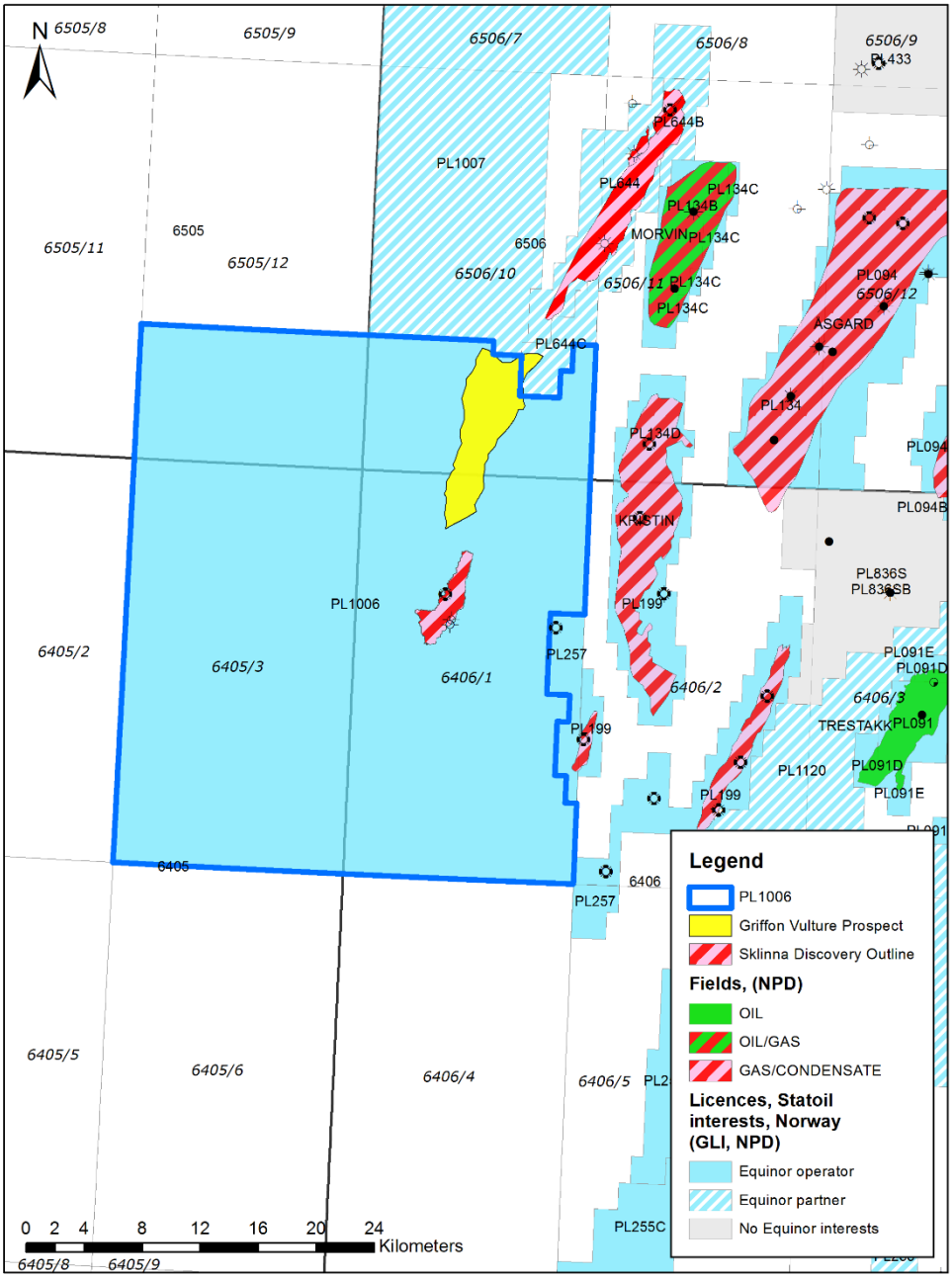


**Figure 1-1:** Location map for PL1006 with prospects, fields and wells.

## 2 Database Overview

### 2.1 Seismic Data

Four legacy 3D seismic surveys were included in the common database (Table 2-1, Figure 2-1). Data quality is summarized in the seismic database table (Table 2-1). The OMV13M01 survey formed the primary dataset used in the APA application and is generally of moderate seismic quality. Data quality is significantly poorer in the Lower Cretaceous section in the area and in deeper parts of the overburden (at the Upper Cretaceous Lysing Formation level). Yet, the far offset data in this survey together with MC3D-HVG2013 represent the best seismic quality in the Cretaceous interval compared to the other available surveys for the area. 25 2D lines within 12 different MNR surveys/vintages were selected to help characterise the subsurface outboard the limit of 3D coverage to the west (Table 2-2).

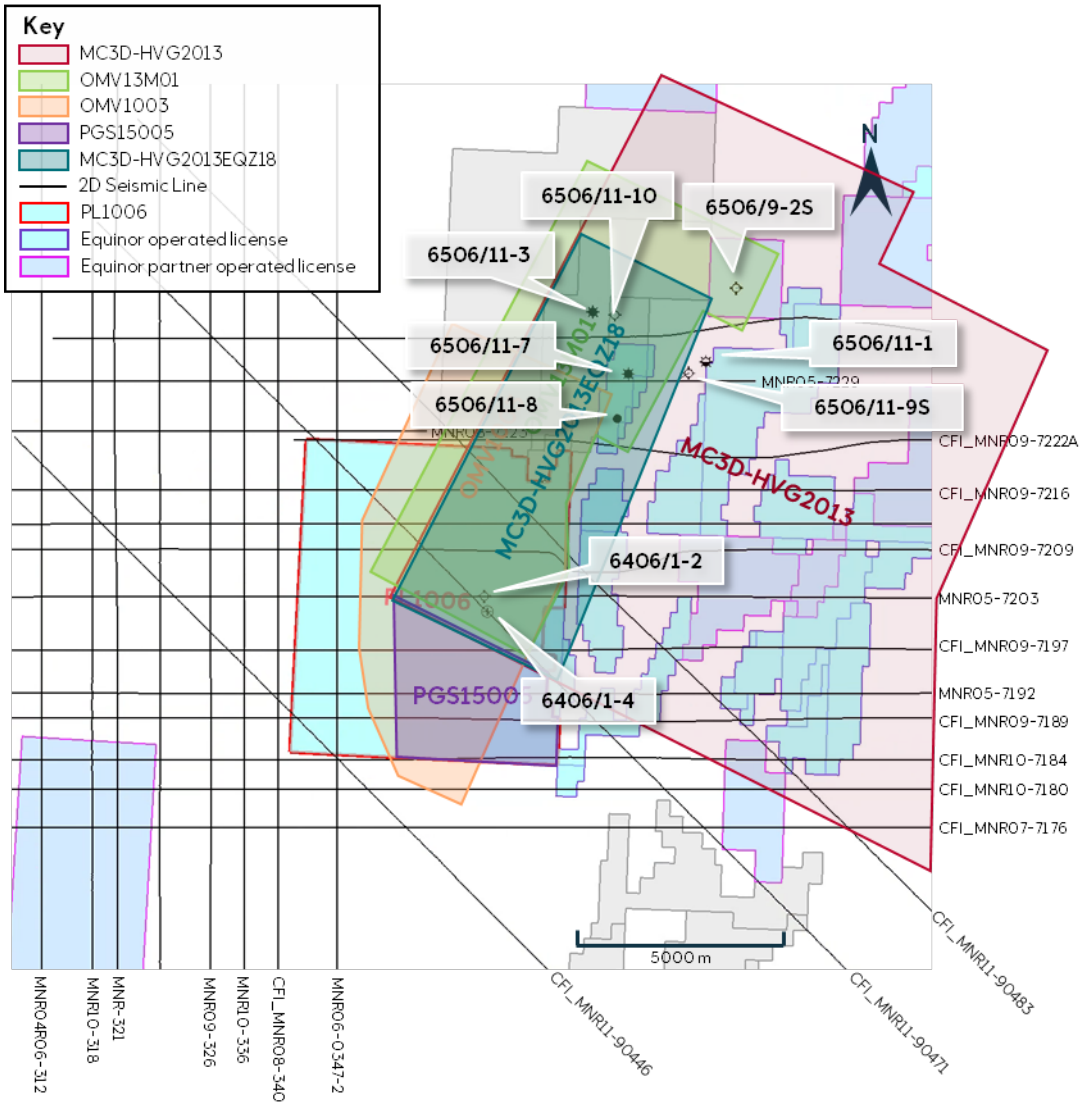


**Figure 2-1:** PL1006 common well and seismic database

**Table 2-1: 3D Common Seismic database**

| Survey | Year | Acquisition | Processing | Migration | Domain | Stacks | Area ($km^2$) | Quality |
|---|---|---|---|---|---|---|---|---|
| MC3D-HVG2013 | 2013 | (PGS) GeoStreamer broadband | PGS (Includes merge of HVG2011 and ST9905) | KPSTM / PSDM | Time / Depth | Raw full, final full and angle stacks | 3962 | Moderate / poor |
| OMV13M01 | 2013 | Merge of OMV13001, OMV1003 and CE0801 | DUG | PSTM | Time | Raw, Final full offset stacks, velocity data | 1125 | Moderate |
| OMV1003 | 2020 | (PGS) Conventional single sensor streamers (8x8 km) with dual source | CCG Veritas | PSTM | Time | Raw, final full and partial angle stacks, pre-stack gathers, velocity data | 1001 | Moderate / poor |
| PGS15005 | 2015 | (PGS) GeoStreamer broadband (12x8 km) | PGS | PSTM / PSDM | Time / Depth | Raw and final full and angle stacks, gathers and velocity models | 389 | Moderate / poor |
| MC3D-HVG2013EQZ18 | 2019 | Merge of HVG2013, HVG2011 and ST9905 | DUG | Anisotropic PSDM | Depth Time | Raw and final full and angle stacks, gathers, anisotropy and velocity data | 936 | Good |

**Table 2-2:** 2D Common Seismic Database

| Survey Lines | Stack Versions |
|---|---|
| CFI_MNR07-7176<br>CFI_MNR07-7184<br>CFI_MNR08-340<br>CFI_MNR09-7189<br>CFI_MNR09-7197<br>CFI_MNR09-7209<br>CFI_MNR09-7216<br>CFI_MNR09-7222A<br>CFI_MNR09-7234A<br>CFI_MNR10-7180<br>CFI_MNR10-7212<br>CFI_MNR11-90446<br>CFI_MNR11-90471<br>CFI_MNR11-90483 | far32_raw<br>ufar32_raw<br>mig32<br>nea32_raw<br>mid32_raw |
| MNR04R06-312 | ang05_20_16<br>ang25_40_16<br>ang15_30_16<br>ang35_50_16 |

| Survey Lines | Stack Versions |
|---|---|
| MNR05-7192<br>MNR05-7203<br>MNR05-7229 | nea_mid32<br>NearMidNG<br>FarMidNoG<br>FarNoGain<br>NearNoGai<br>far_mid32<br>nea320001<br>FullAmpNG<br>mig160001<br>far320001 |
| MNR08-7223 | ang25_40_16<br>ang15_300<br>ang05_20_16<br>ang35_50_16<br>ang25_400<br>ang05_200<br>mig320001<br>ang15_30_16<br>ang35_500 |
| MNR-321 | far320001<br>mig32_16 |

| Survey Lines | Stack Versions |
|---|---|
| MNR06-0332<br>MNR06-0347-2 | far320001<br>mig320001<br>ang05_20_16<br>nea_mid32<br>FullAmpNG<br>nea320001<br>far_mid32<br>FarNoGain<br>FarMidNoG<br>ang15_30_16<br>NearNoGai<br>NearMidNG<br>ang35_50_16<br>ang25_40_16 |
| MNR09-326<br>MNR10-318<br>MNR10-336 | far320001<br>nea320001<br>mig320001<br>ang25_40_16<br>far_mid32<br>ang35_50_16<br>ang05_20_16<br>nea_mid32<br>mig32_16<br>ang15_30_16 |

## 2.2 Well Data

9 wells were included in the common well database (Table 2-4).

**Table 2-3:** Common well database

| Well | Year | Operator | Status | Formation at TD |
|---|---|---|---|---|
| 6506/11-10 | 2017 | OMV | Gas discovery in Lange Fm and Garn Fm | Ror Fm |
| 6506/11-3 | 1992 | Statoil | Shows in Lange Fm | Not Fm |
| 6506/9-2S | 2010 | Centrica | Week shows in Lange Fm | Åre Fm |
| 6506/11-1 | 1987 | Statoil | Weak shows in Lange Fm | Åre Fm |
| 6506/11-9S | 2012 | Centrica | Shows in Lange Fm | Åre Fm |
| 6506/11-7 | 2001 | Statoil | Very weak shows in Lange Fm | Åre Fm |
| 6506/11-8 | 2006 | Statoil | Very weak shows in Lange Fm | Tilje Fm |
| 6406/1-2 | 2003 | Agip | Gas discovery in Lange Fm | Red beds |
| 6406/1-4 | 2007 | Eni | Shows in Lange Fm | Red beds |

# 3 Results of Geological & Geophysical Studies

The following G&G studies were carried out in the license evaluation:

- Seismic reprocessing
- Seismic interpretation and mapping
- Geophysical observations and AVO assessment
- Prospect evaluation

## 3.1 Seismic Reprocessing

The seismic reprocessing commitment was met using a sub-cube of the Equinor 2018 DUG reprocessed HVG2013 data with focus on Cretaceous (Table 2-1). The sub-cube covers 936 $km^2$ and includes Hades well 6506/11-10 and the Cenomanian-Turonian turbidite fairway along the Sklinna Ridge towards the north of PL1006 (Figure 2-1). Reprocessing started from the P-up original gathers. The data was reprocessed by DUG in their London office to improve imaging of Cretaceous layers and focused on denoising, removing multiples, and creating an improved velocity model incorporating anisotropy parameters. The data was processed through a broadband anisotropic Kirchhoff prestack depth migration processing sequence. The input data consisted of three 3D surveys, HVG2013 being the main, while data from HVG2011 and ST9905 were used to fill the rig hole and ensure a full coverage migrated output polygon. A post migration processing sequence consisting of a comprehensive noise and multiple attenuation was applied to push the signal to noise ratio without compromising the AVO response. Final statics were applied to the data. Since the area of reprocessing was quite large, interbedded multiples were not removed.

To improve imaging of the Cretaceous layers, a new anisotropic velocity model was created by DUG. The model was derived by 5 iterations of tomography. Wells with good quality, reliable sonic data from sea surface to BCU were included in the velocity model building and comprise: 6506/11-2, 6406/3-1, 6406/3-2, 6506/11-8, 6506/11-10,6406/3-3 and 6506/12-7. These were tied at Top Kai, Base Tertiary, Near top Lysing, an Early Turonian reflector and the BCU. For improving gather flatness for far and ultrafar offsets, an epsilon scan was run after iteration 5 of tomography resulting into a laterally varying epsilon field. Misties are low with values of less than 1% of the layer's thicknesses. The reprocessing result is good quality seismic data sufficient for interpretation and geophysical analysis.

## 3.2 Seismic Interpretation and Mapping

Seismic interpretation of key horizons was re-evaluated using the new reprocessed data set. Locally, faults were verified or remapped. This resulted in a new set of time and depth structure maps. The maps were used to create amplitude extractions to look for features to aid the interpretation of reservoir and/or hydrocarbon presence. The updated structure maps did not significantly impact the prospects and leads outlines or gross rock volumes.

### 3.3 Geophysical observations and AVO assessment

Minimum amplitude extractions using the reprocessed seismic dataset confirmed the amplitude anomaly at Griffon Vulture identified in the APA application. Some issues were found with larger angle stack (stronger tuning effects, possible remaining multiples) and thus angle stacks were limited in the quantitative AVO analysis.

Fluid substitution modelling focusing on the Breiflabb and Smørflyndre reservoir levels based on the wells in the common database including the Hades appraisal wells was completed. A soft response for sandstone on was seen for all offsets from modelling in 6506/11-10. It is possible to recognise the sand/shale response from a clear decrease in Vp/Vs and density. The modelling suggests an AVO class III for hydrocarbon bearing Cenomanian reservoir sandstones with expected visible fluid effect for good quality sandstones and sufficient gas saturation. The modelling showed that is it difficult to differentiate the fluid and lithology effects with poorer properties (lower porosity) and lower saturations comparable to those seen in nearby wells.

A slight P impedance softening in some parts of the Griffon Vulture prospect was seen. Amplitude anomalies extracted from the Lithology (EEI-50) cube suggest sand presence in the Cretaceous prospects. Some fluid anomalies and AVO effect were visible in the prospect from the Fluid (EEI+14) cube, but not clear within the whole of the Griffon Vulture prospect. Fluid effect can be detected as well outside of the Griffon prospect. However, it is not easy to argue that the fluid effect is not only due to sand response based on the modelling. Some partly depth conformance shut-off was also identified in places, but likewise not for the entire prospect.

An AVO screening study found limited evidence for hydrocarbon indications from seismic amplitudes throughout the Cretaceous section in the license area.

## 4 Prospect Update Report

### 4.1 Griffon Vulture

The Griffon Vulture is an amplitude driven Lange Fm. prospect defined downflank to the Hades discovery as the continuation of the underlying Cenomanian turbiditic sandstone fairway passing over a saddle in the Sklinna Ridge (Figure 4-1). Reservoir quality was initially predicted using nearby wells available at the time in the APA application, and carries some risk due to the unpredictability and generally low quality of Lange Fm. reservoirs in addition to the rather distal position of Griffon with respect to the Lange Fm. feeder systems. Reservoir quality was revised integrating the results of two Hades appraisal wells (6506/11-11S and 11-12S) and an improved understanding of the Lange Fm. turbidite systems from a regional internal R&D study. In conclusion whilst the P90-P10 range was narrowed a general downgrade in reservoir quality was applied.

The trap is complex defined as combined structural/stratigraphic with an E-W faulted anticline and a N-S pinch-out component. Trap/seal forms the key risk for Griffon due to significant uncertainty in apex and overpressure and thus trap seal integrity and potential column heights. In addition to a reliance on a functioning fault membrane seal and/or pinch-out in the northeast to hold an attractive column. Even with improved Cretaceous imaging from the reprocessing unravelling the complexity in the northeast remained challenging being at the limits of seismic resolution meaning a high trap/seal risk remained.

An AVO revisit on the new seismic data failed to provide conclusive DHI results for Griffon Vulture. Whilst positive indications for reservoir (sand) presence could be detected only hints of possible fluid effects were detected, with

limited to no depth-conformance. Discriminating between low saturation gas and notable tuning effects impacted the final assessment. In summary, Griffon Vulture remains a high risk, challenging prospect concept, with only limited resource potential. Hence is currently not attractive enough to be prioritized as a drilling candidate due to small resource size and high associated risk.

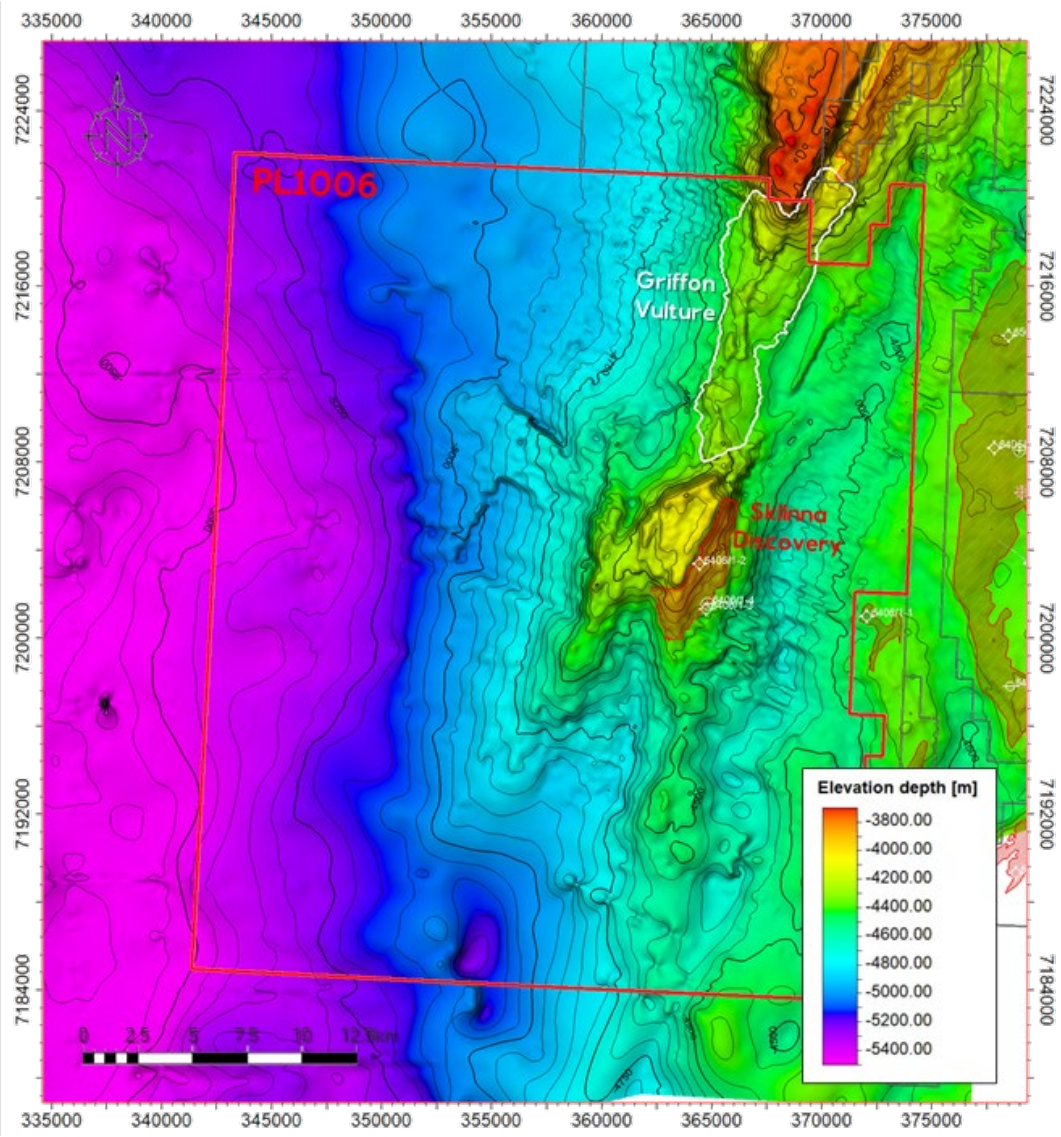


**Figure 4-1:** Top Cenomanian (Smørflyndre) reservoir map.

## 5 Technical Evaluation

The opportunity located within PL1006 remain (very) high risk. Given recent experience with regards to producing Cretaceous deepwater reservoirs, the resource potential for Griffon Vulture is marginal and not sufficient to be matured as a potential candidate for drilling an exploration well

## 6 Conclusion

The work programme for PL1006 has been fulfilled. The main prospect (Griffon Vulture) has been evaluated within the specified time frame and numerous geological and geophysical studies have been completed. Based on lack of attractive prospects (moderate hydrocarbon volumes and/or high geological risk) the PL1006 partnership agreed to drop the licence.

# 7 Appendix

**Table 7-1:** Griffon Vulture Prospect Data - Gas

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Block | 6506/10 | Prospect name | Griffon Vulture | 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 | Equinor AS | Reference document | | | | Assessment year | 2021 |
| This is case no.: | 1 of 2 | Structural element | Sklinna Ridge | Type of trap | Struc/strat | Water depth [m MSL] (>0) | 400 | 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) | | | | | 0,20 | 0,28 | 0,37 | 0,59 |
| | Gas [$10^9$ $Sm^3$] (>0.00) | 2,52 | 3,43 | 4,67 | 7,44 | | | | |
| Recoverable resources | Oil [$10^6$ $Sm^3$] (>0.00) | | | | | 0,08 | 0,12 | 0,17 | 0,28 |
| | Gas [$10^9$ $Sm^3$] (>0.00) | 0,67 | 1,07 | 1,64 | 2,83 | | | | |
| Reservoir Chrono (from) | Cretaceous Late;Cenoma | Reservoir litho (from) | CROMER KNOLL G | Source Rock, chrono primary | Upper Jurassic | Source Rock, litho primary | Spekk Fm | Seal, Chrono | Cenomanian |
| Reservoir Chrono (to) | Cretaceous Late;Cenoma | Reservoir litho (to) | CROMER KNOLL G | Source Rock, chrono secondary | Cenomanian | Source Rock, litho secondary | Lange Fm | Seal, Litho | Lange Fm |
| **Probability [fraction]** | | | | | | | | | |
| Total (oil + gas + oil & gas case ) (0.00-1.00) | 0,10 | Oil case (0.00-1.00) | 0,10 | Gas case (0.00-1.00) | 0,90 | Oil & Gas case (0.00-1.00) | 0,00 | | |
| Reservoir (P1) (0.00-1.00) | 0,83 | Trap (P2) (0.00-1.00) | 0,13 | Charge (P3) (0.00-1.00) | 0,89 | Retention (P4) (0.00-1.00) | 1,00 | | |
| **Parametres:** | Low (P90) | Base | High (P10) | *Comments* | | | | | |
| Depth to top of prospect [m MSL] (> 0) | | 3925 | | | | | | | |
| Area of closure [$km^2$] (> 0.0) | 9,1 | 13,7 | 22,3 | | | | | | |
| Reservoir thickness [m] (> 0) | 33 | 47 | 62 | | | | | | |
| HC column in prospect [m] (> 0) | 252 | 297 | 359 | | | | | | |
| Gross rock vol. [$10^9$ $m^3$] (> 0.000) | 0,227 | 0,558 | 0,844 | | | | | | |
| Net / Gross [fraction] (0.00-1.00) | 0,20 | 0,30 | 0,42 | | | | | | |
| Porosity [fraction] (0.00-1.00) | 0,12 | 0,14 | 0,15 | | | | | | |
| Permeability [mD] (> 0.0) | | 10,0 | | | | | | | |
| Water Saturation [fraction] (0.00-1.00) | 0,45 | 0,40 | 0,35 | | | | | | |
| Bg [Rm3/Sm3] (< 1.0000) | 0,0028 | 0,0029 | 0,0029 | | | | | | |
| 1/Bo [Sm3/Rm3] (< 1.00) | | | | | | | | | |
| GOR, free gas [$Sm^3/Sm^3$] (> 0) | 11074 | 12500 | 14737 | | | | | | |
| 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) | 0,20 | 0,35 | 0,50 | | | | | | |
| Recov. factor, liquid ass. phase [fraction] (0.00-1.00) | 0,30 | 0,45 | 0,60 | For NPD use: | | | | | |
| Temperature, top res [°C] (>0) | 129 | | | 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) | 700 | | | 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. Permeability < 1 mD | 2. Vshale < 0.4 | 3. | | | | | Kart nr | NPD will insert value |

**Table 7-2:** Griffon Vulture Prospect Data - Oil

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Block | 6506/10 | Prospect name | Griffon Vulture | Discovery/Prosp/Lead | Prospect | Prosp ID (or New!) | NPD will insert value | NPD approved (Y/N) | |
| Play name | NPD will insert value | New Play (Y/N) | | Outside play (Y/N) | | | | | |
| Oil, Gas or O&G case: | Oil | Reported by company | Equinor AS | Reference document | | | | Assessment year | 2021 |
| This is case no.: | 2 of 2 | Structural element | Sklinna Ridge | Type of trap | Struc/strat | Water depth [m MSL] (>0) | 400 | Seismic database (2D/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) | 3,37 | 6,28 | 6,53 | 10,30 | | | | |
| | Gas [$10^9$ $Sm^3$] (>0.00) | | | | | 0,81 | 1,03 | 1,62 | 2,54 |
| Recoverable resources | Oil [$10^6$ $Sm^3$] (>0.00) | 0,47 | 0,88 | 0,96 | 1,53 | | | | |
| | Gas [$10^9$ $Sm^3$] (>0.00) | | | | | 0,12 | 0,20 | 0,24 | 0,37 |
| Reservoir Chrono (from) | Cretaceous Late;Cenoma | Reservoir litho (from) | CROMER KNOLL G | Source Rock, chrono primary | Upper Jurassic | Source Rock, litho primary | Spekk Fm | Seal, Chrono | Cenomanian |
| Reservoir Chrono (to) | Cretaceous Late;Cenoma | Reservoir litho (to) | CROMER KNOLL G | Source Rock, chrono secondary | Cenomanian | Source Rock, litho secondary | Lange Fm | Seal, Litho | Lange Fm |
| **Probability [fraction]** | | | | | | | | | |
| Total (oil + gas + oil & gas case ) (0.00-1.00) | 0,10 | Oil case (0.00-1.00) | 0,10 | Gas case (0.00-1.00) | 0,90 | Oil & Gas case (0.00-1.00) | 0,00 | | |
| Reservoir (P1) (0.00-1.00) | 0,83 | Trap (P2) (0.00-1.00) | 0,13 | Charge (P3) (0.00-1.00) | 0,89 | Retention (P4) (0.00-1.00) | 1,00 | | |

| **Parametres:** | Low (P90) | Base | High (P10) | *Comments* |
|---|---|---|---|---|
| Depth to top of prospect [m MSL] (> 0) | | 3925 | | |
| Area of closure [$km^2$] (> 0.0) | 9,1 | 13,7 | 22,3 | |
| Reservoir thickness [m] (> 0) | 33 | 47 | 62 | |
| HC column in prospect [m] (> 0) | 252 | 297 | 359 | |
| Gross rock vol. [$10^9$ $m^3$] (> 0.000) | 0,227 | 0,558 | 0,844 | |
| Net / Gross [fraction] (0.00-1.00) | 0,20 | 0,30 | 0,42 | |
| Porosity [fraction] (0.00-1.00) | 0,12 | 0,14 | 0,15 | |
| Permeability [mD] (> 0.0) | | 10,0 | | |
| Water Saturation [fraction] (0.00-1.00) | 0,45 | 0,40 | 0,35 | |
| Bg [Rm3/Sm3] (< 1.0000) | | | | |
| 1/Bo [Sm3/Rm3] (< 1.00) | 0,43 | 0,48 | 0,53 | |
| GOR, free gas [$Sm^3/Sm^3$] (> 0) | | | | |
| GOR, oil [$Sm^3/Sm^3$] (> 0) | 200 | 250 | 300 | |
| Recov. factor, oil main phase [fraction] (0.00-1.00) | 0,12 | 0,15 | 0,18 | |
| Recov. factor, gas ass. phase [fraction] (0.00-1.00) | 0,12 | 0,15 | 0,18 | |
| Recov. factor, gas main phase [fraction] (0.00-1.00) | | | | |
| Recov. factor, liquid ass. phase [fraction] (0.00-1.00) | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | For NPD use: | | | | | |
| Temperature, top res [°C] (>0) | 129 | | | 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) | 700 | | | 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. Permeability < 1 mD | 2. Vshale < 0.4 | 3. | | | | | Kart nr | NPD will insert value |