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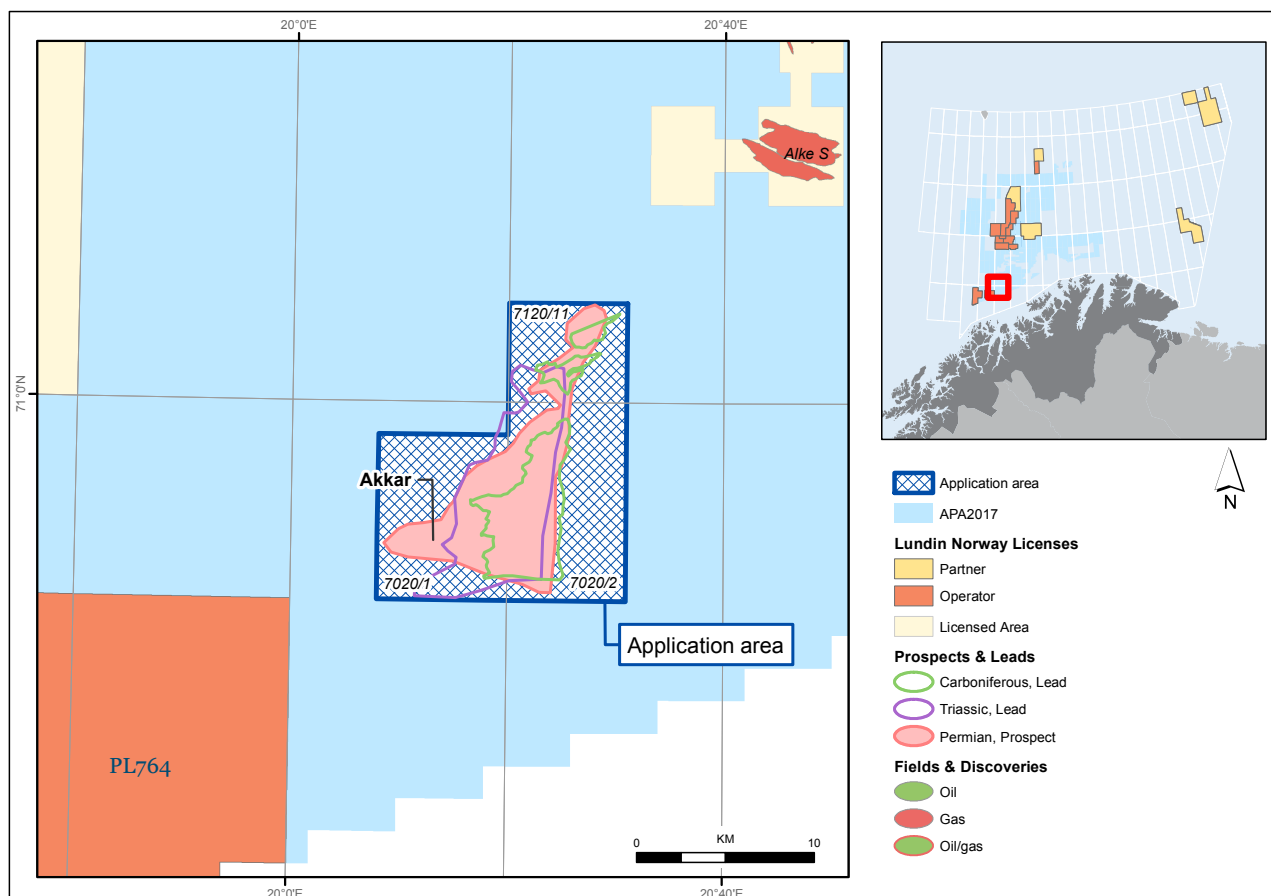


Fig. 1.2 APA2017 Akkar prospects and leads

Charge was expected from local source rocks in the Permian Ørret Fm and speculative sources in the Carboniferous Billefjorden Gp. Complex charge across the Troms Finnmark Fault Complex from Triassic or remigrated Hekkingen sources is regarded as having a higher risk.

The licence commitment to acquire and reprocess TGS FP13 3D survey is fulfilled. Based on the uplift in data quality of reprocessed TGS FP13LNR17 in PL764, a similar processing sequence was applied in PL950. The reprocessed FP13LNR18 shows improved imaging, but does not have sufficient resolution to de-risk the critical apex area including the canyon fill.

The interpretation of reprocessed 3D seismic data together with geological/geophysical studies such as: a petroleum system analysis, a gravity and magnetic modelling, and a structural fault seal analysis has not de-risked the Akkar prospect. The results of the grav/mag modelling are negative with respect to presence of the Billefjorden local source rocks under and on the flanks of the Akkar horst. Geochemical studies and resampling of material from the key wells 7120/12-4 and 7120/12-2 show poor source rock quality of the lower Triassic and Permian mudrocks. Based on the results of structural studies performed by Badley Geoscience and Inpex, Akkar is now defined as a structural/stratigraphic trap relying on a sealing fault and canyon infill. This is an additional risk factor, due to the poorly resolved canyon fill by the seismic data.

The remaining prospectivity consists of marginal to non-economical volumes with an associated high risk. The license group therefore agreed to relinquish the licence.

1.2 Award and work program

PL950 was awarded 02.03.2018 (APA 2017) to Lundin as operator (50%), INPEX Norge (30%) and Petoro (20%).

The work program was to acquire and/or reprocess 3D seismic with a drill or drop decision within 2 years (02.03.2020).

1.3 Identified prospectivity APA 2017

Akkar is a multi-target closure containing one Permian prospect and two leads (Carboniferous/Basement and Triassic) (Fig. 1.2). The gentle, northwestwardly dipping Akkar horst is delineated by faults to the east and south (Lundin, 2017). The NW-SE striking fault has limited throw down to the south. The primary reservoir target is Late Permian siliciclastic sandstones of the Ørret Fm. Good reservoir properties were encountered in Well 7120/12-4 12 km NE from Akkar. The well tested a stratigraphic trap but was dry with no shows. The secondary targets (leads) are Carboniferous-Basement, and lower-mid Triassic (Havert and Kobbe Fms) sandstones. Charge is expected from local source rocks in the Permian Tempelfjorden and speculative Billefjorden sources. Complex charge across the Troms Finnmark Fault Complex from Triassic or re-migrated Hekkingen sources is regarded as higher risk.

Akkar Ørret prospect

The Akkar Ørret prospect has an areal closure of 51 km² with the apex at 1250 m. An oil case with a gas cap is evaluated with oil contacts (P90-P10) at 1300 - 1500 - 1600 m (Fig. 1.3, Fig. 1.4, Fig. 1.5, Fig. 1.6).

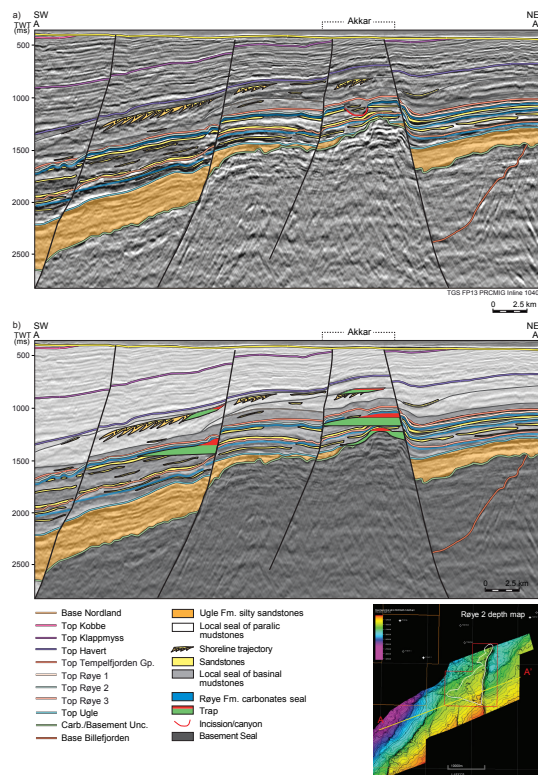


Fig. 1.3 Akkar prospect geoseismic profile
 Illustrates the structure, target reservoirs and seal

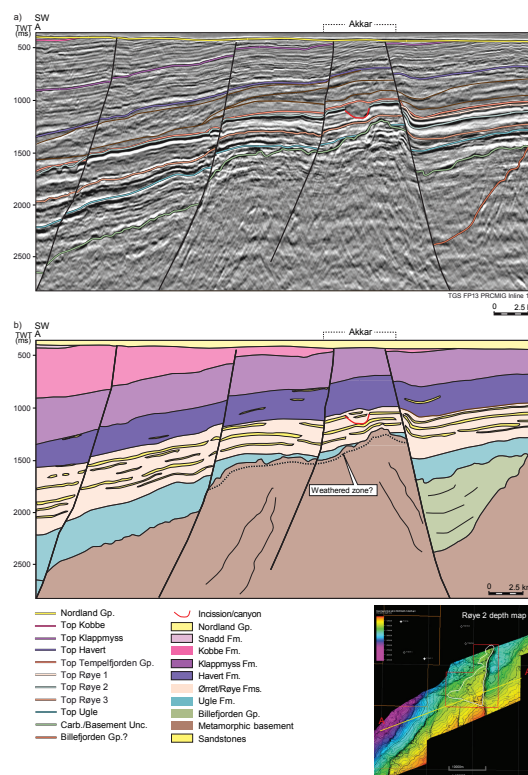


Fig. 1.4 Akkar prospect geoseismic profile
 Illustrates the target reservoirs

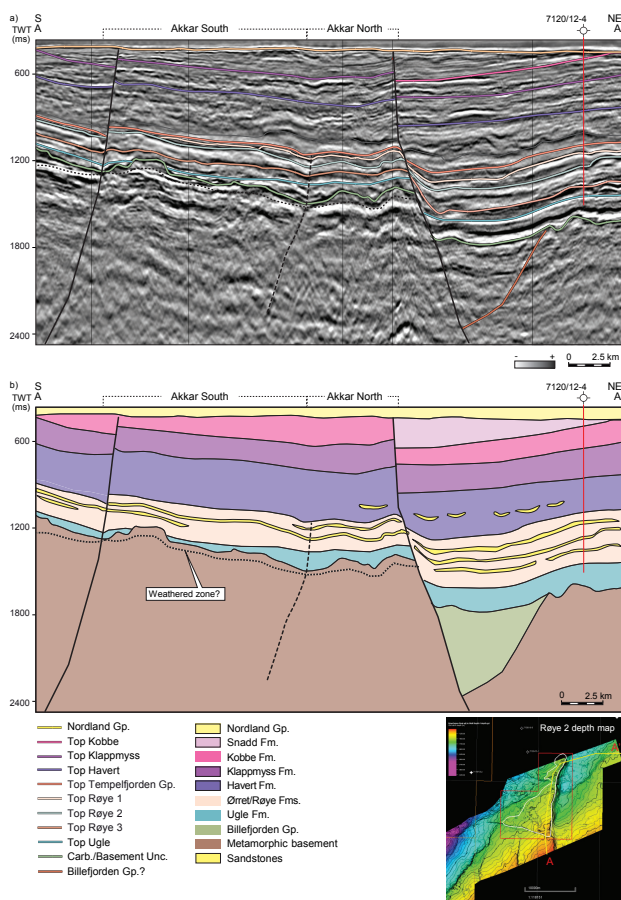


Fig. 1.5 Akkar prospect geoseismic profile Illustrate the structure and target reservoirs

20%. The reservoirs interfinger with Ørret Fm mudrocks and Røye Fm spiculitic carbonates, which provide the seal. The Ørret Fm reservoirs are truncated by a canyon, covering a 12 km² area of the prospect. The incision varies across the structure, but the lower part of Ørret3 unit is preserved. The lithology of this canyon is unclear, but is believed to be younger Ørret Fm interbedded sandstones and mudrocks in addition to Havert Fm predominantly mudrocks. The prospect will be segmented and volumes smaller, if the entire canyon is mud-filled. The interpretation of well 7120/12-4 and seismic data revealed three sequences of the Ørret Fm sandstones. No DHI's are observed. However, the seismic response is complex and there may be tuning effects.

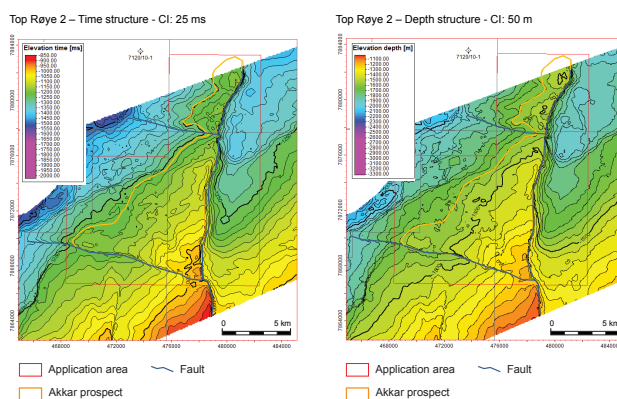
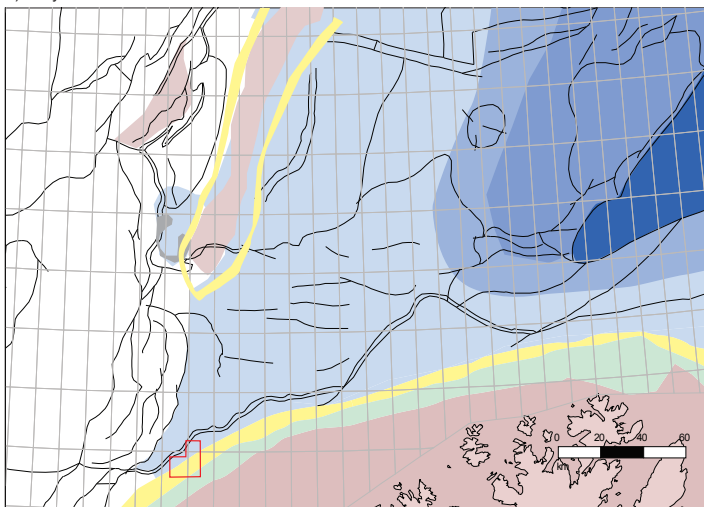


Fig. 1.6 Akkar - Ørret Fm prospect time and depth structures Illustrates the Akkar structure in time (left) and depth (right). The outline of the prospect shows the maximum contact at 1600 m.

In the licence area, relatively coarse siliciclastic sediments of the Ørret Fm are deposited in a fluvio-deltaic environment derived from Fennoscandia. The sandstones are interbedded with spiculitic carbonate beds deposited as inner ramps (Fig. 1.7). At least five cycles of progradation are identified with HST sandstones of shoreface or distributary sandstones with coals of delta top origin, overlain and interbedded with TST spiculitic carbonates. The sandstones in the Ørret3 unit constitute the main reservoir. The well 7120/12-4 proved 48 m gross (36 m net) sandstones in Ørret3 with a porosity range of 16 -

a) Røye Fm. 3/Ørret Fm. 3



b) Røye Fm. 2/Ørret Fm. 2

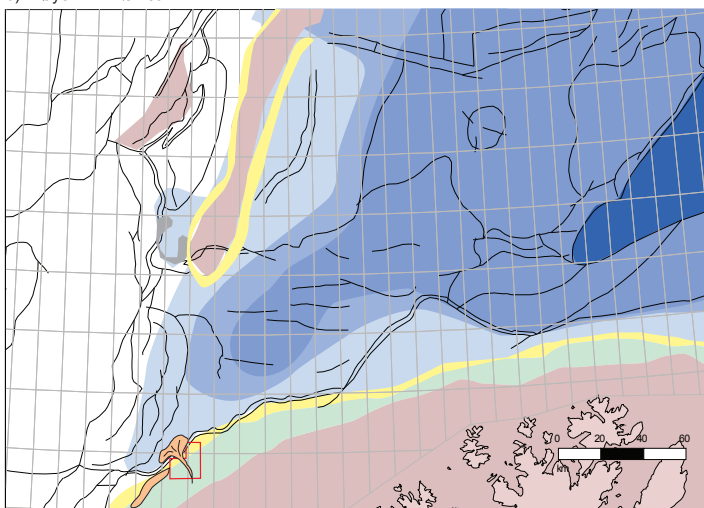


Fig. 1.7 Late Permian paleogeography

Prospect probability is listed in Table 1.1. Main risk factors are: Source rock presence and charge. In addition poor imaging of the prospect apex with intersecting faults and a canyon cut with uncertain stratigraphic fill.

Table 1.1 Akkar discovery probability

Discovery probability	Reservoir	Trap	Charge	Retention	Probability
Akkar	0,67	0,5	0,5	0,9	0,15

Leads

Akkar Carboniferous-Basement Lead

A secondary and speculative play is identified in the Akkar structure (Fig. 1.8, Fig. 1.9). The Ugle Fm is proposed to contain reservoir facies in possible exposed and weathered basement rocks. The Ugle Fm was cored in Well 7120/12-4 and shows a reddish weathered silt- and mudstones with poor to no reservoir properties. The well did not penetrate the interpreted Carboniferous/Basement Unc. surface. A prominent relief with NWSE trending ridges and valleys is observed in the Akkar horst and may contain sandy alluvial deposits. The trap depends on fault seal. Areal extent: 28 km² (Akkar South), 4-way closure: 2 km². The apex is at 1500 m. Possible reservoir thickness of 100 m.

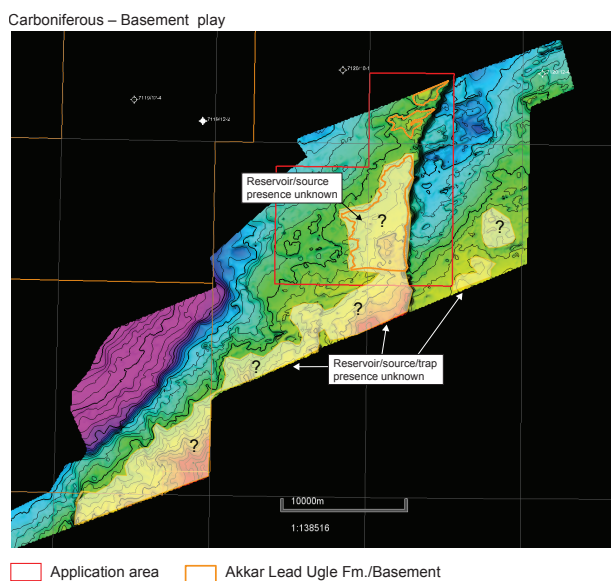


Fig. 1.8 Carboniferous - Basement play

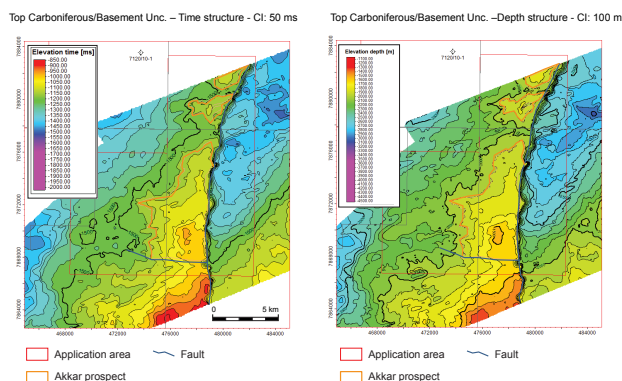


Fig. 1.9 Akkar Carboniferous/Basement Unc. prospect structural maps The maps illustrates the time (left) and depth (right) structural closures

Uncertain deterministic volumes are calculated and show a potential of inplace oil of 11-113 MSm³.

Akkar lead - Havert Fm

This secondary and speculative play is identified in the westernmost part of Akkar (Fig. 1.10). The nearby wells (7120/12-4 and 7120/12-2) show poor reservoir development. However, wells in the eastern Finnmark Platform encountered better reservoir quality in sediments derived from Fennoscandia. Wells 7122/7-3 (Goliat), 7128/4-1, 7128/6-1 and the recent 7130/4-1 (Ørnen) proved good reservoir quality in clinoform topsets of prograding deltas (60-80 m with 15-20% porosity). None of the wells proved hydrocarbons in the Havert Fm reservoirs, but may not have been optimally located to test this play. In the westernmost part of Akkar closure the observed clinoforms prograde towards the NW and W. The trapping mechanism depends on a stratigraphic pinch-out to the SE and S. It was not possible to define a trap with the current poor seismic coverage and quality of the Triassic succession. A potential outline of a Top Havert closure is illustrated in the structural time map (Fig. 1.11, Fig. 1.12).

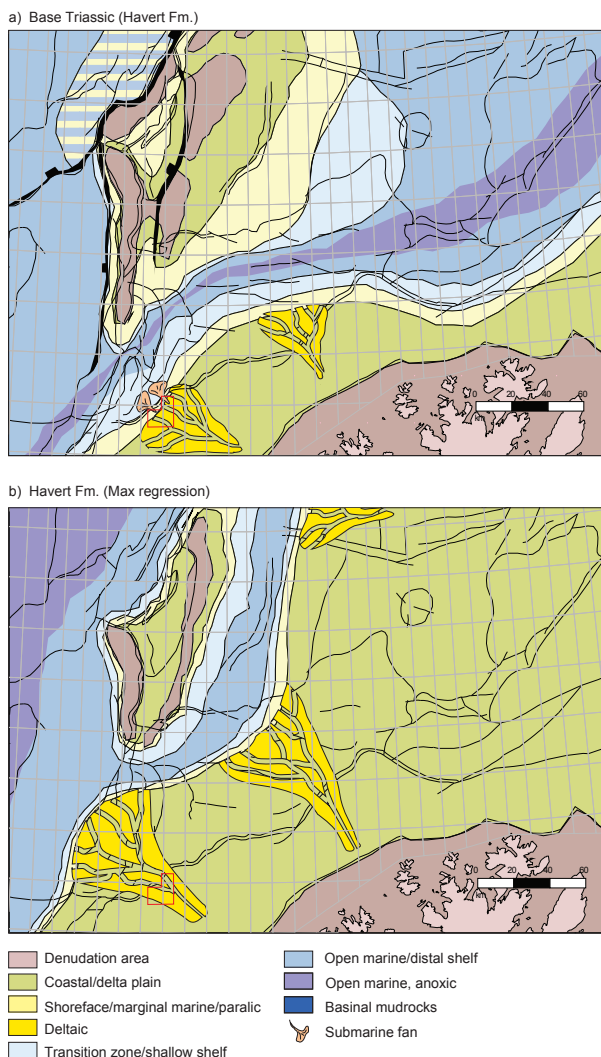


Fig. 1.10 Paleogeographic reconstruction of the Lower Triassic

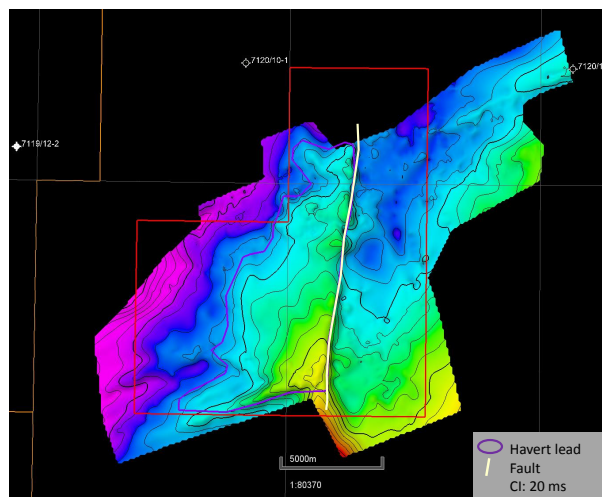


Fig. 1.11 Akkar lead - Havert fm The structural TWT map illustrates a possible closure of the Top Havert. The best reservoir is expected in the western part of the closure.

The areal extent of the lead is 54 km².

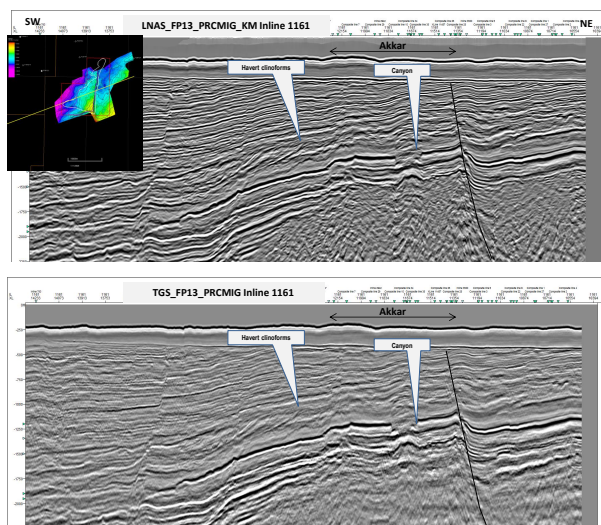


Fig. 1.12 Akkar lead - Havert Fm clinoforms Induan clinoforms are seen in the western part of the application area. The Upper seismic TWT profile is a Lundin improved version of the TGS PRCMIG TWT data seen below. A better imaging is required to map out the Havert Fm prospectivity.

2 Database

2.1 Seismic database

The seismic 3D data set used in the evaluation of the PL950 area is the TGS multiclient FP13 (Fig. 2.1). In addition the seismic database comprises public and purchased 2D data. The data quality of the 3D FP13 survey was poor due to severe multiple noise. Based on the uplift in data quality of reprocessed TGS FP13LNR17 in PL764, a similar processing sequence was applied in PL950 (TGS, 2018). The reprocessed FP13LNR18 shows improved imaging, but not sufficient resolution to de-risk the critical apex area and the canyon fill lithology. The additional Lundin post stack processing products were also helpful in the evaluation.

The licence commitment to acquire and reprocess TGS FP13 3D survey is fulfilled. (Fig. 2.1).

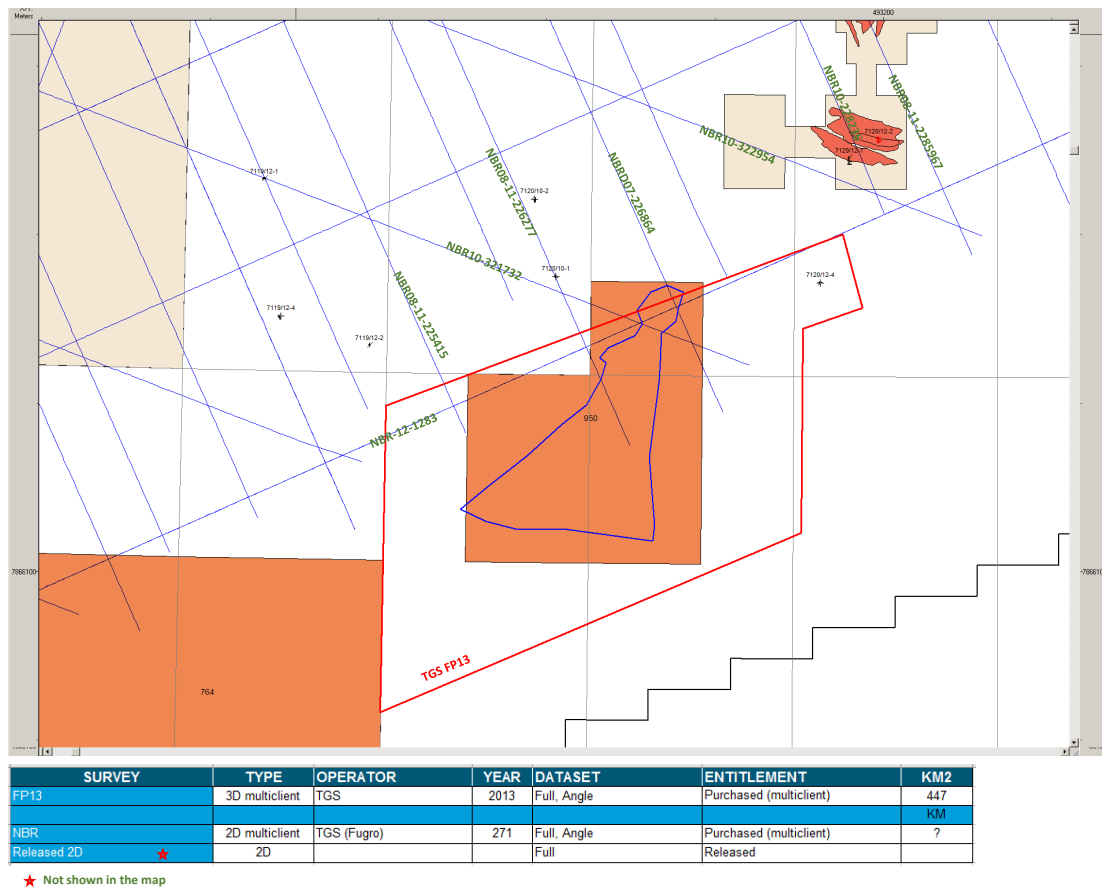


Fig. 2.1 PL950 common seismic database Outline of common TGS FP13 (reprocessed survey name FP13LNR18).

2.2 Well database

The well database utilized in the licence work is shown in Fig. 2.2

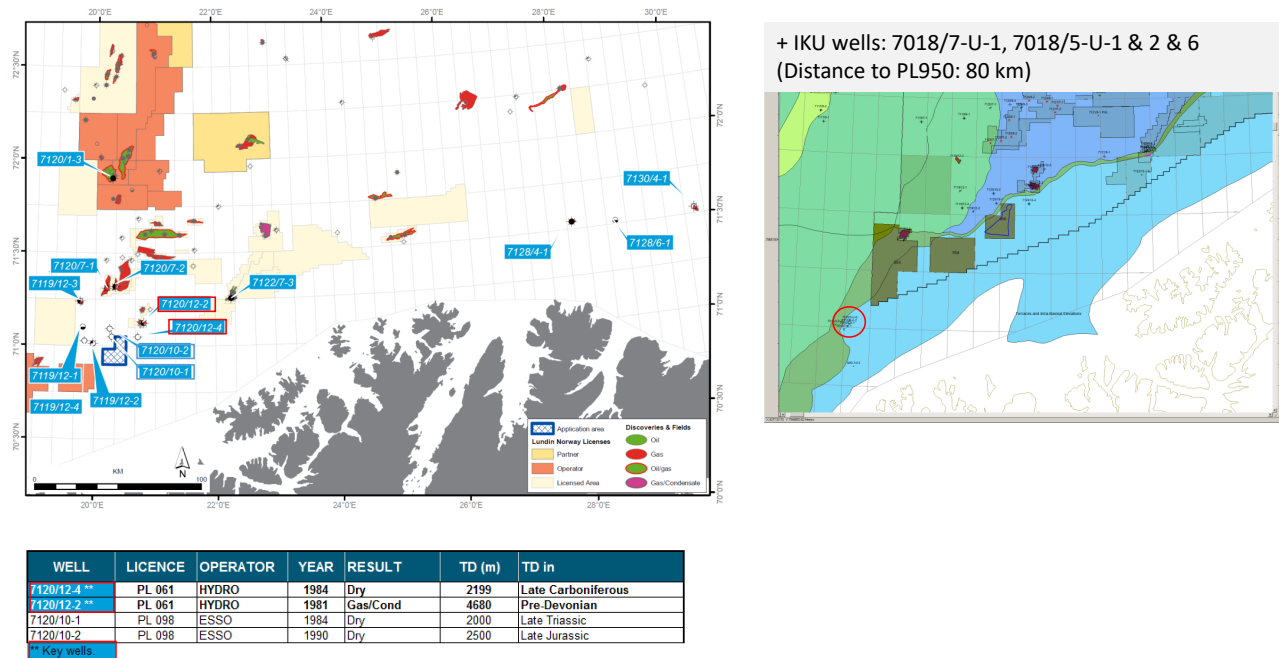


Fig. 2.2 PL950 well database

2.3 Special studies

Seismic Processing 3D FP13LNR18 (TGS, 2018)

Conclusions

A high-quality dataset with improved imaging and resolution through key target areas has been produced, especially when compared to previous processing. This success was primarily due to the following:

- Clari-Fi *Totus*™ processing at 2ms, significantly enhancing the frequency bandwidth, thereby improving the resolution of events and fault definition.
- An extensive and robust demultiple sequence, employing 2D SRME/SWME, SMELT™, multi-domain Tau-p deconvolution and high-resolution Radon.
- Careful iterative manual velocity picking, on de-sampled but fully 3D migrated data, to generate an accurate 1km velocity field. These velocities were used to drive migration, and after, used by the structural auto-picker at every CMP location to provide a dense velocity field for stacking. This detailed velocity appraisal was essential in providing a good image for interpretation.
- Extensive multi-domain noise attenuation on a particularly noisy dataset - addressing swell, linear, seismic interference and diffracted multiple noise - to enhance the final image for interpretation.
- Implementation of time and space varying inverse amplitude Q pre-stack – enhancing resolution and frequency content across different geological events.

Post stack processing (Lundin, 2019):

The following post stack processing products were produced:

- Structural oriented de-noising: Smoothed along the structural events plus frequency character boost (spectral whitening).
- Relative amplitude volume: Blends relative impedance with sharpened reflection data.
- Fault likelihood volume: Values range from 0 to 1 are defined as $1-s^3$ (where s is the structure oriented semblance).
- Structural oriented de-noising: Smoothed along the structural events plus frequency character boost (spectral whitening).
- Relative amplitude volume: Blends relative impedance with sharpened reflection data.
- Fault likelihood volume: Values range from 0 to 1 are defined as $1-s^3$ (where s is the structure oriented semblance).

Fluid Inclusion study (UIB, 2018)

Wells 7120/12-2, 7120/12-4, 7018/5-U-1 and 7018/5-U-6

Objectives:

- Screening for hydrocarbon fluid inclusions (HCFIs) and aqueous fluid inclusions (AQFIs).
- Microthermometry. Homogenisation temperature (T_h) and melting point temperature (T_m) of AQFIs
- Interpretation of burial temperature, burial depth and chemical environment

Conclusions and summary

1. Hydrocarbon charge observed in the wells 7018/5-U-6 and 7120/12-2 by HCFIs trapping confirm only a single type of oil fluorescing blue/whitish under UV-light. Only traces and very scattered occurrences of HCFIs suggest restriction of fluid flow due to pore cementation.
2. The shallow drilling wells have signature of deep burial history.
3. The absence of HCFIs trapped in quartz overgrowths cement at overgrowths boundary suggest trapping after main quartz cementation.

Petroleum system analysis

New samples have been collected and analysed without proving oil prone source rocks (TOC 1 or less) (APT, 2018).

Summary

Several source rocks are possible candidates to charge traps in PL950:

Lower Carboniferous, Upper Permian, Lower-Mid Triassic, Upper Jurassic

- Kobbe-oil in Goliat proves Triassic source rocks in the Hammerfest Basin
- No Palaeozoic or Triassic source rocks proven in closest offset wells
- Source rock presence in the PL950 area remains speculative

Basin modelling results

- Carboniferous-Permian potential hydrocarbon kitchens identified on the Finnmark Platform/ PL950 area, but limited oil charge to PL950 using source rock parameters from local wells.
- Charge from Triassic-Jurassic kitchens in Hammerfest Basin is possible, but migration into PL950 prospects via TFFC may be limited by small kitchen sizes/moderately mature source rocks

Grav/Mag modelling (Lundin, 2019)

A 2D GravMag modelling was performed by Lundin on FP13LNR18 inlines 2715 and 2200.

Summary of modelling results:

- Unlikely with a deep Top Basement east of major fault at the Akkar eastern border. This would respond in significant gravity and magnetic lows, not in agreement with observed data.
- Consequently, there is no space for deep sediments, i.e. Billefjorden Gp between Røye 3 and Basement. The Ugle Fm does not affect model response in a significant degree.
- Modelling of Top Basement alone cannot satisfy observed anomalies. Modelling has demonstrated that this gives rise to a Basement relief incompatible with seismic fabric.
- For best results, basement needs to be sub-divided into units with different properties; something that might reflect distribution of a Precambrian intrusives/metamorphic (more dense and magnetic) and Caledonian basement-units. Such a setting is in agreement with observed lithology onshore Finnmark.
- Resulting Basement depth estimates in the interval 1.7 –2.9 km below MSL along 2200 & 2715 seismic lines.

Fault seal analysis (Badleys, 2019)

An overview of Akkar prospect, faults- and surface interpretation was given as input to the structural study (Fig. 2.3). Additional input was a pseudo-well with a constructed Vshale log, based on key well 7120/12-4 but adjusted to fit the predicted lithology in the Akkar prospect.

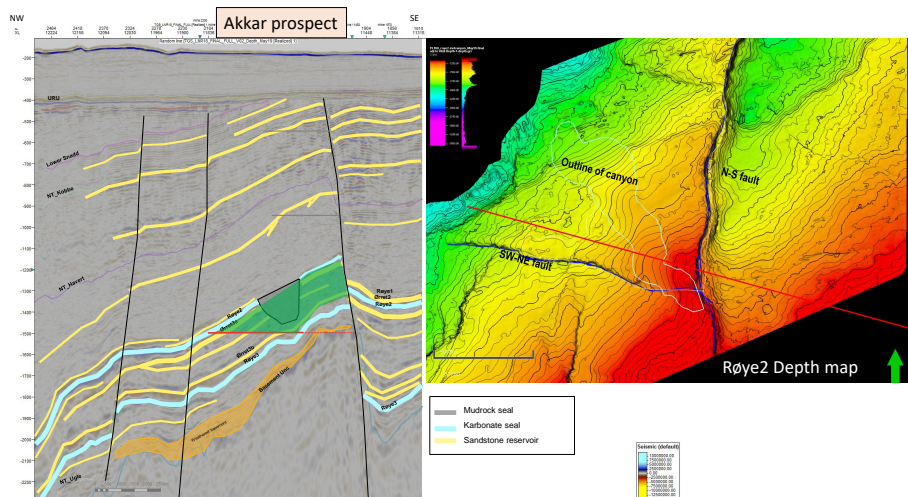


Fig. 2.3 Akkar Ørret prospect Geoseismic depth profile and Røye2 depth map given as input to the fault seal study

Results and summary

In the summary it is assumed, that the canyon will act as a side seal (Fig. 2.4).

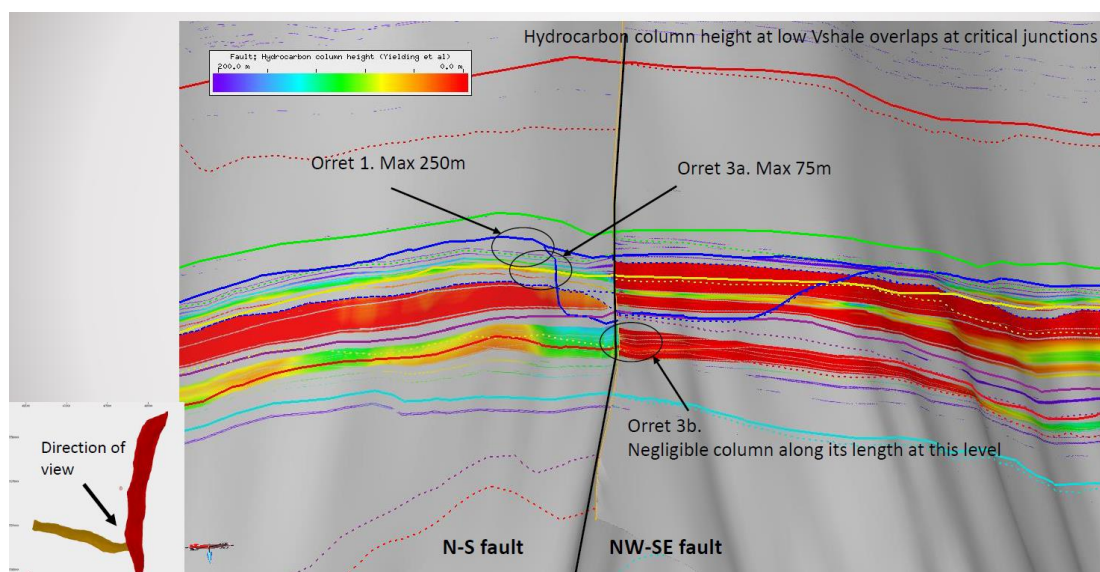


Fig. 2.4 Summary fault seal analysis Assumed that the canyon will act as side seal.

Ørret1: 250 m column?? Uncertain results!

Ørret3a: 75 m column

Ørret3b: No column

Ørret1. The faults here are strong seals owing to the presence of shale within and above the unit. A column of c.250 m is predicted at the junction with the canyon on the N-S trending fault (1170 m depth), filling to a maximum c.1420 m depth (not to structural spill, but potentially present at the pseudo-well location if filled to maximum). The results are uncertain for this unit, due to poor interpretation. Ørret1 is cut by the canyon according to Lundin.

Ørret3a is cut by the canyon, hence this unit does not occur at the intersection of the two faults (Fig. 2.5). At the contact with the N-S fault the maximum column height is predicted to be 75m where it juxtaposes against sand on the hanging wall side of the structure (weak seal). Assuming the canyon is completely sealing, the maximum fill produces a down to a 1280 m depth, not penetrated by the pseudo-well.

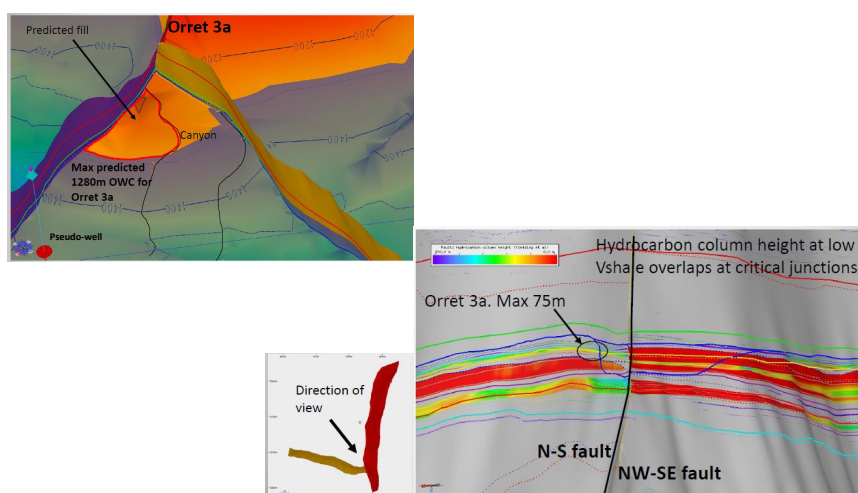


Fig. 2.5 Fault seal and predicted fill Ørret3a The Orret3a is cut by the canyon, hence this unit does not occur at the intersection of the two faults. At the contact with the N-S fault the maximum column height is predicted to be 75m where it juxtaposes against sand on the HW side of the structure (weak seal). Assuming the canyon is completely sealing, the maximum fill produces a down to of 1280 m depth, not penetrated by the pseudo-well.

Ørret3b. Whilst the N-S fault here could support reasonable columns, the low throw on the NW-SE trending fault (even at its maximum of ~75m throw where seismically resolvable away from the canyon) means that the column supportable is negligible at the level of the Ørret3b sands where they self-juxtapose across this structure. It may form a baffle but not a barrier.

Sedimentology and reservoir quality, well cores 7120/12-4 (Cambridge Carbonates, 2018)

7120/12-4 contains 3 cores from the Ugle, Røye and Ørret Formations.

The Ugle Formation (core 3) consists of fine sandstone and siltstone red beds that were deposited in a fluvial setting. Fine and medium sandstones were deposited in overbank settings as crevasse splay and channel levees. These were initially deposited in bodies of standing water in which the sediment was bioturbated. Siltstones were deposited in more distal over bank settings in ephemeral bodies of standing water. The environment subsequently dried out and was colonized by plants with the development of rhizcretions and calcrete. There is minimal reservoir quality within the Ugle Formation, the sandstones are matrix rich; detrital grains are commonly coated by hematite and the development of calcrete within the sandstones has further reduced the interparticle porosity.

The Røye Formation (core 2) consists of bioclastic limestones and sponge spiculite deposition on the mid- to deep part of a carbonate ramp below storm wave base. There is minimal reservoir quality within the Røye Formation; bioclastic limestones are compacted and have been cemented by crinoid overgrowths, the spiculite also contains minimal porosity having been cemented by silica.

The Ørret Formation (core 1) consists of a well-sorted medium to coarse grained bioclastic sandstone deposited as a high energy shallow marine siliciclastic sand body. It contains excellent reservoir quality in well-preserved interparticle porosity. Porosity has been reduced by calcite cementation, but this is restricted to minor nodules and tabular intervals.

Core workshop

The PL950 partnership reviewed cores from wells 7120/12-4 and 7120/12/2. Analog deposits and facies were studied in cores from Ørret, Røye, Ugle fms and Basement.

Rock physics study (Lundin, 2018)

Fluid substitution of well 7120/12-4 and seismic prestack modelling of Ørret2 reservoir unit. A wedge modelling of sandstones and spiculitic carbonates was also done.

Wedge modelling for 55 m thick Ørret2 sandstone:

- Sandstone already within tuning thickness
- Difficult to say whether variation in amplitude is due to hydrocarbons fill or variation in sandstone thickness/quality

The spiculitic carbonate layers of the Røye Fm and the sandstone layers of the Ørret Fm are all within tuning thickness. The seismic response of the Tempelfjorden Gp is therefore complex, and seismic amplitude information should be used with care, when applied as a direct hydrocarbon indicator.

3 Remaining prospectivity

The interpretation of reprocessed 3D seismic data together with geological/geophysical studies such as: a petroleum system analysis, a gravity and magnetic modelling, and a structural fault seal analysis has not de-risked the Akkar prospect. Based on the results of structural studies, the Akkar Ørret prospects trap is now defined as combined structural/stratigraphic, relying on a sealing fault and canyon infill. This is an additional risk factor, due to the poorly resolved canyon fill by the seismic data.

The remaining licence prospectivity is summarized in Fig. 3.1 and the prospect volumes are listed in Table 3.1. The geoseismic depth profiles illustrate the remaining prospects and leads (Fig. 3.2).



Fig. 3.1 Remaining prospectivity PL950

Table 3.1 Remaining prospectivity volumes

Akkar	P/L	Case Oil/Gas/ Oil&Gas	Unrisked recoverable resources						Probability of discovery	Resources in acreage applied for (%)	Reservoir	
			Oil [*10 ⁶ sm ³]			Gas [*10 ⁹ sm ³]					Litho/Chrono	Depth (m MSL)
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)				
Akkar NE Ørret 1 & 2a	P	Oil&Gas	4	7	10	Not calculated		0,04	100	Ørret Fm sandstones (Permian)	1100	
Akkar NE Ørret 3a	P	Oil&Gas	1	2	4	Not calculated		0,05	100	Ørret Fm sandstones (Permian)	1170	
Akkar SW Ørret 1 & 2	P	Oil&Gas	1	1	2	Not calculated		0,03	100	Ørret Fm sandstones (Permian)	1290	
Akkar Kobbe	L	Oil&Gas		Not calculated					100	Kobbe Fm sandstones (Anisian)	450	
Akkar Havert	L	Oil&Gas		Not calculated					100	Havert Fm sandstones (Induan)	705	
Akkar Ugle	L	Oil&Gas		Not calculated					100	Ugle Fm sandstones (Carboniferous)	1500	

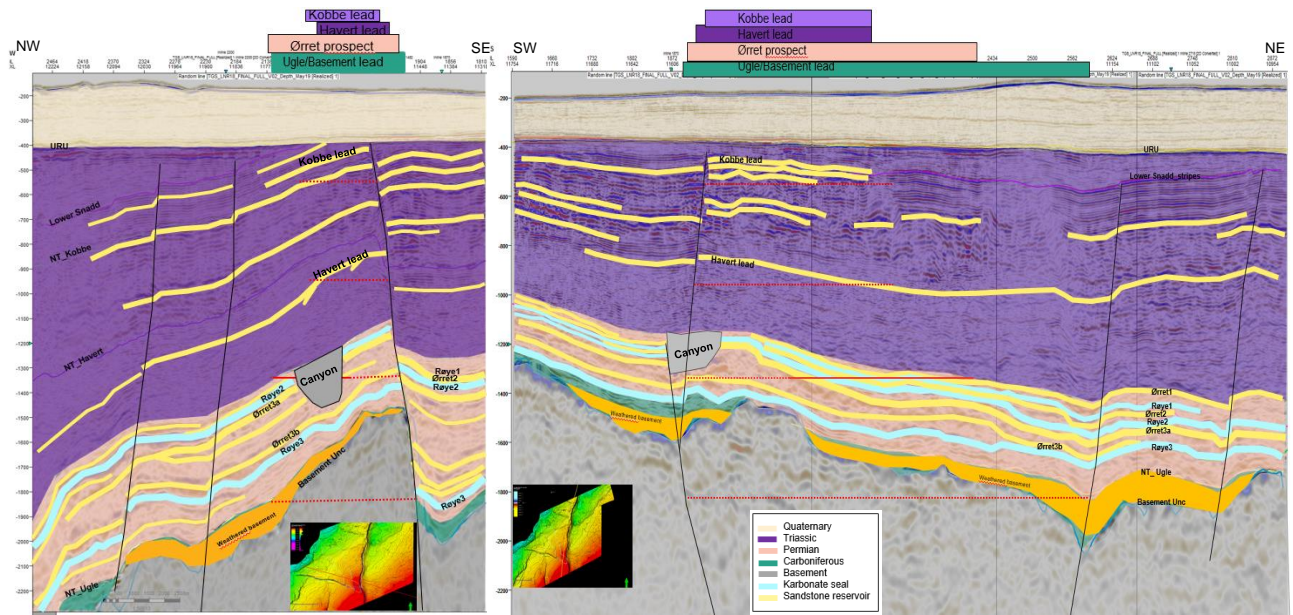


Fig. 3.2 Akkar prospects and leads outlines in two different geoseismic depth profiles

Akkar NE Ørret 1 & 2b prospect

Geoseismic depth profiles and prospect map illustrate the prospect (Fig. 3.3, Fig. 3.4, Fig. 3.5, Fig. 3.6). The Akkar Ørret prospectivity is defined in Ørret 1 and 2b reservoirs separated from the Ørret 3a reservoir by Røye2 spiculitic carbonate. The top seal is provided by mudrocks of Ørret and Havert fms. The Akkar NE Ugle prospect area is 10 km², apex is at 1100 m, a maximum column height of 250 m is applied based on Badley (2019). A gas (50%) and oil (50%) case is assessed. Only oil volumes are calculated (gas GRV are subtracted). A gross reservoir thickness of 55 m is applied (Table 3.2).

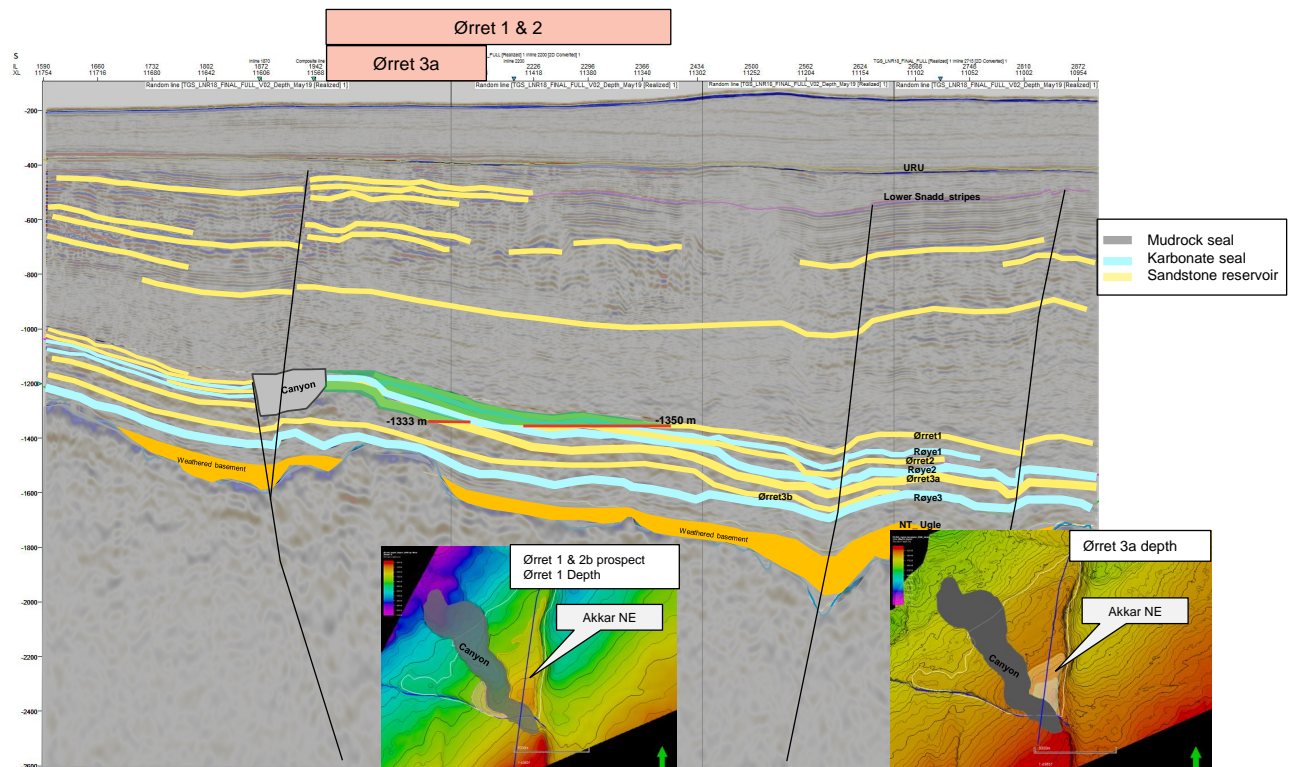


Fig. 3.3 Akkar Ørret NE prospects geoseismic depth profile

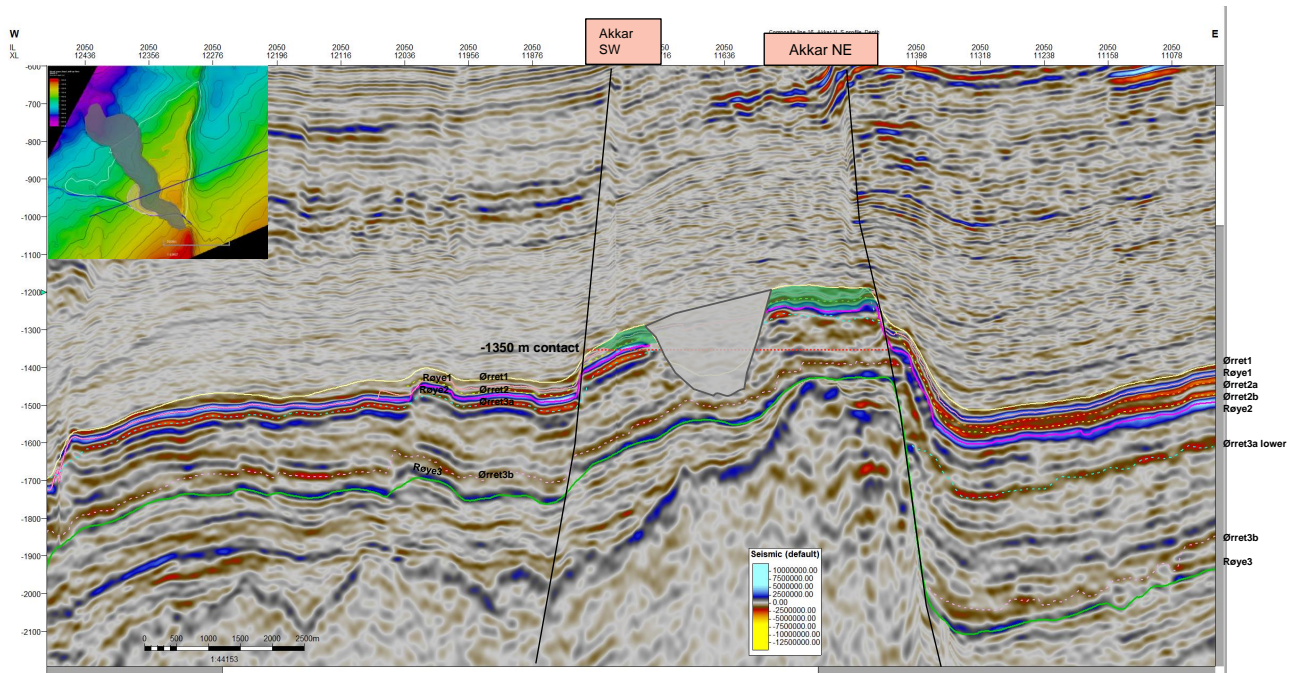


Fig. 3.4 Akkar Ørret 1 & 2b prospects geoseismic depth profile

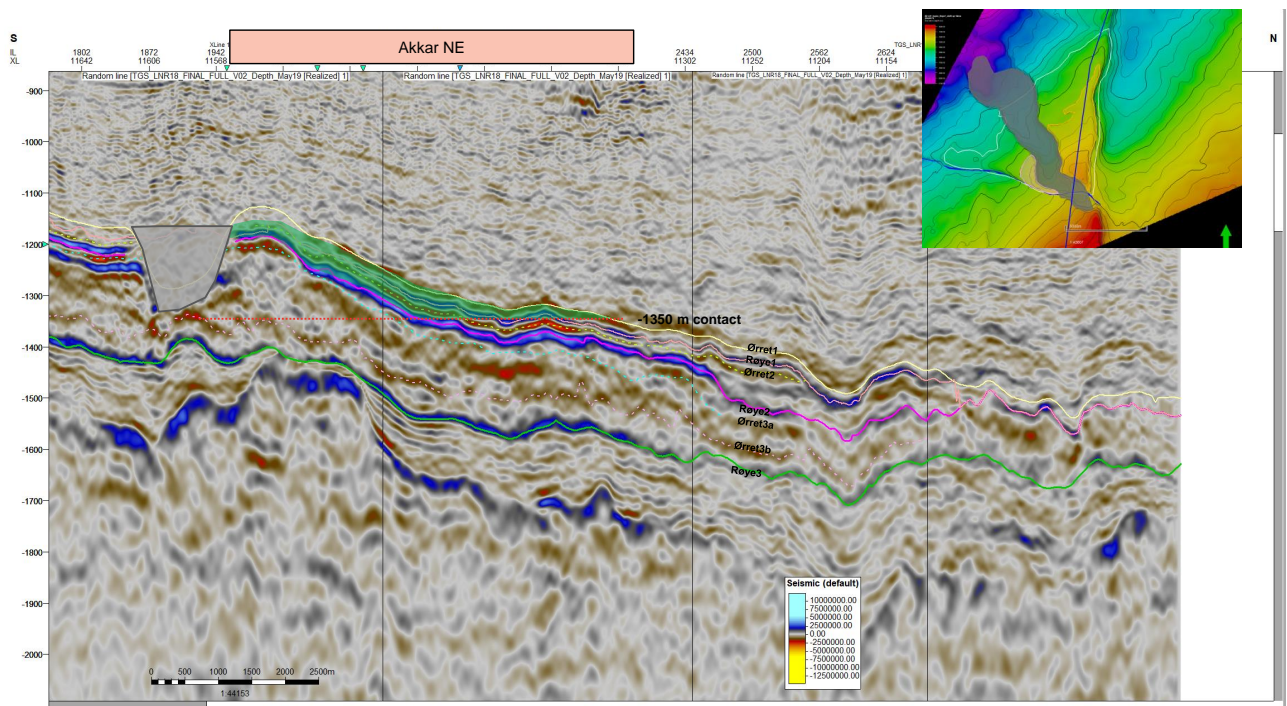


Fig. 3.5 Akkar Ørret 1 & 2b prospects geoseismic depth profile

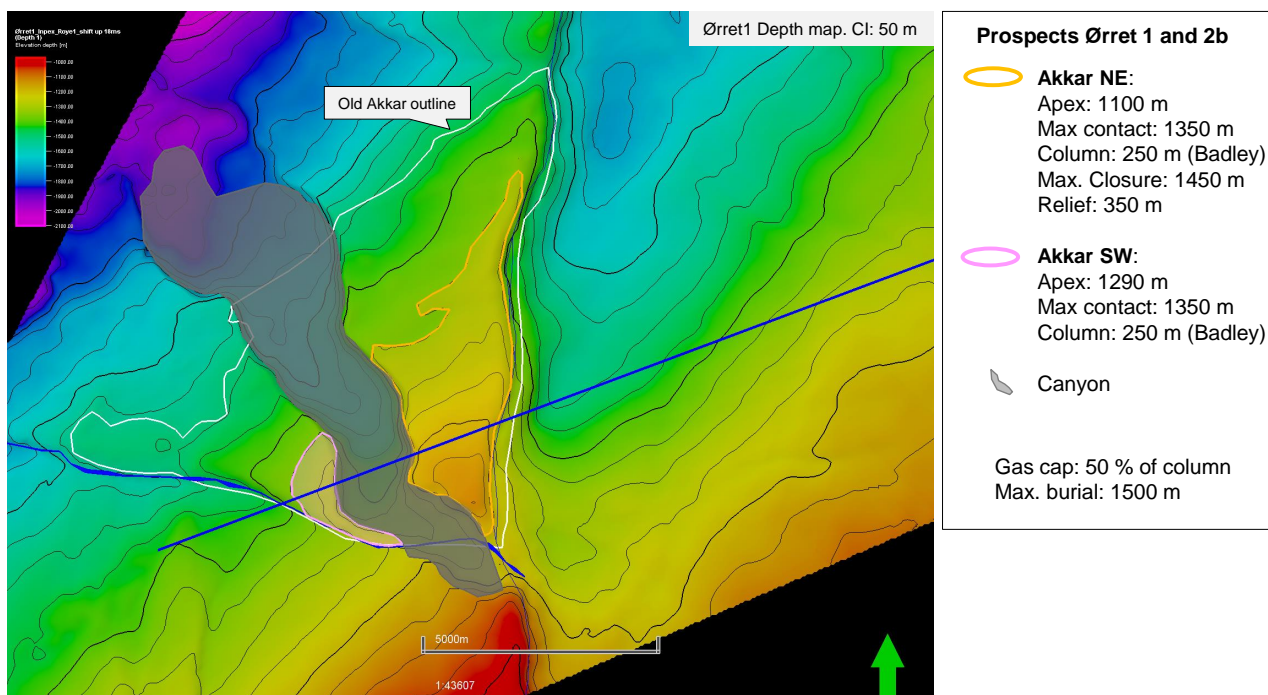


Fig. 3.6 Akkar Ørret 1 & 2b prospects

Table 3.2 Akkar NE prospects assessments *Left: Ørret 1 & 2b prospect*
Right: Ørret 3a prospect

Akkar NE Ørret 1 & 2b					
Akkar prospect oil and ass gas					
Gas cap: 50% of column subtracted					
Input					
	Low	Medium	High	Mean	
GRV [Mm ³]	152	218	311	230	
N/G	0,65	0,70	0,75	0,70	
Porosity	0,15	0,17	0,20	0,17	
So	0,70	0,75	0,80	0,75	
Bo	0,80	0,83	0,85	0,83	
Recovery factor oil	0,30	0,40	0,50	0,40	
GOR	55	60	65	60	
Deterministic output (all medium values)					
STOOIP [MSm ³]		16			
Resources [MSm ³]		6			
Associated gas [MSm ³]		388			
Stochastic output					
	P90	P50	P10	Mean	
STOOIP [MSm ³]	11	17	24	17	
Resources [MSm ³]	4	7	10	7	
Associated gas [MSm ³]	242	401	617	417	
Associated gas [GSm ³]	0,2	0,4	0,6	0,4	

Akkar NE Ørret 3a					
Akkar prospect oil and ass gas					
Gas cap: 50 % of column subtracted					
Input					
	Low	Medium	High	Mean	
GRV [Mm ³]	29	42	131	75	
N/G	0,65	0,70	0,75	0,70	
Porosity	0,15	0,17	0,20	0,17	
So	0,70	0,75	0,80	0,75	
Bo	0,80	0,83	0,85	0,83	
Recovery factor oil	0,30	0,40	0,50	0,40	
GOR	55	60	65	60	
Deterministic output (all medium values)					
STOOIP [MSm ³]		3			
Resources [MSm ³]		1			
Associated gas [MSm ³]		75			
Stochastic output					
	P90	P50	P10	Mean	
STOOIP [MSm ³]	2	5	10	6	
Resources [MSm ³]	1	2	4	2	
Associated gas [MSm ³]	48	122	245	136	
Associated gas [GSm ³]	0,0	0,1	0,2	0,1	

Akkar Ørret prospects risk are listed in Table 3.3. The size of Akkar SW prospect is below economic interest.

Table 3.3 Akkar Ørret prospect risk

Prospect	Reservoir	Trap	Retention	Charge	Probability
Akkar NE Ørret 1 +2	0,8	0,2	0,9	0,3	0,04
Akkar NE Ørret 3a	0,7	0,25	0,9	0,3	0,05
Akkar SW Ørret 1 +2	0,7	0,15	0,9	0,3	0,03

Akkar NE Ørret 3a prospect

The prospect is illustrated in the geoseismic depth profiles and prospect map (Fig. 3.3, Fig. 3.7, Fig. 3.8, Fig. 3.9). The Ørret 3a prospect is overlain by Røye2 spiculitic carbonate, providing the top seal. Ørret fm mudrocks constitute the base seal. The mean column height of 75 m is based on the results of the structural study, showing juxtaposed reservoirs along the N-S fault. The maximum column (165 m) assumes a working fault seal along the N-S fault, and is based on filling down to spillpoint: the top of Ørret 3b sandstones. The Ørret 3b reservoir unit is not eroded by the canyon and sandstones self-juxtapose across the NW-SE fault. In the assessment a gross reservoir thickness of 55 m is applied (Table 3.2).

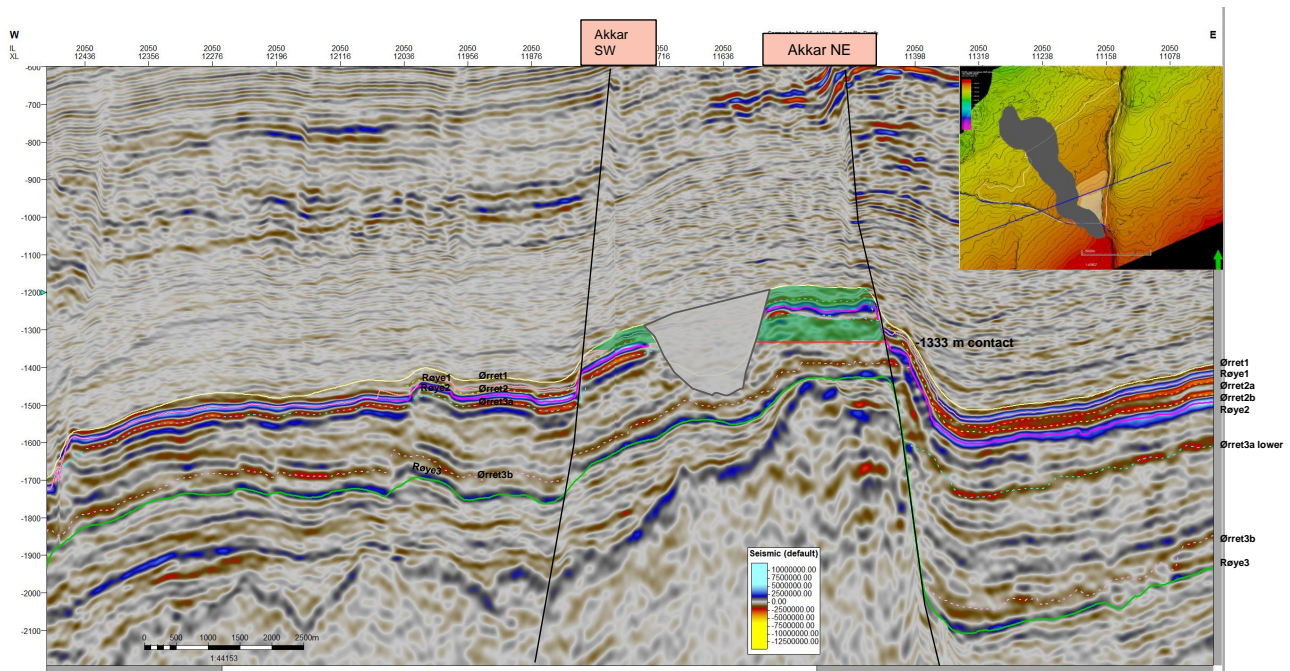


Fig. 3.7 Akkar Ørret 3a prospect geoseismic depth profile

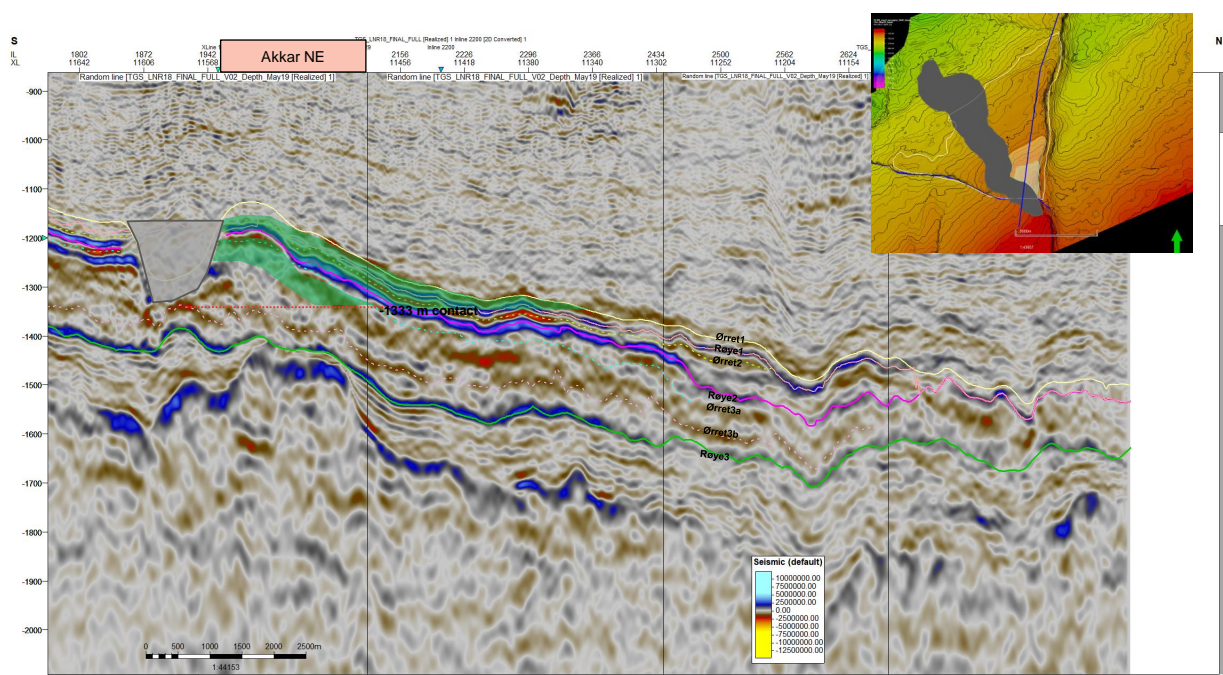


Fig. 3.8 Akkar Ørret 3a prospect geoseismic depth profile

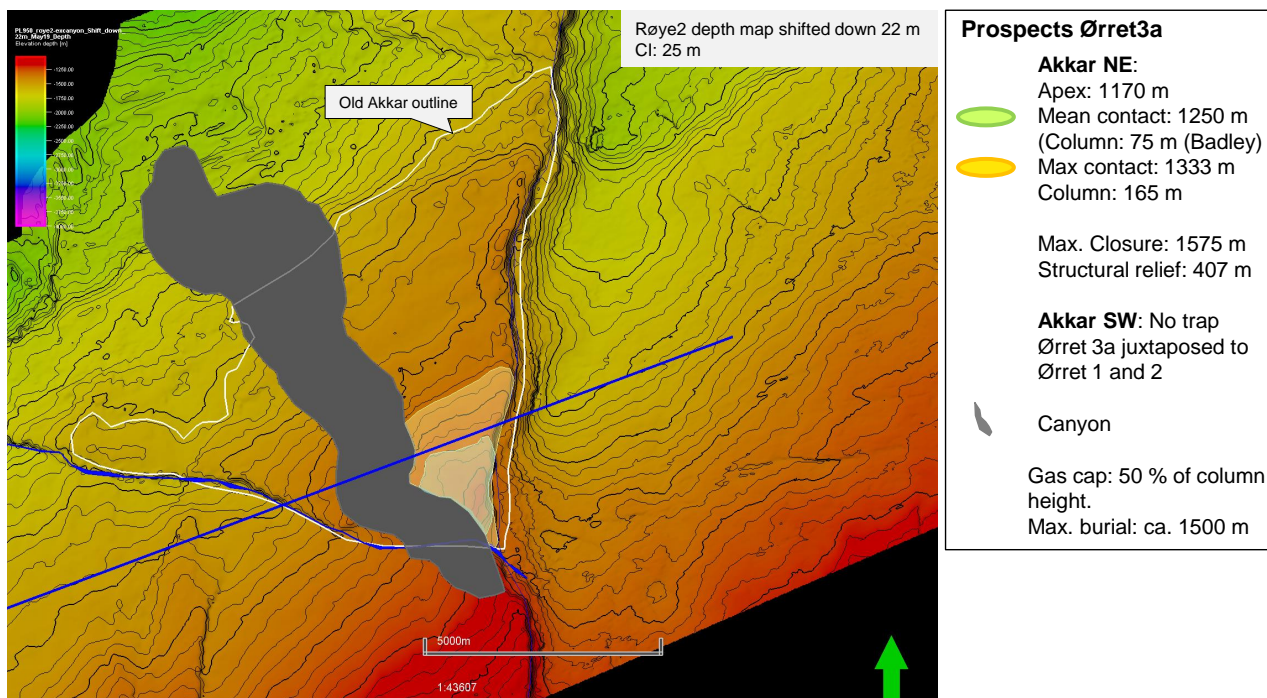


Fig. 3.9 Akkar NE Ørret 3a prospect map

Akkar Ørret prospects risk are listed in Table 3.3.

Risk summary for Akkar NE Ørret prospects

Reservoir

- Ørret 1 and 2 reservoir is locally present in the Akkar horst, but thinner compared to the well 7120/12-4.
- Main reservoir: Ørret3a covers most of the Akkar prospect and seems to be better than in 7120/12-4.
- Canyon fill: Is poorly resolved. The current interpretation is that the chaotic reflection pattern is caused by deformed muddy or heterolithic lithology. Non reservoir.

Trap and seal

- Complex structuration in apex of Akkar with intersecting faults and canyon cut. Poor seismic imaging.
- Depends on stratigraphic sealing NW-SE canyon. Canyon fill is poorly resolved. Probably Havert Fm heterolithics.
- N-S trending fault with large vertical displacement offsets Akkar from the eastern minibasin.
- NW-SE fault has low sealing potential. Small vertical offset and self-juxtaposed reservoirs.
- Fault reactivation (Jurassic-Cretaceous and Paleogene). May affect seal capacity of Røye spiculitic carbonate? None of the faults intersect the URU.

Source and charge

- The main risk is presence and quality of Permian/Carboniferous source rocks near Akkar. Good source rocks are not identified in local wells.
- Presence of Billefjorden source rocks around Akkar are not likely, based on gravity/magnetic modelling.

- Possible lower Triassic source rocks in front of clinofold systems may charge Akkar Triassic leads and PL764 prospects rather than Akkar Ørret reservoirs. The Havert/Klappmyss fms in well 7120/12-4 showed however poor source rock quality.
- Charge to Akkar Ørret prospects depends on complex migration across TFFC (possible gas risk?).

Akkar Leads

The leads are influenced by the same risk factors mentioned above, such as source/charge and low sealing potential of the NW-SE fault.

Ugle lead

Ugle lead is illustrated in Fig. 3.10 and Fig. 1.9.

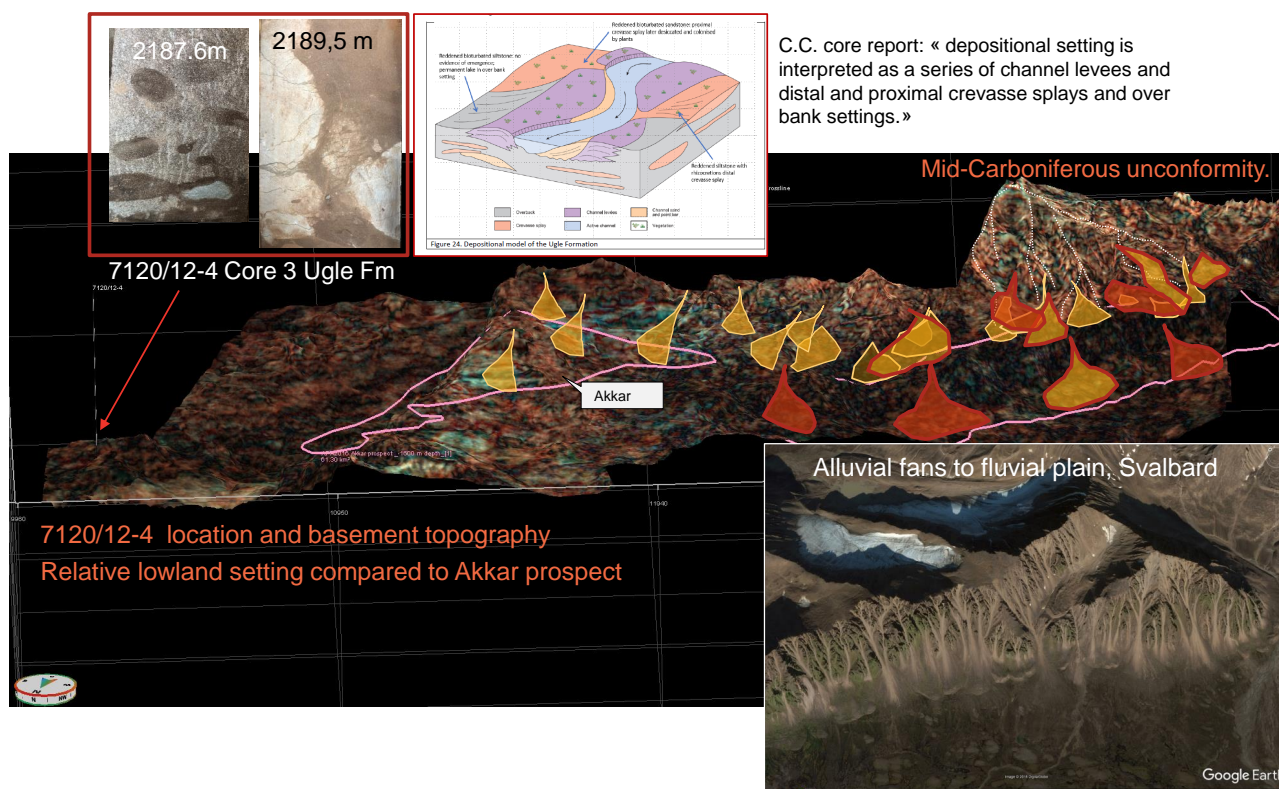


Fig. 3.10 Akkar Ugle lead reservoir model

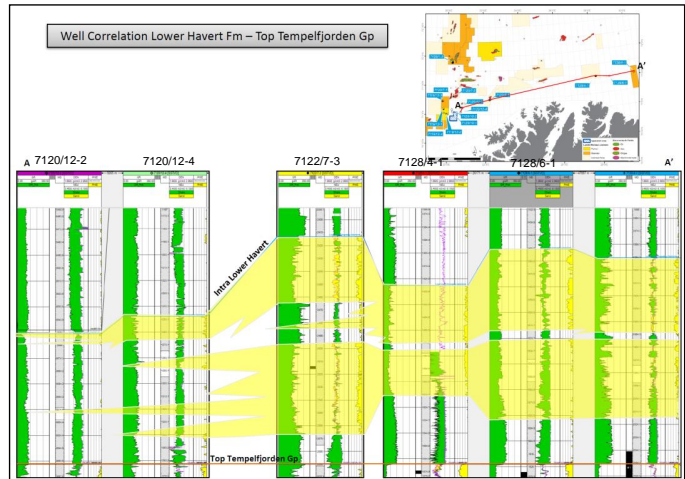
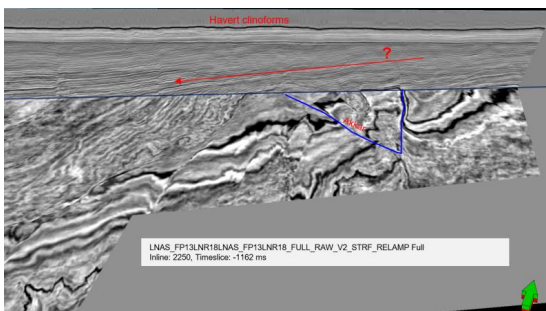
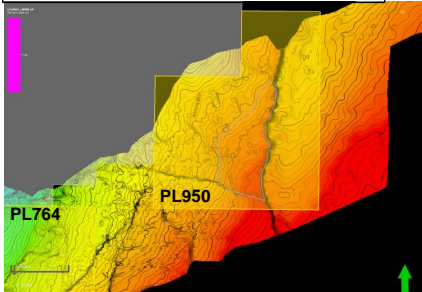
The high risk associated with reservoir quality adds to the other risk factors mentioned above.

Havert lead

A summary of the Havert lead is illustrated in Fig. 3.11, Fig. 3.12. The combined stratigraphic and structural trap remains poorly imaged (1.3 Identified prospectivity APA 2017). Well defined clinofolds are seen in the western area of the licence, partly outside the Havert closure. The Havert Fm reservoirs may self-juxtapose across the NW-SE fault. Additional risk factors as mentioned above.

The best reservoir is expected in the southwestern part, partly outside of the closure. No volumes are estimated.

Structural closure area: 28 km²
 Apex: 705 m
 Max. possible closure: 980 m



Paleogeography of the Lower Triassic (Induan) Havert Fm

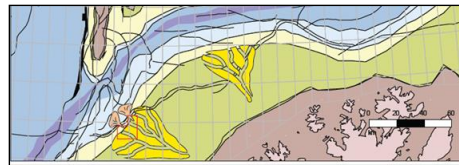
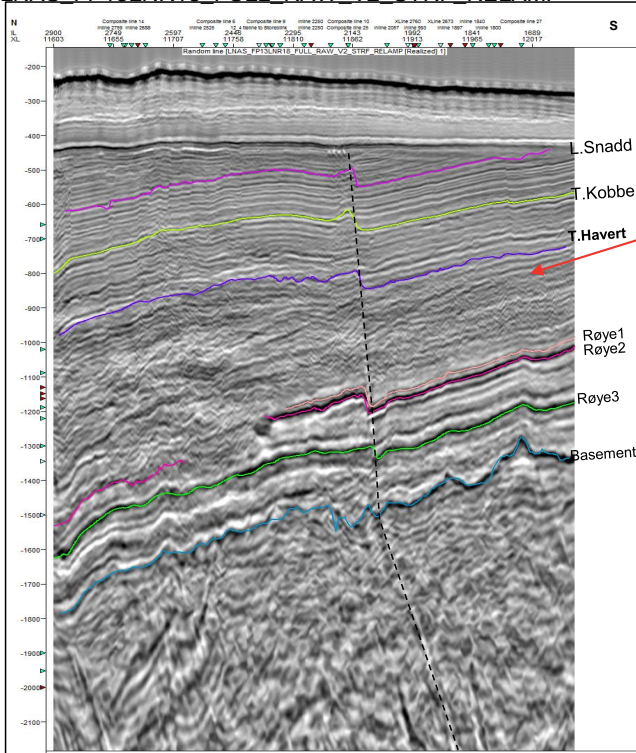


Fig. 3.11 Akkar lead Havert Fm summary

LNAS_FP13LNR18_FULL_RAW_V2_STRF_RELAMP



Improved imaging of clinoforms. Risk of juxtaposed reservoirs across NW-SE fault. The best reservoir is expected in the southwestern area, partly outside of the closure.

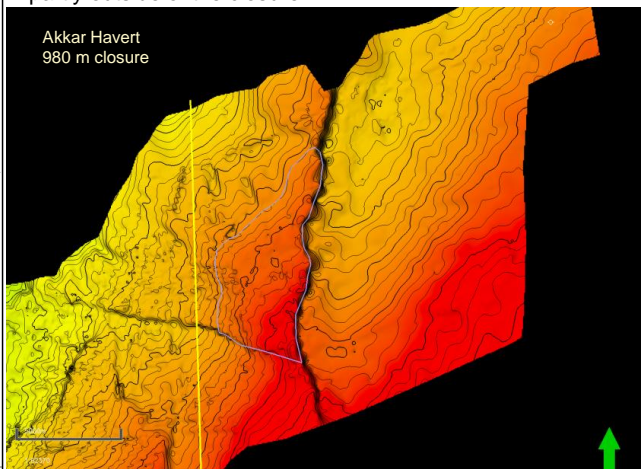


Fig. 3.12 Akkar lead Havert seismic profile (TWT)

Kobbe lead

The Kobbe shallow lead is defined as a 18 km² structural closure. The trap depends on sealing faults. A summary of the lead is illustrated in Fig. 3.13. DHI's are observed in the apex of Akkar Kobbe lead, but continues to the south. There is a high risk of juxtaposed reservoirs across the NW-SE fault. The reservoirs consist of fluvial channel deposits, indicated by amplitude maps and 7120/12-4 interpretation.

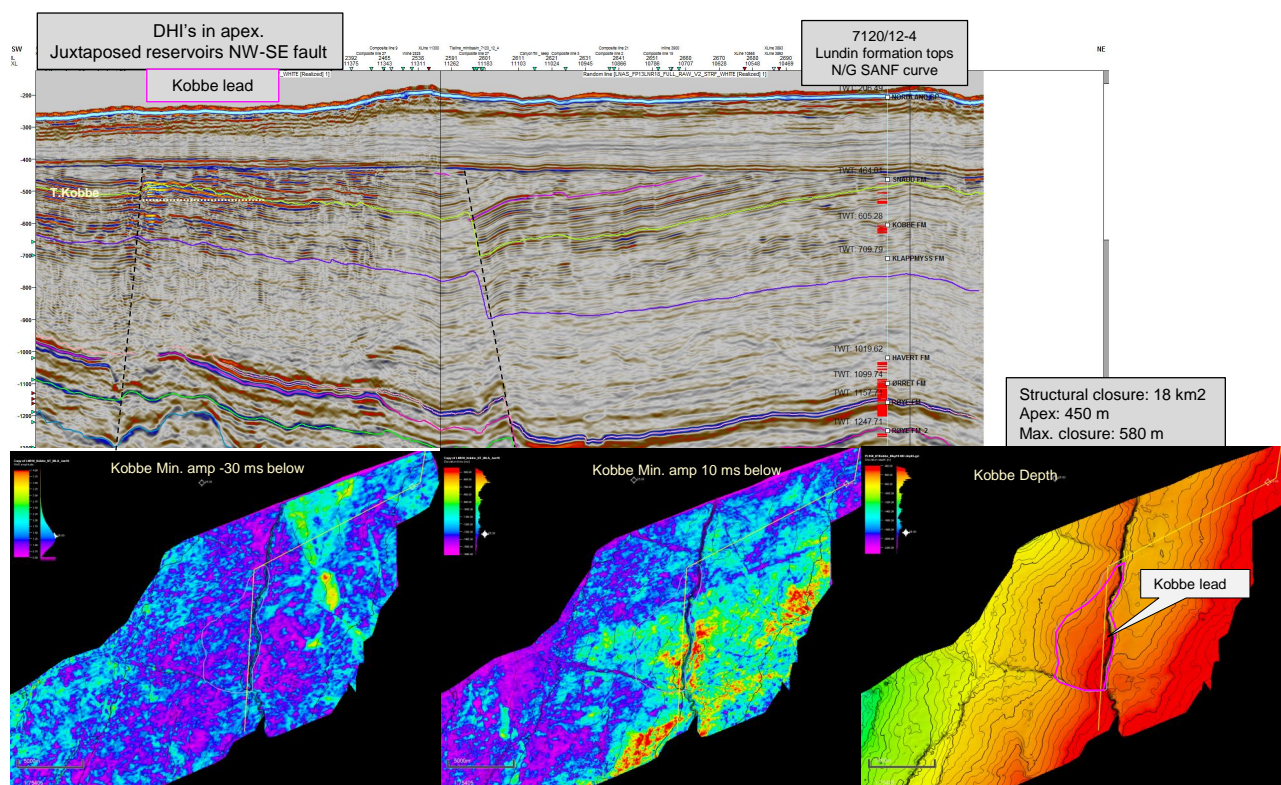


Fig. 3.13 Akkar lead Kobbe Fm seismic profile (TWT)

4 Conclusion

The licence commitment to acquire and reprocess TGS FP13 3D survey is fulfilled. The reprocessed FP13LNR18 showed improved imaging, but do not have sufficient resolution to de-risk the critical apex area and the canyon fill.

The evaluation of improved 3D seismic data together with geological/geophysical studies such as: Petroleum systems analysis, gravity and magnetic modelling, and a structural fault seal analysis have not reduced the risk of the Akkar prospect. The results of the gravity and magnetic modelling were negative with respect to presence of Billefjorden local source rocks under and on the flanks of the Akkar horst. Geochemical studies and resampling of material from the key wells 7120/12-4 and 7120/12-2 showed poor source rock quality of the lower Triassic and Permian mudrocks. Charge to Akkar prospects will depend on complex migration across TFFC. Based on the results of structural studies Akkar is now defined as a combined stratigraphic and structural trap, relying on a sealing fault and canyon infill. This is an additional risk factor, due to the poorly resolved canyon lithology by the seismic data.

The remaining prospectivity consists of marginal economical volumes with an associated high risk. The license group therefore agreed to relinquish the licence.

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