

PL 1038
Relinquishment Report

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1 History of the production licence

Production Licence 1038 is located in the Central North Sea, in parts of blocks 16/4, 16/5, 16/7 and 16/8, on the southern Utsira High (Fig. 1.1) with a total area of 296 km². The licence was awarded 14th February 2020 (APA2019) to a licence group consisting of Capricorn Norge AS, later Sval Energi AS, (operator and 70% equity) and Spirit Energy Norway AS (30%). The partnership remained unchanged during the licence period.

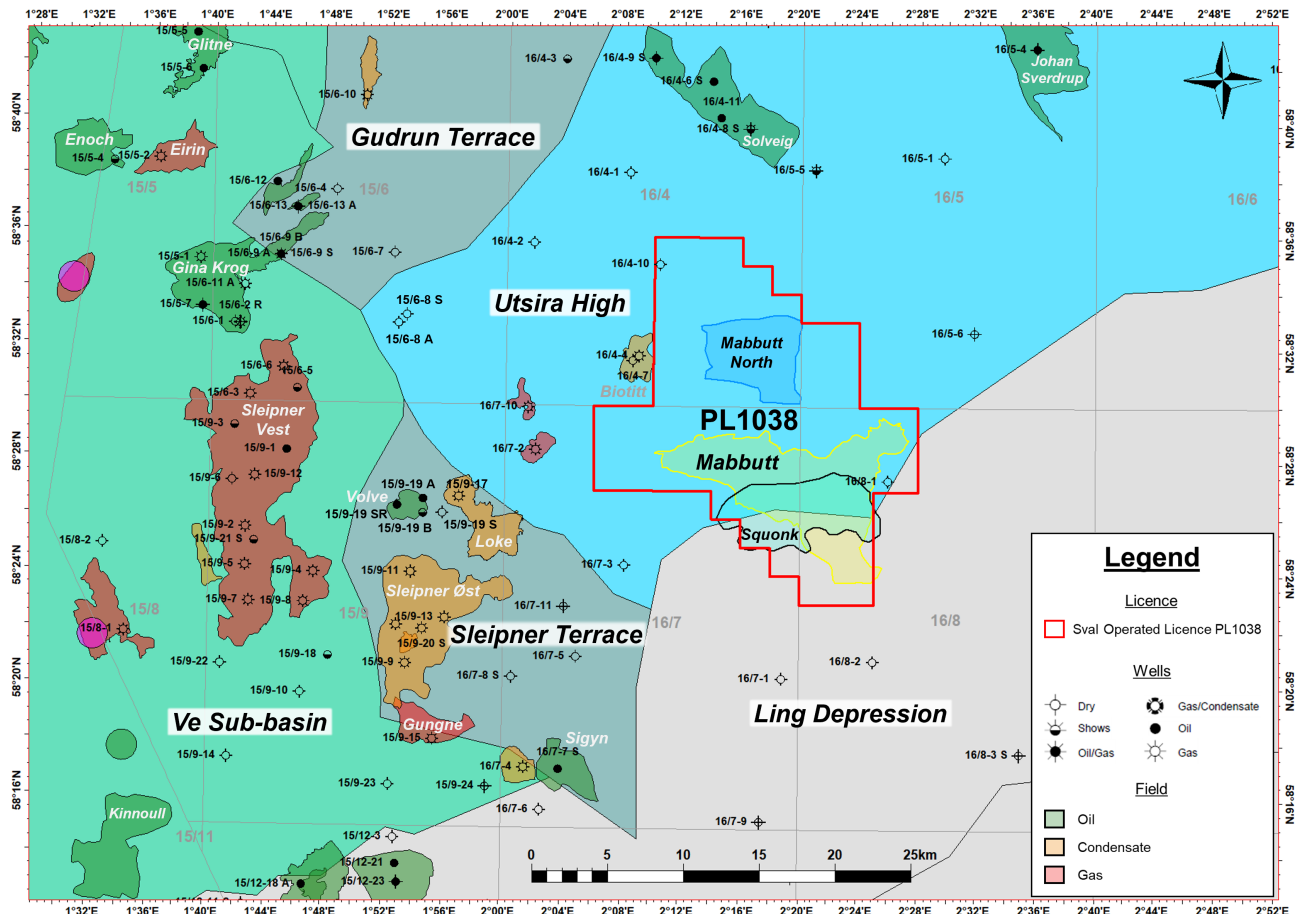


Fig. 1.1 PL 1038 location and structural elements map

At application time one prospect and one lead, Mabbutt and Mabbutt North respectively, were identified at Ty Formation level. The Mabbutt Prospect was defined as a potential eastward extension of the npc-1 play, with turbidite gravity flows of the Ty Formation filling in an area with an eroded chalk section. Charge would be by long distance migration from mature Sleipner Formation coals and marine shales of the Draupne and Heather formations in the Ve sub-basin to the west. One pre-salt lead, Squonk, was identified during the licence evaluation.

The licence commitments in Phase 1 were to perform geological and geophysical studies, acquire 3D-seismic and to reach a drill or drop decision within 2 years of the award (Table 1.1). The seismic commitment was fulfilled by licensing the MC3D-PGS16M03-16902 survey. Interpretation of this survey demonstrated that the Ty Formation pinches out to the west of the Mabbutt Prospect and as the Squonk Lead could not be matured to a viable prospect, a unanimous decision to surrender the licence at end of Phase 1 was made.

Table 1.1 Work obligations and decisions

Commitments - Decisions	Deadline
Study of geology and geophysics, acquire 3D-seismic - Decision to drill	14.02.2022
Drill exploration well - Decision to concretize	14.02.2024
Conceptual studies - Decision to continue	14.02.2026
(PDO) Prepare plan for development - (PDO) submit plan for development/ Decision to enter extension period	14.02.2027

1.1 Licence Meetings

Table 1.2 summarises the meeting activity in the licence.

Table 1.2 EC and MC Meetings

Date	Licence Meetings	Description
25.03.2020	EC/MC	Initiate licence
24.11.2020	EC/MC	Common database, preliminary results of seismic interpretation and special studies
21.06.2021	EC	Results of in-house evaluation and special studies
19.11.2021	EC/MC	Relinquishment proposed

2 Database overviews

2.1 Seismic data

The common seismic database consist of the MC3D-PGSM03-16092 Broadband 3D seismic survey and covers the PL 1038 licence area plus an extension westward to include four key wells (Fig. 2.1). This is a merge of three seismic surveys; PGS15002 (NPDID 8245), PGS16002 (NPDID 8322) and MC3D-Q16UK2012 (NPDID 7571). The areal extent of the common seismic database is 371 km².

The seismic data include post-stack, velocity, migrated products and offset cubes (Table 2.1).

The data quality is good above the Base Cretaceous Unconformity (BCU). Below the BCU the quality is lower with multiples from the strong BCU reflector distorting imaging of the primary events. A study to see if the seismic quality could be improved upon by for example conditioning of gathers concluded that, although some enhancement could be achieved, this would not change the fundamental interpretation of the Ty Formation pinch out (3 Results of geological and geophysical studies).

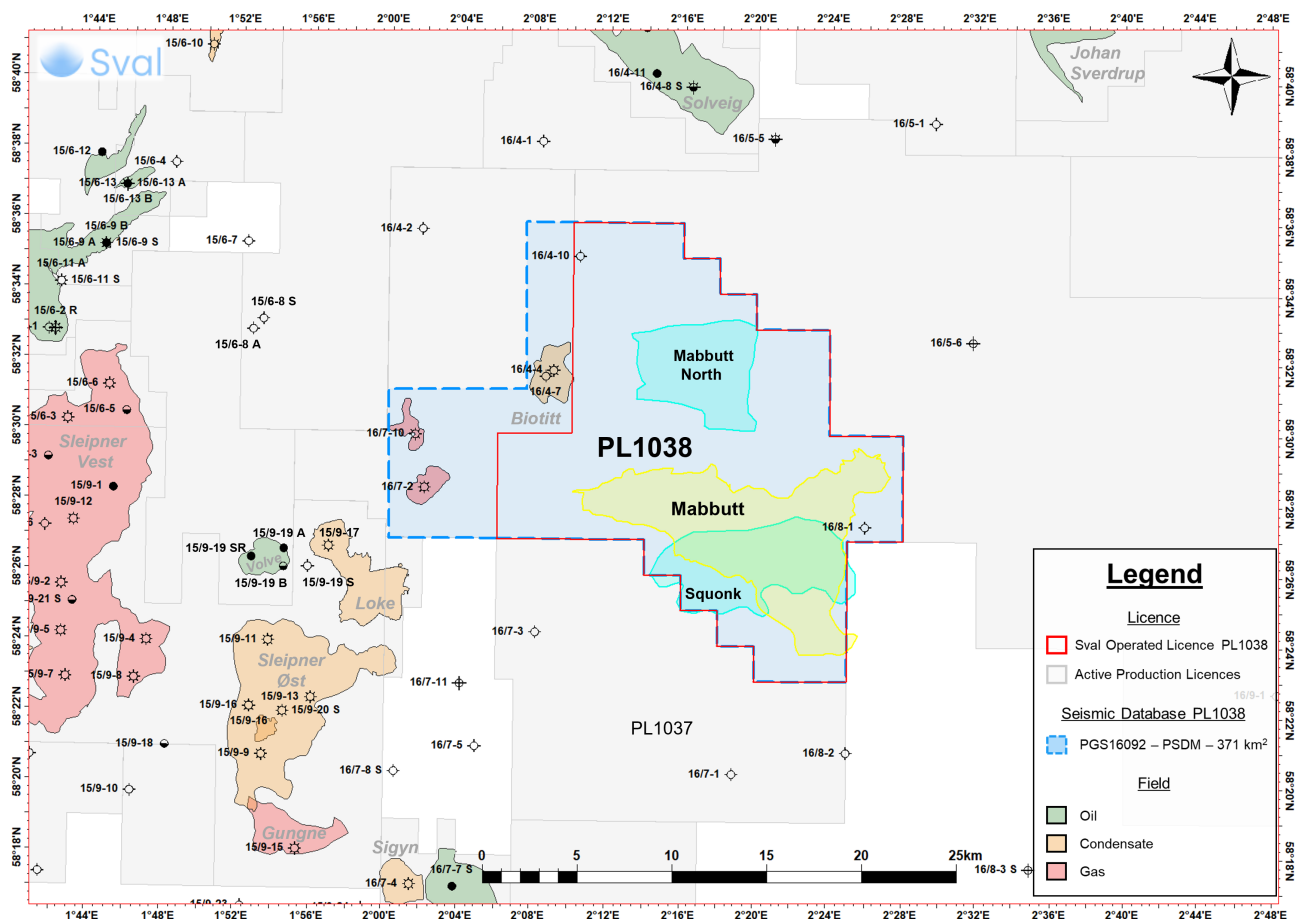


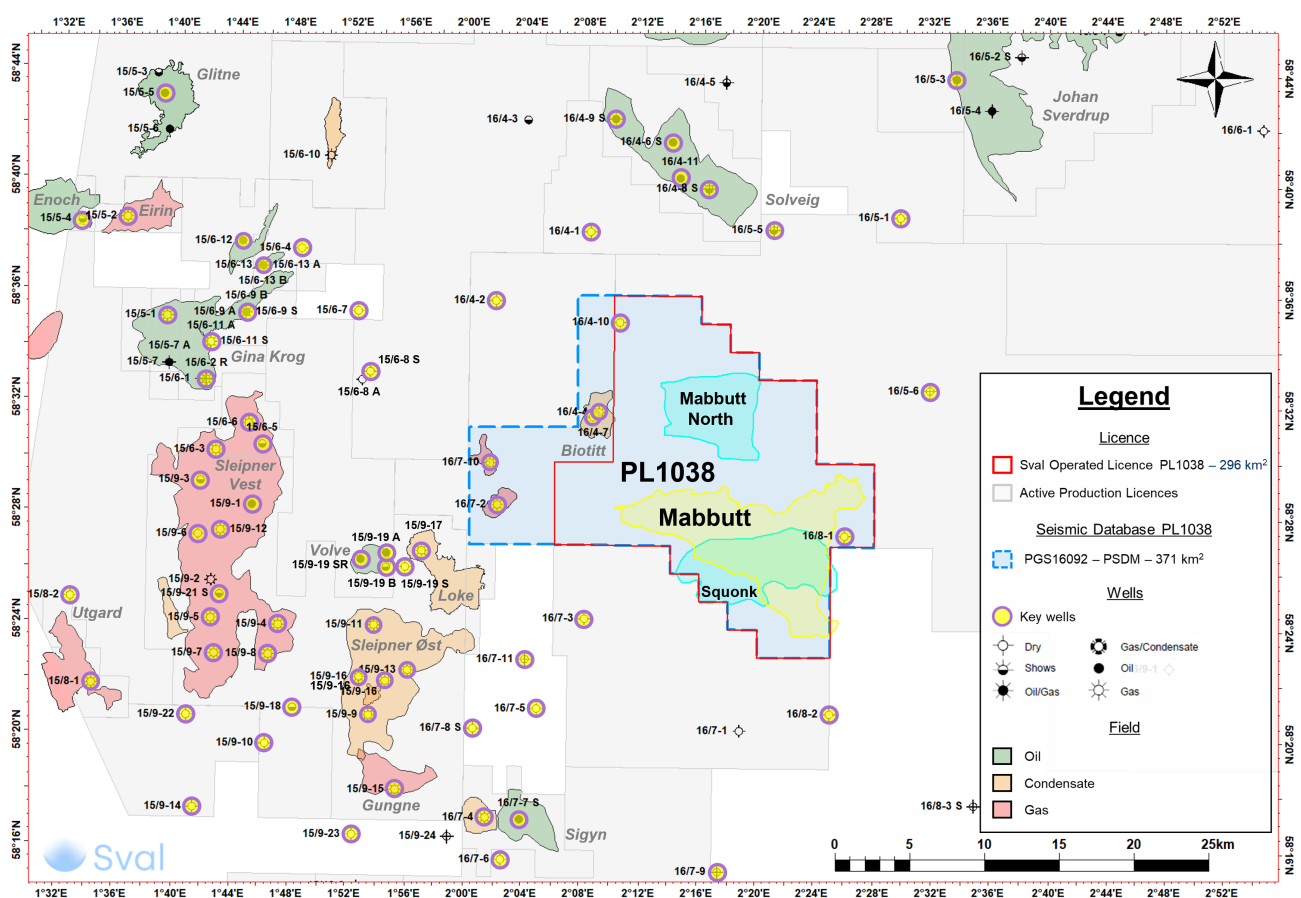
Fig. 2.1 Common seismic database

Table 2.1 Common seismic database

Survey name/Versions	Acquisition year	Class	Processing year	Comment
MC3D-PGS16M03-16902	2012 - 2016	3D	2015 - 2017	Geostreamer
Full offset, Kirchhoff migration				Time and depth PSDM
5-17 degrees, Kirchhoff migration				Time and depth PSDM
17-25 degrees, Kirchhoff migration				Time and depth PSDM
25-33 degrees, Kirchhoff migration				Time and depth PSDM
33-39 degrees, Kirchhoff migration				Time and depth PSDM
Full offset, BEAM migration				Time and depth PSDM

2.2 Well data

The common well database is shown in Fig. 2.1 and listed in Table 2.2 . All wells are released or public.

**Fig. 2.2 Common well database map**

Wells used in the evaluation are indicated with red circles and yellow fill.

Table 2.2 Common well database

Well	NPDID	Operator	Licence	Purpose - Planned	Content	Completed date	Stratigraphy & Reservoir	Oil typing	Sval CPI
15/5-1	315	Norsk Hydro Produksjon AS	048	Wildcat	Gas/ Condensate	08.04.1978	Y		Y
15/5-2	316	Norsk Hydro Produksjon AS	048	Wildcat	Gas	16.12.1978			Y
15/5-5	2635	Norsk Hydro Produksjon AS	048	Wildcat	Oil	05.10.1995	Y		
15/6-2 R	517	Esso Exploration and Production Norway A/S	029	Appraisal	Gas/ Condensate	01.08.1974	Y		
15/6-3	318	Esso Exploration and Production Norway A/S	029	Wildcat	Gas/ Condensate	19.12.1974	Y		Y
15/6-6	38	Esso Exploration and Production Norway A/S	029	Appraisal	Gas/ Condensate	09.06.1982	Y		
15/6-7	2084	Deminex Norge AS	166	Wildcat	Dry	08.06.1993	Y		
15/6-9 S	5566	Statoil ASA (old)	303	Appraisal	Oil/Gas	27.05.2007	Y		
15/6-13	7667	Statoil Petroleum AS	029B	Wildcat	Oil	15.05.2015	Y		
15/8-1	321	Den norske stats oljeselskap a.s	046	Wildcat	Gas/ Condensate	07.01.1982	Y		
15/8-2	6681	Statoil Petroleum AS	303	Wildcat	Dry	21.10.2011	Y		
15/9-1	322	Den norske stats oljeselskap a.s	046	Appraisal	Oil/Gas	30.05.1977	Y		Y
15/9-4	325	Den norske stats oljeselskap a.s	046	Appraisal	Gas/ Condensate	14.06.1979	Y		
15/9-5	326	Den norske stats oljeselskap a.s	046	Appraisal	Gas/ Condensate	11.04.1980	Y		
15/9-7	218	Den norske stats oljeselskap a.s	046	Appraisal	Gas/ Condensate	29.04.1981	Y		
15/9-9	328	Den norske stats oljeselskap a.s	046	Wildcat	Gas/ Condensate	14.07.1981	Y		Y
15/9-10	69	Den norske stats oljeselskap a.s	046	Wildcat	Dry	07.11.1981	Y		
15/9-11	329	Den norske stats oljeselskap a.s	046	Appraisal	Gas/ Condensate	23.12.1981	Y		
15/9-13	45	Den norske stats oljeselskap a.s	046	Appraisal	Gas/ Condensate	27.05.1982	Y		
15/9-14	71	Den norske stats oljeselskap a.s	046	Wildcat	Dry	27.06.1982	Y		
15/9-15	74	Den norske stats oljeselskap a.s	046	Wildcat	Gas/ Condensate	01.08.1982	Y	Y	
15/9-17	60	Den norske stats oljeselskap a.s	046	Wildcat	Gas/ Condensate	30.03.1983	Y		Y
15/9-18	36	Den norske stats oljeselskap a.s	046	Wildcat	Dry	02.03.1984	Y		
15/9-19 A	3145	Den norske stats oljeselskap a.s	046	Appraisal	Oil	09.11.1997	Y	Y	
15/9-19 B	3251	Den norske stats oljeselskap a.s	046	Appraisal	Dry	02.02.1998	Y		
15/9-21 S	3334	Den norske stats oljeselskap a.s	046	Appraisal	Dry	23.05.1998	Y		
15/9-22	5174	Esso Exploration and Production Norway A/S	241	Wildcat	Dry	13.03.2006	Y		
15/9-23	6186	Det norske oljeselskap ASA (old)	408	Wildcat	Dry	03.01.2010	Y		
16/2-6	6374	Lundin Norway AS	501	Wildcat	Oil	20.09.2010	Y		
16/2-7	6561	Lundin Norway AS	501	Appraisal	Oil	01.09.2011	Y		
16/2-11	6742	Saga Petroleum ASA	116	Wildcat	Dry	19.05.1997	Y		
16/4-1	229	Norsk Hydro Produksjon AS	087	Wildcat	Dry	18.11.1984	Y		Y

16/4-2	1560	Norsk Hydro Produksjon AS	087	Wildcat	Dry	29.07.1990	Y		
16/4-4	5441	Statoil ASA (old)	339	Wildcat	Gas/ Condensate	23.03.2007		Y	
16/4-5	6216	Lundin Norway AS	359	Wildcat	Dry	07.03.2010	Y		
16/4-6 S	7098	Lundin Norway AS	359	Wildcat	Oil/Gas	03.05.2013	Y		Y
16/4-7	7208	Lundin Norway AS	544	Wildcat	Dry	21.08.2013	Y		Y
16/4-8 S	7415	Lundin Norway AS	359	Appraisal	Oil/Gas	26.08.2014	Y		Y
16/4-9 S	7631	Lundin Norway AS	359	Wildcat	Oil	16.08.2015	Y		Y
16/4-10	7731	Lundin Norway AS	544	Wildcat	Dry	07.03.2016	Y		Y
16/4-11	8353	Lundin Norway AS	359	Appraisal	Oil	01.04.2018	Y		Y
16/5-1	189	Elf Petroleum Norge AS	007	Wildcat	Dry	08.02.1973	Y		
16/5-3	7123	Statoil Petroleum AS	502	Appraisal	Oil	20.03.2013	Y		
16/5-5	7285	Lundin Norway AS	410	Appraisal	Dry	29.12.2013	Y		Y
16/5-6	7962	Tullow Oil Norge AS	776	Wildcat	Dry	10.07.2016	Y		Y
16/7-2	40	Esso Exploration and Production Norway A/S	072	Wildcat	Gas	30.03.1982	Y		Y
16/7-3	75	Esso Exploration and Production Norway A/S	072	Wildcat	Dry	27.07.1982	Y		Y
16/7-4	91	Esso Exploration and Production Norway A/S	072	Wildcat	Gas/ Condensate	16.12.1982	Y	Y	Y
16/7-5	134	Esso Exploration and Production Norway A/S	072	Wildcat	Dry	03.08.1984	Y		Y
16/7-7 S	3244	Esso Exploration and Production Norway A/S	072	Wildcat	Oil	29.12.1997	Y	Y	Y
16/7-8 S	1612	Esso Exploration and Production Norway A/S	072 B	Wildcat	Dry	19.01.2003	Y		
16/7-9	6382	Lundin Norway AS	409	Wildcat	Dry	03.01.2011			Y
16/7-10	6607	Statoil Petroleum AS	569	Wildcat	Gas/ Condensate	13.09.2011	Y		Y
16/7-11	7750	Statoil Petroleum AS	072 F	Wildcat	Dry	04.09.2015	Y		
16/8-1	335	Conoco Norway Inc.	020	Wildcat	Dry	29.10.1976	Y		Y
16/8-2	234	BP Norway Limited U.A.	020	Wildcat	Dry	13.08.1980	Y		
16/9-1	151	Esso Exploration and Production Norway A/S	002	Wildcat	Dry	12.07.1968	Y		

3 Results of geological and geophysical studies

The following special studies addressed the key risk factors; charge and reservoir presence.

Seismic quality and AVO study

The objectives of the study were to:

1. Verify expected seismic response of sandstone with and without hydrocarbons
2. Define a suitable interpretation strategy to map the Ty Formation sandstone
3. Investigate the potential to improve the pre-stack data through gather conditioning
4. Assess the impact of gather conditioning on data quality and interpretation confidence

Top Ty Formation is an AVO Class I (hard kick) and if thicker than 15 m it should be visible and show a soft response with oil or gas presence (AVO class IIP). In the PGSM03-16092 survey reflectivity is clearly observed at top Ty Formation sandstone in the control wells 16/4-4 and 16/4-7, while the equivalent section is reflection free in the Mabbutt Prospect. Although test conditioning of a swath across the prospect demonstrated improved quality it did not change the revised interpretation that the Ty Formation pinches out to the west of the Mabbutt Prospect (4 Prospect update report). It was thus decided not to condition the entire dataset.

Sequence stratigraphy, sedimentology and reservoir study

The purpose of this study was to improve the geological understanding of the greater Sleipner area with respect to the structural and depositional evolution. The study included:

- Sequence stratigraphic and petrophysical interpretation of 40 wells in the area of interest
- Interpretation of key seismic horizons
- Construction of series of cross sections highlighting the Permian, Triassic-Jurassic and Paleogene stratigraphy and its relationship to the structural framework/evolution
- Production of integrated seismically controlled structure, isochron and amplitude maps
- CPI analysis of key reservoir intervals (Skagerrak, Hugin, Ula and Ty formations)

Result: The Heimdal/Ty submarine depositional system shows an overall westward backstepping. The eastern depositional pinch-out of the Ty Formation is to the west of the Mabbutt Prospect. Rotliegend Group sandstones and conglomerates are present in halfgrabens below Zechstein Group carbonates and evaporites in the licence.

Oil to source rock typing

This study examined the possibility for source rocks other than the Draupne Formation contributing to the oils/condensates in 15/9-15 (Gungne), 15/9-19 (Volve), 16/4-4 (Biotitt), 16/7-4 (Sigyn Vest) and 16/7-7 (Sigyn Øst). Candidates were a lacustrine unit in the Sleipner Formation, seen in 16/4-10, and the Kupferschiefer. The latter was identified as a possible source for the unusually low Pr/Ph Volve oil in the APA application.

The study concludes that the Volve oil most likely comes from a highly anoxic interval within the Draupne Formation. No accumulations are thus proven to be sourced by the Kupferschiefer. This is in line with the thin development of the source rock facies (a few meters only) that do not expel significant volumes. Sigyn, Gungne and Biotitt all have a humic/terrestrial signature, most likely from

Sleipner Formation coals. A late Early Oil Window maturity suggests that these easternmost discoveries are locally sourced with no access to the prolific deeper parts of the Viking Graben to the west.

Basin modelling and oil to source typing

The objectives of the study were to model potential migration routes to the Mabbutt Prospect and to type oils and condensates in the Sleipner area to likely source rocks. The study confirmed that the Draupne, Heather and Sleipner Formation source rocks are immature in PL 1038. The Kupferschiefer is mature in a small basin in Block 16/7 but have only generated small volumes due to an expected thin development.

A terrestrial signature is found in Sigyn and Gungne while the oil in Volve is typed to a highly anoxic interval within the Draupne Formation.

4 Prospect update report

Mabbutt Prospect

Mabbutt was identified as a potential extension of the Ty Formation fan into an area of chalk erosion creating accommodation space. Mean recoverable resources were estimated to 17.8 Million Sm³ oil equivalents with gas constituting 72% of the volume in oil equivalent terms (Table 4.1). The key prospect risks at the time of application were assigned to reservoir presence, trap, and migration with an overall chance of discovery estimated to 30%.

Table 4.1 NPD Table 2 (form APA application)

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)	Resources in acreage applied for [%] ⁶ (0.00 - 100.0)	Reservoir		Nearest relevant infrastructure ⁸	
			Oil [10 ⁶ Sm ³] (>0.00)			Gas [10 ⁹ Sm ³] (>0.00)					Litho-/ Chrono- stratigraphic level ₇	Reservoir depth [m MSL] (>0)	Name	Km (>0)
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)						
Mabbutt	P	Gas	0.80	4.90	10.50	2.30	12.90	27.20	0.30	82.5	Ty fm/Danian	1860	Sleipner East	26
Mabbutt North	L	Gas	0.10	0.80	2.40	0.20	2.10	6.20	0.22	100.0	Ty formation	1935	Sleipner East	26

In the APA2019 application Top Ty Formation, tied to 16/4-4 and 16/4-7, was mapped on a continuous peak above the chalk on full stack released 3D-seismic to extend into the "Mabbutt embayment" (Fig. 4.1 and Fig. 4.2). The peak is also prominent in the PGS16M03 survey at the well locations and can be mapped with high confidence to show a depositional pinch-out to the west of the Mabbutt Prospect, close to the boundary of the npc-1 play (Fig. 4.3). The prospect concept of a potential eastward extension of the play was thus invalidated by the modern seismic. The "embayment" with an eroded chalk section was confirmed by the new seismic.

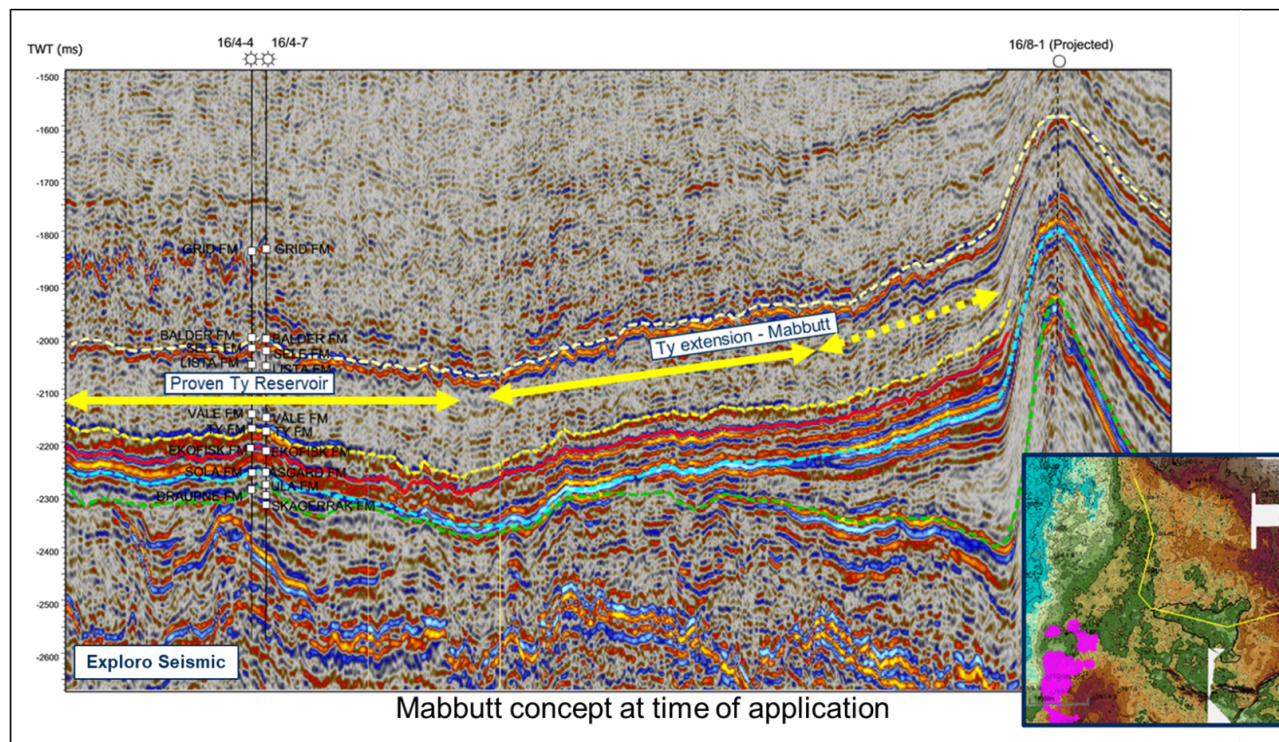


Fig. 4.1 Seismic section along Mabbutt prospect (APA2019 application)

The Ty Formation (lower yellow dashed line) was mapped on released full stack 3D seismic to continue to the east setting up a stratigraphic trap at the pinch out against the 16/8-1 diapir. The Top Chalk to Top Balder Formation isopach in the insert map shows a thicker section in the "Mabbutt embayment", interpreted as potential accommodation space for the Ty Formation submarine fan.

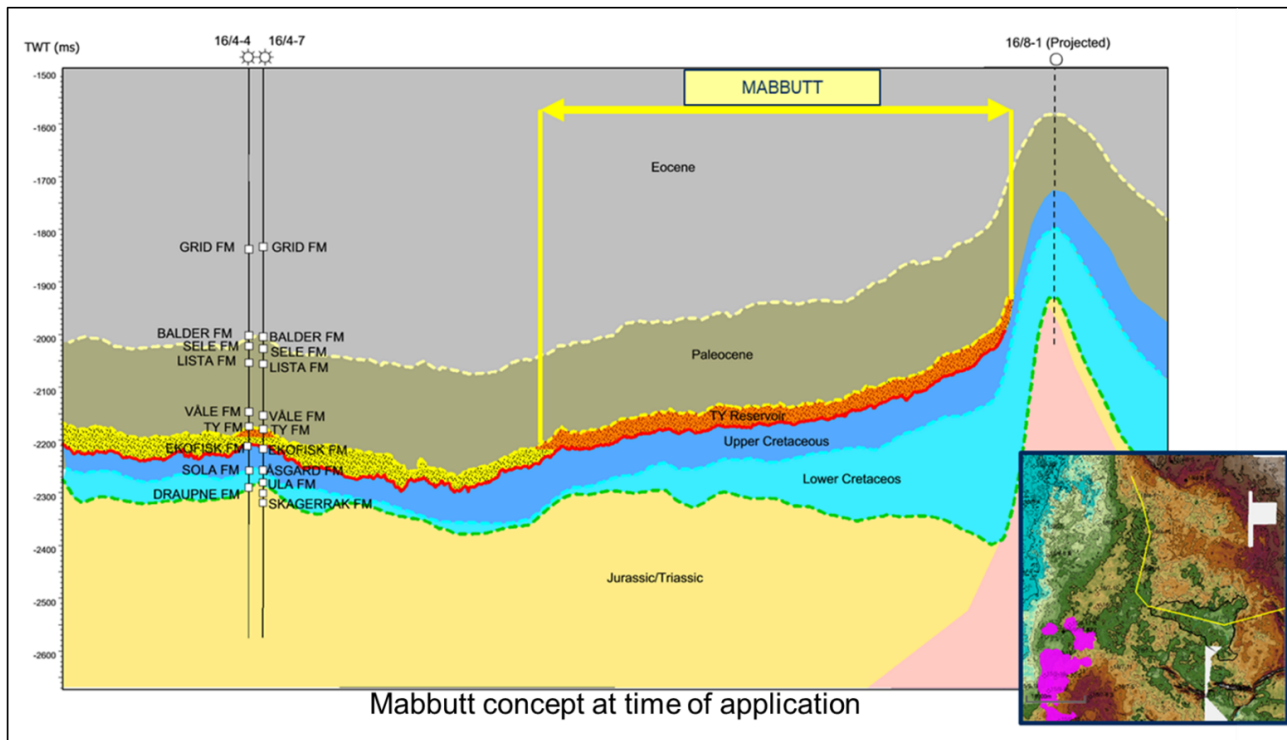


Fig. 4.2 Mabbutt prospect geosection (APA2019)

Geosection showing the concept behind the Mabbutt prospect.

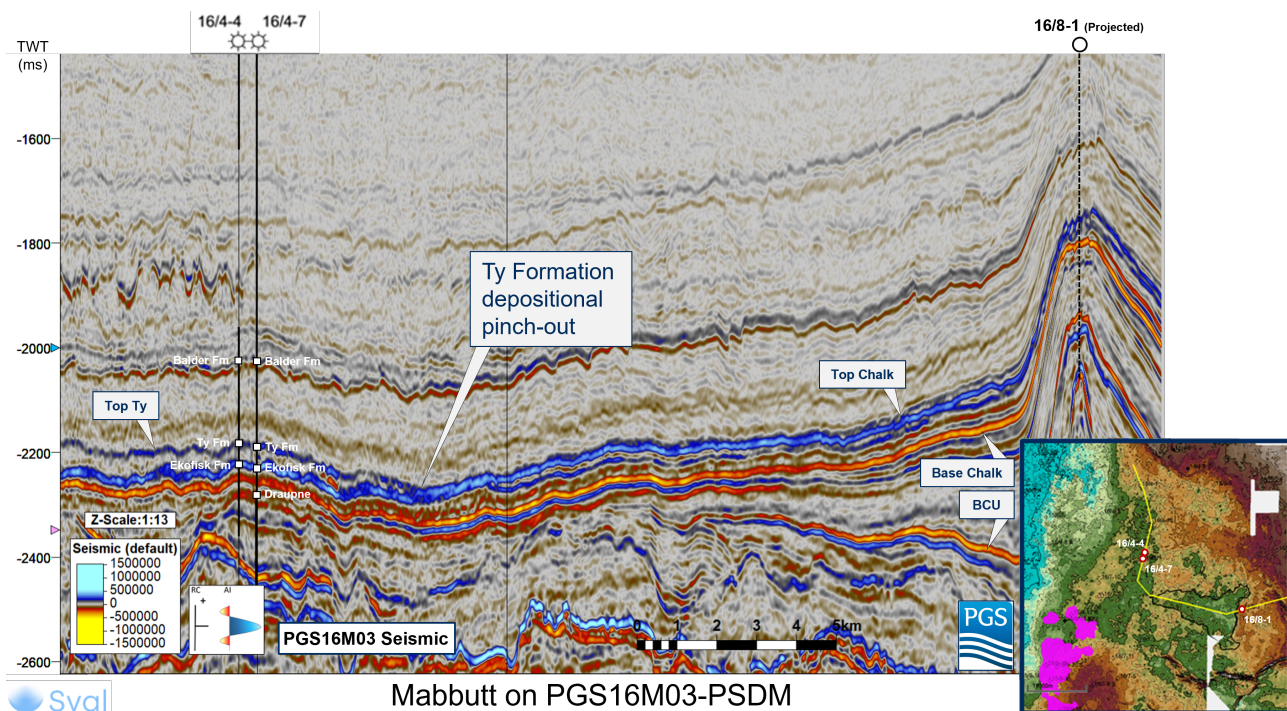


Fig. 4.3 Seismic section along Mabbutt prospect on PGSM03

The Ty Formation is mapped with high confidence to pinch out to the west of the Mabbutt prospect. Line reproduced with courtesy of PGS.

Leads

Several half grabens with likely Permian Rotliegend Group sandstone were mapped as part of the licence evaluation. Traps are set up where tight "Auk conglomerate" or basement sub-crop Zechstein Group carbonates and evaporites, the two former providing base seal and the latter top seal respectively. Reservoir quality is generally poor and charge has to rely on the Kupferschiefer source rock.

Squonk lead

The lead comprises Rotliegend Group ("Auk sandstone") reservoir in a sub-crop trap below Zechstein Group carbonates and evaporites (Fig. 4.4). Reservoir quality for oil is seen as a major risk element with all local wells failing to encounter permeable reservoir in this section. Zechstein carbonates are known to be porous and permeable in the area and thus is an unreliable top seal. If dominated by anhydrite and halite however, a good top seal is expected. Squonk is the first trap out of a mature Kupferschiefer kitchen to the south. An optimistic estimate of 10 m thick Kupferschiefer suggests a STOIP of 5 Million Sm³ allowing for a 75% migration loss. Given the small volume and high reservoir, charge and top seal risks Squonk retains lead status.

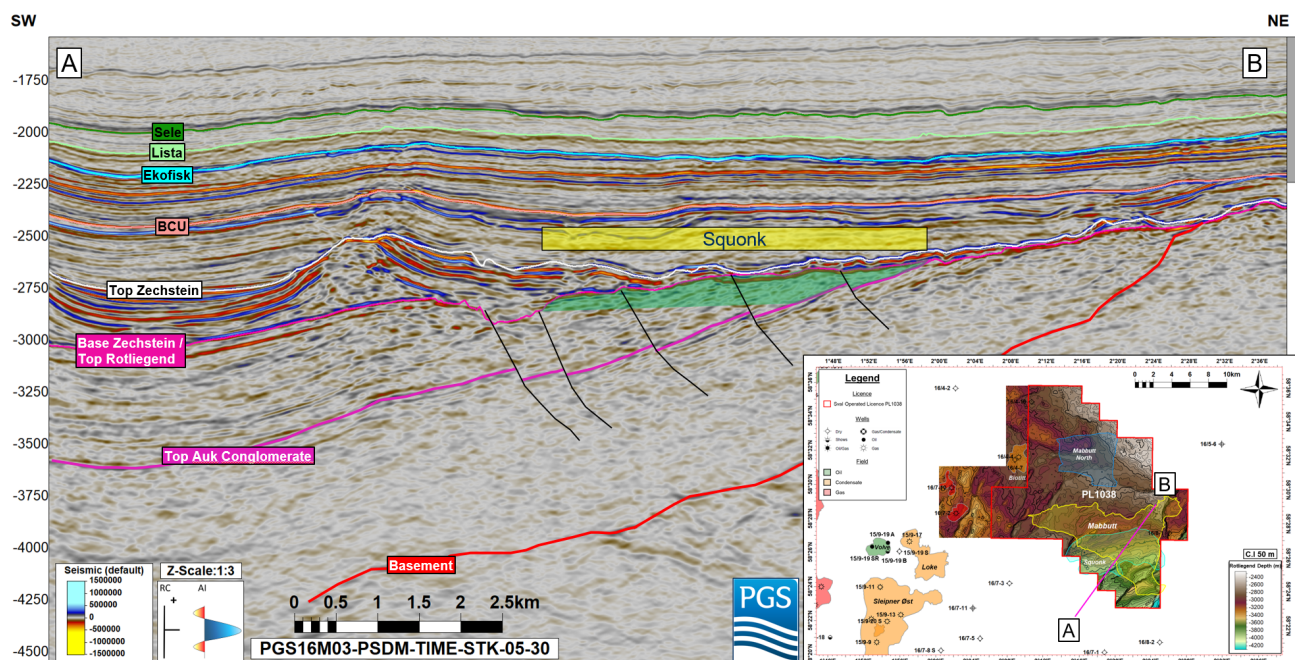


Fig. 4.4 Squonk Lead

Seismic line illustrating the concept behind the Squonk lead. The Kupferschiefer is mature in a small basin just to the south of the line. If the Auk Conglomerate fails as base seal a trap may be set up where the Basement sub-crops Base Zechstein Group. Line reproduced with courtesy of PGS.

5 Technical evaluation

Following the thecnical work conducted in Phase 1 the licence no longer holds any prospects.

6 Conclusion

The modern PGSM03-16092 3D seismic clearly demonstrates that the Ty Formation pinches out to the west of the Mabbutt Prospect. The pre-salt lead Squonk has a very high reservoir quality, charge and top seal risks.

Most of the licence is barren in shallow gas anomalies, else prominent in the working basins to the west (Fig. 6.1). Accepting the premise that shallow gas mainly originates from biodegradation of thermogenic oil and gas rather than disseminated organic material, this supports the basin modelling in that lateral hydrocarbon migration only has reached the north-western part of PL 1038.

As the Mabbutt Prospect is invalidated and the Squonk Lead is unlikely to mature to prospect, a unanimous decision to relinquish the licence was made.

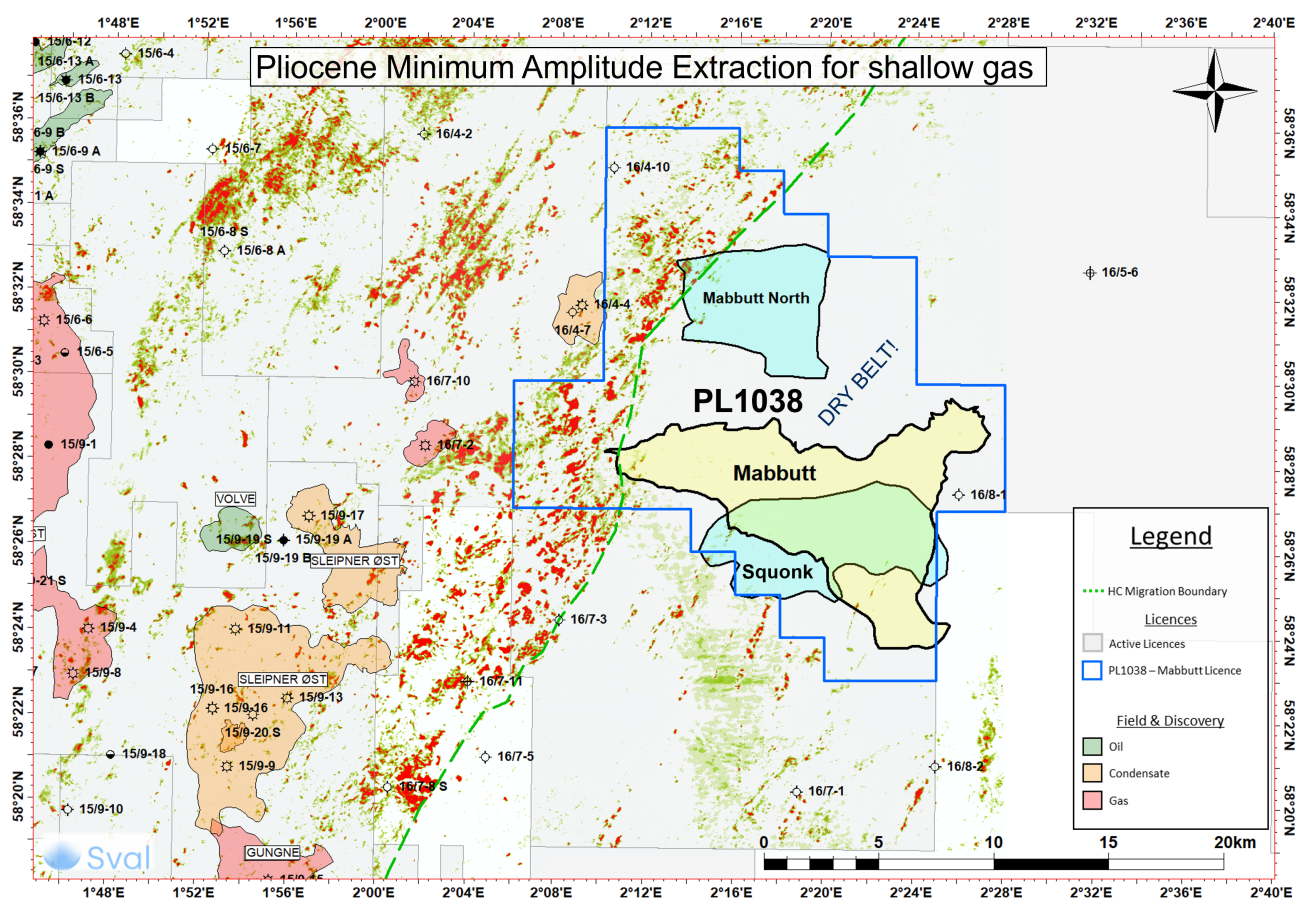


Fig. 6.1 Pliocene Minimum Amplitude Extraction indicating shallow gas

A clear shut off to the east, indicating the limit of the working petroleum system, is seen.