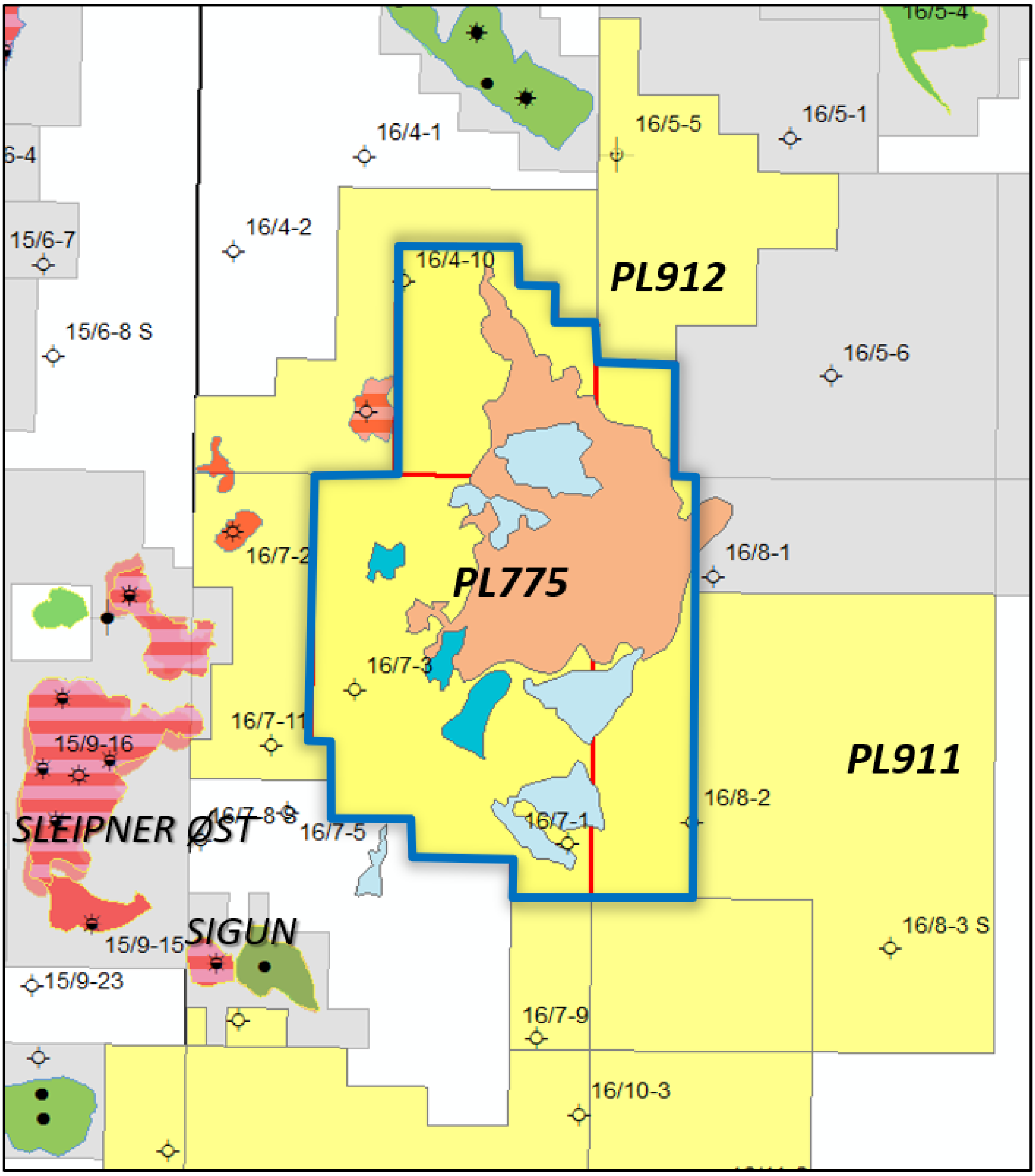
PL775 Relinquishment Report



Prepared by ConocoPhillips 2018

Table of Contents

List of Figures

List of Tables

1 Key License History

Production license PL775 and PL775 B are located in the Southern Viking Graben (Fig. 1.1) and consists of parts of block 16/7, 16/8, 16/4 and 16/5. On 18th of January 2017 ConocoPhillips Skandinavia AS took over all equity and operatorship from Tullow Oil Norge AS.

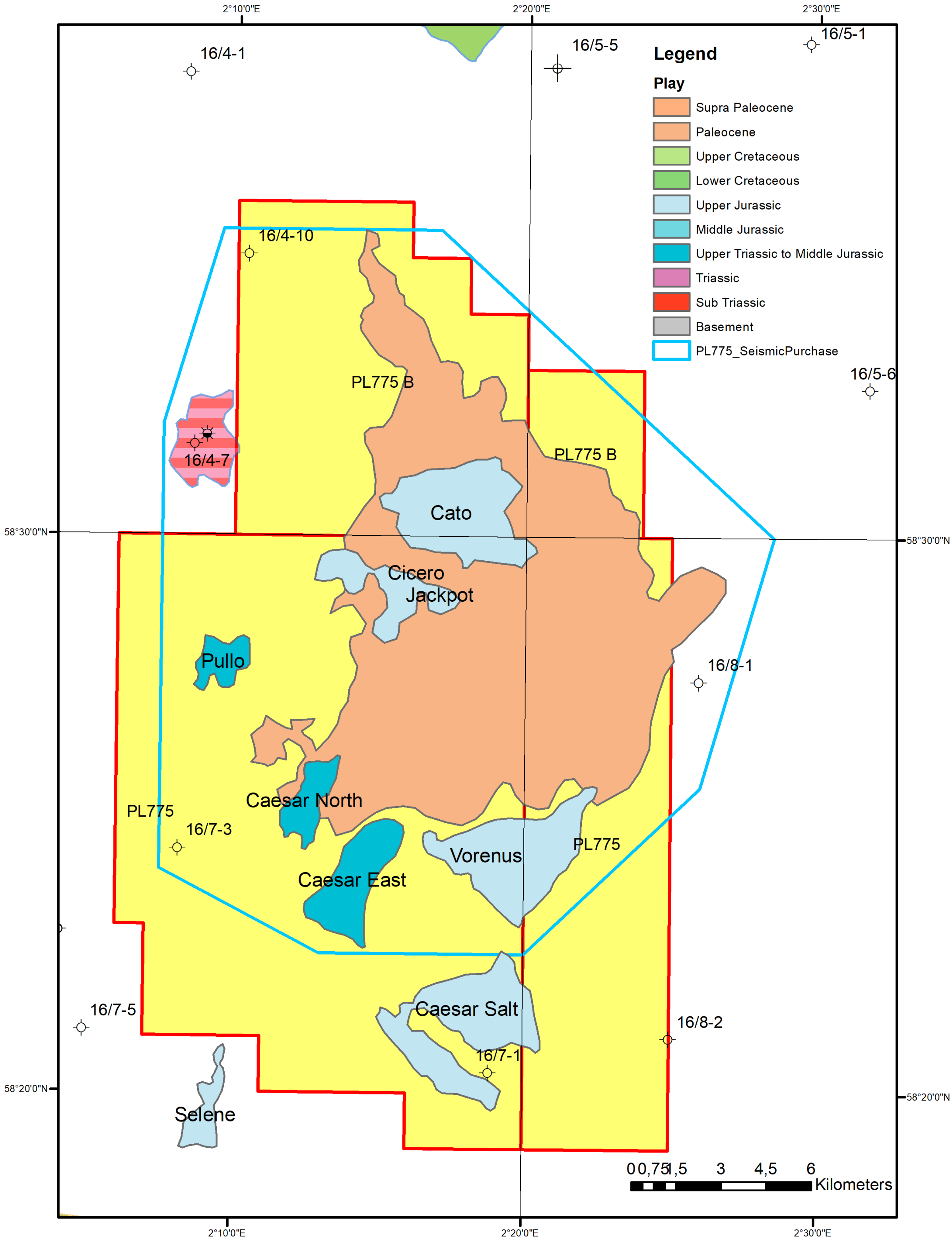


Fig. 1.1 Location and outline of PL775 and PL775 B prospectivity.

The partnership in PL775 and PL775 consists of

- ConocoPhillips Skandinavia AS 40%
- Point Resources AS 20%
- Concedo 20%
- Petoro 20%

The original work obligation of reprocessing the seismic was already fulfilled by Tullow Oil as the operator. To further characterise the opportunities in PL775, the license elected to purchase additional modern broadband 3D multi client data. The purchased dataset is the PGS16902VIK (PGS16M03) and consists of 381.8 km2 PSDM/PSTM processed geostreamer high quality seismic data.

Due to ConocoPhillips taking over operatorship from Tullow on the 18.01.2017, the late arrival of the new seismic, and a shift in perception of prospectivity within the license away from the Jurassic to the Tertiary potential, a license extension by one year was requested and approved. The extension set the ending of the initial phase to the 06.0.2024. A successful application for additional acreage covering the entire Jackpot prospect was filed for the APA 2017 round and was granted as license PL775 B on the 02.03.2018. The PL775 license extension (PL775 B) follows the same work program and decision gates as the original PL775 license.

The work obligations are stated below:

- Reprocess 3D seismic
- By 6 February 2019 decide whether to drill an exploration well or relinquish the license

The partnership decided to drop the license at the drill or drop deadline 6th February 2019 based on the conclusion that the the Paleocene play does not extend into the license area. The remaining potential in the traditional Paleocene and Jurassic play fairway are deemed too small and too high risk to be of economic interest to the partners.

1.1 License Meetings

In total seven combined EC/MC meetings and two work meetings were conducted in this license. The 5 last meetings were held while ConocoPhillips was the operator (Fig. 1.2).

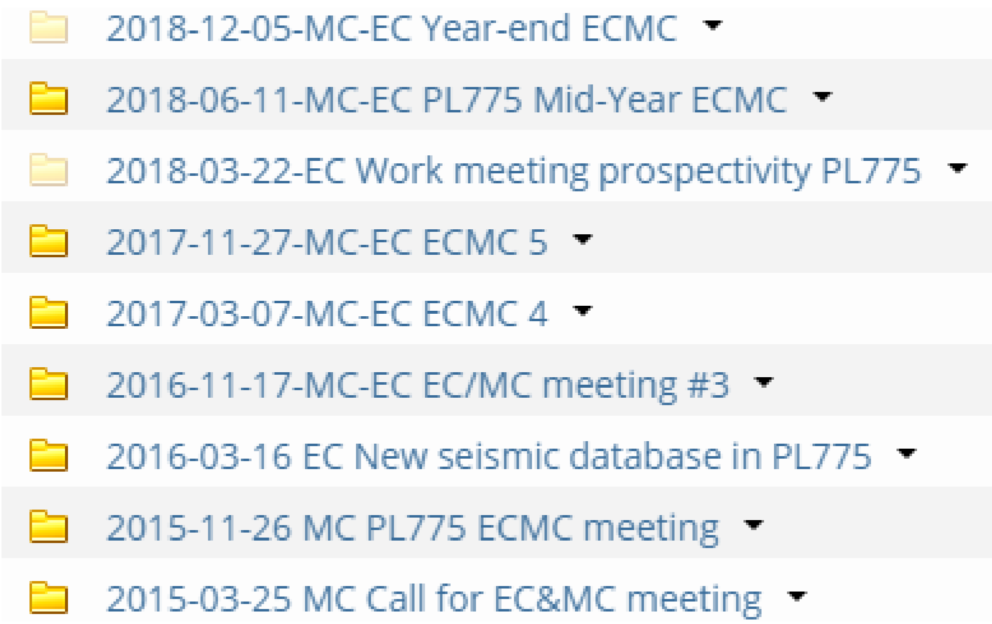


Fig. 1.2 Work-, EC-, and MC meetings held in the PL775 license

1.1 License Meetings

Table 1.1 License Meetings

Date	Activity	Theme
25. March 2015	EC/MC Meeting #1	License establishment
26. November 2015	EC/MC Meeting #2	year-end status update
16. March 2016	EC meeting	meeting on new seismic data base
17. November 2016	EC/MC Meeting #3	year-end status update
07. March 2017	EC/MC Meeting #4	Change in operatorship
27. November 2017	EC/MC Meeting #5	year-end status update - New seismic database and early results
22. March 2018	EC meeting	Prospectivity workshop - Paleocene & Jurassic
11. June 2018	EC/MC meeting #6	mid-year status update
14. November 2018	EC/MC meeting #7	year-end status update

2 Database

2.1 Seismic Database

Seismic database
A common license database was established at the beginning of the PL775 license award and expanded during initial phase.

The main component of the seismic database for PL775/B is the TUN15M01 (Fig. 2.1) dataset which was generated by Tullow Oil as balanced post stack merge of several released and prioritized seismic surveys. This fulfils the original work obligations.

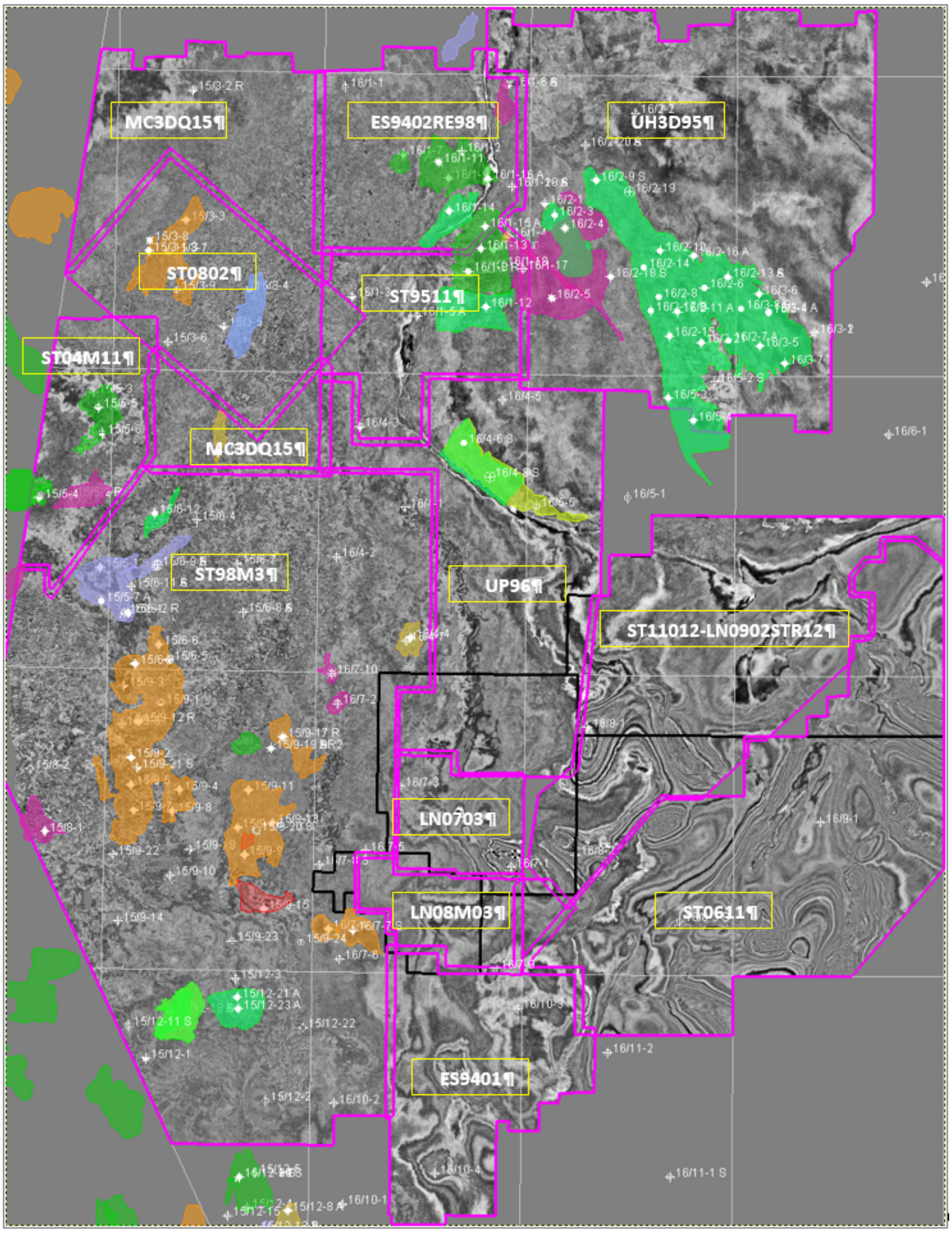


Fig. 2.1 Distribution of individual seismic surveys used for the TUN15M01 merged survey

Processing Summary for the TUN15M01 survey

1. Input of stack volumes
2. Regularize to common grid 25x25 m
3. Crop each survey to overlap with neighbor surveys and cut out low fold data.
4. Compute Matching filter using traces in overlap zones between base survey and added survey
5. Volumes were merged in the following order: ST11012 >ST0611 >ES9401 > LN08M03 > LN0703 > UP96 > ST98M3 > ST9511 > ES9402RE98 > UH3D95 > MC3DQ15 (Southern part) > ST0208 > ST04M11 >MC3DQ15 (Northern part)
6. Each Survey was scaled in 5 time variant windows to a common Median value in each time window.
7. Output TUN15M01-NOSC
8. Envelope gain applied
9. Output TUN15M01

In 2017, the PL775 partnership decided to add approximately 381.8 km2 of a modern broadband 3D dataset to the common database. The volume was acquired and processed by PGS multiclient as PGS16902VIK (PGS16M03). The processed dataset covers over 5,500km2 in the Southern Viking Graben area and is deemed to be of high quality. It is part of PGS's PURE library which follows a state-of-the-art processing workflow including near-offset infill from multiple data, full-waveform inversion to generate a high resolution velocity model in the shallow part and an extensive tomographic workflow to get the most out of the prestack depth migration. The area that is covered by the PGS160902VIK seismic dataset is outlined in Fig. 1.1. The selected polygon covers all prospects and leads as well as key well locations around the license for higher confidence interpretation of the stratigraphic framework, especially in the Paleocene.

2.2 Well Database

Well Database

The released wells in and surrounding the license constituted the common well databaseand are shown in table below. In addtion the well 16/4-7 (Biotitt Deep) was traded for the license.

Table 2.1 Wells used in the study with NPD ID

Well Name	NDPID
15/6-4	319
15/6-7	2084
16/4-1	229
16/4-2	1560
16/4-4	5441
16/4-6 S	7098
16/4-7	7208
16/4-10	7731
16/5-1	189
16/5-5	7285
16/5-6	7962
16/7-1	146
16/7-2	40

16/7-3	75
16/7-5	134
16/7-10	6607
16/8-1	335
16/8-2	234
16/8-3 S	7115

2.3 Special Studies

Special Studies:

- With ConocoPhillips as the operator a very large and detailed regional basin model was constructed and calibrated to all relevant offset wells. In contrast to the publically available basin models special care was taken to correctly map and incorporate many of the shallow horizons post Balder Formation deposition. This was done to be able to model the intricacies of long distance migration in a basin that underwent very late stage changes with regional tilts and late glacial adjustments. The spatial extend and the horizons utilized by the basin model are shown in Fig. 2.2. The migration and generation was modelled on a 200x200m grid size.
- *Seissquare UDOMoRe Depth uncertainty management workflow:* To get a better estimate of the total remaining depth uncertainty after carrying out a full well-tied PSDM reprocessing workflow on the PGS16902VIK seismic survey the license engaged Seisquare to apply their UDOMoRe Depth uncertainty management workflow to the mapped horizons and the given seismic. A key component of this workflow is to quantify and remove higher frequency residuals and seismic acquisition artefacts from the velocity field. This operation is successively performed on defined geological intervals such that a conditioned and an artificatual interval velocity for these intervals can be computed. In a final step the smoothed filtered time surfaces, the conditioned interval velocity and the residuals are combined to produce a stochastic depth conversion that delivers a depth map with the associated depth uncertainty distribution.
- *Stochastic Basin modelling to determine fill and spill routes:* The subtlety of the Jurassic structures and long distance migration required to fill the Jackpot prospect required a non traditional approach to the mapping of potential hydrocarbon fills and the determination of the fill spill routes. We developed and in-house workflow where the standard deviation derived from the Seissquare depth uncertainty modelling workflow is randomly sampled and used to produce a set of 300 to 500 valid depth surfaces that represent the depth uncertainty ranges. Migration runs are then performed on all of these surfaces and the modelled hydrocarbon fills and spill routes are converted to probability density maps such that an interpreter can read of the chance of migration and or hydrocarbon fill at any given depth along a certain structure or fill route. This allowed a very deep assessment of the charge likelihood in the face of seismic and well tie uncertainty.
- *Rock Physics :* Rock physics analyses were done to assess amplitude expectations on modern broadband 3D seismic data and its potential to help differentiating lithologies and fluid content.
- *Neural Network Lithology Prediction :* In collaboration with a summer student from the NTNU a machine learning, artificial intelligence trial using 3D seismic data to classify seismic facies was carried out. Application of this technology showed that computers are able to generate precise and unbiased 3D seismic facies classifications. The automated and unbiased seismic facies mapping calibrated to 35 exploration wellbores did not predict any sand prone seismic facies indicators east of the currently proven pinch-out line of the Tertiary sandstones.
- *CPI Well Reports*: To better constrain expected reservoir properties for the prospect, CPI analyses were conducted on nearby key wells
- Extensive seismic forward modelling of potential Tertiary reservoirs sands has been undertaken to determine the minimum unresolved sandstone thickness of a Tertiary sandstone on the PGS16902VIK

seismic that is part of the common license database. The modelling showed that is very unlikely that a sandstone body with a net of greater than 15 meters of sand would be resolved by the high quality available seismic. The modelled response was compared real seismic and it was concluded that no sandstone body of such a thickness is present east of the currently mapped pinch out line for Tertiary sands. A sandstone body with less than 15 meters net sand combined with the areal extent of the Jackpot stratigraphic closure is not deemed to be an economically viable development scenario in 2018.

- The uniform shale model, originally derived in the Balder area, stipulates that the combined shale thickness for large parts of the Tertiary fairway is regionally constant and hence the thickness change in the Top Chalk to Sele seismic interval can be attributed solely to the change in Tertiary sandstone thickness. The shale hence was deposited as a time constant background rain sedimentation. This model was cross validated in the area to the west and around the Jackpot prospect and it was found that there are semi regional (>10km) significant changes in shale thickness that needed to be incorporated into the model. Taking regional trends into account the model predicts theTertiary sand thickness to the west of the Jackpot prospect rather well.
- *Traditional high resolution sequence stratigraphic mapping* of the Tertiary section was performed in an area spanning from the UK/ Norway border to the east of well 16/9-1 was performed to determine the spatio/temporal development of the accommodation space and depositional patterns in the area. Eight high resolution reflectors were mapped in the interval from top Chalk to Balder. This lead to the conclusion that the excess accommodation space that is apparent over the Jackpot area from the application of the uniform shale model was infilled post the deposition on the youngest Heimdal sands. Hence the excess top Chalk to Sele thickness that initially defined the Jackpot prospect using the uniform shale model was infilled after the deposition of the Heimdal sands.
- *Geochemical analysis of well 16/7-3:* The dry well 16/7-3 was analysed by Dag Karlsen from the University of Oslo for traces of fluid inclusions and to be able to type the source of the oil stains that is present on the middle Jurassic core from 2343 to 2375m MD. Eight core samples were sampled at the NPD core store and subjected to solvent extraction. Additionally thin sections and sieved grain fractions for the analysis of fluid inclusions were prepared. The analysis by Dag Karlsen has revealed that there is very strong evidence for thermodynamic gas found in petroleum inclusions in sand grains isolated from the dry well 16/7-3. This gas is condensate- to oil-wet (generated together with oil) and the maturity is estimated close to 0.9% Ro. Molecular investigations of the core extracts reveal normal light oil to condensate type n-alkane profiles and a distribution-pattern similar to that of many core extracts from Johan Sverdrup. The biomarker and medium-range maturity parameters (C11-C17) are consistent with a maturity of about 0.9% Ro, with possibly biomarkers pointing to a somewhat lower maturity which is normal in strata having received several charges of petroleum over time. A preliminary comparison of the core extracts with regional oils, show less similarity to Loke, Sigyn and Gungen (lower Jurassic derived and coal influenced) oils, than to more normal Draupne oils of the Southern Viking Graben
- *Ip Survey:* The license purchased the ORG15252-5 induced polarity survey from ORG Geophysical in 2015. Induced polarity is touted as a technique that can directly sense oil fields by the detection of mineralogical overburden changes overlying oil fields. Five survey lines were acquired in the PL775 area. Some anomalies where discovered on line 775-3 and 775-5. The latter and and strongest anomaly was attributed to a pipeline crossing the survey area. Generally the low interpretability of the IP survey results and therefore the limited potential to use this technique as a risk reduction mechanism makes the use of this data challenging in an exploration context.

[redacted]

Fig. 2.2 Extend and content of the 2018 regional basin model.

2.4 External Studies

External Studies:

- *Reservoir Analysis*: For regional trends on reservoir properties, summary reports for analogue fields by C&C Reservoirs were used.
- *Geochemistry*: The Petroleum Geochemical Database for the Norwegian North Sea from IGI (Integrated Geochemical Interpretation Ltd., 2016) was used to complement in-house geochemical evaluations of source rocks in the area.
- *Rock Physics*: RSI's (Rock Solid Images Inc.) regional rock physics database comprising 186 wells from RSI's multiclient Atlas supplemented with 55 proprietary wells (combined Norwegian Sea and North Sea) was used to complement in-house rock physics analyses. The wells are delivered in an interactive Rock Physics Atlas inside RSI's proprietary rockAVO® browser, allowing the interpreter easy access to rock physics data with capability to perform either fluid & porosity modelling or just fluid-sub modelling.

3 Review of Geological and Geophysical studies

Of the many studies that were carried out in this licene and that are listed in (2 Database) only two will be highlighted in this section in detail since the were instrumental in polarizing the assessed prospect risks and lead to the drop decision of the license:

The uniform shale concept was initially derived in the Balder Field area after it was discovered that the combined total net shale thickness in the interval between top Chalk and the Top Sele Formations do not change significantly over semi regional areas (Fig. 3.1). Applying the same concept in the PL775 area and calibrating it to the local wells clearly outlines a Tertiary thickness anomaly that was used to define the Jackpot prospect initially Fig. 3.2 . The uniform shale model however only highlights that there is a thickness anomaly but it does not reveal at which time this thickness anomaly was filled in. In order to unravel the spatio-temporal distribution of the Paleocene deposition a high resolution sequence stratigraphic mapping of the interval was undertaken. Eight detailed surfaces where mapped between the Sele and Top Chalk pick and were been tied to the wells wherever possible (Fig. 3.3). The stratigraphic dip line)Fig. 3.3) shows clearly that the majority of the of the accommodation space in the eastern part of the section was filled in post the deposition of the Ty Formation which is characterized by the strong hard reflections (pink reflector). The light green reflectors in the eastern part of the section are not correlatbale in the western part of the section due to thinning of the interval. It is however likely that these reflectors are younger than the top Heimdal marker in the west. It therefore looks like that the entire surplus thickness, that is evident from the application of the uniform shale model, was infilled post the deposition of the Tertiary sands. The origin of the excess shales that filll in the accommodation space to the east can only be speculated about. One possible explanation is that these shales where shed in the form of ultra low density mass flows from the surrounding salt domes that were emerging at the time. Interestingly none of the areas where the uniform shale model has so far shown to be valid contain any salt domes. The current thinking of the tectonic sedimentary history at the Jackpot prospect has been summarized in Fig. 3.4. The incipient uplift of the Utsira High created a hydraulic ramp for the Tertiary sandstones arriving from the west. This hydraulic ramp lead to the rapid drop of sands from the turbiditic flow such that they were deposited mostly to the west and directly on top of the ramp. The later Heimdal sands never reached as far east as the initial Ty sands. In the Balder times the majority of the accommodation space was created and infilled to the east of the Ty/ Heimdal pinchout line.

Assumptions

- Shales are pelagic rain only. The amount varies little areally
- Sandstones are transported laterally into the system
- Siltstones are neglected in the model

- Sele + Lista + Vale Fm thickness = turbiditic sandstones plus pelagic shales
- Turbiditic sandstone = (Sele + Lista + Vale Fm thickness) – shale Thickness

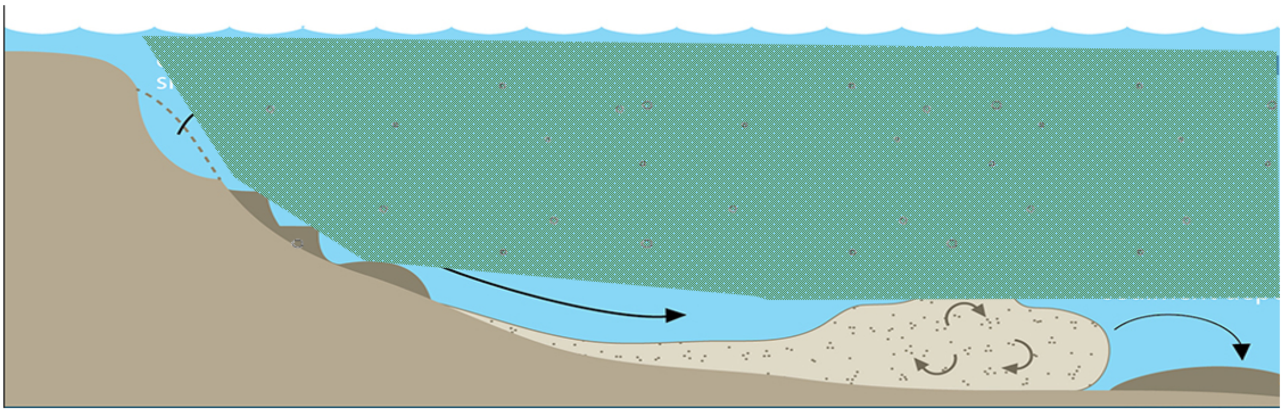


Fig. 3.1 Uniform shale model concept

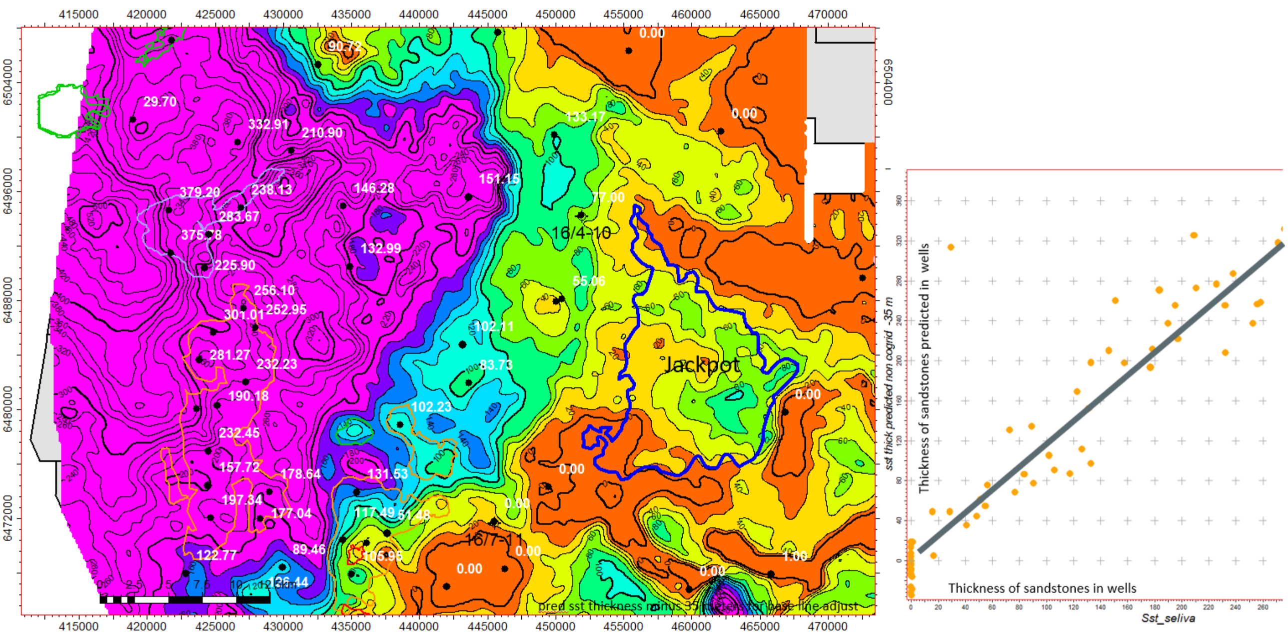


Fig. 3.2 Predicted net Tertiary sand thickness applying a modified uniform shale model

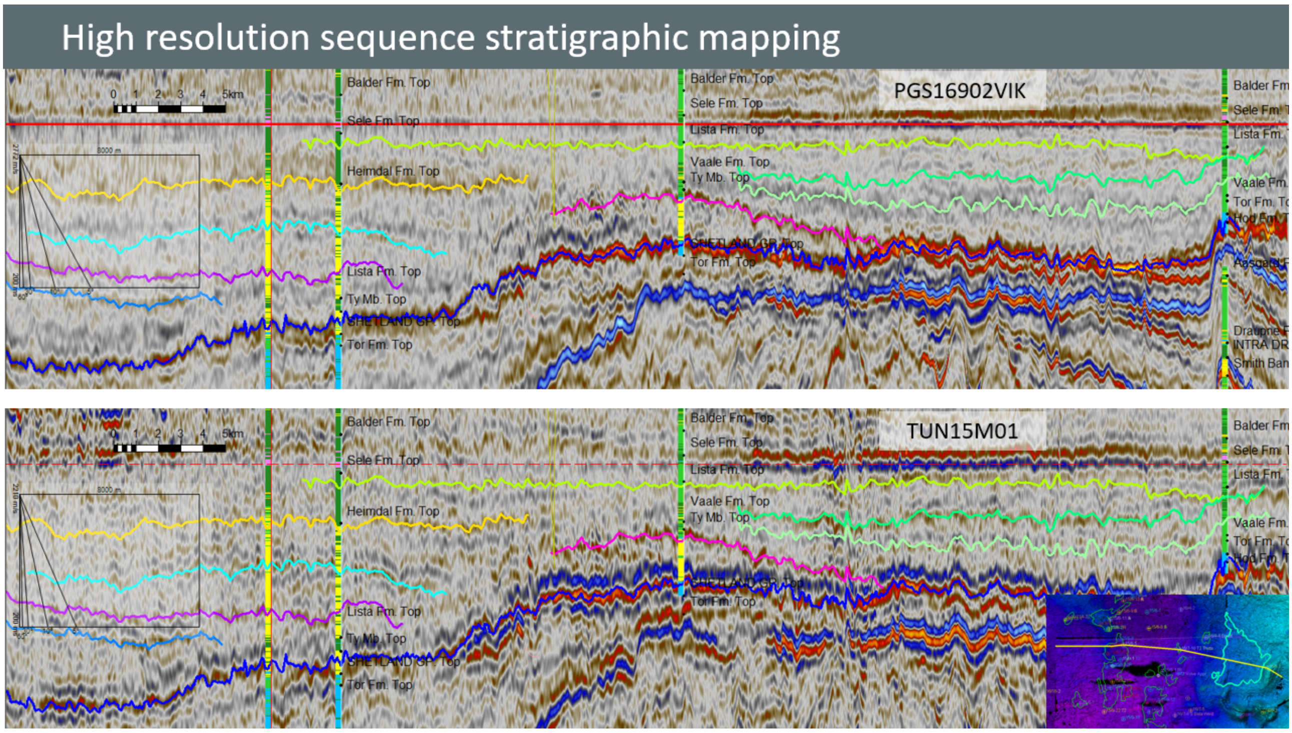


Fig. 3.3 Sequence stratigraphic subdivision of the Paleocene.

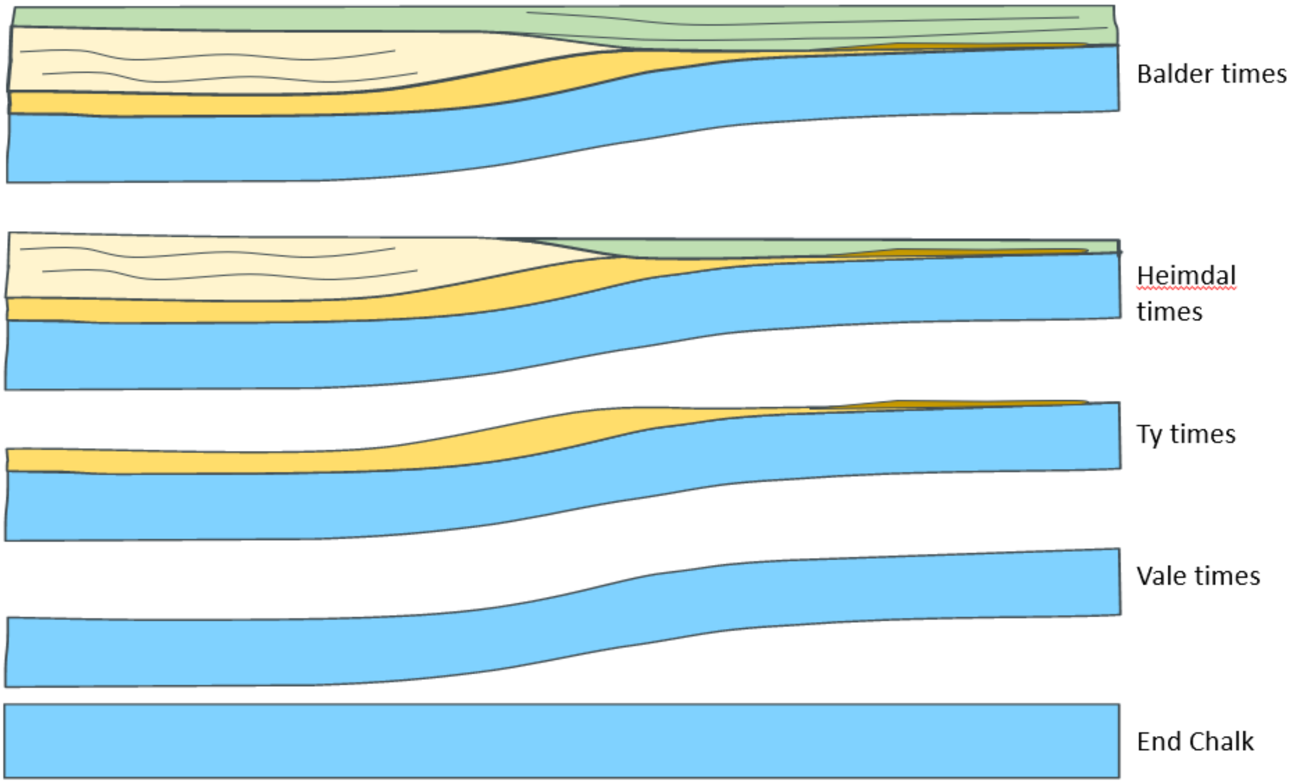


Fig. 3.4 Tectono- sedimentary model over the Jackpot area

The wedge modelling of the the Tertiary amplitude response increased our confidence in the conclusion that there are no significant Paleocene sandstone packages east of the currently mapped pinchout lines. In order to test the full potential solution space several sand distribution scenarios were modelled (Fig. 3.5, Fig. 3.6) to determine the minimum detectable sandstone thickness. The sand and shale rock physical models were calibrated to the offset well data. The values used for the formations are tabulated in Table 3.1.

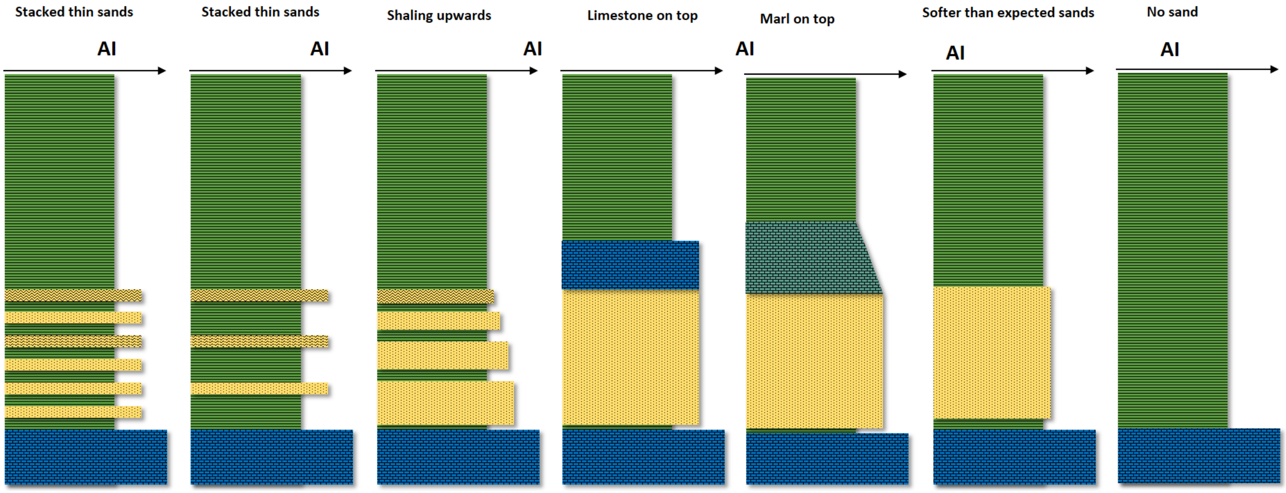


Fig. 3.5 Different lithology distribution models used in the wedge modelling to determine the minimum detectable sandstone thickness

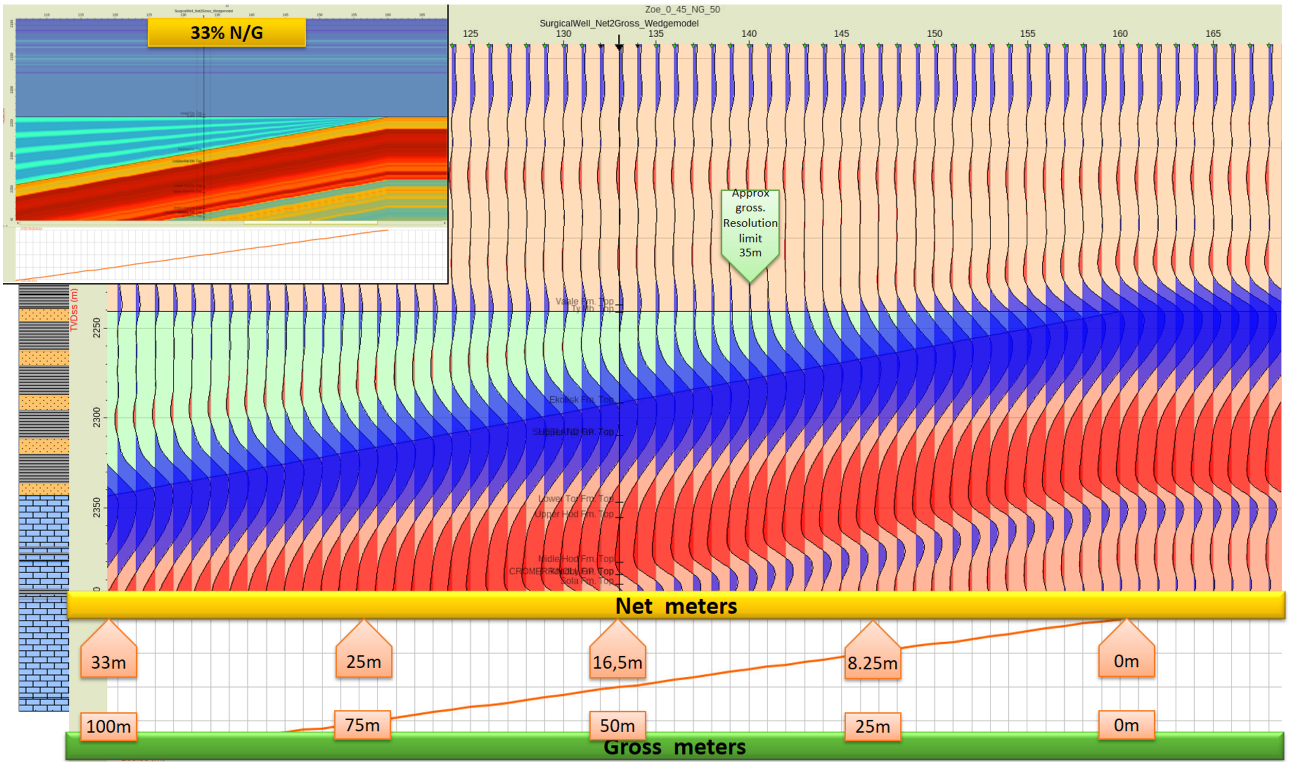


Fig. 3.6 Example of a wedge model with 33% N/G

Table 3.1 Rock Properties used for wedge modelling

	RHOB	Vp	Vs
Lista / Vaale	2.3 g/cc	2600 m/s	1250 m/s **(Vp/Vs = 2.1)
Ty/ Heimdal	2.18 g/cc	3300 m/s	1850 m/s **(Vp/Vs = 1.8)

The wedge modelling indicated very clearly that a Ty /Heimdal sandstone with a combined net thickness of greater than 15 meters should be resolvable on the high quality seismic. This is quantitatively confirmed by the 15/9-23 well that encountered a 10 m thick sandstone in the Ty Formation which is surprisingly well defined on the seismic. The only geological possible rock physics model that could explain not resolving a smaller than 25 m net Paleocene sandstone on the current seismic would be one where a thick and marly Vale Formation is gradually blended with the sandstones such that no clear impedance contrast is created. Looking at offset wells this scenario is however deemed unlikely and would also negatively impact producibilty and therefore the economics of a hydrocarbon trap in such a reservoir. The result of the extensive studies on the Jackpot project led to a downgrading of the prospect risk and resources which in turn drives the current decision to relinquish the licence. The updated prospect risk is shown in Fig. 3.7.

	Jackpot @ ConocoPhillips farm in	Jackpot after current re-evaluation
Reservoir	0,5	0,25
Trap	0,5	0,6
Seal	0,8	0,8
Source	1	1
HGMT	0,7	0,7
CoS	**0,14**	**0,084**

Fig. 3.7 Jackpot prospect risk after completed studies

The Jurassic prospectivity was the main focus for the license when Tullow Oil was the operator. The Caesar North prospect was seen to be most attractive based on the oil shows identified in the well 16/7-3 and the possibility that the Caesar north represented and independent closure that was filled via and initial spill from the 16/7-3 well. Although ConocoPhillips was attracted to the license mostly by the Tertiary potential that was initially identified by Spike Exploration, the Jurassic closures were thoroughly re-evaluated with ConocoPhillips as the operator. Especially the arrival of a PSDM velocity model reduced the previous depth conversion uncertainty significantly and allowed a more parametric approach to the quantification of the uncertainty. In a first step the closure likelihood of Caesar North was assessed by stochastic sampling from the PSDM depth uncertainty that was in turn derived from using the Seissquare UDOmore workflow. This indicated that Caesar North structure is likely part of the 16/7-3 structure (Fig. 3.8). In a second step the charge probability for Caesar North was assessed by migration modelling along the the 300-500 stochastically sampled depth maps. Assuming surplus charge at the 16/7-3 well, the Caesar North is filled in 100% of the cases while Caesar East would only receive charge via the 16/7-3 well in 25 % of the cases (Fig. 3.9.). Even though it is likely that the 16/7-3 well already tested the Caesar North structure there is still a chance for an independent closure that relies on a better top seal than in the 16/7-3 well where the Hod formation is juxtaposed straight against the Draupne Formation. If the thicker lower Cretaceous shale section that is apparent over the Caesar North prospect retains hydrocarbons than the closure is still very small and even with a reasonably optimistic volume assessment it seems unlikely that the structure could hold more than 15 million barrels in the mean case (Fig. 3.10.). The moderate to small volumes did not justify drilling an exploration well on the prospect give a current prospect risk of 22% (Source Rock Presence =1.0, HGMT=0.8, Reservoir=1.0, Seal and Retention=0.6, Trap Geometry=0.46)

Trap probability summary

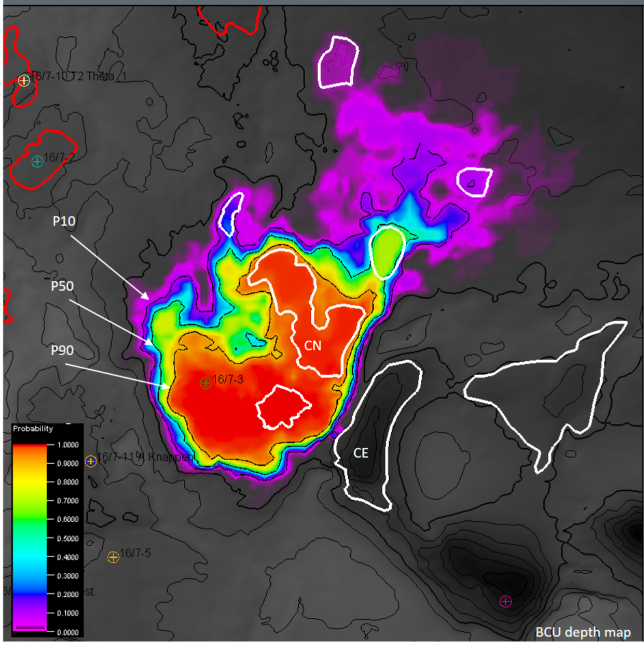


Fig. 3.8 Caesar North stochastic trap likelihood assessment

- CN within P90 outline of macro structure
  - Caesar North more likely to be part of the tested 16/7-3 structure
- CE only receives charge if macro structure filled to spill which most likely did not happen although almost 1/3 spill towards CE
- Methodology somewhat dependent on how to define points that are def. In or out of the structure.
  - How does the structure influence fluid flow?

Charge probability map 16/7-3 structure

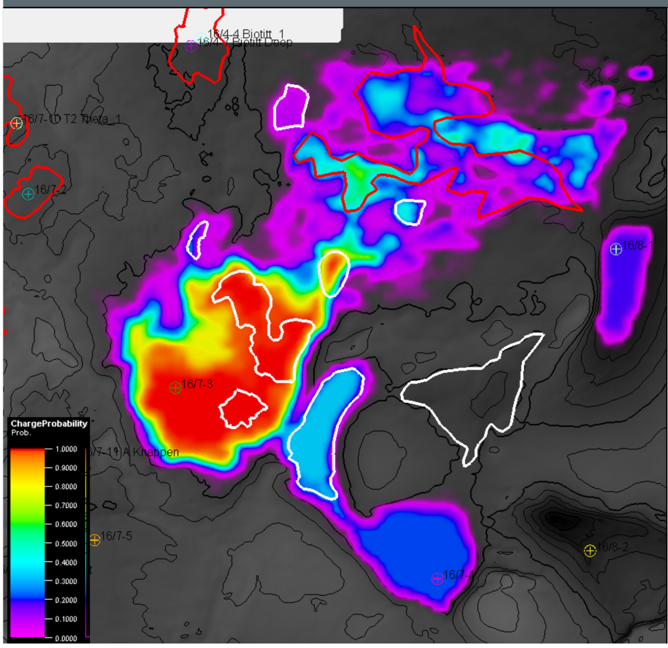
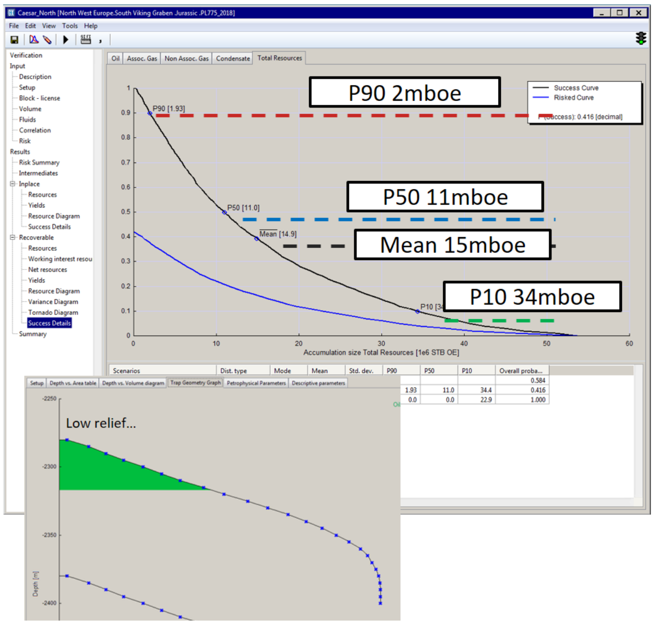
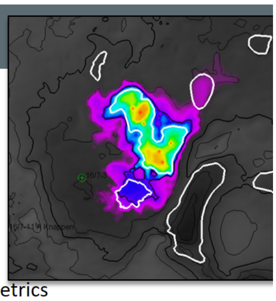


Fig. 3.9 Caesar North likelihood of charge from 16/7-3

- Stacked up map normalized to number of simulations
- Results in a heatmap of fluid flow where the only variables are the depth uncertainty and entry point
- Seeded infinite fluids into 16/7-3
- Caesar North always receives charge
- Caesar East only receiving charge in 25% of <u>all fill-to-spill scenarios</u>

Caesar North Volumes





- P50 BCU surface used for volumetrics
- Spillpoint set to constant@2335m TVDss
- Reservoir & fluid paramters used reasonable Tullow parameters

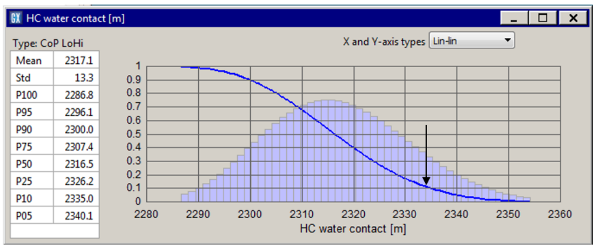


Fig. 3.10 Caesar North Volume assessment

4 Prospect Updates

As described in the section 3 Review of Geological and Geophysical studies the Jackpot prospect has been downgraded by the performed geological and geophysical work (Fig. 3.7). The previous volume range of 19-177-(237)-599mmboe (P10-P50 (mean), P90) has not been reassessed in detaile after the negative risk adjustment for the prospect. The existing volume assessment was however based on a P50 sand thickness of 50 meters and recent studies indicate that the net sandstone thickness has to be below 15 meters to not be seismically detectable. A sandstone thickness below 15 meters would significantly reduce the to be expected volumes.

The main Jurassic propect, Cesar North, has also been described in more detail in section (3 Review of Geological and Geophysical studies). The current risk and resource asessment of the prospect are very similar to one that Tullow Oil initially carried out. The current volume assessment is shown in Fig. 3.10 and the currently assigned risks are shown in Fig. 4.1.

	Cesar North
Reservoir	1,00
Trap	0,46
Seal	0,60
Source	1,00
HGMT	0,80
CoS	**0,22**

Fig. 4.1 Risk assessment for Cesar North prospect

The Cesar East prospect is represented by a high amplitude salt cored anticline located to the east of the 16/7-3 well and is separated from the 16/7-3 closure by a spill point (Fig. 4.2). While the Cesar east propsect is volumetrically interesting with a conservative resource distribution of 3-25-(34)-78mmboe P10-P50 (mean), P90) the recently undertaken stochastic charge modelling indicates that the structure is only filled in 25% of the cases (Fig. 3.9) by spill from the 16/7-3 structure. Such a spill scenario would require that the 16/7-3 structure was once filled to spill, filled the Caesar East prosepct and subsequently leaked all hydrocarbons. The currently assessed prospect risk for Caesar East is shown in Fig. 4.3. Caesar East can at best be considered an upside prospect to an existing discovery in Caesar North. The structure on its own does not warrant further exploration activities.

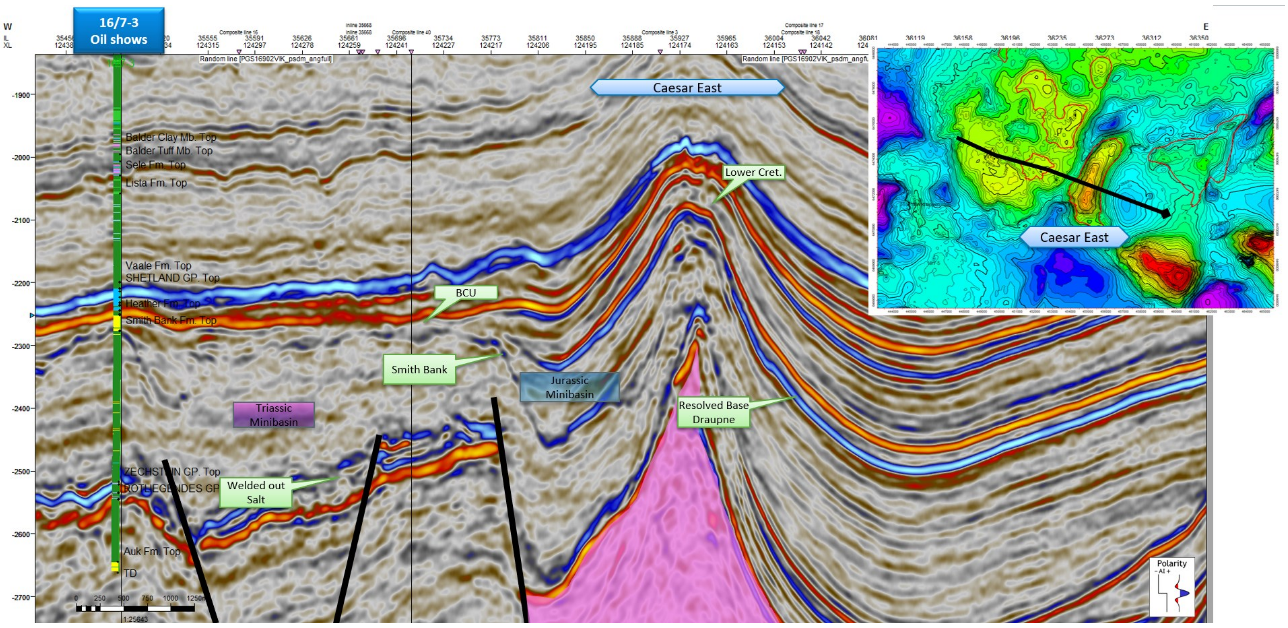


Fig. 4.2 NW SE line over the Caesar East prospect

	Cesar East
Reservoir	1,00
Trap	0,60
Seal	0,60
Source	1,00
HGMT	0,40
CoS	**0,14**

Fig. 4.3 Risk assessment for Caesar East

The Cato and Cicero leads as shown in map Fig. 1.1 require an analogous trapping configuration to the failed Fosen well (16/10-4) that required a base seal against the speculated Triassic shale marker. While the Fosen well had relatively direct charge access the Cato and Cicero leads require charge from the failed Fosen well along the Triassic shale pinchout line to the south. Fosen is structurally lower and did potentially have some highly disputable hydrocarbon shows in Permo-Triassic reservoir section. Due to the convoluted charge pathways and the currently at irreducible risk definition of the base seal, the Cato and Cicero leads are not considered to be attractive drilling candidates.

5 Technical Evaluations

The development concept for the Jackpot prospect envisaged a development with three- 4-slot templates and a tie back to the Sleipner Øst Field (Fig. 5.1) in the P50 oil discovery case. The economic modelling indicated that given a mean sandstone thickness of 50 meters a break even commodity price of below 30USD/boe could reasonably be achieved.

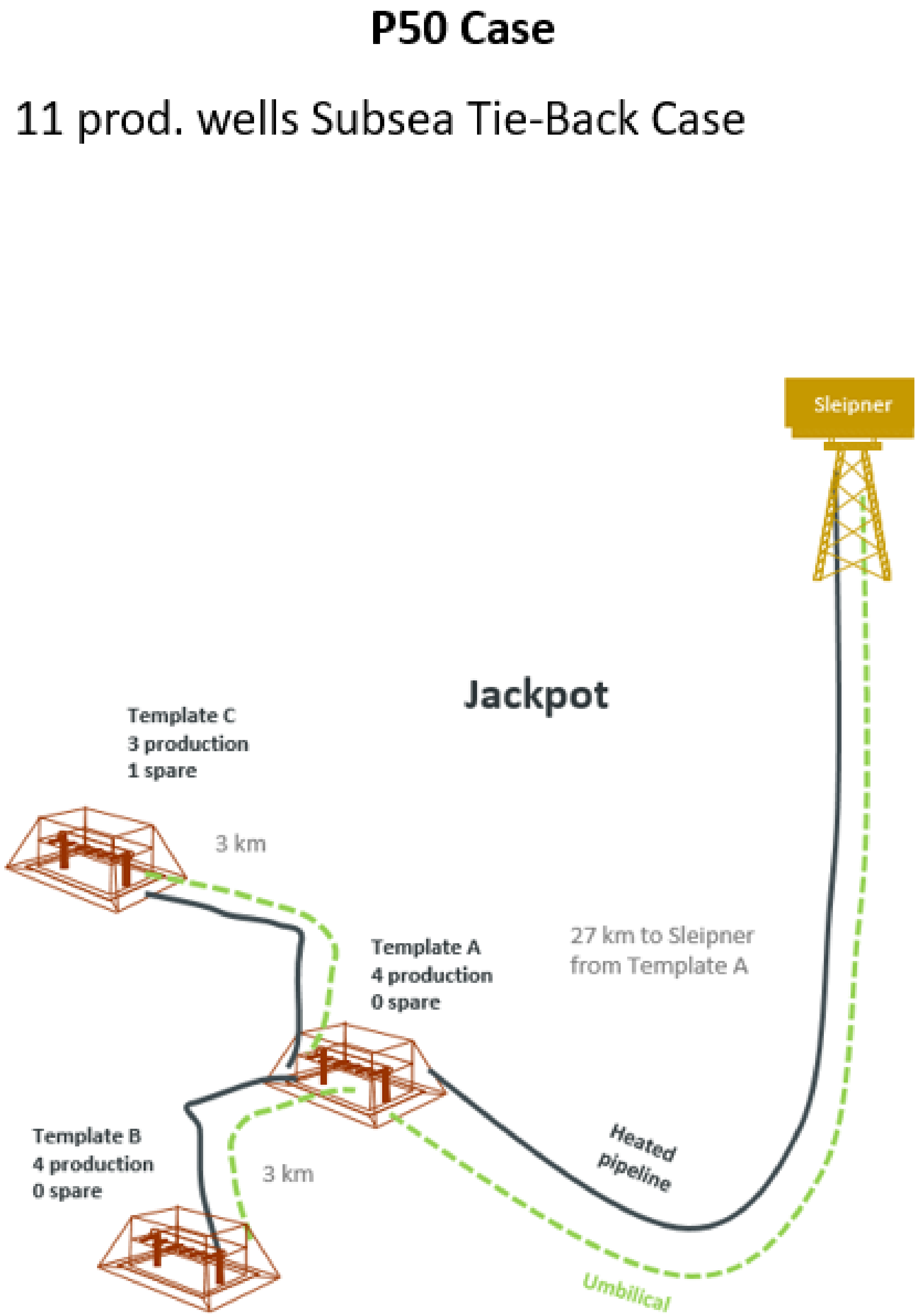


Fig. 5.1 P50 development scenario for a Jackpot discovery

6 Conclusions

The extensive work has unfortunately lead to a downgrade of the main prospect called Jackpot. The prospect relied on extending the Paleocene sands eastwards of the currently identified pinch out line. in light of recent seismic as well as sequence stratigraphic studies it seems very unlikely that the sands extend east of the currently identified pinch out line and therefore the increased prospect risk and the reduced resource base do not warrant the drilling of an exploration well. The additional prospectivity identified in the Jurassic is deemed to be either too risky or of too little resource volumes to be of interest to the license group.

7 Appendix