PL590 Relinquishment report

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1. License History

1.1 Executive summary

PL590/Pl590B (Fig 1.1) is located in the Norwegian sea (Halten area), positioned east of the Grinda Graben, 15 km east of the Åsgard field and with a water depth of approximately 260 meters.

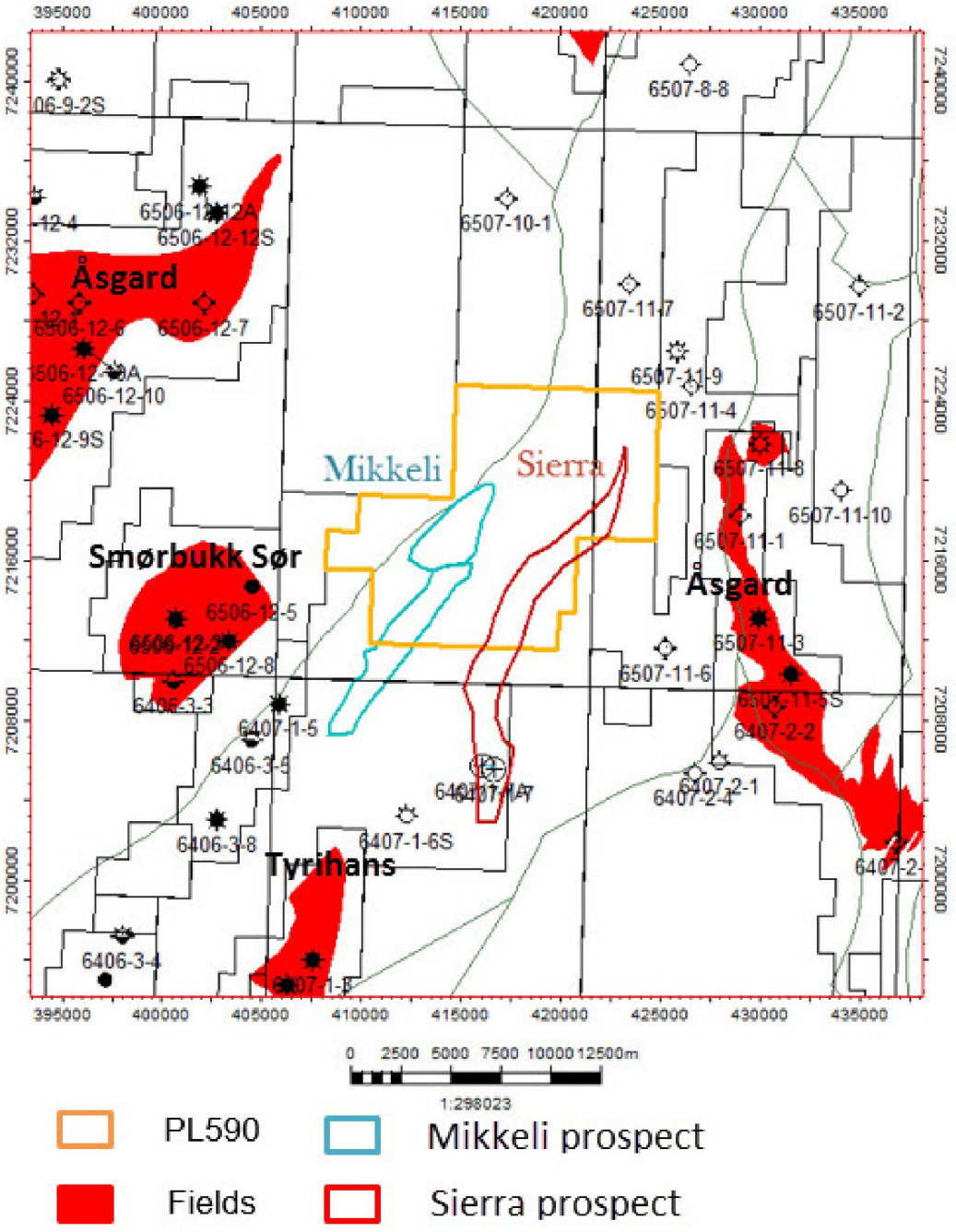

Figure 1.1 Map showing the PL590/590B licenced area. The evaluated Mikkeli and Sierra prospects is outlined on the figure

The play concept in the APA2010 application was the middle Jurassic Mikkeli prospect, a prospect formed by a rotated fault block in the Grinda Graben. An upside potential of the Mikkeli prospect is formed by the potential for faul seal up against the main Grinda Graben faults (Mikkeli Large). The main reservoir of the Mikkeli prospects is the representative shoreface sands of the Garn, Ile Formations, Tilje and Åre Formations was considered secondary targets. Top seal is provided by the Upper Jurasssic Melke and Spekk Fms. The main risks was considered to be the reservoir quality of the Garn sands and migration into the trap. Drilling of well 6407/1-6S in neighbouring license PL475 in 2012 changed the focus of the license to add to its prospectivity the Sierra Blålange Cretaceous prospect. The Sierra prospect changed the focus of the license and prompted the APA2013 extension PL590B.

The area was applied for in APA 2010 and the PL590 was awarded in February 2011. The extension PL590B was applied for in APA 2013 and awarded February 2014. Several comprehensive studies and acquisitions has been performed in order to reduce risk and establish viable economics.

The work programme has been fulfilled and the main objective were to reduce risk and understand prospectivity of the license. The first part of the work commitment was fulfilled with the purchase and reprocessing of already acquired 3D data into the new MGW98NER11 3D survey made up from the MGW98 and ST0614 surveys covering 543 square kilometres. This dataset made the license able to image the Mikkeli prospect better but also changed the view on the prospect to be to uncommercial.

Based on the gas/condensate discovery in 6407/1-6S in the neighbouring PL475 triggered production license PL590 to both seeks 1 year extension and apply for license extension in APA 2013. To better image the cretaceous section of the seismic the license decide to buy the multi-client data MC3D-HVG2011/HVG2013 and PGS14002. Well 6407/1-7A and its side track 1-7S which specifically targeted the amplitudes of the Blålange sands unlike the previous well 6407/1-6S, was however proven not to contain enough thickness of sand to make Sierra economically viable. The production license found the volumes of the Sierra prospect to be non-commercial and therefore dropped the license.

The evaluation of the MIkkeli prospect indicated that the likely p50 case resources is 4.1 * 10^6 Sm^3 of oe recoverable and the Sierra prospect indicated that the likely P50 case resources is 4.6 * 10^6 Sm^3 of oil recoverable.

2. Database

2.1 Seismic database

The original interpretation was based on the MC3D-MGW98 and PGS megamerge seismic surveys, and as part of the work commitment the MGW98NER11 3D seismic (Fig 2.1) was reprocessed, this survey is a merge of the seismic surveys MC3D-MGW98 and ST0614. In 2014 the PL590/590B purchased a mix of MC3D-HVG2011/2013 and PGS14002 to cover a relevant area of the license and all relevant wells for the maturation of the Sierra prospect. This seismic purchase covers a total for 343 square kilometres.

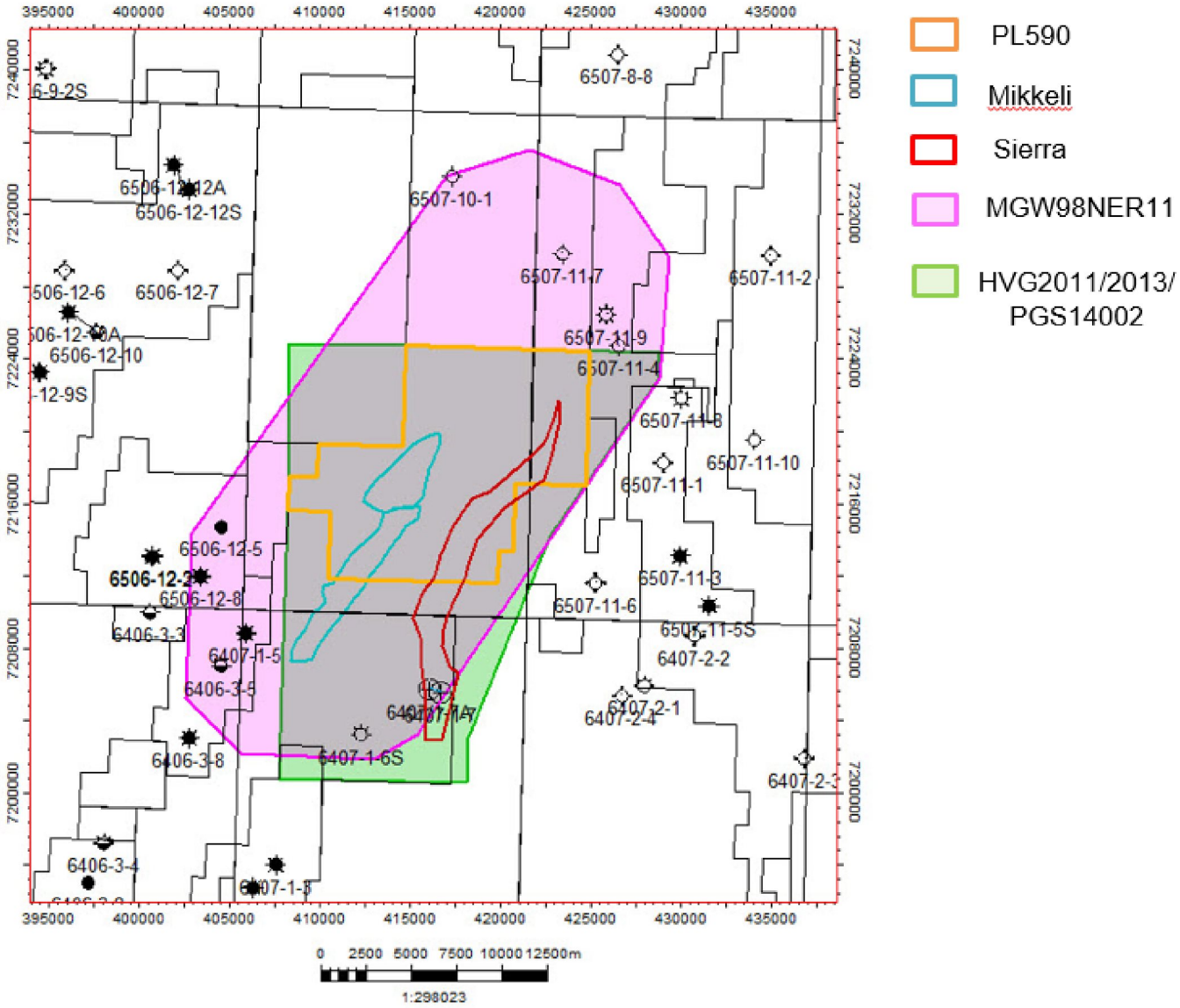

Figure 2.1 Seismic database PL590/590B

2.2 Well database

The key wells used for seismic to well ties, depth conversion, stratigraphic and petrophysical analysis are listed in table 2.1. The two wells 6407/1-6S and 6407/1-7 was traded with PL475 to enable the license to perform its evaluation the Cretaceous prospectivity

Tabell 2.1 Well database PL590/590B

Well	Year	Company	TD	Fm at TD	Status	HC zone	Name
6406/3-2	1986	Statoil	4523	Åre Fm	Oil	Garn Fm	Trestakk
6406/3-5	1988	Statoil	4283	Tilje Fm	Shows	(Fangst Gp)	*Lambda*
6407/1-2	1983	Statoil	4560	Grey beds	Gas/Condensate	Garn Fm	Tyrihans S
6407/1-3	1984	Statoil	4469	Grey beds	Oil/Gas	Fangst Gp	Tyrihans N
6407/1-6S	2013	Wintershall	4250	Ror	Gas/Condensate	Blålange Fm	Roderiguez
6407/1-7S	2014	WIntershall	3602	Kvitnos	Gas/Condensate	Blålange Fm	Solberg
6506/12-3	1985	Statoil	4360	Tilje Fm	Oil/Gas	Fangst Gp, Tilje Fm, Lysing	Smørbukk S
6506/12-5	1985	Statoil	4587	Åre Fm	Oil	Garn Fm, Lysing Fm	Smørbukk S
6506/12-8	1988	Statoil	4335	Tilje Fm	Oil/Gas	Fangst Gp, Tilje Fm	Smørbukk S
6507/7-1	1984	Conoco	4825	Tilje Fm	Gas shows	(Ile Fm)	
6507/7-3	1985	Conoco	2850	Åre Fm	Oil/Gas	Garn Fm	Heidrun
6507/7-4	1986	Conoco	2851	Tilje Fm	Oil/Gas	Ile Fm	Heidrun
6507/7-8	1987	Conoco	2855	Åre Fm	Oil/Gas	Garn Fm, Ile Fm	Heidrun
6507/7-11S	1997	Conoco	3749	Åre Fm	Dry	(Target Middle Jurassic)	Heidrun SW
6507/8-5	1991	Statoil	2000	Tilje Fm	Dry	(Target Middle Jurassic)	*Omega*
6507/10-1	1982	BP Norway	3693	Åre Fm	Dry	(Target Middle/Late Jurassic)	
6507/11-3	1985	Saga Petroleum	3250	Grey beds	Oil/Gas	Garn Fm, Ile Fm	Midgard
6507/11-4	1987	Saga Petroleum	3045	Tilje Fm	Dry	(Target Jurassic)	*Y-5*
6507/11-6	2001	Norsk Hydro	3440	Åre Fm	Gas/Condensate	Garn Fm	Sigrid
6507/11-7	2007	Norsk Hydro	2950	Lange Fm	Dry	(Target Lysing Fm strat trap)	*Zita*

3. Review of the geophysical Framework

3.1 Studies

Several comprehensive studies have been performed in the license since it was awarded in APA2010. The purpose of these studies was to gain knowledge of the geological and geophysical understanding of the hydrocarbon potential area. An overview of the studies is listed below:

- Inversion MGW98NER11 (in-house) 2012
- Inversion HVG2011/2013/PGS14002 (in-house) 2015
- Fault seal analysis MGWNER11 (RDR) 2012
- Pore pressure prediction (in house) 2012-13
- Reservoir study (in-house) 2011-12
- Basin modelling (in-house) 2012/2014
- Fault restoration (Midland Valley) 2015

3.2 Results of Block Evaluation

The initial evaluation done for the APA 2010, the probability of success was 0.56 for the Garn Fm. The main risk was the quality of the Garn reservoir and the migration into the trap through several faults.

Inversion studies was done on both vintages of 3D seismic and the low porosity of the Garn/Ile as expected showed no response in the Mikkeli prospect, while amplitudes in the lower cretaceous Blålange showed response as expected from a hydrocarbon fill. Thickness prediction from inversion results was considered to have low confidence.

Pore pressure analysis was performed with a geo hazard purpose to avoid potentially over reassured cretaceous sands on while drilling middle Jurassic targets. The results was that the slightly over pressured Cretaceous sands were well within the range to be dealt with efficiently in well planning.

The reservoir study was aimed at reducing the risk to reservoir quality in the deeper interpreted Garn Fm, and showed that both Garn and Ile Fm had the potential to have sufficient quality, while Tilje and Aare Fm was considered to have too low porosity/permeability.

The basin modelling show that the main source rock in the area is the Spekk and Aare Fm, and that the Mikkeli and Sierra prospect cannot be charged without faulting in the Grinda Graben.

The reprocessing of the MGW98NER11 showed that the Mikkeli trap was deeper than initially interpreted and changed the geometry of the trap. A fault seal analysis were performed to assess the sealing properties of the sealing faults in the Mikkeli prospect. The analysis showed a problematic seal towards the north western fault towards the western edge of the Grinda Graben. The study revealed a higher risk to the trap and lowered the column height potential significantly.

The fault restoration project done by Midland valley indicated that the amplitudes seen in the intra Blålange formation was not directly linked to thickness of sand as the depo centres as intra Blålange time has low correlation to them. This lowered the license belief that we would fin significantly more thickness of sand in the Sierra prospect compared to what was proven in 6407/1-7S well.

Following the studies performed in the license, Mikkeli now has a main risk in the trap and charge of the complicated fault structure. Final risk for Mikkeli Garn is 0.12.

The final risk after the 6407/1-7S well for the Sierra prospect is 0.34, with main risks being the vertical and horizontal seal of the trap (Blålange Fm). The main concern of the Sierra prospect was despite lower risk the reservoir thickness which never exceeded 12 meters.

4. Prospect update

4.1 Mikkeli prospect

At the time of application, with old public seismic the Mikkeli prospect was estimated in the order of 6.4 *10^6 Sm^3 oil (Table 4.1). Following the award North Energy carried out a full evaluation after the reprocessing of the MGW98NER11, and the recoverable volumes was reduced to 4.6 *10^6 Sm^3 oil (Table 4.2). The reason for this downgrade in volumes was the new interpretation performed on the MGW98NER11 seismic and the risks highlighted in the fault seal analysis. The Mikkeli prospect was considered below commercial threshold and was abandoned to pursue the newly interpreted prospect of Sierra following the well results in 6407/1-6S.

The Mikkeli prospect was interpreted on the Top Garn horizon (Figure 4.1)

Table 4.1 Mikkeli resource estimate APA2010

Discovery/ Prospect/ Lead name	D/ P/ L	Unrisked recoverable resources						Probability of discovery	Part in acreage applied for %	Reservoir		Distance to infra-structure (km)
		Oil 10^6Sm^3			Gas 10^9Sm^3					Litho-/ Chrono-stratigraphic level	Reservoir depth (m MSL)	
		Low	Base	High	Low	Base	High					
Mikkeli	P	3,30	6,40	10,30	1,00	2,20	4,00	0,56	90 %	Garn Formation / Bajocian	3800	21
Mikkeli Large Garn	L								90 %	Sinemurian- Bajocian	3650	21
Mikkeli Large Ile	L								100 %	Sinemurian- Bajocian	3800	21
Flintfjellet	L								100 %	Lyr Formation /Valangian	2950	25

Table 4.2 updated resource estimate for Mikkeli and Sierra

Prospect name	Case (oil/gas/oil&gas)	Unrisked recoverable resources						COS
		Oil (10^6Sm3)			Gas (10^9Sm3)			
		Low (P90)	Base (P50)	High (P10)	Low (P90)	Base (P50)	High (P10)	
Mikkeli Garn	O	2,97	4,40	6,39	0,13	0,22	0,36	0.12
Sierra, Blålange	G	0,38	0,68	1,14	2,10	3,60	5,84	0.34

4.2 Sierra prospect

At the time of APA2013 extension application the Sierra prospect was estimated in the order of 8.4 *10^6 Sm^3 OE (gas/condensate) (Table 4.3) Following the award North Energy carried out a full evaluation and with the results of the 6407/1-7S well, the recoverable volume was reduced to 4.1 *10^6 Sm^3 OE (Table 4.2) due to the thin nature of the Blålange sandstones. The Sierra prospect was also considered to be below commercial threshold and the license decided to go for a drop decision.

The Sierra prospect was interpreted on the intra Blålange reflector with sand both above and below the reflector (Figure 4.2)

Table 4.3 Sierra resource estimate APA 2013

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] (0.0 - 100.0)	Reservoir		Nearest relevant infrastructure [8]	
			Oil [10^6Sm^3] (>0.00)			Gas [10^9Sm^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)						
16/7 Sierra	P	Gas	0,99	1,69	2,51	5,94	9,35	13,40	0,16	20,0	Blaalange Fm /Lower Cretaceous	2800	Åsgard	12

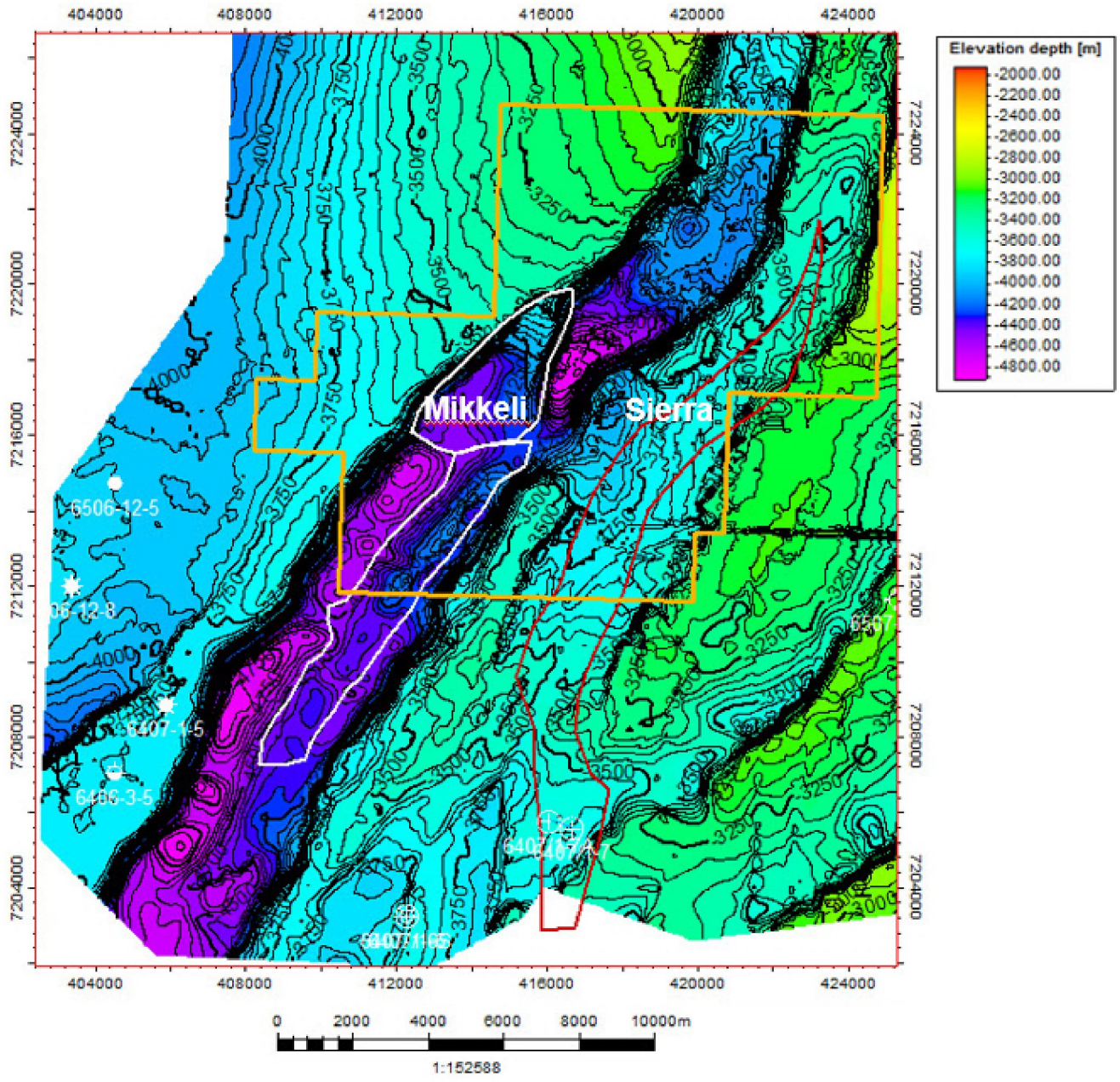

Figure 4.1 Depth map of the Garn formation showing the Mikkeli prospect

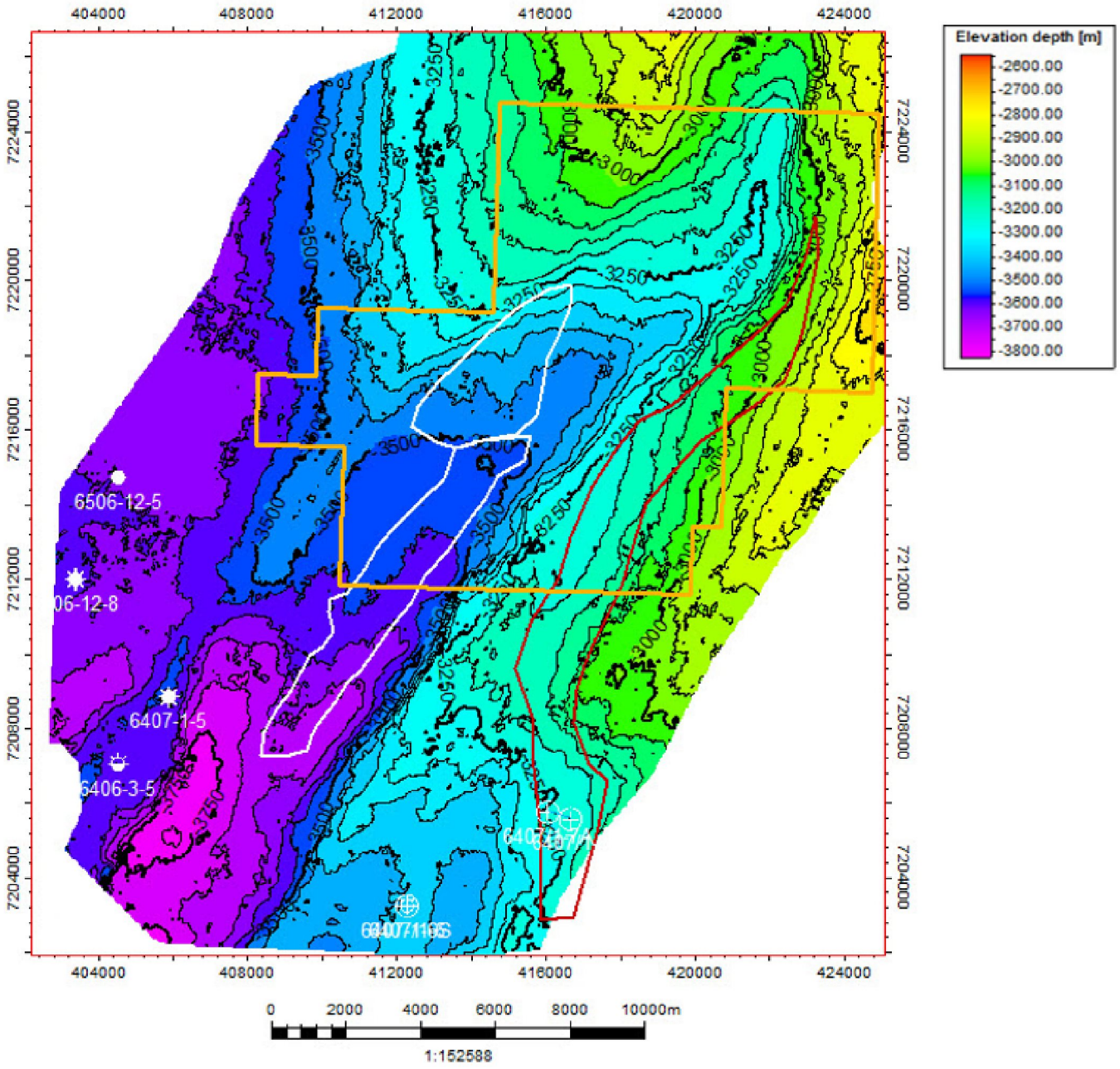

Figure 4.2 Depth map Intra Blålange sst showing Sierra prospect

5 Technical evaluation

PL590/590B is located around the Grinda Graben with a water depth between 270 to 300 m, it's a mature area of the Norwegian Sea close to existing infra structure. The nearest existing oil and gas processing facilities is the Åsgard A and B located 20-25 km east of the license. Electricity from Åsgard would be used to power the tie back solution with only minor alterations needed for the tieback.

Sierra would be a tie back development to Åsgard B (Figure 5.2), with the condensate faction (15%) would be being extracted and sent to Åsgard C, and the gas would be transported with pipeline to Åsgard B with connection to the Åsgard Transportation pipeline to Kårstø.

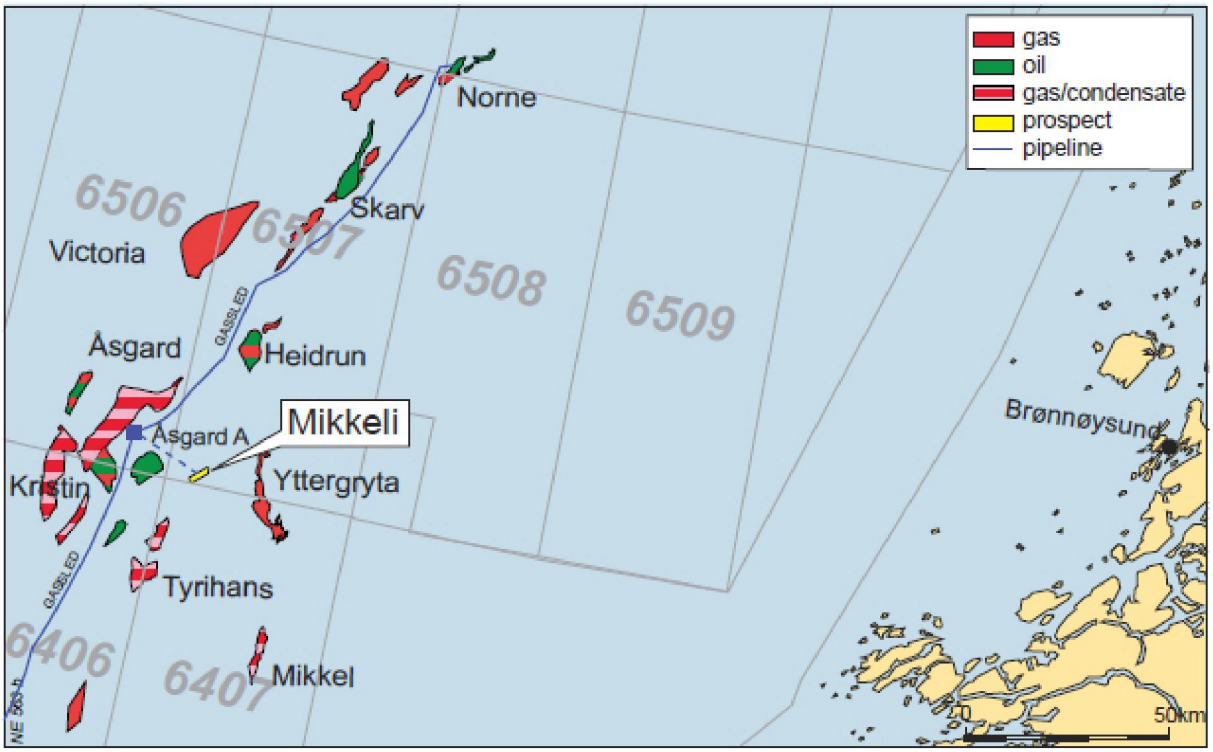

Figure 5.1 Mikkeli main development solution

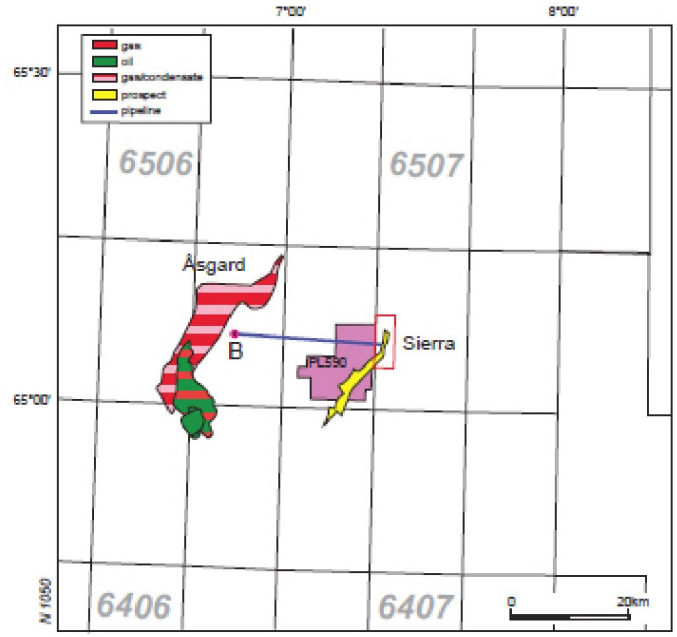

Figure 5.2 Sierra main development solution

6 Conclusions

The full G&G technical evaluation carried out by the operator has concluded with:

- Reduction in total recoverable in both Mikkeli and Sierra with 50% comparing to the applications in APA 2010 and 2013.
- The Flintfjellet lead was found to be unprospective
- The main risk of the Mikkeli changed from reservoir quality to trap efficiency due to reinterpretation
- The volumes in both the Mikkeli and Sierra prospects are below economic minimum

The recommendation to relinquish is based on this evaluation and concluded that there are no more viable exploration targets within the PL590 license at present.