# PL 1011 – Licence status report

## Summary

The PL1011 licence was located in the southeastern part of the Trøndelag Platform, along the boundary with the Froan Basin. The PL1011 licence was applied for during the APA2018 application round and awarded in 2019. Equinor Energy AS was granted operatorship of the licence together with licence partner Lundin Energy Norway AS.
The main prospective intervals in this licence were defined within the Paleozoic and Lower to Middle Triassic. This play has so far been tested with limited success within the Norwegian Sea and as result of this, high risk was related to the licence prospectivity. The first 2 years of the licence were dedicated to G&G technical work and evaluation of the results from the 6307/1-1 S well, which would test similar play elements in the Froan basin. Subsequently, a decision to continue and acquire 3D data within the licence was to be made. The results of the 6307/1-1 S well did however not provide sufficient uplift to derisk some of the key play risk elements the PL1011 licence had to deal with. Consequently, it was decided not to proceed with the licence. The licence was dropped on 01.03.2022.

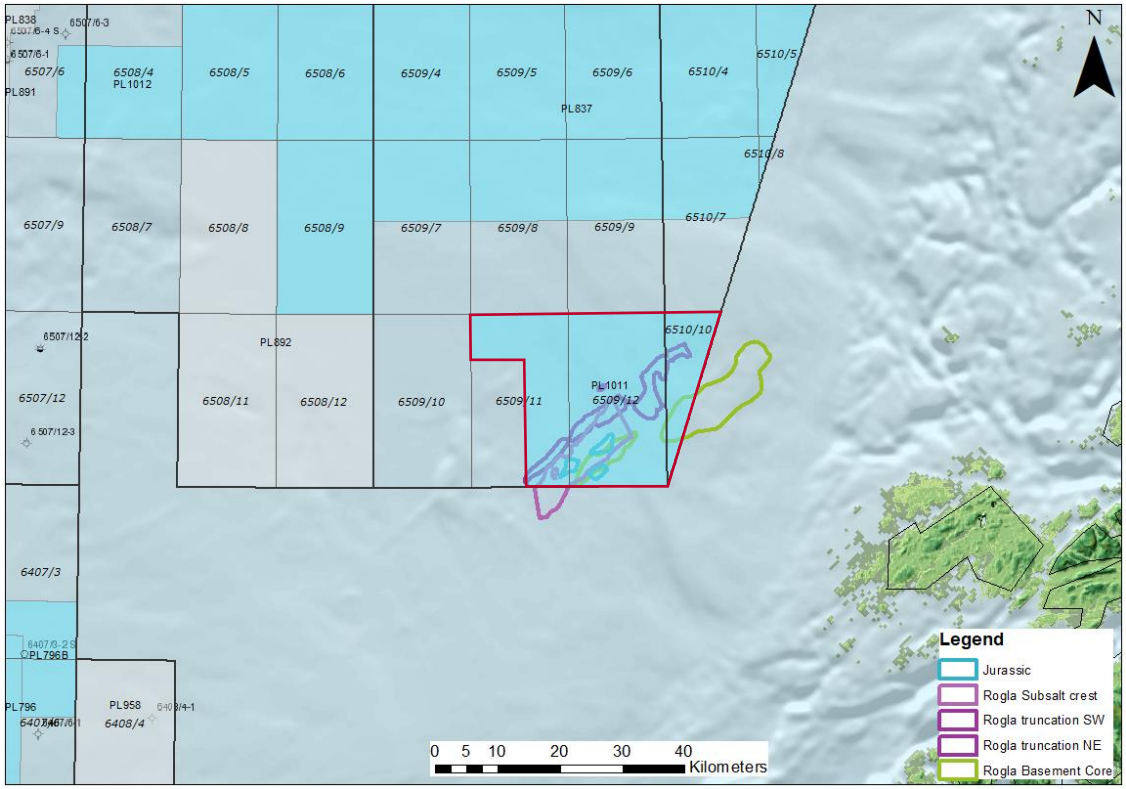

**Table of contents**

# Contents

# 1 Licence history

**Licence:** PL1011

**Awarded:** 01.03.2019

**License period:** Expires 01.03.2028
Initial period: 9 years

**License group:**

| | |
|---|---|
| Equinor Energy AS | 60% (Operator) |
| Lundin Energy Norway AS | 40% |

**License area:** 822.82 km$^2$

**Work programme:**

| | | |
|---|---|---|
| Technical G&G work | 01.12.2020 | Fullfilled |
| Acquire new 3D seismic | 01.03.2022 | Exempt |
| Drill exploration well | 01.03.2024 | Not to be fulfilled |
| Conceptual studies | 01.03.2026 | Dropped |
| Prepare plan for development | 01.03.2028 | Dropped |

**Meetings held:**

| | |
|---|---|
| 24.04.2019 | EC/MC startup meeting |
| 02-03.10.2019 | EC work meeting – Field workshop |
| 12.11.2019 | EC/MC meeting |
| 09.07.2020 | EC work meeting |
| 26.10.2020 | EC/MC meeting |

**Work performed:**

| | |
|---|---|
| 2019: | Licence start-up. |
| 2019: | GnG work: fractured basement reservoir |
| | Field workshop Basement reservoir characterization |
| 2020: | NGU Gravmag study |
| | Basin modeling |
| | Decision made to acquire 3D seismic. Due to a non-unanimous decision, the operator was required to find a new partner |
| 2021 | BD activity |
| | Surrender of licence |

**Reason for surrender:**

The PL1011 licence was acquired to further investigate the presence of a deeper permotriassic petroleum system within the Norwegian Sea. This play is tested by several wells on the Nordland Ridge and in 2019 the 6307/1-1 S well aimed to test the extend of the play within the Froan basin.

The licence carried a high risk related to source presence and reservoir quality, whilst, even though identified on old vintage 2D lines, this area indicated presence of potential 4-way closures at basement level (buried hill) and truncational traps within the Triassic strata onlapping the basement. The different traps are referred to as the Rogla prospects.

The first licence milestone, decision to acquire 3D seismic, targeted specifically the uncertainty related to trap definition and gross rock volumes. Additionally, the licence envisaged that given the presence of good source rock

downflank of the prospect has the potential to be identified on AVO attributes. These attributes would eventually also help to derisk hydrocarbon presence.
Despite all the uplift, the acquisition of the new seismic dataset could bring, still several risks and uncertainties would be difficult to derisk. This, combined with the remote location of licence and the uncertain low oil price, made it difficult to defend going forward with the current partnership. The partnership had different view on this which result in a non-unanimous decision to acquire the 3D data. As a result, the operator had to find a new partner to acquire the 3D data as part of the licence database and to continue the work. The operator was granted a 1 month extension with deadline 01.04.2021 to find a new partner in the licence. During the subsequent BD round in Q1 2021, no other companies showed interest with a relinquishment as consequence.

# 2 Database overviews

## 2.1 Seismic data

| Seismic Survey | Lines | Vintages | 2D/3D | Acquisition | Reprocessing | Qual. |
|---|---|---|---|---|---|---|
| GMNR-94 | 105A | Full | 2D | 1994 | | Moderate |
| GMNR-94 | 105B | Full | 2D | 1994 | | Moderate |
| MNR | 518 | Full | 2D | | | Moderate |
| MNR | 7250 | Full | 2D | | | Moderate |
| MNR | 7297 | Full | 2D | | | Moderate |
| MNR | 7216B | Full | 2D | | | Moderate |
| MNR | 7229C | Full | 2D | | | Moderate |
| MNR05 | 7282 | Full | 2D | 2005 | | Moderate |
| MNR06 | 7260 | Full | 2D | 2006 | | Moderate |
| MNR06 | 0525 | Full, Angle stacks | 2D | 2006 | | Moderate |
| MNR06 | 0552 | Full, Angle stacks | 2D | 2006 | | Moderate |
| MNR07 | 0540 | Full, Angle stacks | 2D | 2007 | | Moderate |
| MNR08 | 0528 | Full, Angle stacks | 2D | 2008 | | Moderate |
| MNR08 | 0532 | Full, Angle stacks | 2D | 2008 | | Moderate |
| MNR08 | 0536 | Full, Angle stacks | 2D | 2008 | | Moderate |
| MNR08 | 0546 | Full, Angle stacks | 2D | 2008 | | Moderate |
| N4PZ93 | 203 | Full | 2D | 1993 | | |
| ST8608 | 101 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 296 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 462 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 464 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 466 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 470 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 472 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 480 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 496 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 498 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 602 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 606 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 608 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 614 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 616 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 698 | Full | 2D | 1986 | 2001 | Poor |
| ST8608 | 806 | Full | 2D | 1986 | 2001 | Poor |

| | | | | | | |
|---|---|---|---|---|---|---|
| ST8708 | 288 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 292 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 474 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 478 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 482 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 486 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 488 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 490 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 493 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 494 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 610 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 613 | Full | 2D | 1987 | 2001 | Poor |
| ST8708 | 802 | Full | 2D | 1987 | 2001 | Poor |
| ST8804 | 292 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 452 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 454 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 458 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 460 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 462 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 466 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 468 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 470 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 472 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 474 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 480 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 482 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 486 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 600 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 604 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 608 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 618 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 870 | Full | 2D | 1988 | 2002 | Fair |
| ST8804 | 952 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 476 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 484 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 488 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 492 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 616 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 620 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 804 | Full | 2D | 1988 | 2002 | Fair |
| ST8808 | 808 | Full | 2D | 1988 | 2002 | Fair |
| VIWT-93 | 201 | Full | 2D | 1993 | | Moderate |

## 2.2 Well data

| Well | Year | Operator | Current Licence | Content | Age TD |
|---|---|---|---|---|---|
| NO 6307/1-1 S | 2018 | Lundin Petroleum | PL830 | D | TRIASSIC |
| NO 6407/10-3 | 1992 | Norsk Hydro Produksjon AS | PL831 | S | PRE-DEVONIAN |
| NO 6407/10-4 | 2016 | Lundin Petroleum | Open | D | PRE-DEVONIAN |

| | | | | | |
|---|---|---|---|---|---|
| NO 6407/11-1 | 2018 | Equinor Energy AS | 751 | S | E. JURASSIC |
| NO 6407/6-1 | 1984 | Den norske stats oljeselskap a.s | Open | D | L. TRIASSIC |
| NO 6407/9-7 | 1988 | A/S Norske Shell | Open | D | L. TRIASSIC |
| NO 6408/12-U-01 | 1988 | Sintef | Open | | PRE-DEVONIAN |
| NO 6408/4-1 | 1988 | Conoco Norway Inc. | Open | D | L. TRIASSIC |
| NO 6507/12-1 | 1980 | Saga Petroleum ASA | Open | D | TRIASSIC |
| NO 6507/12-2 | 1981 | Saga Petroleum ASA | Open | S | M. TRIASSIC |
| NO 6507/12-3 | 1985 | Saga Petroleum ASA | Open | D | E. JURASSIC |
| NO 6507/6-1 | 1981 | Saga Petroleum ASA | PL891 | S | E. TRIASSIC |
| NO 6507/6-4 A | 2012 | E.ON Ruhrgas Norge AS | PL838 | D | PERMIAN |
| NO 6508/5-1 | 1987 | A/S Norske Shell | Open | D | L. TRIASSIC |
| NO 6510/10-U-1 | 1982 | Sintef | Open | | PALEOGENE |
| NO 6510/10-U-2 | 1982 | Sintef | Open | | L. CRETACEOUS |
| NO 6510/10-U-3 | 1982 | Sintef | Open | | L. CRETACEOUS |
| NO 6510/10-U-4 | 1982 | Sintef | Open | | U. CRETACEOUS |
| NO 6510/10-U-5 | 1982 | Sintef | Open | | PALEOGENE |
| NO 6510/11-U-1 | 1982 | Sintef | Open | | L. JURASSIC |
| NO 6510/11-U-2 | 1982 | Sintef | Open | | L. JURASSIC |
| NO 6510/2-1 | 1997 | A/S Norske Shell | Open | S | E. TRIASSIC |
| NO 6608/8-1 | 1997 | Den norske stats oljeselskap a.s | PL841 | S | L PERMIAN |
| NO 6609/7-1 | 1983 | Phillips Petroleum Company Norway | PL762 | D | PRE-DEVONIAN |
| NO 6609/10-1 | 1983 | Saga Petroleum ASA | PL843 | D | L. TRIASSIC |
| NO 6609/10-2 | 2009 | Den norske stats oljeselskap a.s | Open | D | L. TRIASSIC |
| NO 6609/11-1 | 1983 | Norsk Hydro Produksjon AS | PL843 | D | L. TRIASSIC |
| NO 6610/7-1 | 2013 | Statoil Petroleum AS | PL1014 | D | L. TRIASSIC |
| NO 6610/7-2 | 1984 | Den norske stats oljeselskap a.s | Open | D | E. TRIASSIC |
| NO 6610/10-1 | 1983 | Den norske stats oljeselskap a.s | PL1014 | S | L. TRIASSIC |
| NO 6611/9-U-1 | 1992 | Sintef | Open | D | PERMIAN |
| NO 6611/9-U-2 | 1992 | Sintef | Open | D | PERMIAN |

## 2.3 Other Geophysical data

| Type | Dataset | Comment |
|---|---|---|
| Aeromagnetic dataset | COOP3 MBAM97-HUNTING86-UHAM09-MAINLAND | Compilation of various datasets |
| Gravimetric dataset | NGU_Compil_2009_NCS | Compilation of various datasets |

## 2.4 Studies

| Name | Year | Consortium/Research institute |
|---|---|---|
| The Mesozoic-Cenozoic succession off Helgeland | 1982 | IKU - Sintef |
| Shallow Drilling surey off Møre-Trøndelag | 1988 | IKU - Sintef |
| Shallow Drilling Helgeland | 1992 | IKU - Sintef |

# 3 Results of geological and geophysical studies

## 3.1 Structure and basement development of the Rogla High from 2D potential field modelling

The study focuses on the inner platform region located near the petroleum licence PL1011 operated by Equinor Energy AS. A 2D potential field modelling has been carried out along the MNR07-540 seismic line (by courtesy of TGS) to better assess the first order basement geometry and composition of the study area (Figure 3-1). This integrated study provides the first insights about the basement depth estimation and the lateral variation of the basement units expected from the Rogla High up to the Nordland Ridge. Considering the gravity and magnetic signatures, the modelling indicates the presence of a deeper Paleozoic Basin in the Trøndelag Platform with a maximum basement depth of 13 km modelled beneath the Helgeland Basin. The modelling suggests the dominance of high magnetisation basement rocks on the Rogla High which are likely of Precambrian age. On top of the Precambrian basement, thin and very low susceptibility Caledonian nappes or preserved Devonian rock could be expected. North of the Rogla High, the presence of deep mafic rocks with high magnetisation is also modelled at the edge of the North Vikna Lineament correlated with an old basement trend.

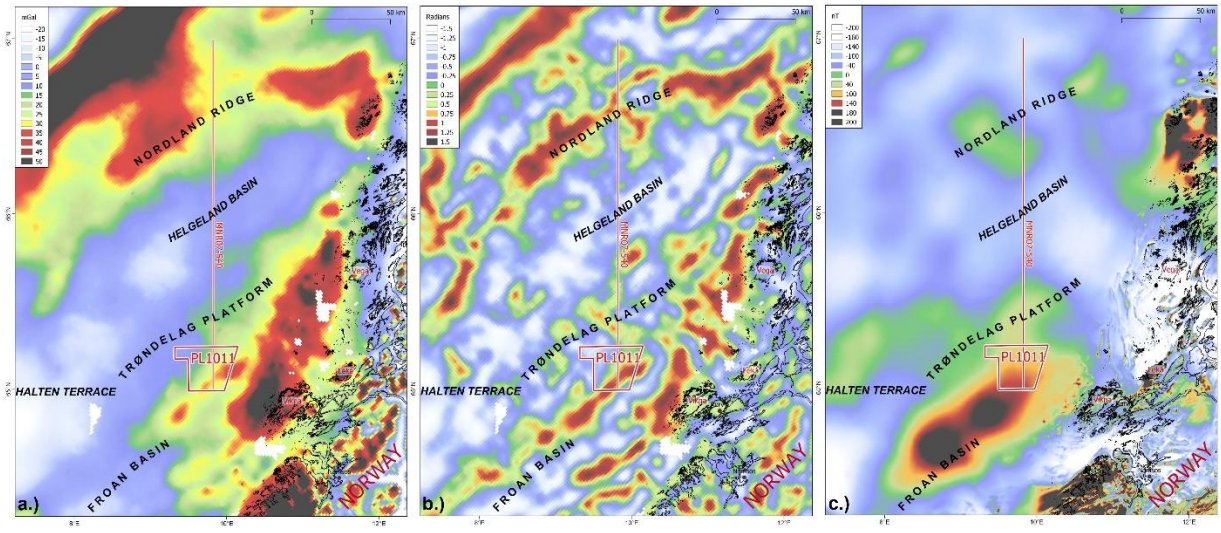


**Figure 3-1** Gravimetry and magnetic field maps showing licence and selected 2D line for modelling. (a) Free-air gravity anomaly of the Trøndelag Platform and adjacent onshore area (NGU Compilation, Olesen et al., 2010).; (b) Tilt Derivative (TDR) filter of the NGU Free-air gravity.;(c) Magnetic total field of the Trøndelag Platform and contiguous onshore area (grid after Nasuti et al., 2015a; Olesen et al., 2019).

## 3.2 Basement characterisation (part of G&G work)

As part of the reservoir characterisation for the Rogla core complex, the G&G work focused partly on characterisation of basement reservoir. The focus of this work during this first part of the G&G work was to evaluate what onshore analogues would be most suited for further characterisation. This is mainly based on the evaluation of relationships observed on seismic and the 2D potential field modelling. 2 onshore locations along major detachment zones (Kollstraumen and Høybakken) were selected (Figure 3-2) from which one site (Høybakken) was visited during the first year of this work program.
A 2 day field campaign was done within the licence to visit and examine the different structural elements in order to place them in context of the Rogla basement core (Figure 3-3).

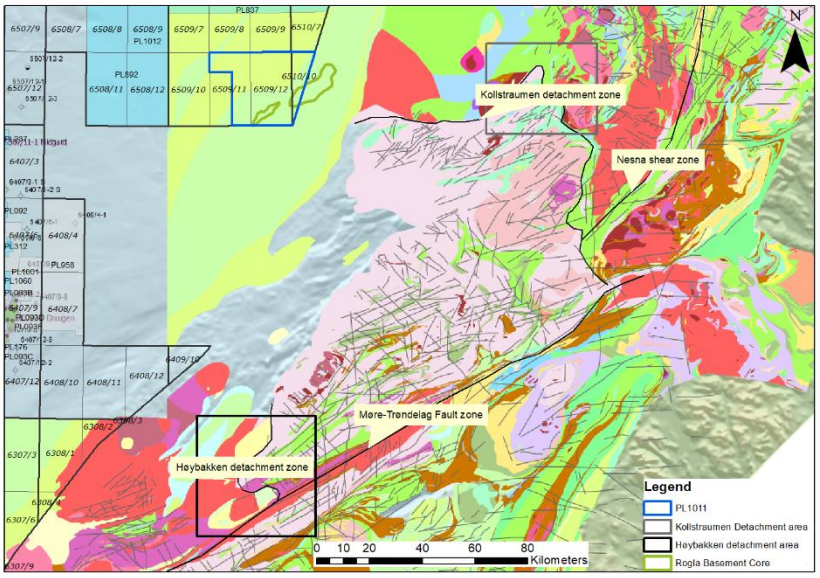


**Figure 3-2** Onshore bedrock map (NGU) with selected onshore analogue sites for the Rogla basement core.

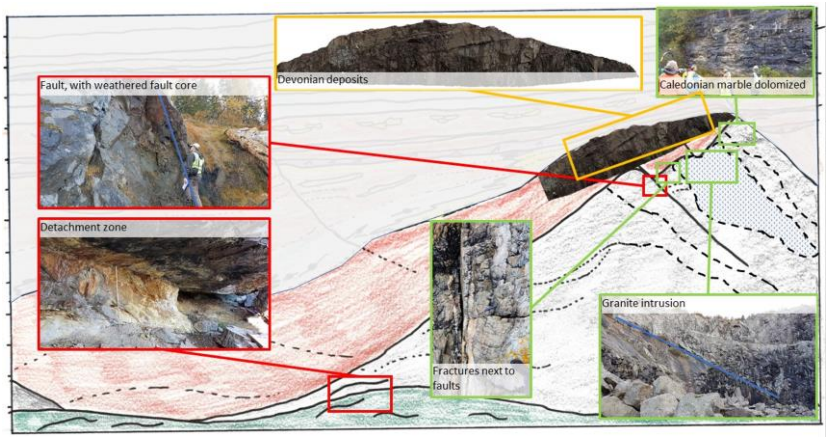


**Figure 3-3** Potential Paleozoic elements in Rogla core complex and onshore observation from and along the Høybakken detachment zone. Colour on the pictures illustrates potential for expecting better/worse basement properties

# 4 Prospect update report

The prospectivity in PL1011 was defined at 4 levels (Figure 4-1) and so far, mapped on 2D surveys. The main uncertainty at all prospects was trap definition, which was to be better constrained on the 3D seismic data in the second phase of the work program

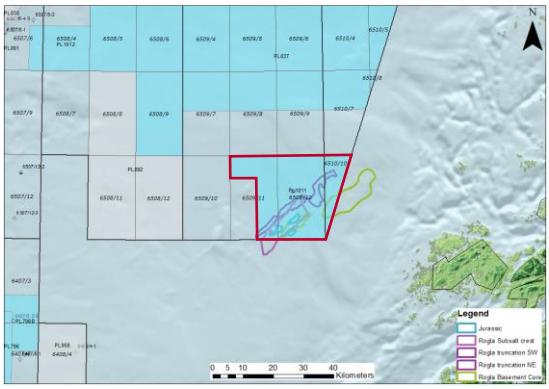


**Figure 4-1** Mapped prospectivity within PL1011

## 4.1 Rogla Triassic subsalt

The subsalt prospect is defined directly underneath the middle Triassic Evaporite. Based on the 2D maps, this prospect has a small four-way closure. To generate adequate volumes to be commercial, this prospect is depended on the presence of a lateral fault to generate a larger column (Figure 4-2). Hints of such a N-S striking fault were observed on the 2D data and are based lateral shift of the basement closures. However, the presence of a four-way closure at the crest and lateral fault was to be verified on the 3D dataset.

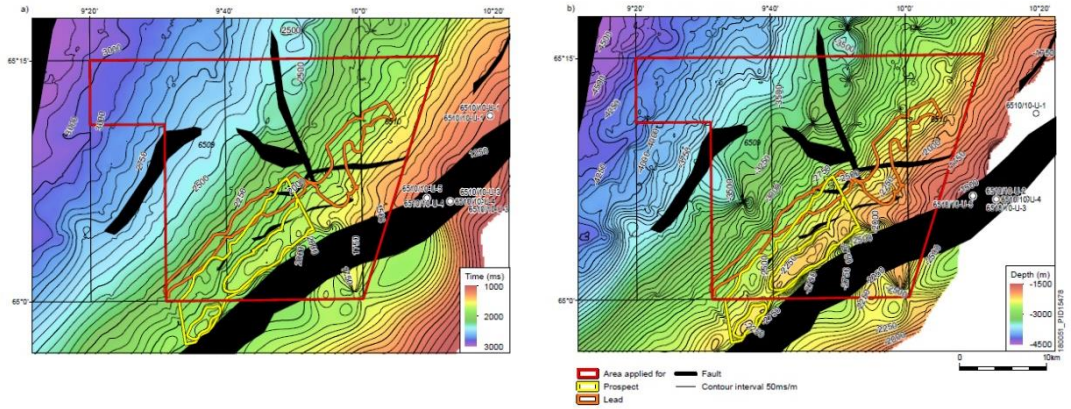


**Figure 4-2** Time and depth maps of the Triassic prospectivity. The Subsalt prospect with small four-way closure at the crest and extension along the N-S striking fault are marked in yellow, the Truncational leads are marked in orange

## 4.2 Rogla Triassic Truncation

Further down flank, clear truncational relationships are observed within the lower Triassic are observed (Figure 4-3). This led to the definition of two truncational traps (Figure 4-2). The filling of these structures is also dependent on the presence of a N-S striking fault system that could separate these different traps.

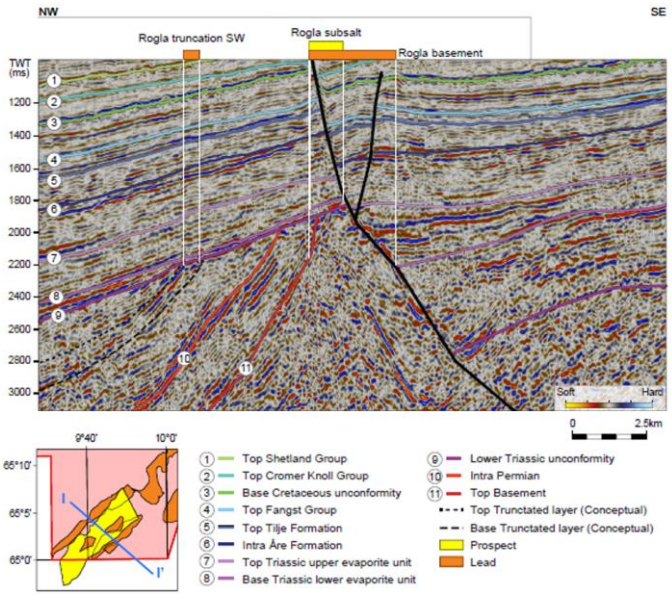


**Figure 4-3** Seismic section across the Rogla structure Even though the seismic image contains lots of noise, some clear truncational features are observed underneath the base of the lower evaporite unit.

## 4.3 Rogla Basement

The most prominent feature in the licence is the basement core complex (Figure 4-4). These structures are present as so-called buried hills along the ridge. The clear presence of these four-way closures on the 2D dataset, implied there is little uncertainty regarding their presence. The main risk related to these traps are the presence of a suitable top seal within the Triassic strata that onlap this structure.

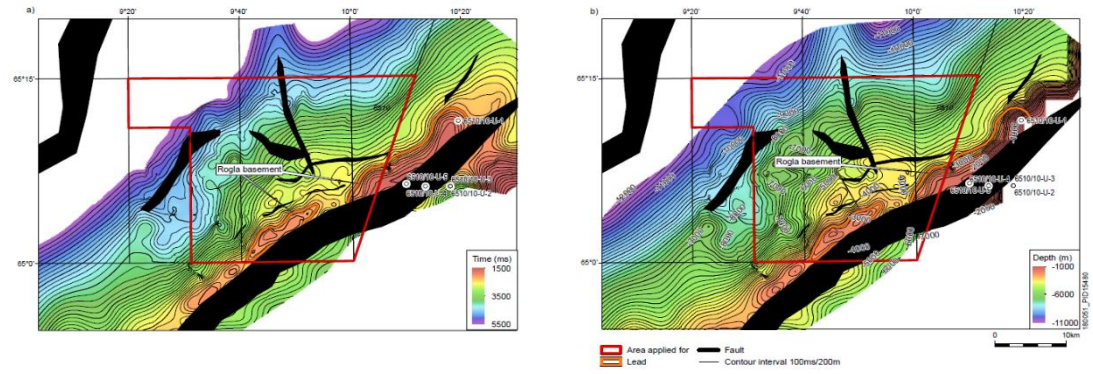


**Figure 4-4** Time and depth maps of the basement core

## 4.4 Rogla Jurassic

3 smaller four-way closures were mapped withing the upper Jurassic covering the Triassic sequences. At this level the throw along the southern boundary fault is minimal and the size of the closures was very small, most likely to disappear when being mapped on a 3D dataset. Consequently, less emphasis was made on this level of prospectivity.

# 5 Technical assessment

## 5.1 Petroleum system analysis

Main risk related to the PL1011 area and more specifically the prospectivity defined within the Lower Triassic and the Palaeozoic, is the presence and maturity of a suitable source rock. Main reference is made to the 6611/9-U-1 well and 6507/6-4 A wells organic rich shales are found within the Permian interval. These shales are interpreted to be time equivalent with the organic rich shales of the Ravnefjeld Formation on Greenland. the presence of a large permotriassic basin north of the Rogla structure led to the hypothesis that thicker sequence of this organic rich shale could be present within this basin.
The main focus of the petroleum system analysis was to prepare a basin model to evaluate, (1) burial and temperature history to asses maturity and timing of expulsion, (2) evaluate the source rock kerogen content and kinetics to better understand the expected fluid phase in the prospect and (3) provided some quantitative information on source rock quality and thickness require to generate adequate volumes to fill the so far defined structures.
The results of this study were planned to be used in the next phase of the work program to verify on AVO attributes whether a source rock interval can be identified on the 3D seismic volumes.

# 6 Conclusion

The PL1011 area, shows the presence of a pronounce basement high, bounding a large permotriassic basin. The Perm and Trias play have been tested by several wells on the Nordland ridge and the Froan basin. The results of these campaigns show the play suffers to large extent from reservoir quality due to the immaturity of the Triassic sediments. Additional risk the PL1011 is the large degree of uncertainty related to the presence of a suitable source to fill identified traps. So far the key prospect levels have been mapped on poor quality 2D data. Especially the deeper stratigraphy is poorly imaged. Despite that some elements that could lead to a proper trapping mechanism are clearly identified.
It is eminent that with the availability of new, high quality broadband seismic, this area still has the potential to be further explored.