



■ BASF Group

Report title:

# PL485 Relinquishment Report

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## **1. Key license history**

PL485 was awarded on 29<sup>th</sup> February 2008 and consists of part of block 6608/8. Revus Energy ASA (40%) was the operator with E.ON Ruhrgas Norge AS (30%) and Concedo ASA (30%) as partners. In March 2008 Det norske oljesleskap ASA became partner with 15 % interest and Concedo ASA reduced its interest to 15 %. In January 2009 after the takeover of Revus Energy ASA Wintershall Norge ASA (40 %) became the operator of PL485. The initial work obligations including reprocessing of seismic data ST9405 3D was fulfilled. The initial 2 year period until a drill or drop decision had to be made was extended by 1 year. EC/MC meetings were held at least once a year, in addition there were several work meetings.

The license area is located at the Nordland Ridge, east-northeast of the Dompap and Linerle discoveries (Figure 1). The application for the area focused on the Tiur prospect identified on 2D seismic. This Jurassic prospect outline changed position and size and was almost out of PL485 area after the reprocessing of ST9405 3D. Tiur was not prospect within PL 485 anymore. Now the focus lied on the Mist prospect, which reservoir was originally described as Permian carbonates. However the seismic reprocessing and an extensive field and core study showed that reservoir of the Mist prospect is in fractured Caledonian marble. Unfortunately the potential volumes are too small and the probability of discovery is too low to defend a drill decision. The decision to relinquish the license was unanimous among operator and partners.

## **2. Database**

The initial database described in the APA 2007 application was extended by the reprocessed ST9405 3D, which was the work obligation. A seismic volume using the new BEAM technology and angel stacks were bought in addition. Well 6608/10-12 and 6608/10-12A were added to the well database. All new data sets were used for maturing prospectivity in PL485.

## **3. Review of geological framework**

After buying seismic ST9405 3D Mist, which was not identified in the initial APA application, became the main prospect in PL485. The reservoir of the Mist prospect was originally described as Permian carbonates. Well 6608/8-1 drilled by Den Norske Stats Oljeselskap AS in 1997, had oil shows in the uppermost Triassic and increased gas readings at prospect depth. At 3013 m RKB massive mud losses occurred and the well had to be plugged back and abandoned.

The results of the seismic reprocessing including the new BEAM method indicated that the prospect is not of Permian age, but consists of Caledonian basement (Figure 2 and 3). This was confirmed by a detailed core study. For improving the understanding of the nature of fractures seen in the core, and expected from further well data and seismic, a field trip to the Lofoten area was organized in 2010 and supplemented by satellite image analysis. Data were recorded and later evaluated especially for the porosity and permeability prediction, as well as fracture orientations for production prediction (Figure 4).

Seismic amplitude and internal patterns combined with core and field trip data were used to build models with different rock properties (Figure 5). The GWC was defined by a seal analysis study and has its maximum contact at the LCC.

A fluid inclusion study of samples from 6608/8-1 supports a thermogenic origin of the encountered gas, probably from Spekk Fm, but charge is still considered as a main risk as the prospect lies east of the northern edge of the Dønna Terrace and it is unknown whether an economic volume of gas has migrated from the upper Jurassic Spekk Fm and other source rocks into the Caledonian basement. Reservoir presence has very high confidence, but its effectiveness is very uncertain due to difficulties in fracture prediction. Trap and seal are expected to work with good confidence.

However due to the difficult prediction of HC volumes (Table 1) in fractured reservoirs and its complicated development, the volumes are too low to support a drill decision for a prospect with GPOS of 16 % (Table 2).

#### **4. Prospect update**

The application for PL485 described only the Tiur prospect. No other prospect or lead was identified at the time of application. However improved understanding of the area, mainly due to reprocessing of 3D seismic, led to the identification of the Mist prospect in Caledonian basement (see table 3 and chapter 3. *Review of geological framework*). Also three leads in Triassic, Palaeocene and Eocene were identified, but could not be matured to prospects.

#### **5. Technical evaluations**

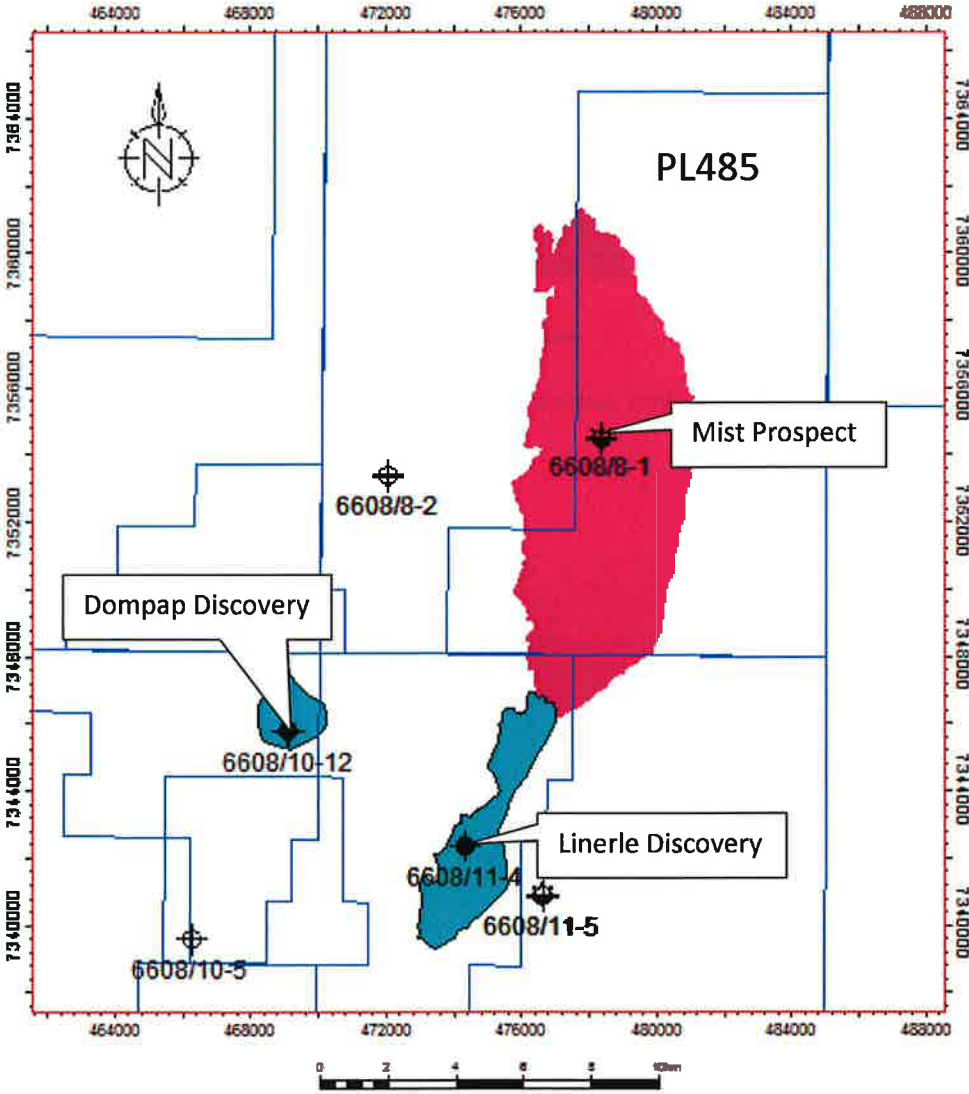
Different production profiles were made based on different assumptions for the fracture distributions and using the White Tiger field in Vietnam as analogue. After a successful exploration well 3 appraisal wells would be needed, but could be turned into production wells. Depending on the appraisal outcome 8 to 12 production wells and no injection wells are needed.

Two subsea development scenarios were designed with tie backs to the Norne (39 km distance) and Luva (108 km distance) facilities. Production start was assumed to be in 2020 with keeping plateau until 2029 (Figure 6).

### 6. Conclusions

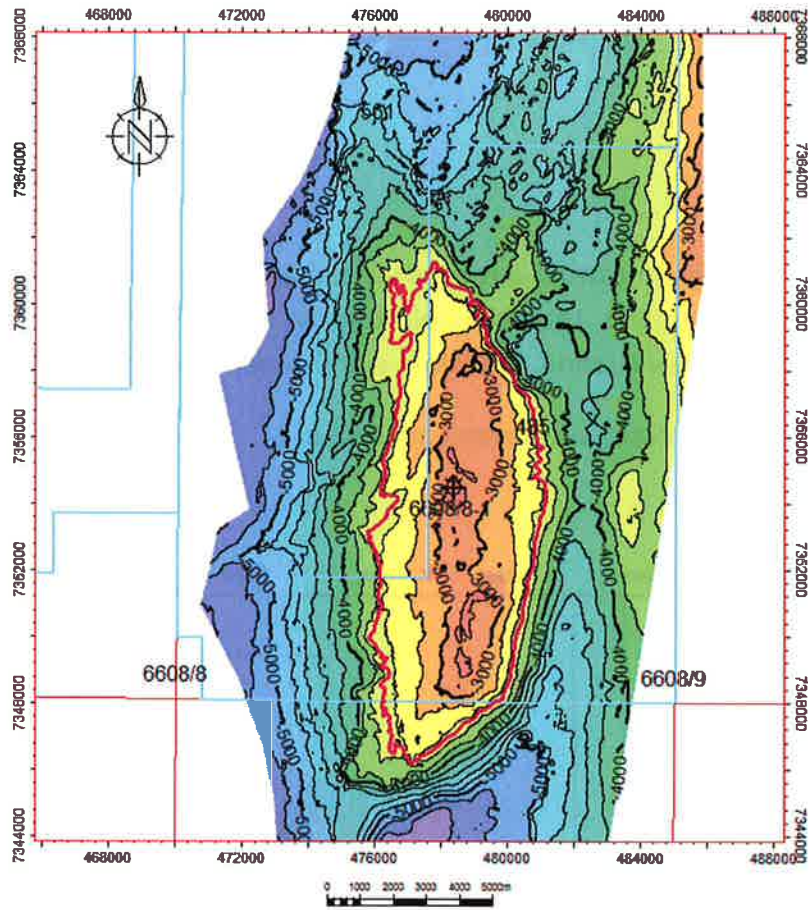
The extensive work program carried out gave a good picture of the GPOS and HC volumes expected in the Mist prospect. Unfortunately the risk is too high, which led to negative numbers in the economic evaluation. Therefore a drill decision could not be supported.

The decision to relinquish PL485 was taken unanimous.

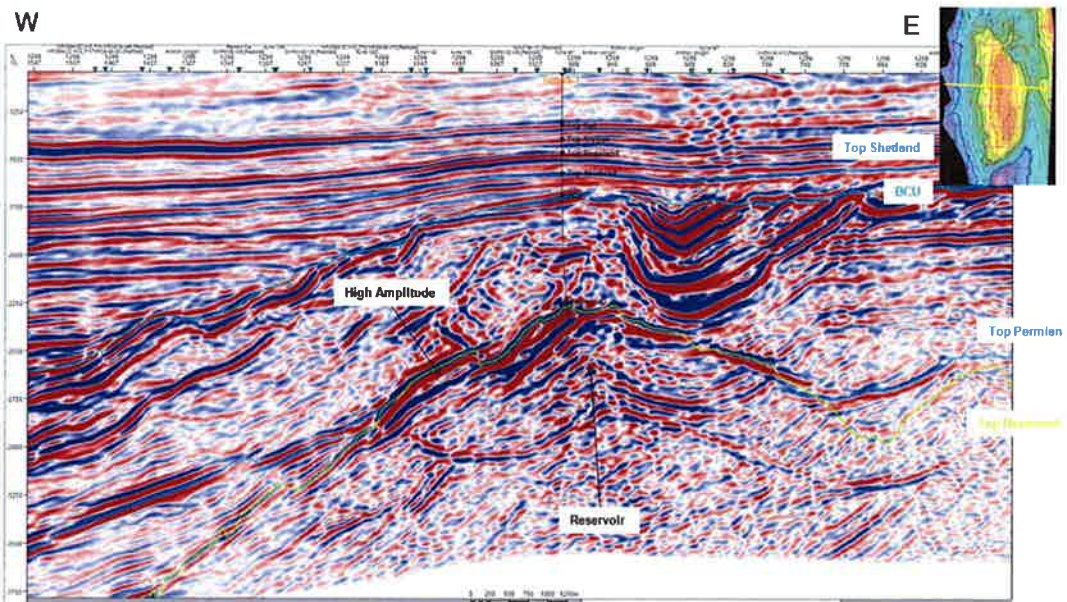


**Figure 1** PL485 location map showing the location of the Mist prospect east-northeast of the Dompap and Linerle discoveries





**Figure 2** Top Basement depth map. Pink outline: P1 GWC at 3486 m TVDSS. CI = 200 m

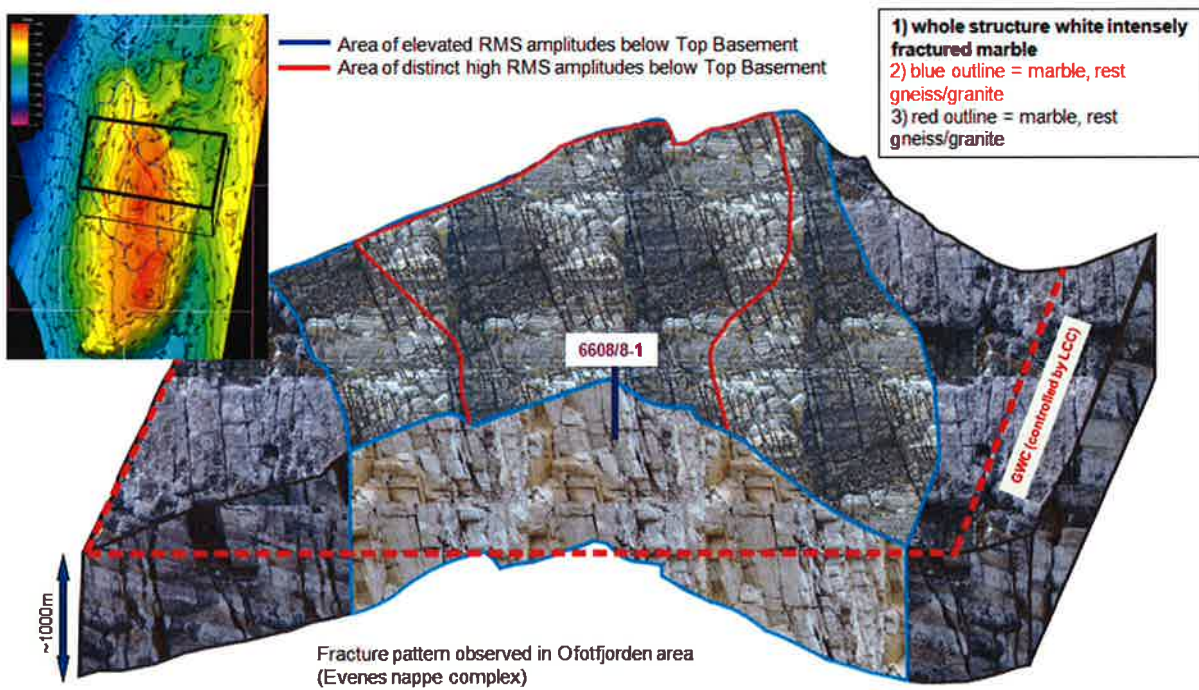


**Figure 3** Seismic cross section of the new BEAM technology showing the reinterpreted Top Basement. Permian strata onlaps east and west of the Mist prospect

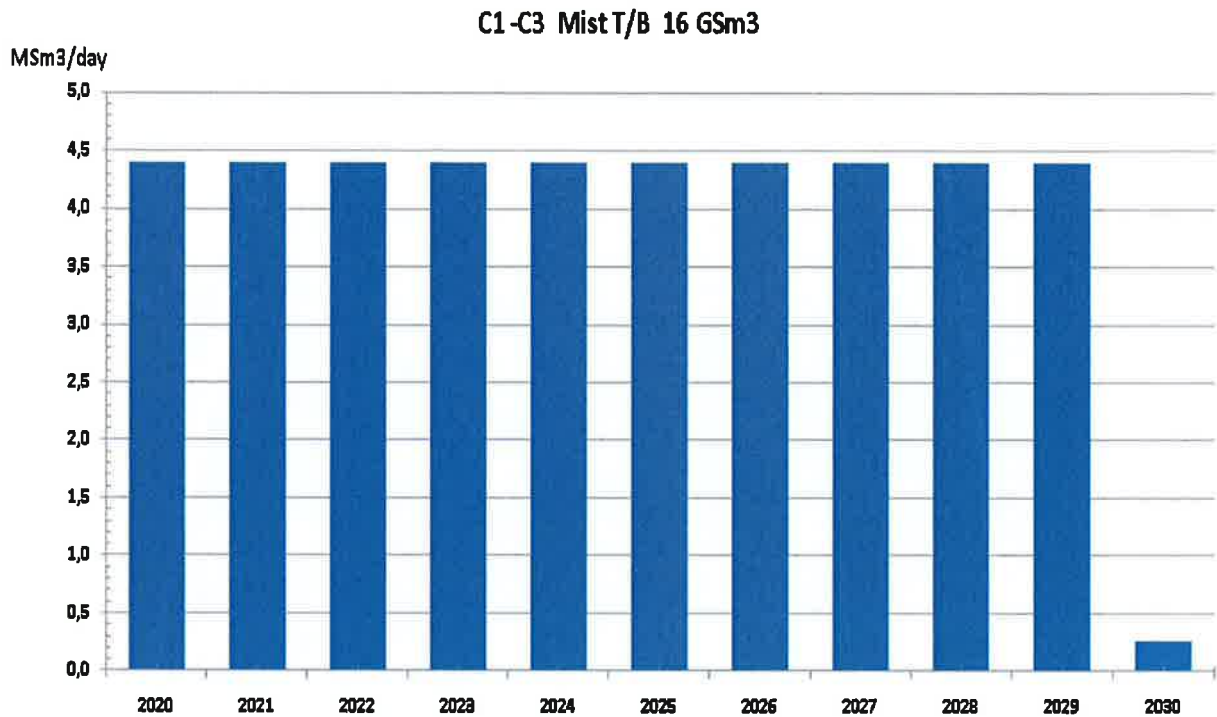




**Figure 4 :** Outcrop image from the Lofoten field trip showing an example of data collection for fracture analysis



**Figure 5 :** Example for the integrated interpretation of seismic, well and outcrop data



**Figure 6** : Production profile for the Mist prospect

	Techn. Rec. Liquids	Techn. Rec. Gases	BOE
P90	0.192 mmstb	7.97 bcf	1.47 mmboe
P50	2.98 mmstb	121 bcf	22.5 mmboe
P10	19.7 mmstb	787 bcf	146 mmboe
Mean	7.62 mmstb	307 bcf	56.9 mmboe

**Table 1**: Expected HC volumes in the Mist prospect

	Reservoir	Seal	Source	Trap	Chance
Play Chance	0.70	0.85	0.85	-	0.51
Prospect Chance	0.90	1.00	0.60	0.60	0.32
GPOS	0.16				

**Table 2**: Summary of risking matrix for the Mist prospect



Block	Prospect name		Discovery/Prosp/Lead	Prosp ID (or New)	NPD approved?
6608:8	Mist		Prospect	<i>NPD will insert data</i>	<i>NPD will insert data</i>
Play (name / new)	Structural element		Company/ reported by / Ref. doc.		Year
<i>NPD will insert data</i>	Nordland Ridge		Wintershall Norge ASA		2010
Oil/Gas case	<b>Resources IN PLACE</b>				
Dry Gas	Main phase			Ass. phase	
	Low	Base	High	Low	Base High
Oil 10 <sup>6</sup> Sm <sup>3</sup>					
Gas 10 <sup>9</sup> Sm <sup>3</sup>	0,504	16,6	42,3		
	<b>Resources RECOVERABLE</b>				
	Main phase			Ass. phase	
	Low	Base	High	Low	Base High
Oil 10 <sup>6</sup> Sm <sup>3</sup>				0,0305	1,21 3,13
Gas 10 <sup>9</sup> Sm <sup>3</sup>	0,226	8,68	22,3		
	Which fractiles are used as:		Low:	90	High: 10
Type of trap	Water depth (m)		Reservoir Chrono (from - to)	Reservoir Litho (from - to)	
Struct. 3-way	335		Caledonian	Marble	
Source Rock, Chrono	Source Rock, Litho		Seal, Chrono	Seal, Litho	
Upper Jurassic	Spekk Fm		Permian-Triassic	Shale	
Seismic database (2D/3D):	3D, OBS 2D				
	<b>Probability of discovery:</b>				
Technical (oil+gas case)	16		Prob for oil/gas case		0/1
Probability (fraction):	Reservoir (P1)	Trap (P2)	Charge (P3)	Retention (P4)	
	42	90	51	85	
<b>Parametres:</b>	Low	Base	High	Comments	
Depth to top of prospect (m)		2650			
Area of closure (km <sup>2</sup> )		84			
Reservoir thickness (m)	430	905	1501		
HC column in prospect (m)	185	406	633		
Gross rock vol. (10 <sup>9</sup> m <sup>3</sup> )					
Net / Gross (fraction)	1	1	1		
Porosity (fraction)	0,019	0,0452	0,079		
Water Saturation (fraction)	0,146	0,105	0,0683		
Bg. (<1)	0,004	0,0049	0,0054		
Bo. (>1)					
GOR, free gas (Sm <sup>3</sup> /Sm <sup>3</sup> )	9090	7143	5882		
GOR, oil (Sm <sup>3</sup> /Sm <sup>3</sup> )					
Recovery factor, main phase	0,268	0,534	0,8		
Recovery factor, ass. phase					
Temperature, top res (deg C) :	132	Pressure, top res (bar) :			
<i>For NPD use:</i>					
Innrapp. av geolog:		Registrert:	Map OK:		Nr:
Dato:		Dato:	Dato:		

**Table 3: Prospect Data**

