

# Relinquishment Report PL 639



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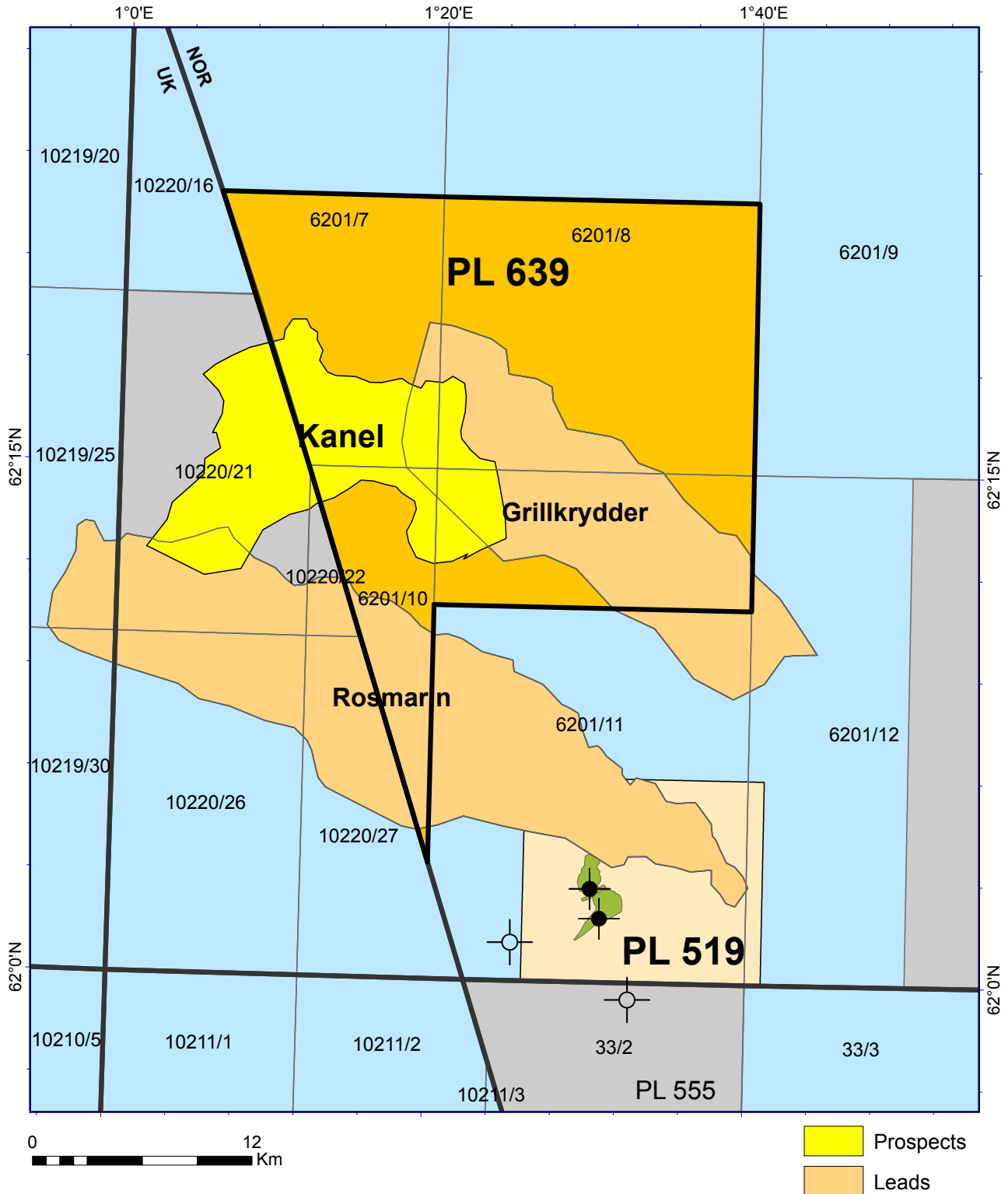
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# 1 Key license history

Production License 639 was awarded to Spring Energy Norway AS (30% and operator), Lundin Norway (20%), Petoro AS (20%), Bayerngas Norge AS (15%) and Nowegian Energy Company ASA (Now Noreco 15%) after the APA 2011, and became effective on the 3rd of February, 2012. The license covers part of blocks 6207/7, 8, 10 & 11 Fig. 1.1.



**Fig. 1.1 License prospect and leads map.** *The Kanel prospect and the Pepper and Rosmarin leads.*

22 Jan 2013 Tullow Oil plc. announced the completion of its acquisition of Spring Energy Norway AS, and therefore the operator from this date become Tullow Oil Norge AS.

The work commitment of the license included acquisition of 3D Seismic and to perform relevant geological and geophysical studies and to decide on a DoD decision before 3rd of February, 2015.

In summer of 2012 the license acquired 1075 km<sup>2</sup> of 3D seismic data (EOTW12) to fully cover the license area and the identified prospectivity. Based on the new data, the license group has performed extensive geological and geophysical analysis to evaluate the prospectivity and commercial potential of the license acreage.

Four formal ECMC meetings have been held in the license, and one work-meeting (EC members). Minutes and/or presentations from the meetings are found on L2S.

Based on the new 3D seismic data and the studies of the exploration potential in the identified prospectivity, the licence has concluded that the probability of proving commercial quantities of hydrocarbons is too low to justify a decision to drill an exploration well.

A unanimous decision to relinquish the licence was taken by the Management Committee, and the Ministry of petroleum and Energy was notified by letter dated 29.01.2015

## 2 Database

### Seismic database

The work commitment for PL639 was to acquire 3D seismic coverage of the licence, and in the summer of 2012 the licence group acquired the 3D survey EOTW12. The EOTW12 survey has formed the base for all the G&G activities. The licence database also includes angle stacks and full elastic inversion cubes derived from the EOTW12 survey. In addition the 3D survey ST0503 have been used in the evaluation of the PL639, as it provides important seismic tie to the stratigraphy in the PL639 area Fig. 2.1.

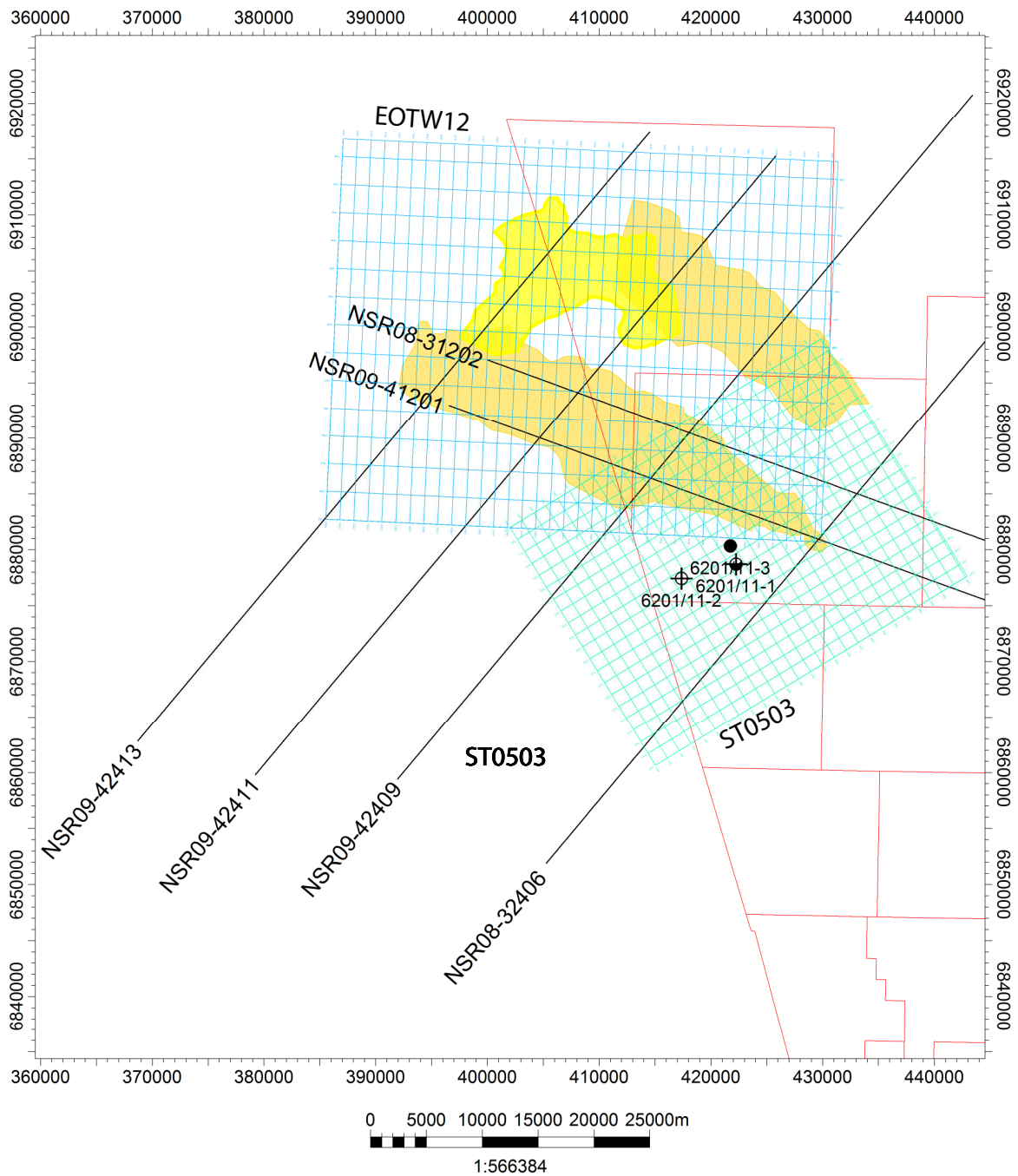


Fig. 2.1 Database for the PL639

## Well database

The wells used to evaluate the prospectivity of the PL639 license is listed in Fig. 2.2

| Well (Discovery)       | Wellbore content    | Operator    | Spud year | T.D (mRKB) | Age at TD      |
|------------------------|---------------------|-------------|-----------|------------|----------------|
| 6201/11-1 (Albert)     | Oil/Gas in Triassic | Statoil     | 1987      | 3850       | E. Triassic    |
| 6201/11-2              | Dry                 | Statoil     | 1991      | 3778       | M. Jurassic    |
| 6305/5-1 (Ormen Lange) | Gas in Egga Mbr.    | Hydro       | 1997      | 3053       | L. Cretaceous  |
| 6305/7-1 (Ormen Lange) | Gas in Egga Mbr.    | BP          | 1998      | 3377       | L. Cretaceous  |
| 6302/6-1 (Tulipan)     | Gas in Egga Mbr.    | Statoil     | 2005      | 4234       | L. Cretaceous  |
| UK 219/20-1            | Dry                 | Conoco      | 1984      | 4878       | U. Cretaceous  |
| UK 220/26-1            | Gas shows           | BP          | 1984      | 5311       | E. Cretaceous  |
| UK 220/26-2            | Oil shows           | BP          | 1985      | 4231       | E. Permian     |
| UK 211/1a-1            | Gas shows           | Enterprise  | 1987      | 3412       | Triassic       |
| UK 211/2-1             | Oil shows           | BP          | 1977      | 4061       | Triassic       |
| UK 211/7a-2 (Magnus)   | Oil in Paleocene    | BP          | 1979      | 4219       | ?Perm-Triassic |
| UK 211/7a-4 (Magnus)   | Dry                 | BP          | 1987      | 1781       | L. Cretaceous  |
| UK 210/5-1             | Oil shows           | Esso        | 1976      | 2855       | Triassic       |
| UK 219/28-2            | Gas in basement     | Sands Expl. | 1984      | 4015       | Pre-Cambrian   |

Fig. 2.2 Well database



### 3 Review of geological framework

The Licence PL639 is located in the southernmost Møre Basin, on the boundary towards the adjacent UK continental shelf Fig. 3.1. The main prospect in PL 639, the Kanel prospect, is interpreted to be represented by a Paleocene basin floor fan deposit, equivalent to the Egga Member basin floor fan sandstones further north in the Møre Basin. No thick Paleocene sandstones have been encountered in wells near the application area. Trace of sandstone and sand stringers are however reported in most wells to the west and south (UK and Norway) of the licence area, and a thin Paleocene sandstone in well 6201/11-1 was filled with residual hydrocarbons. The regionally low sand-content is supported by seismic observations, no significant variations are seen in interval thickness and internal geometry south of the licence area. Seismic data does however support that late Paleocene sands are likely to be developed to the north of the Margarita Spur / Manet Ridge, within the Møre Basin.

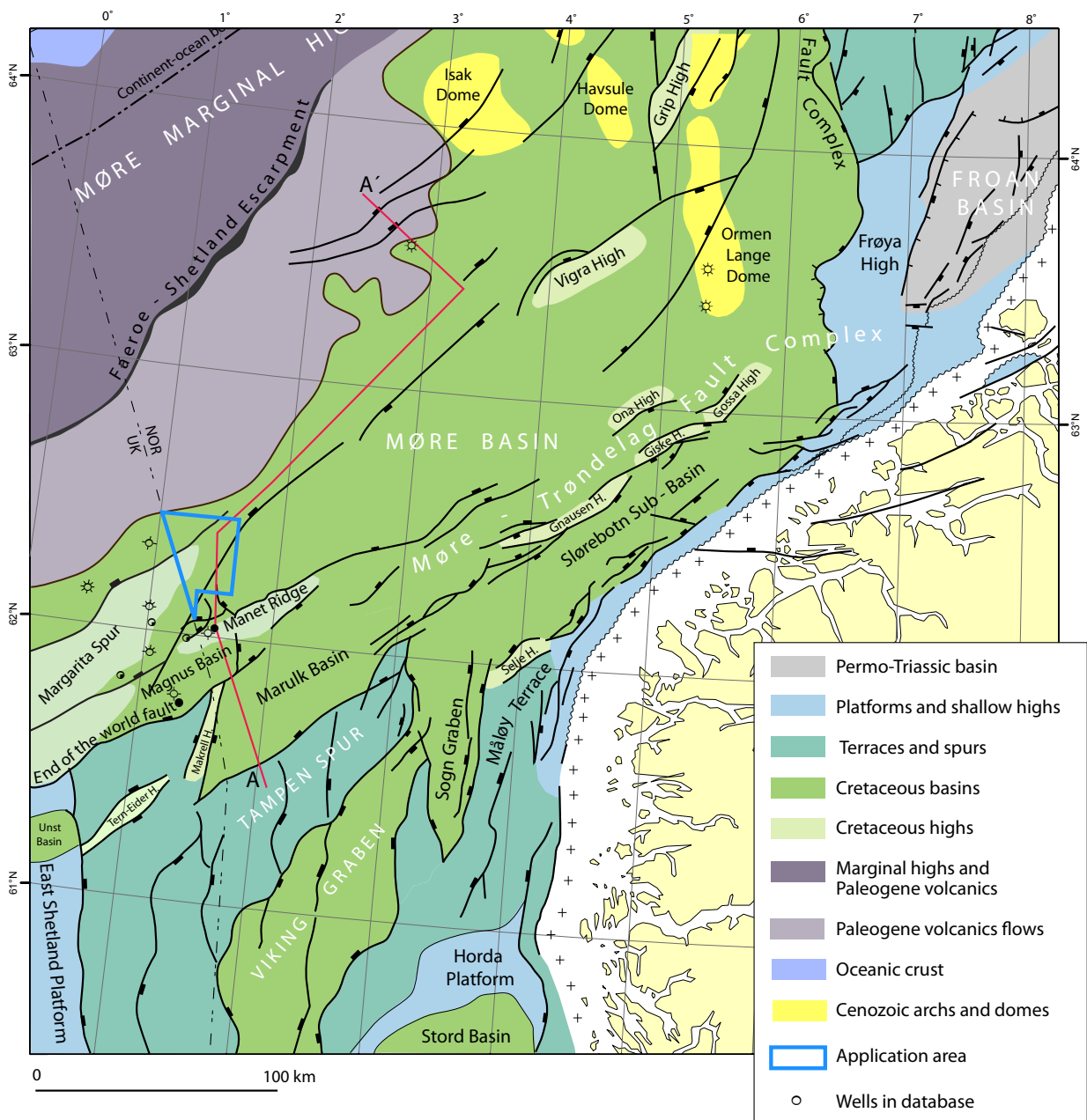


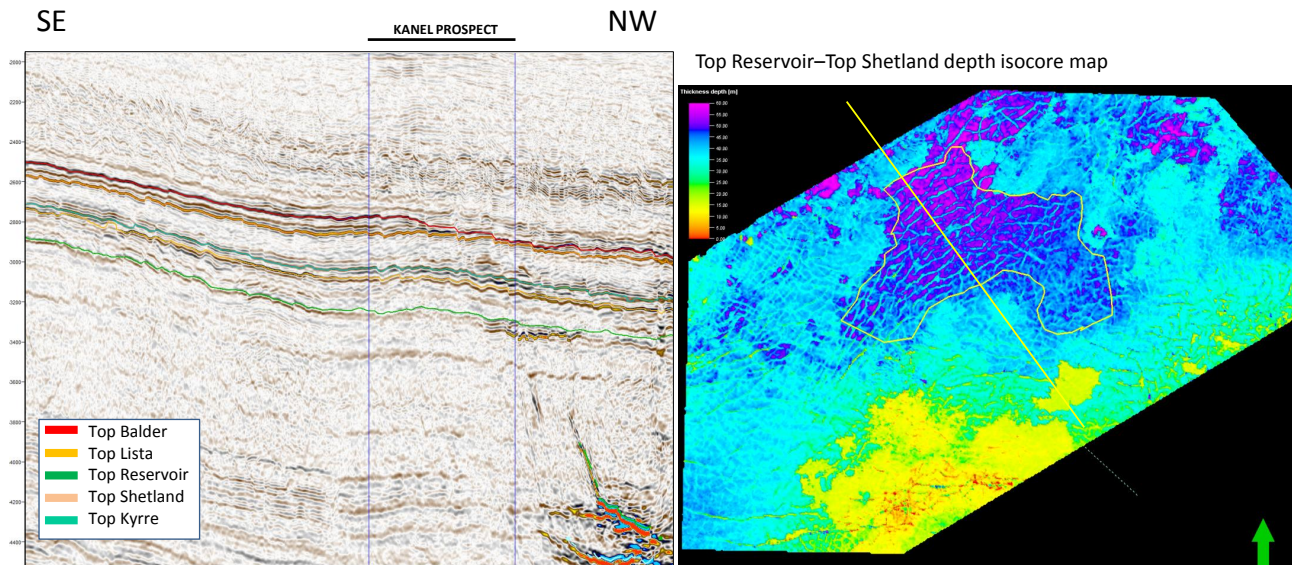
Fig. 3.1 Structural elements in the Møre Basin and the Northern North Sea.

Regional basin modelling of possible Late Jurassic source indicates that the drainage area for Kanel is gas mature to overmature at present day, with only the NE-SW trending Manet Ridge and Margarita Spur presently oil mature.

The migration model for Kanel is a possibly vertical migration from the underlying Upper Jurassic Draupne Fm, into permeable layers of Paleocene age, with subsequent lateral migration into the Kanel prospect.

## 4 Prospect update

The Kanel prospect has been interpreted using the EOTW12 and the ST0503LNR10 seismic 3D surveys. The Kanel prospect is defined as a Paleocene basin floor fan deposit, situated northwest of the Manet Ridge. The prospect outline is defined by a thickness anomaly within the Palaeocene section Fig. 4.1, that has both a seismic amplitude and AVO anomaly. The trap relies on a up dip pinch out of the reservoir towards the north western flank of the Manet Ridge. This introduces a high risk on the trap integrity related to leakage of hydrocarbons towards the high. The sediments in the Kanel prospect is believed to be sourced from northwest, that introduces a large risk on reservoir presence and properties as the provenance area for the reservoir sands are not known.



**Fig. 4.1 Kanel prospect outline definition**

The deep burial of the source rock for hydrocarbons within the licence, the Upper Jurassic Spekk Fm., suggests that the most likely hydrocarbon phase for the Kanel prospect is gas.

Seismic inversion and AVO analysis indicates hydrocarbon fill within the Kanel structure. However the AVO anomaly map points in the direction of a scattered and patchy distribution of the AVO response (Fig. 4.2A). Rock physics analysis of the seismic inversion data into different lithoclasses, based on  $V_p/V_s$  vs Acoustic Impedance relationship, brings out the distribution of the potential hydrocarbon response defined by lithoclass 1 (Fig. 4.2B). The scattered pattern of the AVO and seismic anomalies indicates a high risk for a heterogeneous reservoir with isolated accumulations and potentially poor internal communication.

The calculated recourses for a gas case in the Kanel Prospect has a  $P_{mean}$  volume estimate of 354 BCF (or 62 MMBOE) Fig. 4.3, and is not sufficient to support an exploration well.

In addition to the Kanel prospect, two leads (Rosmarin and Grillkrydder) Fig. 1.1. The leads are all of Cenozoic age and were described in the 20th round application from Spring Energy for the blocks 6201/11 and 6201/12. None of the leads represents individual drilling candidates.



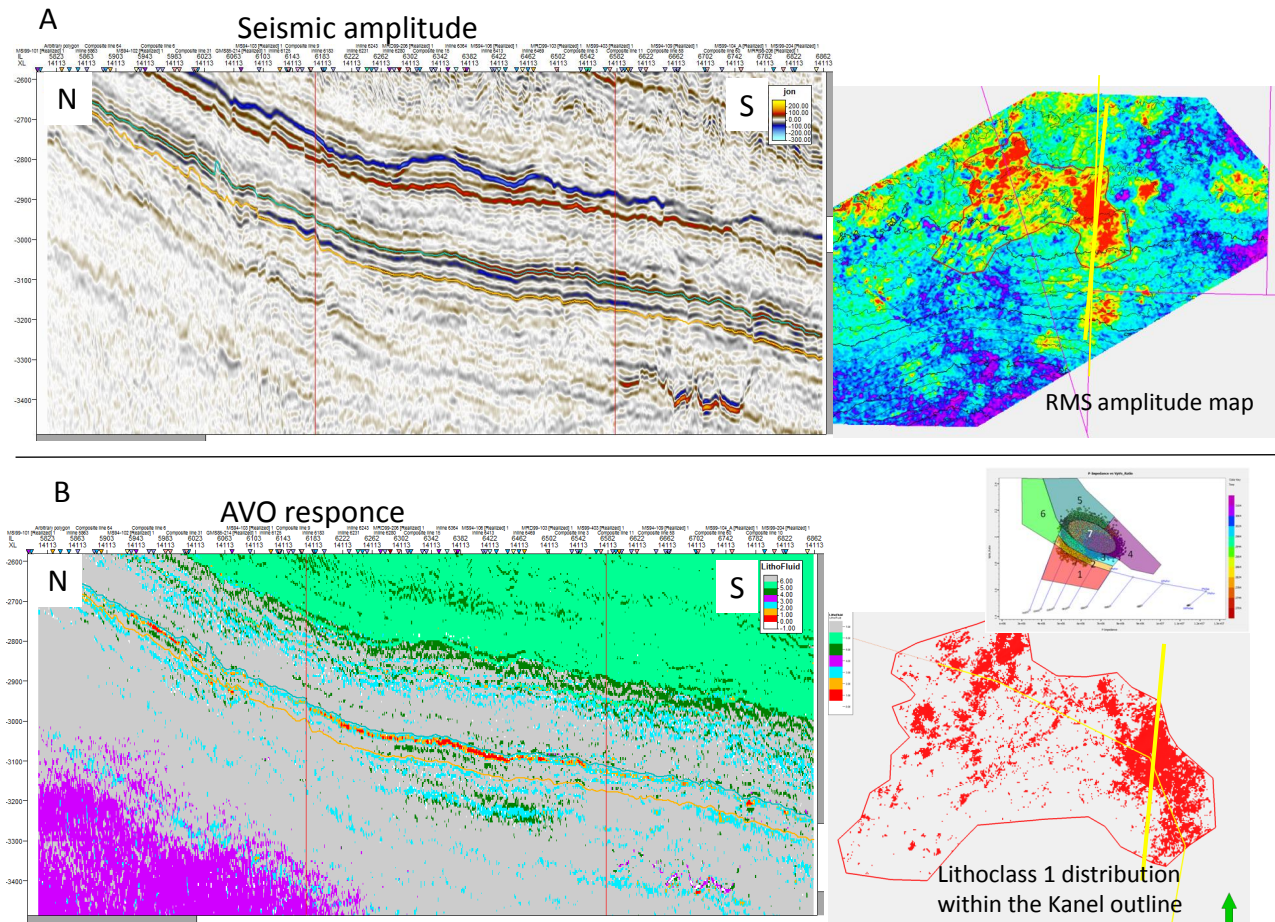


Fig. 4.2 AVO vs Seismic amplitude distribution

|                           | Original In Place  |         | Prospective Undiscovered Recoverable Resources |            |            |      | Total Geologic Pre-Drill |
|---------------------------|--------------------|---------|--|------------|------------|------|--------------------------|
|                           | Simulation Current |         | Liquids  |            | Sales Gas  |      |                          |
|                           | Oil                | Raw Gas | Oil  | Total Cond | Non- Assoc | Soln |                          |
|                           | MMBO               | BCF     | MMBO   | MMBO       | BCF        | BCF  |                          |
| <b>P99</b>                | 0,00               | 78,09   | 0,00   | 0,38       | 48,72      | 0,00 | 8,50                     |
| <b>P90</b>                | 0,00               | 162,92  | 0,00   | 0,88       | 103,62     | 0,00 | 18,15                    |
| <b>Mode</b>               | 0,00               | 268,57  | 0,00   | 1,16       | 130,25     | 0,00 | 22,78                    |
| <b>P50</b>                | 0,00               | 422,56  | 0,00   | 2,43       | 271,82     | 0,00 | 47,74                    |
| <b>Mean (P99-&gt;P01)</b> | 0,00               | 548,83  | 0,00   | 3,24       | 354,89     | 0,00 | 62,39                    |
| <b>P10</b>                | 0,00               | 1130,83 | 0,00   | 6,84       | 735,20     | 0,00 | 129,37                   |
| <b>P01</b>                | 0,00               | 2542,47 | 0,00   | 15,59      | 1655,30    | 0,00 | 291,47                   |

Fig. 4.3 CalculatedMMRA volumes for the Kanel prospect

## **5 Technical evaluations**

No new evaluations regarding possible developments has been performed since the APA2011 application.

## 6 Conclusions

The Kanel prospect has a very high risk associated with the presence and quality of the reservoir, and the up-flanks sealing potential of the stratigraphic pinch-out. The observations of a scattered distribution of potential gas fill in the prospect, based on seismic amplitude and AVO analysis, has increased the risk for a poor reservoir development and internal communication.

The high risk on key elements in the petroleum system and the calculated in-place volumes for a gas accumulation in the Kanel prospect, do not reflect a commercial potential to support a decision to drill an exploration well.

The partnership of the PL639 has in good cooperation evaluated and concluded on the exploration and commercial potential in the license, and a unanimous decision to drop the license was taken in February 2015.