

PL 855 – Licence status report

Summary

The prospectivity of PL855 is summarised based on the two wells drilled within PL855. The wells tested the Jurassic (7325/4-1 Gemini Nord) and the Late Triassic (7324/6-1 Sputnik) plays. Uncommercial gas was encountered in Jurassic shallow marine sandstones in the Gemini Nord Well and low saturation oil was found in Well 7324/6-1. The Viasat and Ferdinand prospects in the licence could trigger an oil tie-back to the Wisting development but are at present in borderline to be economic. Other remaining Jurassic prospects are regarded to contain gas, and hence seen as uncommercial. Follow-up potential exists in the Triassic. However, the Triassic reservoir has poor reservoir quality, and is therefore challenging.

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1 Licence history

Licence: PL855

Awarded: 10.06.2016

License period: Initial period; 10.06.2016 – 10.06.2019
Initial extended; 11.06.2019 – 10.12.2020

License group:

Equinor Energy AS	55% (Operator)
OMV	25%
Petoro	20%

License area (initial): 1171,24 km²

Work programme: 1 firm well (min depth 1000 m).

Meetings held:

22.06.2016	MC startup meeting
10.08.2016	EC work meeting, well location
17.10.2016	EC work meeting, Ferdinand/Viasat well loc discussion
08.12.2016	MC meeting
16.02.2017	EC work meeting, Geophysical
12.09.2017	EC work meeting, Gemini N post well studies
06.12.2017	MC meeting
15.03.2018	EC meeting, Gemini N post well studies
15.05.2018	EC work meeting, CSEM joint inversion
28.05.2018	EC meeting, Sputnik evaluation
19.06.2018	EC work meeting, CSEM inversion
20.09.2018	EC meeting, Sputnik well location
05.12.2018	MC meeting, Sputnik well planning
11.04.2019	EC work meeting, Sputnik Diffraction Imaging project
10.09.2019	EC work meeting, Sputnik
26.11.2019	EC work meeting, Sputnik post well, first results
19.12.2019	MC meeting, West Hercules Downtime clarification
13.05.2020	MC meeting, Sputnik post well eval and Sputnik Up-side evaluation
12.11.2020	MC meeting; end of licence.

Work performed: Seismic reprocessing & interpretation. CSEM inversion and modeling. Prospect evaluation of Jurassic and Triassic play levels. Field development studies and completion of two exploration wells; 7325/4-1 (Gemini Nord, NPDID 8211, 2017) and 7324/6-1 (Sputnik, NPDID 8741, 2019)

Reason for surrender: The licence partners have decided to let the licences lapse on the expiry of the extended initial period on 10.12.2020. This is due to limited remaining commercial prospectivity (mainly gas for the Jurassic play, mainly due to challenging reservoir for the Triassic play) and lack of commerciality of the gas and oil discoveries made in the licence.

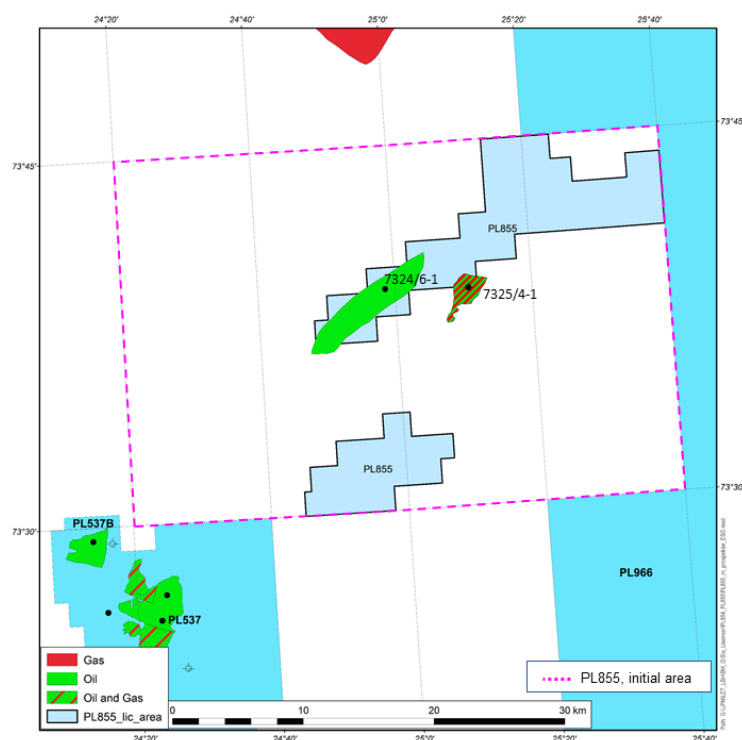


Figure 1. License overview showing PL855 together with surrounding licenses. The pink dashed polygon shows the original outline of the licence.

2 Database overview

2.1 Seismic data

The common seismic database consists of 2D seismic (high resolution site survey data), 3D seismic and 3D high resolution seismic (P-cable) (Figure 2). In the lifetime of the license two site surveys have been acquired; ST16319 (Gemini Nord), EQ18313 (Sputnik). The 2D HR survey TUN14302 acquired by Tullow was also part of the common data base. In addition, the high resolution 2D seismic survey ST14312 was acquired to evaluate the Gemini Nord Prospect.

3D data:

- **HFC11_4ms (Hoop_3D):** Full stack and angle stacks. Pre-stack gathers. Hoop_3D is a merge of several surveys. The original surveys that are parts of the licence common data base are: HFC09 (TGS0901 NPDID 7060, multiclient data), HFCE11 (Hoop 11 NPDID 7424, multiclient data) and HFCE14 (TGS14002 NPDID 7988, multiclient data)
- **HFC09_HFCEW11_GOK** (Geokinetics, OMV internal processing, traded by the licence); Full stack and angle stacks. AI volume. Original data used in this reprocessing are HFC09 (TGS0901 NPDID 7060, multiclient data), HFCE11 (Hoop 11 NPDID 7424, multiclient data).
- **HR14_3D_HFCE1 and HR14_3D_HFCE2:** P-Cable 3D data. Multiclient data.

2.2 CSEM data

The EMGS covering the three easterly blocks:

- **BSTEN02** (blocks 7324/5 & 7325/5)
- **BS1316** (Note only the part of the survey covering block 7325/6)

In addition, the two surveys in PL537 was used for calibration:

BSMC08 (multi-client data in PL537 (part of PL537 common database))

MCPL537 (acquired in 2104)

In 2017 the MCPL855 survey (SLS61-SLS63) became a part of the licence common database

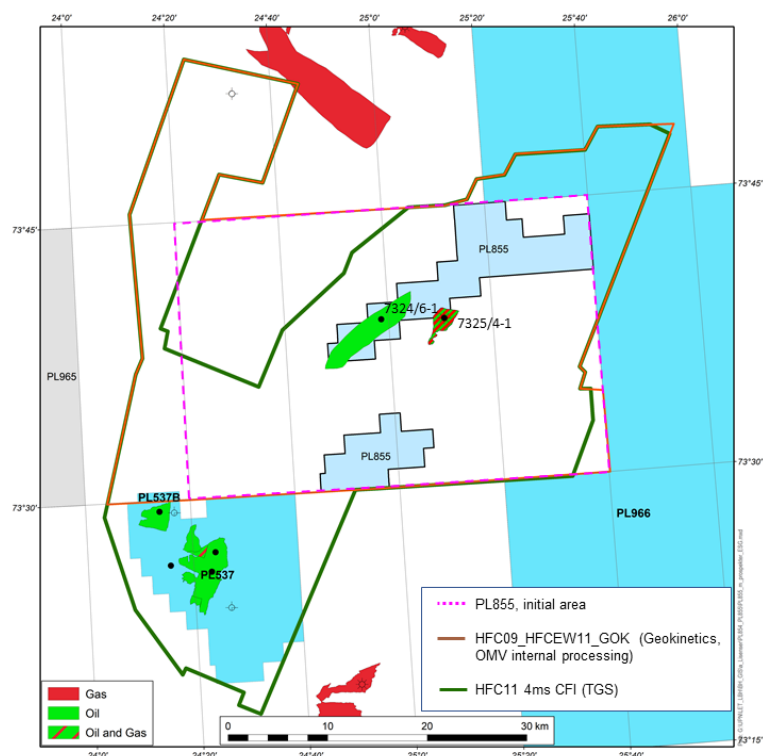


Figure 2: Common 3D seismic database PL855

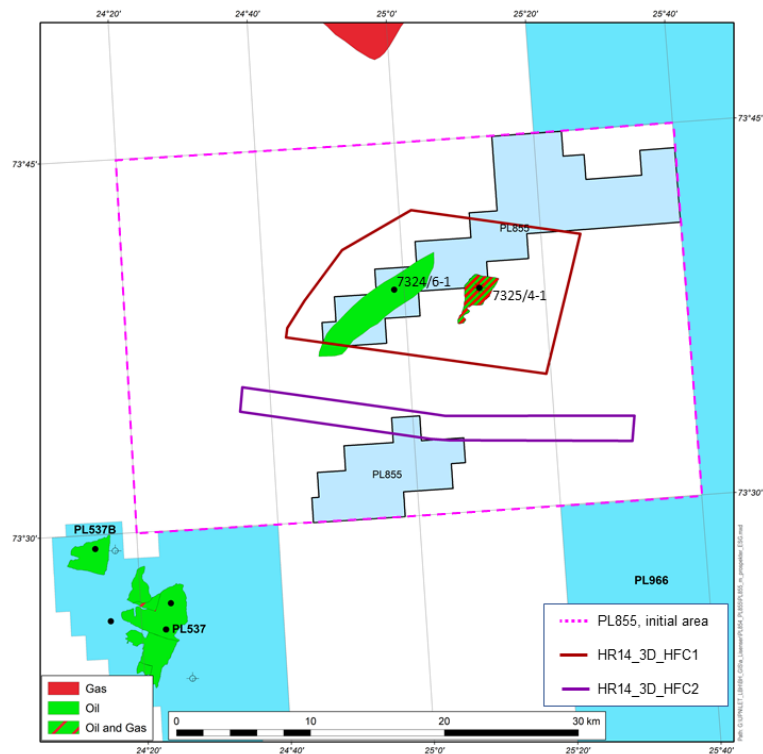


Figure 3: Common 3D P-Cable database PL855

2.3 Well data

Wells 7325/4-1 (Gemini Nord, NPDID 8211) and 7324/6-1 (Sputnik, NPDID 8741) were drilled in PL855 in 2017 and 2019, respectively (Statoil 2018 and Equinor ASA 2019).

The Gemini Nord well targeted a smaller segment within a large rotated fault block. The Realgrunnen Subgroup reservoir was the main target. The well TD'ed in the Snadd Formation. The well encountered gas in the Stø Formation, and oil in a thin sandstone in the Triassic Snadd Fm. Good oil shows were present in the Fruholmen Fm. The well is classified as a non-commercial gas and oil discovery and was permanently plugged and abandoned.

Well 7324/6-1 was drilled on the Sputnik prospect. The purpose of the well was to test the hydrocarbon potential in the Late Carnian interval (Carn01) in the Snadd formation of Middle to Late Triassic age. The prospect was a direct follow-up of the small oil volume encountered in 7325/4-1 at similar stratigraphic depth. A secondary objective of the well was to clarify whether there was an oil leg present below the depth of the gas-water contact encountered in Well 7325/4-1 (Stø Fm), as well as testing two secondary targets in the Early to Middle Carnian interval of the Snadd Fm (Carn02 & Carn01). The well TD'ed at 1600 meters (MD), 50 m below the base of sand in the deepest secondary target (Carn01).

3 Results of geological and geophysical studies

The two wells have provided important data increasing the understanding of the prospectivity of the area, briefly summarised in subsections below.

Source and Migration

The early to Middle Triassic Steinkobbe Formation source rocks are the main source for hydrocarbons in the Hoop area. The source rock has a mixed marine and terrestrial kerogen composition and is of good to excellent quality. At present it is oil to gas mature in the area. The observed hydrocarbons and shows in the Gemini Nord and Sputnik wells have been extracted and typed by biomarker analysis to be sourced from the Steinkobbe Formation (Statoil 2018b and 2019b).

Reservoir Quality

The Middle Jurassic Stø Formation constitutes the main reservoir within the Realgrunnen Subgroup and was the main target in the Gemini Nord Well, and a secondary target in the Sputnik Well. The Stø Fm was cored in both wells, and excellent reservoir properties were present.

The Late to Middle Triassic succession has reservoir potential at several intervals within the PL855 area. However, the reservoir quality is challenging. All the main reservoir intervals (Carn03 – Carn01) penetrated by 7324/6-1 have reasonable porosity, but the permeability is moderate to poor. The poor to moderate reservoir quality, together with the low hydrocarbon saturation is the main risk for the Triassic play in the PL855 area.

Trap and Seal

Traps at the Jurassic Play level are faulted horst blocks in a platform setting sealed vertically by the Fuglen and Hekkingen formations mud rocks. Laterally some horsts may be sealed by younger lower Cretaceous mud rocks. In addition to the live gas (Gemini Nord, Stø Fm) and oil columns (Gemini Nord and Sputnik; Snadd Fm), good oil shows have been found in the Gemini Nord (Fruholmen and Snadd Fms) and Sputnik wells. This indicates migration of oil to this reservoir level. The Realgrunnen Subgroup has been shown to be normally pressured in all wells.

The traps of Ladinian to Carnian channel sandstones are structural with a stratigraphic contribution as tested in both the Sputnik Well and the Intrepid-Eagle Well (7324/3-1). Top seal is commonly marine influenced transgressive mudrocks whereas lateral seal is attributed to muddy floodplain facies. The Sputnik Well encountered slightly under pressured reservoirs at this level such that a strong vertical pressure barrier is considered proven.

Geological studies

Bore hole image log (FMI) have been processed and interpreted (Gemini Nord Well, Eriksfjord 2017). Cores and side wall cores have been measured, described and studied petrographically and geochemically (Statoil 2018c, Equinor, 2019b). Cuttings and fluid samples have been subjected to geochemical analysis (Statoil 2018b, Equinor, 2019b). Hydrocarbon core scanning has been carried out on both wells (APT, 2017 and IFE, 2019).

Geophysical studies

Seismic data have been analysed regarding attributes, amplitudes and AVO responses, both absolute and relative. Hydrocarbons are proven to be visible on seismic in both for the Jurassic reservoirs and partly for the

Triassic reservoirs. Seismic 3D data have been reprocessed in two rounds (Geokinetics (in 2016) and refraction imaging project (2019)).

CSEM data has been inverted using both BFGS (a smooth inversion algorithm) and Gaus Newton (GN) algorithms. In addition, a joint inversion project was run, to try to benefit the best of both data (BSTEN02 and MC PL855). Vertical resistivity logs were acquired in the Sputnik well drilled for ground truth.

In short:

- high background resistivities in the Triassic succession makes it very hard to predict any anomalous resistivity to be associated with hydrocarbons
- For the remaining Gemini Nord segments, resistivity anomalies conform to structure or segment outlines can be identified on the high-resolution MC PL855 survey. However, these are from the seismic and wells de-risked as gas accumulations.

4 Prospect update report

The Gemini Nord prospect was the licence primary prospect, and was drilled in 2017 (7325/4-1, small gas discovery in the Jurassic Stø Fm, and a minor oil discovery in the Triassic Snadd Fm.) to clarify a potential standalone development for oil. Based on the oil discovery in Snadd Fm. the Sputnik prospect was defined. This prospect was drilled in 2019, see section 2.2 for more information.

Remaining prospectivity within PL855 after these two wells is related to finding oil, which can be tied back to the Wisting development. Several smaller Jurassic closures with seismic DHIs exist within the initial PL855 area. Most of them are however evaluated to contain gas, or low saturation gas, and are such not commercial. The mean recoverable gas volumes in the remaining Gemini Nord segments are 10,4 GS_m3.

Potential remaining Jurassic oil prospects are the Viasat and Ferdinand prospects located south in the initial area. However, the size of these are on the borderline to be commercial. Figure 4 shows the remaining prospects within the initial licence area, while the remaining resources are summarized in table 1.

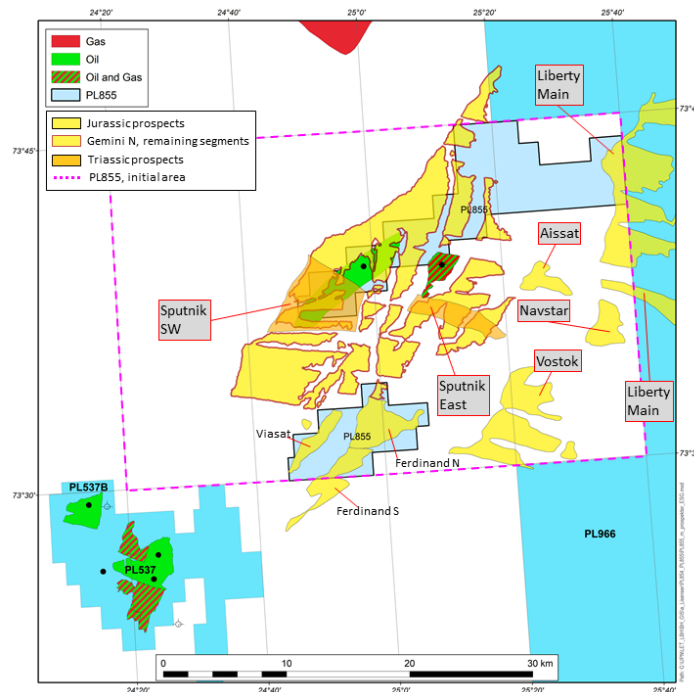


Figure 4: Remaining prospects within PL855 (initial area).

Discovery /Prospect	D/P	Case	Unrisked recoverable resources						Probability	Lito strat	Reservoir dept (m)	Comment
			Oil [10 ⁶ Sm ³]			Gas [10 ⁹ Sm ³]						
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)				
Gemini North*	D	Gas				0,50	0,60	0,70	1,00	Stø Fm/Jurassic	710	Proven by 7325/4-1
Gemini North, remaining*	P	Gas	0,10	0,12	0,16	9,00	12,00	15,00	0,67	Stø Fm/Jurassic	710	Remaining potential after 7325/4-1 & 7324/6-1
Sputnik*	D	Oil	0,80	1,20	1,50	0,10	0,12	0,17	1,00	Snadd Fm/Triassic	1290	Proven by 7324/6-1
Sputnik East*	P	Oil	5,50	8,30	8,70	0,30	0,50	0,50	0,15	Snadd Fm/Triassic	990	
		Gas	1,30	1,90	2,00	0,01	0,02	0,03	0,15	Snadd Fm/Triassic	990	
Sputnik SW	P	Oil	2,10	8,30	10,80	0,50	1,80	2,30	0,15	Snadd Fm/Triassic	1005	
		Gas	0,50	1,80	2,60	0,01	0,04	0,06	0,15	Snadd Fm/Triassic	1005	
Liberty Main*	P	Oil	11,80	24,60	42,90	0,70	1,90	3,40	0,07	Stø Fm/Jurassic	803	
		Gas	2,70	5,40	5,70	0,02	0,05	0,11	0,33	Stø Fm/Jurassic	803	
Vostok	P	Oil	9,10	16,20	24,40	0,50	0,80	1,20	0,08	Stø Fm/Jurassic	710	
		Gas	0,03	0,07	0,10	1,90	3,20	4,60	0,16	Stø Fm/Jurassic	710	
Liberty South*	P	Oil	1,70	5,10	9,20	0,09	0,26	0,47	0,08	Stø Fm/Jurassic	830	
Aissat	P	Oil	0,86	1,70	2,60	0,04	0,34	0,51	0,08	Stø Fm/Jurassic	783	
Navstar	P	Oil	1,20	3,70	6,60	0,06	0,19	0,33	0,08	Stø Fm/Jurassic	790	
Ferdinand North*	P	Oil	6,30	9,80	13,90	0,22	0,30	0,50	0,17	Stø Fm/Jurassic	765	
Ferdinand South*	P	Oil	3,00	5,50	8,40	0,15	0,28	0,43	0,17	Stø Fm/Jurassic	795	
Viasat*	P	Oil	2,30	4,10	6,00	0,10	0,20	0,30	0,27	Stø Fm/Jurassic	738	

Table 1: Remaining resources within PL855 (initial area). *Evaluation updated after 23R award

Triassic potential: the licence has worked hard to evaluate the upside potential after the oil discovery in 7324/6-1 (Triassic, Carn02 level). The well proved a 17 meter oil column in the well. Potentially, large in-place resources exist within the mapped structural 3-way closure (Figure 5). The structure is affected by faults and likely comprised of smaller compartments. Reservoir quality is challenging, and reservoir development is

prognosed only in parts of this area (channels, Figure 5). The challenge is that these volumes are in a low relief structure within the channel facies in poor reservoir. In such, the total net/gross and oil column is limited. Low oil saturation and low permeability makes the producibility (low recovery) a key risk and uncertainty. The licence have therefore not succeeded in identifying an area for a drilling candidate for the upside potential after the 7324/6-1 discovery. The volumes are too small, and the risk for a commercial success too high.

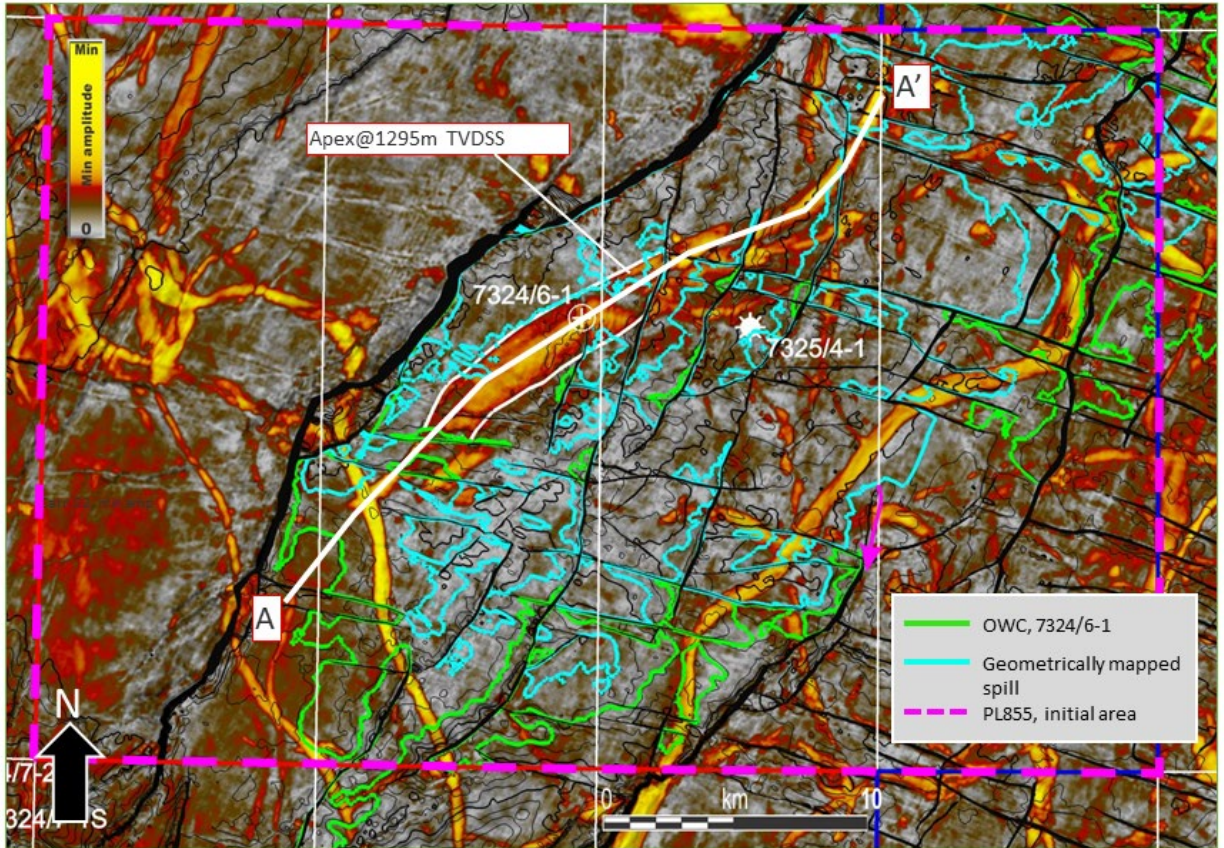


Figure 5: Carn02 minimum amplitude map, Hoop_3D full offset. White polygon defines the area of the Sputnik proven volumes.

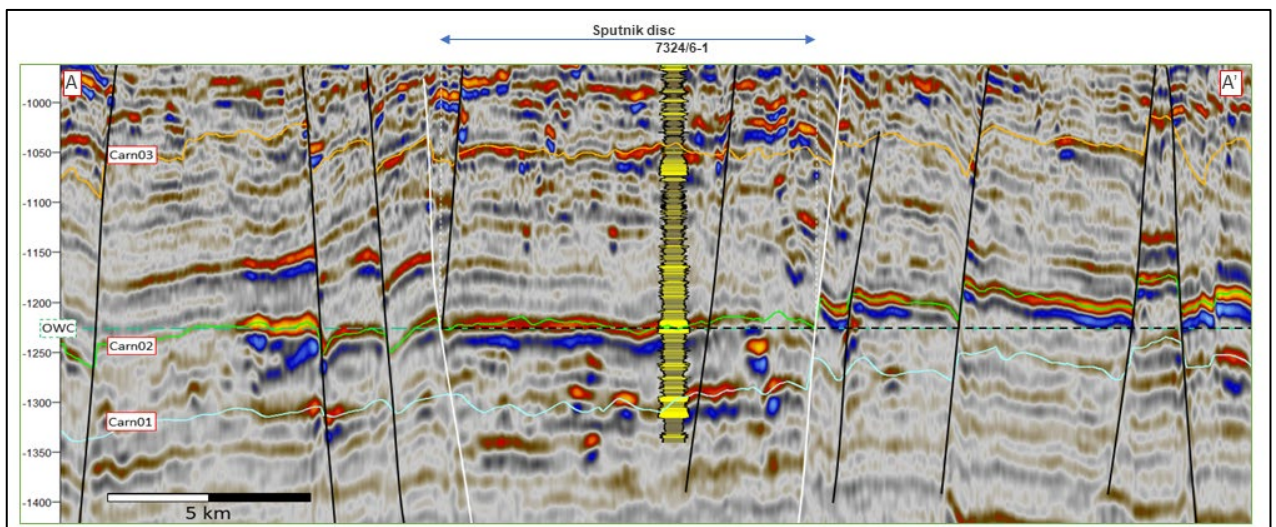


Figure 6: Seismic random line through the Sputnik discovery channel (Carn02). See Figure 5 for location.

5 Technical evaluation

Two primary prospects have been drilled, testing two plays in PL855; the Gemini Nord (7325/4-1 (Statoil, 2018)) and Sputnik (7324/6-1 (Equinor, 2019)).

Jurassic prospectivity is evaluated likely to contain gas, except for two prospects (Viasat and Ferdinand) located south of the licence acreage. These prospects are located 15-20 km from Wisting and regarded as feasible oil tie-back candidates to the Wisting development. The volumes for these tie-back candidates are in the borderline to be economic.

During the Sputnik post-well evaluation and work related to the Sputnik up-side evaluation, field development work and reservoir simulation work was carried out. No economical evaluation was done. However, economical and reservoir engineering parameters (ie. MEV (minimum economical volume), oil breakeven price, minimum oil column needed, minimum permeability needed, recovery factors) were benchmarked against similar prospects in the area.

6 Conclusion

The licence partners have unanimously decided to let the licences expire when the initial extended period ends 10.12.2020, due to limited remaining prospectivity (high chance of discovering gas) and lack of commerciality of the gas and oil discoveries made in PL855.

References

- APT, 2017. HCS scanning of well 7325/4-1 Gemini Nord, 22 pp.
- Eriksfiord, 2017. Gemini Nord Prospect, Well 7325/4-1 Hoop area, Barents Sea Geological interpretation and correlation based on FMI borehole images. 134 pp.
- IFE, 2019. HCS scanning of well 7324/6-1 Sputnik, 28 pp.
- Statoil, 2018. Final Well Report, Exploration Well NO 7325/4-1 and NO 7325/4-U-1, Gemini Nord. 120 pp.
- Statoil, 2018b. Geochemistry Special Study for PL855, Well NO 7325/4-1 (Gemini Nord). Statoil Internal report by Nieve El Souki. 565 pp.
- Statoil, 2018c. Discovery Evaluation Report Exploration Well 7325/4-1 PL855 – 7324/5, 6 & 7325/4,5 Gemini Nord. 111 pp.
- Equinor, 2019. Final Well Report, NO 7324/6-1, Sputnik. PL855. 155 pp.
- Equinor, 2019b. Discovery Evaluation Report Exploration Well 7324/6-1 PL855 – 7324/5, 6 & 7325/4,5 Sputnik. 133 pp.

Appendices

1. NPD form no 5, Ferdinand N prospect, oil case
2. NPD form no 5, Ferdinand N prospect, gas case
3. NPD form no 5, Viasat N prospect, oil case
4. NPD form no 5, Viasat N prospect, gas case
5. NPD form no 5, Viasat N prospect, oil+gas case

