

# PL 649

# Relinquishment Report



# **PL 649 Relinquishment report**



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## 1 Key licence history

Production licence PL 649 covers a total area of 1032.806 km<sup>2</sup> and comprises parts of the Blocks 6506/1, 6506/2, 6506/3 and 6507/1.

The licence was awarded to VNG Norge AS (Operator 40%), Maersk Oil Norway AS 30%, and Dana Petroleum Norway AS 30% on February 3<sup>rd</sup> 2012 as part of the APA (Awards in Predefined Areas) 2011.

The work programme was to reprocess existing seismic and perform relevant geological and geophysical studies with a drill and drop deadline February 3<sup>rd</sup> 2014.

- BOK February 3<sup>rd</sup> 2016.
- BOV February 3<sup>rd</sup> 2018.
- PDO February 3<sup>rd</sup> 2019.

The prospect applied for was named Dewey. It is a 3-way structural closure at the Lysing Formation level relying on fault seal updip towards the dry 6506/3-1 well. PL 649 and PL 597 shared the same partnership and has been worked up as one entity as the main play is in the Lysing reservoir level for both licences.

In light of the results from the dry Albert well (6506/6-2) which TD'ed in February 2013, the partners in PL 597 decided not to support VNG Norge in a drill decision with a well on the Herzer prospect. VNG was not able to mature the Dewey prospect, nor any of the nine leads within PL 649 into a drillable prospect and it was unanimously agreed within the partnership to relinquish the licence in the management committee in December 2013.

During the life of the licence the following meetings took place and is documented:

Intital EC workmeeting 13.02.2012 in order to discuss different reprocessing approaches and sequence and to get early input from partners.

ECMC #1 07.03.2012. Establishment of Management committee and Exploration subcommittee. Prospectivity review and agreement on processing alternative and special studies.

ECMC #2 07.012.2012

ECMC #3 27.11.2013 Prospectivity and special studies review and recommendation on forward plan for the licence.

## 2 Database

The common database includes:

### 3D seismic:

- VNG13Mo1, a reprocessed 3D comprising parts of BGo701 and DTW2000 covering the licence as well as tie to the 6507/1-1 well.
- VNG12MO2 covering licence PL 579.
- MC3D Mid Norway Megamerge for semi-regional mapping outside the licence area.

Table 2.1: 2D seismic:

MNR07-7319 sp14500-17000	MNR10-90532 sp21900-24300
MNR05-7314 sp14500-15279	MNR09-387 sp16100-18200
MNR08-7314 sp15281-17000	MNR07-7269 sp14000-16000
MNR07-7312 sp14500-17600	MNR07-7276 sp14500-17400
MNR09-387 sp14500-19000	MNR05-7282 sp14500-16500
MNR08-0394 sp17100-19000	MNR08-7288 sp14500-16800
MNR07-0402 sp16800-19000	MNR08-7292 sp14500-16800
MNR06-0411 sp16800-19000	MNR05-7300 sp14500-16800
MNR10-90568 sp20500-24400	

### Wells:

6506/3-1 Grong. P&A 2001 as a dry well

6506/6-1 Victoria. P&A 2000 as a Middle Jurassic gas discovery.

6506/6-2 Albert. P&A February 23rd 2013 as a dry well.

6507/1-1 Sahara. P&A 2004 as a dry well.

6507/2-1 Outer Marulk. P&A 1986, shows in Lysing and Lange Formations

6507/2-2 Marulk. P&A 1992 as Cretaceous gas condensate discovery.

6507/2-3 Snadd Outer. P&A 1994, oil shows in Cretaceous sst

6507/5-1 Skarv. P&A 1998 as oil/gas/condensate discovery in Cretaceous and Middle Jurassic

6507/5-2 Skarv. P&A 1999 as gas condensate appraisal.

6507/5-4 Skarv. P&A 2001 as oil/gas discovery in Cretaceous and Middle Jurassic

6507/5-3 Snadd. P&A 2000 as a Cretaceous gas discovery.

PL 649

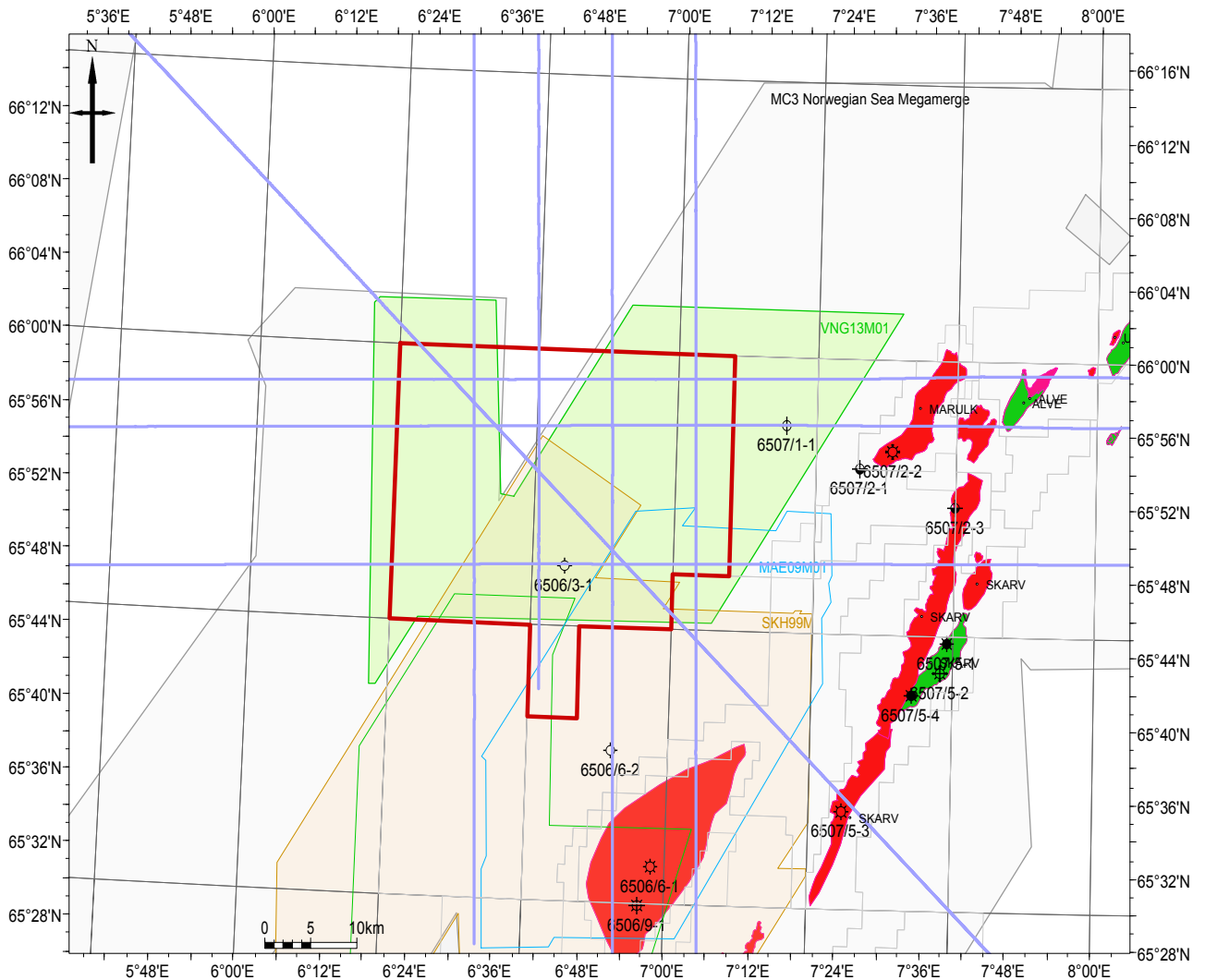


Fig. 2.1 PL649 Common well and seismic database. Offset wells including 6506/6-2 with TD February 2013.

### 3 Review of geological framework

Licences PL649 and PL597 have been evaluated together as the partnership was the same within both licences. Costs, databases and special studies like core descriptions and sedimentological analysis, petrophysical evaluation, biostratigraphic analysis, rock physics and seismic modelling, inversion and basin modelling are shared between the licenses.

The main challenges for the prospectivity of the licence acreage located on the outer part of the Dønna Terrace are the uncertainties with respect to hydrocarbon presence and quality as well as trap geometry and integrity as several of the offset wells were dry.

Summary of studies performed within the two licences:

#### Petrophysics:

Eleven wells were evaluated focusing on the Lange and Lysing Formations but also the deeper Jurassic Fangst and Båt Groups were included. Clay volumes, porosity and saturation were interpreted. The log interpretation is calibrated with core measurements where available. Formation water samples are rare, thus the quality of the formation water resistivity estimate varies resulting in uncertain water saturation estimates.

#### Biostratigraphic analysis:

Six wells (6507/1-1, 6507/2-1, 6507/2-3, 6507/5-1, 6507/5-2 and 6506/6-2) were analysed specifically for the two licences by Petrostrat. In addition parts of Petrostrat multiclient data set were purchased (6506/3-1, 6506/6-1, 6507/2-2, 6507/5-3, 6507/5-4). These studies provided a stratigraphic framework which has worked as a fundament for the understanding of how the Lysing system developed through time. The Lysing Formation has been subdivided into 3 different depositional sequences, K62 and K60 of Coniacian age and K58 of Late Turonian age. Top K 57 always represents the base of the sand rich part of the Lysing formation on the Dønna Terrace, while the top of the sandstone may vary. The main outcome of this study was a subdivision of the Lysing Formation into two sand-rich depositional systems Fig. 3.1 and Fig. 3.2.

#### Core descriptions:

Cores from the following wells were described and interpreted 6507/5-3 Lysing, 6507/2-2 Lysing and Lange, 6507/2-3 Lysing and Lange, 6506/3-1 Lysing and Lange. This work was integrated with new stratigraphic framework, an idea of basin configuration at the time of deposition in order to update the Gross depositional environment maps for the Turonian and Coniacian Fig. 3.3 and Fig. 3.4. The main outcome of this was an understanding of an early depositional system filling in pre-existing lows more dominant in the north and a late depositional system with more a lobeswitch geometry more prominent in the southern part of the Dønna Terrace.

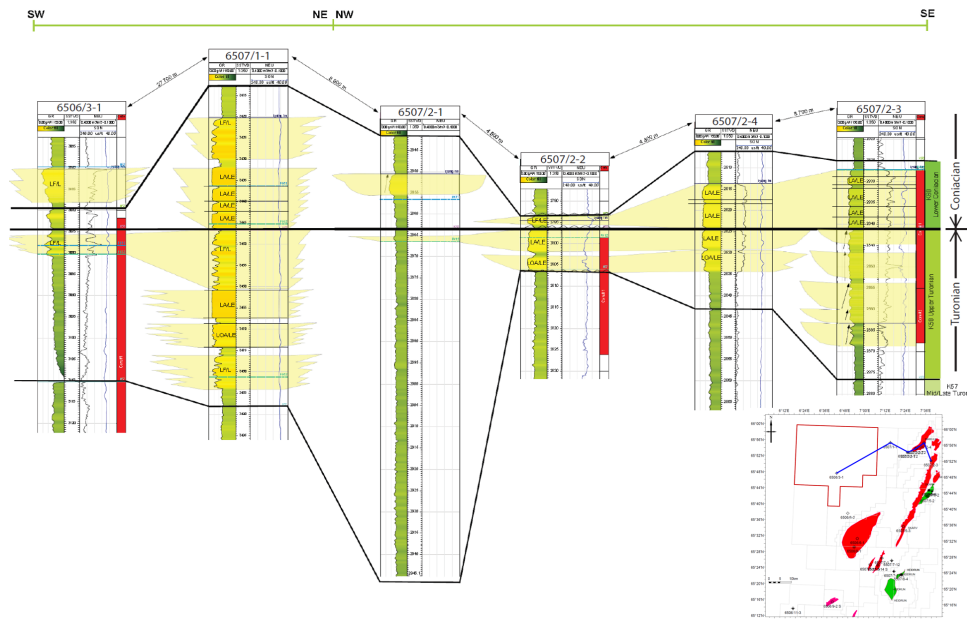


Fig. 3.1 Lysing Northern Wellsection. *Flattened on top K60*

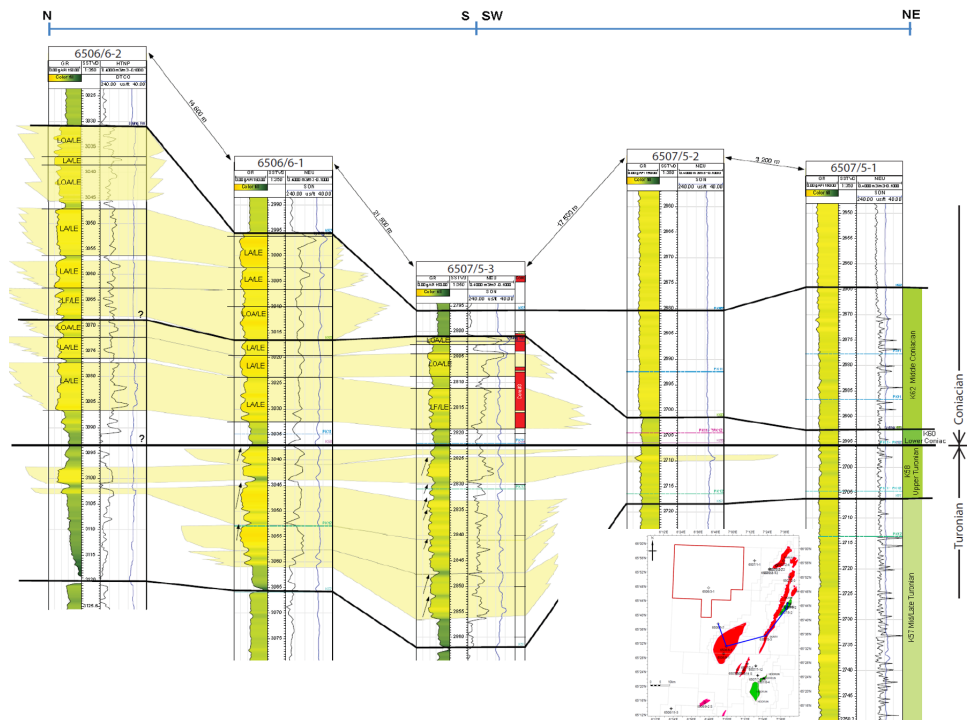


Fig. 3.2 Lysing Southern Wellsection. *Flattened on top K60.*

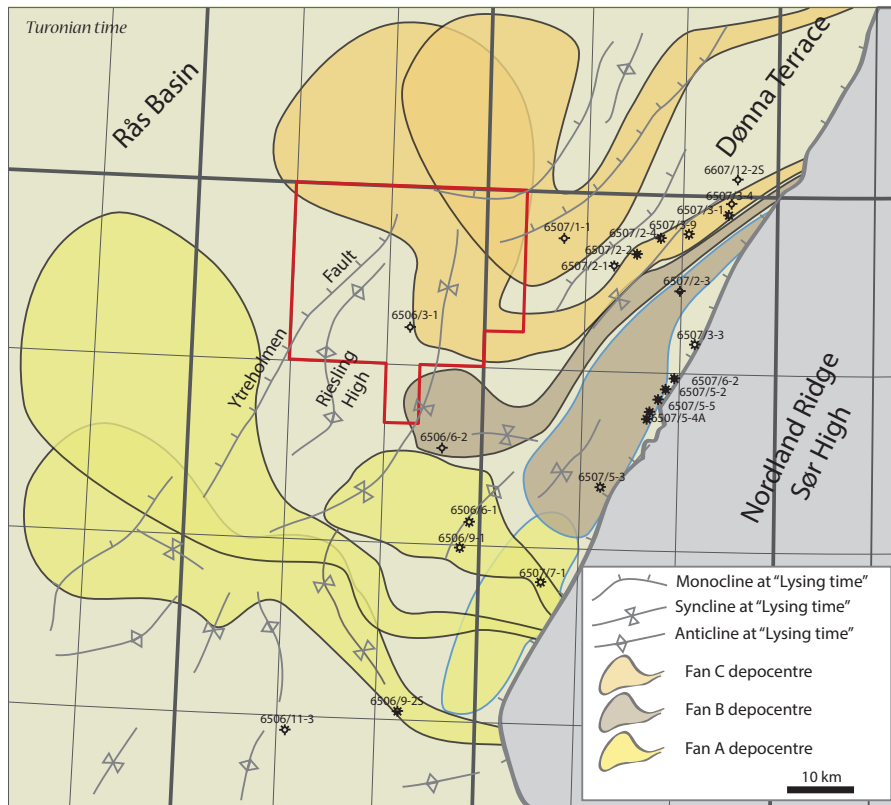


Fig. 3.3 Lysing K58 Turonian Gross depositional environment map

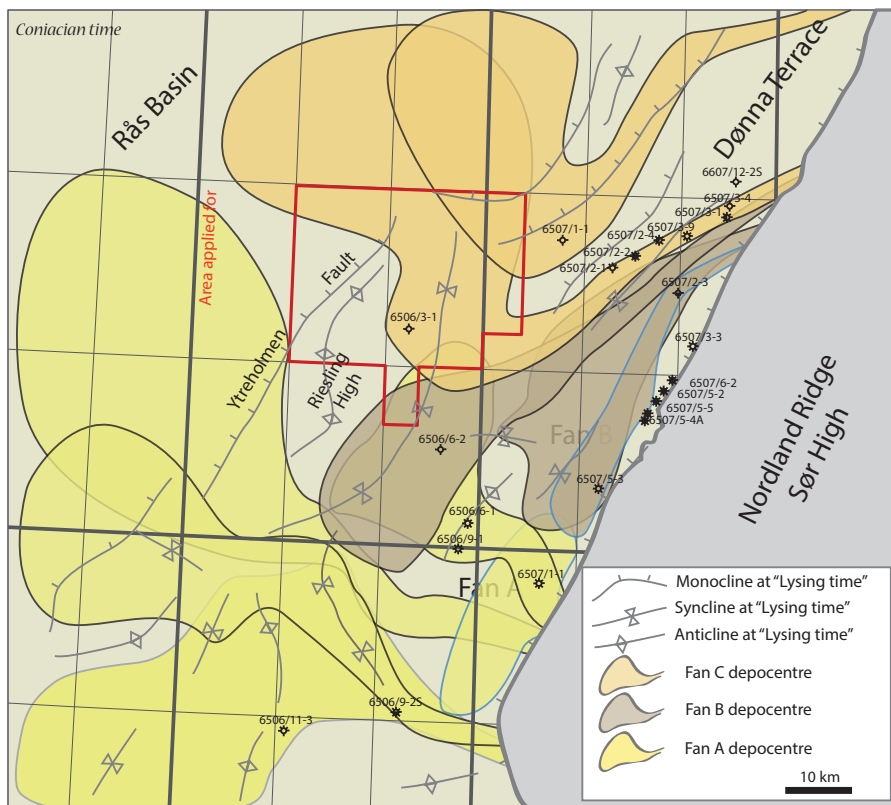


Fig. 3.4 Lysing K60 and K62 Coniacian Gross depositional environment map

Seismic reprocessing:

VNG13Mo1 comprises 571 km<sup>2</sup> of DTW2000 and 264 km<sup>2</sup> of BGo701 and 68 km<sup>2</sup> of BGo803. The 3D PSDM reprocessing sequence (Fig. 3.5) was performed by CGG Oslo and final data delivered February 2013.

<b>SAIL LINE PROCESSING</b>	
1	Reformat from SEG-D to CGG Format and Navigation merge
2	Spherical Divergence Gain Correction T <sup>2</sup>
3	Anti-alias filter: 94Hz, 72 dB/Octave
4	Resampling to 4 msec.
5	Low cut filter: 3Hz, 18dB/Octave
6	Zero-Phasing including de-Bubbling
7	Swell noise attenuation
8	Linear Noise Attenuation (Refraction Zone only)
9	Spatial Anti-Alias Filtering
10	Missing Trace Interpolation
11	Gun and Cable Static Correction
12	Model based 3D SRME (Surface Related Multiple Elimination) with Adaptive Subtraction
13	2D SRME with Adaptive Subtraction
14	Tau-P deconvolution and mute in shot domain
15	Tau-P deconvolution and mute in receiver domain
16	Additional linear noise attenuation and F-K filter
17	High Resolution Radon Demultiple
18	Phase only Q-Compensation (Q=150)
19	Surface consistent amplitude scaling
<b>OFFSET PROCESSING</b>	
20	Split into 52 Offset Classes
21	Static Binning to decimate to 1 trace per Offset per Bin
22	Match and merge 3 surveys
23	3D Anti-Alias Regularization to 12.5m x 25m Bin
24	Denoise in offset class ⇒ SEG Y output: pre-migration gathers
<b>TTI Model building</b>	
25	Initial model
26	Multi-layer tomography (2 iterations)
27	Stack sweep scan ⇒ SEG Y output: migration velocity
<b>PSDM</b>	
28	VTI Amplitude preserving Controlled Beam Pre Stack Depth Migration (merge some PL597 data for migration aperture)
29	Stretch to time
30	Automatic RMO Correction ⇒ SEG Y output: stacking velocity
31	HR Radon Demultiple ⇒ SEG Y output: post-migration gathers
<b>STACKING</b>	
32	Angle Mute (Full/Near/Mid/Far/Ultra-far)
33	Stacking ⇒ SEG Y output: raw stack (T,Z)
34	Dip filtering
35	Amplitude Q-Compensation (Q=180) ⇒ SEG Y output: final stack (T)
36	Stretch to depth ⇒ SEG Y output: final stack (Z)

Fig. 3.5 CGG 3D PSDM reprocessing sequence

The final result did not give improved data quality compared with the MC3D Norwegian Sea. Thus selected test lines were provided to Sharp Reflections to test if conditioning could improve the seismic quality. The result was that the data supplied for investigation were of low quality because of initial bad quality of the field data and the uplift of conditioning of the seismic data would be minimal.

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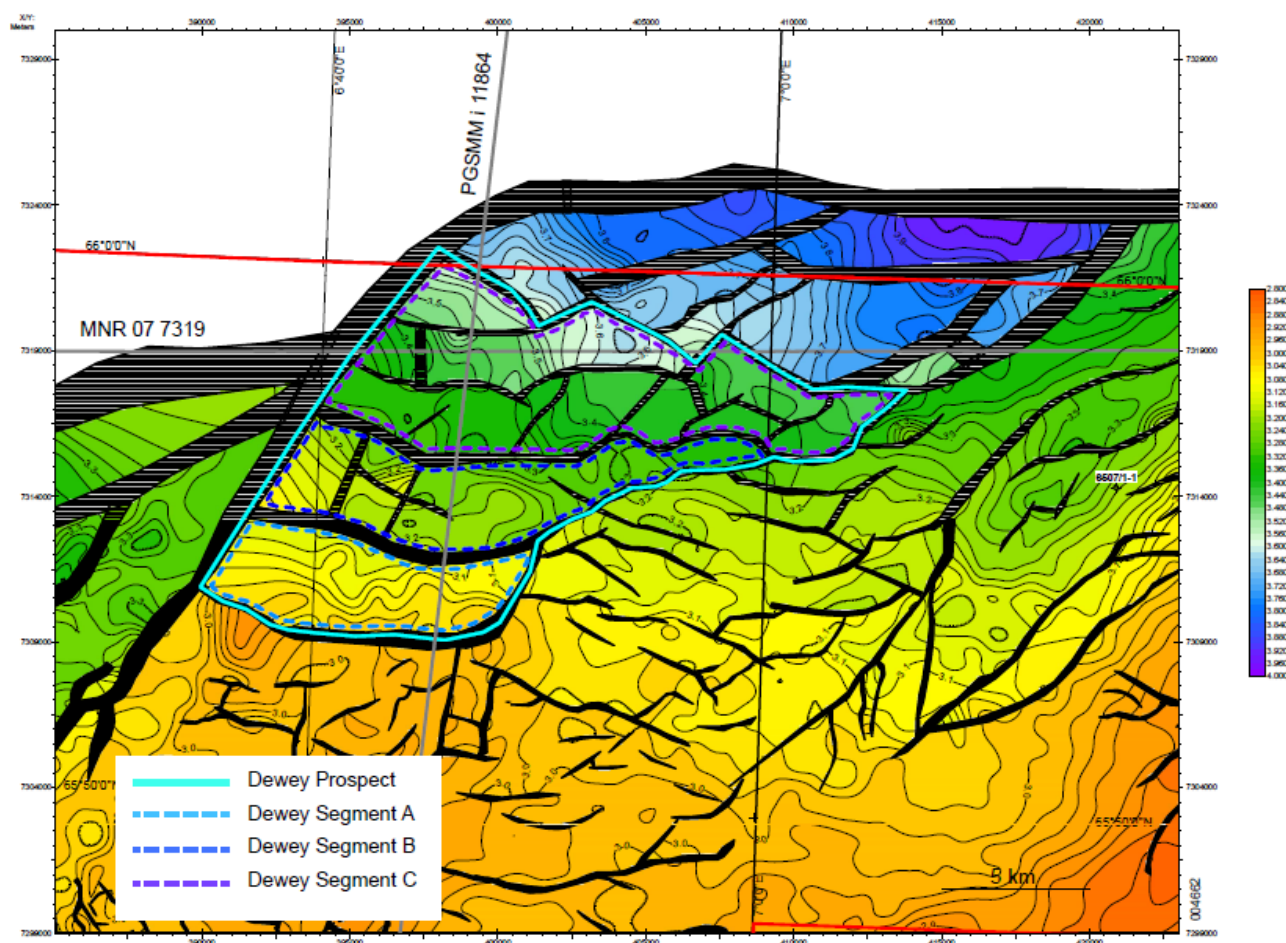
### Rock Physics and seismic wedge modelling:

Ten wells were analysed for rock physics by IKON. The resulting AVA plots suggests a class IV dimming response at the top Lysing Formation when the sand in 6507/1-1 is brine-filled shifting to a class III brightening of amplitude with angle when the gradational wedge thickness is below/thinner than 66m and 90m for a 25Hz and 18Hz Ricker wavelet, respectively. In addition the AVA plot suggest a class III brightening of amplitude with angle when the sand in the 6507/7-1 well s hydrocarbon filled (80% oil, or 90% gas) for both 18Hz and 25Hz irrespective of the gradational wedge thickness.

## 4 Prospect update

At the time of application one prospect and nine leads were identified. None of the leads have been matured to a drillable prospect.

The main prospect at the time of application was called Dewey. It was defined as a down-thrown 3-way fault closure at the Lysing Formation level. The prospect is intersected by several internal faults, and is interpreted to be in a large relay zone. The chance of discovery was estimated to be 0.27 with trap (P2) being the principal risk.



**Fig. 4.1** Near Top Lysing TWTmap from the application

The seismic data quality was very poor at the time of application. The work programme of reprocessing the existing 3D seismic was hoped to solve of the critical risk factors associated with the Dewey Prospect.

The main fault to the south required clay smear in order to be able to seal off the Dewey prospect against the updip 4-way closure tested by the dry 6506/3-1 well. The updated map based on reprocessed survey (Fig. 4.2) shows the presence of a series of minor faults none of them with large enough throw to generate the required amount of clay smear required to seal the prospect. In addition, the lack of seismic amplitude observations indicative of hydrocarbons (Fig. 4.3) support the decision to degrade the Dewey Prospect to a lead with very high risk of fault seal leakage.

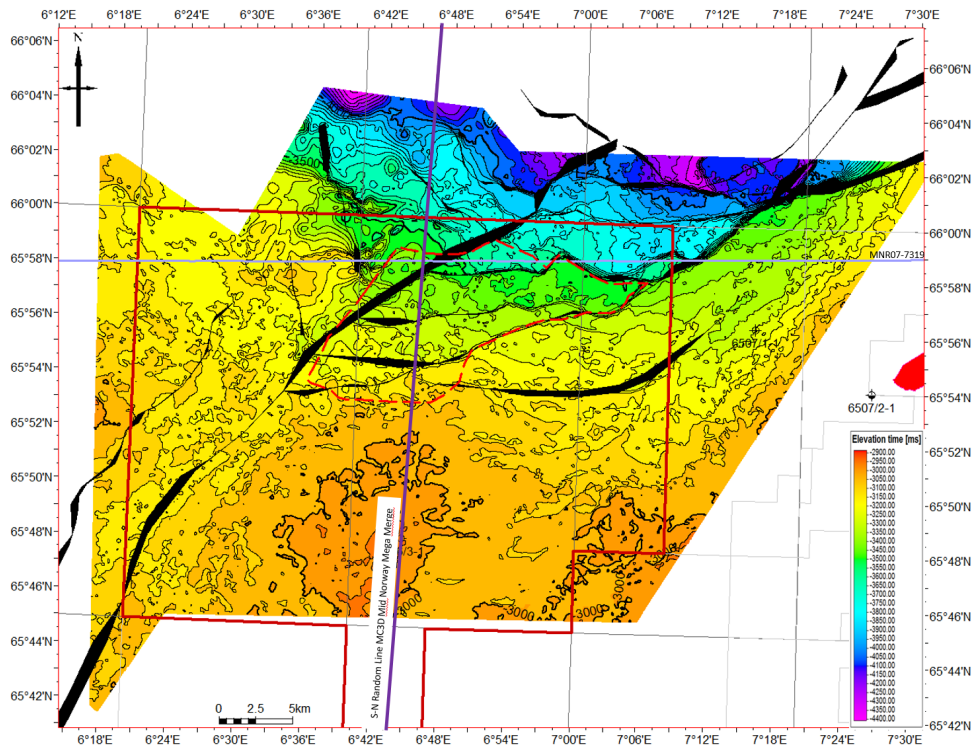


Fig. 4.2 Near Base Lysing Formation TWT based on VNG13Mo1

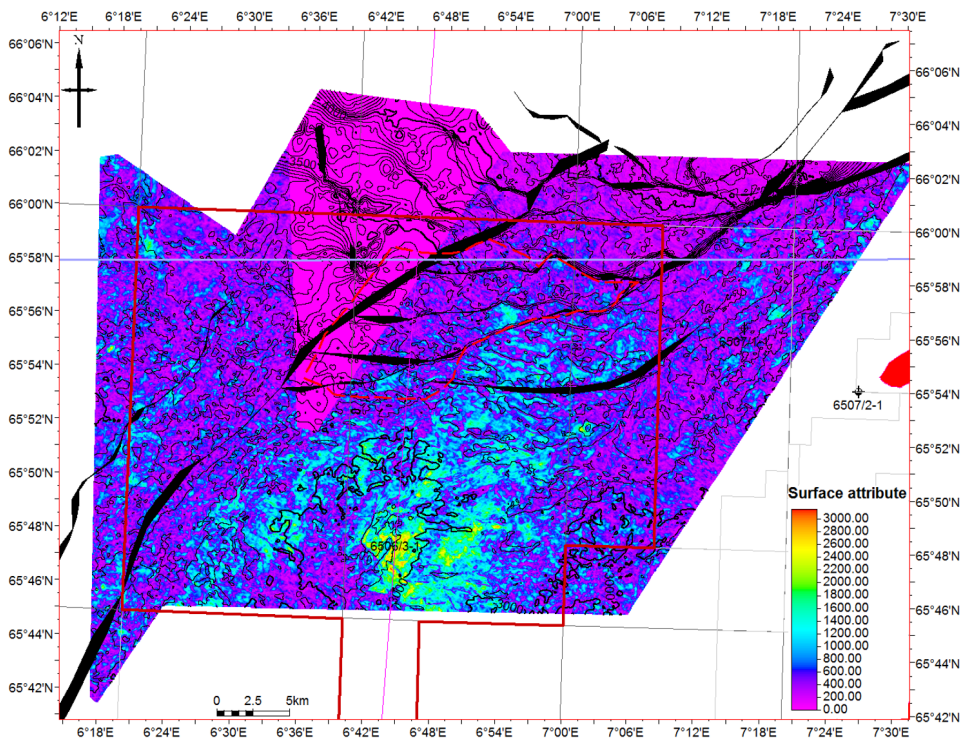


Fig. 4.3 PL 649 RMS Amplitude map Near Top Lysing on VNG13Mo1 seismic data

Fig. 4.4 shows a S-N line through the 6506/3-1 well from the application and Fig. 4.5 shows the reprocessed data along the same line. Fig. 4.6 shows a regional EW 2D line which was used at the time of application, while Fig. 4.7 shows the same line with MC3D Mid-Norway Mega Merge data, and Fig. 4.8 shows the VNG13Mo1 reprocessed version of the same line.

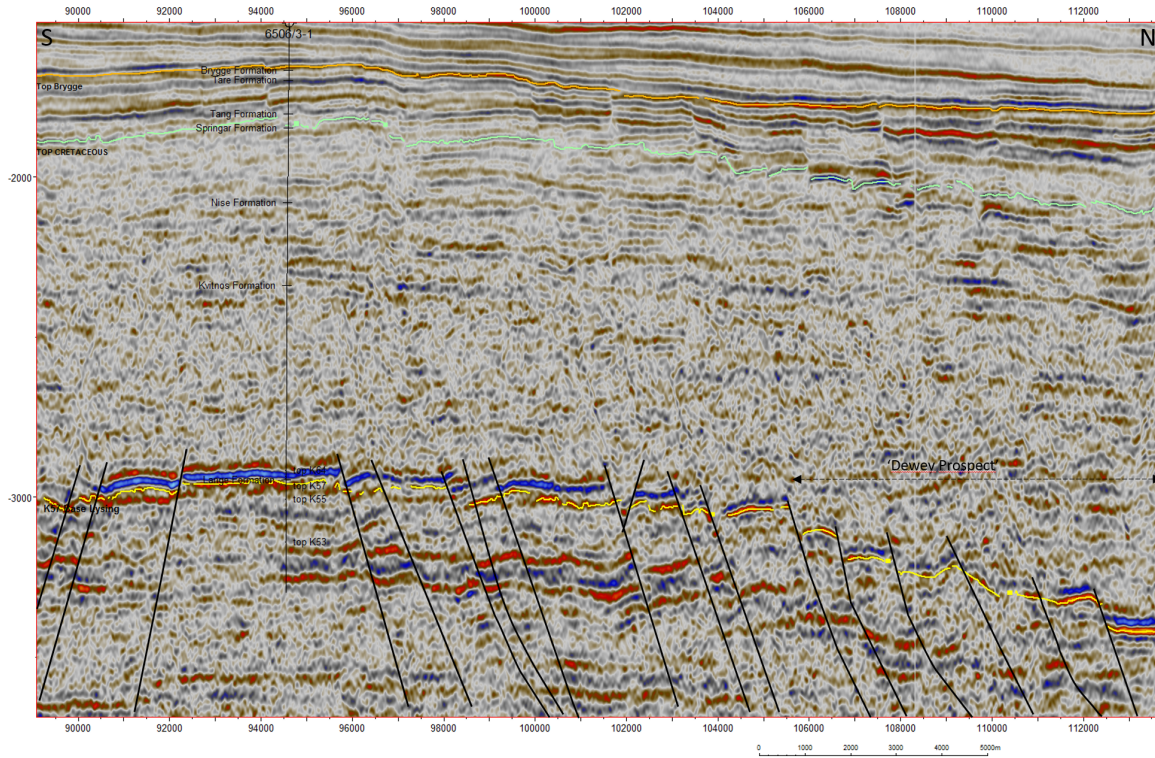


Fig. 4.4 MC3D Mid-Norway Mega merge S-N line. Line location is illustrated in Fig. 4.1

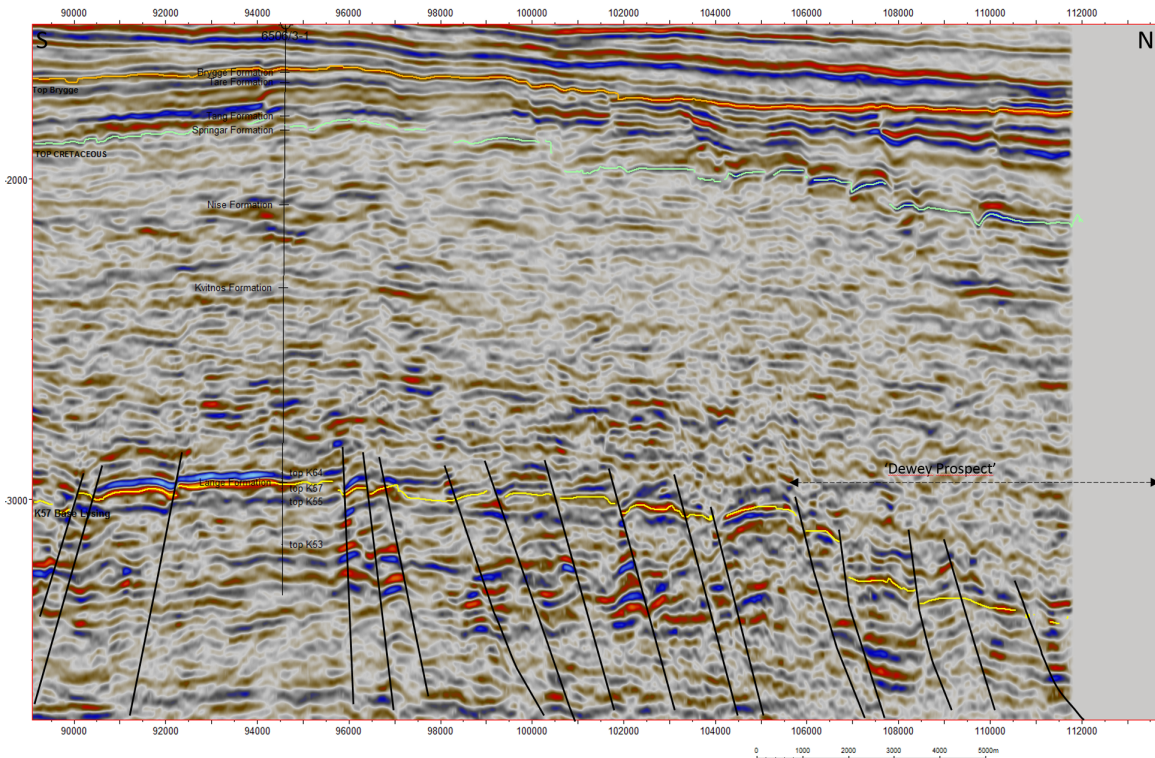


Fig. 4.5 VNG13Mo1 S-N line. Line location is illustrated in Fig. 4.1

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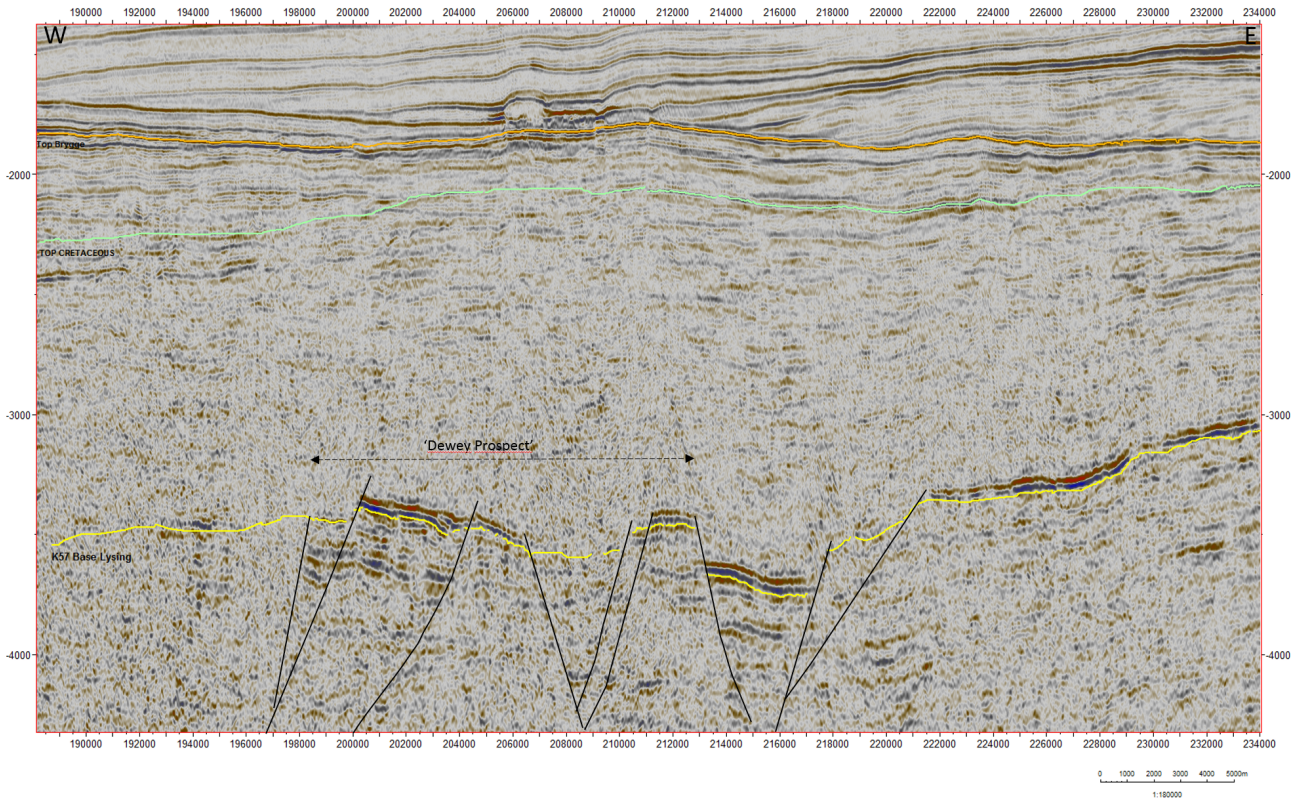


Fig. 4.6 MNR077319 W-E. Line location is illustrated in Fig. 4.1

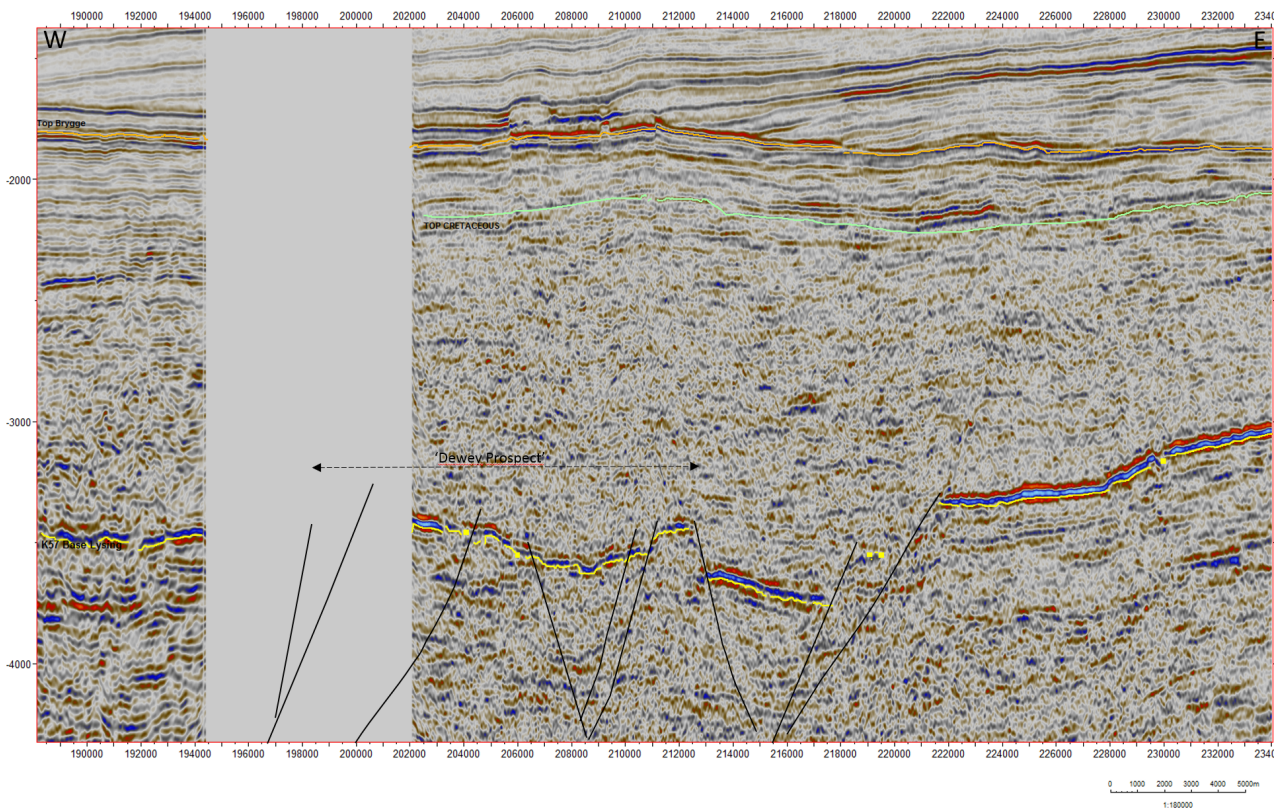
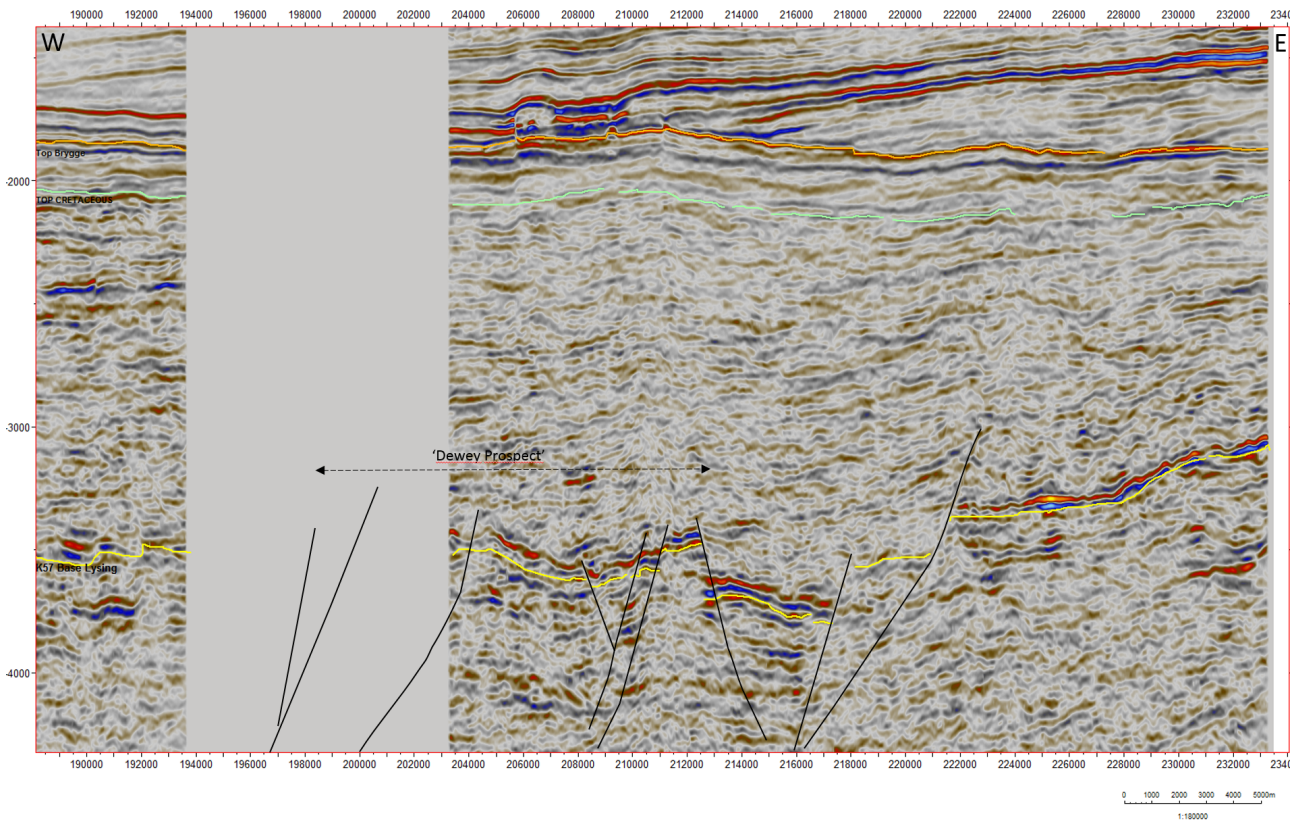


Fig. 4.7 W-E line MC3D Mid-Norway Mega Merge. Same position as MNR077319  
Line location is illustrated in Fig. 4.1

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**Fig. 4.8 W-E line 3D- VNG13Mo1. Same position as MNR077319. Line location is illustrated in Fig. 4.1**

The comparison of the lines from the application and reprocessed seismic shows how the seismic data quality did not improve with the performed reprocessing.

The result was an unanimous decision within the licence to relinquish without any prospect identified within the licence area.

## 5 Technical evaluations

No further technical evaluations has been performed after the application.

## 6 Conclusions

In light of the results from the dry Albert well (6506/6-2) which TD'ed in February 2013, the partners in PL 597 decided not to support VNG Norge in a drill decision with a well on the Herzer prospect. VNG was not able to mature Dewey to a drillable prospect in PL 649 and it was an unanimous agreement within the partnership to relinquish the licence in the management committee in December 2013.

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## 7 REFERENCES

VNG Application for Blocks 6506/2,3,6 (part), 6507/1 (part) and 2 (part) APA 2011.