PL 916

Relinquishment Report

Partners:

equinor Lundin Petroleum petoro

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1 Introduction

1.1 License Group

Aker BP ASA 40 % (Operator)

Equinor Energy AS 20 %

Lundin Energy Norway AS 20 %

Petoro 20 %

1.2 Award and work program

Production license 916 was awarded 02.03.2018 as part of the APA 2017, with a firm well commitment (well to be drilled within 2 years).

The 25/11-29 S well was drilled in May 2019 on the JK Prospect to fulfil the license obligation.

The JK well was a successful test of the addressed play concept but no hydrocarbon shows were recorded in the well. The negative well result gives increased risk on the remaining prospectivity within PL 916.

As the work obligations have been fulfilled, a unanimous decision was made in PL 916 to relinquish the license at the BOK gate 02.03.2020.

1.3 Identified Prospectivity

The main prospectivity in PL 916, and basis for the firm well comitment in the application for the acreage, was the JK Prospect. The prospect is a large north-south oriented, low relief fault block at the Statfjord Group reservoir level, located north of the Johan Sverdrup Field and south of the Grane Field (Fig. 1.1).

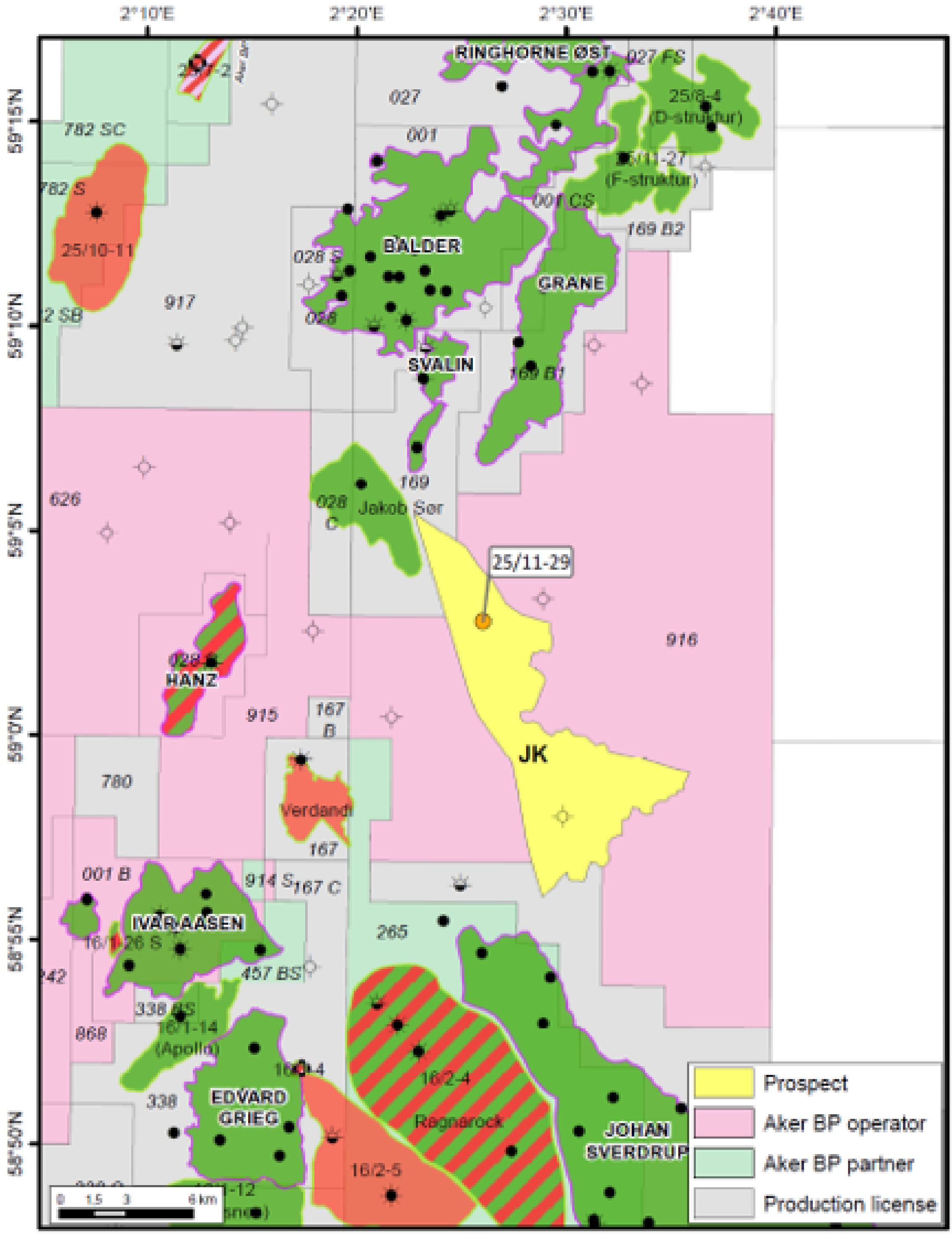

Fig. 1.1 PL 916 location map with the outline of the JK Prospect.

The objective of the 25/11-29 S exploration well was to test the potential of the JK Prospect with the primary target in sandstones of the Lower Jurassic Statfjord Group and with a secondary target in the Paleocene Heimdal Formation. The primary target Statfjord Group was allready proven in the license in the closest two offset wells 25/11-17 and 25/11-28, which are 2.9 km NE and 6.0 km SW from the JK surface location, respectively (Fig. 1.2). The Statfjord Group is positioned directly below the Base Cretaceous Unconformity (BCU) and a thin Draupne shale sequence and consists of a thick, heterolithic succession of marginal marine sandstones to fluvial channel systems.

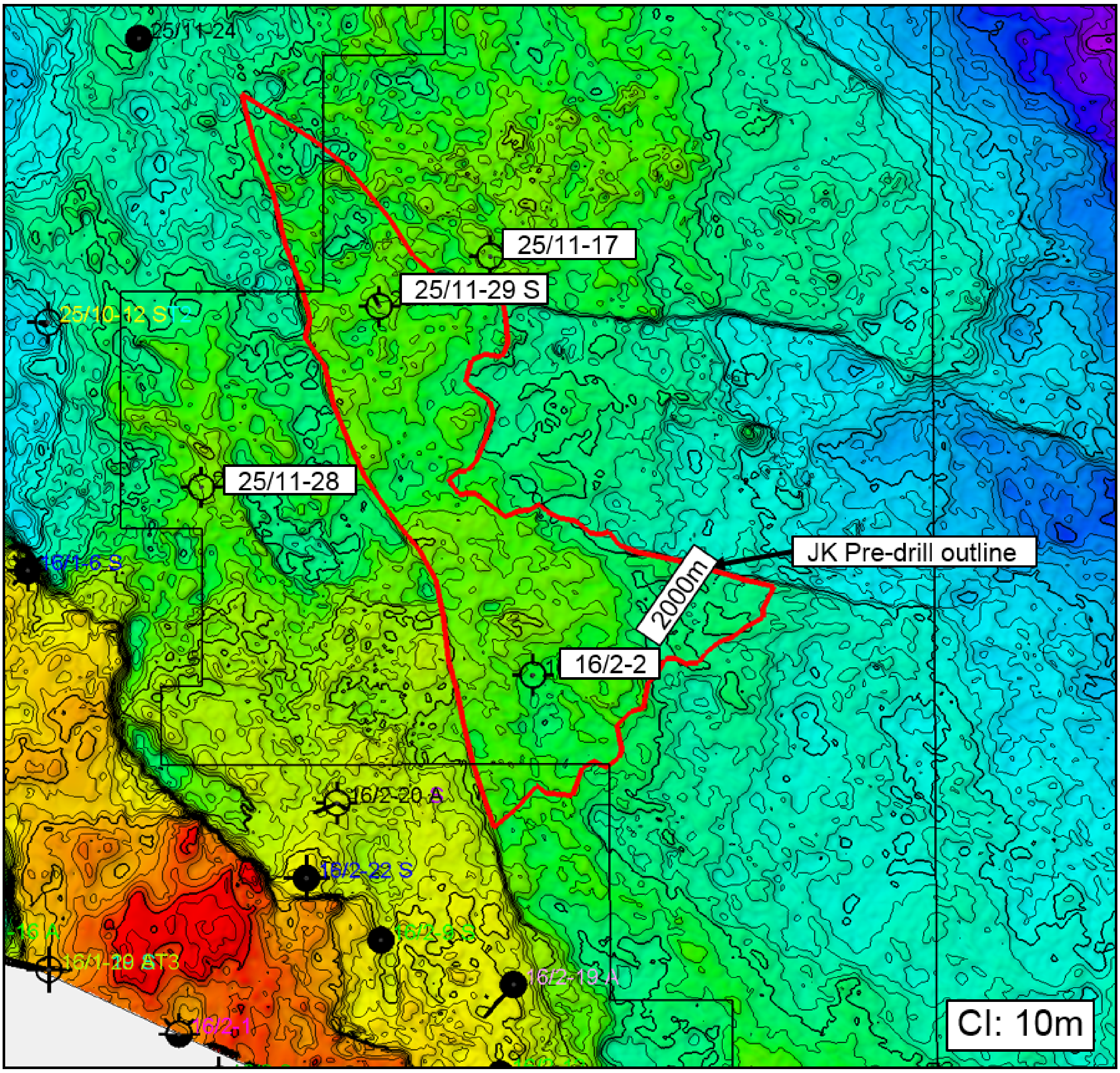

Fig. 1.2 Top reservoir map in depth at top Statfjord Group level *With JK well location and closest offset wells.*

The latest seismic interpretation of the JK Prospect was based on the Aker BP in-house conditioned seismic from PGS15917VIK PSDM gathers. The seismic interpretation of BCU is of high confidence and the top Statfjord reservoir map was constructed by adding a Draupne isochore map based on the well thicknesses from the nearby wells.The uncertainty to the top Statfjord reservoir depth prognosis (before drilling) was hence mainly linked to the uncertainty to the thickness of the Draupne shale and the depth conversion. As both the BCU and the top Statfjord reservoir came in only a few meters off prognosis, no changes to the seismic interpretation has been made post drill. A top reservoir map in depth at top Statfjord Group level with the JK well location and the closest offset wells is shown in Fig. 1.2.

The seismic interpretation of the Heimdal Formation sand system is challenging in the PL 916 area, and the main risk for the secondary target was sand presence. The Heimdal Formation was deposited during Paleocene times as submarine turbidite complexes consisting of heterolithic sand/shale packages. No firm seismic interpretation of the Heimdal Formation sands at JK existed pre-drill and the nearest tie-wells have no Heimdal sands present. The JK well result showed that the Heimdal sands have pinched out before reaching the JK area.

The chance of success (COS) for the Statfjord Group target in the JK Prospect was estimated to be 26% with the trap being the main risk. COS for the Heimdal Formation target was estimated to be 20% with reservoir presence as the main risk.

The 25/11-29 S exploration well was drilled in May 2019 with conclusive results. The well was drilled to 2313m MD with TD in metamorphic basement. The main target (Statfjord Group) came in on prognosis with good reservoir quality but was water wet. The secondary target (Heimdal Formation) was not present at the well location. In addition, a 13m thick interval of Grid Formation was drilled, with good reservoir quality, but no hydrocarbon shows were recorded in the well.

At reservoir levels, the JK well can be illustrated in a seismic section (Fig. 1.3) and a well correlation (Fig. 1.4). Both figures show a good correlation for the JK well to the nearby tie-wells 25/11-28 (to the southwest) and 25/11-17 (to the northeast). The Statfjord Group show a similar facies development as the tie-wells. The total thickness of the Statfjord Group is 96.5 meters, of which approximately 66.3 meters with good reservoir quality as illustrated in the CPI in Fig. 1.5.

Formation pressure tests with GeoTap (LWD) were performed to determine pressure and mobility at two levels: Grid Formation and Statfjord Group. The pressure points showed a clear water gradient at both levels, with 1.03 g/cc gradient in the Grid Formation and 1.04 g/cc in the Statfjord Group (Fig. 1.6). The pressures in the Statfjord Group is slightly lower than hydrostatic, confirming that the Statfjord reservoir in the JK well is connected to the larger Statfjord pressure system (pressure is depleted due to producing fields in the area).

The JK Prospect dry hole analysis is summarised as follow:

- Reservoir in the Statfjord Group was as predicted and connected to the larger pressure system
- Trap – depths are as predicted pre-drill, trap model valid after the JK well result (well drilled on apex of structure)
- Heimdal Formation is not present (sands have pinched-out as also seen in the nearest tie-wells)
- Migration – no HC shows in any levels in the JK well, no migration through the JK Prospect
- Seal – unknown/as predicted

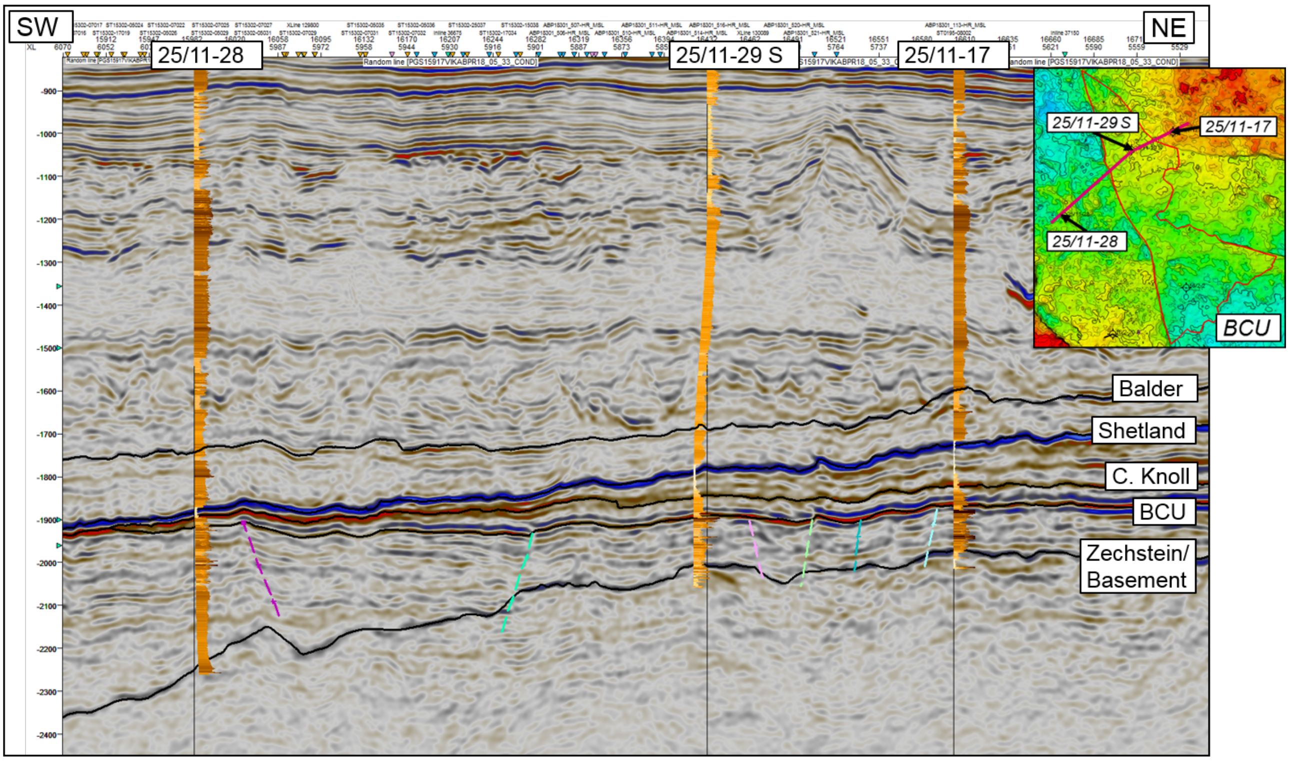

Fig. 1.3 SW-NE seismic section through the 25/11-29 S wellpath.

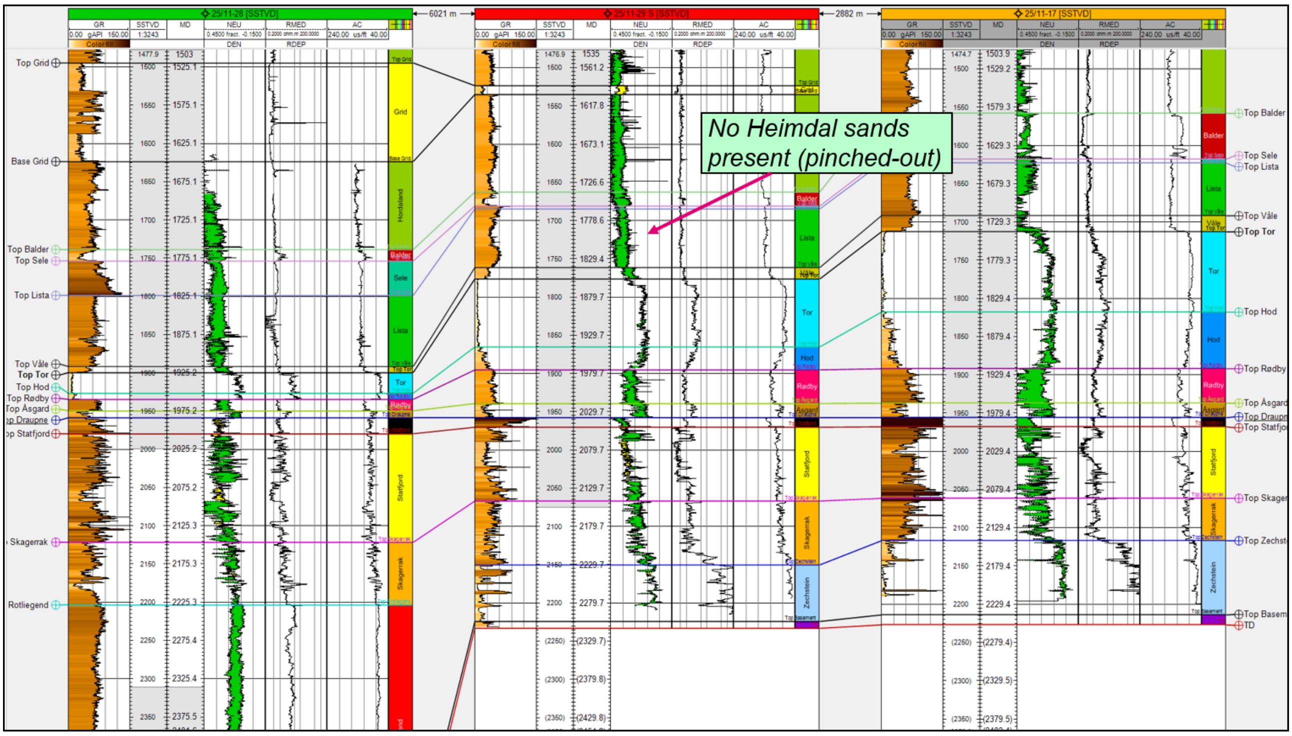

Fig. 1.4 Well correlation focusing on the reservoir target levels.

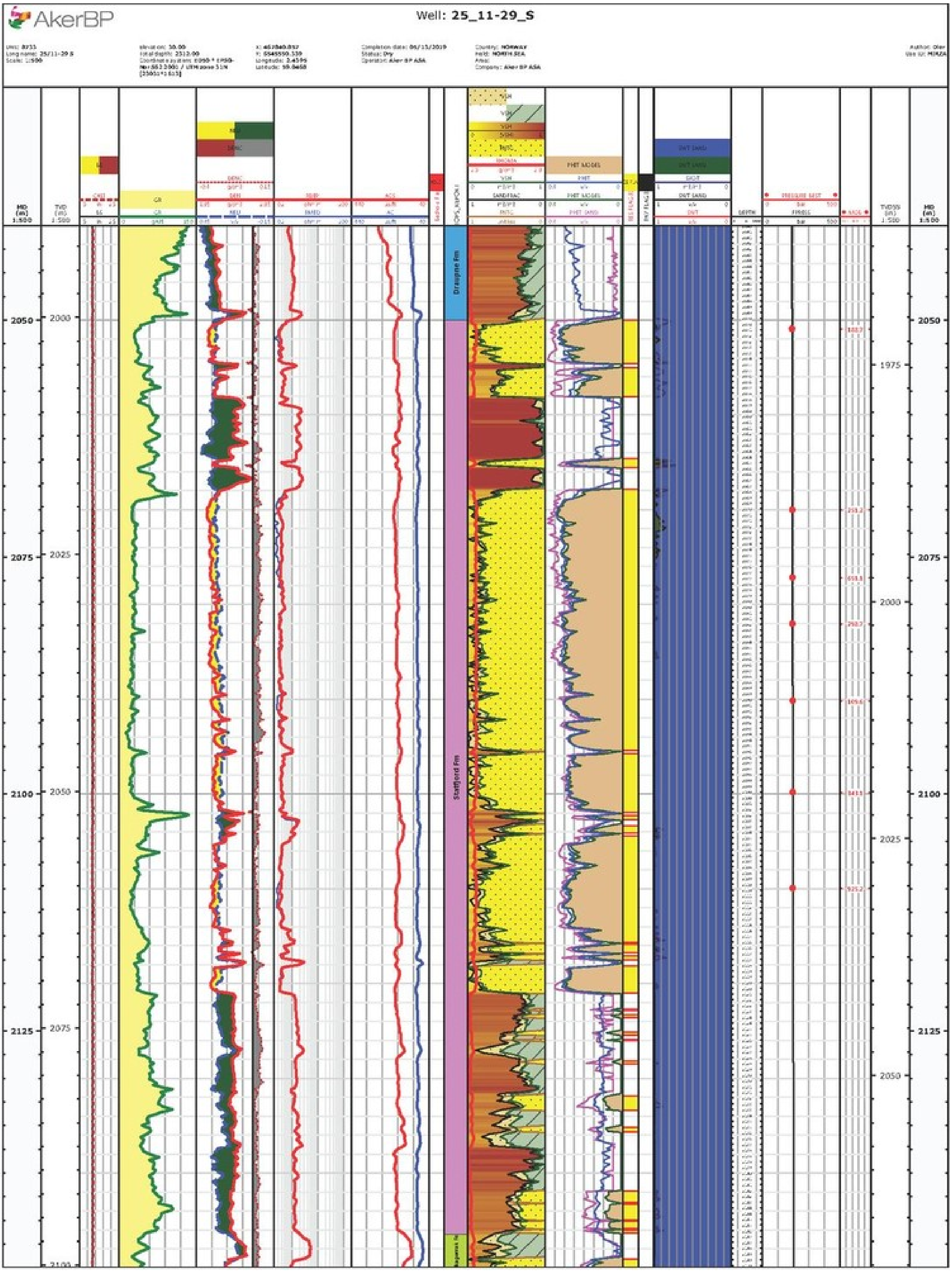

Fig. 1.5 CPI plot 25/11-29 S, Statfjord Group.

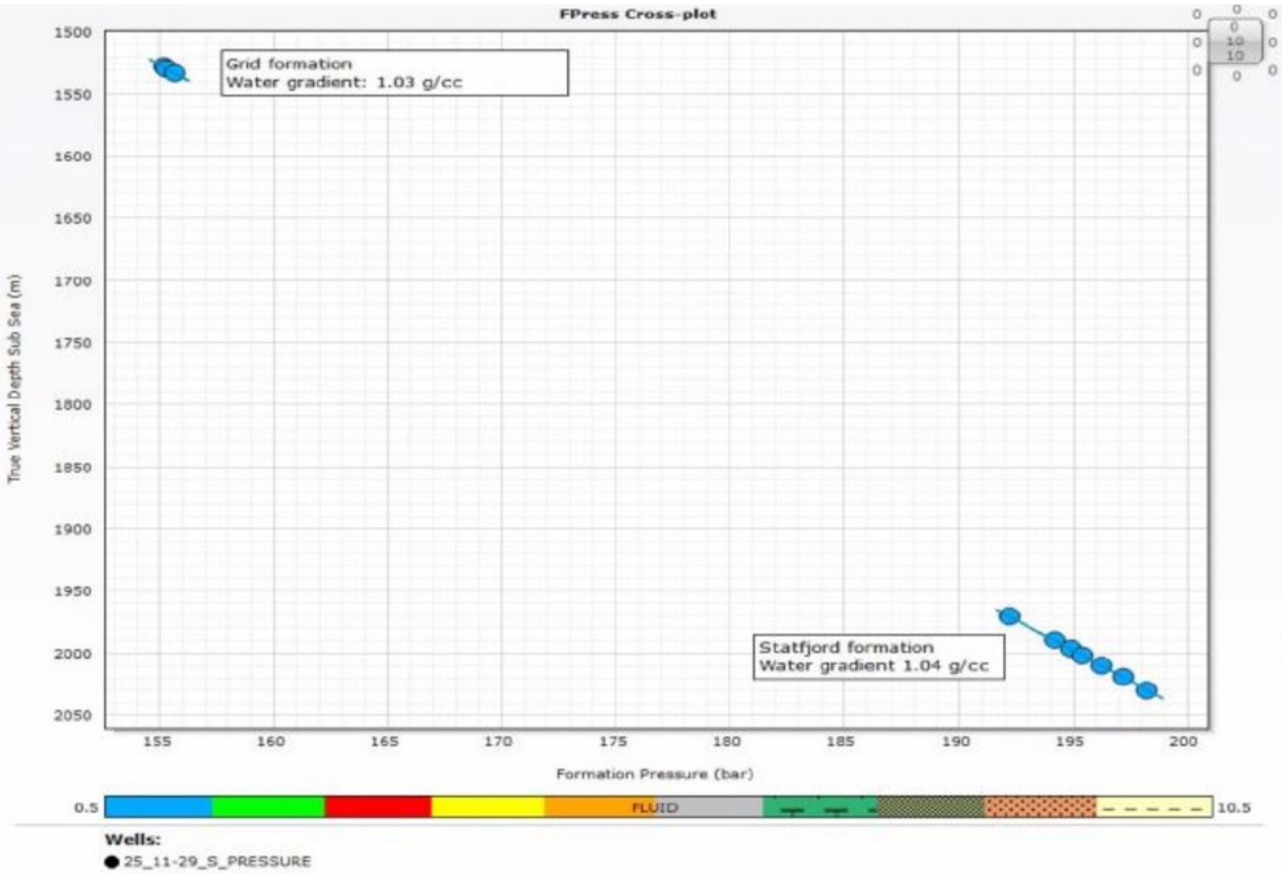

Fig. 1.6 Pressure vs depth plot, Well 25/11-29 S.

2 Database

2.1 Seismic database

The seismic database for PL 916 is shown in Fig. 2.1 and the survey details is listed in Table 2.1.

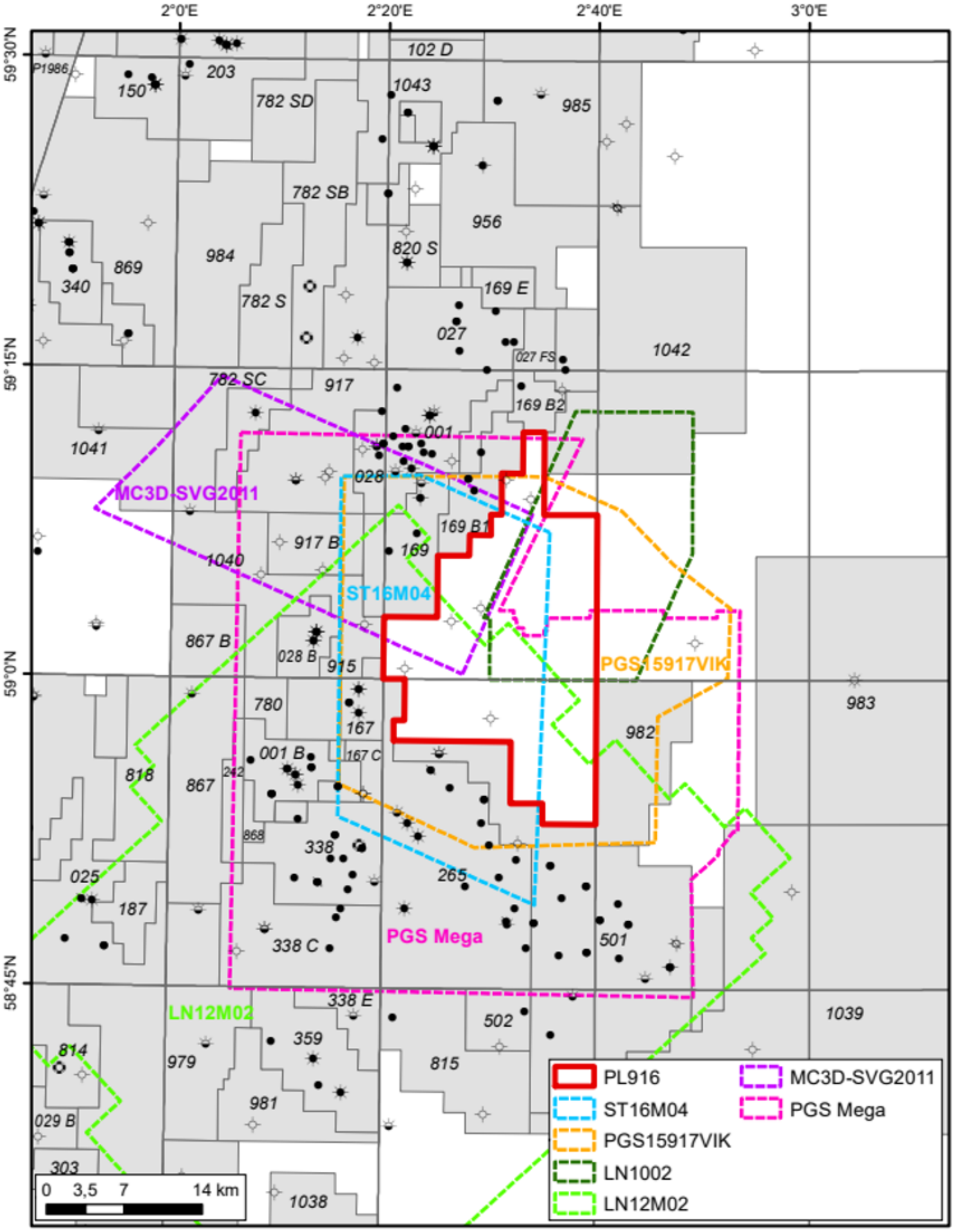

Fig. 2.1 Common seismic database.

The initial interpretation in the license and mapping of the JK Prospect was based on the four 3D seismic cubes:

- PGS Norwegian North Sea Mega Survey
- LN12M03
- LN1002
- MC3D-SVG2011

Before drilling of the JK well the PGS15917VIK and the ST16M04 was also included as part of the common seismic database. Reprocessing of the PGS15917 was done to increase seismic resolution and to improve disturbed imaging beneath shallow channels and V-brights in the area.

The latest seismic interpretation of the JK Prospect and basis for the current prospectivity evaluation of PL 916 is based on the Aker BP in-house conditioned seismic from PGS15917VIK PSDM gathers.

Table 2.1 Seismic database, survey details.

3D seismic survey	Survey type	Year	Offset data
PGS North Sea Mega Survey	Merged 3D	Multi	No
LN12M02	Merged/Reprocessed 3D	2012	Yes
LN1002	3D	2010	Yes
MC3D-SVG2011	GeoStreamer 3D (PSTM)	2011-2012	Yes
ST16M04	Equinor PSTM reprocessing of MC3D SVG11	2016	Yes
PGS16M01-PGS15917VIK	Merged/Reprocessed 3D	Multi	Yes

2.2 Well database

The wells defined in the PL 916 common database are shown in Table 2.2.

Table 2.2 Common well database.

Well	Informal Name	Year	Stratigraphy at TD	TD m MD	Operator	Status	2 year released	20 year released
16/2-U-19		2016		2017	Statoil	J Sverdrup		
16/2-U-18		2016		2143	Statoil	J Sverdrup		
16/1-6 A		2003	L Cretaceous	2194	Statoil	Dry		
16/1-6 S		2003	L Cretaceous	1997	Statoil	Oil/Gas		
16/2-1		1967	Basement	1906	Esso	Oil shows		
16/2-2		2001	E Cretaceous	1880	Statoil	Dry		
16/2-9 S		2011	Basement	2082	Statoil	Oil		
16/2-12		2012	Basement	2067	Statoil	Oil		
16/2-19		2014	Basement	2023	Statoil	Oil		
16/2-19 A		2014	Basement	2347	Statoil	Oil		
16/2-20 A		2014	Basement	2215	Lundin	Shows		
16/2-20 S		2013	Basement	2150	Lundin	Shows		
16/2-22 S		2017	Basement	1993	Statoil	Oil		
25/10-12 ST2		2015	Triassic	2597	Lundin	Dry		
25/11-16		1992	L Cretaceous	1945	Hydro	Oil		
25/11-17		1993	Basement	2256	Hydro	Dry		
25/11-18		1994	L Cretaceous	1875	Hydro	Oil		
25/11-20		1995	L Cretaceous	1828	Hydro	Dry		
25/11-22		1998	L Cretaceous	1805	Hydro	Dry		
25/11-24		2007	E Jurassic	2117	Hydro	Oil		
25/11-25 A		2008	E Jurassic	2448	Statoil	Dry		
25/11-25 S		2008	Tertiary	2142	Statoil	Oil		
25/11-28		2015	Basement	2590	Statoil	Dry		
25/12-1		1973	Devonian	2865	Shell	Dry		
							Yes	No

2.3 Special studies

Rock characterization of sidewall cores in 25/11-29 S

The JK well was drilled to 2313m MD with TD in metamorphic basement. When drilling through the Zechstein Group some high gamma ray peaks were recorded as illustrated on the composite log in Fig. 2.2. Side-wall coring (SWC) was decided in order to find out more what the high gamma ray peaks in the Zechstein Group represents.

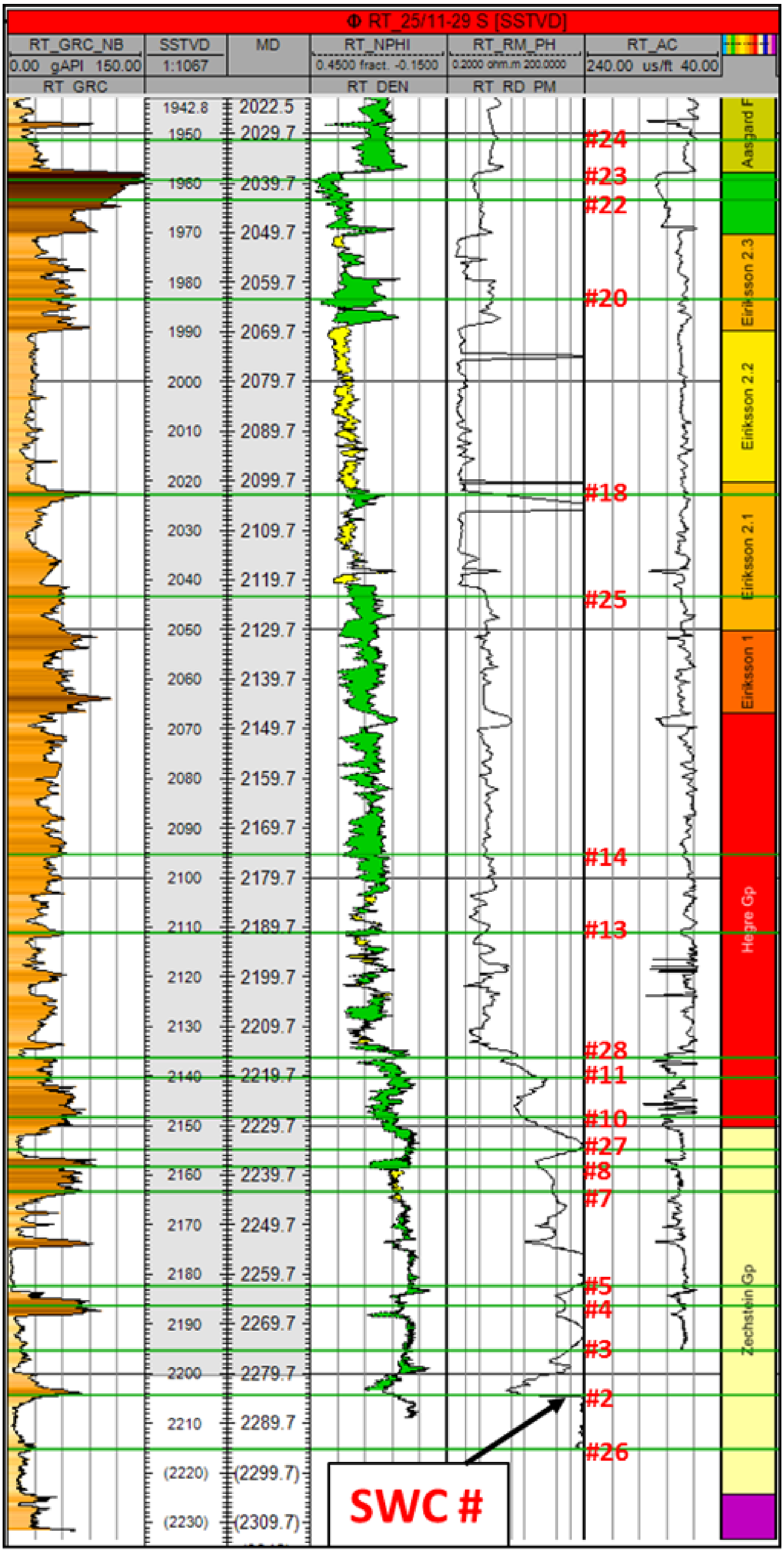

Fig. 2.2 JK completion log with SWC sample intervals marked.

The sample description (Table 2.3) stated the samples from the mentioned intervals to be crystalline or possibly intrusive. In order to prove that the samples represent old basement rocks (massive slides from Utsira) and not younger intrusives in the Permian sediments, the samples were analysed at the University of Oslo (thin section and isotopic dating).

Table 2.3 SWC sample description.

#	Depth	Recovery (mm)	Lith.	Description	Comment
1	2295	NONE			
2	2284	40	Claystone	Medium grey, banded dark grey and darl yellow orange, common pyrite, fractures cemented by white calcite	
3	2275	40	Limestone	White to light grey, micro crystalline, sucrosic texture in parts, argillaceous laminations, very piritic, non visible porosity	
4	2266	50	Intrusive ?	Dark brown to dark reddish brown, very hard, massive, very fine crystalline, abundant brown feldspar or quartz, very rich in biotite	
5	2262	40	Limestone	White to very light grey, speckled medium light grey, massive, some fractures with argillaceous filling, medium grained calcite crystals, non visible porosity	
6	2249	NONE			
7	2243	42	Crystalline	Moderately reddish brown to dusky brown, massive red opaque quartz embedding coarse muscovite crystals, rich in biotite	
8	2238	10	Crystalline	As above	Poor recovery. Fragment from side of the core .
9	2235	NONE			
10	2228	40	Claystone	Moderately brown to light brown, fractured	Core split in two
11	2220	45	Claystone	Moderately brown, very light grey and yellowish orange laminae and veins, very rich in micro plates of biotite	
12	2212	NONE			
13	2190.8	45	Claystone	Moderately brown, light olive grey silty veins, generally silty, micro micaceous, trace micro pyrite and calcite crystals	
14	2175	50	Claystone	As above	
15	2150	NONE			
16	2124	NONE			
17	2111.2	NONE			
18	2102.4	35	Sandstone	Medium grey, speckled white, brownish grey argillaceous laminations, very fine quartz grains	
19	2084	NONE			
20	2063	35	Sandstone	Dark yellowish brown, very fine to medium quartz, grading to silt in parts, micro micaceous, trace pyrite, very argillaceous	

A picture of the SWC samle # 8 at 2238m MD is shown in Fig. 2.3. The red granite seems to have a surface that was exposed to weathering and biological activity. It seems to preserve roots attached from some plants growing on it. This is strong evidence of having been part of an eroded basement, rather than an intrusive into the Zechstein Group sediments. The isotope dating point to a Caledonian origin.

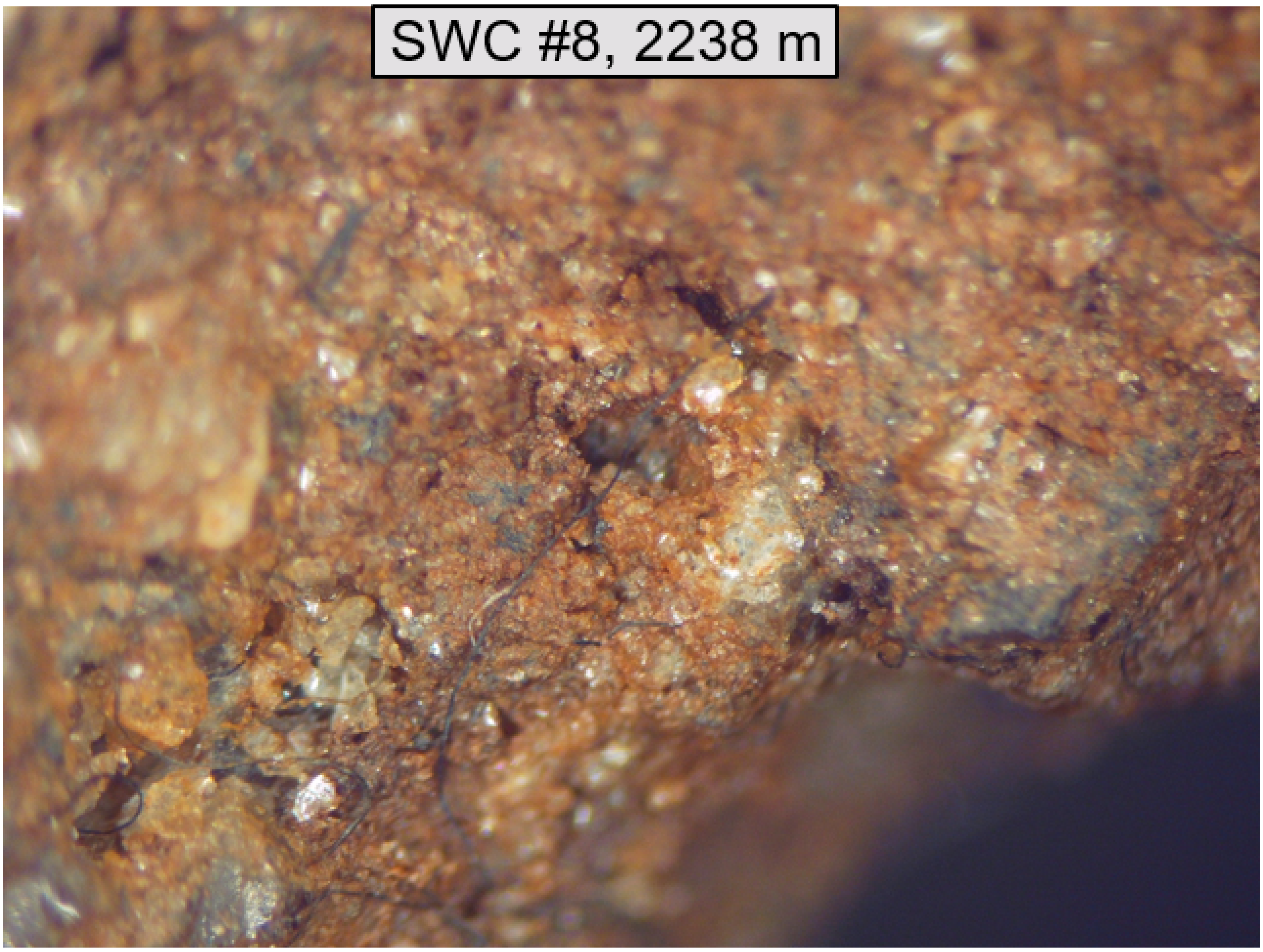

Fig. 2.3 Picture of SWC #8 at 2238m MD.

3 Remaining prospectivity

The JK well was a successful test of the addressed play concept but no hydrocarbon shows were recorded in the well. The negative well result gives increased risk on the remaining prospectivity within PL 916.

Before the drilling of the JK Prospect, another prospect in the eastern part of the license, named PA-East, was mapped (Fig. 3.1). The PA-East Prospect was downgraded to a lead after the drilling of the JK Prospect, as explained below.

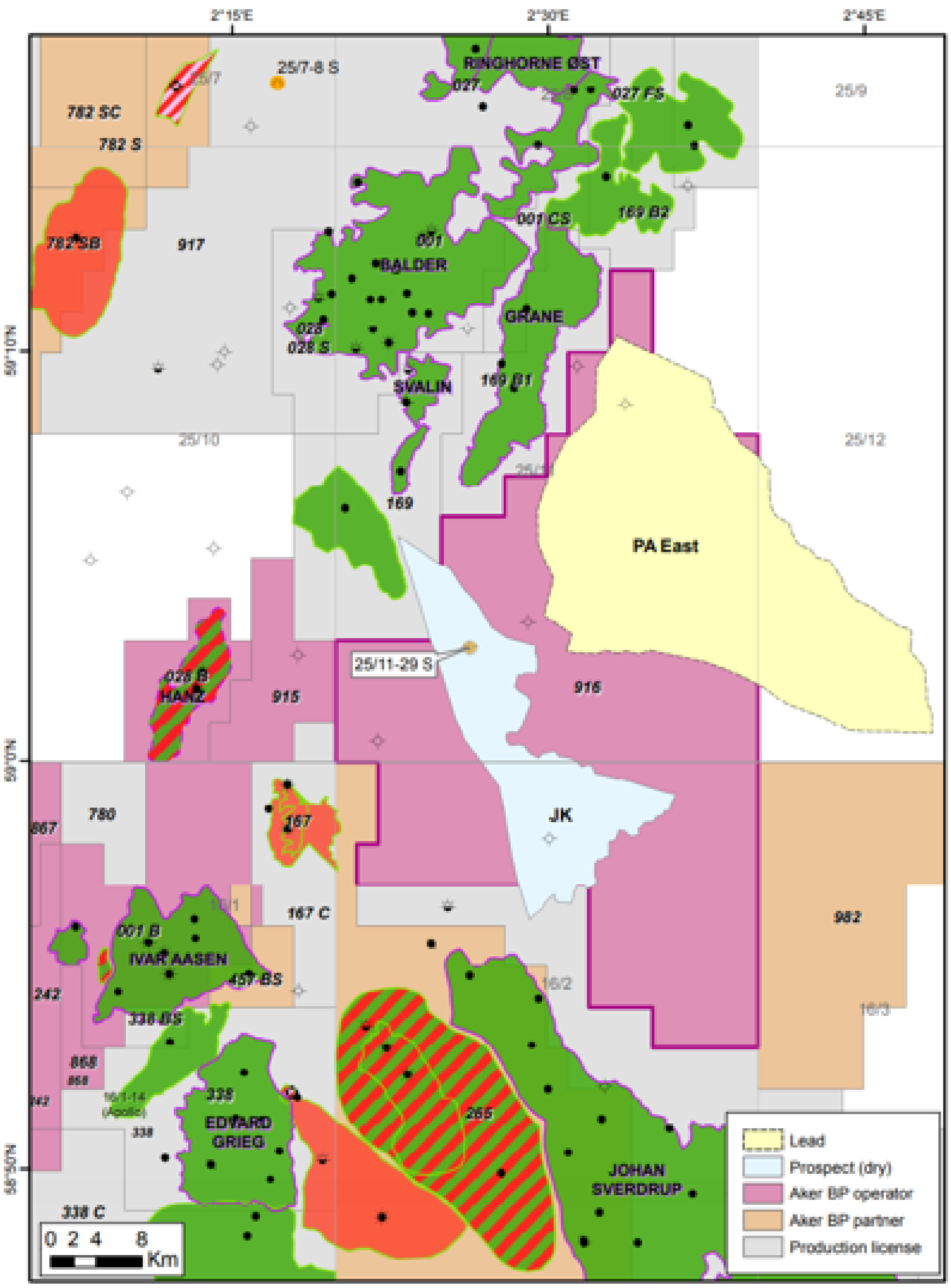

Fig. 3.1 PA-East Lead location map.

The PA-East Lead is located just east of the dry well 25/11-17. The well was drilled in 1993 testing the Statfjord Group reservoir level at the western rim of a larger structure. The well is a valid test of the structure if assuming reservoir communication across the entire structure. The PA-East Lead is assessed to be at the Hugin/Sleipner Formation level and delineated from 25/11-17 by both a north to south oriented fault set and the pinch out of the Hugin/Sleipner Formation. A top porosity map with the PA-East Lead outline is shown in Fig. 3.2 and a seismic line through the PA-East Lead is shown in Fig. 3.3. A well correlation through the nearest tie-wells illustrating the pinch out of the Hugin/Sleipner Formation is shown in Fig. 3.4.

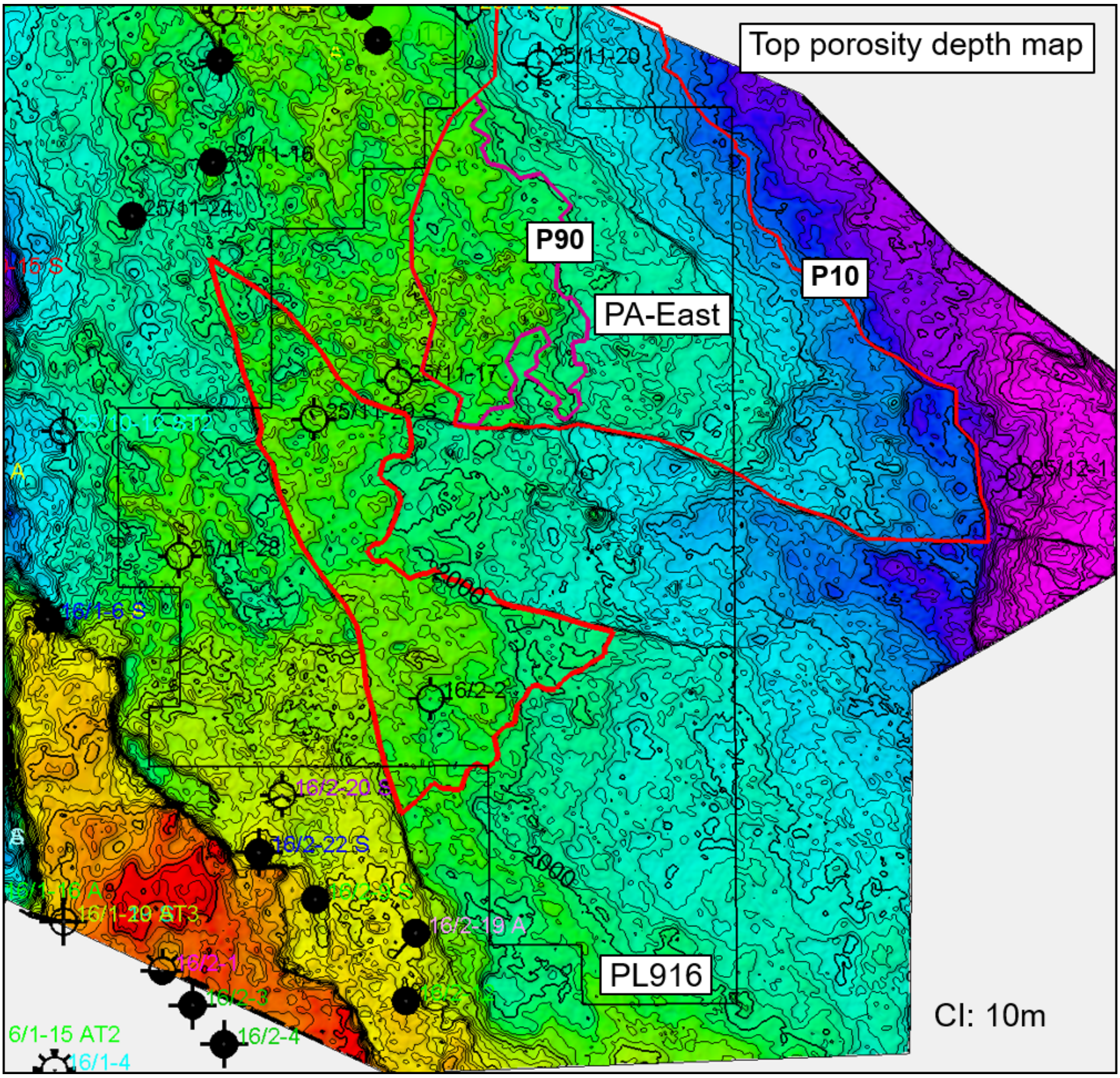

Fig. 3.2 PA-East Lead top porosity depth map.

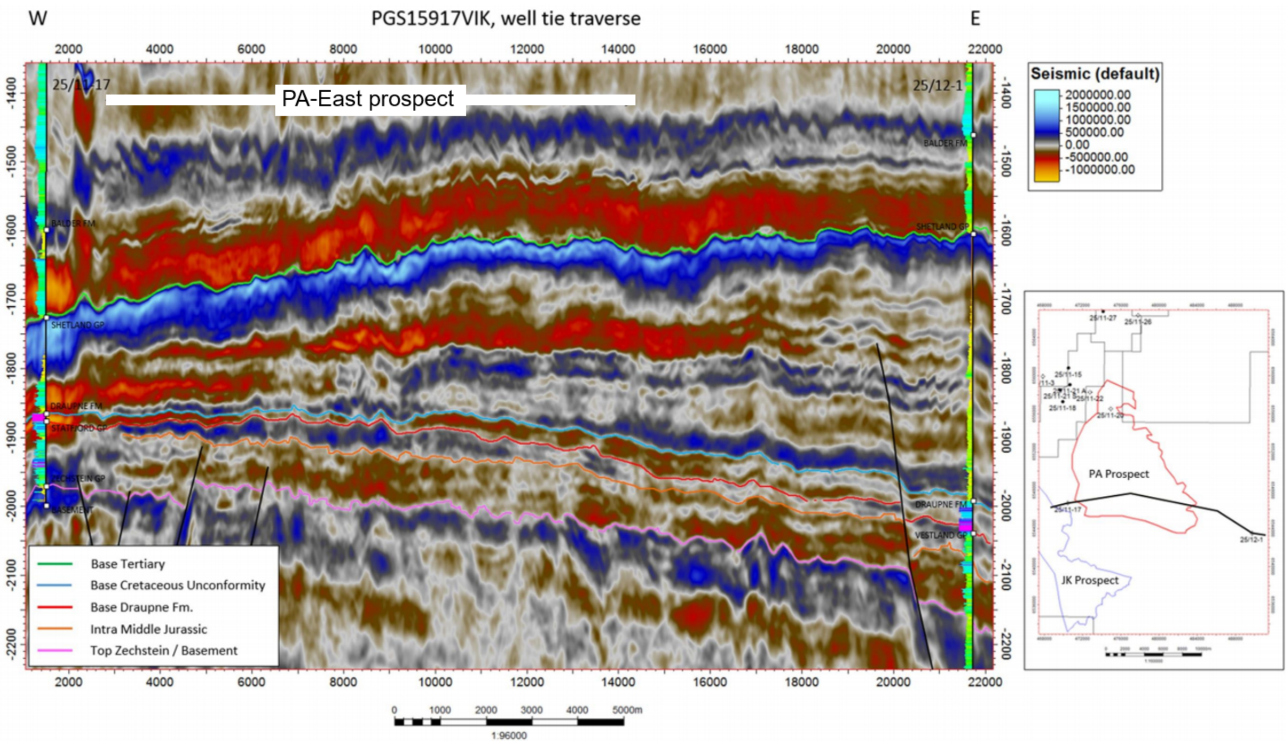

Fig. 3.3 Seismic line through the PA-East Lead *(Coloured Inversion PGS15917VIK)*

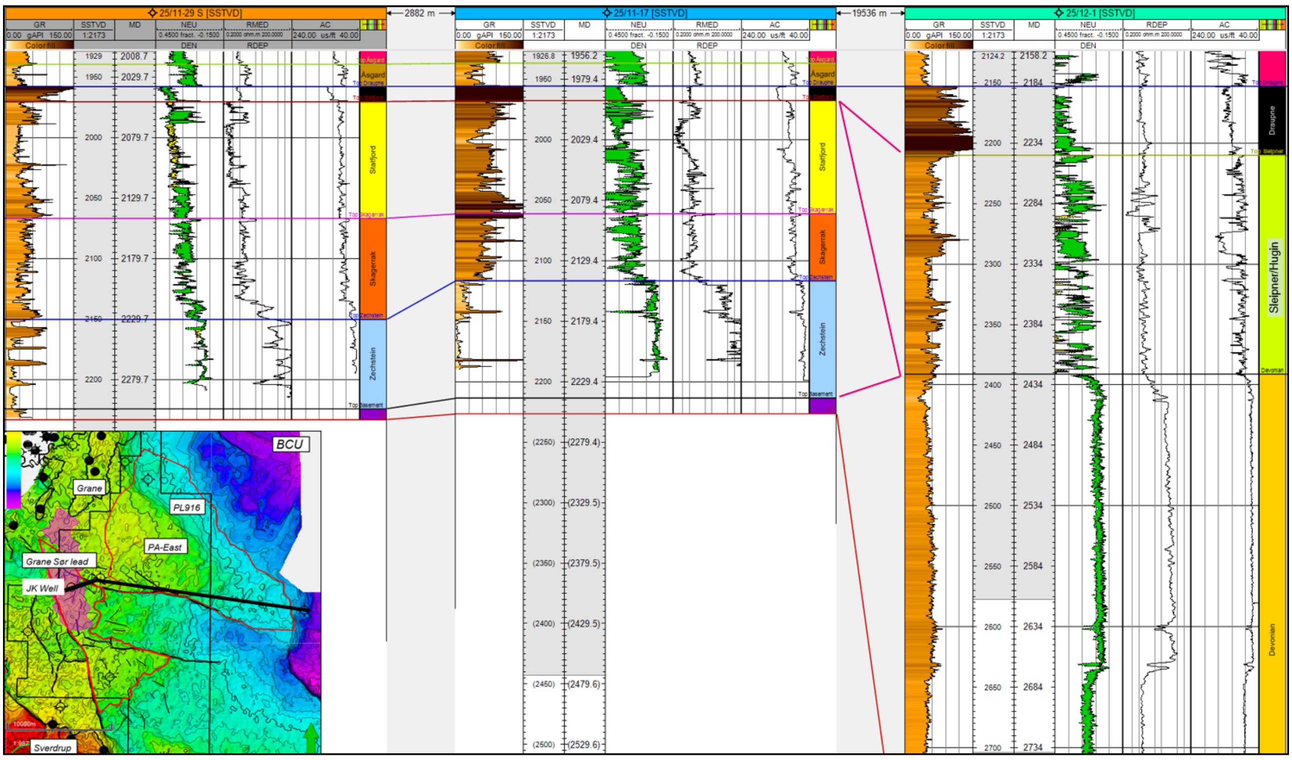

Fig. 3.4 PA-East Lead well correlation.

Before the results from the JK well 25/11-29 S, the HC migration route into the PA-East Lead was predicted to be from the west or alternatively from the north as illustrated in Fig. 3.5 . As the JK well was drilled on a valid trap (i.e. top Statfjord Group/top porosity came in at predicted depth), and failed to detect any hydrocarbon shows, the western migration route is now excluded. The northern migration route runs from north of the Ringhorne East Field and is regarded as high risk due to long distance and stuctural complexity along route. The updated chance of success (COS) for the PA-East Lead is hence risked to 0,12 after the 25/11-29 S well results. It is difficult to see how the PA-East Lead can be significantly de-risked and the lead will remain as high risk. The calculated resources for the PA-East Lead is shown in Table 3.1.

On the Paleocene Heimdal Formation level, the JK well 25/11-29 S failed to prove any presence of sand, similar to the nearest tie-wells 16/2-2, 25/11-17 and 25/11-28. Based on this, the prospectivity at this level within PL 916 is regarded as limited.

A 13m thick interval of Grid Formation was drilled in well 25/11-29 S, with good reservoir quality, but no hydrocarbon shows were recorded in the well. No potential traps are mapped on this level within PL 916 and the exploration potential is regarded as limited.

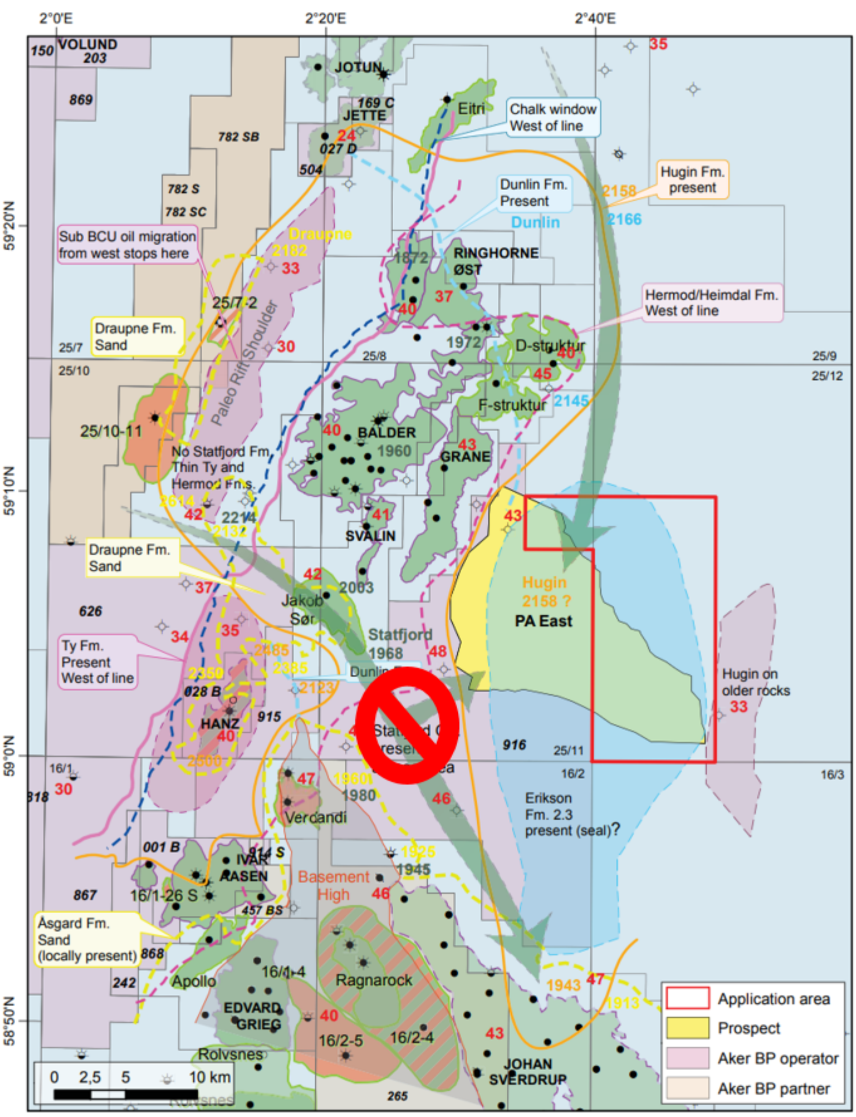

Fig. 3.5 PA-East Lead migration map.

Table 3.1 Resources PA-East Lead.

Discovery/ Prospect/ Lead name [1]	D/ P/ L [2]	Case (Oil/ Gas/ Oil&Gas) [3]	Unrisked recoverable resources [4]						Probability of discovery [5] (0.00 - 1.00)
			Oil [$10^6 Sm^3$] (>0.00)			Gas [$10^9 Sm^3$] (>0.00)			
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)	
PA-East	L	Oil	28,50	65,00	108,00	1,50	3,47	5,85	0,12

4 Conclusion

The work programme for PL 916 has been fulfilled and one exploration well (25/11-29 S JK) has been drilled and proven dry. The negative well result gives increased risk on the remaining prospectivity within PL 916.
As the work obligations have been fulfilled, a unanimous decision was made in PL 916 to relinquish the license at the BOK gate 02.03.2020.

5 References

Aker BP ASA, 2019: Well 25/11-29 S Final Well Report. License PL916.

University of Oslo, 2019: Rock characterization and U-Pb dating well 25/11-29 S: cores SWC # 4, 7 and 8, Utsira High.

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