PL728 – PL728B

Relinquishment Report

August 2018

Table of Contents

Figures

Tables

1. License History

Licenses PL728 and PL728B are located in the Norwegian-Danish Basin and comprise blocks 3/3, 4/1, 4/2 and 4/3 (Fig. 1).

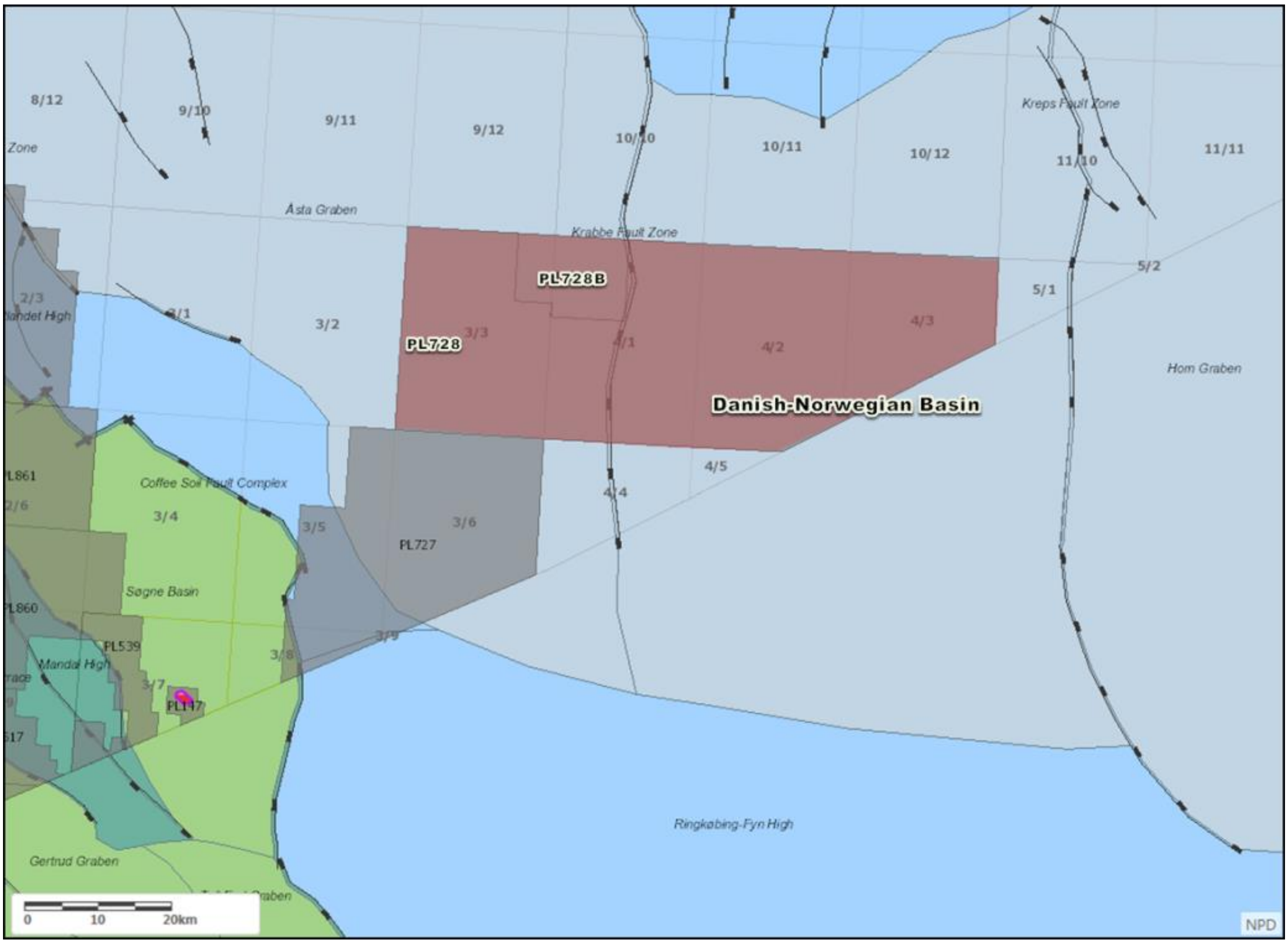

Fig.1: Location Map

PL728 (blocks 3/3-part, 4/1 part, 4/2 and 4/3) was awarded 7th February 2014 as a result of the APA 2013 Round application. Ineos E&P Norge (previously DONG E&P Norge) was assigned as Operator with 45% share. Total E&P Norge (previously Maersk Oil Norway AS) with 35% and Petoro, 20% are the other partners in the license.

On 6th February 2015 PL728B (part of blocks 3/3 and 4/1) was awarded as additional acreage with the same ownership and the same work program. This award was the result of an APA 2014 application.

Work commitments in the PL728 and PL728B licenses were the following:

- Acquire new 3D seismic over the license
- Conduct geological and geophysical studies

- Drill or drop decision within 3 years from award
- Decision to concretize (BoK) or drop within 5 years from award
- Decision to continue (BoV) or drop within 7 years from award

An application for deferment of the decision on drilling one exploration well was submitted to the authorities on 14th January 2016. This was granted by the authorities on 26th April 2016, and subsequently the drill or drop decision was deferred to 7th February 2018.

An extensive assessment of the license was performed and the results shared through a high number of meetings and workshops (Tab.1) where Ineos E&P Norge and Total E&P Norge have actively shared their knowledge and experience.

Tab.1: License meetings 2014-2017

MEETING	DATE
MC-EC Meeting #1 - Licence Establishment	March 2014
EC Working Meeting - Seismic Acquisition	March 2014
EC Working Meeting - Seismic Tender Results	April 2014
EC Working Meeting - Seismic Tender Results	May 2014
EC Meeting - Seismic Acquisition	September 2014
MC-EC Meeting #2 - Seismic Acquisition	November 2014
EC Working Meeting - Grav-Mag and Prospect Review	December 2014
EC Working Meeting - Seismic Acquisition	October 2015
MC-EC Meeting #3 - Seismic Acquisition and Processing	November 2015
EC Working Meeting - Processing	June 2016
EC Working Meeting - Processing - Basin Modelling	September 2016
MC-EC Meeting - Final Seismic Products - G&G Update	December 2016
EC Reservoir/Seal Workshop	May 2017
EC Charge Workshop - FIS Study Results	June 2017
EC Work Meeting - Play and Prospect Analysis	October 2017
EC Work Meeting Paleocene Prospects Analysis	November 2017
MC-EC Meeting - Technical Evaluation Drill or Drop	December 2017

As a result, more than 30 prospects and leads belonging to four main plays (Lower Paleocene Play, Upper-Middle Jurassic Play, Lower Jurassic - Upper Triassic Play and the Middle-Lower Triassic Play) have been mapped in the license area (Fig.2)

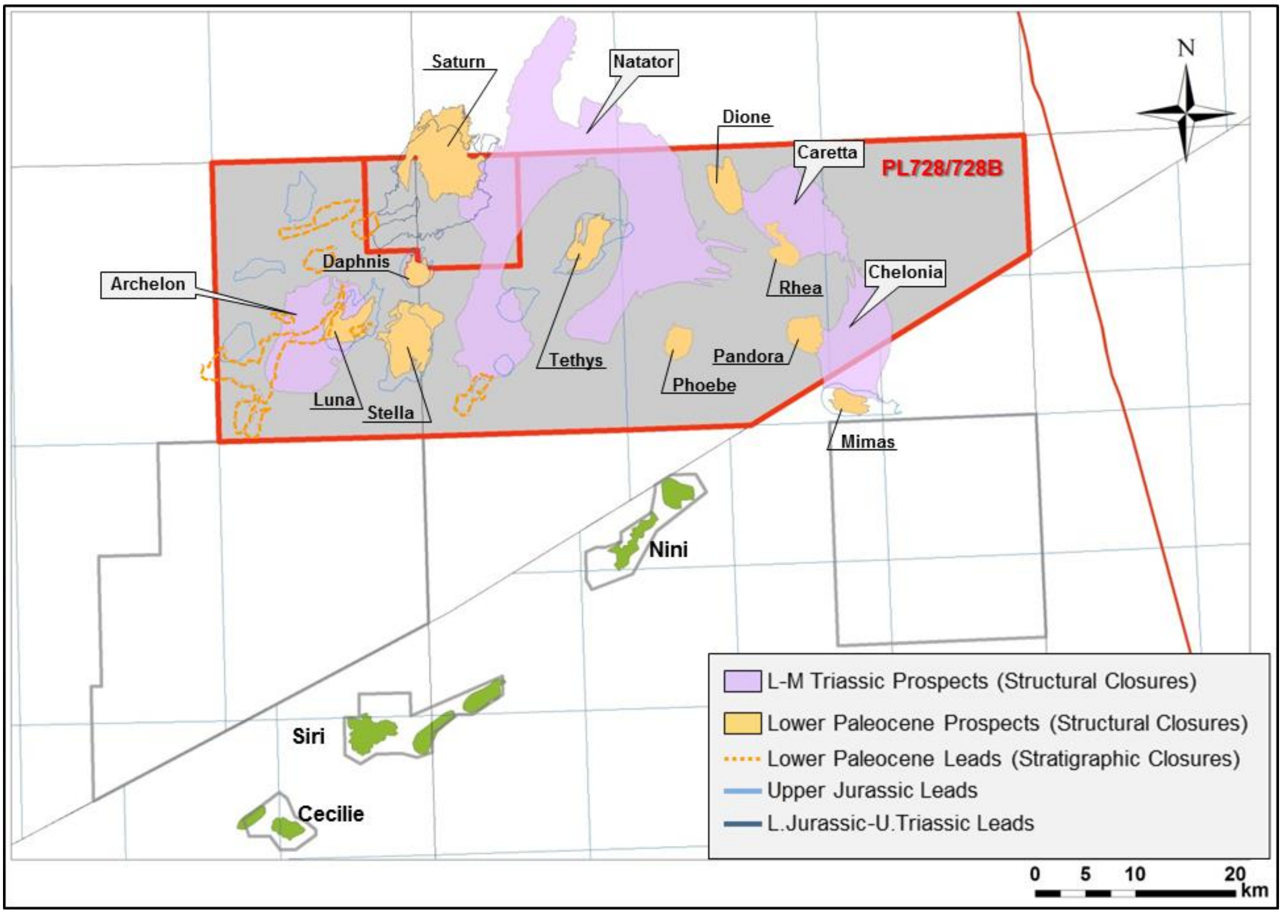

Fig.2: PL728/728B Prospects and Leads Inventory

The Operator has identified the Lower-Middle Triassic as the key play holding the most attractive prospects. Out of these, Natator Cluster, has been identified as the driving prospect for economical evaluation.

However, at the combined EC/MC meeting on December 2017 it emerged that Ineos E&P Norge and Total E&P Norge had a different evaluation of the risk associated to the Natator Cluster and this, in concomitance with the almost contemporaneous change of ownership and management in both companies, made difficult to reach a decision within the deadline of 7th February 2018.

The Operator then applied for a further deferment of the Drill or Drop decision until 7th May 2018. The deferment was granted by MPE and on the 7th May 2018 the decision to surrender in their entirety both licenses PL728 and PL728 B was filed by the Operator. The decision was unanimously taken by the partnership and was justified by the high risk associated with Charge and by the high chances of having an underfilled accumulation because of the presence of a possible leaky top seal. Basin Modelling in fact shows that migration occurs soon after the structures are created and the sealing lithologies deposited, thus giving a high chance to have a non-perfectly lithified top seal.

2. Database

All the wells, 3D and 2D seismic data included on the Agreed Common Data Base (Table 2, Table and Table 4), along with all the additional data not included in the Common Data Base but available in the area of interest have been used in the evaluation of the license prospectivity. In addition, and as part of the license work program, Ineos E&P Norge undertook the acquisition of the DG15001 3D seismic survey. This survey has excellent data quality at the prospect level and was used to perform the detailed prospect evaluation.

Tab.2: Well Common Database

	WELL	YEAR	TD (m MD)	FORMATION	NOTES
NORWAY	3/4-1	1994	3107	Zechstein	Ineos Petrophysics
	3/5-1	1978	3426	Rotliegend	Ineos Petrophysics
	3/5-2	1978	3825	Smith Bank	Ineos Petrophysics
	3/6-1	2000	2167	Tor	Ineos Petrophysics
	3/7-2	1981	4330	Rotliegend	Ineos Petrophysics
	3/8-1	2010	4070	Rotliegend	Ineos Petrophysics
	8/3-1	1966	3015	Basement	
	8/3-2	1982	2657	Skagerrak	
	8/9-1	1976	2376	Zechstein	
	8/10-1	1969	3089	Zechstein	Ineos Petrophysics
	8/10-3	2010	5738	Rotliegend	Fluid Inclusion Study
	9/8-1	1968	2176	Zechstein	Ineos Petrophysics
	9/10-1	1970	2205	Tor	Ineos Petrophysics
	9/11-1	1971	2196	Skagerrak	Ineos Petrophysics
	9/12-1	1969	2698	Smith Bank	Ineos Petrophysics
	9/2-1	1987	3756	Skagerrak	Fluid Inclusion Study
	9/2-2	1987	3550	Skagerrak	
	9/2-3	1989	3424	Bryne	
	9/3-2	2005	3154	Skagerrak	
	9/4-1	1968	2963	Zechstein	
	9/4-2	1970	3025	Skagerrak	
	9/4-3	1972	2682	Skagerrak	
	9/4-4	1977	2902	Skagerrak	
	9/4-5	2006	5881	Carboniferous	Ineos Petrophysics - Fluid Inclusion Study
	10/5-1	1976	1843	Basement	Ineos Petrophysics
	10/7-1	1992	1890	Zechstein	Ineos Petrophysics
	10/8-1	1971	2861	Zechstein	Ineos Petrophysics
	11/5-1	2007	1950	Basement	Ineos Petrophysics - Fluid Inclusion Study
	11/9-1	1976	1972	Zechstein	Ineos Petrophysics
	11/10-1	1969	2430	Skagerrak	Ineos Petrophysics
	17/12-1	1971	4298	Sandnes	
	17/12-2	1973	2334	Sandnes	
	18/10-1	1979	2800	Skagerrak	
DENMARK	C-1X	1968	3206	Zechstein	Ineos Petrophysics
	D-1X	1968	3526	Rotliegend	Ineos Petrophysics
	ELNA-1	1985	3145	Rotliegend	Ineos Petrophysics - Fluid Inclusion Study
	F-1X	1968	2420	Muschelkalk	Ineos Petrophysics - Fluid Inclusion Study
	IBENHOLT-1	1987	1700	Zechstein	Ineos Petrophysics
	IDA-1	1992	1700	Trias	Ineos Petrophysics
	INEZ-1	1977	1983	Upper Trias	Ineos Petrophysics
	K-1X	1970	2291	Keuper	Ineos Petrophysics
	NOLDE-1	1997	1818	Zechstein	Ineos Petrophysics - Fluid Inclusion Study
	WEST LULU-1	1983	4232	Zechstein	Ineos Petrophysics

Tab.3: 3D Seismic Common Database

	SURVEY NAME	TYPE	YEAR	COMPANY
NORWAY	DG15001	3D	2015	DONG E&P (INEOS E&P)
	MC3D-NDB2008	3D	2008	PGS
	MC3D-Q4	3D	1996	PGS
	MC3D-Q9	3D	2010	PGS
	NODAB97	3D	1997	CGG
	ST9602	3D	1996	DNO
	ST0807	3D	2008	Statoil
DENMARK				
	DN0101N	3D	2001	DONG E&P (INEOS E&P)
	KMC99-5605	3D	1999	Fugro GeoTeam
	NODAB97	3D	1997	Dansk Operatørselskab
	SIRINOR-96	3D	1996	Statoil
	SIRIWEST-96	3D	1996	Geco-Prakla
	TRYM-90	3D	1990	Geco-Prakla
	TRYM-92	3D	1992	Geco-Prakla
	223D DENMARK	3D	2012	TGS

Tab.4: 2D Seismic Common Database

	SURVEY NAME	TYPE	YEAR	COMPANY
NORWAY	CAST-90	2D	1990	Nopec
	CGME96	2D	1998	Nopec
	DG15001	2D	2015	DONG E&P (INEOS E&P)
	EBS00	2D	2000	Nopec
	GFR-93	2D	1993	WesternGeco
	MN9206	2D	1992	Mobil
	MN9604	2D	1996	Mobil
	SET96	2D	1996	Nopec
	SH8709	2D	1987	Shell
	SHD97	2D	1997	Nopec
	SKAGRE96	2D	1986	Nopec
	ST8630	2D	1986	Statoil
	ST8716	2D	1987	Statoil
	UG97	2D	1997	GeoTeam
	UCGE97	2D	1997	GeoTeam
	UGI98	2D	1998	GeoTeam
DENMARK	AG9801	2D	1998	Norsk Agip
	DCS	2D	1983	WesternGeco
	DK1	2D	1982	Geophysical Service International
	DT97	2D	1996	GeoTeam
	NDB86	2D	1986	Horizon Exploration
	PH85N	2D	1985	Phillips Petroleum
	RTD-81	2D	1982	Geco Geophysical
	RTDI-82	2D	1982	Geco Geophysical
	SP82	2D	1982	Merlin Geophysical

3. Geological Framework

A general litostratigraphic column of the Norwegian North Sea is shown in Fig. 3.

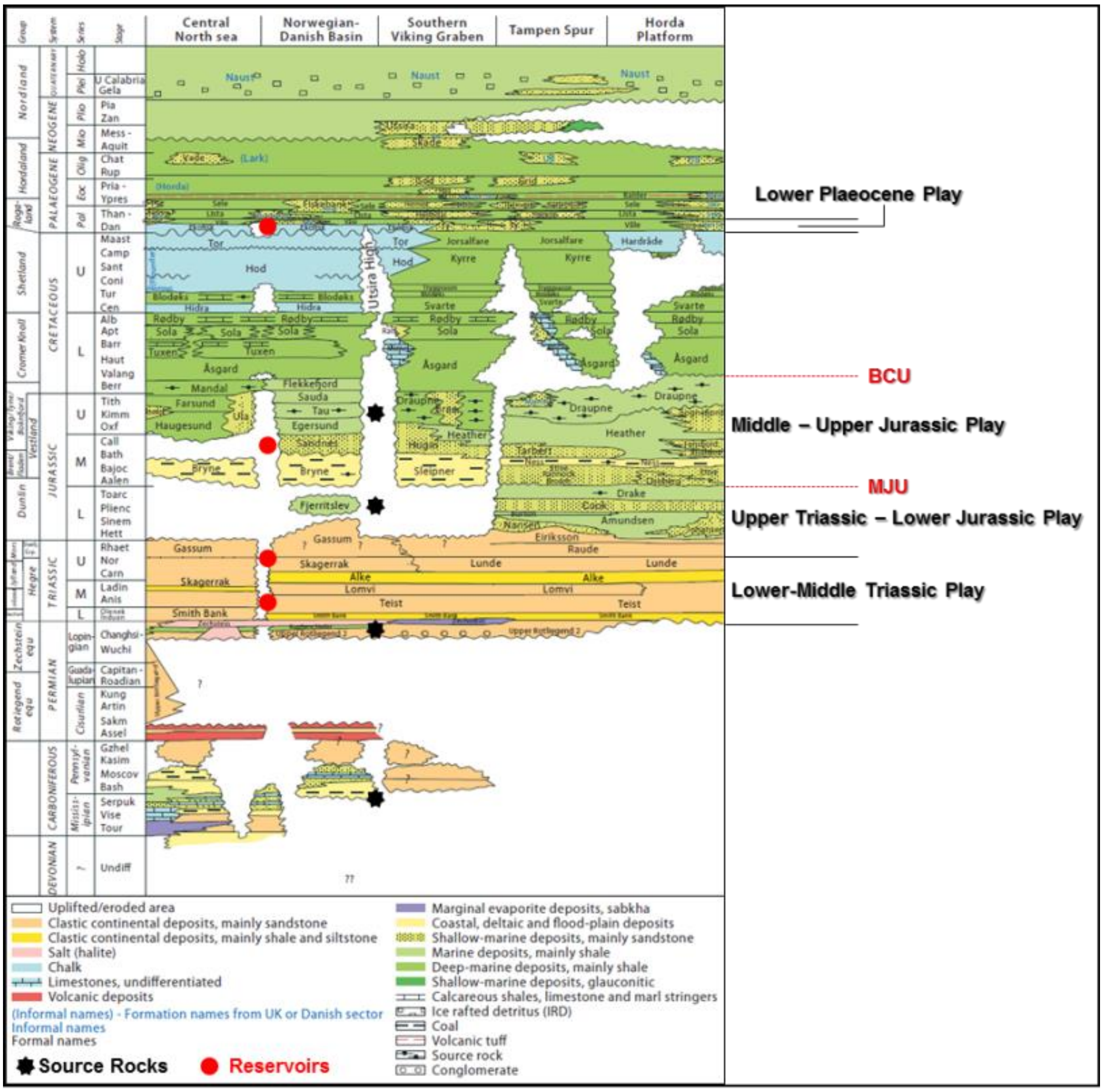

Fig.3: Generalized litostratigraphic column of the Norwegian North Sea showing the stratigraphic position of the four considered plays, the source rocks and reservoir intervals.

Four geological plays and five source rock layers are recognized in a stratigraphic interval spanning from Lower Carboniferous to Lower Paleocene.

Source Rocks

The main source rock layers in the considered stratigraphic interval are the Tau Formation (Upper Jurassic), the Bryne Fm. (Middle Jurassic), the Fjerritslev Formation (Lower Jurassic), the Kupferschiefer Fm. (Upper Permian) and the Laarstrine Fm. (Lower Carboniferous, Norlex, 2012).

In the area of interest, the Mesozoic source rocks are mainly immature or, locally (deepest rim synclines, Fig.4A), in the early oil maturity window.

The Fjerritslev and Tau formations are, on the other hand, mature in the Egersund Basin (Fig.4B) where they charge the Yme Field and the Mackerel, Vette and Briesling discoveries.

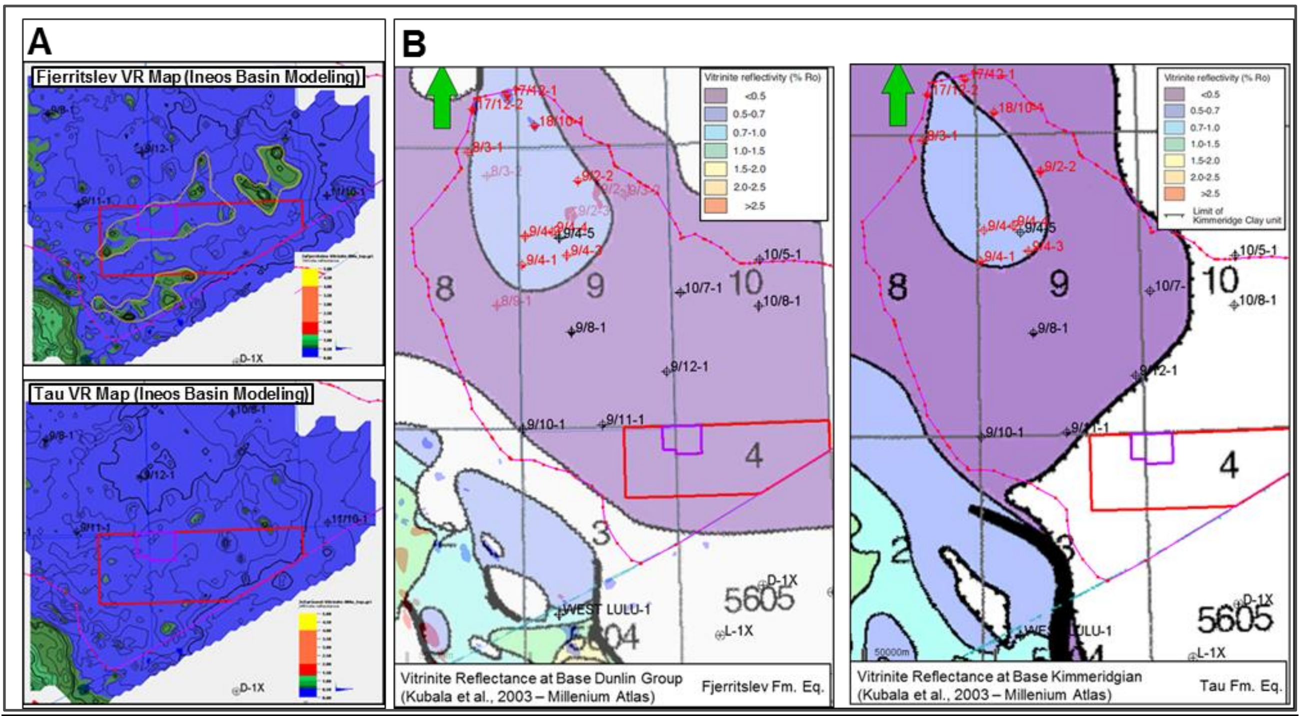

Fig.4: Ineos (A) and literature (B) maturity maps for the Fjerritslev and Tau Source Rocks.

The Paleozoic source rocks are represented by the Kupferschiefer Shales (Upper Permian) and by the coals of the Lower Carboniferous Laarstrine Fm. (Norlex, 2012). These coals are possibly equivalent to those of the U.K. Scremeston Fm. or to the coal layers encountered in the Danish wells Gert-2 and Gert-3.

The presence of Kupferschiefer Shales is proven in most of the wells around the area of interest (Fig.5A) but, at present, there are no known HC accumulations sourced by these shales.

Because of the lack of well penetrations, the presence of Lower Carboniferous Coals is highly questionable in the area of interest. The DG15001 3D seismic allowed for a better imaging (Fig.5B) of the pre-Permian interval revealing the presence of a thick sedimentary sequence possibly coinciding with the Lower Carboniferous. In seismic, this sequence is characterized by numerous bright amplitude events (both soft and hard kicks) that can be associated to the presence of coals (soft kicks) and magmatic intrusions (hard kicks) like those shown by the nearby Danish wells Gert-

2 and Gert-3. It is important to notice that, when mapped areally, these bright amplitudes are concentrated in correspondence of basement structural lows (Fig.5C).

Ineos Basin Modelling shows (Fig.5D) that, if present, the Paleozoic source rocks will be mature in the gas window.

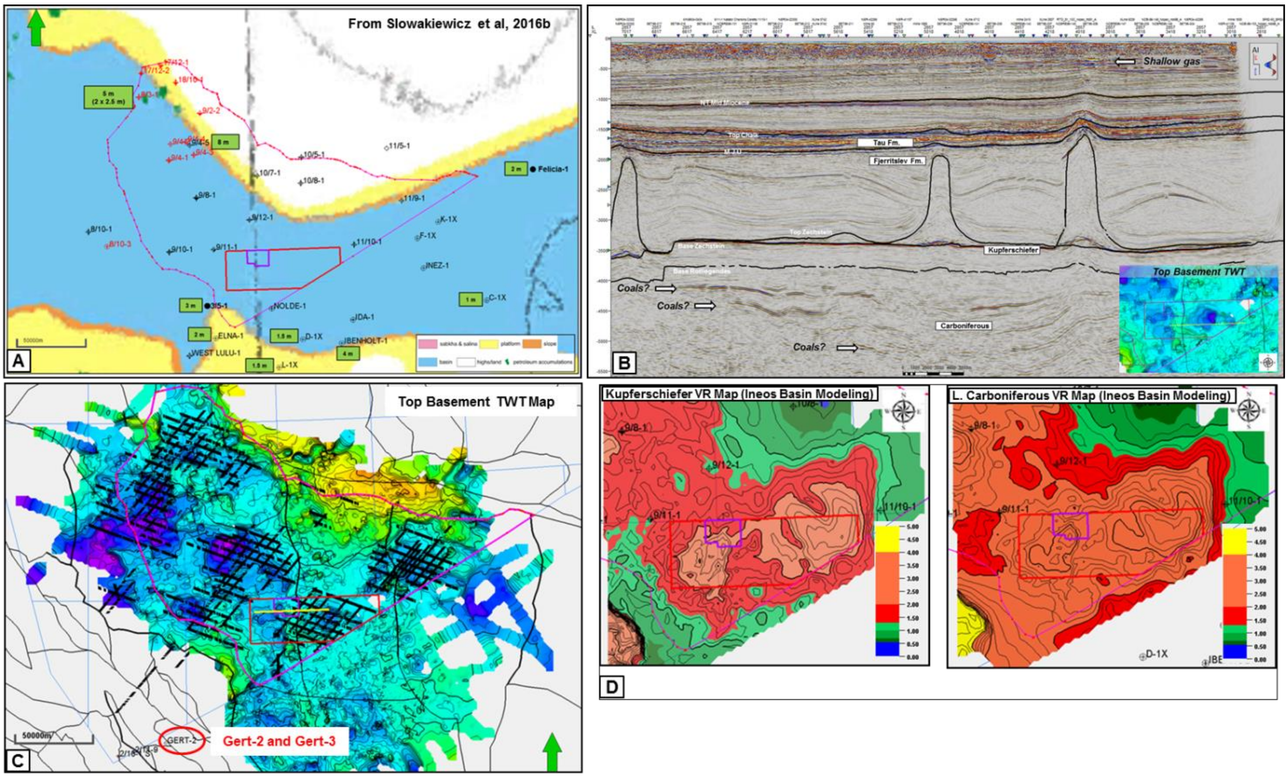

*Fig.5: **(A)** Kupferschiefer Shales distribution – **(B)** Presence of possible Lower Carboniferous Coals (bright amplitudes) in pre-Rotliegend grabens – **(C)** Areal distribution of pre-Rotliegend bright amplitudes in correspondence of basement structural lows – **(D)** Maturity maps of Kuferschiefer Shales and Lower Carboniferous Coals*

In 2017 the PL728/728B partnership commissioned to FIT Tulsa a fluid inclusion study on 7 Norwegian and Danish wells whose results (along with those from a 1996 Surface Geochemical Study) are shown in Fig.6. The study shows that in 5 of the 7 wells fluid inclusions were found, although in limited number, in Zechstein, Rotliegend and Skagerrak deposits. For these wells, with the only exception of well 11/5-1 where the structural configuration seems to support an Upper Jurassic origin, a Paleozoic origin of the fluid inclusions is considered highly probable. Whether these fluid inclusions are derived from Kupferschiefer Shales and/or from the Lower Carboniferous Coals remain to be understood but, ultimately, they show that in this area, the presence of a viable Paleozoic petroleum system is possible.

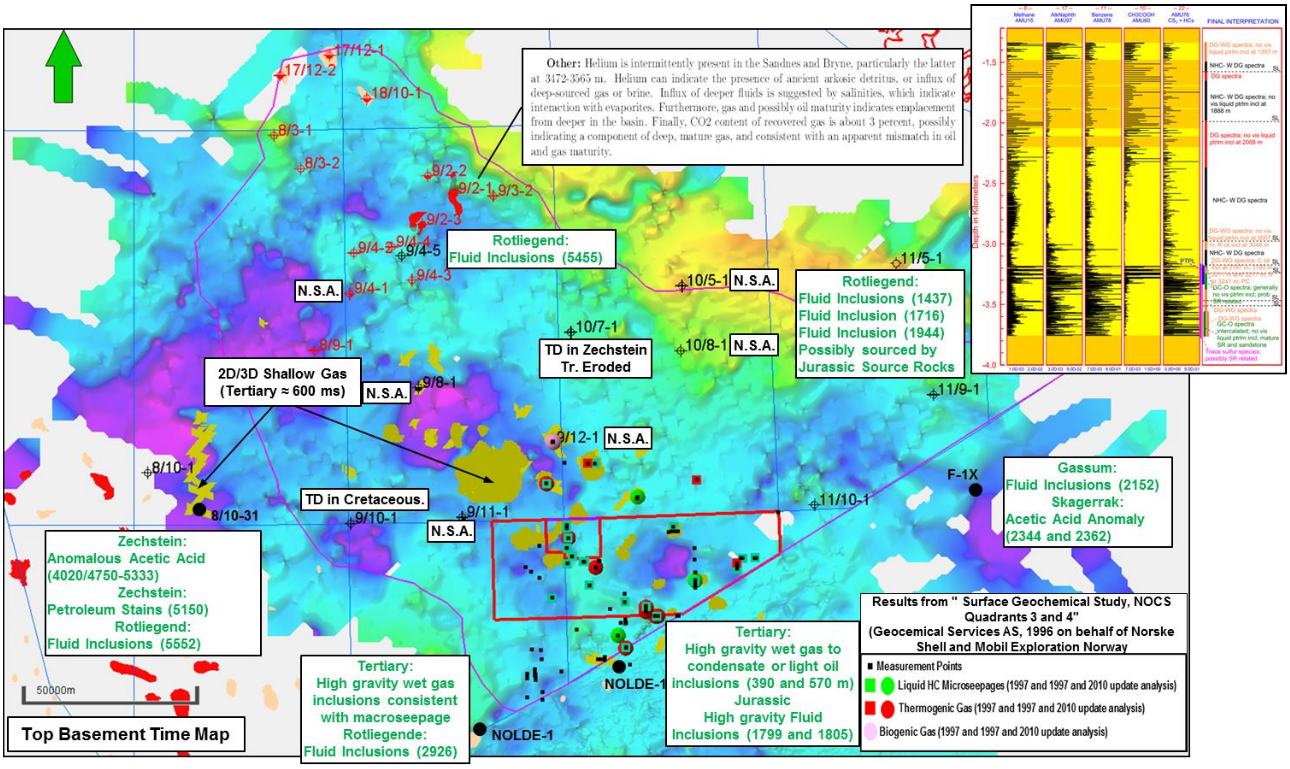

Fig.6: Synopsis of the 2017 Fluid Inclusion Study and 1996 Surface Geochemical Study.

Geological Plays

The four geological plays have been evaluated following the general workflow shown in Fig.7.

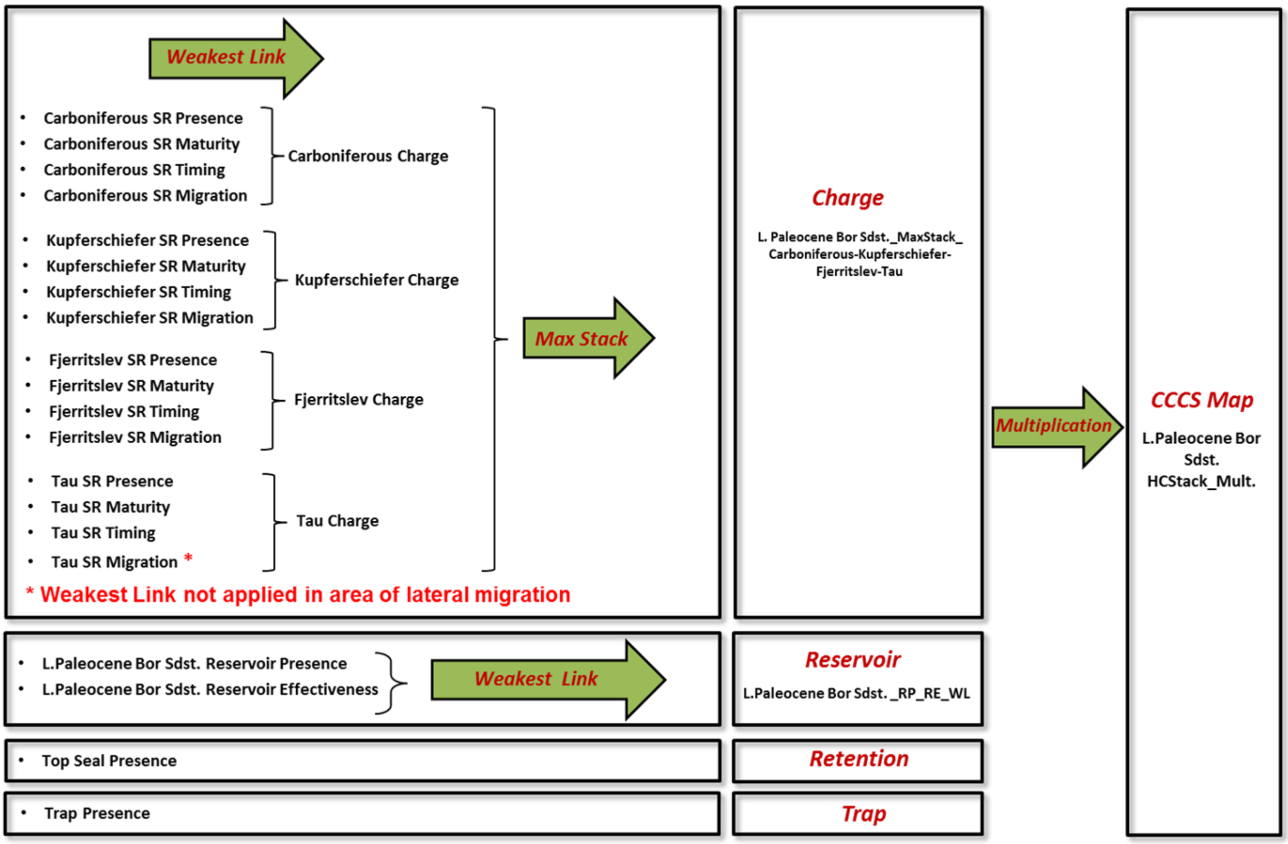

Fig.7: General workflow for Geological Play evaluation.

The evaluation is based on the analysis and mapping of the risk associated to 4 main elements: *Charge, Reservoir*, *Retention* and *Trap*. The four maps are stacked (Multiplication) to create the final CCCS Map.

The *Charge Map* is created by aggregation (Weakest Link) of four basic maps: source rock Presence and Maturity, Timing and Migration. If one play is characterised by more than one source rock, an intermediate Charge Map for each source rock level is created using the above-mentioned workflow and then aggregated (Max Stack) to form the final Charge Map.

The *Reservoir Map* is produced by aggregation (Weakest Link) of two basic maps: Reservoir Presence and Reservoir Effectiveness.

Finally, *Top Seal Map* and *Trap Map* are single maps realised by mapping the presence of sealing lithologies and traps in the area of interest.

Lower Paleocene Play:

The Danian deep marine Bor sandstones (Våle Fm.) are the reservoir of the Lower Paleocene Play.

The top seal is represented by the marlstone and mudstone of the Våle and Lista-Sele formations.

In the Licence area, Seal and Charge (Fig.8) are the main risk elements for this play.

Seal risk is increased in the area of the Siri Canyons because of the well-known presence of younger sandstones (Ty, Idun, Rind, Kolga and Hefring sandstones) that might act as thief layers.

Vertical migration from underlying source rocks is very unlikely because they are not mature (Fjerritslev and Tau) and/or stratigraphically too far (Kupferschiefer and Lower Carboniferous) from the reservoir layers. Charge risk is reduced in the License area because potential carrier beds (Bor sdst.) connecting the area of interest with the Tail End Graben and Sogne Basin have been mapped. In these basins the Upper Jurassic source rocks are mature and can (similar to the Siri Canyon Fairway) charge Lower Paleocene prospects in PL728 area. Basin Modeling based on paleo-restored surfaces to take into account the effect of the Cenozoic uplift and tilting (Fig.9) and including the presence of a possible sealing fault North of the Siri Field indicates that long distance migration via a possible spill from the Siri structure is a possible mechanism. Oil shows in the Lower Paleocene sequence of the well 3/6-1 seem to support this interpretation.

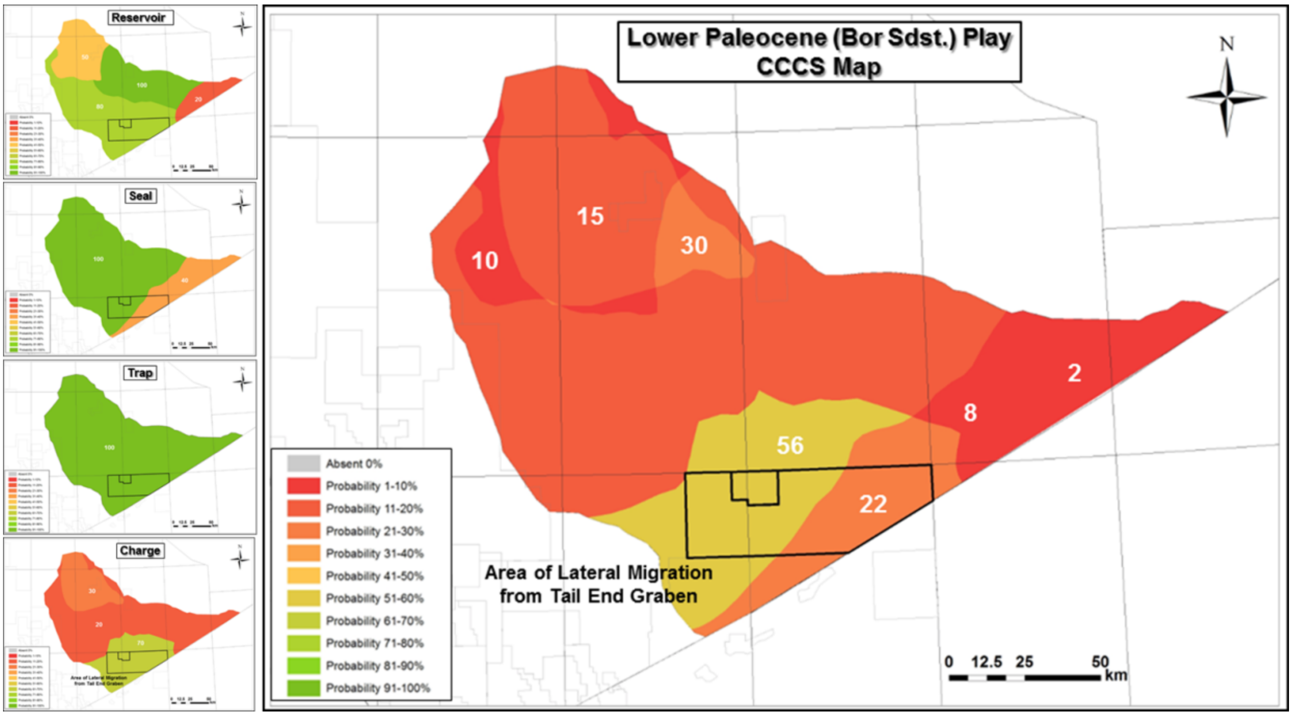

Fig.8: Lower Paleocene Play (Bor sdst.) CCCS Map

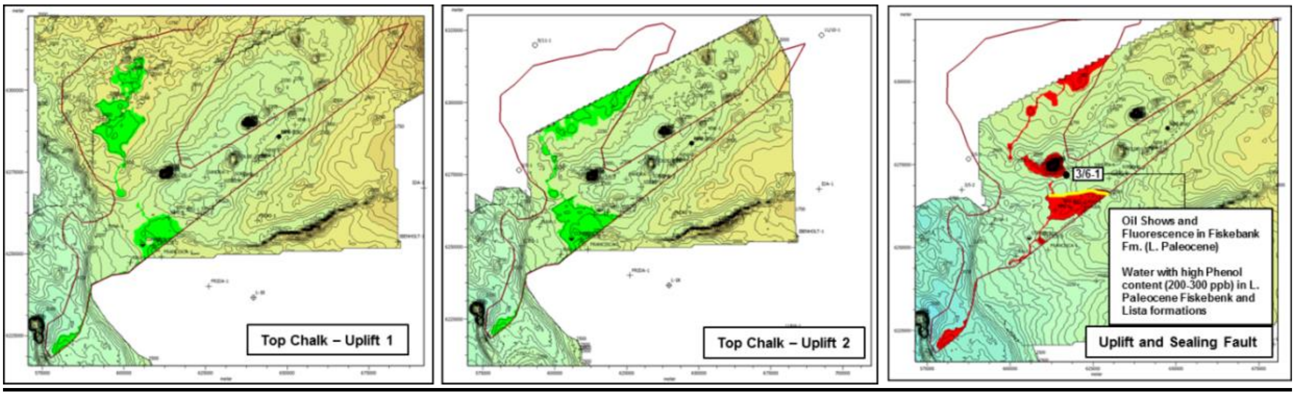

Fig.9: Basin Modeling realizations showing the possibility to charge L. Paleocene prospects with HC generated in the Tail End Graben.

Middle - Upper Jurassic Play

The reservoir is the Middle-Upper Jurassic sandstone of the Sandnes Fm. (same reservoir as the Yme Field) with shales of the U. Jurassic (Egersund, Tau and Sauda formations) and L. Cretaceous (Åsgard Fm.) forming the seal. Charge is the main risk for this Play as the Fjerritslev and Tau formations are mature only in the Egersund Basin (Yme Field and Mackerel, Vette and Briesling discoveries, Fig.10) and charge from deeper Paleozoic sources is considered highly unlikely.

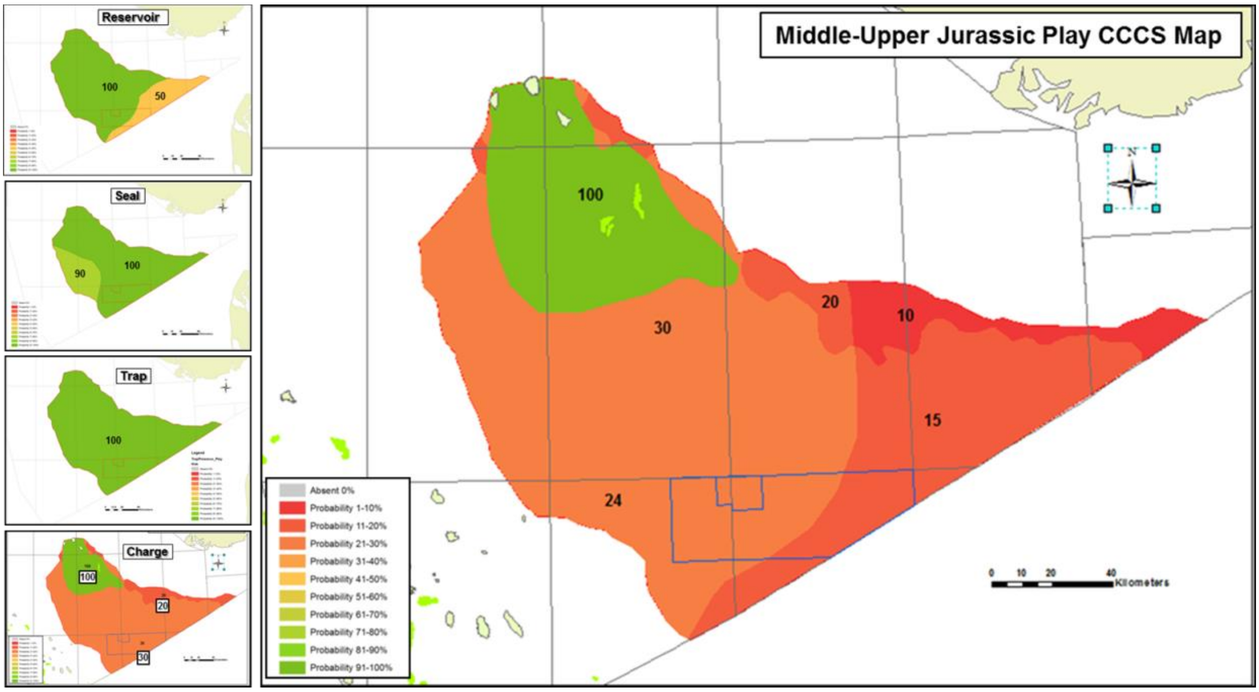

Fig.10: Middle-Upper Jurassic Play (Sandnes Sdst.) CCCS Map

Upper Triassic – Lower Jurassic Play

Two main reservoirs (Rhaetian-Hettangian Gassum and Norian Skagerrak formations), sealed by the shales of the Fjerritslev Fm., are recognized in this play. In the area of interest, the Fjerritslev Fm. has a patchy distribution being eroded by the Middle Jurassic Unconformity (MJU) and preserved in the deepest rim synclines and as such constitutes one of the mayor elements of risk (Fig. 11). The other element of risk is Charge (Fig. 11) as vertical migration from Paleozoic source rocks is considered unlikely.

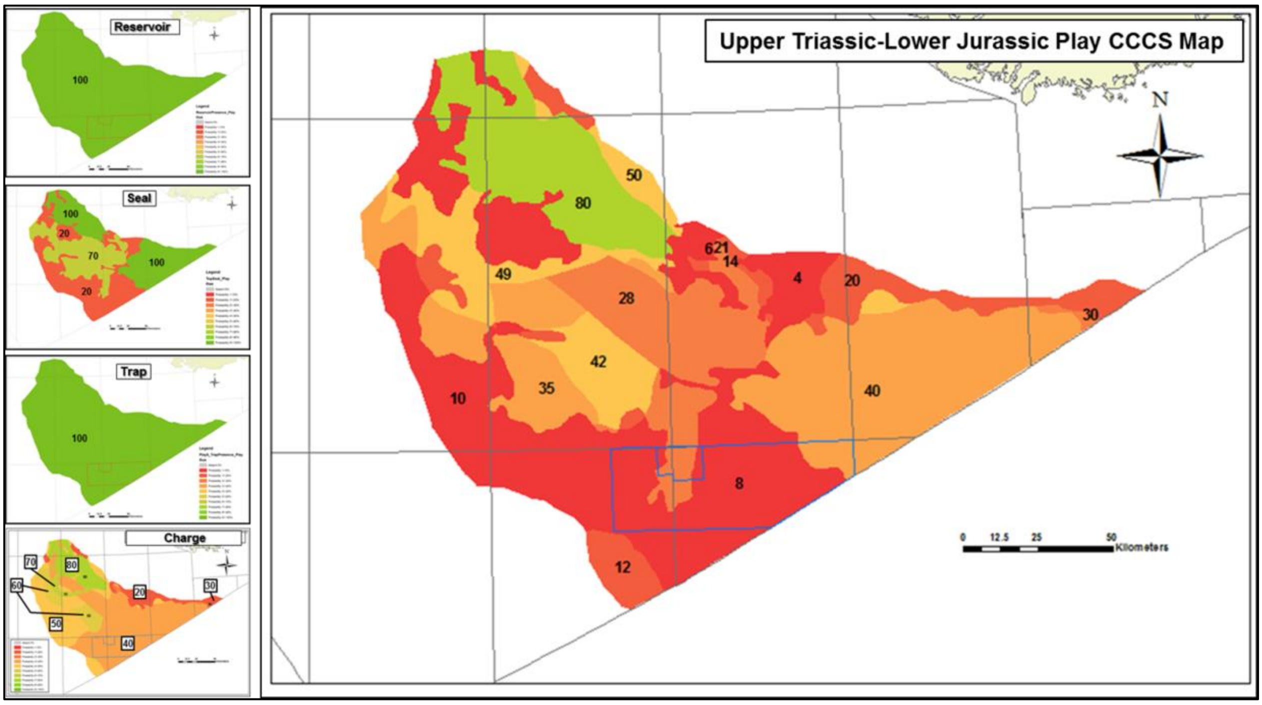

Fig.11: Upper Triassic - Lower Jurassic Play (Gassum-Skagerrak sdst.) CCCS Map

Lower - Middle Triassic Play

The fluvial-lacustrine delta (McKie et al., 2009) sandstones of the Skagerrak Fm. are the reservoir of the Lower – Middle Triassic Play. The seal is represented by a thick layer of playa lake (McKie et al., 2009) mudstones that are particularly developed in wells 10/8-1 and 11/9-1 (Fig.12).

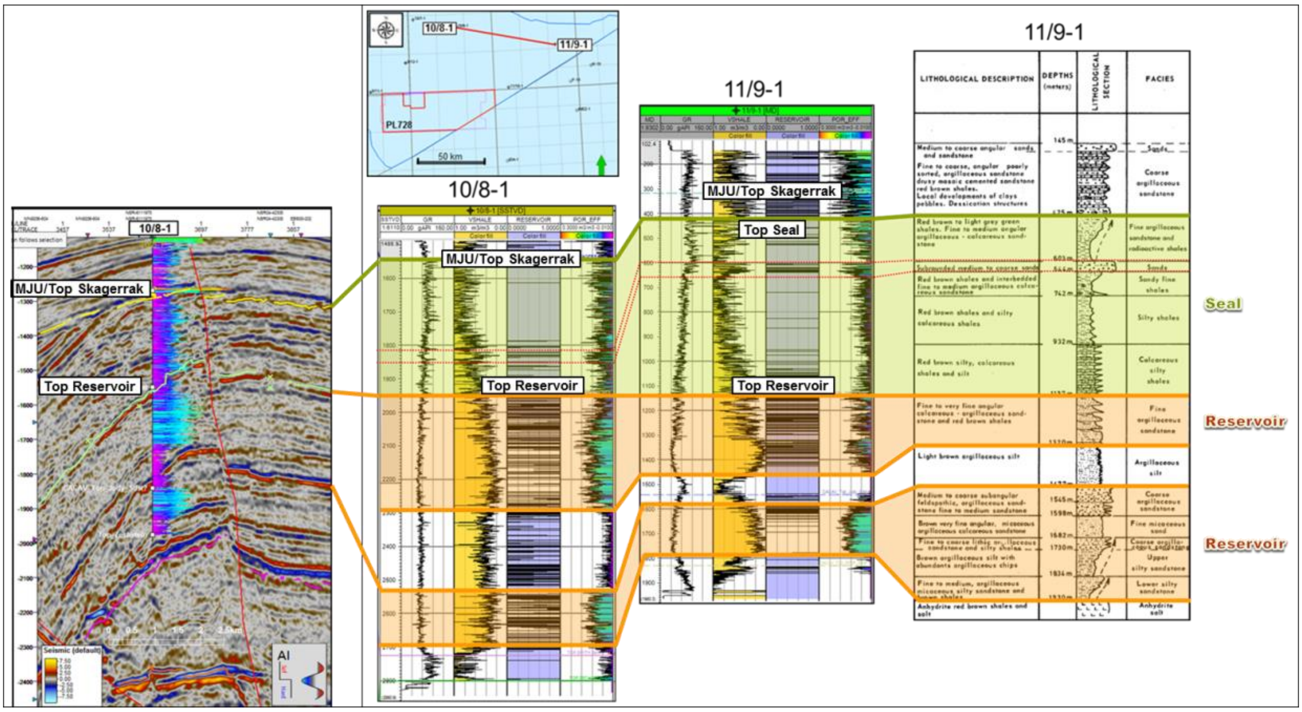

Fig.12: Lower – Middle Triassic Play reservoir and seal

Sands were, according to McKie et al., 2009, deposited during pluvial phases when the increased precipitations led to the development, across the Central North Sea, of large fluvial drainage systems. Seal lithologies were, on the contrary, deposited during arid phases when the fluvial activity was reduced and the playa lake could expand.

Charge (Fig.13) is considered the main element of risk for this play because of the uncertainties related to the presence of the Paleozoic Source Rocks and of an effective charge mechanism that is envisaged to occur through welds in the Zechstein salt (Fig.14). Although several extensive salt welds have been mapped in the area of interest (Fig.14) it is worth to consider that these actually are apparent salt welds (sensu Jackson et al., 2016), that is, structures that appear free of salt at the scale of observation that, in our case, is the seismic scale. At this scale it is not possible to define whether the structures are completely free of salt hence it is believed that a relatively high risk on charge should be retained.

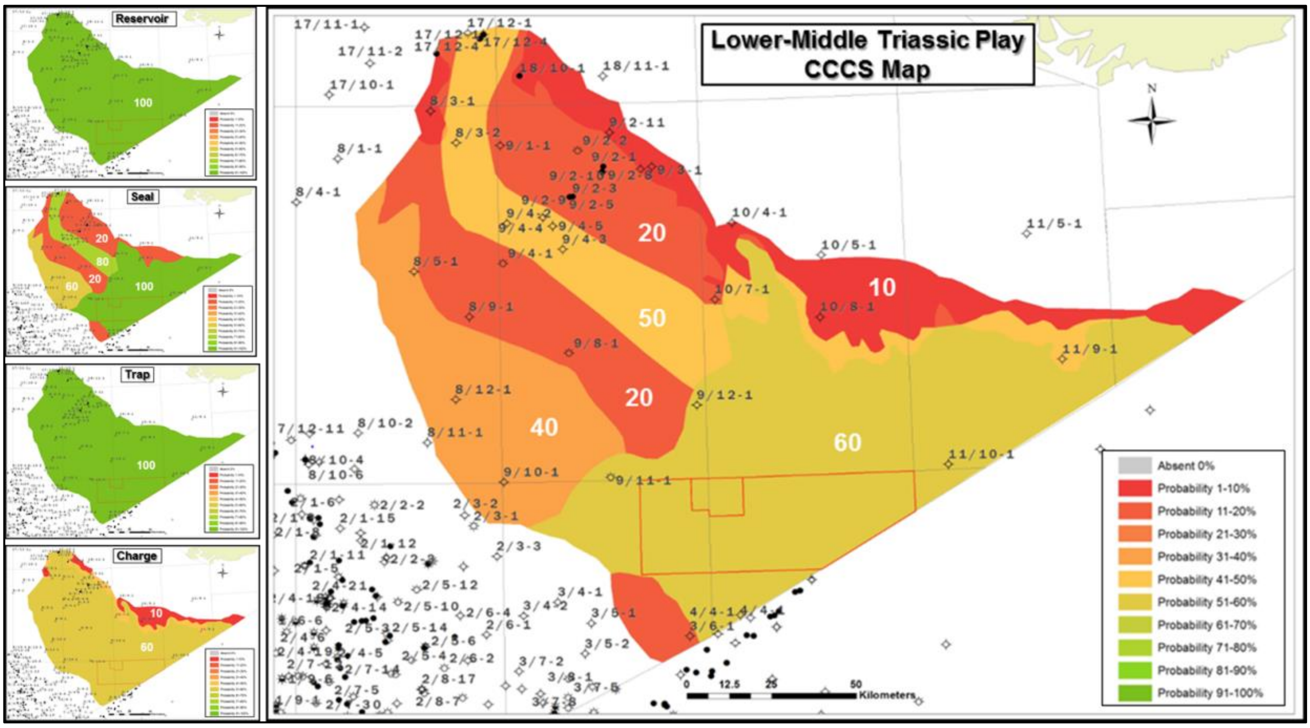

Fig.13: Lower – Middle Triassic Play (Skagerrak Sdst.) CCCS Map

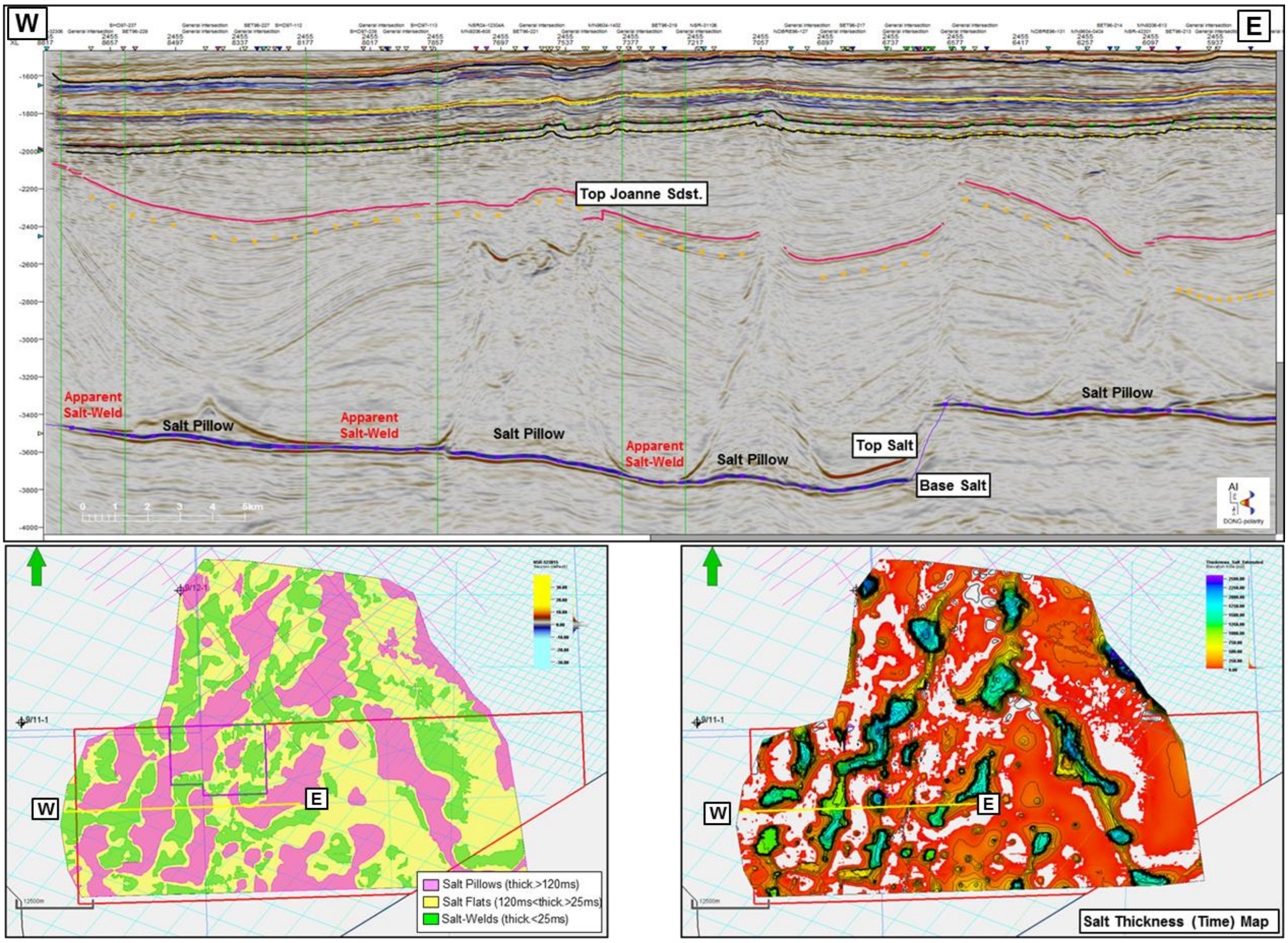

Fig.14: Apparent Salt Welds

The Lower – Middle Triassic and Lower Paleocene plays show, in the license area (Fig. 13 and Fig.8), a slightly positive risk profile while the Upper Triassic – Lower Jurassic and Middle – Upper Jurassic ones (Fig. 11 and Fig. 10) are characterized by high risk. For this reason only the prospectivity associated with Lower – Middle Triassic and Lower Paleocene plays has been further analysed for volumes and risk definition.

4. Prospect and Leads Update

Prospects and leads identified in the licences (Fig.15), belong to four main plays: 1) Lower Paleocene, 2) Upper-Middle Jurassic, 3) L.Jurassic-U.Triassic and 4) Middle-Lower Triassic.

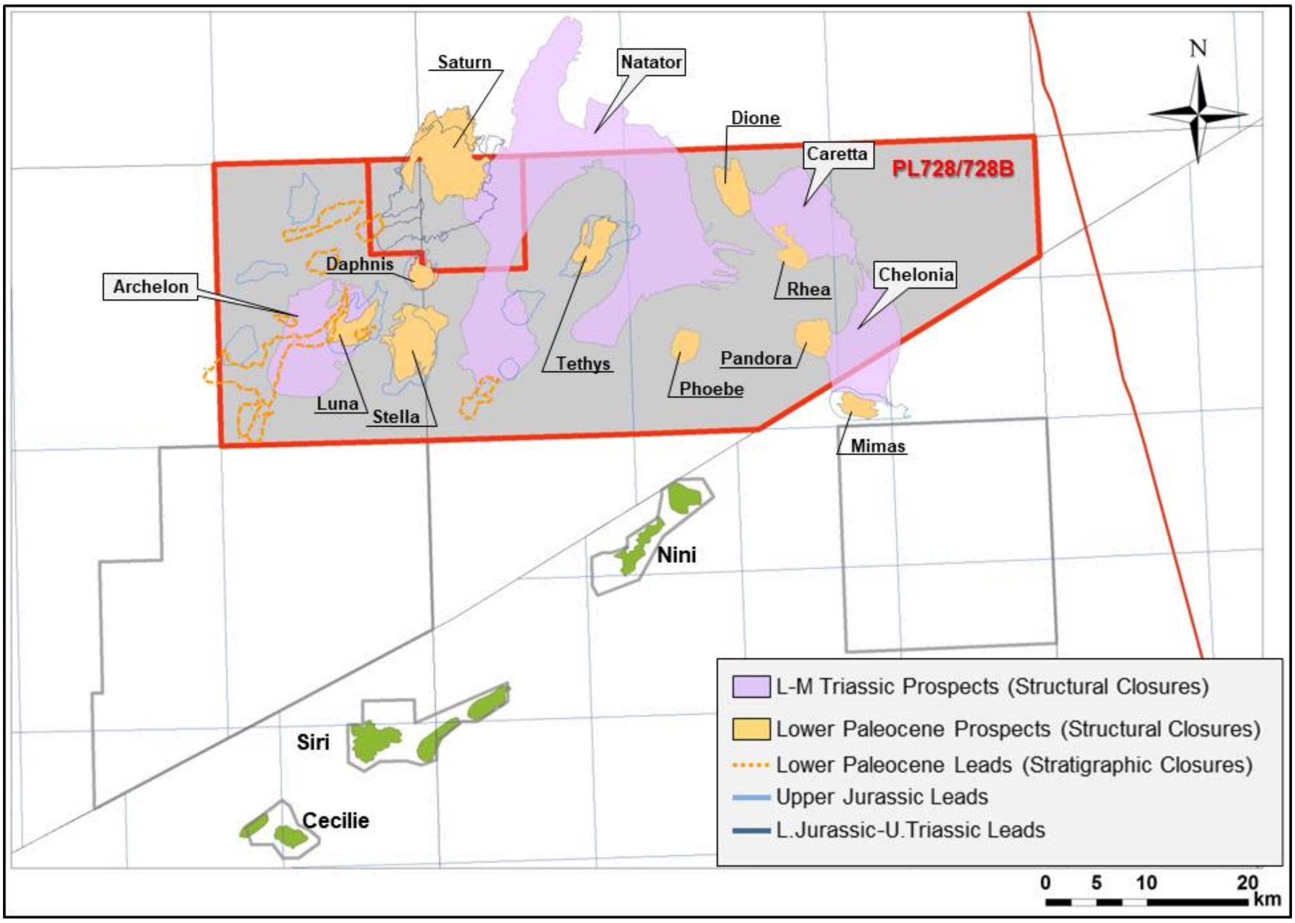

Fig.15: PL728 and PL728B Prospects and Leads

Leads in the Upper-Middle Jurassic and Lower Jurassic-Upper Triassic plays have been discarded either because of the high play risk or because of the very small volumes associated (Upper-Middle Jurassic Leads).

Lower Paleocene Prospects

In the Lower Paleocene Play 10 prospects have been identified (Fig.15).

The trapping mechanism of these prospects is structural as they mainly correspond to 4-way closures developed on top of salt diapirs. The 4-way closures are complicated by the presence of normal faults associated with the stretching induced by the rising salt diapirs (Fig.16).

The reservoir of the Lower Paleocene prospected is assumed to be the Bor Sdst member of the Våle Fm. while the seal is provided by the overlying shales belonging to the same formation.

The Bor Sdst. are not proven in the area of interest and, although the presence and the geometry of amplitude anomalies mapped in the 3D area suggest that their existence is highly probable, this constitutes a substantial element of risk.

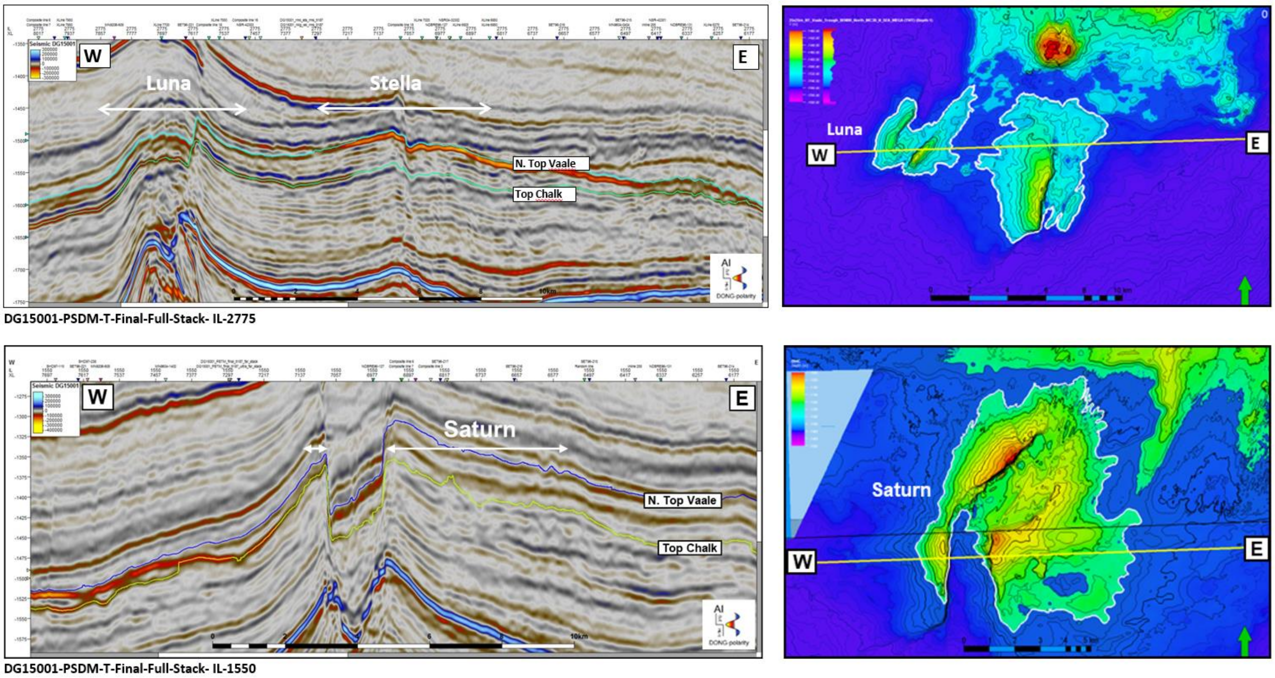

Fig.16: Seismic lines describing the geometry of the Lower Paleocene prospects

The Bor Sdst. are considered (Fig. 17) to extend southward (where they might connect with the coeval sands of the Siry Canyon fairway) where they might intercept hydrocarbons spilling from the Siri Field (Fig. 18). Basin Modeling realisations that consider the structural changes induced by the Cenozoic uplift indicate that this is a possible mechanism for charging the Lower Paleocene prospects of the PL728 and PL728B licences (Fig. 18).

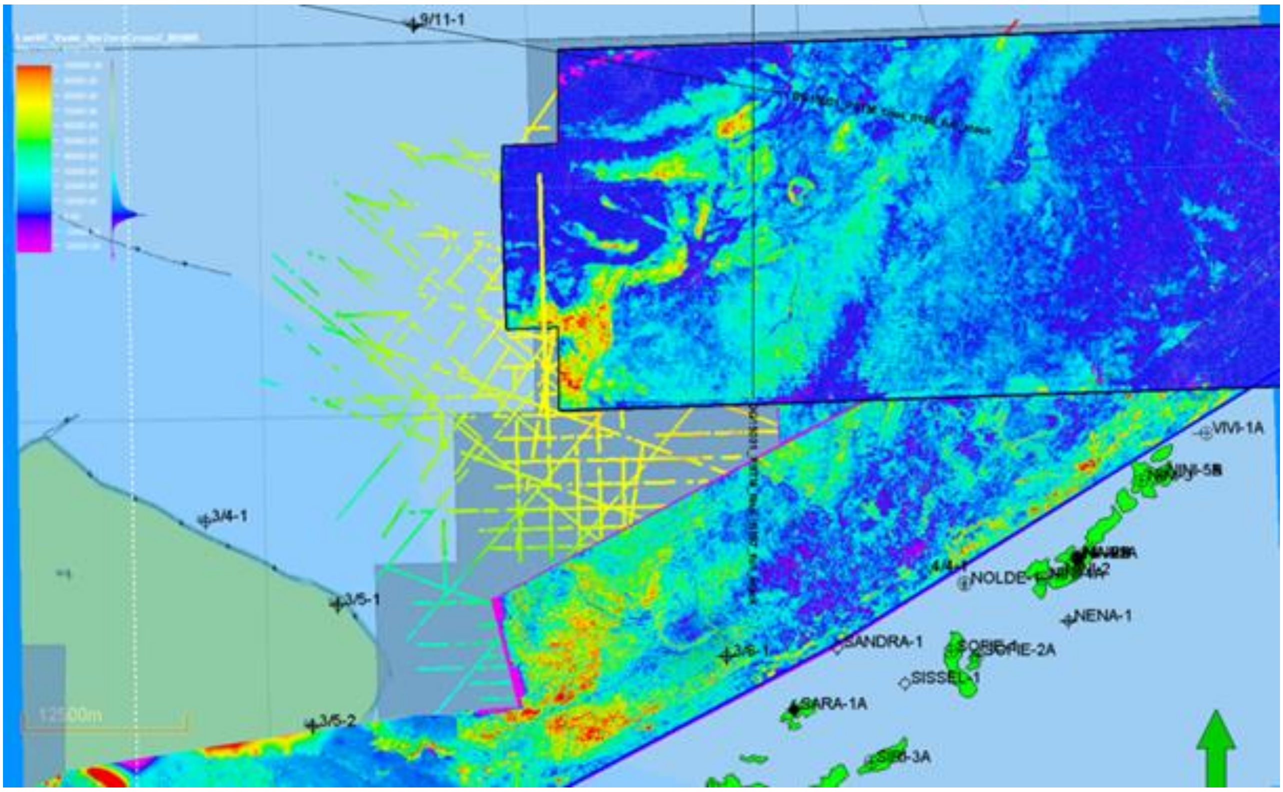

Fig.17: Possible extension of the Bor Sdst. based onseismic amplitude extraction

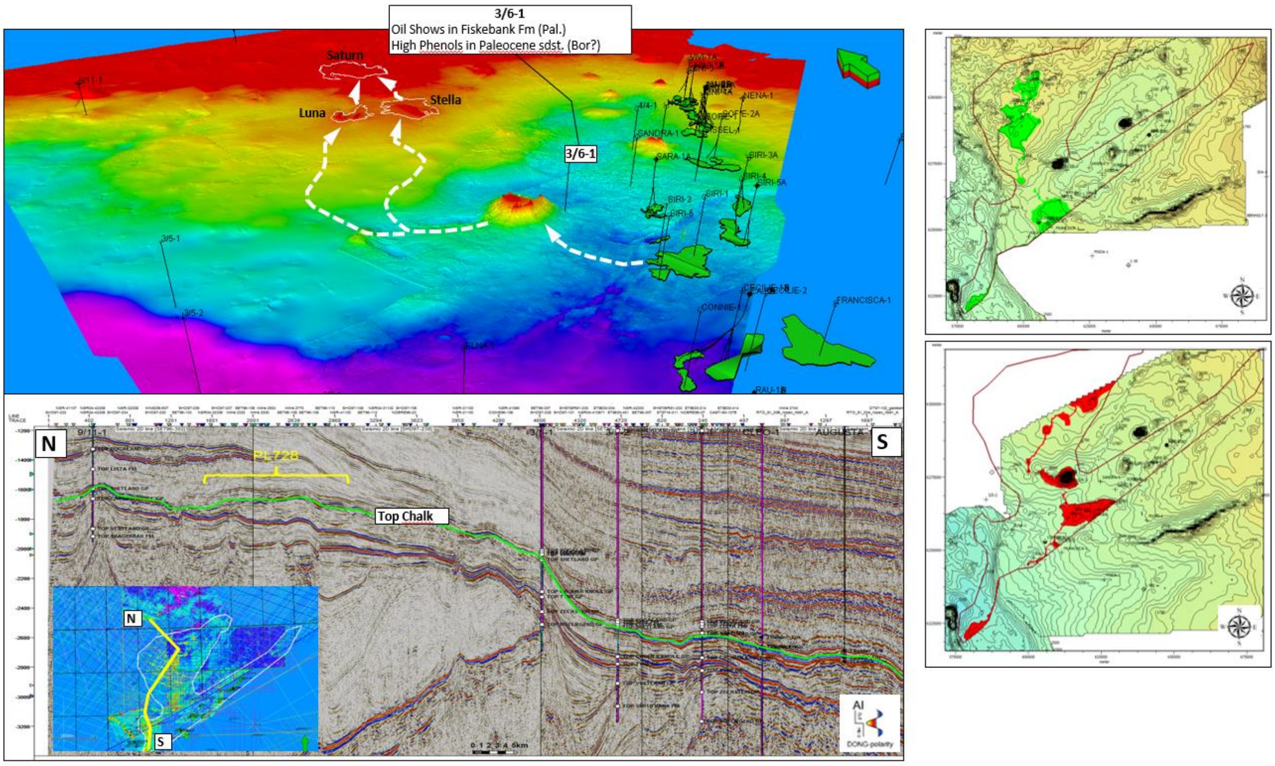

Fig.18: Possible migration patterns for the Lower Paleocene prospects

Although a very complex long-distance migration mechanism from the Tail End Graben is proven in the Siri Canyon Play, Charge represent the main element of risk for the Lower Paleocene prospects of the PL728/728B area.

Saturn, Stella and Luna are the most sizeable Lower Paleocene prospects and have been evaluated in terms of risk and volumes (Tab. 5).

All these prospects are characterized by relatively small volumes and high risk and this represent a problem in the definition of an economically viable development plan also considering that the different HC phase of these prospects (oil) with respect to that of the main Natator prospect would require a specific production, treatment and delivery system.

Tab.5: Risk and volumes for the Saturn, Stella and Luna prospects

SATURN PROSPECT					
Volumes (1e6 STB)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	23,50	87,60	13,90	59,60	196,60
Recoverable	8,02	37,20	5,90	25,10	83,60
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0.7	1.0	0.8	1.0	0.56
Prospect	0.6	1.0	0.6	0.8	0.29
Final POS					**0.16**

STELLA PROSPECT					
Volumes (1e6 STB)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	36,40	60,90	18,90	49,90	117,10
Recoverable	13,50	25,90	7,88	20,90	50,00
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0.7	1.0	0.8	1.0	0.56
Prospect	0.7	1.0	0.7	0.8	0.39
Final POS					**0.22**

LUNA PROSPECT					
Volumes (1e6 STB)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	10,40	21,20	5,49	16,70	43,10
Recoverable	3,47	9,00	2,28	6,98	18,40
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0.7	1.0	0.8	1.0	0.56
Prospect	0.7	1.0	0.8	0.8	0.39
Final POS					**0.25**

Middle-Lower Triassic Prospects

The Middle-Lower Triassic prospect have been the main driver for the 2013 Application through which the PL728 Licence was awarded to a partnership composed by Ineos E&P Norge, Total E&P Norge and Petoro. At that time 6 main prospects (Archelon A, Archelon B, natator, Chersina, Caretta and Chelonia, Fig. 19) were defined, at various stratigraphic levels within the Middle-Lower Triassic Sequence.

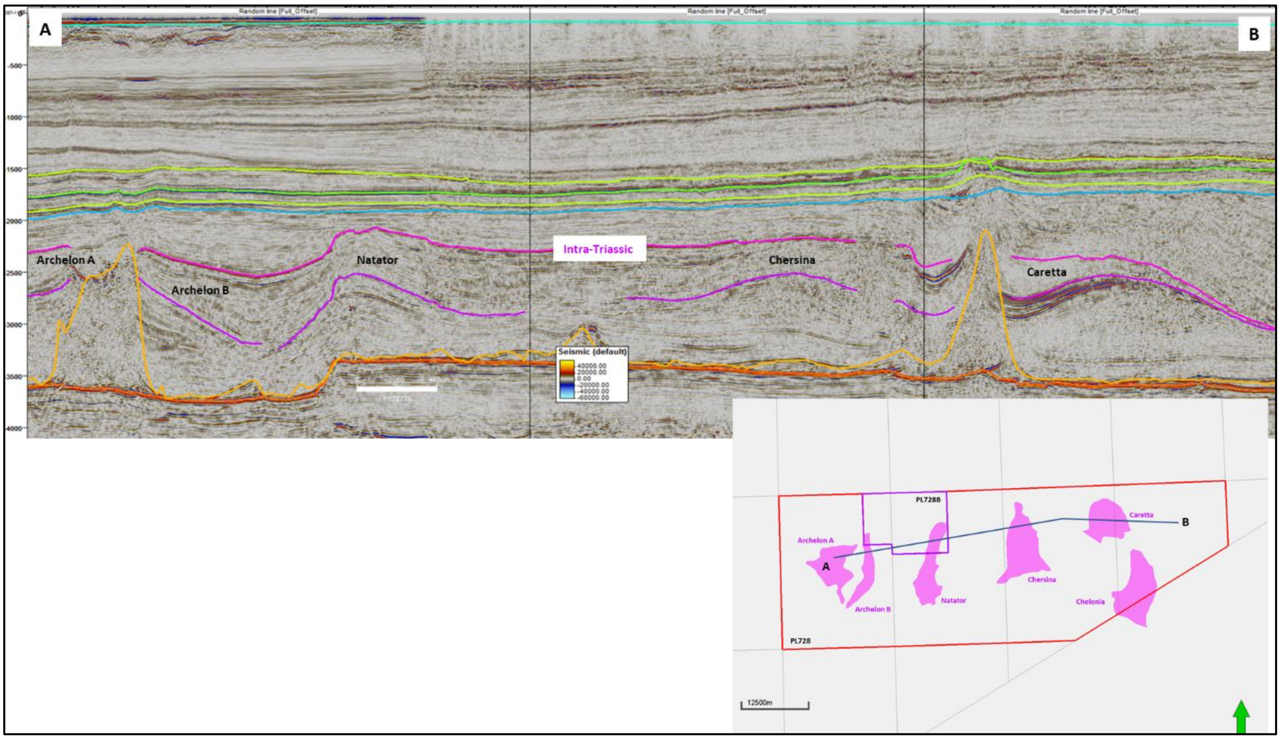

Fig.19: The Middle-Lower Triassic Prospects in 2013

The acquisition and processing of new 3D seismic data (DG15001) has allowed a better delineation of the geometry of these prospects mainly through the definition of a common top reservoir that, by correlation with the neighbouring and UK wells, has been interpreted as the Top of the Joanne Sdst. Member of the Skagerrak Fm. (Fig. 20)

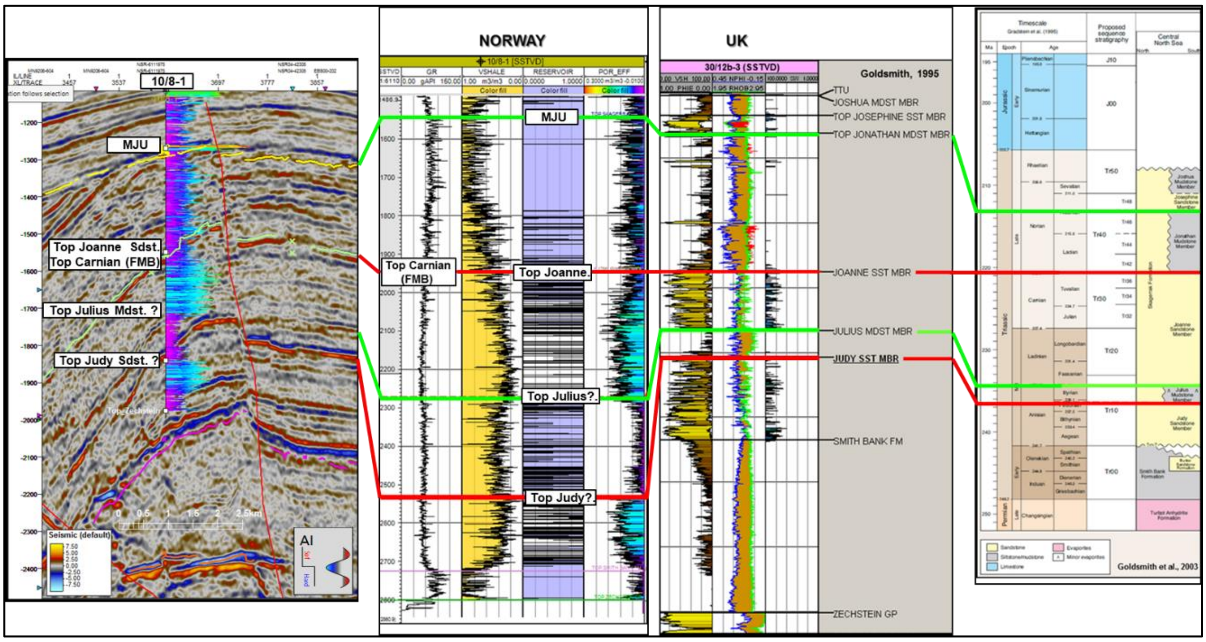

Fig.20: Definition of the Top Reservoir for the Middle-Lower Triassic prospects

On this basis four main Middle-Lower Triassic prospects, roughly coinciding with those reported in the APA 2013 Application, have been mapped (Fig. 21): Archelon, Caretta, Chelonia and Natator Cluster, which consists of 3 structures: Natator A, Natator B (roughly coinciding with the Natator Prospect of APA 2013) and Natator C (roughly coinciding with the Chersina Prospect of APA 2013) characterized by a common spill-point at -3002 m (Fig. 21).

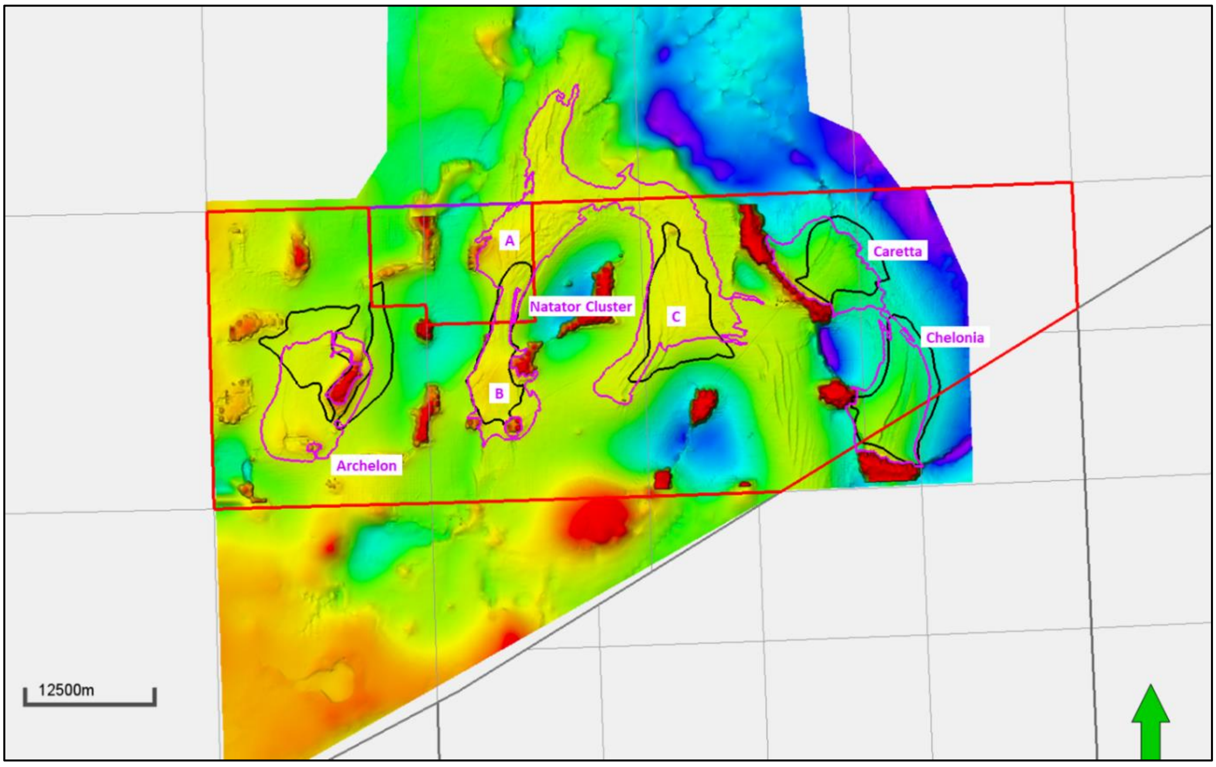

Fig.21: The Middle-Lower Triassic Prospects

Caretta (Fig. 22) and Chelonia are 3-way salt assisted structural closures while Natator Cluster (Fig. 23) and Archelon are 4-way structural closure locally complicated (mainly Archelon) by piercing salt diapirs.

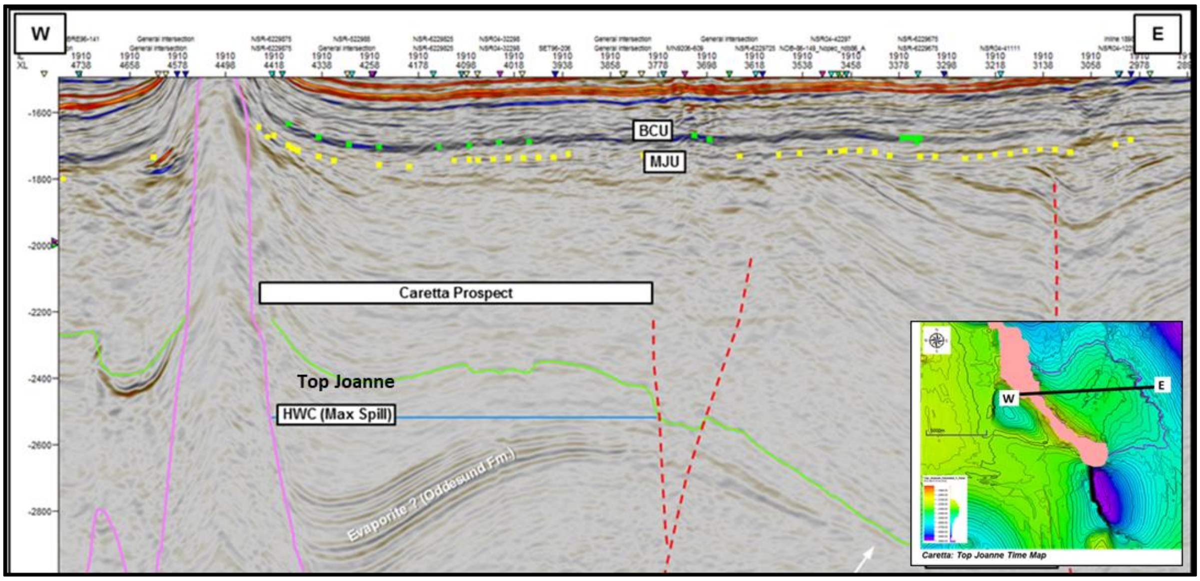

Fig.22: Structural geometry of the Caretta Prospect

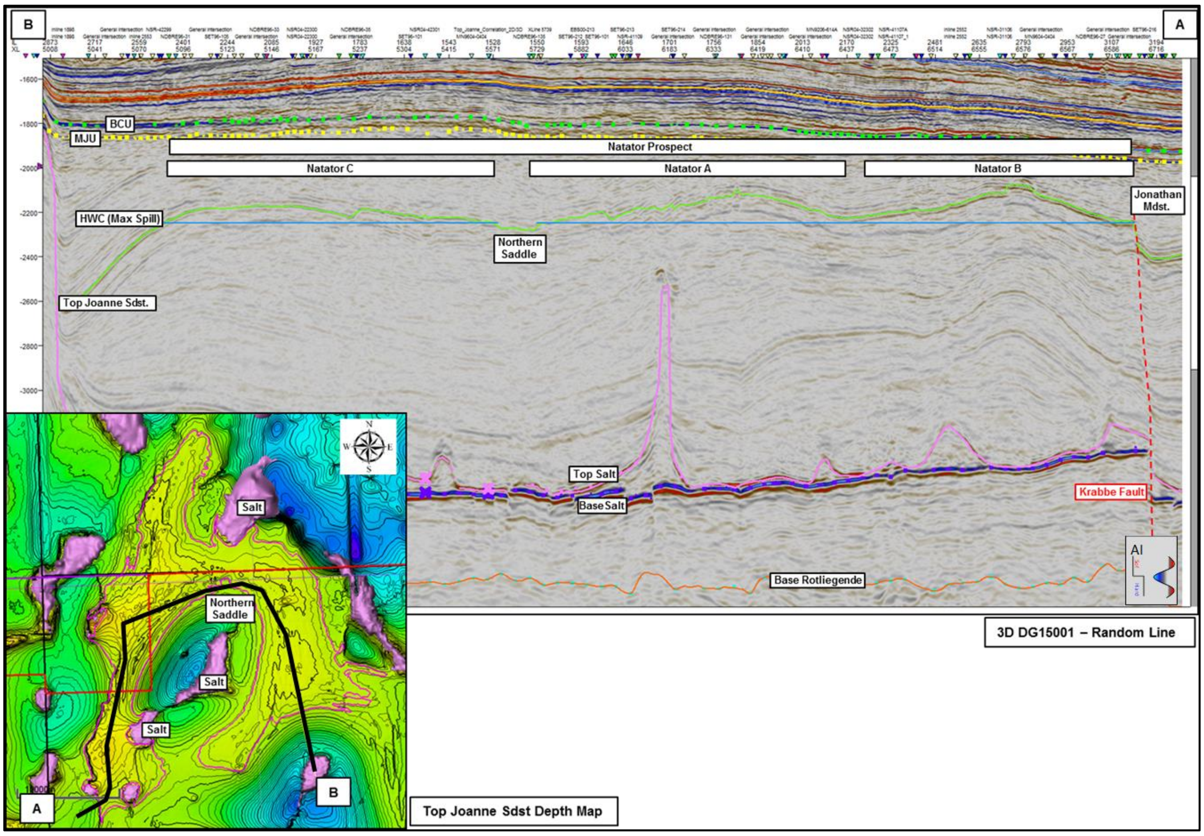

Fig.23: Structural geometry of the Natator Cluster

These structures (Turtle-back Structures) formed during periods of salt activity and are the result of the structural inversion of former salt-controlled mini-basin.

The main reservoir of the Middle-Lower Triassic prospects is the Joanne Sdst. Member of the Skagerrak Fm. and, according to Mckie et al. (2009), is made of fluvial sandstone deposited during pluvial phases when large terminal fluvial drainage systems developed across and outside the Central North Sea. The presence and the quality of the reservervoir is not considered a risk.

On the other hand, always according to McKie et al. (2009) the sealing lithologies, that for the prospects in question are represented by the deposits of the Jonathan Mdst. Member of the Skagerrak Fm., were deposited in a Playa Lake environment developed during phases of arid climate when the fluvial activity was greatly reduced and the terminal fluvial systems were poorly developed. Although the Jonathan Mdst. are the top seal of the Jade Field in UK their effectiveness as sealing lithology is still debated and may represent an element of risk particularly for these prospects where, according to the result of the basin modelling, the emplacement of the hydrocarbon shortly post-dates the formation of the trap and the deposition of the top seal.

The Natator Cluster

As mentioned before the Natator Cluster has then been identified as the driving prospect for the economical evaluation.

The Natator Cluster is formed by three culminations (Natator A, Natator B and Natator C) sharing a common spill point at -3002 m (Fig. 24).

Natator C spills (Fig. 24) into Natator A at -2954 m while Natator A spills into Natator B at -2919 (Fig. 24)

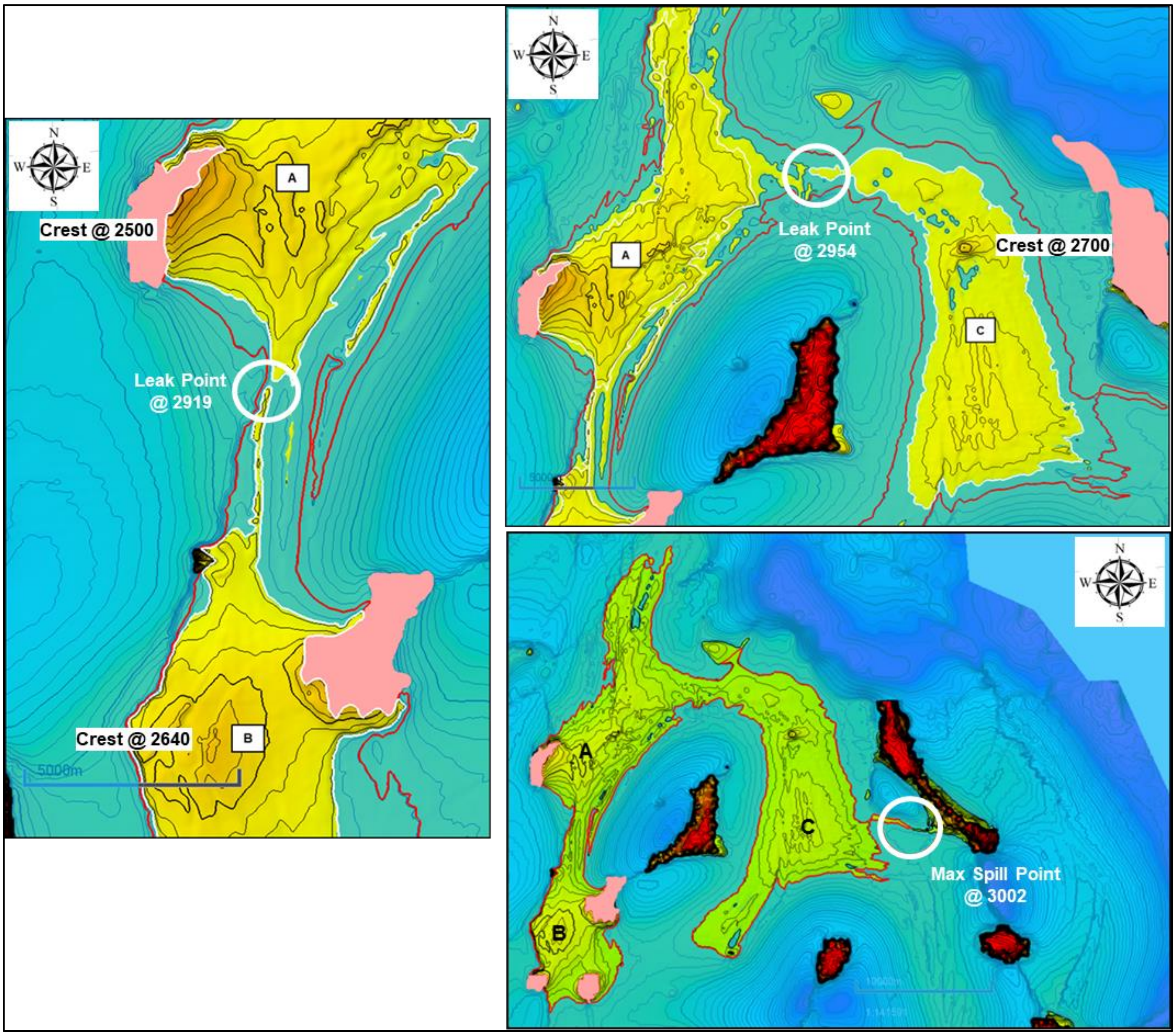

Fig.24: Relationships between the different structures of the Natator Cluster

The presence of these leak points has been implemented in the GeoX© software for the calculation of the hydrocarbons volumes of the cluster. The fill scenarios (Fig. 25) are steered by the generated volume output from an extensive stochastic Basin Modelling that consider the possible presence of a leaky top seal and the complex migration patterns of hydrocarbons moving into the Middle-Lower Triassic reservoirs from a Lower Carboniferous kitchen and through an intermediate reservoir (the Rotliegend Sdst.) and an extensive Zechstein salt layer. The structural configuration of the Rotliegend Sdst. and the presence of extensive salt welds (Fig. 14) seem to favour the charge of some (Natator Cluster is among these) of the Middle-Lower Triassic prospects.

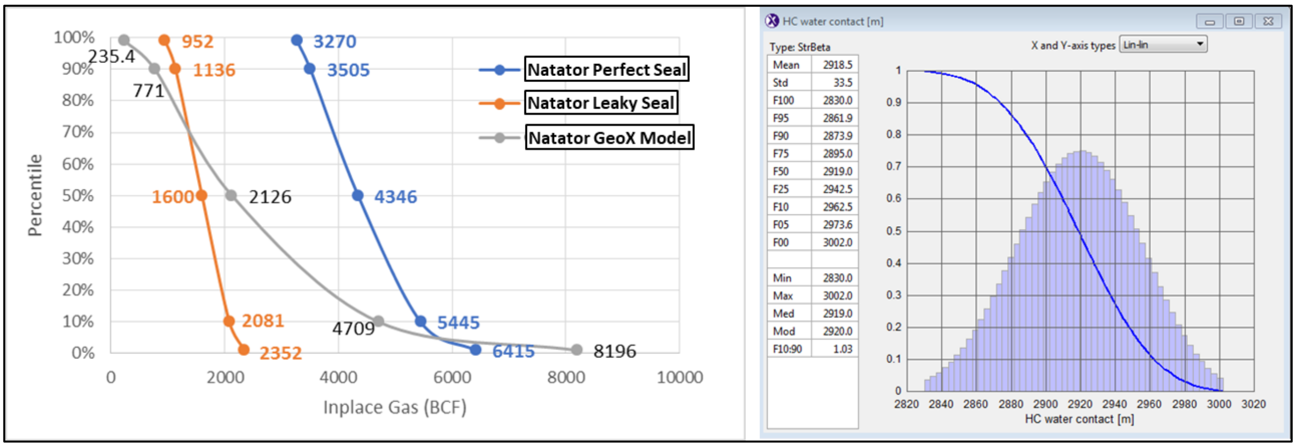

Fig.25: Definition of the HCW contacts in the Natator Cluster

The volume and risk outputs for the Natator Cluster are provided in Tab. 6 while those of the other Middle-Lower Triassic prospects are summarized in Tab. 7.

Tab.6: Natator Cluster Prospect Data Sheet

Table 5: Prospect data (Enclose map)

Block	3/3-4/1-4/2-4/3	Prospect name	Natator Cluster	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)		NPD approved (Y/N)	
Play name	L.-M- Triassic	New Play (Y/N)	Yes	Outside play (Y/N)	No				
Oil, Gas or O&G case:	Gas	Reported by company	INEOS E&P Norge	Reference document				Assessment year	2017
This is case no.:	1 of 1	Structural element	NO-DK Basin	Type of trap	Structural	Water depth [m MSL] (>0)	40	Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE		**Main phase**				**Associated phase**			
Volumes, this case		Low (P90)	Base, Mode	Base, Mean	High (P10)	Low (P90)	Base, Mode	Base, Mean	High (P10)
In place resources	Oil [10^6 Sm^3] (>0.00)					0,01	0,01	0,18	0,41
	Gas [10^9 Sm^3] (>0.00)	21,80	41,10	71,00	133,40				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)					0,01	0,01	0,12	0,29
	Gas [10^9 Sm^3] (>0.00)	15,10	32,40	49,60	94,20				
Reservoir Chrono (from)	Induan	Reservoir litho (from)	Bunter Sdst.	Source Rock, chrono primary	L. Carboniferous	Source Rock, litho primary	Coal and Shale	Seal, Chrono	Norian
Reservoir Chrono (to)	Carnian	Reservoir litho (to)	Skagerrak Sdst	Source Rock, chrono secondary	U. Permian	Source Rock, litho secondary	Shale	Seal, Litho	Jonathan Mdst.
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,24	Oil case (0.00-1.00)	0,00	Gas case (0.00-1.00)	1,00	Oil & Gas case (0.00-1.00)	0,00		
Reservoir (P1) (0.00-1.00)	0,80	Trap (P2) (0.00-1.00)	0,90	Charge (P3) (0.00-1.00)	0,42	Retention (P4) (0.00-1.00)	0,80		
Parametres:	Low (P90)	Base	High (P10)	*In Parameters "Base" = P50*					
Depth to top of prospect [m MSL] (> 0)	2500	2500	2500	*Very Dry gas - Esmond Field in UK as possible analogue GOR = 0,2 bbl/mmcf*					
Area of closure [km^2] (> 0.0)	76,6	130,3	186,2						
Reservoir thickness [m] (> 0)	164	295	444						
HC column in prospect [m] (> 0)	374	419	462						
Gross rock vol. [10^9 m^3] (> 0.000)	5,136	9,605	15,277						
Net / Gross [fraction] (0.00-1.00)	0,30	0,44	0,61						
Porosity [fraction] (0.00-1.00)	0,12	0,14	0,17						
Permeability [mD] (> 0.0)	1,0	6,0	10,0						
Water Saturation [fraction] (0.00-1.00)	0,20	0,30	0,40						
Bg [Rm3/Sm3] (< 1.0000)	0,0041	0,0038	0,0033						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)									
Recov. factor, gas ass. phase [fraction] (0.00-1.00)									
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,60	0,70	0,80						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,60	0,70	0,80	For NPD use:					
Temperature, top res [°C] (>0)	200			Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
Pressure, top res [bar] (>0)	296			Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
Cut off criteria for N/G calculation	0,10 Porosity	0,10 Porosity	0,10 Porosity					Kart nr	NPD will insert value

Tab.7: Risk and volumes for the Caretta, Chelonia and Archelon Prospects

CHELONIA PROSPECT					
Volumes (1e9 scf)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	366,00	690,00	183,00	578,00	1354,00
Recoverable	202,00	507,00	112,00	408,00	1034,00
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0,60	1,00	1,00	1,00	0,60
Prospect	0,60	0,90	0,70	0,70	0,26
Final POS					**0.16**

CARETTA PROSPECT					
Volumes (1e9 scf)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	115,00	277,00	78,00	216,00	552,00
Recoverable	80,00	205,00	48,00	151,00	428,00
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0,60	1,00	1,00	1,00	0,60
Prospect	0,60	0,90	0,70	0,70	0,26
Final POS					**0,16**

ARCHELON PROSPECT					
Volumes (1e9 scf)					
	Mode	**Mean**	**P90**	**P50**	**P10**
In Place	38,00	154,00	27,00	98,00	349,00
Recoverable	23,00	117,00	16,00	69,00	274,00
Chance Element					
	Charge	**Trap**	**Reservoir**	**Retention**	**Total**
Play	0,60	1,00	1,00	1,00	0,60
Prospect	0,60	1,00	0,80	0,60	0,30
Final POS					**0,18**

5. Technical Evaluation and Development Plan

In the APA 2013 Application, a technical evaluation and development plan for the Chersina Prospect were presented.

The development scenario for the Natator Cluster has been updated with the new recoverable hydrocarbon volumes (Tab.). The new development scenario assumes that in the P90 case only one structure (Natator C) is filled, in the P50 case, two structures (Natator B and C) are filled and that in the P10 case all the three structures (Natator A, B and C) are filled.

The Natator Cluster is assumed to be developed with a standalone jacket based production platform positioned in correspondence of the Natator C structure. In the P90 case, the Natator C structure will be drained with 4 producers drilled from the platform. In the P50 case, two structures (Natator C and B) are assumed to be filled and the development scenario envisages the drilling of three additional producers (for a total of 7 wells) in Natator C and 4 in Natator B. Wells will be drilled from a 4-slots subsea template and production will be tied-back to Natator C Platform through a 12" flowline. In the P10 scenario 4 additional producers will be drilled in Natator B from a new 4-slots subsea template and 10 (2x4slots + 1x2-slots templates) in Natator A. Also in this case produced hydrocarbons will be tied-back to the Natator C Platform through a 12" flowline.

The number of wells for the different scenarios is showed in Tab. 8.

Tab.8: Development scenario for the Natator Cluster

Number of Wells (Increment)			
Structure	**P90**	**P50**	**P10**
Natator C	4	7 (3)	7 (0)
Natator B		4	8 (4)
Natator A			10 (10)
TOTAL	**4**	**11**	**25**

The development scenario assumes that all the produced gas will be conveyed to the Europipe II pipeline (Fig. 26) that runs for 658 km from the Kårsto processing complex north of Stavanger to the receiving facilities at Dornum in northern Germany.

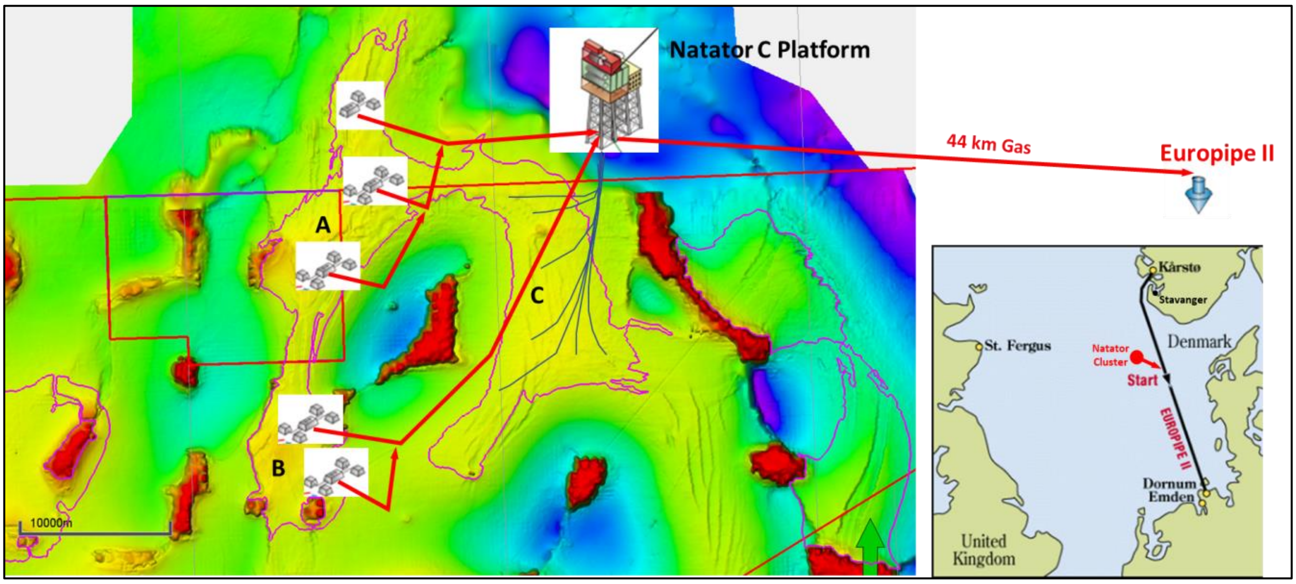

Fig.26: Development scenario for the Natator Cluster

6. Conclusions

Acquisition and processing of new 3D seismic data (DG15001) has been the fundamental input for an extensive assessment of the P728 and PL728B licences that the Operator has carried out in cooperation with the Partners.

This assessment led to a better definition of the Middle-Lower Triassic prospectivity and to the definition of several additional prospects and leads in three different plays (Lower Paleocene, Upper-Middle Jurassic and Lower Jurassic-Upper Triassic).

Both the Operator and Partners agreed that the Lower-Middle Triassic is the key play holding the most attractive prospects and that one of these, Natator, was the driving prospect for the economical evaluation.

Notwithstanding the extensive work carried out it has not been possible to sufficiently de-risk the prospect that still carries a substantial risk on Charge (the presence/effectiveness of a Lower Carboniferous Source Rock and the existence of an effective migration mechanism through the Zechstein evaporites are problematic) and Top Seal (the effectiveness of the Jonathan Mdst. as sealing lithology is debatable).

A unanimous drop decision was taken by the partnership and was justified by the high risk associated with Charge and by the high chances of having an underfilled accumulation because of the presence of a possible leaky top seal. Basin Modelling in fact show that migration occurs soon after the structures are created and the sealing lithologies deposited, thus giving a high chance to have a non-perfectly lithified top seal.

.