PL901 Relinquishment

Status Report

vår energi

Table of Contents

List of Figures

List of Tables

1 Key license History

The PL901 license, located in the Barents Sea, NW of Goliat, was awarded in October 2017, with an initial drill-or-drop firm commitment by February the 10th 2019. A one-year extension to the drill or drop decision was requested and approved, and a drill decision was taken in Feb 2019. At time of relinquishment, the JV is composed of Vår Energi (op 50%), Concedo (20%), LongboatJAPEX Norge (20%) and Equinor Energy (10%) (Figure 1.1). Since the awarding date the Operator held two EC/MC meetings in 2017, one EC and one EC/MC meetings in 2018, two EC/MC and one EC meetings in 2019, one EC/MC meeting in 2020, two EC Well Planning and one MC meetings in 2021, one EC and one MC meeting in 2022 and a EC/MC meeting in 2023.

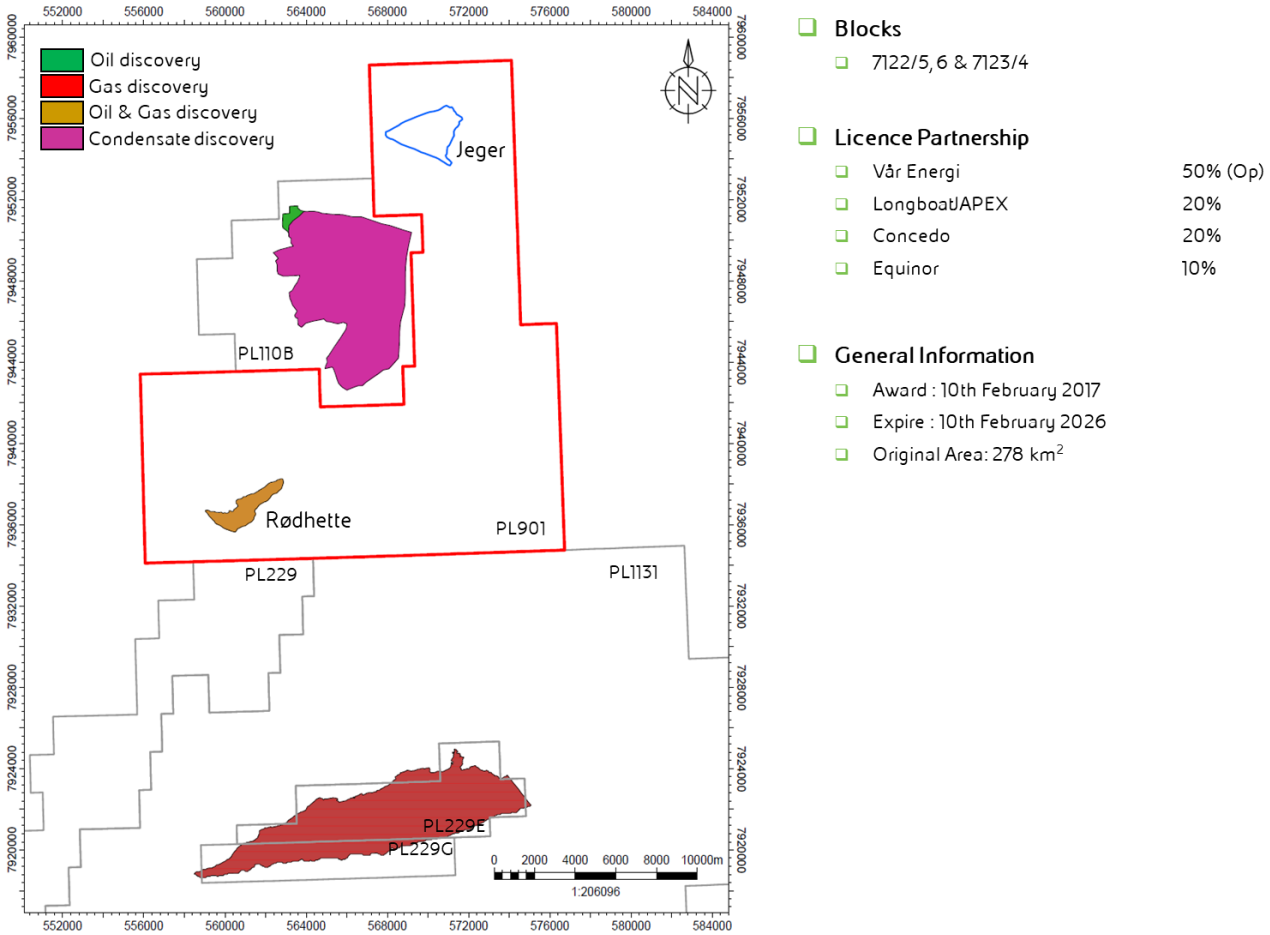

Fig. 1.1 PL901: Location Map & Licence Information

The well 7122/6-3S was drilled in September 2021, fulfilling the work commitment for the license. The well proved HC presence in the Realgrunnen Subgroup, in the Stø Formation. No hydrocarbons were found in the Nordmela and Fruholmen Fm sandstone layers. E-logs suggest the presence of residual hydrocarbons in the Tubåen Formation.

The post well economic assessment of the Rødhette well (7122/6-3S) resulted in a negative NPV for the project.

Following the well, an evaluation of the remaining prospectivity in the license was carried out, leading to a unanimous license decision to drop the license.

2 Database

The seismic interpretation was carried out on the 3D survey ST17M04 PSDM (Figure 2.1), a re-processing of parts of ST05M09 dataset (purchased earlier from Statoil/Equinor). The 3D survey ST05M09 consists of three merged surveys as input: ST0509, ST0515 and ST0306, of which the ST0509 and ST0515 were processed as part of the merge and do not exist as separate processed datasets. The ST17M04 PSDM was processed following a modern broadband workflow, and a comprehensive de-multiple and depth model building workflow by DUG. Overall data quality is good and appropriate for AVO study with angle stacks out to 45 degrees showing good amplitude and phase consistency and time alignment. All available wells within the 3D seismic area and nearby surrounding areas covered by 2D seismic have been investigated and were previously tied to the seismic.

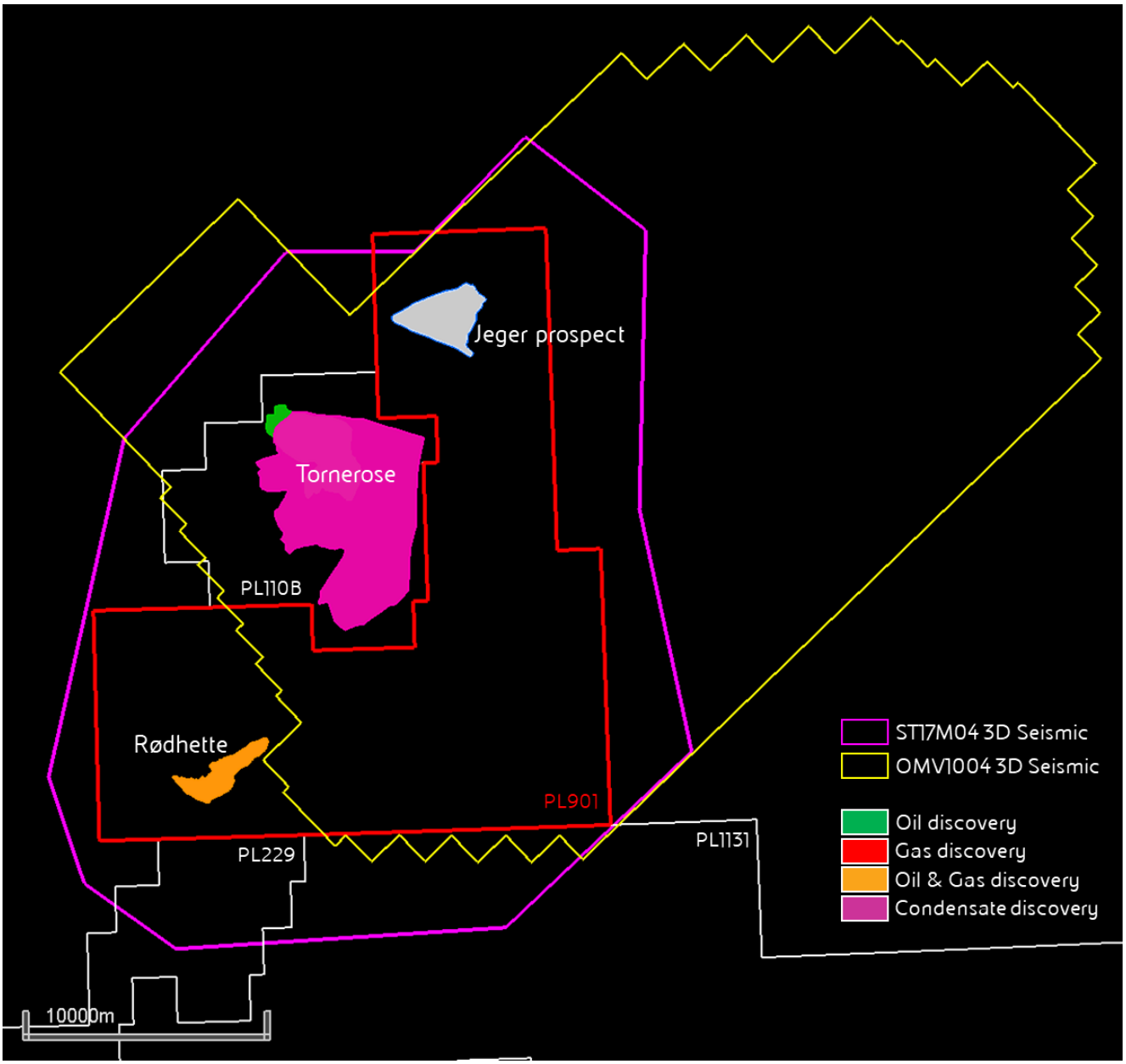

Fig. 2.1 PL901 Seismic Database

The well database, consisting of data from 22 exploration wells, is listed in Table 2.1. Well data consist of well logs, core photos and completion report which provide well tops and geochemical information on the hydrocarbon bearing sections. Stratigraphic tops have been re-interpreted in-house and are used to tie and constrain seismic interpretation.

Name	Status	Completion date	License	Total Depth (MD m RKB)	Oldest penetrated formation	Reservoir with HC	Core (MD m RKB) at reservoir level
7121/4-1	Oil/Gas	27.10.1984	PL099	2609	Fruholmen Fm	Stø and Nordmela Fms	Stø and Nordmela Fms (2321-2416)
7121/4-2	Gas/Cond.	14.04.1985	PL099	2800	Fruholmen Fm	Stø and Tubåen Fms	Stø and Nordmela Fms (2477.5-2597)
7121/5-1	Oil/Gas	28.09.1985	PL110	3200	Snadd Fm	Stø Fm	Stø, Nordmela and Tubåen Fms (2365-2536), Snadd Fm (3082-3103)
7121/5-2	Oil/Gas	06.07.1986	PL110	2543	Fruholmen Fm	Stø Fm	Stø Fm (2324-2399)
7121/5-3	Oil/Gas shows	07.07.1986	PL110	2265	Snadd Fm	Stø and Tubåen Fms	Stø Fm (1887-1915) and Tubåen Fm (1992-2017.6)
7121/7-1	Gas/Cond.	05.08.1984	PL100	2160	Fruholmen Fm	Stø Fm	Stø and Nordmela Fms (1851-1935)
7121/7-2	Gas	12.08.1986	PL100	2156	Fruholmen Fm	Stø Fm	Stø Fm (1903-1939)
7122/2-1	Dry	11.11.1992	PL179	2120	Stø Fm		
7121/9-1	Dry	29.11.2011	PL518	2458	Kapp Toscana Gp		
7122/4-1	Oil Shows	13.01.1992	PL178	3015	Snadd Fm	Stø and Nordmela Fms	Stø and Nordmela Fms (2333-2410)
7122/6-1	Gas/Cond.	11.11.1987	PL110B	2707	Snadd Fm	Snadd Fm, (1.5 m oil leg in the Stø Fm)	Stø, Nordmela, Tubåen and Fruholmen Fms (2019-2099)
7122/6-2	Gas	19.09.2006	PL110B	3070	Kobbe Fm	Snadd Fm	Snadd Fm (2452-2506.7)
7122/7-1	Oil	05.10.2000	PL229	1524	Snadd Fm	Tubåen and Fruholmen Fms	Fruholmen Fm (1133-1178)
7122/7-2	Oil	19.10.2001	PL229	1418	Snadd Fm	Tubåen and Fruholmen Fms	Tubåen and Fruholmen Fms (1078-
7122/7-3	Oil/Gas	08.01.2006	PL229	2726	Tempelfjorden Gp	Tubåen, Fruholmen and Snadd Fms	Tubåen and Fruholmen (1087-1104, 1146.5-1156), Snadd (1187-1192), Kobbe (1812-1836), and Havert (2519-2521) Fms
7122/7-5	Dry	23.12.2006	PL229	2228	Klappmyss Fm		Kobbe Fm (1900-1910.7)
7122/7-6	Oil/Gas	04.01.2013	PL229	2026	Klappmyss Fm	Fruholmen and Kobbe Fms	Fruholmen(1126-1163) and Kobbe (1759-1766) Fms
7122/7-4S	Oil/Gas	25.11.2006	PL229	2550	Havert Fm	Fruholmen, Kobbe and Klappmyss Fms	Fruholmen (1182.5-1216), Kobbe (1885-1886) and Klappmyss (2052-2064) Fms
7122/7-5A	Oil	13.01.2007	PL229	2186	Kobbe Fm	Kobbe Fm	
7123/4-1A	Oil/Gas shows	14.05.2008	PL110C	2855	Snadd Fm	Snadd Fm	Snadd Fm (2670-2697)
7123/4-1S	Oil/Gas shows	21.04.2008	PL110C	2920	Snadd Fm	Snadd Fm	Snadd Fm (2435-2452, 2474-2501)
7124/4-1S	Dry	12.10.2011	PL530	2814	Havert Fm		

Table 2.1 PL901 Well Database - reference wells highlighted in green.

Key wells were chosen based on data availability in analogue reservoir intervals in the vicinity of the prospect and leads (Figure 2.2). Specifically, wells 7122/6-1, 7122/6-2, 7123/4-1A and 7123/4-1S were particularly important for the petrophysical evaluation of the Rødhette prospect. Well 7122/7-3 from the Goliat area was used to tie seismic horizons deeper than Kobbe Formation. Additional petrophysical data were also provided by well 7124/4-1S, although no specific well-to-seismic tie was performed as this well since is not covered by 3D seismic data.

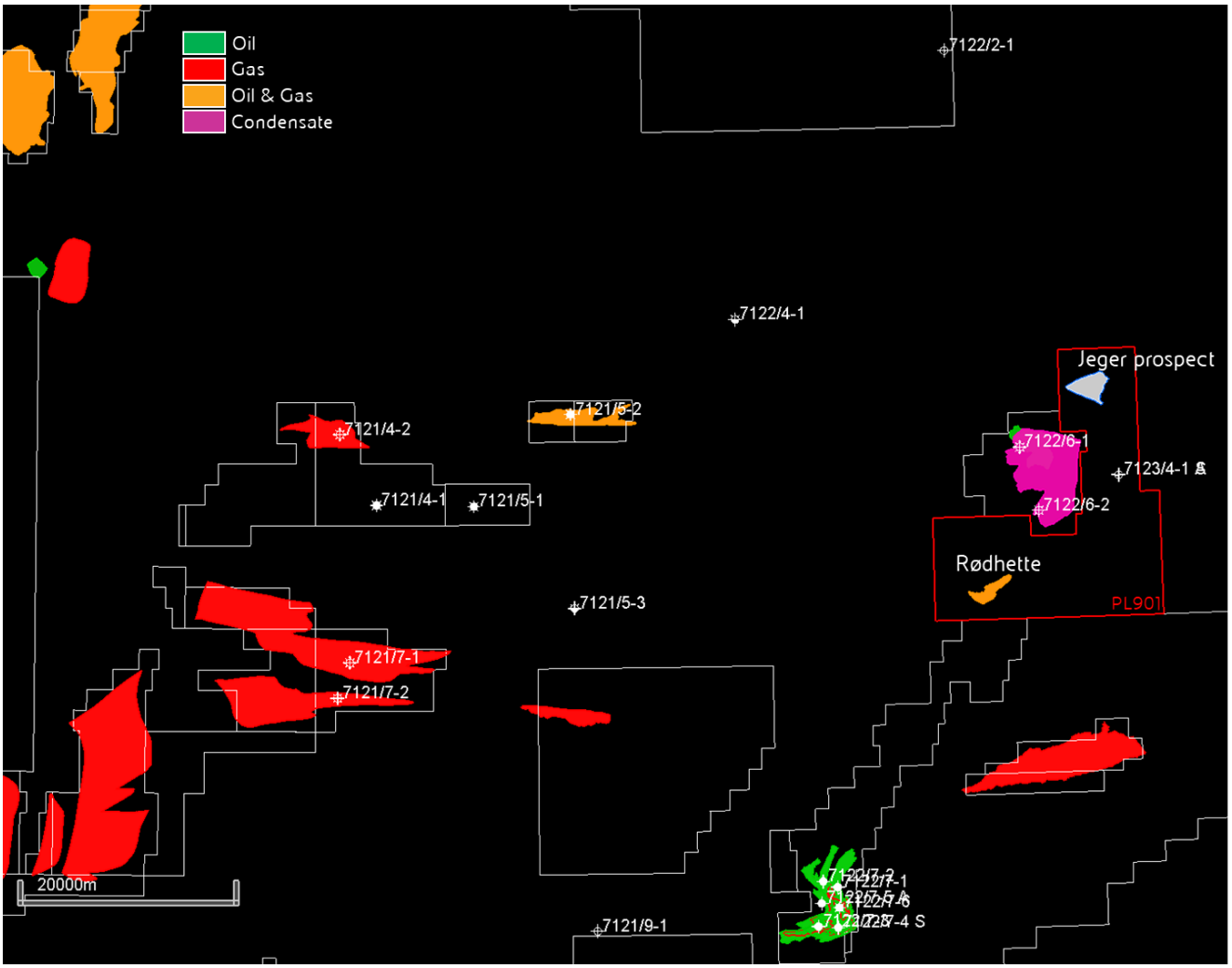

Fig. 2.2 PL901 Well Database

3 Geological and Geophysical Studies

On the seismic interpretation the top reservoir of the Realgrunnen Subgroup (Top Realgrunnen horizon) is interpreted on a strong peak, which corresponds to an increase of acoustic impedance. At prospect locations, the Top Realgrunnen reflection shows a dimming of the amplitude in every angle stack, which is comparable to that observed towards the crest of the Tornerose discovery.
The analysis and interpretation of seismic amplitudes was carried out in-house within Eni Norge. This preliminary study reveals that shallow gas in the overburden has a significant impact on the amplitudes of the Top Realgrunnen horizon. To remove this shallow gas effect, an amplitude normalization of the Top Realgrunnen horizon amplitude at different stratigraphic levels has been carried out: BCU, Top Knurr and Top Kolje. Amplitude normalization consists of dividing the amplitude extraction at Top Realgrunnen by the amplitude extraction at shallower stratigraphic levels, this to eliminate the effect of shallow gas. Although the normalizations gave promising results, it was chosen to use the full angle non-normalized amplitude extraction at Top Realgrunnen horizon for the preliminary AVO study. This because the amplitude normalizations at different stratigraphic levels gave inconsistent results and they may be affected by diverse geological factors such as angular unconformities, varying lithologies and different fault patterns which may introduce additional errors.
A fluid replacement exercise of the Tornerose wells (7122/6-1 and 7122/6-2) shows that there may be a separation visible between brine, oil, and gas in the area. Together with amplitude extractions on the different angle stacks (Near, Mid, Far), the amplitudes at the Top Realgrunnen were used to carry out AVO cross-plots to constrain the oil and gas columns in the Rødhette prospect.
Sedimentological, structural and PSM studies carried out in 2013-2015 were also available for the evaluation of the Rødhette prospect. The sedimentological model SPES 2013 was also used, and the reference wells are: 7122/6-1, 7122/6-2 and 7123/4-1.

4 Prospect Update

The Rødhette discovery is located inside license PL901 towards the eastern margin of the Hammerfest Basin. Rødhette consists of a horst structure developed along the Goliat rollover anticline, which is part of the footwall of Troms-Finnmark Fault Complex located to the east. The Rødhette horst is defined by two intersecting fault systems directed respectively NW-SE and NE-SW (Figures 4.1, 4.2 and 4.3).

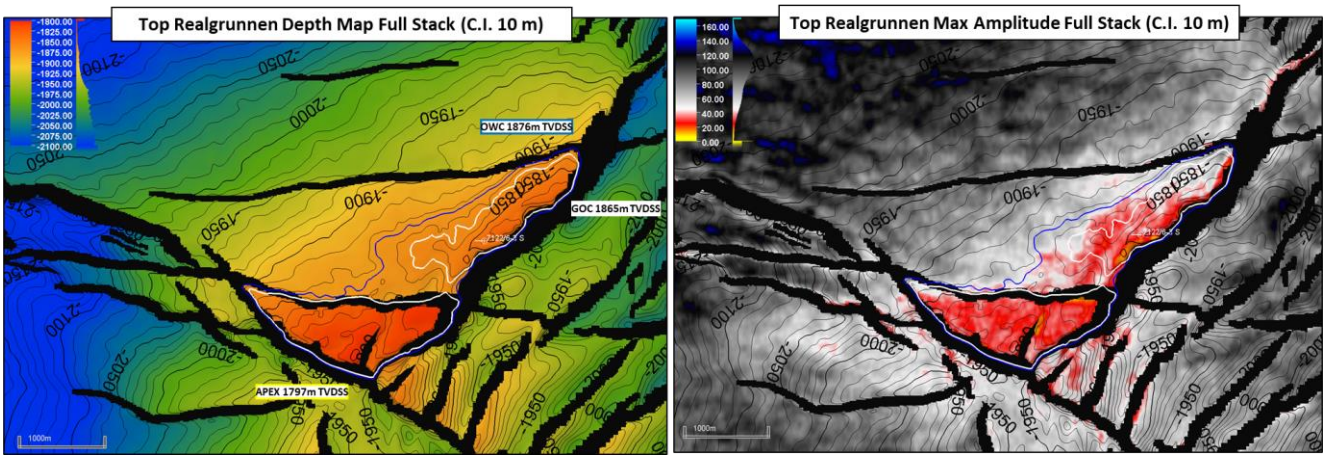

Fig. 4.1 Rødhette Discovery – Realgrunnen Target – maps

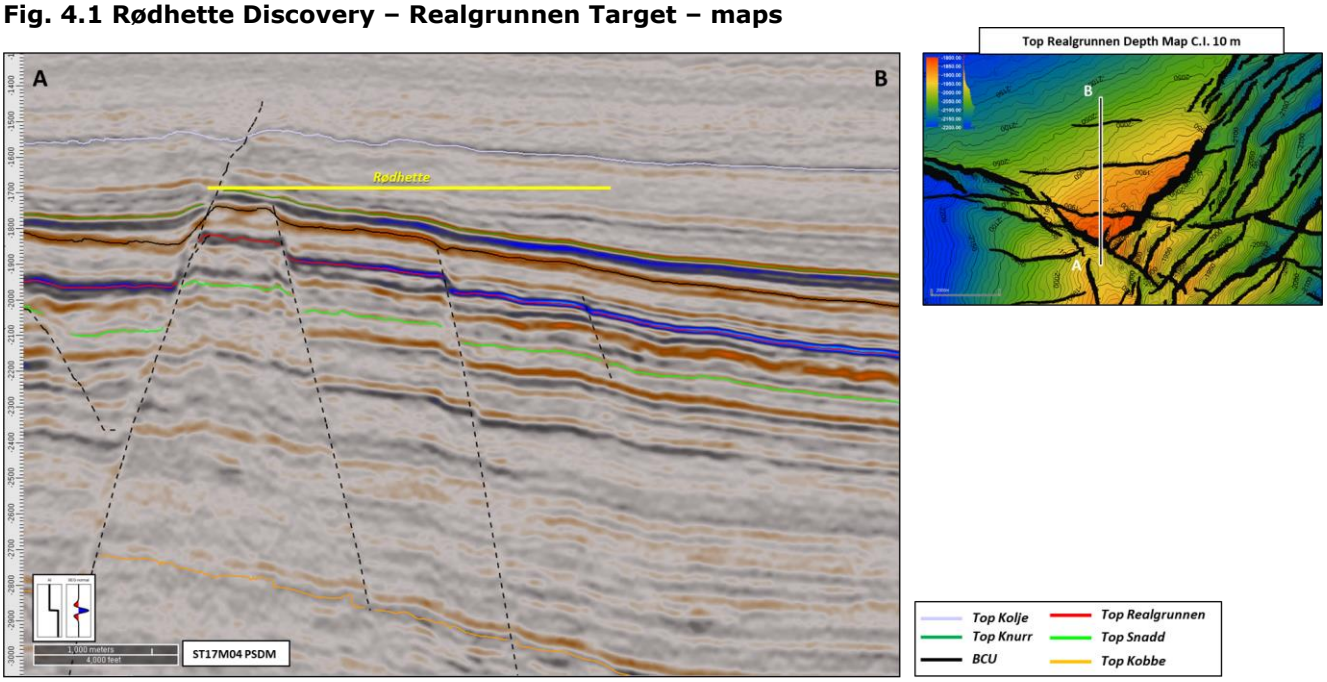

Fig. 4.2 Rødhette Discovery – Realgrunnen Target – seismic section

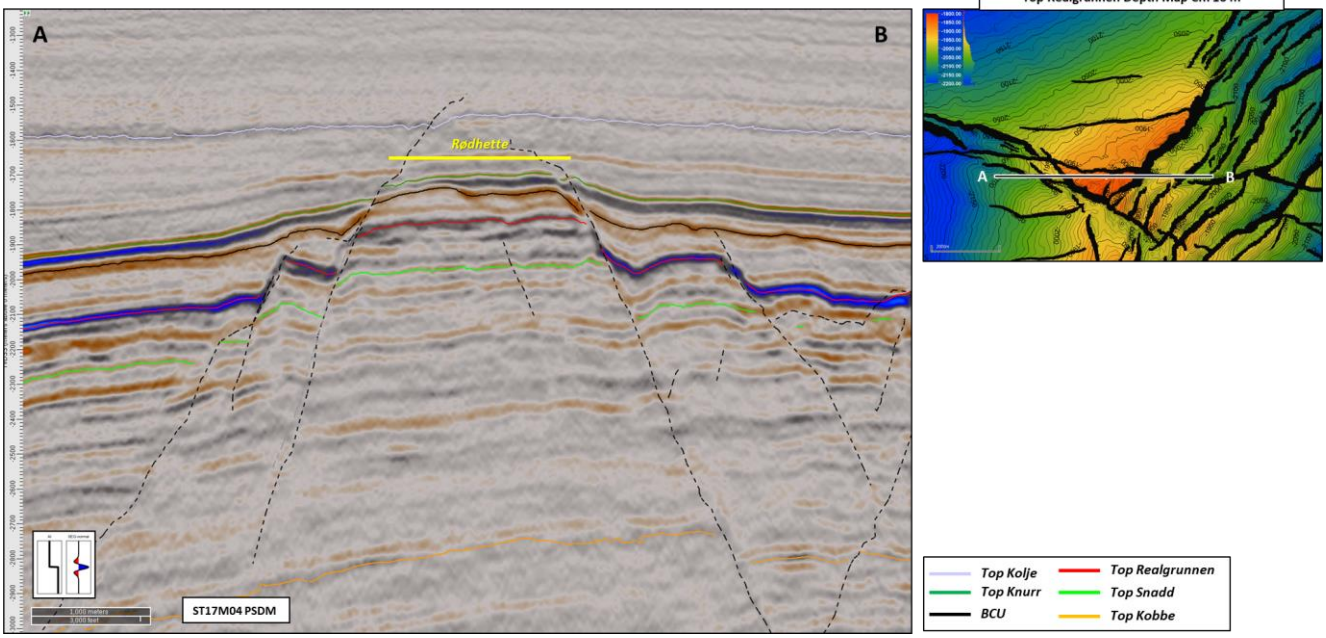

Fig. 4.3 Rødhette Discovery – Realgrunnen Target – seismic section

The Jeger structure is situated towards the northeast margin of one of these northeast-southwest trending basins, the Hammerfest Basin. Jeger consists of a horst structure developed along the Goliat rollover anticline, which is part of the footwall of Troms-Finnmark Fault Complex located to the east. The Jeger horst is defined by two intersecting fault systems directed respectively NW-SE and NE-SW (Figures 4.4, 4.5 and 4.6).

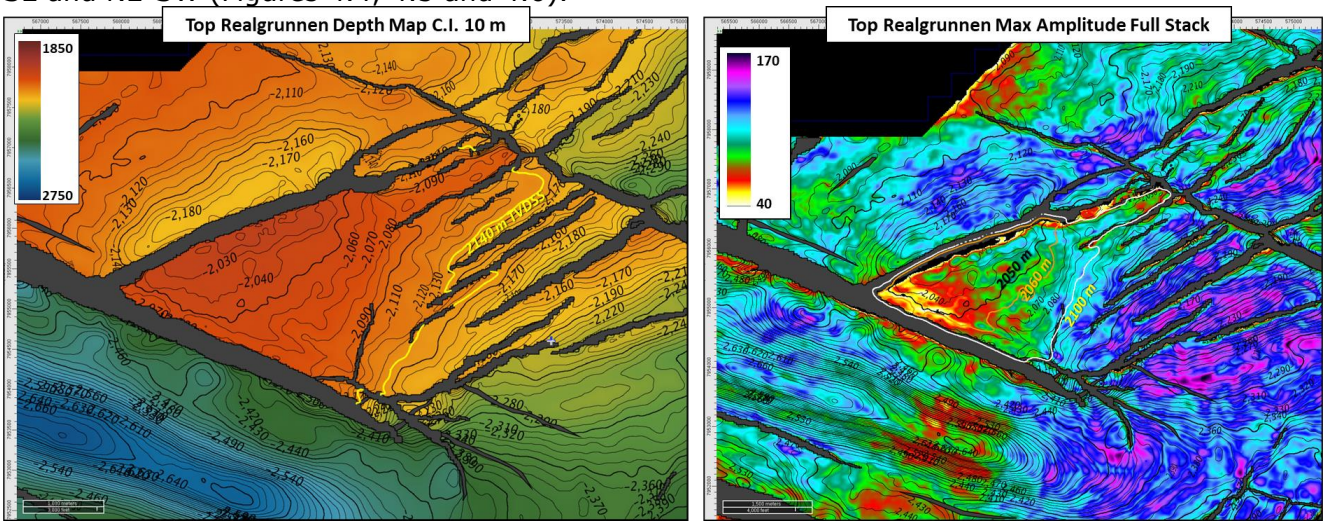

Fig. 4.4 Jeger Prospect – Realgrunnen Target – maps

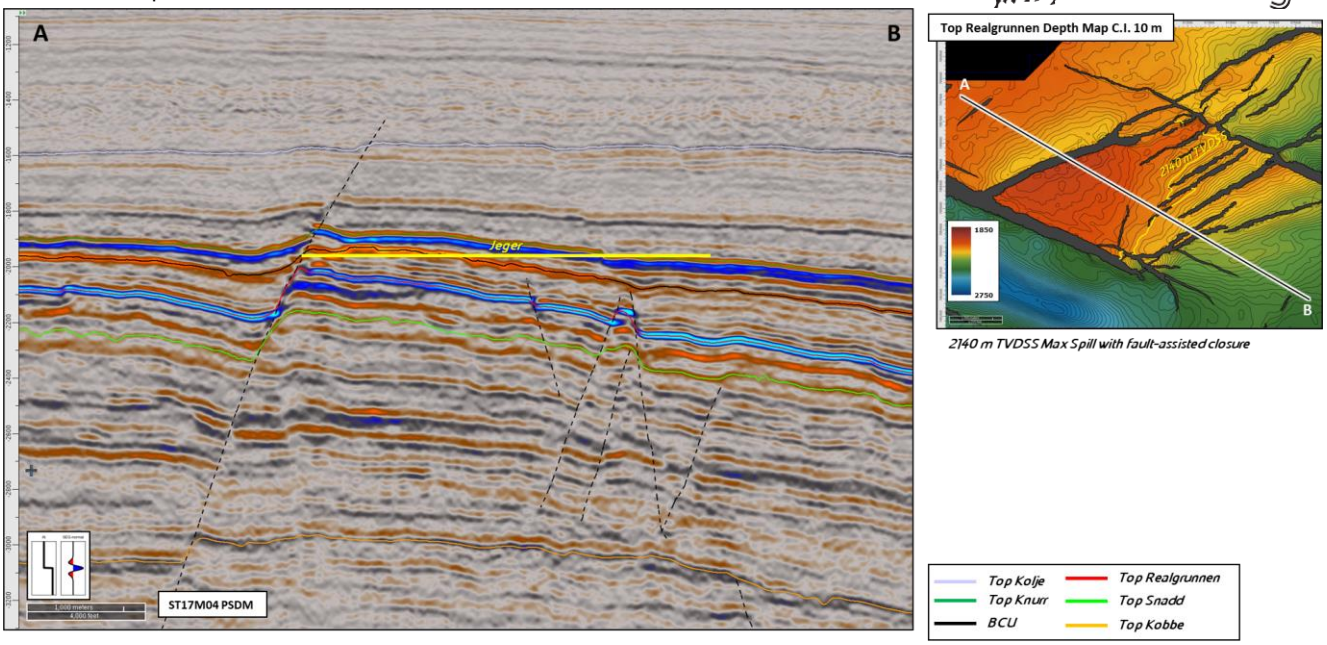

Fig. 4.5 Jeger Prospect – Realgrunnen Target – seismic section

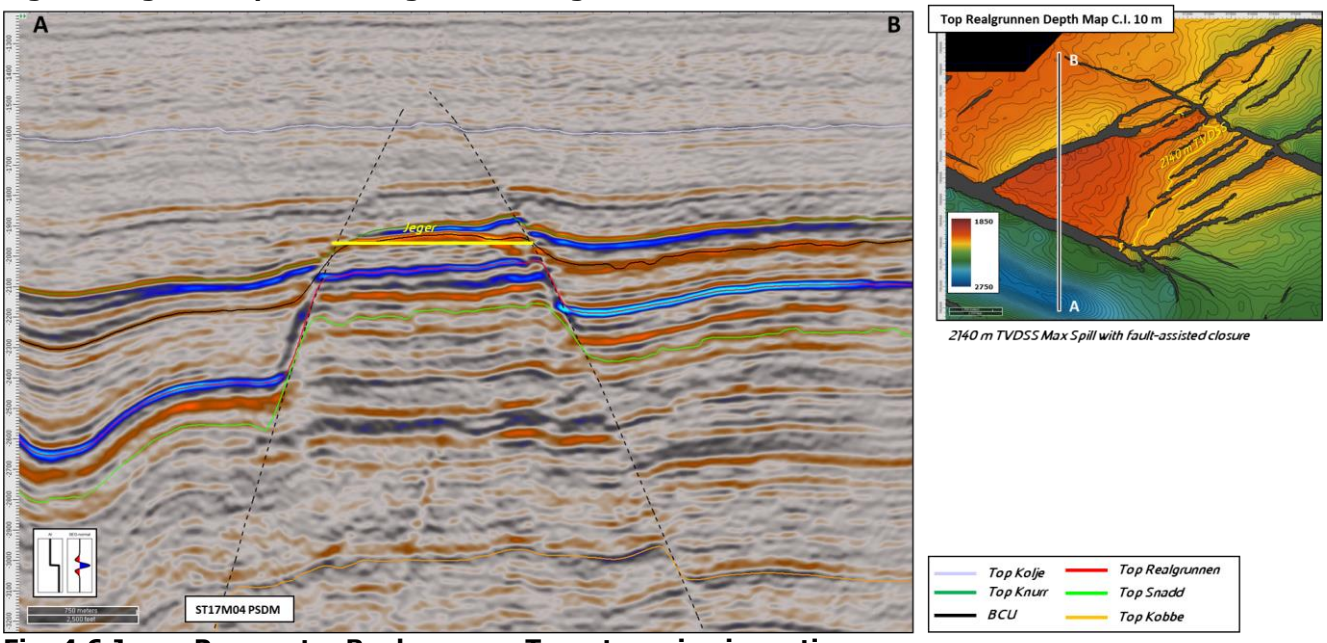

Fig. 4.6 Jeger Prospect – Realgrunnen Target – seismic section

Seal

The top seal is provided by the Upper Jurassic Hekkingen formation and the considerations for lateral seal continuity and top seal pressure retention from leak-off tests are the same as for Rødhette: the prospects can be filled to spill without risk on top seal breaching, regardless of hydrocarbon phase.

While both prospects are bounded by two intersecting faults, the Jeger prospect faults exhibit significant larger throws than those bounding Rhodhette. This suggests that Cenozoic reactivation of faults could have had an impact for Jeger, more than at Rødhette. The two prospects show a similar thickness of ca. 100 m for the Hekkingen formation, but the Knurr formation is significantly thinner at Jeger (50-60m). Opposite trend is observed during deposition of the Kolje and Kolmule Formations. This suggests larger tectonic uplift and associated erosion at Jeger than at Rødhette during Knurr time (Early Cretaceous), followed by a more quiescent regime during the Albian to Campanian times.

Charge

The main petroleum system for the Rødhette prospect is considered deriving from the Upper Jurassic Hekkingen Formation with the main expulsion phase occurring during Oligocene-Miocene time and continuing hydrocarbon generation and expulsion in the basin to the present-day. A long-distance migration is foreseen and Rødhette is favorably located along the hydrocarbon pathways that are believed to have charged the Tornerose discovery at the Realgrunnen Subgroup hydrocarbon level. Charging took place from the west by Realgrunnen Subgroup carrier beds through a fill-to-spill mechanism from the greater Snøhvit field. Dismigration of oil towards the east, and then south, during late Cenozoic times due to tilting is believed to have led hydrocarbons to the Rødhette prospect through a fill-to-spill mechanism on their way to Goliat.

The main petroleum system for the Jeger prospect is the same as Rødhette.

A long-distance migration is also foreseen in Jeger, but compared to Rødhette, Jeger appears to be in a less favorable location along the hydrocarbon pathways that are believed to have charged the Tornerose discovery at the Realgrunnen Subgroup. Jeger is located on the northern shoulder of a deep graben, and the structure is west-facing with the crest bounded by a NE-SW fault. If charging is considered to occur from the west, by fill-to-spill from the greater Snøhvit area along Realgrunnen Subgroup carriers, only a migration through fault planes would have led hydrocarbons to the Jeger prospect.

5 Technical Evaluations

Volumetrics & Risking

A summary of the proven Rødhette well volumes and calculated in-place volumes for the Jeger prospect, with associated risk are found in Table 5.1.

Table 5.1 PL901: Volumes & Risk Summary

Prospect	OIIP mboe	POS avg
Rødhette	9	proven
Jeger	11	37%

Main risking for the Jeger prospect is outlined below:

Reservoir has been given a chance of 90%. Although the presence and quality of the Realgrunnen is well constrained by nearby wells and discoveries mapped, local uncertainties in the reservoir quality can occur.
Seal has been given a chance of 90%. Upper Jurassic Hekkingen Formation is also mapped both seismically and by wells across the entire area on interest. However, local sandstone layer may be present and compromise its sealing capabilities.
Trap has been given a chance of 65%. Jeger is a well-defined, fault-bounded 3-way closure. However, leaking along fault planes during the several reactivation phases may have occurred and is a well-known phenomenon in the area at this stratigraphic level.

Charge is set at 70%. Although the charging route of the Jeger requires a long-distance migration and the structure is not perfectly positioned to receive charging from west, the presence of amplitude anomaly is interpreted as indication of an effective reservoir and hydrocarbons presence.

Overall, the local chance is 37%, with no DHI upgrade. This because of the relatively weak and patchy amplitude anomaly at Top Realgrunnen reservoir compared to that observed in the Rødhette discovery.

Economics

A post drill economics assessment of the Rødhette well was carried out using an assumption of a development through the Goliat FPSO, with the presence of a gas sales outlet and spare capacity from 2035 onwards. Analogues were used to estimate the recovery factor.
The base case for the economics produced a very robust negative NPV for the proven Rødhette accumulation. The Rødhette economics analysis results were used as the basis for estimating the NPV of the Jeger prospect, which was also heavily negative.

6 Conclusions

The proven reserves in the Rødhette well together with the estimates of the remaining potential in the Jeger prospect are not enough to make a viable development in this license possible. The JV unanimously voted to relinquish the license in its entirety.