MOL Norge AS

PL 773 Relinquishment Report

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1 Key License History

Production License 773 (Fig. 1.1) was awarded to operator Ithaca Petroleum Norge AS (60%) and partner Fortis Petroleum AS (40%) on February 6th 2015 as part of the APA 2014 license round. From September 4th 2015 the Operator's company name was changed to MOL Norge AS. The license comprises parts of Block 15/12.

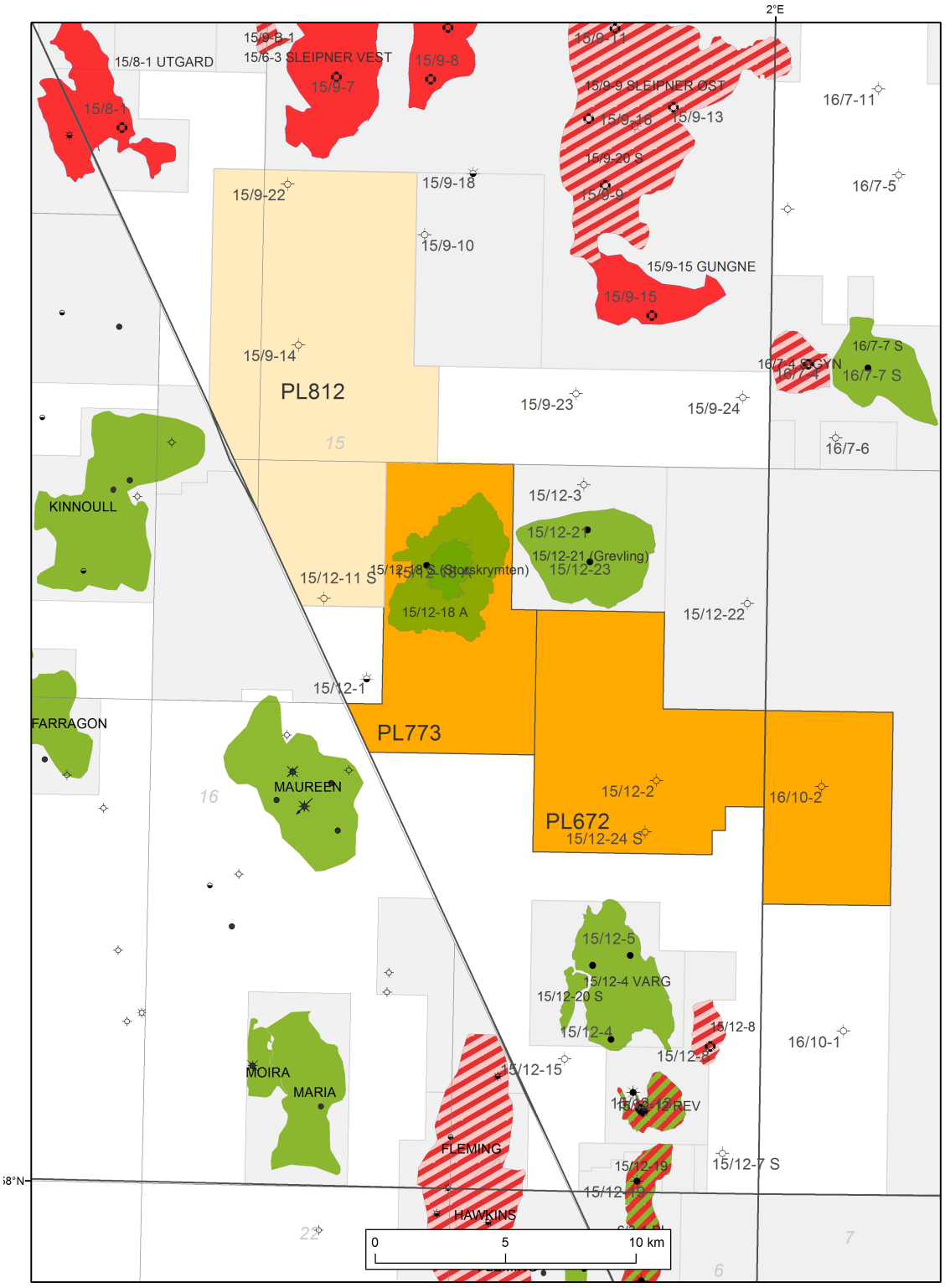

Fig. 1.1 PL 773 Overview

The license was awarded with a work commitment such that within 2 years i.e. by 6th February 2017 the partnership would:

- Reprocess 3D seismic and conduct geophysical and geological studies.
- Make a drill or drop decision.

Following an application for extension of the license period, an approval from the ministry was given on April 19th 2017 such that the drill or drop decision was to be taken August 6th 2017.

After performing a PSDM reprocessing of the MC3D-GRVLIN2012 seismic during autumn 2016-winter 2017 all work commitments and obligations for the license were fulfilled.

The following work program has been performed:

- Acquisition of two IP lines (measurement of pyrite anomalies) by ORG Geophysical
- Gather conditioning of the GRVLIN2012 survey by Sharp Reflections
- PSDM reprocessing by PSS-Geo
- Review of biostratigraphic data from relevant wells to obtain a consistent dataset
- Basin and petroleum systems modelling to reduce uncertainty in hydrocarbon generation and migration
- License field trip (common with PL771) to Book Cliffs, Utah, USA

The results of the evaluation was presented in an ECMC meeting on August 3rd 2017, and posted on L2S the same day. The Operator recommended to relinquish the license since no prospect having a resource potential and risk profile that could justify a drilling decision has been identified. Fortis replied that they did not support the Operator's recommendation, and tried unsuccessfully to form a new partnership by the DoD deadline. Hence, the license was terminated on August 6th 2017.

The following meetings have been held within the license since the award:

2015:

3 ECMC meetings: 04.03.2015, 22.06.2015, 10.11.2015

2016:

1 ECMC meeting: 18.11.2016

3 EC Work Meetings: 08.03.2016, 10.05.2016, 20.12.2016 (Core Viewing)

2017:

ECMC meeting: 03.08.2017

2 Database

2.1 Seismic database

The common seismic database for the license consist of approx. 390 km^2 of MC3D-GRVLIN2012 broadband 3D seismic (Figure 2.1). Two joint projects with neighbouring license PL 672 have been performed to improve seismic data quality. During 2016 gather conditioning of the MC3D-GRVLIN2012 survey was performed by Sharp Reflections. However, not all multiple and velocity issues were removed, and a PSDM reprocessing (MOL16M01) was performed by PSS-Geo during autumn 2016 - winter 2017, aiming at eliminating multiples, improving vertical seismic resolution in the target zone below BCU and remove dipping noise in the deeper part of the section, e.g. below T. Sleipner/T. Salt. Another important issue was to be able to map the distribution of the sandstones observed in the 15/12-24S Snømus well towards the PL 773 area (Fig. 2.1).

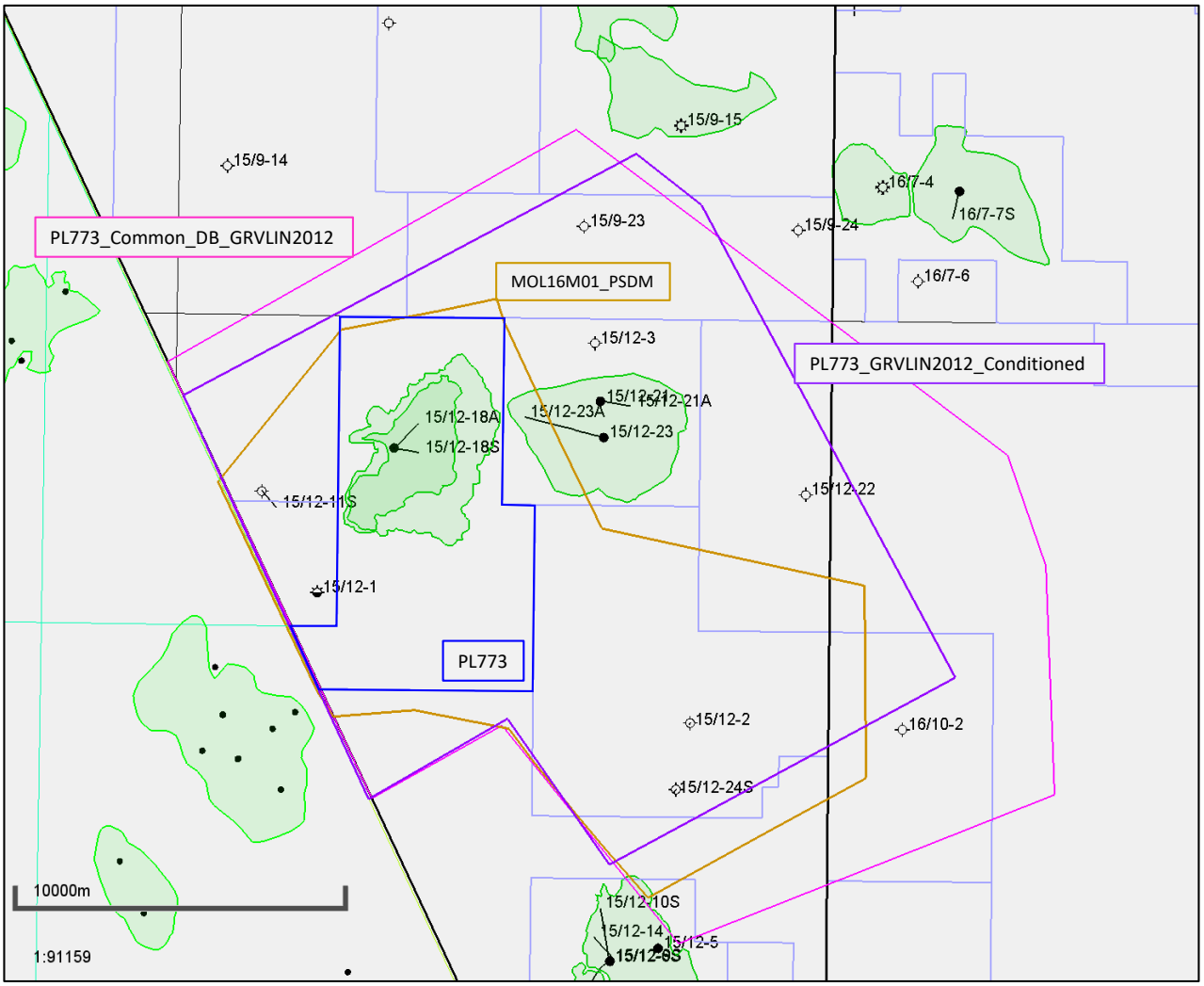

Fig. 2.1 PL 773 Seismic database

The resulting data sets together with a detailed biostratigraphic study of all nearby wells provided an increased understanding of reservoir distribution and quality across the license.

2.2 Well database

The PL 773 well database comprises 19 NCS wells (Fig. 2.2). In addition data from six relinquished UK wells have been used in the biostratigraphic evaluation and petrophysical evaluation (Fig. 2.3). An overview of the wells used in the evaluation is shown in Table 2.1 .

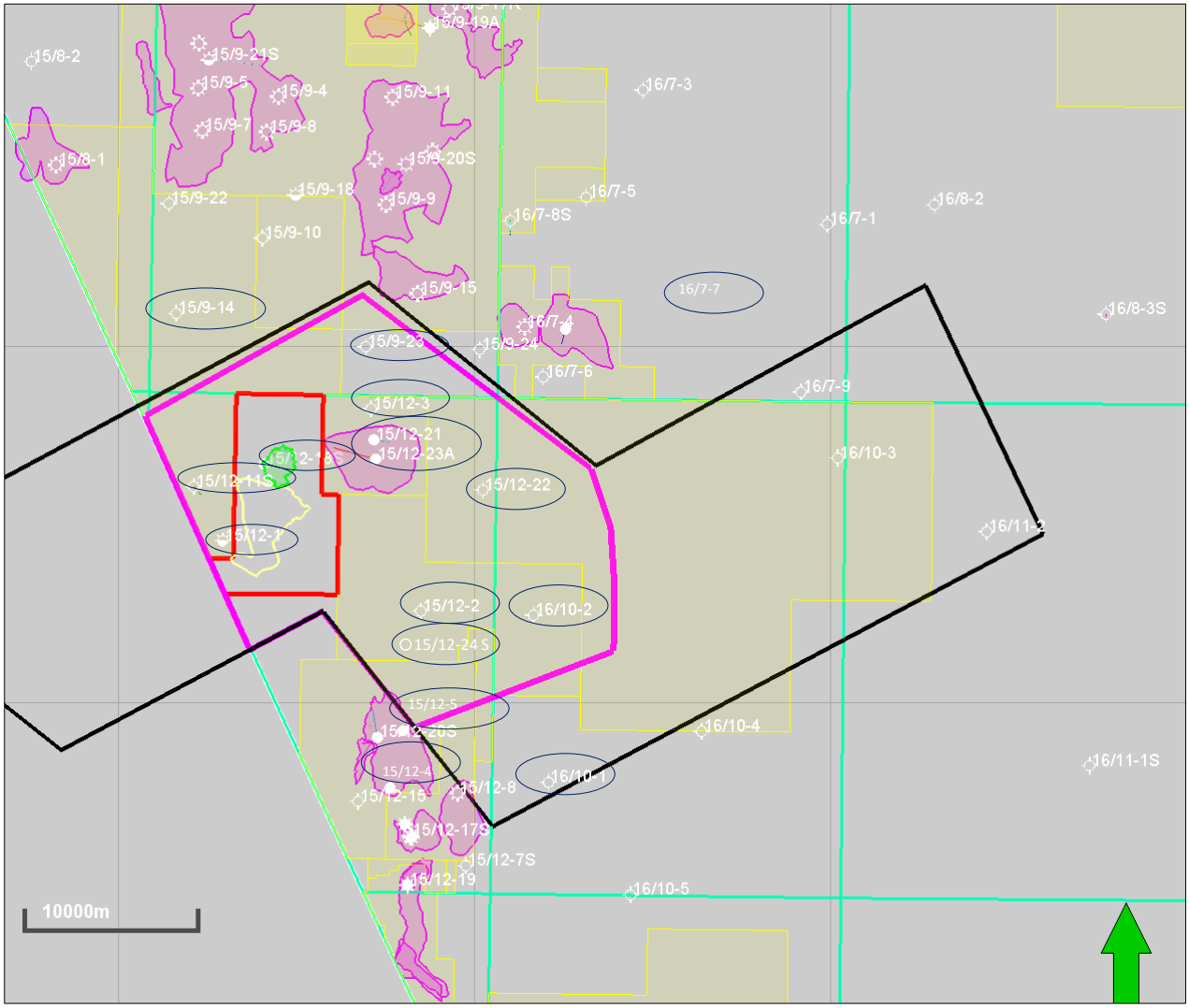

Fig. 2.2 PL 773 Well database Wells included in database are marked with grey circles.

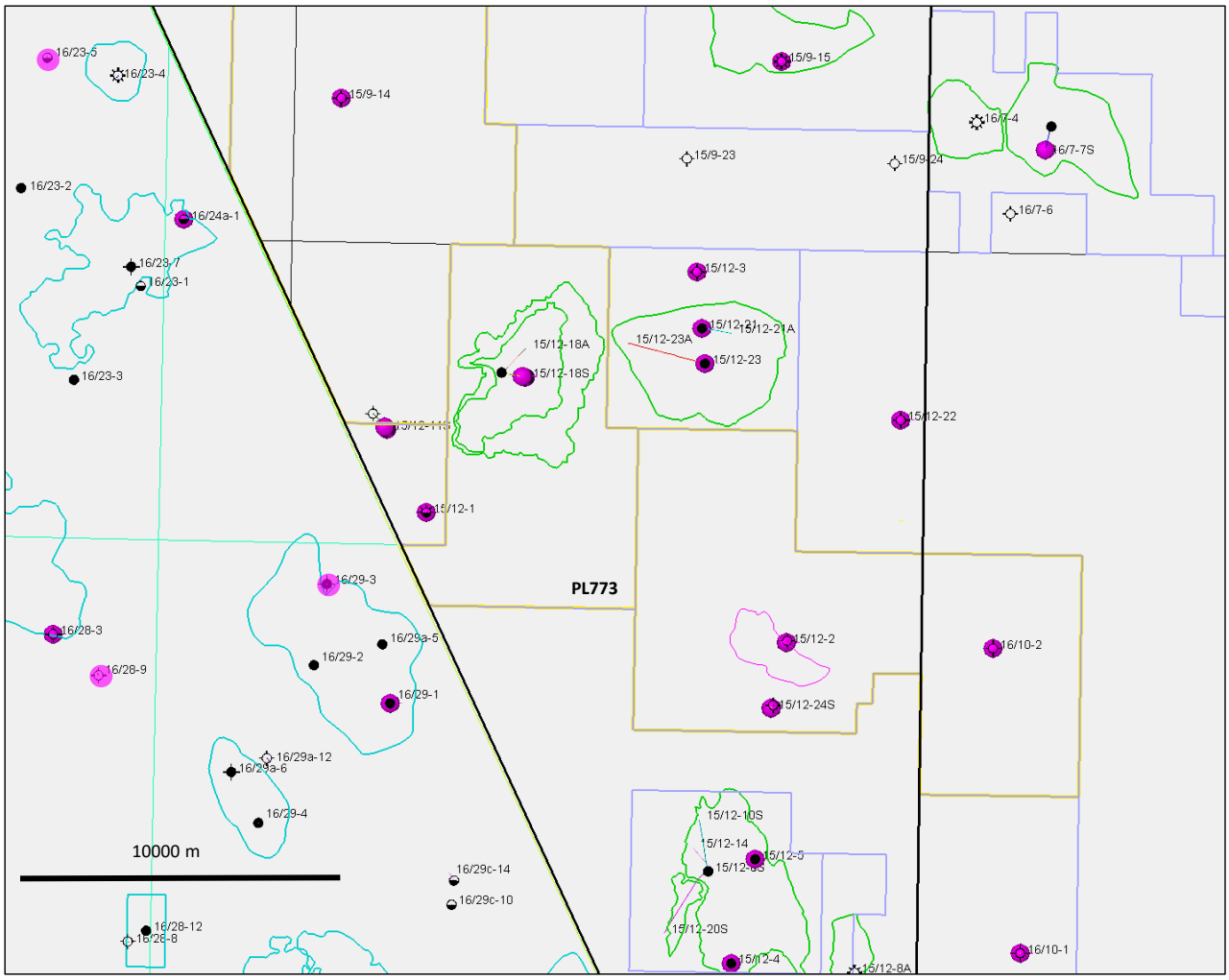

Fig. 2.3 PL 773 Well data. Review of biostratigraphic data performed in wells marked in pink.

Table 2.1 Well used in evaluation

Wellbore	NPDID	Field/Discovery	Content	Age / Fm at TD	Fm with HC
15/9-14	71		Dry	Smith Bank Fm	
15/9-23	6186		Dry		
15/12-1	94		Oil Shows	Skagerrak Fm	
15/12-2	331		Dry	Zechstein Gp	
15/12-3	199		Dry	Rotliegend Gp	
15/12-4	438	Varg	Oil	Triassic	Hugin
15/12-5	113	Varg	Oil	Skagerrak Fm	Ula Fm
15/12-11 S	3074		Dry	Skagerrak Fm	
15/12-18 A	5608		Oil	Tor Fm	Heimdal Fm
15/12-18 S	5607		Oil	Zechstein Gp	Ty Fm
15/12-21	6047	Grevling	Oil	Skagerrak Fm	Hugin & Sleipner Fm
15/12-21 A	6139	Grevling	Oil	Skagerrak Fm	Hugin & Sleipner Fm
15/12-22	6326		Dry	Skagerrak Fm	
15/12-23	6327	Grevling	Oil	Skagerrak Fm	Sleipner & Skagerrak Fm
15/12-23 A	6404	Grevling	Oil	Sleipner Fm	Sleipner Fm
15/12-24 S	7661		Dry	Skagerrak Fm	
16/7-7 S	3244	Sigyn	Oil	Skagerrak Fm	Intra Draupne SS & Skagerrak Fm
16/10-1	901		Dry	Zechstein Gp	
16/10-2	1767		Dry	Skagerrak Fm	
UK 16/23-5			Dry	Triassic	
UK 16/24a-1		Martha	Dry	Middle Jurassic	
UK 16/28-3		Andrew	Dry	Triassic	
UK 16/28-9			Dry	Triassic	
UK 16/29-1		Maureen	Oil	Zechstein Gp	Paleocene
UK 16/29-3		Maureen	Dry	Triassic	Paleocene

The most important wells for the evaluation of the Storekvina Prospect have been wells 15/12-1 and 15/12-24 S Snømus.

Well 15/12-1, drilled in 1976, encountered reservoir sandstones in the Hugin and Sleipner formations and proved this structure to be dry, with oil shows. Well 15/12-24 S Snømus, drilled in 2015, was dry with minor hydrocarbon shows, and encounterered thick J52 and J54 sands.

3 Review of geological and geophysical studies

PL 773 is located in the Ling depression, to the northeast of the triple junction between the South Viking Graben, the Central Graben and the Witch Ground Graben (Fig. 3.1). The license is located to the north of Varg, Rev and Gaupe fields and west of the 15/12-21 Grevling discovery, and comprises the 15/12-18 S Storskrymten Paleocene discovery. Several dry wells are drilled in the areas surrounding the license.

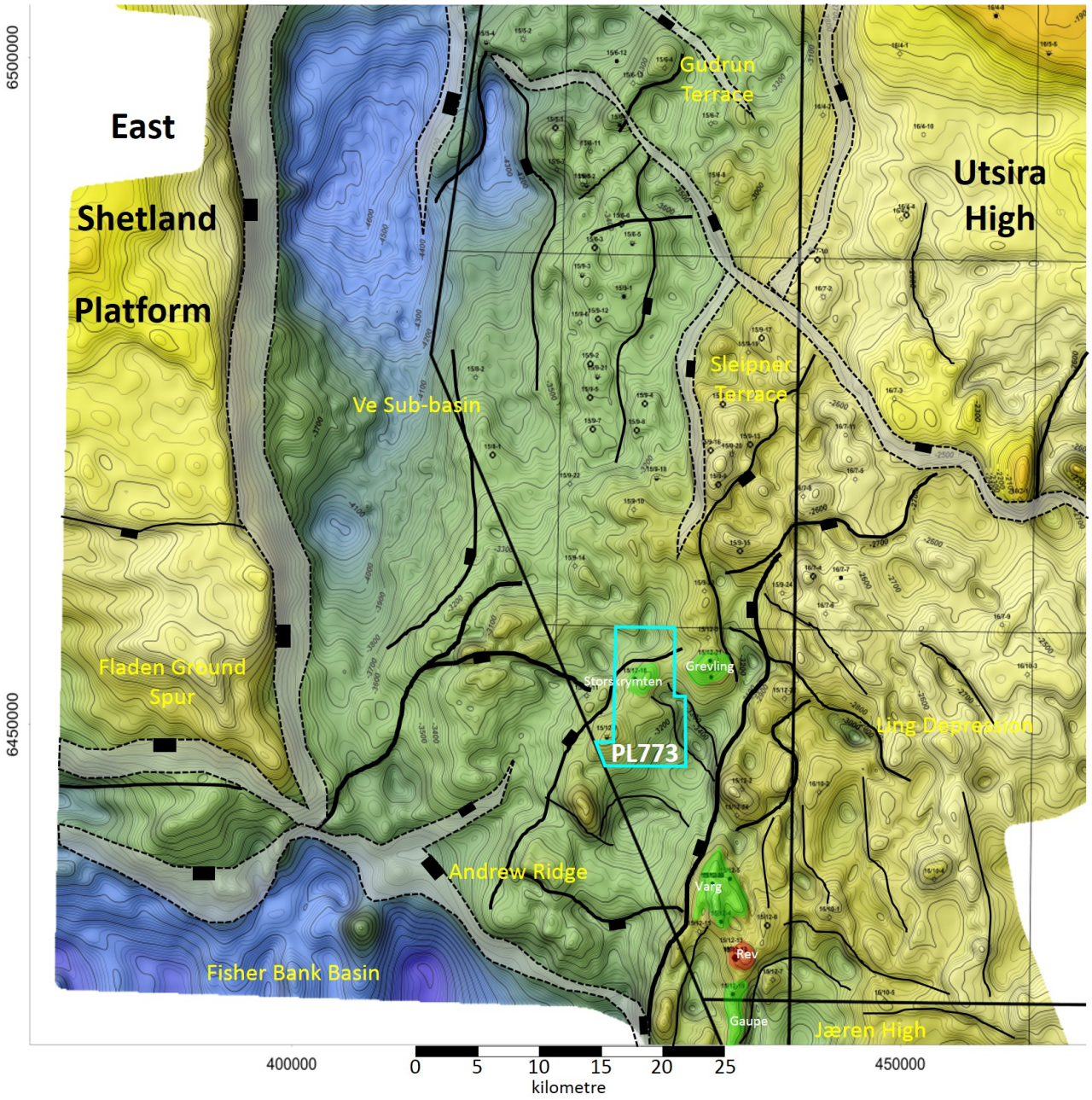

Fig. 3.1 Regional Base Cretaceous structural elements depth map PL 773 is located within the Ling depression between the Jæren High and the Sleipner Terrace and the Andrew Ridge to the east.

The resource potential of the Storskrymten discovery is considered to be limited, and would need additional resources to be commercial. The Storekvina Prospect, defined as a pinch-out trap with

reservoir in Late Oxfordian sandstones and relying on Upper Jurassic Draupne and Heather source rocks in the APA2014 application has been the main focus for the mapping and evaluation of the license area.

A semi-regional seismic line and the Base Cretaceous depth map is shown in Fig. 3.2 and Fig. 3.3, respectively.

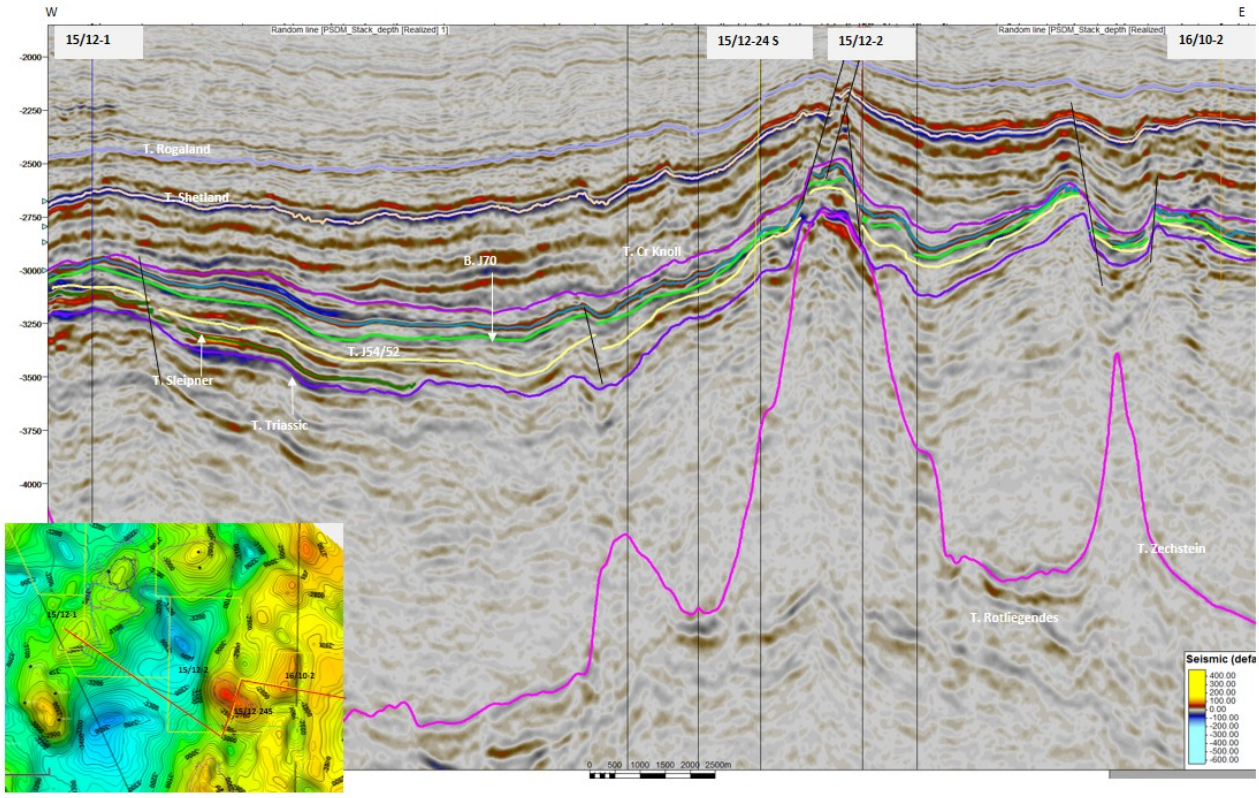

Fig. 3.2 Semi-regional seismic line

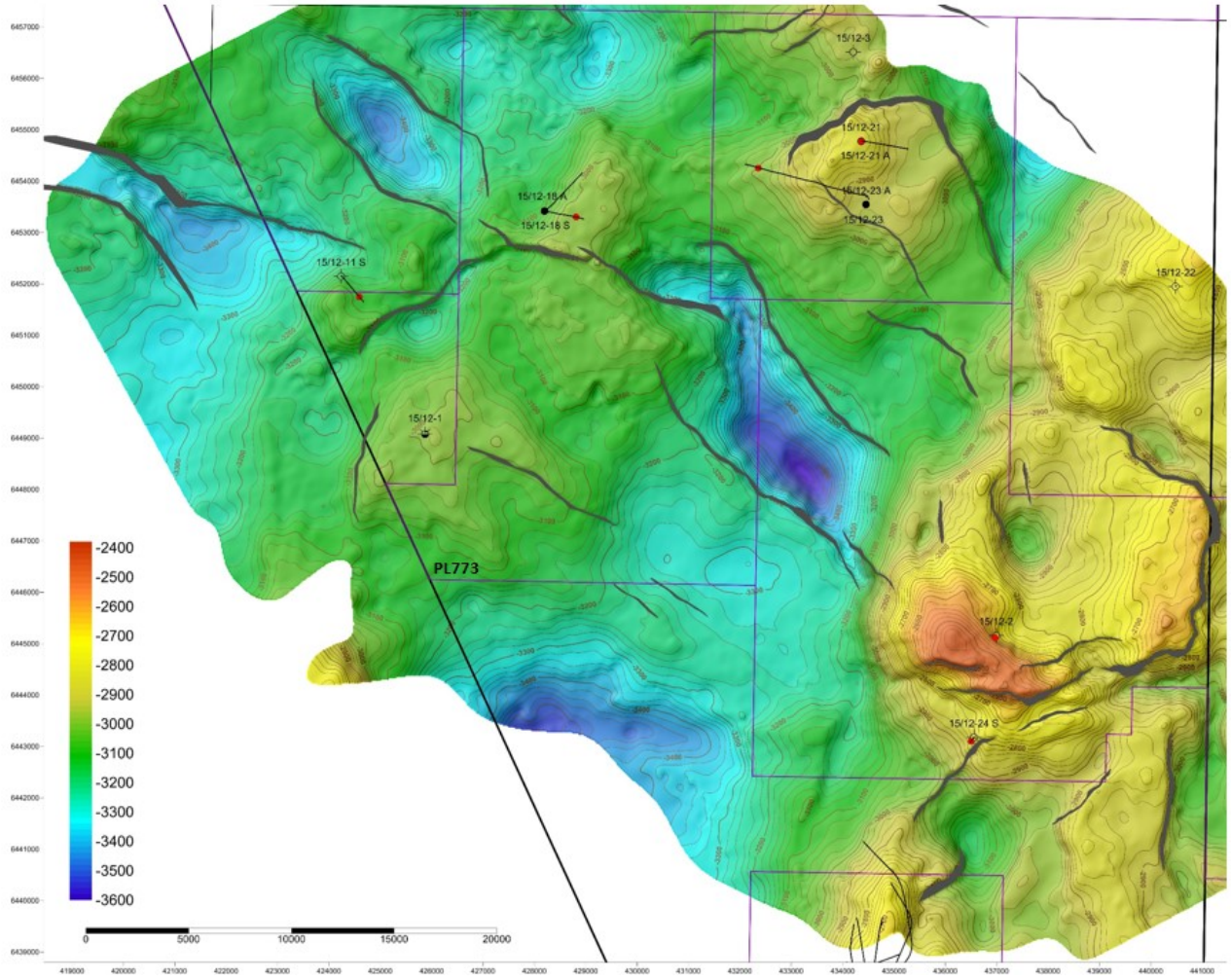

Fig. 3.3 Base Cretaceous Unconformity depth map

Biostratigraphic study

A biostratigraphic study has been performed by Merlin Energy using the J-sequence scheme of Partington et al. (1993). The study included a biostratigraphic review, interpretation and correlation of nearby wells, 17 on the NCS and 6 UK wells, and has resulted in the definition of new well tops, correlations, cross-sections, Wheeler diagrams and GDE maps for the Jurassic reservoir intervals.

A well correlation panel is shown in Fig. 3.4, illustrating the large variety in the distribution and thickness of J50 (J52 and J54) sands. The Storekvina Lead is located in the area between wells 15/12-24 S (Snømus) and 15/12-1. Well 15/12-24 S encountered nearly 200 m of J50 (J52 and J54) sands, but the J52 sand has shaled out between this well and 15/12-1. The J54 sequence is not present in the 15/12-1 and disappears between 15/12-24 S and 15/12-1.

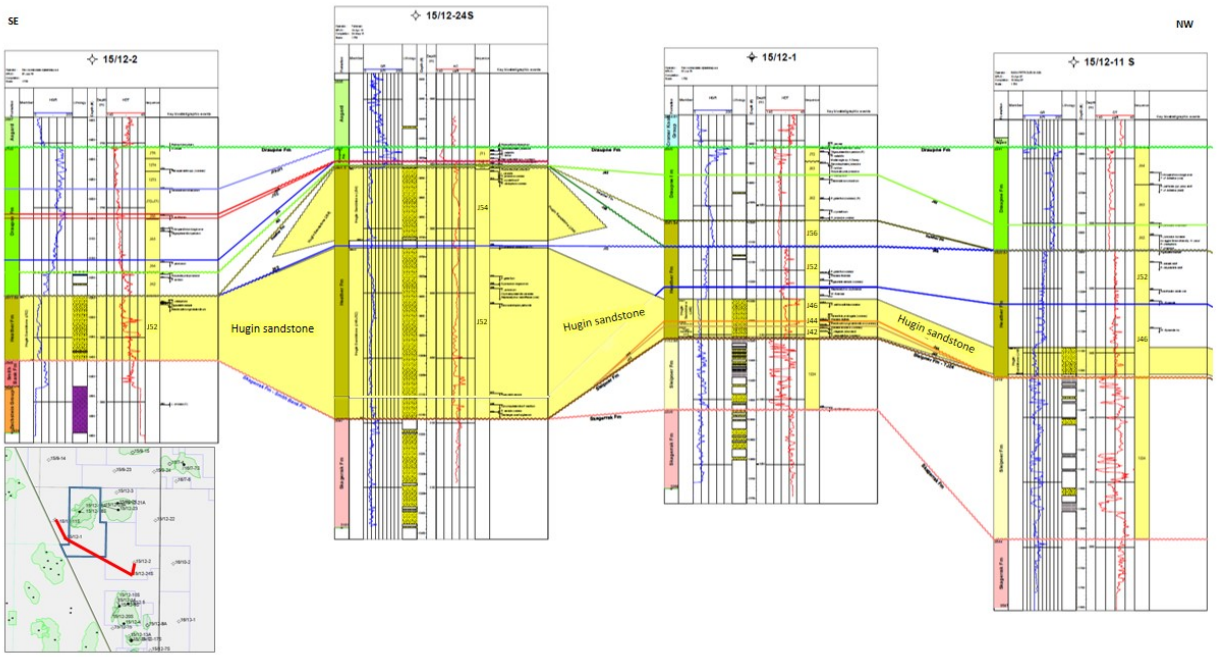

Fig. 3.4 Well correlation based on updated biostratigraphic interpretation Hugin sandstone (J52) is present in all four wells, whereas J54 is only present in the 15/12-24 S well.

On the other hand, J40 sands (J42, J44, J46) observed in 15/12-1 are not present in 15/12-24 S. Except for some thin sandstringers, no sandstones are observed in the J60-J70m secquences in the area.

Petrophysical Analysis

In-house CPI's are available for relevant wells surrounding PL 773, including four wells on the UKCS. These indicate good reservoir properties in the J52 and J54 sands.

Induced Polarity (IP) lines

The ORG15252-7 survey was acquired during May-July 2015, and consisted of two 2D lines adding up to 45 km of full subsurface coverage, in water depths varying between 72 - 93 m. The Grevling (15/12-21) and Storskrymten (15/12-18 S) discoveries were crossed, as well as the Maureen Field on the UK side. The survey lines were acquired in two parts, and parts of one of the lines was acquired twice with different aquisition parameters (4 vs 8 sec pulsing), leading to differences in the inversion results. This seemed to be caused by a combination of unusual tau4 values and the fact that we were near the sensitivity limit of the technology.

Fig. 3.5 shows the results in Layer 4 (target layer), where correlation between chargeability and known fields Maureen (UK) and Grevling is observed. IP responses in the survey area are relatively weak overall, on average 1.5%, indicating that the overall background chargeability in this area is low. Several areas with higher chargeabilities are observed, which may be related to "micro-seeps", but do not correspond to any mapped prospects. Some of the higher values seem to be related to pipelines, e.g. in the NW and SE part of line 15252-007-002. The mismatch of chargeabilities at the line crossing is a concern, since nothing in the raw data can be identied as a possible noise source, causing a higher changeability on line 152252-007-002 compared to line 152252-007-001 in this area.

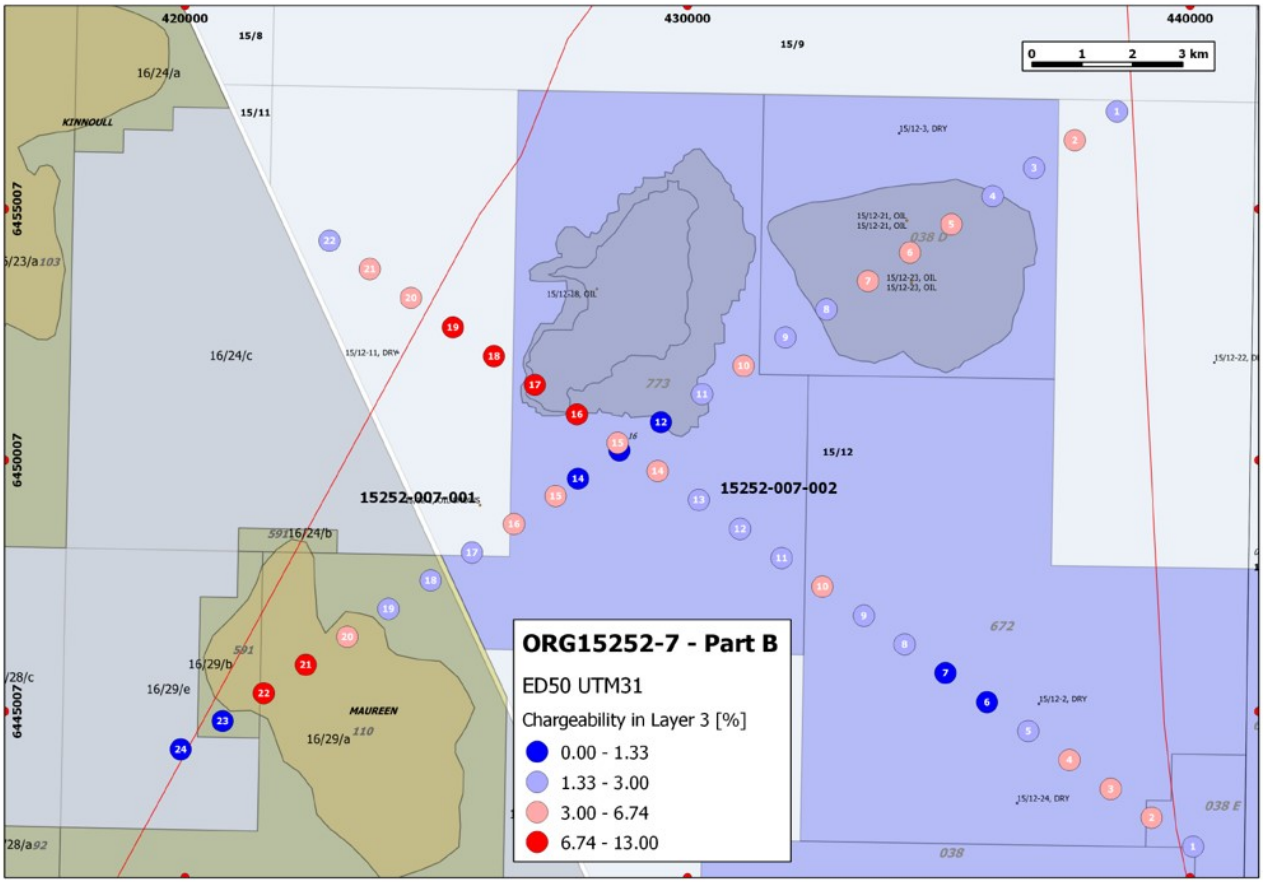

Fig. 3.5 Chargeability in Layer 4 for ORG15252-7 survey lines

Gather conditioning

Gather conditioning of a subset of the MC3D-GRVLIN2012 survey was performed by Sharp Reflections, focusing on the interval between Top Rogaland Gp and Top Sleipner Fm. This resulted in improved seismic data quality, however not all multiple and velocity issues were removed.

PSDM reprocessing (MOL16M01)

PSDM reprocessing of the MC3D-GRVLIN2012 seismic was performed by PSS-Geo during autumn 2016-winter 2017. Pre Stack Depth Migration was run using a 3D Kirchoff algorithm. The initial velocity field derived from wells and horizons was used as the vertical velocity field and the final velocity updated from tomography was used as the horizontal velocity field.

Basin modelling

The petroleum systems modelling has been performed in-house, using Zetaware Trinity T3 software, and included evaluation of the Draupne and Heather formation source rocks. The coals of the Sleipner Formation represents an additional source rock, but does not make a large contribution. The thicknesses of the Draupne and Heather source rocks are based on isopachs derived from the interpreted seismic horizons BCU-Base J70 and Base J70-Top J54-J52, respectively. Influence of sediment dilution on source rock properties of the Heather and lower part of the Draupne is seen for some of the J50s and J60s sequences (e.g. well 15/12-2); i.e. increasing thermal maturity with depth is not being expressed.

The thermal calibration of the basin model considers maturity and temperature data, as well as salt geometry and its influence on thermal conductivity. Maturity of the source kitchen is highly sensitive to depth conversion. The petroleum system model is calibrated against the Grevling Discovery.

For the Storekvina Lead a drainage area of 41 km^2 has been defined, oil and gas are being expelled from the Draupne and Heather marine shales at present day. A migration efficiency of about 35% is required to fill the Storekvina Lead (P10 volumes), integrating both Draupne and Heather source rocks. Undersaturated oil with gravity of ~34 °API, mono-phase is predicted.

4 Prospect update

The main basis for the evaluation license has been the MOL16M01 PSDM reprocessing of MC3D-GRVLIN2012 geostreamer survey, and the updated biostratigraphic interpretations.

A geoseismic section between wells 15/12-1 and 15/12-24 S is shown in Fig. 4.1. The seismic line is flattened on BCU, and shows a possible distribution of the J42-J46 sands observed in 15/12-1, and the J52-J54 sands observed in 15/12-24 S. In both wells the sands were waterfilled. The Storekvina stratigraphic trap, i.e. the pinch-out of the thick J52 and J54 sands in Snømus/onlap of the sands onto an Intra Jurassic unconformity is difficult to map out due to limitations in the resolution of the PSDM seismic data. The new interpretation shows that the onlap most likely will be downflank and with a limited volumetric potential compared to the prospect defined in the APA2014 application.

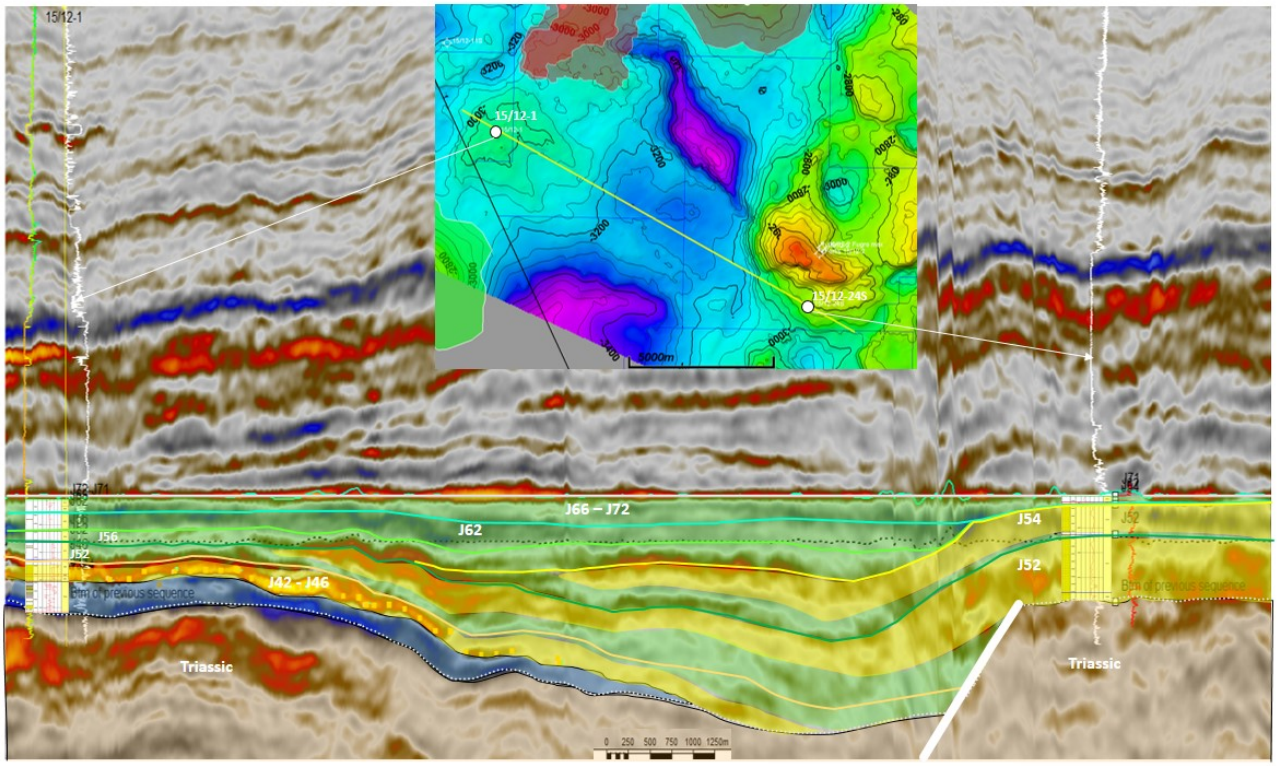

Fig. 4.1 Geoseismic section between wells 15/12-1 and 15/12-24 S A possible J52 and J54 sequences pinch-out/onlap between the two wells is shown below a flattened BCU.

The J50 sandstones are shallow marine sandstones, deposited from the east and with an uncertain extent towards the west. The GDE maps of J52 and J54 (Fig. 4.2) illustrates the potential lack of J52/ J54 sand in the Storekvina area (located between the 15/12-1, 15/12-18 S and Grevling wells, and wells 15/12-2 and 15/12-24 S to the southeast).

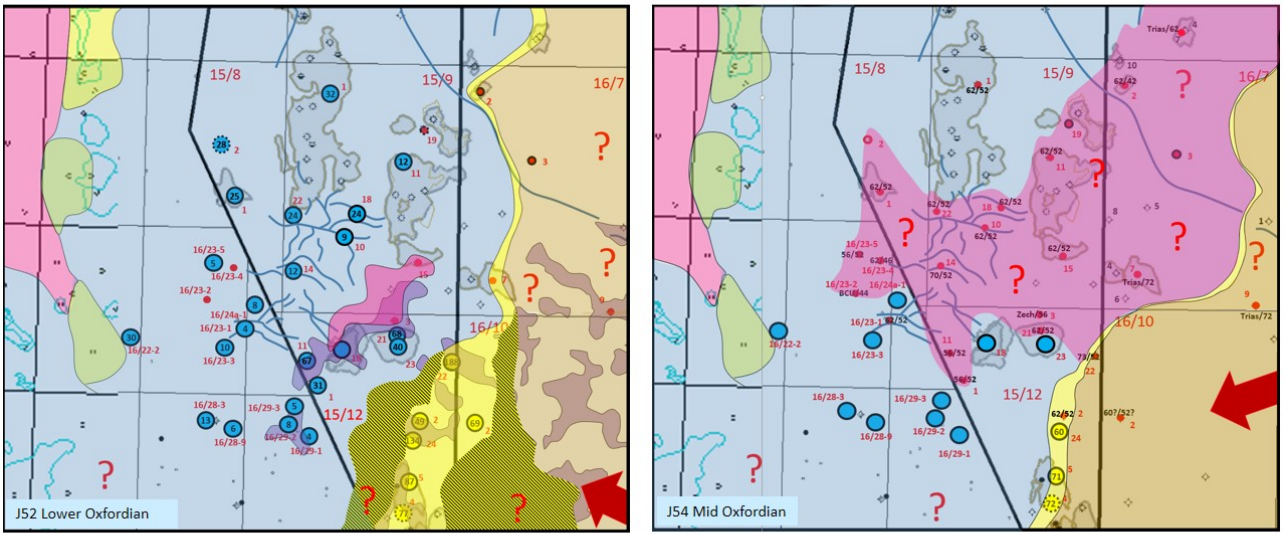

Fig. 4.2 Gross depositional environment maps of J52 and J54 sequences

Upper Jurassic Draupne source rock to the west and east of the prospect area (Fig. 3.3). However, the main hydrocarbon basin to the east is mainly considered to be an Early Cretaceous basin, and does not contain a thick upper Jurassic sequence. Based on well data and spectral decomposition at BCU level it may also be inferred that the source rock is diluted. The maturity of the source kitchen is highly sensitive to the depth model used in the PSDM reprocessing, leaving source and migration as a high risk for the Storekvina Lead. A seismic line through the Storekvina Lead is found in Fig. 4.3, in this case showing a possible termination of the lead towards the fault.

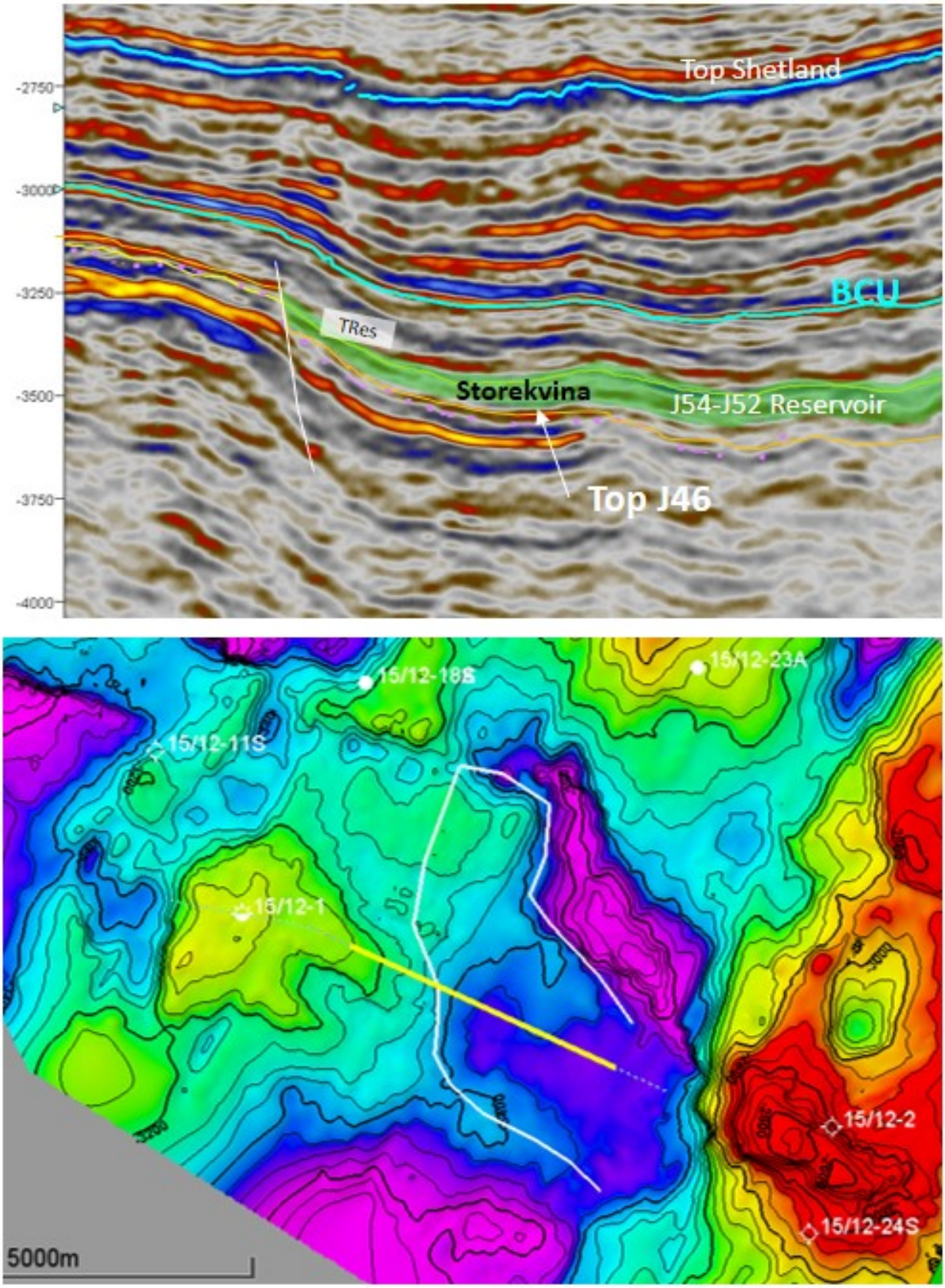

Fig. 4.3 Storekvina Lead Seismic line and Top J54-J52 reservoir depth map. High uncertainty related to the presence of the reservoir.

Tentative volumes for the Storekvina Lead is shown in Table 4.1. The CoS is set to 0.12, with reservoir presence and source rock maturation as the main risk element.

Table 4.1 Tentative volumes for the Storekvina Lead

Resources	P90	P50	Mean	P10
MMBOE in total	14	29	33	60

5 Conclusions

Apart from the 15/12-18 S Storskrymten discovery, one lead, Storekvina, is identified within the PL 773 license area.

The new evaluation of Storekvina Lead based on reprocessed seismic and updated biostratigraphic interpretations still indicate uncertainties concerning the reservoir distribution (presence) and quality of reservoir, and the amount of hydrocarbons migrated into the trap.

Following internal reviews MOL Norge recommended to relinquish the entire license area, as volumes are evaluated to be economically unattractive and with a high risk.

A relinquishment letter was sent to the Ministry of Petroleum and Energy on August 3rd 2017 by MOL Norge, stating that MOL Norge wanted to relinquish the license, whereas partner Fortis Petroleum would send a separate application concerning continuation of the license.