



PL 615/PL 615B – Licence status report

Summary

The prospectivity of PL 615 and 615B is summarised based on the three wells drilled within PL615. The wells tested the Jurassic (7324/2-1 Apollo), Late Triassic (7324/3-1 Intrepid-Eagle) and Early to Mid Triassic (7325/1-1 Atlantis) plays. Uncommercial under pressured gas was encountered in Carnian fluvial channels (wells 7324/3-1 and 7325/1-1) and low saturation gas was found in Well 7324/2-1. The Buran Prospect in PL615B is the largest remaining prospect which could trigger an oil tie-back to the Wisting development. Other smaller remaining prospects and leads represent follow-up prospectivity in case of an oil discovery in Buran as they are too small to be developed on their own.

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1 Licence history

Licence: PL615/615B

Awarded: 13.05.2011/21.06.2013

License period: Expires 13.05.2020/21.05.2020
Initial period: 5 years

License group:

Equinor Energy AS	51% (Operator)
OMV	25%
Petoro	20%
Aker BP	4%

License area: 409.662/ 95.776 km²

Work programme: 1+1 well (615) / 3D seismic (615B)

Meetings held:

29.06.2011	MC startup meeting
14.10.2011	EC work shop Kobbe
15.11.2011	MC meeting
02.02.2012	EC workshop Jurassic
03.05.2012	EC workshop Atlantis well location
28.06.2012	EC workshop well location
21.11.2012	EC/MC meeting
26.02.2013	EC meeting Apollo well location
03.07.2013	EC workshop well data acquisition
21.10.2013	EC meeting data acquisition
19.11.2013	EC workshop drilling
26.11.2013	EC/MC meeting
10.04.2014	EC work meeting HSE
21.05.2014	Apollo well meeting
19.09.2014	ECMC well reporting meeting
13.11.2014	EC meeting
13.02.2015	EC meeting
16.04.2015	ECMC post well meeting
19.11.2015	ECMC meeting
18.03.2016	EC work meeting
18.04.2016	ECMC work meeting
25.11.2016	EC work meeting
02.12.2016	ECMC meeting
01.12.2017	ECMC meeting
15.03.2018	EC data acquisition meeting
19.11.2018	EC work meeting PL615B
30.11.2018	ECMC post well meeting

27.11.2019

ECMC post well meeting II

30.04.2020

ECMC PL615B DoD meeting

Work performed: Seismic acquisition, reprocessing & interpretation. CSEM inversion and modeling. Prospect evaluation at Cretaceous, Jurassic and Triassic play levels. Field development studies and completion of three exploration wells, 7324/2-1, 7325/1-1 and 7324/3-1.

Reason for surrender: The licence partners have unanimously decided to let the licences lapse on the expiry of the initial period on 13.05.2020 ref. "Utvinningstillatelsen punkt 1b)", due to limited remaining prospectivity (mainly gas) and lack of commerciality of the gas discoveries made in the licence.

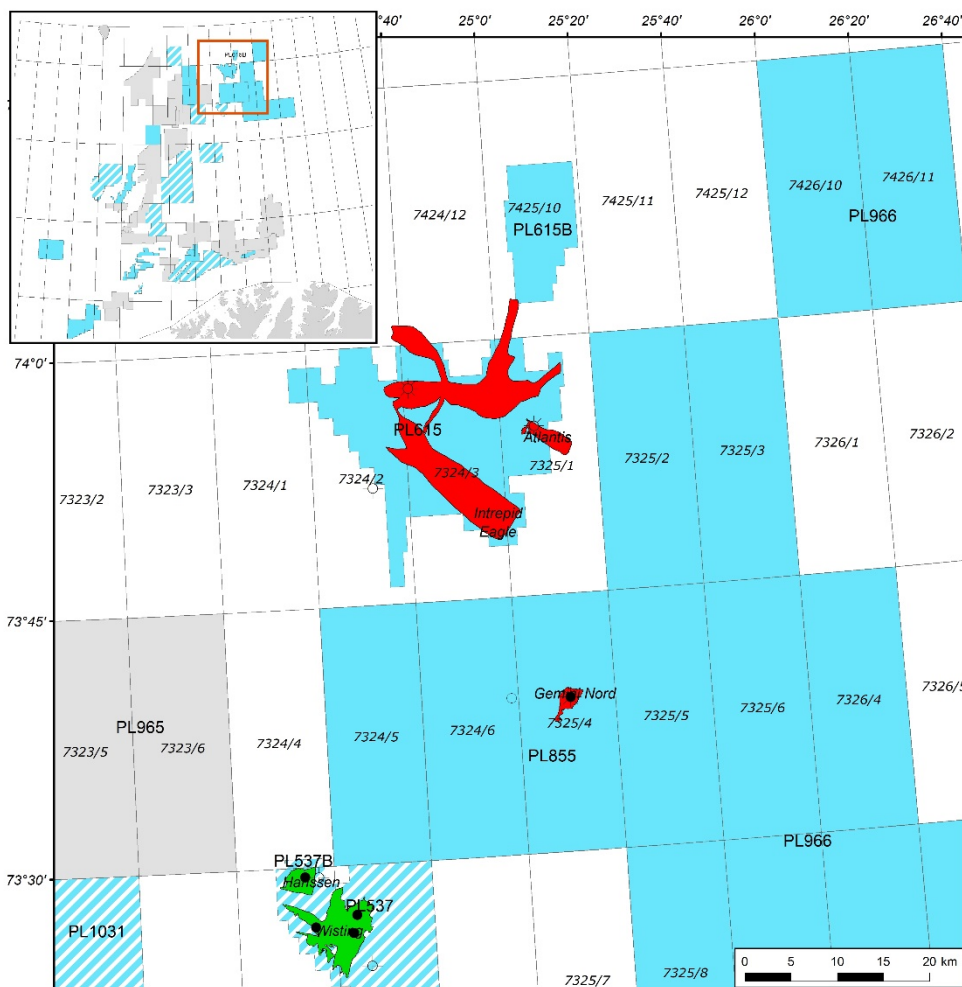


Figure 1. License overview showing PL615 and 615B together with surrounding licenses. Oil discoveries in green and gas discoveries in red.

2 Database overviews

2.1 Seismic data

The common seismic database consists of 3D seismic HFC11_CFI_4ms, a merge (approximately 1700 km²) of the surveys HFC09, HFCE11, HFCW11, HFCN11 & HFCNW13. Also, 2D seismic lines from surveys EL-8703, NBR06, NBR07, NBR08, NBR09 have been a subordinate part of the seismic database. In the lifetime of the license three site surveys have been acquired; ST12307 (Apollo), ST12329 (Atlantis) and ST17305 (Intrepid-Eagle). In addition, the high resolution 2D seismic survey ST12320 was acquired to evaluate the Buran Prospect.

3D CSEM data covering blocks 7324/1-1 to 3, 7325/1-1 and 7425/10 and 11 are part of the common database.

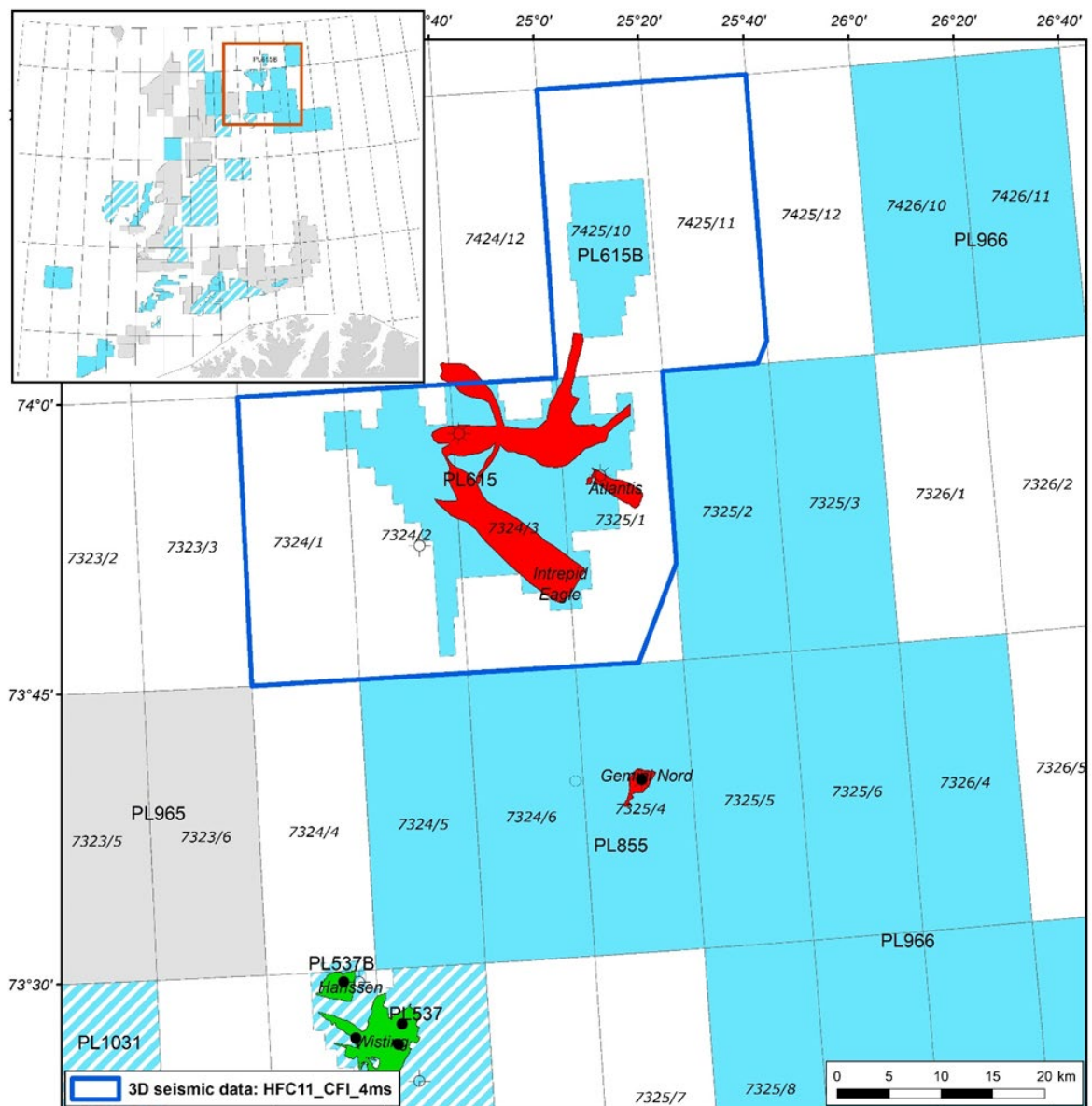


Figure 2. Outline of the common seismic database PL615 and PL615B

2.2 Well data

Wells 7324/2-1 (Apollo) and 7325/1-1 (Atlantis), and 7324/3-1 (Intrepid-Eagle) were drilled in PL615 in 2014 and 2018, respectively (Statoil 2014 & 2015a and Equinor ASA 2019a). The Apollo well targeted the Realgrunnen Subgroup reservoir with a TD in the Snadd Formation, shows were encountered in the Fruholmen and Snadd formations and the target was brine filled with low saturation gas. The Atlantis well targeted a Kobbe Formation reservoir which was encountered with poor properties and water filled. A technical underpressured gas discovery was made in a poor reservoir of the Snadd Formation. Shows were encountered in the Realgrunnen subgroup as well as in the Snadd Formation. The Intrepid-Eagle well targeted a shallower channel than the technical discovery in Atlantis, also in this case a gas discovery was made, in a moderate quality reservoir with under pressure. The well also penetrated the Atlantis discovery in a down flank position and discovered gas in a poor and under pressured reservoir. Shows were encountered in the Realgrunnen Subgroup as well as into the upper part of the Snadd Formation.

3 Results of geological and geophysical studies

The three wells have provided important data increasing the understanding of the prospectivity of the licenses, summarised in subsections below.

Source and Migration

The early to Middle Triassic Steinkobbe Formation source rocks were penetrated and sampled in the Atlantis well. 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 shows at shallower levels in the three wells have been extracted and typed by biomarker analysis to be sourced from the Steinkobbe Formation (Equinor 2015b and 2019b).

The only live hydrocarbons encountered was dry gas in Carnian channels in the Atlantis and Intrepid-Eagle wells. Apollo and Intrepid-Eagle encountered low saturation gas in the Stø Formation. It is anticipated that the gas encountered in Intrepid-Eagle has a similar source as the oil shows based on isotopic maturity constraints.

Reservoir Quality

The Stø Formation constitutes the main reservoir within the Realgrunnen Subgroup and was the target in the Apollo well. Sidewall cores combined with biostratigraphy shows that it is composed of a poor upper silty part and a good lower sandy part. The upper silty part has previously not been identified in the wider area, however, this may largely be due to a lack of biostratigraphic samples.

The Carnian Snadd Formation proved a technical discovery in the Atlantis well in a diagenetically deteriorated fluvial channel sandstone (Statoil 2009). This discovery was further appraised as a secondary target in the Intrepid-Eagle well. The primary target of the Intrepid-Eagle well was a 45 m thick fluvial channel sandstone with moderate reservoir quality (Equinor 2019b).

The Anisian to Ladinian Kobbe Formation was the main target in the Atlantis well, the fine grained marine siliciclastic reservoir was of poor quality due to deep burial and subsequent cementation.

The well also penetrated the uppermost Havert Formation sandstones, also these were fine grained and heavily cemented.

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. Good shows have been found in the Atlantis and Intrepid-Eagle wells indicating past 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 possible stratigraphic contribution as tested in both the Atlantis and Intrepid-Eagle wells. Top seal is commonly marine influenced transgressive mudrocks whereas lateral seal is attributed to muddy floodplain facies. Both wells encountered under pressured reservoirs at this level such that a strong vertical pressure barrier is considered proven. The discovery channel penetrated by both The Atlantis and Intrepid-Eagle wells has different pressure such that there is no present pressure communication through the sand filled channel between the two wells. The Kobbe Formation trap tested in the Atlantis well has a top seal of organic rich transgressive mudrocks. Pressure readings are poor at this level, however, it is anticipated that also this unit is significantly under pressured, indicating a working seal.

Geological studies

Bore hole image logs (FMI) have been processed and interpreted (Eiriksfjord 2015 and 2019). Cores and side wall cores have been measured, described and studied petrographically and geochemically. Cuttings and fluid samples have been subjected to geochemical analysis (Statoil 2014, Statoil, 2015b, and Equinor, 2019b).

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 the Jurassic reservoirs of Apollo and Intrepid-Eagle (low saturation gas) and in the Carnian reservoir in Intrepid-Eagle (gas).

CSEM data has been inverted using both BFGS and GN algorithms and vertical resistivity logs have been acquired in wells drilled for ground truth. However, high background resistivities means that for any anomalous resistivity to be associated with hydrocarbons, the water saturation of the reservoir must be extremely low i.e. below seven percent. No resistivity anomalies conform to structure or prospect outlines have been identified within the licenses, consequently, CSEM data have been of minor focus in risking.

4 Prospect update report

The only remaining prospect which is large enough to trigger an oil tie-back to the Wisting development is the Buran Prospect in PL615B (Fig. 3; Statoil, 2012). An updated volume estimate of Buran is attached in a spreadsheet and the corresponding maps used are shown in Figure 4. All other remaining prospects and leads are too small to facilitate a development on their own. However, they may represent important additional prospectivity in case of a future oil discovery in the Buran Prospect. The remaining prospects and leads are documented in Statoil (2010 and 2012).

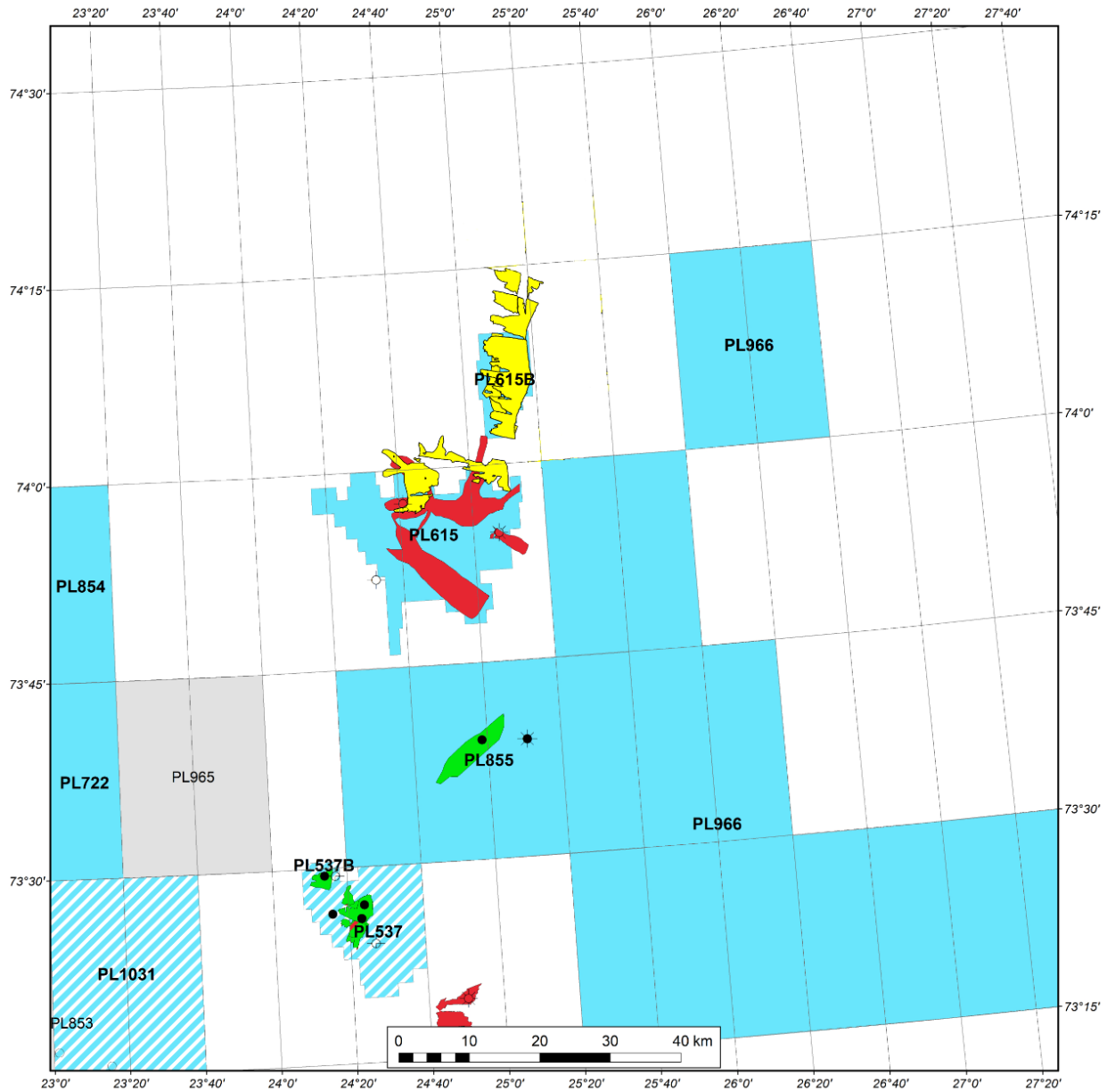


Figure 3. Remaining prospects (in yellow) within PL615 and PL615B, prospects and leads are documented in Statoil (2012 and 2014). The Buran Prospect is the main prospect in PL615B. Oil discoveries in green and gas discoveries in red.

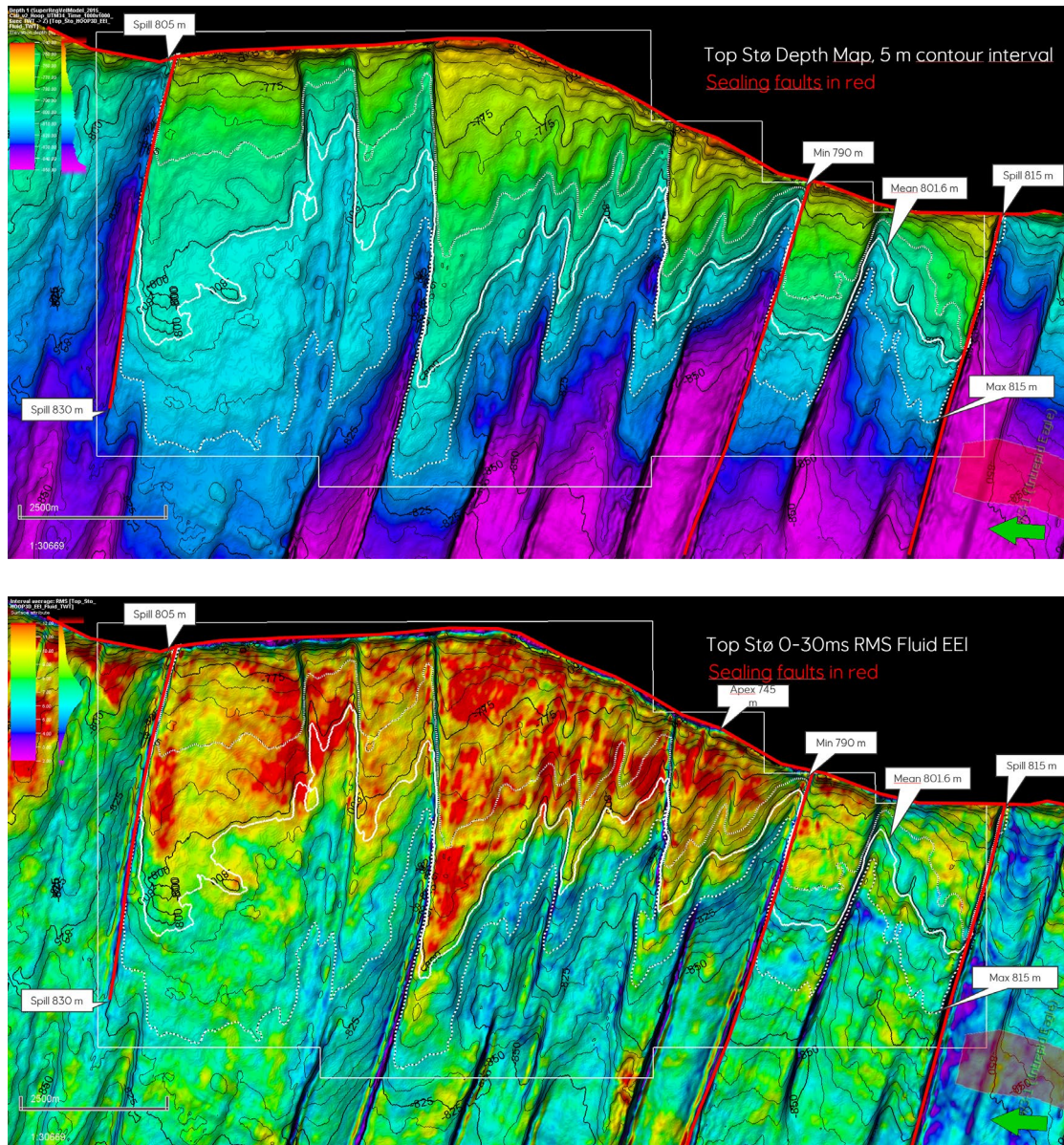


Figure 4. Buran Prospect depth map (above) and top reservoir RMS amplitude map based on a fluid elastic impedance cube. Note depth conformance of the amplitudes indicating the presence of hydrocarbons.

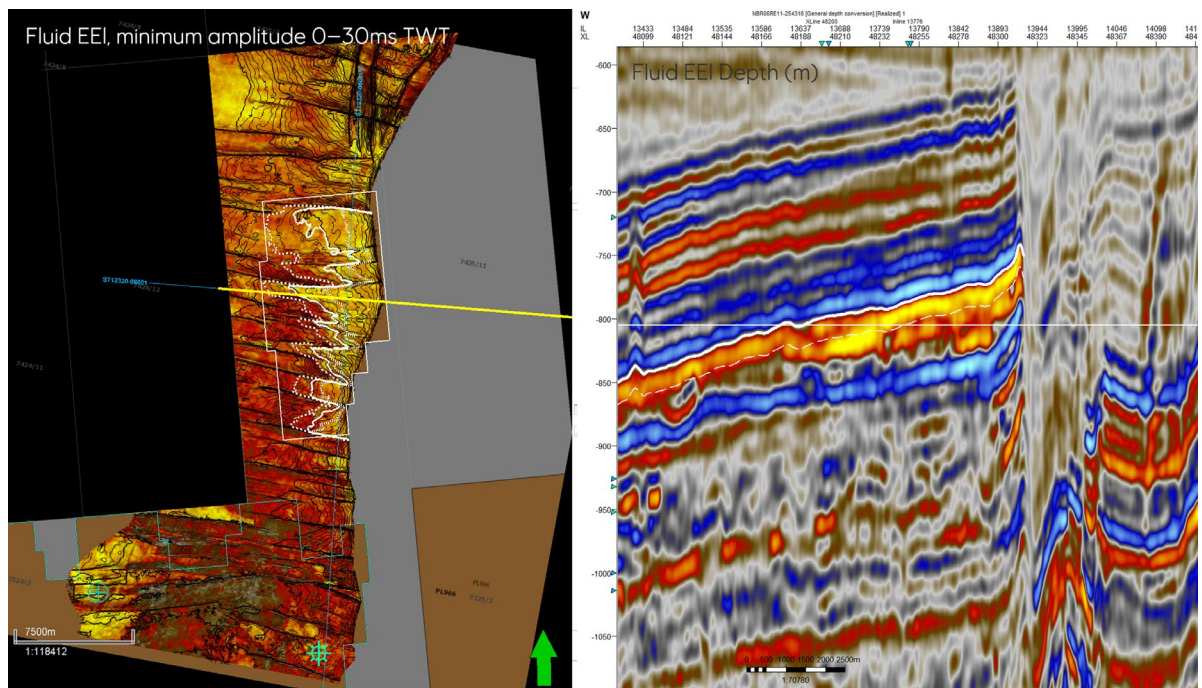


Figure 5. Seismic (EEI fluid cube) dip profile in depth showing the top reservoir interpretation in bold white and the base Stø Fm. reservoir in stippled white.

5 Technical evaluation

Three main prospects have been drilled across three plays in PL 615; the Apollo (7324/2-1 (Statoil, 2014)), Atlantis (7325/1-1 (Statoil, 2015) and Intrepid-Eagle (7324/3-1 (Equinor, 2019)). The wells proved low saturation gas and under pressured gas discoveries in good to poor quality reservoirs. Based on the results of these wells only the Buran Prospect can be viewed as a feasible drilling candidate amongst the remaining prospectivity in PL615 and 615B. The Buran Prospect is 80 km away from Wisting but is regarded as an feasible oil tie-back to the Wisting development using existing technology including multi-phase pumps, insulated and/or heated pipes and a subsea automatic pig launcher for wax control. The latest evaluation of the Buran Prospect considering all information gained from the wells, however, only shows a moderate chance of discovering oil (18.5%) compared to gas or low saturation gas (76.5%).

6 Conclusion

The licence partners have unanimously decided to let the licences lapse on the expiry of the initial period on 13.05.2020 ref. "Utvinningstillatelsen punkt 1b)", due to limited remaining prospectivity (high chance of discovering gas) and lack of commerciality of the gas discoveries made in PL615 and 615B.

References

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