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Petroleum geological and prospect evaluation of three open blocks in the G-quad of the Netherlands Offshore

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1 Summary

This preparatory study has been performed as an initiative of the Ministry of Economic Affairs of the Netherlands to improve access to information for the mining industry and other interested parties. It should be seen as a first try out of an inventory study of the exploration potential of three open blocks. These open blocks G10, G11 and G13 are straddling the German median line and are located on the Schill Grund High structural element. The blocks are largely covered with 3D seismic and in total 7 wells were drilled. The recent discovery of a shoestring of gas fields in the G14 and G17 blocks, located on the Schill Grund High, and their connection to the NGT pipeline opens up the area for exploration of smaller targets.

All data of the study area in the public domain available to TNO have been used, including seismic surveys (3D and 2D), well logs, check shots, well reports, core descriptions, core photos, vitrinite reflection analysis and biostratigraphical data. The lithostratigraphy has been updated and the following horizons have been interpreted and mapped: Base North Sea Group, Base Chalk Group, Base Rijnland Group, Top Volpriehausen reservoir, Base Triassic and Base Zechstein. The base Rotliegend is isochored from base Zechstein downward.
From the maps prospective structures were defined. For these prospective structures summary information sheets were compiled with accompanying post-mortem information sheets giving a “drilled structure” summary.
On one well in the study area a burial history analysis was performed. The main gas generation phase on the Schill Grund High from the Carboniferous source rock dates from Late Triassic to Mid-Jurassic. A minor phase may potentially occur from mid-Tertiary onwards. Gas could have migrated from the neighboring Terschelling basin, Dutch Central Graben and the Horn Graben which stretches the timeframe for charge up to present day.
Though migration routes are long and difficult, gas is proven to be in the system by gas fields in G14, G16 and G17 and by gas shows in G10.

Main proven plays are: The Triassic play, proven by the F15-A and the G14/G17 fields, and the Upper Jurassic play, proven by the G16-A field. Secondary plays may be the: unconsolidated Quaternary or Tertiary silt and sandstones, Chalk, “Jurassic Gullies”, Rotliegend Sandstone and Carboniferous Sandstones.

In total 19 prospects have been defined. The summed estimated Mean Success Volume is quite sizable: 50 bcm. The estimated risks for the prospects are quite high, mainly due to the limited information on the charge. The resulting total risked volume of the main plays, Jurassic and Triassic is some 6 bcm.

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Further study is necessary, especially on migration and charge to de-risking the prospects.
Though the charge is uncertain, it is proven that the migration paths are functioning and the traps are effective

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2 Preface

The Ministry of Economic Affairs of the Netherlands wishes to maximize the opportunities ahead in the exploration and production of oil and gas. It is seen as a governmental task to provide all the information needed to keep improving the exploration and production climate. Measures to further encourage exploration for, and production of natural gas and oil include:

- elimination of hurdles in legislation and regulations,
- making procedures for license applications more efficient,
- continuation of the small fields policy,
- tackling the issue of 'sleeping' licenses,
- actively approaching new companies and
- Improving access to information.

Improving access to information
The Ministry of Economic Affairs took the initiative to increase the access to information on oil and gas exploration and production, including legislation and procedures information and geological and technical data. The oil and gas portal of the Netherlands (www.nlog.nl) has been launched to give a complete overview of all relevant data available at the three key organisation involved: the Ministry of Economic Affairs (EZ), TNO-NITG, State Supervision of Mines (Dutch acronym: SodM for Staatstoezicht op de Mijnen). The new Mining Act led to a large volume of new, public information. This is due to:

- the uniform arrangement concerning the release of onshore and offshore data,
- the fact that production plans have to be submitted which contain a public part and
- production data per well is available in the public as from 2003.

This preparatory study has been performed in the scope of increasing access to information and should be seen as a first try out of an inventory study of the exploration potential of 3 open blocks.

3 Introduction

For this inventory study three blocks in the G-quad were chosen for the purpose of compiling an adequate dataset useful as a quick scan of the exploration potential and the type of plays present. The three open blocks G10, G11 and G13 are straddling the German median line and are located on the Schill Grund High structural element (Fig. 1).

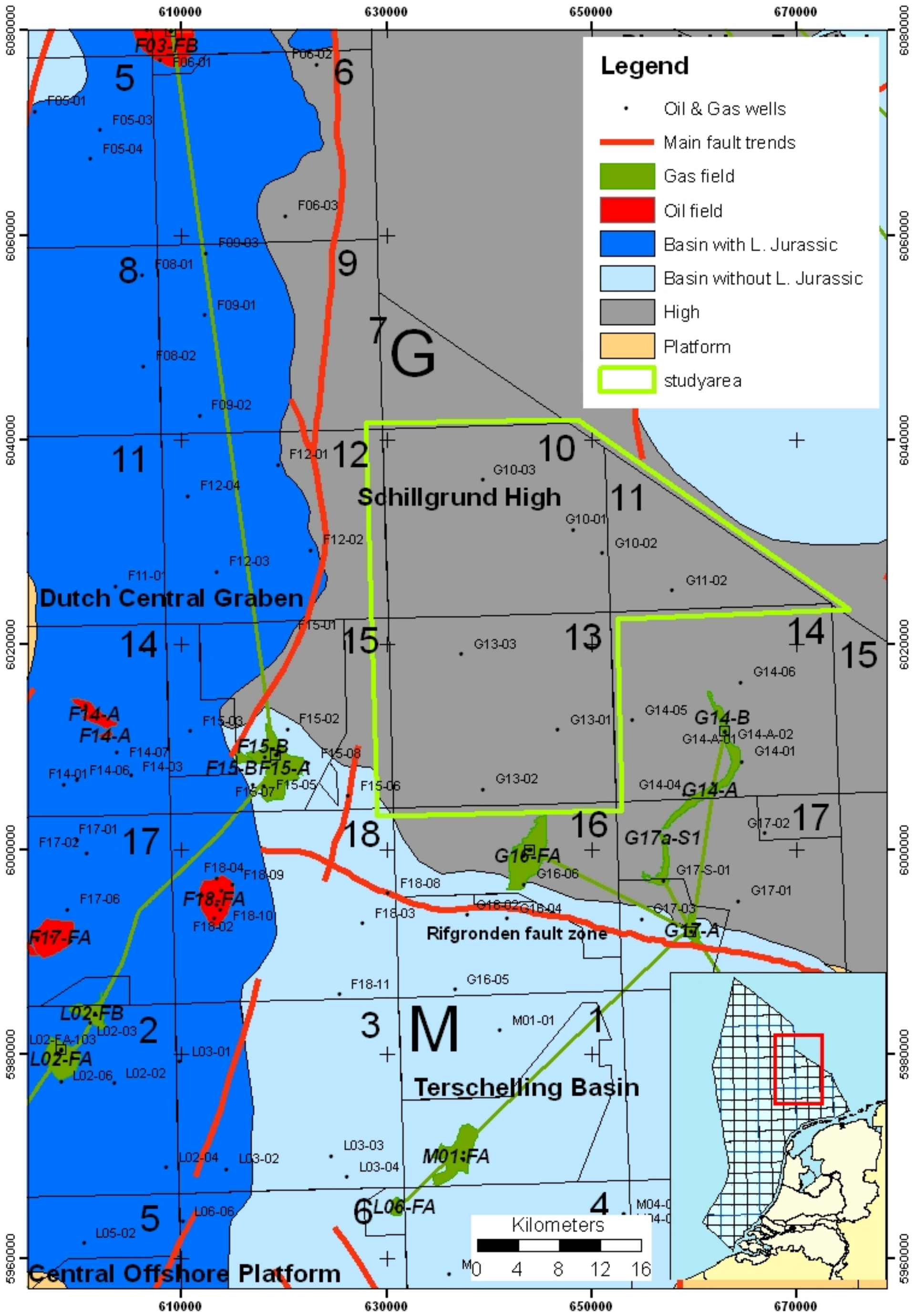

Figure 1: Location of study area.

The blocks are largely covered with 3D seismic and in total 7 wells were drilled (Fig.2). The Schill Grund High has seen reasonable exploration interest with a success in the G16-A field and more recently the discovery of a shoestring of gas fields in the blocks G14 and G17. These fields are all connected to the NGT pipeline, opening up the area for the exploration of the smaller targets.

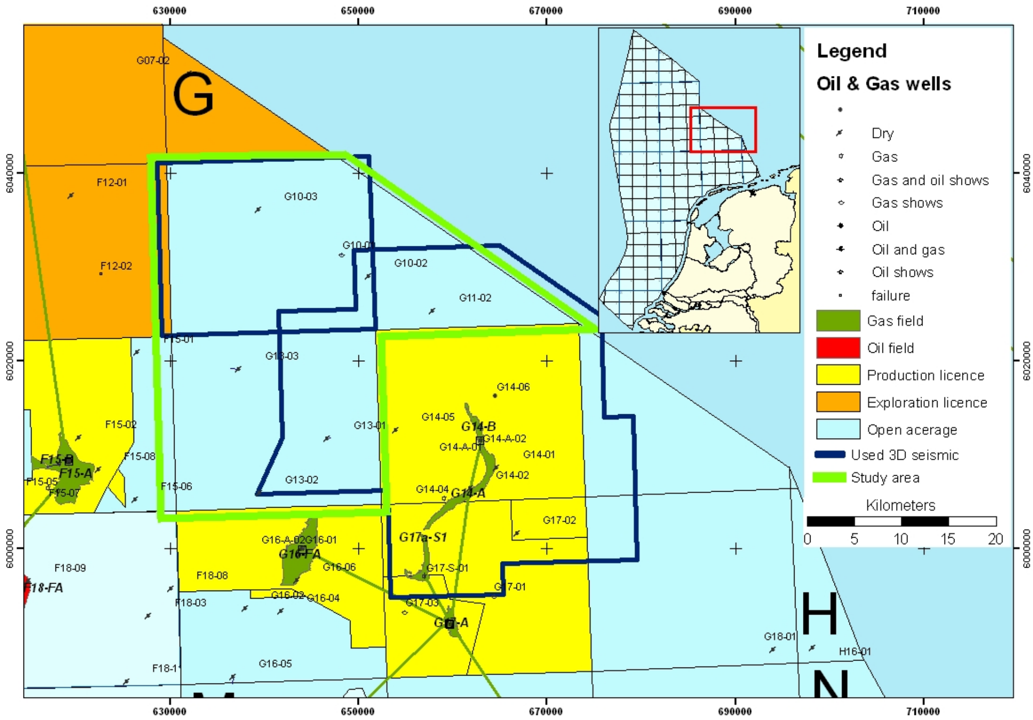

Figure 2: License situation.

4 License history

Figure 2 shows the current license situation. The block G10 was awarded to a group operated by Elf Petroland in 1987 during the 6th round. Part of the block (G10 c, d en e) was relinquished in 1993 and the expiry date of the remaining block part (G10 a, b) was in 1997.

Block G11 (175km^2) was awarded to Mobil in the 1979 during the 4th round. In 1985 half of the block was relinquished. NAM took a farm-interest in the remaining part of the block till the final relinquishment in 1989. In 1996 during the 9th round an exploration license for G11 was granted to Elf Petroland which was subsequently relinquished in 2001.

Block G13 was awarded as one block together with G15 b, c to Mobil during the 4th round in 1979. NAM farmed in and after completing a drilling program in 1987 earned the right of a major interest in this license. Nevertheless, NAM decided to cease its exploration and the license expired in 1989. In 1992 in the 8th round G13a was awarded to the Mobil, which decided to relinquish the block shortly after in 1994. During the 6th round in 1987 an exploration license for block G13b was awarded to a group operated by Unocal. After two successive farm-ins by Elf Petroland, Eurafrep and Corexland, Elf Petroland became the main operator. In 1993 half of the license was relinquished and the other half expired in 1997.

Since 2001 the blocks G10, 11 and 13 are open areas.

Area	Year	Licensing round	Company	Status
G10	1987	6th	Elf Petroland	awarded
G10; part c, d and e	1993		Elf Petroland	relinquished
G10; part a and b	1997		Elf Petroland	license exp.
G11	1979	4th	Mobil	awarded
G11 northern half	1985		Mobil	relinquished
G11 southern half	1985		NAM	farm-in
G11 southern half	1989		Mobil, NAM	relinquished
G11	1997	9th	Elf Petroland	awarded
G11	2001		Total Fina Elf	relinquished
G13	1979	4th	Mobil	awarded
G13; part b	1985		Mobil	relinquished
G13; part a	1987		NAM	major farm-in
G13; part a	1989		NAM	license exp.
G13; part b	1987	6th	Unocal	awarded
G13; part b	1992		Elf Petroland, Eurafrep, Corexland	farm-in
G13; 50% of part b	1993		Elf Petroland, Eurafrep, Corexland	relinquished
G13; 50% of part b	1997		Elf Petroland, Eurafrep, Corexland	license exp.
G13; part a	1992	8th	Mobil, Energie Vers. Weser-Ems, HDM	awarded
G13; part a	1994		Mobil, Energie Vers. Weser-Ems, HDM	relinquished

Table 1: Licence history

5 Drilling activity and results

Seven exploration wells were drilled in the blocks G10, 11 and 13. In the early days of exploration in this area the two main objectives were the Lower Permian and Carboniferous sandstones and the Vlieland Sandstone (nowadays interpreted as Scruff sandstone) in combination with the Zechstein caprock. Later the Triassic play became the main target.
In 1986 the wildcat G13-01 was the first well in the study area, drilled by NAM to a total depth of 4758 m (Westphalian B). Although this well resulted in valuable stratigraphic data, all the objectives were water bearing or of poor reservoir quality. The Lower Permian and Carboniferous sandstones were tight but the Vlieland Sandstone showed reasonable reservoir quality. The second well into the Carboniferous, G13-02-S1 drilled by Unocal in 1991, was tight as well. No other wells in the study area have reached the Carboniferous.
The Scruff Sandstone / Zechstein caprock play has been proven on the Schill Grund High by the G16-A discovery. Well G10-01 found encouraging gas shows. However, this well, drilled by Elf Petroland in 1990, found a poorly developed reservoir being very thin at the well location. The other wells testing this play were either water bearing (G13-01, G10-03, Elf Petroland 1997), had a poor reservoir quality (G11-02 NAM 1988) or the reservoir was absent (G13-02-S1, G13-03 Elf Petroland 1996).
Exploration of the Triassic play showed that the reservoir quality of the Volpriehausen is generally good, but regretfully all wells, G10-02, G10-03, and G13-03-S1, were found water bearing.

Wells within G10, G11 and G13 block	Company	Year	Trap type	Objectives	Results	Post Mortem	total depth (RKB)
G10-1	EPTL	1990	Four way dip closure above saltdome	Vlieland sdst	No significant reservoir+good gas shows	Reservoir failure	2873
				Upper Zechstein caprock	Tight carbonate	Reservoir failure	
				Chalk	Water bearing	Charge failure	
G10-2	EPTL	1993	Truncation trap below unconformity	Lower Volpriehausen sandstone	Good reservoirs, water bearing	Sealing failure	3240
G10-3	EPTL	1997		Lower Cretaceous sandstone	Very thin reservoir, water bearing	Charge failure	3267
			Truncation trap below unconformity.	Volpriehausen sandstone	Water bearing	Sealing failure and/or charge failure	
G11-02*	NAM	1988	Four way dip closure above saltdome	Vlieland sandstone	Poor reservoir quality	Reservoir failure	2663
				Upper Zechstein caprock	Poor reservoir quality	Reservoir failure	
G13-01	NAM	1987	Four way dip closure above saltdome	Vlieland sandstone	Water bearing sandstones	Charge failure	4758
				Upper Zechstein caprock	Tight carbonates except a thin layer of fractured limestone which was water bearing.	Reservoir failure and charge failure	
				Lower Permian	Tight reservoir	Reservoir failure	
				Carboniferous	Tight reservoir	Reservoir failure	
G13-02-S1	Unocal	1991	Four way dip closure above saltdome	Vlieland sandstone	Reservoir absent	No reservoir present	4641
				Upper Zechstein caprock	Reservoir absent	No reservoir present	
				Carboniferous	Tight reservoir	Reservoir failure	
G13-03	EPTL	1996	Four way dip closure above saltdome	Vlieland sandstone	Reservoir absent	Reservoir failure	3087
			Truncation trap below unconformity	Lower Volpriehausen sandstones	Not reached	Structural failure	
G13-03-S1	EPTL	1996	Faulted pannel against Upper Triassic seal	Lower Volpriehausen sandstone	Water bearing sandstones	Charge failure	3568

- Note: the well G11-01 is located in the German sector, no data of this well is available to TNO
- EPTL: Elf Petroland

Table 2: Listing of wells drilled in the study area with basic information.

6 Data and Methods

6.1 Well log interpretation and correlation

The stratigraphic interpretations of 15 wells in and around the study area have been updated. The lithostratigraphic subdivision has been made conform the Stratigraphic Nomenclature of the Netherlands, revision and update by the RGD and NOGEPA, nr 50 (Adrichem Boogaert et al, 1993). The update predominantly concerns the Upper Jurassic and Lower Cretaceous (Abbink et al 2006), Appendix 2). Additionally two N-S and two E-W well correlation panels have been composed, see Appendix 3-6. For the interpretation and correlation all data available to TNO were used, including composite well logs, core photos, cutting descriptions, biostratigraphical data and well reports.

6.2 Seismic Interpretation

The 3D seismic coverage of the study area, in total about 1754 km^2, was interpreted. In addition some 448 km 2D seismic lines were interpreted over the area which is not covered by 3D seismic (western part of block G13). All the surveys were brought to zero phase.

Year	Type	Client	Acquisition	Processing	Block
1988	2D	Unocal	GSI		20 lines: G13
1992	3D	Elf Petroland	Western	CGG	G10
1997	3D	NAM	GECO	CGG	G14/ G13, G11 partly

Table 3: Overview of interpreted seismic data.

The overall quality of the 3D surveys is good, although some multiples occur. In the G11 block the multiples are dominant on the flanks of the domes, overprinting the Triassic reflections. Near the salt domes the seismic signal gets generally weaker and less continuous. This is also the case below the Zechstein Formation. As a consequence the interpretation of these areas is less reliable. The 2D lines in the western part of the G13 block are in general of a lower quality. In some areas the signal is discontinuous and almost all lines show some diffraction hyperboles.

A match of the seismic reflections and the stratigraphy found in the wells was made using sonic logs, checkshots and synthetic seismograms.
The following horizons were interpreted over the entire area: base North Sea Supergroup, base Chalk Group, the Mid Kimmerian Unconformity, top Volpriehausen Sandstone, base Triassic Supergroup and base Zechstein Group.
The quality of the seismic signal below the Zechstein did not allow the interpretation of the underlying horizons. The depth of the base Rotliegend was constructed with a regional thickness grid using all public wells of the Dutch offshore and several wells in the German territorial waters.

6.3 Time-depth conversion

For all layers, except the Zechstein layer, the linear velocity function $V(z)=V_0 + k*Z$ has been used for the time-depth conversion. For the Zechstein layer a constant velocity has been used. To determine the constants V_0 and k per velocity layer, a plot has been made of the interval velocity and Z_{mid} i.e. the depth of the midpoint of the velocity layer. The linear relationship in these plots gives a good estimation of the V_0 and k. The plots were compared with regional studies done by TNO and showed a good fit. In case of the North Sea Supergroup the $V_{interval}$-Z_{mid} plot showed no significant correlation. This was due to the limited Zmid range. For this layer the regional constant k is used to make a V_0 grid using $V_0=(k*(Z_b-Z_t*EXP(k*dt)))/(EXP(k*dt)-1)$.
No complete section of the Triassic was found in any of the wells in the study area. Only two wells encountered the Volpriehausen. Therefore the regional velocity constants (internal TNO reports) were also used for the Triassic layer.

Velocity layer	V_0 (m/s)	k (1/s)	V_{halite} (m/s)
North Sea Supergroup	V_0 grid	0.4686	
Chalk Group	1883.7	1.0155	
Lower Cretaceous Super group + Scruff Group	1879.4	0.499	
Triassic Supergroup	2575	0.466	
Zechstein			4402.5

Table 4: Parameters of the velocity model.

This velocity model gives a good fit with the depths measured in the wells down to the Volpriehausen level. The uncertainties in the depth increase strongly below the Zechstein layer. This is mainly due to the enormous lateral thickness variations in the Zechstein, which are closely related to velocity variations. The use of a constant velocity of halite, generally underestimates the depth underneath the saltdomes. The structures seen in the Rotliegendes underlying these domes should therefore be addressed with care. A more complex velocity model or extra horizon interpretations are needed to better define the sub-salt structures.

6.4 Burial history

The burial history of sedimentary rocks on the Schill Grund High has been examined by correlating the geological events to the thermal history and a calibration by organic temperature and time-temperature parameters. A numerical simulation of the burial history of well G13-01 has been carried out. The lithological input for this model was derived from lithological descriptions in well reports, the well log interpretation and the lithological descriptions in Adrichem Boogaert et al. (1993 - 1997). Furthermore, absolute values for the original thicknesses of stratigraphic units in individual wells were estimated using among others the structural position of the well, literature data, surrounding wells, local and regional geological and seismic information. For the calibration of the well vitrinite reflectance (VR) and RockEval data (RE) are used. This data is compared to the calculated Vitrinite Reflectance, based on the kinetic model by Sweeney and Burnham (1990). According to the relationship between Rock-Eval data and Vitrinite reflectance data which has been developed by TNO the RockEval data was recalculated into VR (%R) data according to a linear relationship and has also been used for calibration purposes.

7 The geological setting of the Schill Grund High

The blocks G10, G11 and G13 are located on the Schill Grund High (SGH), limited to the West by the Dutch Central Graben, to the North-East by the southern extensions of the Horn Graben and to the south the Terschelling Basin. All boundaries are defined by major deep seated fault zones like the Rifgronden Fault Zone in the south (Figure 1). For the geological history of the larger SGH area, the southern Permian Basin one is referred to the geological Atlas of Western and Central Europe (Ziegler 1999)

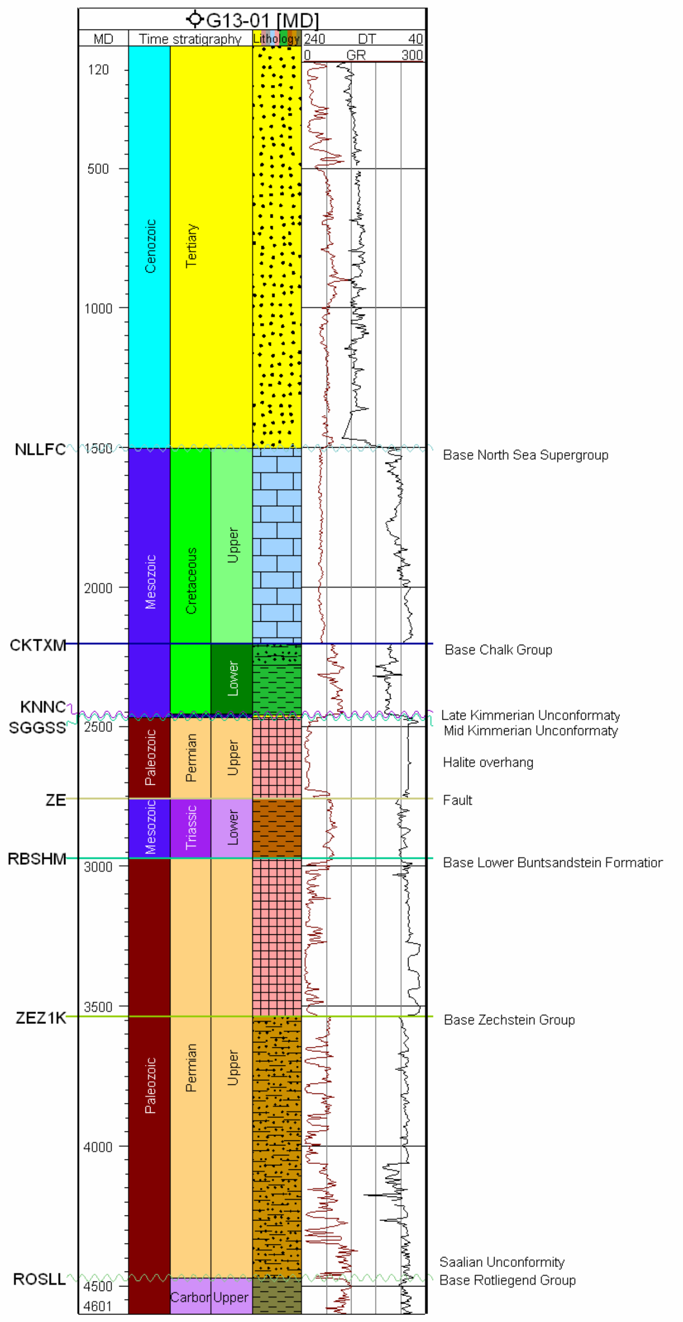

Figure 3: The litho-stratigraphy of well G13-1.

The general stratigraphy of the SGH is shown in figure 3 taking the litho-stratigaphy of the well G13-1 as an example. It has to be noted that a fault/salt overhang obliterates the sequential order of the strata. For the definitions of the various litho-stratigraphic zones one is referred to Adrichem Boogaert et al. 1993

The oldest formation drilled on the SGH is the Maurits Formation, the main coal bearing sequence of Westphalian B/C age. It is interpreted that the Step Graben Formation (Westphalian C/D) overlies the Maurits Formation in well G13-1. This implies that the Westphalian Hospital Ground reservoir formation, prolific in the Dutch southern D&E and northern K quads, is not present on the SGH. It may be postulated that the Step Graben is unconformably overlying the Maurits Formation. Since it remains difficult to date the red bed series it is unclear whether the Step Graben formation encountered on the SGH is of late Westphalian age or perhaps even Stephanian. It is known from Germany that within the Late Carboniferous redbed series numerous intra-formational unconformities are present. The contact between the Maurits and the Step Graben Formation may be one of them. The top pre-Permian distribution map (Figure 4) shows the Carboniferous formation at the base Permian (Saalian) unconformity (Mijnlieff, 2002) where the unusual contact is depicted. An unknown portion, which may well add up to some 600m, of the Late Carboniferous sediments is eroded during the Variscan/Saalian tectonic phase.

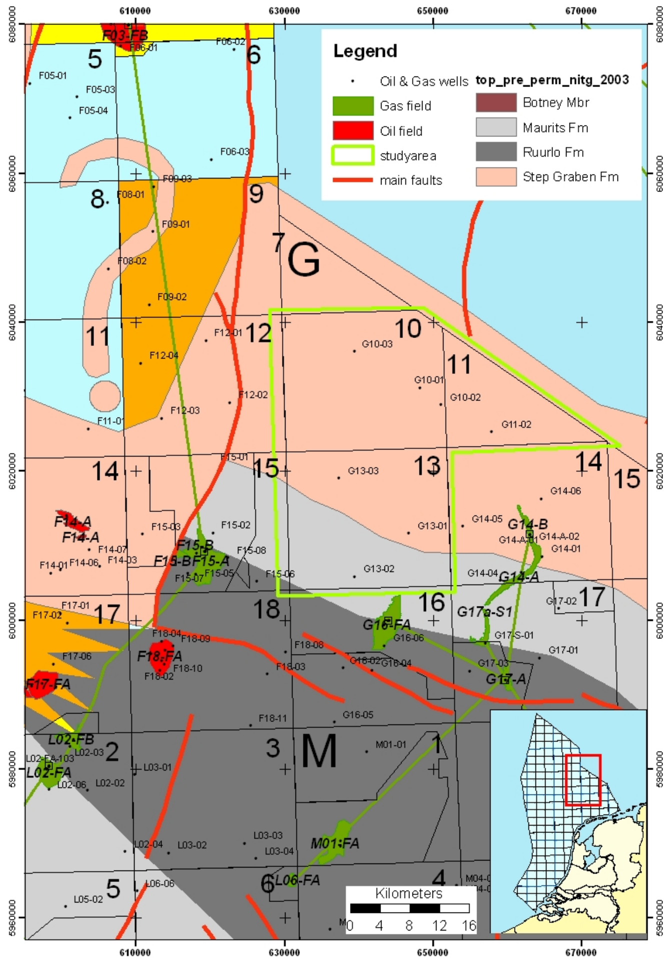

Figure 4: Top Pre-Permian distribution map of the larger study area.

A thick succession of Upper Rotliegend sediments is found on top of the Carboniferous. In both wells, G13-1 and G13-2 the basal sandstone of the Slochteren Formation is encountered. It has limited thickness and is of poor reservoir quality. The sediment is seen as a distal deposit of the earliest depositional cycles of the late Permian infill of the Silverpit basin. Distribution of the Lower Slochteren Sandstone in the Rotliegend Sandstone feather edge is thought to be erratic and being a function of the paleaorelief (Geluk et al., 2002). Despite the encountered thin Slochteren Sandstone the possibility of a thick sandstone of approximately 30m, exists. The subsequent Silverpit succession exists of the Silverpit Claystones Members and the Silverpit Evaporite Members. The total thickness of the Rotliegend amounts to 1000m.

The Zechstein series from the Coppershale to the Zechstein 3 cycle deposits have been encountered comprising the classic basal succession. The post-Z2 anhydrite evaporates are thoroughly deformed by halokinesis. Salt structures from mild cushions to large domes are common on the SGH. Some overhangs and salt intrusions into juxtaposed strata do occur. Although difficult the see on the seismic it is likely that not only the Zechstein salts but also the Silverpit Evaporites have deformed by halokinesis. The uppermost Zechstein member in all wells in the study area is the Zechstein Caprock. Lithologies of this member comprise the relatively insoluble Zechstein evaporites like carbonates and anhydrites. These were left after the soluble evaporites like halite were removed by either subrosion or erosion when the salt dome was exposed at the surface. The present average thickness of the Zechstein in the area is some 300m. From regional trendmaps an original thickness of some 2000m is expected for the Zechstein on the SGH (NCP1, 2006). This supports the hypothesis that a large volume of salt was removed.

The Triassic Lower Buntsandstein Formation is present over the whole SGH apart from the locations where salt domes pierced through the Triassic. An incomplete Triassic section is present in the study area because the Triassic is deeply truncated by the Mid and/or late Kimmerian unconformity. Most of the Triassic formations encountered in the wells are from the Lower Germanic Triassic Group. The Upper Germanic Triassic Group is only preserved in “Triassic pods” bordering saltdomes. The youngest Triassic sediments encountered in a well in the study area are from the Upper Germanic Triassic Group, probably the Dolomitic Keuper Member (Well G13-3). In the study area no indication is found of the development of syn-sedimentary faulting during deposition of the Solling sediments resulting in the Solling Fat Sand as seen in the L9 block (de Jager, 2003).

No record of Lower Jurassic sediments (Altena Group) is present in wells or on seismic on the SGH. It is assumed that it was deposited and subsequently eroded during Mid- and/or Late Kimmerian tectonic phases. The estimated thickness of the removed strata (from regional maps) is about 700-1200m.

After the Mid Kimmerian tectonic phase the Upper Jurassic sediments were deposited. Abbink et al. (2006) proposed a new sequence stratigraphical subdivision of the Upper Jurassic and Lower Cretaceous series. The three lowermost sequences are located between the Mid-Kimmerian and Late-Kimmerian unconformity. Sediments from these sequences are litho-stratigraphically assigned to the Schieland Group and the Scruff Group. The fourth sequence corresponds to the lower part of the Cretaceous Rijnland Group.
On the Schill Grund High sediments of the sequences 1, 2 and 3 are recorded. The sediments of sequence 1 are from terrestrial to marginal marine origin whereas those of sequence 2 and 3 are exclusively from marginal marine to marine origin. The Jurassic sediments are predominantly found on the top of salt domes overlying and presumably

interfingered/mixed with the Zechstein Caprock deposits. Sediments of sequence 3 are mainly found on the top of salt domes. Especially in the northern part of the SGH the occurrence of this sequence spreads to the off-dome areas (G10-3). Noteworthy is that there are also pre-Late Kimmerian unconformity depressions related to dissolution of Upper Triassic Evaporites which could be filled with Upper Jurassic sediments. These dissolution features are recognized as gully like patterns on seismic (Appendix 9).

The basal formation of the Rijnland Group in the study area is the Vlieland Claystone, lying above the Late Kimmerian Unconformity. More detailed age dating of the sediments in the area revealed that all sandy intervals formerly interpreted as Vlieland Sandstone are dated Ryazanian or older and are consequently re-interpreted as Scruff Group Sandstones. Therefore, Vlieland Sandstone reservoir does not exist on the SHG, though it can not be excluded that the basal part of the Vlieland Claystone may be silty and acts as a thief zone. The Holland Formation is present over the whole study area and is fairly uniform of thickness.

The Chalk Group is recorded over the whole study area and is up to 1200 m thick on the SGH. The section appears to be easily correlatable on wells and on seismic with only minor thickness variations. In must be noted that the minor thickness variations occur in the vicinity of the domes indicating that halokinesis occurred during deposition of the Chalk. Only in the eastern part of the study area evidence of seismic scale sediment reworking in the top of the Chalk series is seen. Allard et al. 2004 mentions the presence of a Late Maastrichtan – Danian, N-S running, channel system crossing the eastern part of the study area (G11). The channels themselves are filled with reworked (allochtonous) Chalk.

The North Sea Group is also omnipresent in the study area with a quite uniform thickness. It conformably overlies the Chalk Group and comprises unconsolidated clay, silt and sand.

Halokinesis
Some indications exist of an Early Triassic onset of halokinetic movements of the underlying Zechstein in the Schill Grund High area (Remmelts, 1996). Late Triassic to Jurassic extension reactivated the main N-S to N20 fault systems resulting in the opening of the Dutch Central Graben and successively the Terschelling Basin to the South of the Schill Grund High. Halokinesis continued and new diapirs started rising over these N-S trending faults. The main salt movements have taken place in the Late Jurassic. At the times when the Mid Kimmerian unconformity was formed and possibly during the deposition of Upper Jurassic sequence 1. The salt diapirs surfaced and salt was removed. It is thought that an enormous amount of salt was removed from the subsurface. Salt continued to move intermittently as evidenced by local thickening of sedimentary strata in the rim synclines. It appears that the halokinesis halted halfway the deposition of the North Sea Group.

8 Source Rock, burial history, maturity and charge

8.1 Source rock

The main source rocks are the Carboniferous coal bearing strata from the Caumer Subgroup as is the case for all plays in the Netherlands. These strata are present on the Schill Grund High and also in the surrounding structural elements. Present depth of the top of the Carboniferous encountered in well G13-1 and G13-2 is around 4600m.

8.2 Burial history analysis

The geological concept and the seismic interpretation formed the basic input data for the model. Figure 5 shows an E-W section through the G13-1 well location. Note that the well is drilled through a saltdome and has a complex stratigraphic succession exemplified by a salt intrusion/hangover between the Lower Buntsandstein and the Jurassic.

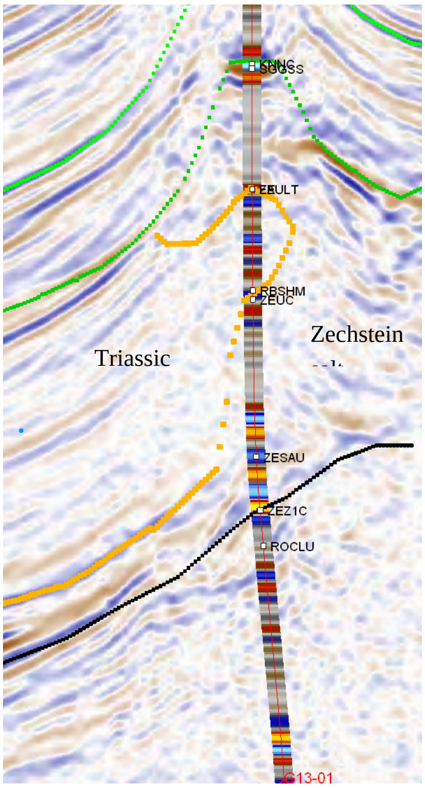

Figure 5: Detail of the G13-1 well location on seismic section.

To estimate the amount of erosion and salt movement different approaches have been tried. The maximum burial depth and apparent uplift of the Triassic Main Claystone was determined by comparing the interval velocity within this layer with other wells in the Dutch on- and offshore (Dalfsen et al., 2005). Assuming the velocity is only depending on the burial depth, which leaves a permanent imprint in the claystone in terms of compaction, the maximum depth of burial can be determined. However, the maximum derived burial depth of the Main Claystone given by the interval velocity, of some 3500m, could not be reached in the model given the vitrinite reflection in the Carboniferous and a realistic geological concept. The explanation of the interval velocity and thus its derived burial depth is thought to be related to salt invasion into the Main Claystone. This salt invasion could be explained by the unusual position of the Main Claystone in this well, i.e. on three sides bounded Zechstein salt. Finally, the original thickness of the Zechstein Evaporites, some 2000 m, is estimated from regional maps.

Since the original thickness of the Triassic and Lower Jurassic is highly uncertain, two scenarios were chosen to evaluate:

1. Estimated maximum thickness of Triassic (1200m) and Lower Jurassic (1200m) sediments.
2. Estimated maximum thickness of Triassic (1000m) and Lower Jurassic (700m) sediments

The burial history diagram with the associated temperature evolution of scenario 2 is shown in figure 6.
In figure 7 the transformation ratio's of the source rock of the two scenarios are shown. In both scenarios the main phase of gas generation is from early Triassic to Mid Jurassic. In scenario 2 the source rock starts generation again in the Early Tertiary. From figure 8 it can be concluded that both scenarios are possible because both scenarios have a reasonable fit with the measured vitrinite reflection. (The full suite of figures illustrating input and results from the burial history model is presented in appendix 14).

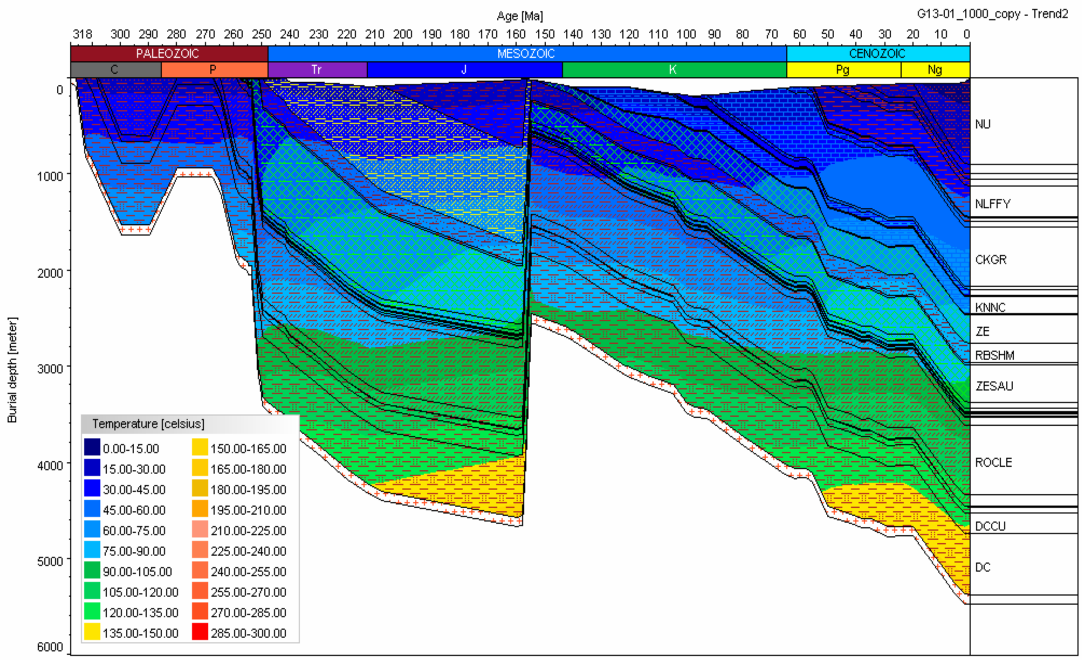

Figure 6: Burial history diagram of well G13-01 on the Schill Grund High with the associated temperature evolution of scenario 2.

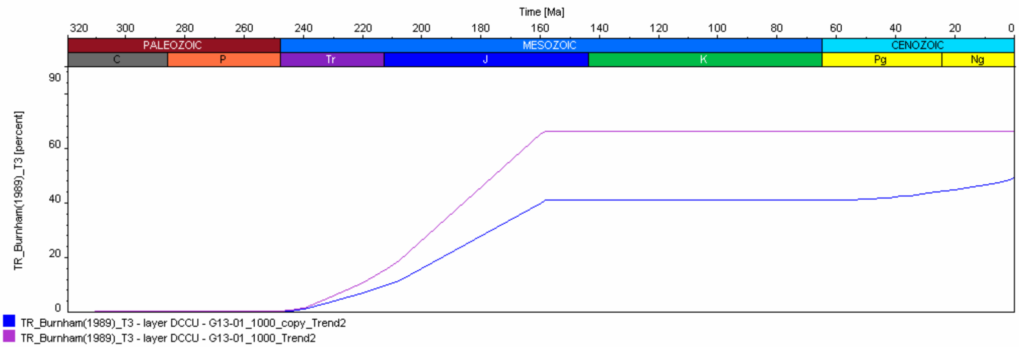

Figure 7: Transformation ratio of the source rock of scenario 1 (pink) and 2 (blue) in well G13-01.

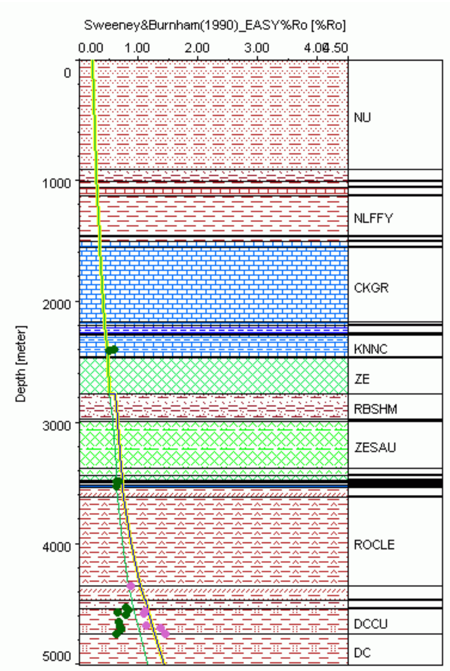

Figure 8: Measured vitrinite reflection and both calculated Vr trend lines from the modelled scenarios (yellow line: scenario 1, blue line: scenario 2)

8.3 Burial history of neighbouring structural elements

The well L3-2 is used as an example of the burial history of the Terschelling Basin. The main charge in the TSB from the Carboniferous source rock is from Early Jurassic till present.
As an example of the burial history of the Dutch Central Graben (DCG) well F17-5 is chosen. The main charge in the DCG from the Carboniferous source rock is from Late Triassic till Late Cretaceous.

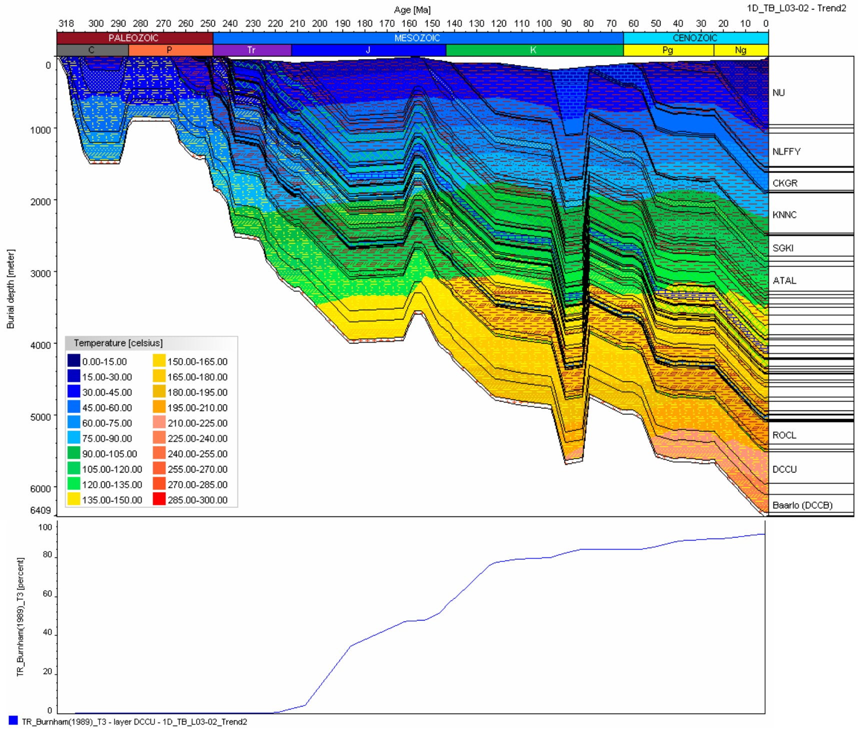

Figure 9: Burial history and transformation ratio of the well L3-2, located in the TSB

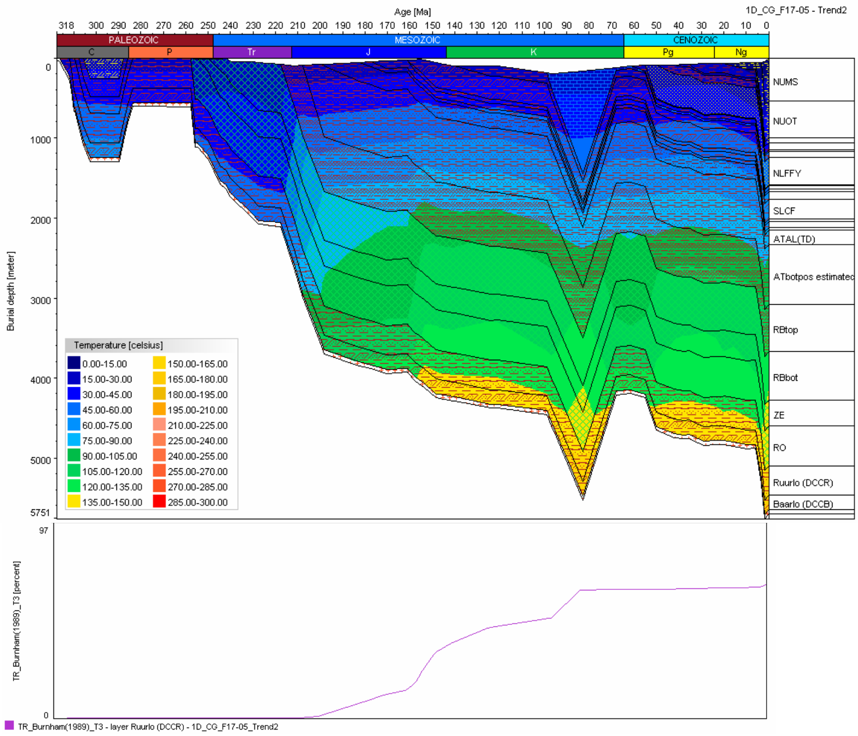

Figure 10: Burial history and transformation ratio of the well F17-5, located in the DCG.

8.4 Generation, migration and charge

8.4.1 Generation

Gas generation in both scenarios on the SGH starts in Early Triassic as shown in figure 7. The transformation ratio of the first scenario, i.e. relatively thick Jurassic and Triassic series, increases more rapidly. In both situations the transformation stops during the Late Jurassic, as a result from the uplift and erosion during the Mid Kimmerian tectonic phase, when no gas is generated anymore.
Looking at the scenario 2, i.e. relatively thin Jurassic and Triassic series, the source rock was not buried as deep as in scenario 1 and with the subsequent burial from Late Jurassic till present the maximum burial depth during the pre-Mid Kimmerian is bypassed (Figure 6). The transformation ratio shows an increase from Early Tertiary, when gas generation starts again.
In both scenarios the main charge from the Carboniferous was during Early Triassic to Late Jurassic.

8.4.2 Migration

The main reservoirs on the SGH are separated from the source rock, the Carboniferous Coal Measures, by the thick Permian Rotliegend and Zechstein evaporitic series. Despite these major screens, gas occurrences are present above the Permian seals (F15-A, G14 and G17 Triassic fields and G16-A Scruff field and gas shows in G10-01). This proves the possibility and existence of long and tortuous migration paths.

In case the SGH is the kitchen area, vertical and to a lesser extend, horizontal migration from source to reservoir may be possible via deep seated N-S faults and Zechstein salt windows. Salt windows are found at locations of thinned Zechstein, where the salt is squeezed out towards the domes and only brittle anhydrites and carbonates are left.

Another possibility is that the kitchen area is in the Terschelling Basin, the Dutch Central Graben or the Horn Graben. Gas may have migrated from the Terschelling Basin northwards to the Shill Grund High along two possible migration paths: The gas could have seeped through major faults into the post-Zechstein series at the edge of the basins. Subsequently migration would have taken place through the Main Buntsandstein series starting to fill of the first positive structure on its path. After completely filling this structure the additional gas would continue on the migration path to fill the next positive structure. Migration with this fill and spill principle on the Schill Grund High will take place parallel to the main structures, i.e. the N-striking salt ridges. It requires a relatively large amount of gas to migrate from the Terschelling Basin into the G10, G11 and G13 blocks.
Alternatively, the gas could have migrated long distances underneath the Rotliegend and Zechstein evaporites before breaking through into the post Zechstein series. This would require that nearly all deep seated faults, including the Rifgronden Fault system, would at least be partly sealing faults.
Like the Terschelling Basin in the south, the Central Graben in the east and the Horn Graben in the north may also be the starting point of long horizontal migration paths to the Schill Grund High.

8.4.3 Timing of charge

The discovered fields on the SGH proof that timing of structuration and charge are well aligned. However, which charge scenario is effective remains unclear. Therefore the estimated risk associated with charge is relatively high. The timing of structuration of the main plays on the SGH is in most cases finished after deposition of the Lower Cretaceous Vlieland Claystone seal. An exception is the truncation of Volpriehausen reservoirs against salt domes. In that case the structure could have formed during the Jurassic.

As mentioned above, the main phase of gas generation is from early Triassic to Mid Jurassic. Most traps in the study area were not finished at this time and gas could have escaped to the surface. Alternatively gas could have been trapped underneath the thick Permian Rotliegend and Zechstein evaporitic series till later halokinetic movements resulted in possible escape routes to post-Zechstein series through salt windows. In this case the structures could have been charged up till recent times.

The same long timeframe for charging of the structures on the SGH is also assumed when the kitchen area is in the DCG or in the Terschelling Basin.

9 Plays

9.1 Proven plays on the SGH:

9.1.1 Main Buntsandstein play

Reservoir

The Triassic sediments on the Schill Grund High are preserved between the salt ridges and are truncated by the Mid-Kimmerian Unconformaty. The main reservoirs are sandstones of the Lower Volpriehausen Member. Overlying strata, sandstones of the Detfurth Member and of the Hardegsen Member, can act as a reservoir as well.
The Volpriehausen reservoir has good reservoir potential with average porosities around 18%, average N/G ratio around 80% and an average thickness around 36m. The reservoir quality can be severely degraded by salt plugging in the vicinity of Zechstein salt ridges. Several hypotheses are proposed explaining the salt plugging mechanism (Dronkert & Remmelts, 1996, Purvis et al., 1996, van Bergen et al., 2001). Infiltration from the juxtaposed salt wall (Dronkert & Remmelts, 1996) appears to be the most applicable in this study area.

The Volpriehausen seismic horizon is picked on a peak with laterally changing amplitude values. Locally a phase change can occur (Figure 11). It is suggested that this phase change can be caused by salt plugging (Dronkert & Remmelts, 1996). An amplitude map of the Volpriehausen horizon has been constructed to see whether this map could be used to get a better grip on the reservoir porosity and to see if there would be a trend indicating the effects of salt plugging (Figure 12). The amplitude map show generally higher amplitudes between the saltdomes and a decreasing amplitude towards the domes. The amplitude decrease is not directly related to a decrease in porosity of the Volpriehausen Sandstone, but is probably due to disturbance of the seismic signal in the vicinity of the salt domes. However, where the amplitude increases towards the saltdome, the high amplitude values could be an indication for gas bearing, high porosity sandstones. Such high amplitude values are found in the North of the G10 block.
In none of the drilled wells in the study area salt cementation in the Volpriehausen reservoir is reported.

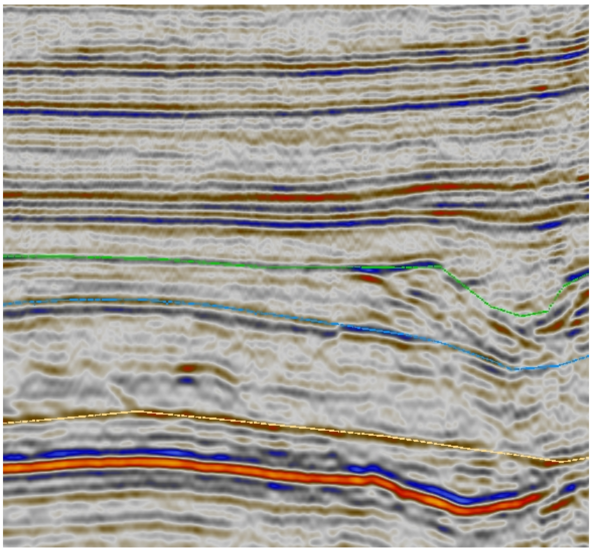

Figure 11: Phase change of the Volpriehausen reflector: block G10 (green=Kimmerian unc., blue=top Volpriehausen Sandstone, yellow=base Triassic Group).

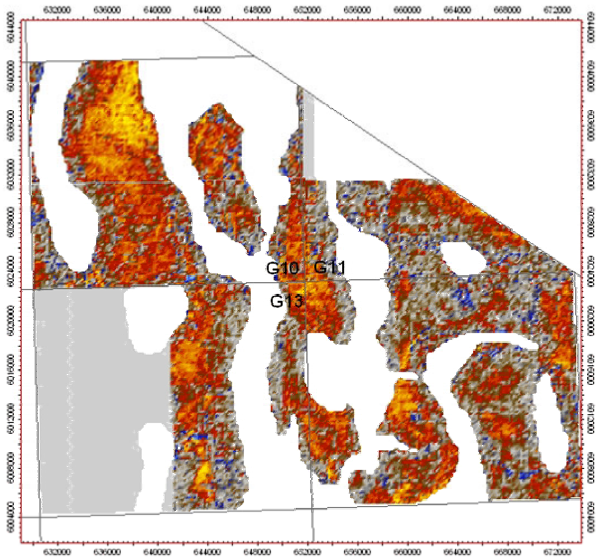

Figure 12: Amplitude map of the Volpriehausen horizon

Seal

The Lower Triassic seat seal and Solling claystones and ultimately the Röt evaporites act as a good intra-Triassic seal, while the Volpriehausen claystones might locally act as a waste zone.

The Lower Cretaceous Vlieland Shales provides the top seal in case of truncation traps. The sealing efficiency is a risk when sand stringers, lateral extension of the Scruff reservoir, act as a thiefzone.

Though several wells in the study area have encountered Upper Jurassic Scruff Sandstone, the distribution of these sediments remains uncertain. The Mid Kimmerian Unconformaty as well as the Late Kimmerian Unconformaty plays a role in this study

area. The Mid Kimmerian Unconformaty is a major phase of uplift which eroded the Triassic and Lower Jurassic sediments. Upper Jurassic sediments were deposited on top of the Mid Kimmerian Unconformaty and were subsequently eroded during the Late Kimmerian Unconformaty. It remains unknown whether the Scruff Sandstone stringers were deposited as a sheet or rather in isolated pockets. G10-03 indicates that Scruff sediments have been deposited as a sheet in the northern part of the G10 block. However, other wells (G10-02 and G13-03) did not encounter sandstones of the Scruff Member. South of G10-03 the Scruff Sandstones seem only to be preserved locally in the depressions on top of the salt ridges formed by dissolution of halite.
A sand stringer above the Late Kimmerian Unconformity, a Vlieland Sandstone equivalent, is less likely because of its absence in the wells in this region.
Truncation of the reservoir against a Zechstein saltdome proves to be an efficient lateral seal.

Structuration
A truncation wedge configuration below the Kimmerian Unconformity is the main type of trap of this play. Truncation of the reservoir against a saltdome is the secondary trap type in this area. A combination of the two situations within one structure is common. A four way dip closure, similar as a turtle back structure can also provide a trap structure for the Main Buntsandstein reservoirs.
The structuration could have started as early as Early Triassic tilting of the Triassic series as a result of halokinesis of the Permian salts (Remmelts 1996 and Jager et al., 2003)
In case the trap is formed by truncation against a saltdome, the timing of the completion of the structuration is less precise. Though it is hard to determine the exact moment when the salt structure broke through the Triassic series, it would have taken place between Early Jurassic and Early Cretaceous.
In case the trap is formed by truncation below the Kimmerian Unconformaty, the structure was present only after deposition of the Early Cretaceous Vlieland Claystone.

Charge
The Main Buntsandstein reservoirs are separated from the source, the Carboniferous Coal Measures, by the thick Silverpit and Zechstein evaporitic series. Despite these major screens, gas occurrences in the area are proven (G10-01, F15A-Triassic field and G16-Scruff field). Thinning of the Zechstein salt and major faulting has resulted in gas migration paths from Westphalian source rock to post Zechstein series.
Whether the kitchen area is situated directly below the prospect or in the Dutch Central Graben, the migration path is long difficult, therefore charging is a major risk for the Main Buntsandstein play.

9.1.2 Scruff Sandstone and Zechstein Caprock play

Reservoir
At the Mid Kimmerian Unconformaty salt ridges the Zechstein salts were exposed at the surface for a long time. Enormous amounts of halite are thought to have been dissolved during this period. A mixture of less dissolvable lithologies, i.e. anhydrites, carbonates and dolomites, were left behind after the halite had been dissolved. The paleotopographic depressions left after dissolution became the depocentre of the first Late Jurassic sediments, either being terrestrial sediments of sequence 1 or marine Scruff sediments of sequence 3 (Abbink et al., 2006). A less than 10m thick layer transgressive sandstone of the Scruff Greensand Member is preserved in these

depressions. Biostratigraphical data show that Early Cretaceous Vlieland Sandstone is absent in this area. The reservoir of this play is the combination of the Scruff Sandstone Member and the conglomerate mixture of anhydrite, carbonates and dolomites, i.e. Zechstein Caprock.
Porosities of the Scruff Greensand member are around 11% and of the Zechstein Caprock around 14%. The architecture of the reservoir is presumed to be chaotic as the clastic sediments have initially filled the spaces between the erosional remnants and later draped these basal series. As a consequence lateral predictability is low.

Seal
The Early Cretaceous Vlieland Claystone acts as an efficient seal. Faulting above the domes caused by halokinetic movements might reduce the efficiency of the seal.

Structure
The trap is formed by a well defined anticlinal structure above salt ridges. Although the trap was completed by the deposition of the Early Cretaceous Vlieland Claystone, the positive structure evolved later due to continues salt movement up to recent times.

Charge
Migration paths and source rocks are similar to those of the Main Buntsandstein Sandstones. Charging is an even bigger risk since contact between Triassic sandstones and the Scruff Sandstones/Zechstein Caprock is needed. Wells G10-01, G16-01 and G16-03 proof that migration along this difficult and long path is possible.

9.2 Unproven Plays on the SGH:

9.2.1 Carboniferous play

Reservoir

The few wells that have penetrated the Carboniferous on the SGH show a bad reservoir quality. The two wells in G13 en countered the Westphalian C and D, consisting of mainly shales with coal seems and a few layers of fine grained sandstones. These sandstones are less than a few meters thick and highly diagenetized. The encountered overpressure in this area indicates overall poor aquifer connectivity.

Seal

The overlying clays and evaporites of the Rotliegend and the Zechstein are considered to form an effective top and lateral seal. Intra-formational seals may be present.

Structure

The thick layer of Rotliegend and Zechstein evaporites makes it difficult to define the geometry. North striking normal faults may form horst like structures, which could form traps. The timing of structuration is linked to the fault movement. These pre-Zechstein faults are reactivated several times from at least Early Triassic times onwards.

Charge

The charging of the reservoir, being in direct contact with the source rock, is not considered to be a risk.

9.2.2 Rotliegend play

Reservoir

A few wells in the surrounding blocks and two wells in the G13 block have penetrated the Slochteren Formation. The Lower Slochteren Sandstone in this area consists of a relatively thin basal sand- siltstone on top of the Saalian Unconformity. Generally, the thickness decreases from the south (G16-01 up to 34 m of Lower Slochteren Sandstone) towards the north G13-01 and G13-02, 6m and 11m respectively). The porosity is around 7% but the reservoir quality in the G13 wells was low due to diagenesis. The quality and presence of the reservoir is considered a major risk.

Seal

Most of the Rotliegend sediments are represented by the Silverpit clays and evaporites which form an effective vertical and lateral seal.

Structure

The thick layer of Rotliegend and Zechstein evaporites makes it difficult to define the geometry. North striking normal faults may form horst like structures, which could form traps. The timing of structuration is linked to the fault movement. These pre-Zechstein faults are reactivated several times from at least Early Triassic times onwards. Defining structures is considered a major risk of the Rotliegend play.

Charge
Since the Carboniferous source rocks are very nearby the migration paths are short. Charging is not considered to be a risk.

9.2.3 *Scruff Sandstone as infill of gullies*

Reservoir
As a marginal play the infill of the gully structures cut into the Kimmerian Unconformaty are introduced. At the unconformity erosion of non-resistant Röt formation caused a topographic relief with prominent elongated (gully-like) depressions. Although no wells have penetrated these structures, it is likely that these gully shaped depressions have been filled with Upper Jurassic sediments. Since no well data are available of this type of play and the seismic signal does not give an indication of the kind sediments deposited in the gullies, the presence of the reservoir is considered a major risk.

Seal
The Rot Formation acts as a seat seal. The gullies are directly overlain by the Cretaceous Vlieland Claystone Member, which act like an efficient top seal.

Structure
The trap is defined as a stratigraphic trap which is formed by the gully shaped structures cut into the Kimmerian Unconformaty, covered by the Vlieland Claystone. The structures have a length varying from 2 km to 8 km. The width varies from 500 m to 1 km and the depth is approximately 50m. The Triassic Röt Evaporites were exposed after the Mid Kimmerian phase and subsequently eroded and filled. The structuration was completed in the Early Cretaceous with the deposition of the Vlieland Claystone.

Charge
The source rocks and migration paths are similar to the Scruff Sandstone/Zechstein play. The Triassic aquifers have to be connected to the Scruff reservoir. Therefore charging is considered a major risk.

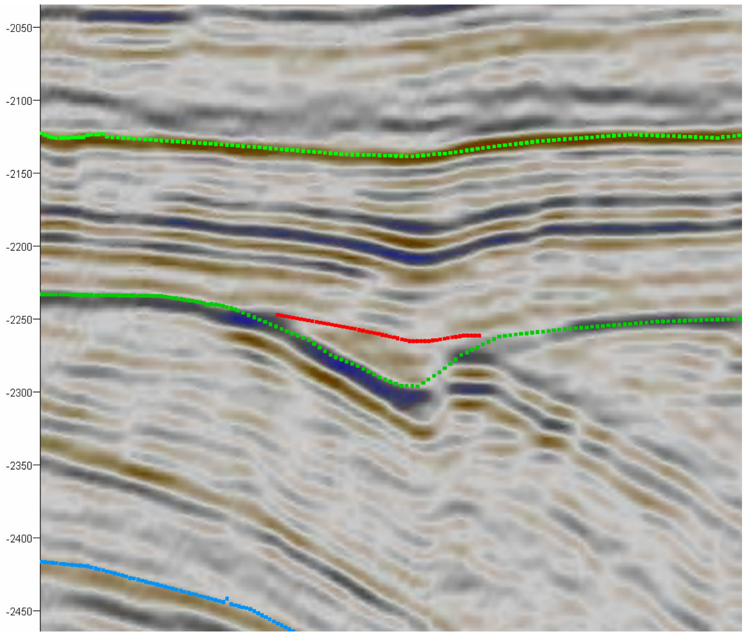

Figure 13: Gully structure on unconformity at Triassic Röt subcrop, block G11 (light green=base Chalk Group, dark green=Mid Kimmerian unc., red=base Late Kimmerian unc., bleu= top Volpriehausen Sandstone).

9.2.4 Chalk play

Reservoir
The Top Chalk play is a marginal play. In general the porosities are high but the permeability is considered to be the main risk. It is thought that enhanced permeability in the Chalk reservoir is associated with resedimentation of chalk following tectonic activity (turbiditic facies). However, the seismic facies of the Top Chalk in the study area show no indications of slump scars or seismic facies which can be related to resedimentation of chalk. Therefore, reservoir quality of the Chalk play is considered to be a major risk. The play is seen as a secondary objective when the Scruff Sandstone/Zechstein play is the main objective.

Seal
The Landen Claystone may form an efficient seal, although the risk leakage due to fractures and faults, induced by doming of underlying salt structures, is high. The seal is proven for gas in the Harlingen field (Bosch, 1983) and for oil in the Netherlands in the F2a field.

Structure
The trap is formed by well defined four way dip closures above salt ridges. The structuration started shortly after deposition of the reservoir with the deposition of the Landen Clay seal. Salt movement, which is continuing till present times, tilted the above lying layers resulting in four way dip closures.

Charge
Apart from the long and difficult migration path past the Rotliegend and Zechstein evaporites, the Vlieland Claystone and Holland Marls have to be passed. Major faults

along which the gas could have been migrated are not abundant. Charging is considered to be a major risk.
Charge from the Posidonia shales in the Central Dutch Graben may be a possibility. However, there appears to be no indication of oil shows or even residual oil on the Schill Grund High. Westward migration is seriously hampered by the N-S striking salt ridges.

9.2.5 North Sea Play

Reservoir
The North Sea play is considered to be a marginal play in this study area. The reservoirs consist of poorly consolidated marine sandstones with porosities varying between 14% and 36% in the A and B blocks. The reservoir is expected to be present over the whole study area.

Seal
The seal is provided by interbedded clay layers. The thickness of the clay layers stipulates the seal strength.

Structure
The structure is formed by four way dip closures formed by salt movement of the underlying salt ridges.

Charge
Migration paths from the Carboniferous source rock are long and difficult due to the many sealing layers in between.
Alternatively, gas could have a biogenic origin from organic rich clay layers interbedded in between the reservoir sandstones. No hydrocarbons of the North Sea play have been encountered in or around this study area. Charging is considered to be the mayor risk.

10 Prospectivity

In total 10 prospective structures with 19 prospects have been defined in the G10, G11 and G13 blocks (Figure 14). A complete description and evaluation of each of the prospects is shown in the summary sheets. An overview of the used parameters is given in Appendix 15.
The gross rock volume above the lowest closing contour, the presumed gas water contact, is calculated using the constructed maps (Appendix 7, 9 and 10). A constant average thickness for the Volpriehausen reservoir and the Scruff reservoir, respectively 36m and 8m, was used for volume calculation.
In case of extraordinary maximum gas column heights the column height is adjusted to 400 m by changing the LCC. The original LCC and gas column height are then used for the maximum case of the GIIP.
The porosity, N/G ratio, gross thickness and the gas saturation factor for the Volpriehausen reservoir are derived from maps based on data points from the public dataset of surrounding wells. The limited amount of data for the Chalk and Scruff reservoirs did not allow for a representative map for the porosity, N/G ratio, gross thickness and the gas saturation factor. Therefore an average of the parameters from the public dataset was used.

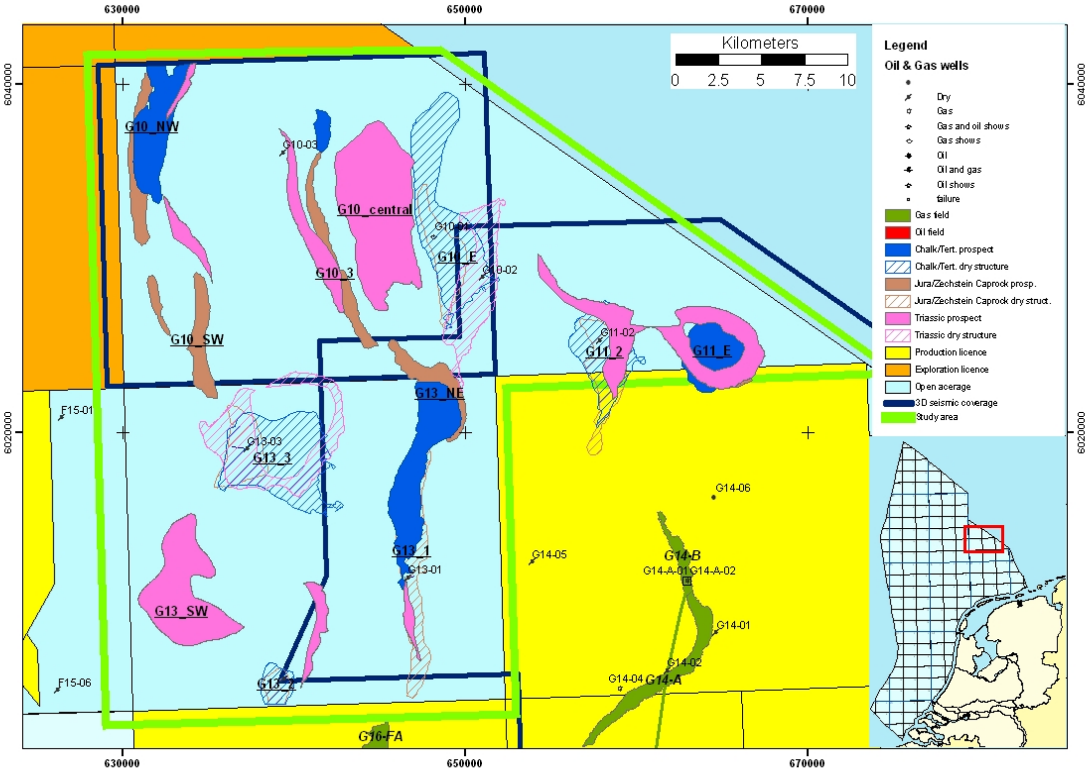

Figure 14: Prospect locations

For the calculation of the expansion factor the pressure and temperature of the lowest part of the reservoir were used.
The volumes presented in the tables below are obtained after using a Monte Carlo simulation (5000 runs) of the relevant attribute distributions, i.e. GRV, porosity, N/G. expansion factor, gas saturation.

	GIIP in 10^9 Nm^3			**Reserves** in 10^9 Nm^3				
G10 Southwest	**Low GIIP**	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**	**EXP**
Upper Jurassic (Scruff)(W-arm)	0.1	0.1	0.1	0.0	0.0	0.0	4	0.00
Upper Jurassic (Scruff)(E-arm)	0.4	0.5	0.6	0.2	0.2	0.3	4	0.01
Lower Volpriehausen	1.3	1.7	2.1	0.9	1.2	1.5	16	0.18
G10 Northwest								
Chalk	1.6	2.3	3.0	0.9	1.4	1.9	6	0.09
Upper Jurassic (Scruff)	0.5	0.6	0.8	0.2	0.3	0.4	10	0.03
Lower Volpriehausen	0.6	0.7	0.8	0.4	0.5	0.6	10	0.05
G10 Central								
Lower Volpriehausen	16.9	22.8	30.0	11.6	15.9	21.0	13	2.01
G10-03								
Chalk	0.0	0.0	0.0	0.0	0.0	0.0	4	0
Upper Jurassic (Scruff)	0.4	0.6	0.7	0.2	0.3	0.4	11	0.03
Lower Volpriehausen	5.5	6.3	7.1	3.8	4.4	5.1	7	0.32

Table 5: Volumes of the prospects in G10.

	GIIP in 10^9 Nm^3			**Reserves** in 10^9 Nm^3				
G11-02	**Low GIIP**	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**	**EXP**
Lower Volpriehausen	8.1	9.2	10.4	5.5	6.4	7.4	6	0.37
G11 East								
Chalk	2.3	3.5	4.6	1.4	2.1	2.8	6	0.13
Upper Jurassic (Scruff)	0.6	0.8	1.0	0.3	0.4	0.5	9	0.04
Lower Volpriehausen	4.6	6.8	9.2	3.2	4.8	6.6	19	0.90

Table 6: Volumes of the prospects in G11.

	GIIP in 10^9 Nm^3			**Reserves** in 10^9 Nm^3				
G13-01	**Low GIIP**	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**	**EXP**
Chalk	1.8	2.7	3.6	1.1	1.6	2.2	3	0.05
Lower Volpriehausen	1.0	1.2	1.3	0.7	0.8	0.9	16	0.13
G13-Southwest								
Lower Volpriehausen	14.8	16.9	19.2	10.3	11.9	13.7	10	1.12
G13 Northeast								
Upper Jurassic (Scruff)	0.6	0.8	1.1	0.3	0.4	0.5	8	0.04
G13-02								
Lower Volpriehausen	2.2	2.6	2.9	1.5	1.8	2.1	29	0.52

Table 7: Volumes of the prospects in G13.

11 Risk assessment

The discovered fields on the SGH proof that timing of structuration and charge are well aligned. However, which charge scenario is effective remains unclear. Therefore, the estimated risk associated with charge is relatively high and consequently is regarded as the main risk of the SGH. For the Chalk reservoirs in particular the reservoir quality is considered to be an additional high risk.

12 Conclusions

The blocks G10, G11 and G13 are considered to be an attractive exploration area. A quite sizable volume of gas may be present although the risk is assessed high. The discovered fields on the SGH proof that good reservoirs and seals are present and that timing of structuration and charge are well aligned.
In total 19 prospects have been defined for the following plays; the Volpriehausen play, the Scruff/Zechstein play and the Chalk play. The first two plays are proven on the SGH. For most of the secondary plays, including the Carboniferous play, the Rotliegend play, and the Chalk play, the reservoir distribution is hard to predict.
The charge is considered to be the main risk. Multiple charge scenarios are possible. Which charge scenario is most effective remains unclear. Therefore, the estimated risk associated with charge is relatively high.
Further study is necessary on the de-risking of the charge. In addition, a better insight in reservoir distribution of the secondary plays is needed.
This study indicates for the proven plays a total mean success volume of 50 bcm and a risked volume of 6 bcm in the G10, G11 and G13 blocks.

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Appendices

Appendix 1.

Overview well data:

Wells within G10, G11 and G13 b	Used digital logs	Checkshots	Biostratigraphical data	Used in well section	Composite well log
G10-1	GR, DT, Nphi, RhoB	yes	yes	section I	yes
G10-2	GR, DT, Nphi, RhoB, Drho	yes	no	section I en IV	yes
G10-3	GR, DT, Nphi, RhoB	yes	no	section I en III	yes
G11-02	GR, DT, Nphi, RhoB	Time-depth couples from SNET project*	yes	section I	yes
G13-01	GR, DT, Nphi, RhoB, Drho	Time-depth couples from SNET project*	yes	section II en IV	yes
G13-02-S1	GR, DT.	no	no	section IV	yes
G13-03	GR, DT, Nphi, RhoB, Drho	no	no	section II	yes
G13-03-S1	GR, DT, Nphi, RhoB, Drho	no	no	section II en III	yes
Surrounding wells	Logs	Checkshots	Biostratigraphical data	Used in well section	Composite well log
F15-01	GR, DT, Nphi, RhoB, Drho	outside surveys	no	section II	yes
F15-06	GR, DT, Nphi, RhoB, Drho	Time-depth couples from SNET project*	yes	section III	yes
F18-01	GR, DT, Nphi, RhoB, Drho	outside surveys	yes	section III	yes
F18-09	GR, DT, Nphi, RhoB, Drho	outside surveys	yes	section III	yes
G16-01	GR, DT, Nphi, RhoB, Drho	outside surveys	yes	section IV	yes
G16-03	GR, DT, Nphi, RhoB, Drho	outside surveys	yes	section IV	yes

* SNET is an internal TNO project

Appendix 2.

Well stratigraphy:

Wells in the F15 Block					
Well F15-01			Well F15-06		
Surface	MD	Z	Surface	MD	Z
NU	989	-960.65	NU	972	-932.49
NMRF	1055	-1026.65	NMRF	1032	-992.49
NLFFB	1130	-1101.65	NLFFB	1062	-1022.49
NLFFM	1175	-1146.65	NLFFM	1134	-1094.49
NLFFY	1530	-1501.64	NLFFY	1459.5	-1419.96
NLFFT	1542	-1513.64	NLFFT	1468	-1428.46
NLLFC	1605	-1576.63	NLLFC	1526.5	-1486.94
CKEK	1683	-1654.63	CKEK	1599	-1559.42
CKGR	2747	-2718.57	CKGR	2226	-2186.24
CKTXP	2749	-2720.57	CKTXP	2230	-2190.24
CKTXM	2838	-2809.56	CKTXM	2311	-2271.22
KNGLU	2849.5	-2821.06	KNGLU	2330	-2290.21
KNGLM	2867.5	-2839.06	KNGLM	2332.5	-2292.71
KNGLL	2876	-2847.56	KNGLL	2337	-2297.21
KNNC	2967	-2938.55	KNNC	2476.5	-2436.68
RNROU	3013	-2984.54	SLCF	2506	-2466.18
RNRO2	3022	-2993.54	ZECP	2549	-2509.17
RNROM	3041	-3012.54	ZESA	2600	-2560.17
RNRO1	3103	-3074.54			
RNSOC	3148	-3119.53			
RBMH	3165	-3136.53			
RBMDC	3190	-3161.53			
RBMDL	3202	-3173.53			
RBMVC	3306	-3277.53			
RBMVL	3338	-3309.53			
RBSHR	3385.5	-3357.02			

Wells in the F18 Block

Well F18-01			Well F18-09		
Surface	MD	Z	Surface	MD	Z
NU	1022	-993.57	NU	1034	-994.4
NMRF	1064	-1035.57	NMRF	1150	-1110.26
NLFFB	1128.5	-1100.06	NLFFB	1170.5	-1130.75
NLFFM	1265	-1236.56	NLFFM	1246	-1206.22
NLFFY	1540	-1511.53	NLFFY	1564	-1524.21
NLFFT	1550	-1521.53	NLFFT	1572	-1532.21
NLLFC	1590	-1561.53	NLLFC	1611.5	-1571.71
CKEK	1652	-1623.52	CKEK	1679	-1639.21
CKGR	1782	-1753.51	CKGR	1927	-1887.2
CKTXP	1783.5	-1755.01	CKTXP	1929	-1889.2
CKTXM	1870	-1841.51	CKTXM	1998	-1958.2
KNGLU	1910	-1881.5	KNGLU	2045	-2005.2
KNGLM	1935	-1906.5	KNGLM	2070	-2030.2
KNGLL	1948	-1919.5	KNGLL	2105	-2065.19
KNNC	2151	-2122.5	KNNC	2243	-2203.17
SGKIS	2175	-2146.5	SGKIS	2282	-2242.16
SGGSS	2193	-2164.5	SGGSS	2298.5	-2258.66
SGGSP	2230	-2201.5	SGGSP	2330	-2290.15
SGGSA	2328	-2299.5	SGGSA	2526	-2486.14
SGGSB	2350	-2321.5	SGGSB	2562.5	-2522.64
SLCFO	2422	-2393.49	SLCFO	2614.5	-2574.63
SLCFM	2622	-2593.37	SLCFM	2799	-2759.1
SLCFR	2686	-2657.32	SLCFR	2885	-2845.07
ATAL	2756	-2727.25	ATAL	2933	-2893.06
FAULT	2756	-2727.25	ATRT	2962	-2922.05
RNKPU	2765	-2736.24	RNKPU	3125	-3084.94
RNKPD	2837.5	-2808.69	RNKPD	3215	-3174.81
RNKPR	2854	-2825.17	RNKPR	3347	-3306.5
RNKPE	2954	-2925.1	RNKPE	3418	-3377.31
RNKPM	3002	-2973.05	RNKPM	3480	-3439.11
RNKPS	3095.5	-3066.43	RNKPS	3706	-3663.96
RNKPL	3176.5	-3147.22	RNKPL	3815	-3772.23
RNMUC	3328	-3298.43	RNMUC	3887	-3843.96
RNMUE	3613	-3583.16	RNMUE	4012	-3968.56
RNMUL	3746	-3716.02	FAULT	4012	-3968.56
			RNRO1	4310	-4266.33
			RNSOC	4366	-4322.32
			RNSOB	4370	-4326.32
			RBMH	4387	-4343.32
			RBMDC	4411	-4367.32
			RBMDL	4425.5	-4381.82
			RBMVC	4530	-4486.31
			RBMVL	4565	-4521.31
			RBSHR	4615	-4571.3

Wells in the G10 Block

Well G10-01			Well G10-02			Well G10-03		
Surface	MD	Z	Surface	MD	Z	Surface	MD	Z
NU	948	-912.02	NU	932	-895.27	NU	970	-929.87
NMRF	1024	-988.01	NMRF	1024	-987.24	NMRF	1035	-994.86
NLFFB	1070	-1034	NLFFB	1065	-1028.23	NLFFB	1064	-1023.86
NLFFM	1151	-1115	NLFFM	1169	-1132.2	NLFFM	1160	-1119.84
NLFFY	1399.5	-1363.5	NLFFY	1437	-1400.14	NLFFY	1516.5	-1476.29
NLFFT	1409	-1373	NLFFT	1449	-1412.14	NLFFT	1530	-1489.78
NLLFC	1467	-1431	NLLFC	1507	-1470.13	NLLFC	1618	-1577.77
CKEK	1545	-1508.99	CKEK	1630	-1593.09	CKEK	1689	-1648.76
CKGR	2395	-2358.96	CKGR	2695	-2657.72	CKGR	2926	-2885.03
CKTXP	2395	-2358.96	CKTXP	2696.5	-2659.22	CKTXP	2928	-2887.03
CKTXM	2412	-2375.95	CKTXM	2716	-2678.71	CKTXM	2946	-2904.99
KNGLU	2469.5	-2433.44	KNGLU	2769	-2731.7	KNGLU	2963	-2921.94
KNGLM	2479	-2442.94	KNGLM	2777	-2739.7	KNGLM	2965	-2923.94
KNGLL	2489	-2452.94	KNGLL	2788	-2750.69	KNGLL	2967	-2925.93
KNNC	2651.5	-2615.4	KNNC	2908	-2870.68	KNNC	3134.5	-3093.03
SGGSS	2667	-2630.89	SGGSS	2909.5	-2872.18	SGGSS	3151.5	-3109.98
ZE	2873	-2836.84	RBMH	2952	-2914.68	RBMVC	3184	-3142.41
			RBMDC	2992.5	-2955.17	RBMVL	3217	-3175.33
			RBMDL	3077.5	-3040.15	RBSHR	3266.5	-3224.7
			RBMVC	3153	-3115.63			
			RBMVL	3196.5	-3159.12			
			RBSHR	3240	-3202.6			

Well in the G11 Block

Well G11-02		
Surface	MD	Z
NU	937	-901.99
NMRF	1012	-976.99
NLFFB	1059	-1023.99
NLFFM	1114.5	-1079.49
NLFFY	1342	-1306.99
NLFFT	1353	-1317.99
NLLFC	1418	-1382.99
CKEK	1535	-1499.99
CKGR	2342	-2306.98
CKTXP	2343	-2307.98
CKTXM	2381	-2345.98
KNGLU	2435	-2399.98
KNGLM	2450	-2414.98
KNGLL	2460.5	-2425.48
KNNC	2582	-2546.97
SGGSS	2588	-2552.97
ZE	2663	-2627.96

Wells in the G13 Block

Well G13-01			Well G13-02-S1			Well G13-03		
Surface	MD	Z	Surface	MD	Z	Surface	MD	Z
NU	903	-863.3	NU	906	-870.98	NU	932	-892
NMRF	1004	-964.29	NMRF	968	-932.98	NMRF	992	-952
NLFFB	1057	-1017.29	NLFFB	1012.5	-977.48	NLFFB	1022	-982
NLFFM	1130.5	-1090.79	NLFFM	1068	-1032.98	NLFFM	1112.5	-1072.49
NLFFY	1449	-1409.29	NLFFY	1464	-1428.97	NLFFY	1470	-1429.99
NLFFT	1459	-1419.29	NLFFT	1473	-1437.97	NLFFT	1490	-1449.99
NLLFC	1502	-1462.29	NLLFC	1492	-1456.97	NLLFC	1527	-1486.99
CKEK	1557	-1517.29	CKEK	1590	-1554.97	CKEK	1580	-1539.99
CKGR	2171	-2131.22	CKGR	2466	-2430.8	CKGR	2484.5	-2444.46
CKTXP	2172.5	-2132.72	CKTXP	2467	-2431.8	CKTXP	2486	-2445.96
CKTXM	2201.5	-2161.71	CKTXM	2530	-2494.7	CKTXM	2492	-2451.96
KNGLU	2266.5	-2226.7	KNGLU	2564	-2528.66	KNGLU	2517	-2476.96
KNGLM	2270	-2230.2	KNGLM	2575	-2539.66	KNGLM	2523.5	-2483.45
KNGLL	2280	-2240.2	KNGLL	2584	-2548.65	KNGLL	2536	-2495.95
KNNC	2458	-2418.16	KNNC	2733	-2697.13	KNNC	2743	-2694.1
SGGSS	2467.5	-2427.66	SGGSS	2736	-2700.11	RN	3087	-2960.83
ZE	2758	-2718.13	ZESAL	3354	-3292.83			
FAULT	2758	-2718.13	ZEZ2A	3365	-3302.91	Well G13-03-S1		
RBSHM	2970	-2929.97	ZEZ2C	3370	-3307.49	Surface	MD	Z
ZEUC	2989	-2948.94	ZEZ1A	3389	-3324.94	NU	932	-891.81
ZESAU	3376	-3334.89	ZEZ1C	3401	-3336.11	NMRF	992	-951.8
ZEZ3A	3437	-3395.46	ZEZ1K	3402	-3337.05	NLFFB	1022	-981.79
ZEZ3C	3439.5	-3397.94	ROCLU	3783.5	-3697.52	NLFFM	1112.5	-1072.27
ZEZ3G	3440.5	-3398.93	ROCLE	4438	-4302.68	NLFFY	1470	-1429.7
ZEZ2T	3441.5	-3399.92	ROCLL	4565	-4415.02	NLFFT	1490	-1449.7
ZEZ2H	3477	-3435.06	ROSLL	4578	-4426.54	NLLFC	1527	-1486.69
ZEZ2A	3483.5	-3441.47	DCCU	4641	-4482.49	CKEK	1580	-1539.68
ZEZ2C	3496	-3453.79				CKGR	2808.5	-2598.1
ZEZ1W	3521.5	-3478.84				CKTXP	2810	-2599.22
ZEZ1C	3535	-3492.06				CKTXM	2827	-2611.99
ZEZ1K	3536	-3493.04				KNGLU	2874	-2647.29
ROCLU	3613.5	-3568.78				KNGLM	2879	-2651.04
ROCLE	4348.5	-4283.87				KNGLL	2892	-2660.81
ROCLL	4465	-4392.15				KNNC	3124	-2837.11
ROSLL	4471.5	-4398.1				RBMH	3175	-2873.64
DCHP	4535	-4456.24				RBMDC	3199	-2890.04
DCCU	4751	-4653.57				RBMDL	3233	-2912.31
						RBMVC	3486.5	-3088.88
						RBMVL	3551.5	-3138.09
						RBSHR	3568	-3150.93

Wells in the G16 Block					
Well G16-01			Well G16-03		
Surface	MD	Z	Surface	MD	Z
N	1434	-1405.29	NU	972	-932.49
CKEK	1505	-1476.26	NMRF	1032	-992.49
CKGR	2154	-2125.2	NLFFB	1062	-1022.49
CKTXP	2155	-2126.2	NLFFM	1134	-1094.49
CKTXM	2165	-2136.2	NLFFY	1459.5	-1419.96
KNGLU	2257	-2228.19	NLFFT	1468	-1428.46
KNGLM	2263	-2234.19	NLLFC	1526.5	-1486.94
KNGLL	2270	-2241.19	CKEK	1599	-1559.42
KNNC	2451.5	-2422.66	CKGR	2226	-2186.24
SGKIS	2469	-2440.16	CKTXP	2230	-2190.24
SGGSS	2477	-2448.16	CKTXM	2311	-2271.22
ZECP	2533	-2504.15	KNGLU	2330	-2290.21
ZEZ3A	2782	-2753.14	KNGLM	2332.5	-2292.71
ZEZ3C	2790	-2761.13	KNGLL	2337	-2297.21
ZEZ3G	2792	-2763.13	KNNC	2476.5	-2436.68
ZEZ3H	3328	-3296.44	SLCF	2506	-2466.18
ZEZ3A	3442	-3408.87	ZECP	2549	-2509.17
ZEZ3C	3444.5	-3411.34	ZESA	2600	-2560.17
ZEZ3G	3445.5	-3412.32			
ZEZ2H	3567	-3532.44			
ZEZ2A	3572	-3537.39			
ZEZ2C	3576	-3541.34			
ZEZ1W	3610	-3574.95			
ZEZ1C	3614	-3578.9			
ZEZ1K	3616	-3580.87			
ROCLU	3723	-3686.7			
ROCLE	4178.5	-4140.27			
ROCLL	4270	-4231.43			
DCC	4321	-4282.27			

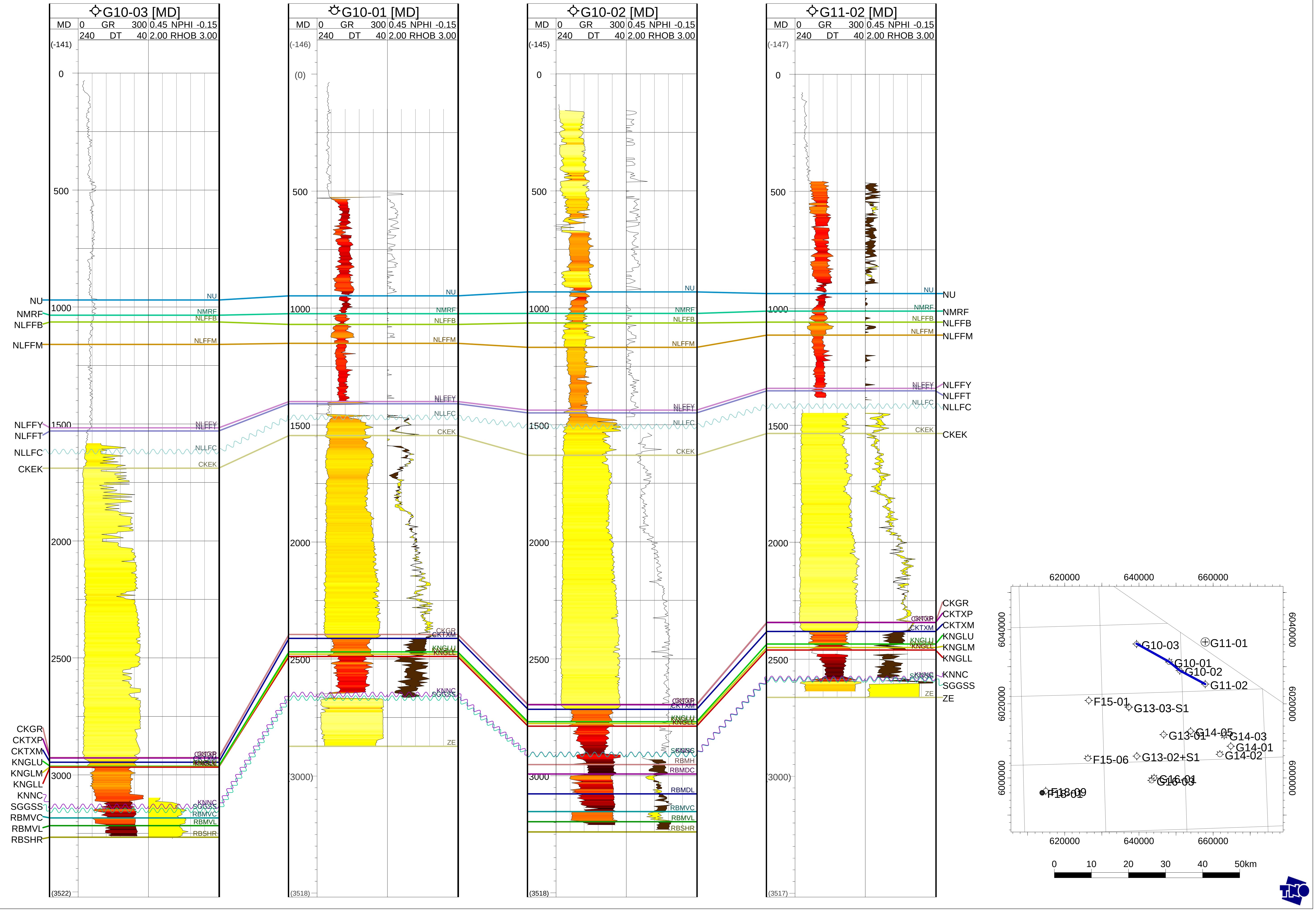
Stratigraphical abbriviations:

Strat. Abbreviation	Strat Full name
ATAL	Aalburg Fm
ATRT	Sleen Fm
CKEK	Ekofisk Fm
CKGR	Ommelanden Fm
CKTXM	Texel Marlstone Mb
CKTXP	Plenus Marl Mb
DCC	Caumer Subgroup
DCCU	Maurits Fm
DCHP	Step Graben Fm
KNGLL	Lower Holland Marl Mb
KNGLM	Middle Holland Claystone Mb
KNGLU	Upper Holland Marl Mb
KNNC	Vlieland Claystone Fm
N	North Sea Supergroup
NLFFB	Asse Mb
NLFFM	Brussels Marl Mb
NLFFT	Basal Dongen Tuffite Mb
NLFFY	Ieper Mb
NLLFC	Landen Clay Mb
NMRF	Rupel Fm
NU	Upper North Sea Group
RBMDC	Detfurth Claystone Mb
RBMDL	Lower Detfurth Sandstone Mb
RBMH	Hardegsen Fm
RBMVC	Volpriehausen Claystone Mb
RBMVL	Lower Volpriehausen Sandstone Mb
RBSHM	Main Claystone Mb
RBSHR	Rogenstein Mb
RN	Upper Germanic Trias Group
RNKPD	Dolomitic Keuper
RNKPE	Red Keuper Evaporite
RNKPL	Lower Keuper Claystone
RNKPM	Mid Keuper Claystone
RNKPR	Red Keuper Claystone
RNKPS	Main Keup Evaporite
RNKPU	Upper Keuper Claystone
RNMUC	Muschelk Claystone
RNMUE	Muschelk Evaporite
RNMUL	Lower Muschelk
RNRO1	Main Rot Evaporite
RNRO2	Upper Rot Evaporite
RNROM	Inter Rot Claystone
RNROU	Upper Rot Claystone
RNSOB	Basal Solling Sandstone
RNSOC	Solling Claystone
ROCLE	Silverpit Evaporite
ROCLL	Lower Silverpit Claystone
ROCLU	Upper Silverpit Claystone
ROSLL	Lower Slochteren Mb
SGGSA	Scruff Argillaceous Mb
SGGSB	Scruff Basal Sandstone

Strat. Abbreviation	Strat Full name
SGGSP	Scruff Spiculite
SGGSS	Stortemelk Mb
SGKIS	Schill Grund Mb
SLCF	Friese Front Fm
SLCFM	Main Friese Front Mb
SLCFO	Oysterground Mb
SLCFR	Rifgronden Mb
ZE	Zechstein Group
ZECP	Zechstein Caprock Fm
ZESA	Zechstein Salt Fm
ZESAL	Zechst Lower Salt Mbr
ZESAU	Zechst Upper Salt Mbr
ZEUC	Zechstein Upper Claystone Mb
ZEZ1A	Z1 Lower Anhydrite Mb
ZEZ1C	Z1 Carbonate Mb
ZEZ1K	Coppershale Mb
ZEZ1W	Z1 Anhydrite Mb
ZEZ2A	Z2 Basal Anhydrite Mb
ZEZ2C	Z2 Carbonate Mb
ZEZ2H	Z2 Salt Mb
ZEZ2T	Z2 Roof Anhydrite Mb
ZEZ3A	Main Anhydrite Mb
ZEZ3C	Z3 Carbonate Mb
ZEZ3G	Grey Salt Clay Mb
ZEZ3H	Z3 Salt Mb

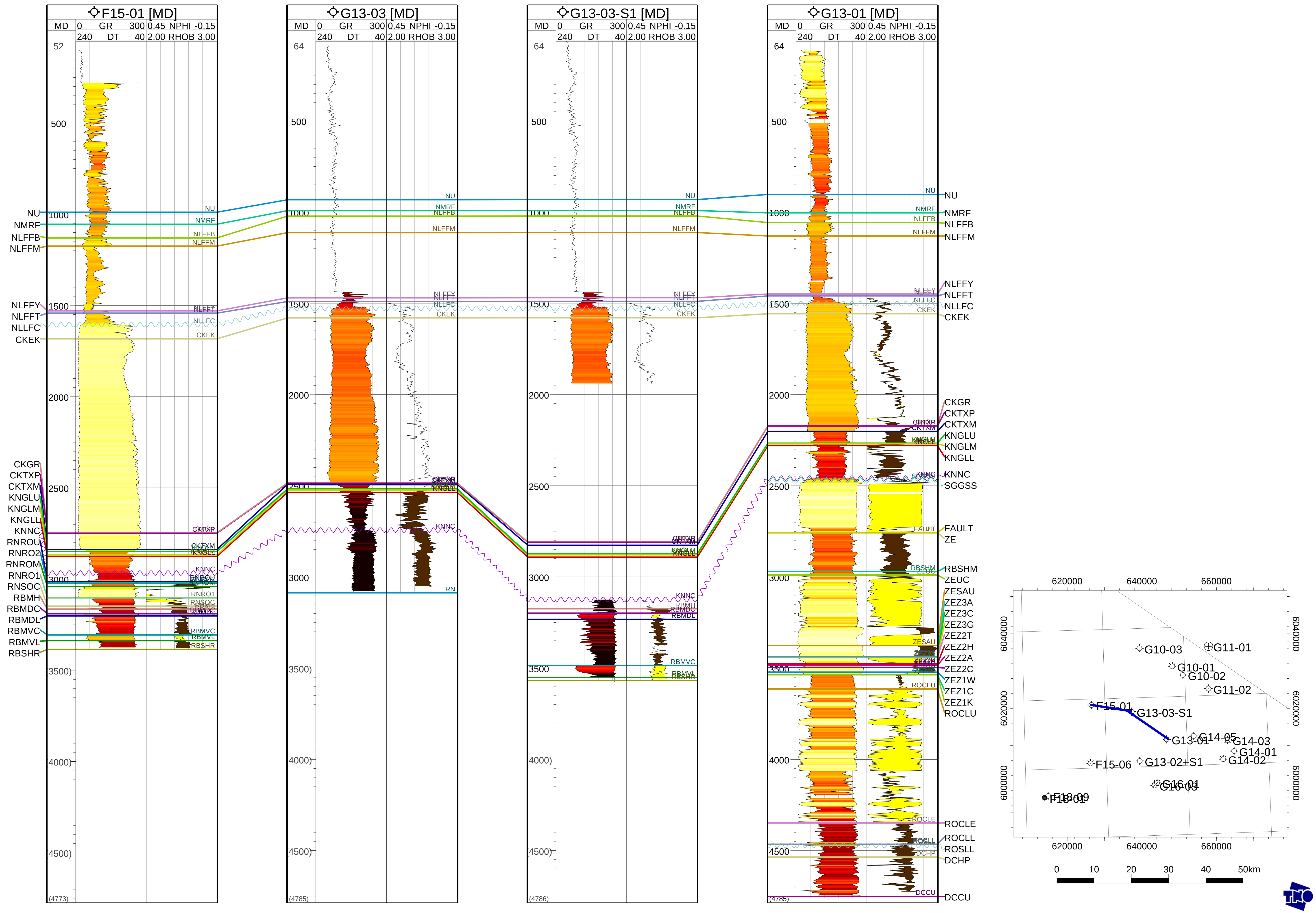
Appendix 3.

Well Section 1



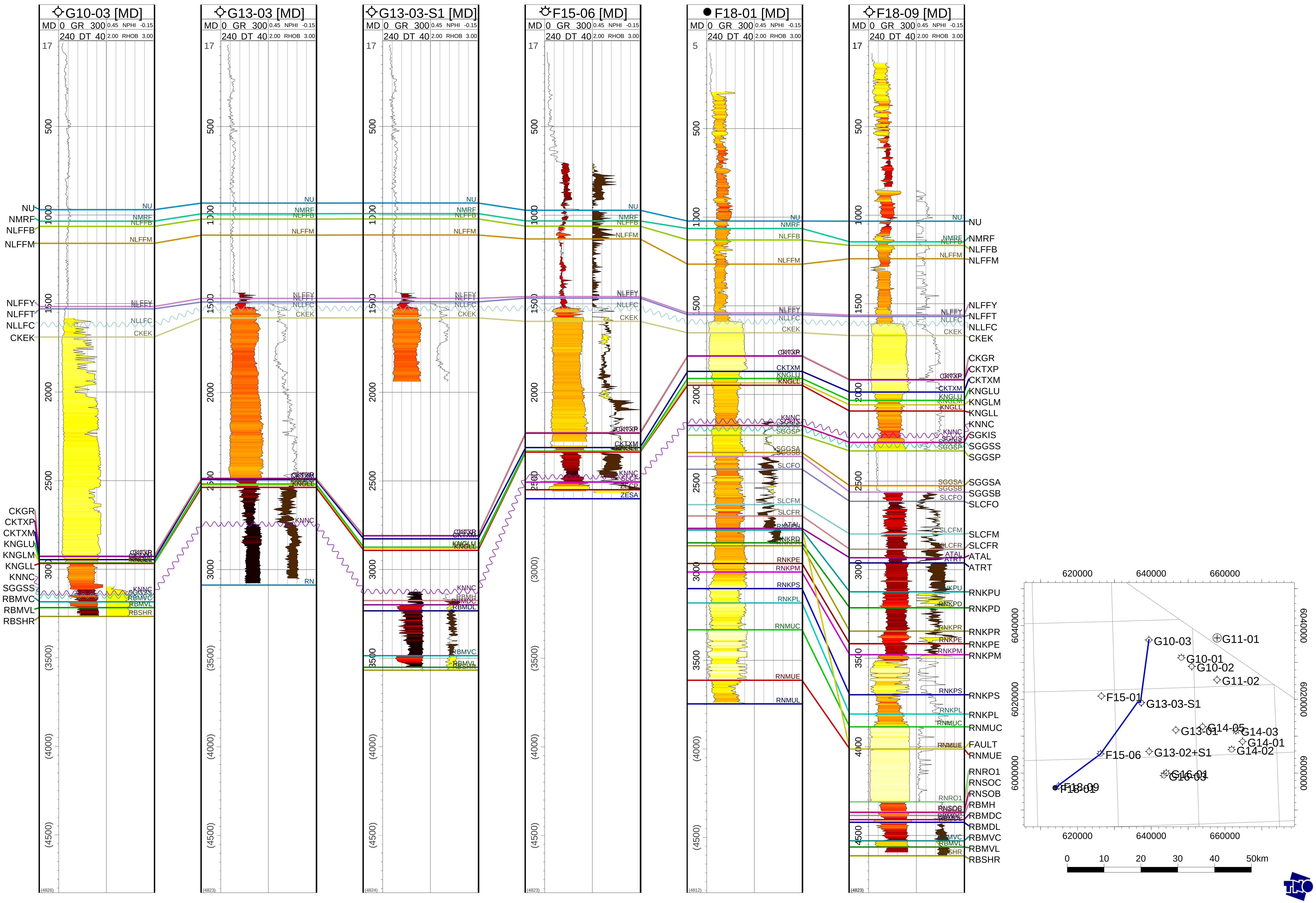
Appendix 4

Well Section 2



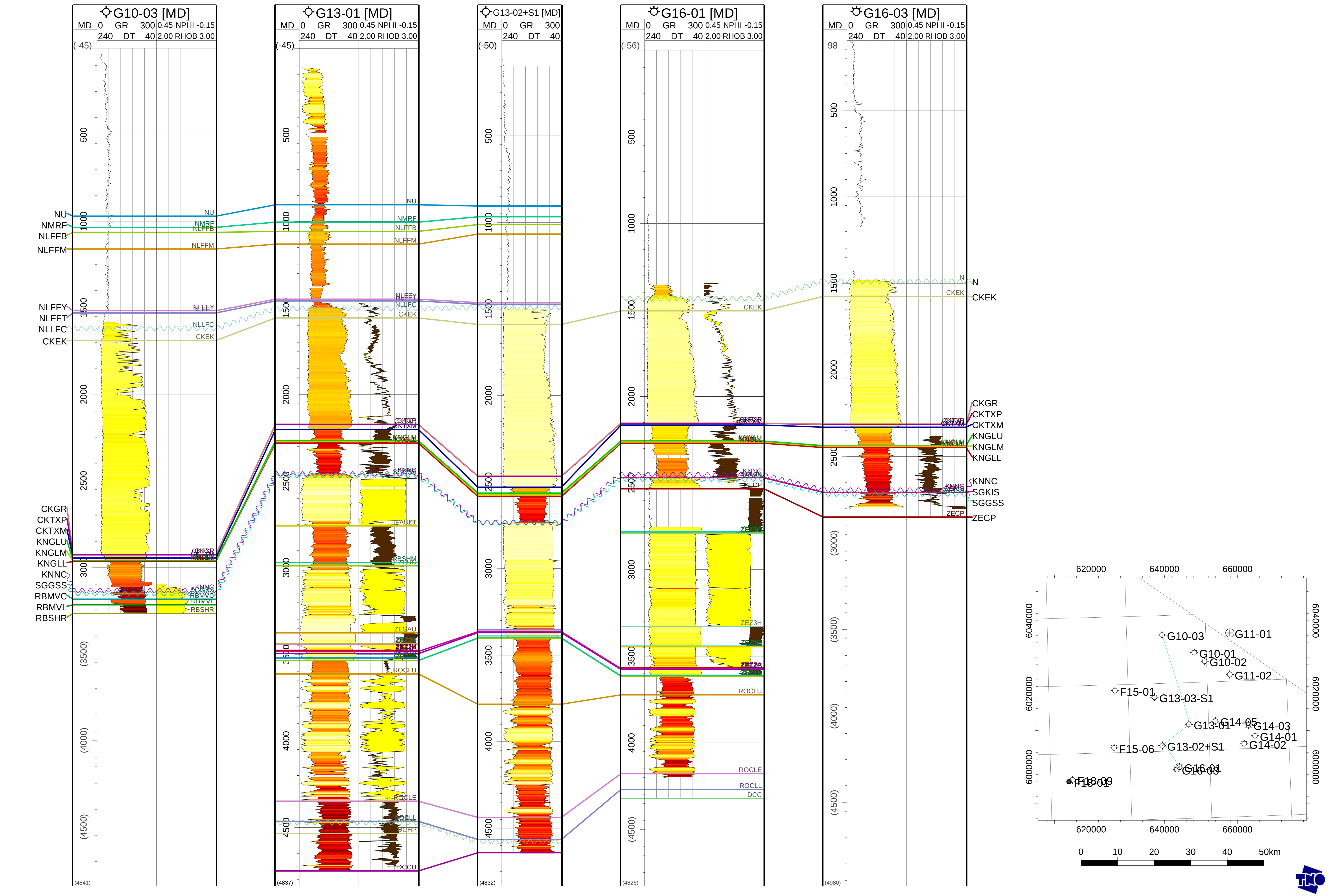
Appendix 5.

Well Section 3



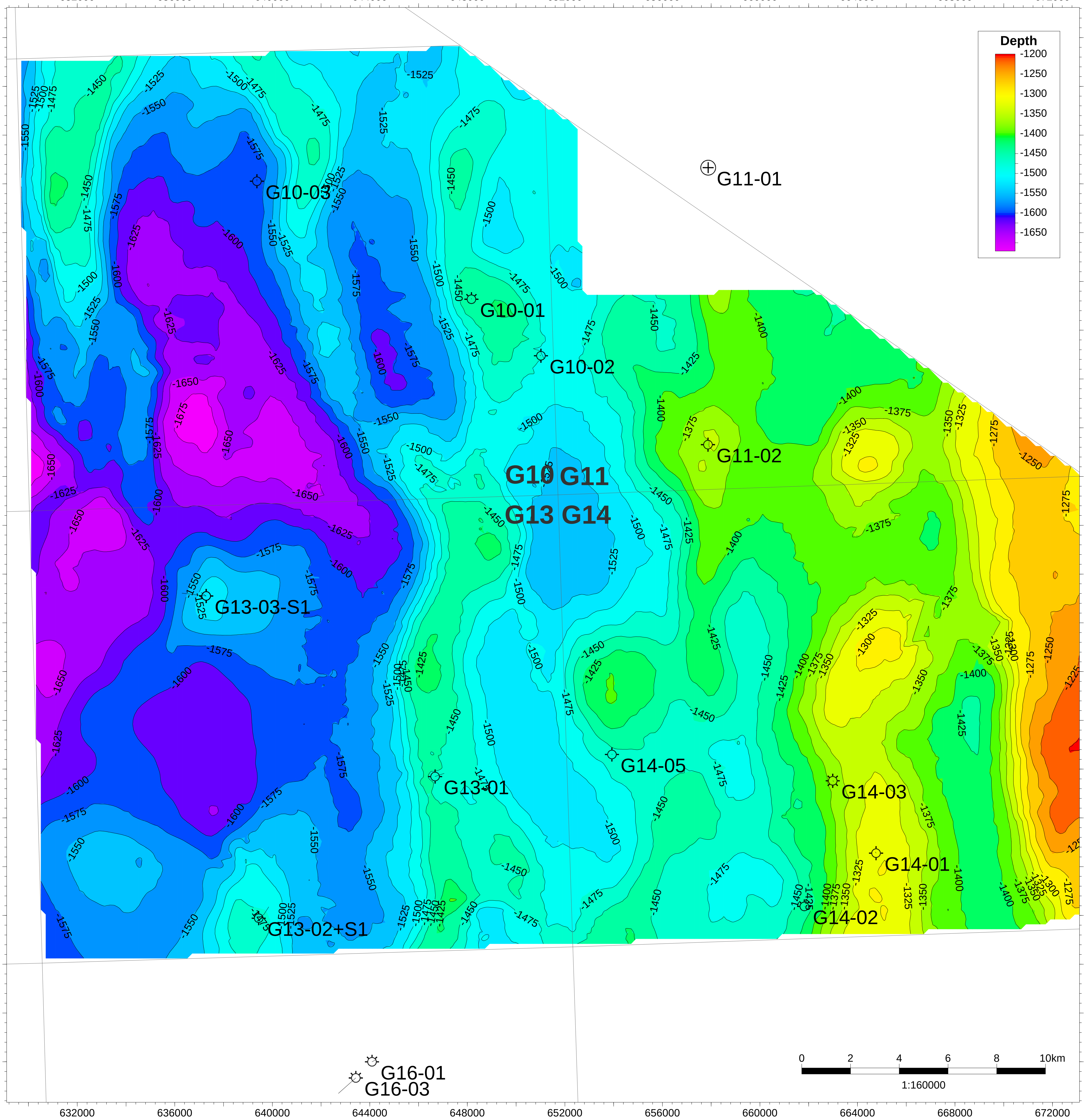
Appendix 6.

Well Section 4



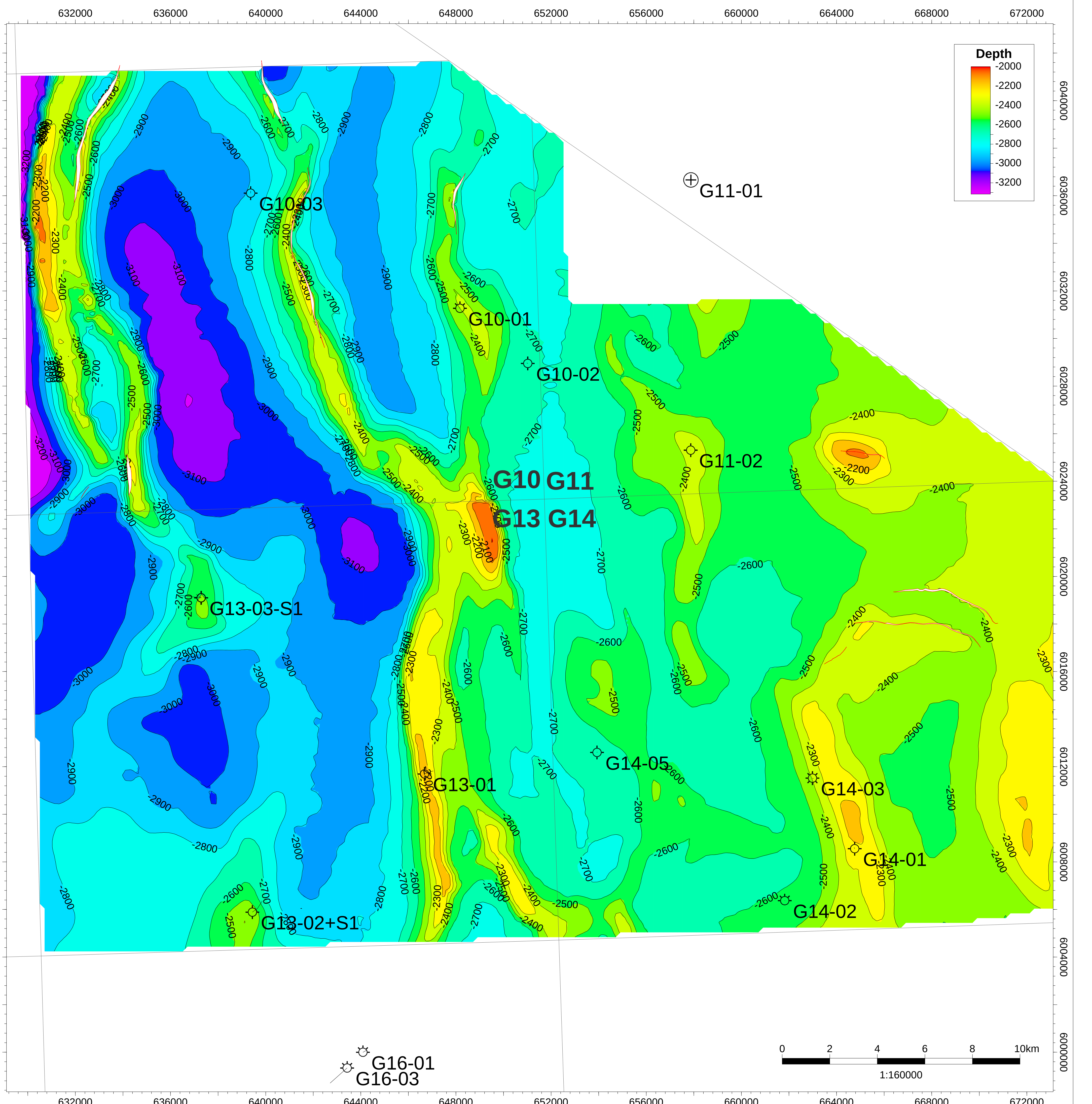
Appendix 7

Depth North Sea Group



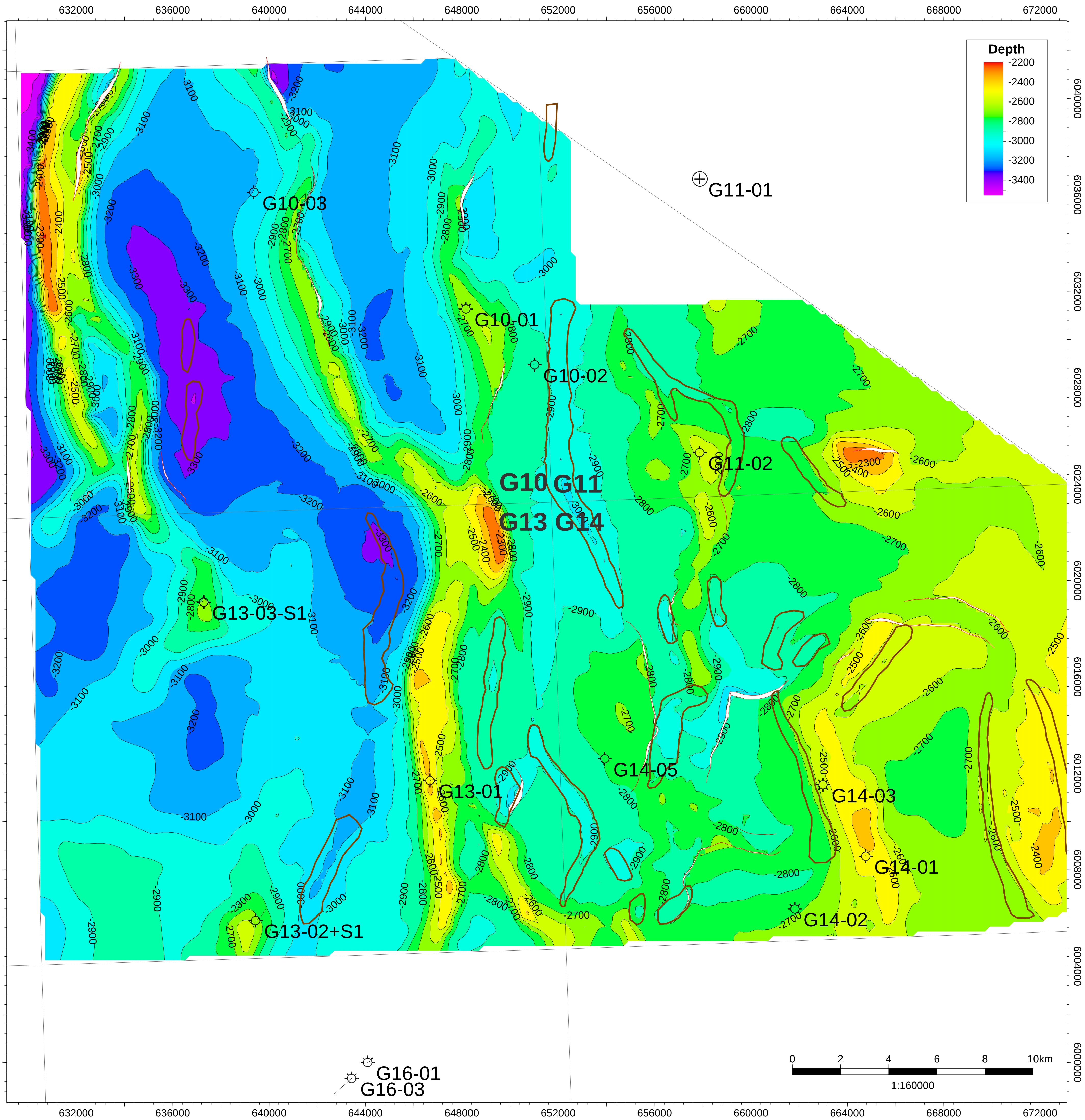
Appendix 8.

Depth Chalk Group



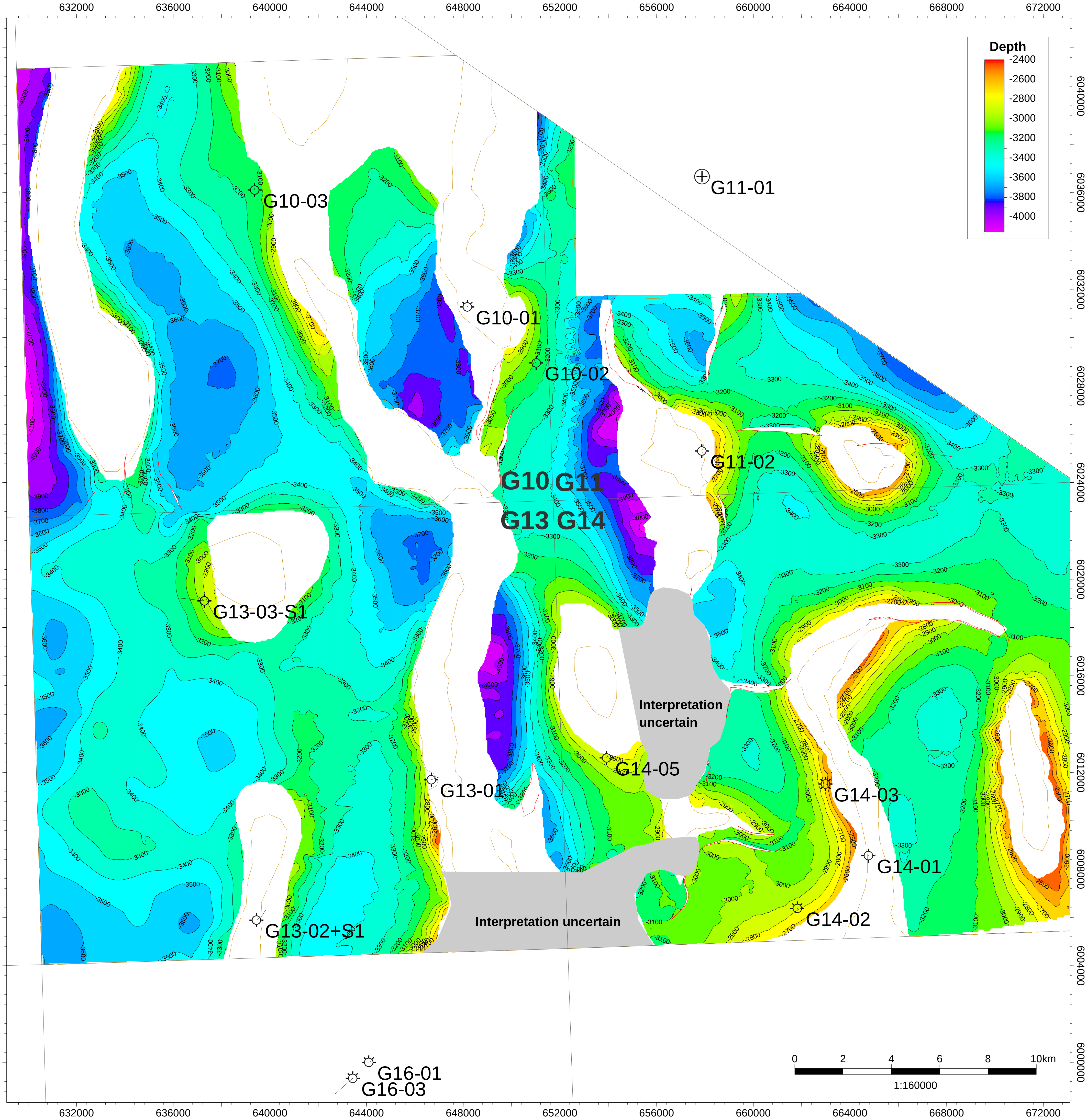
Appendix 9.

Depth Late Kimmerian Unconformity with erosional gullies



Appendix 10.

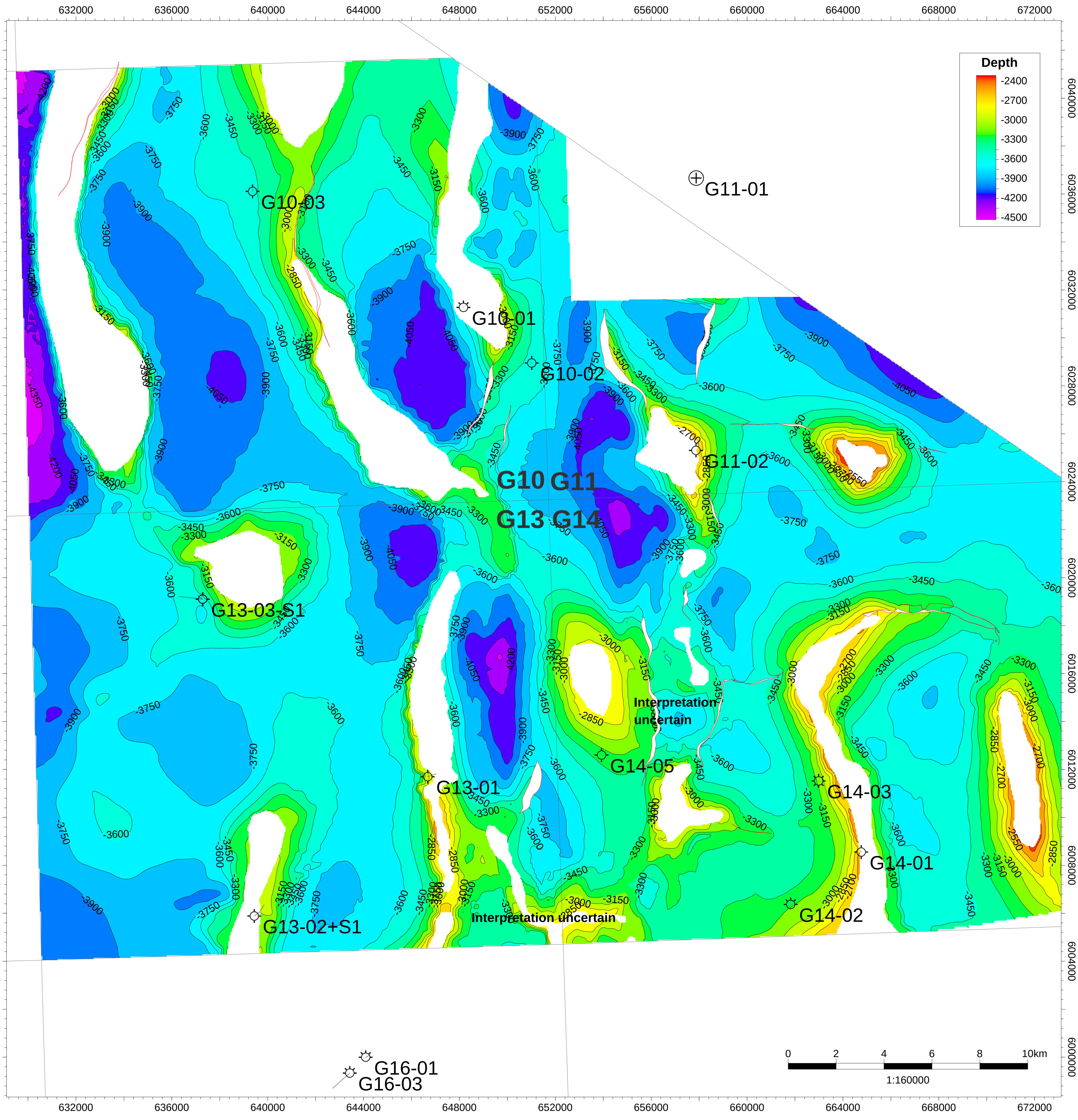
Depth Volpriehausen



* Braun line indicates where Triassic is absent

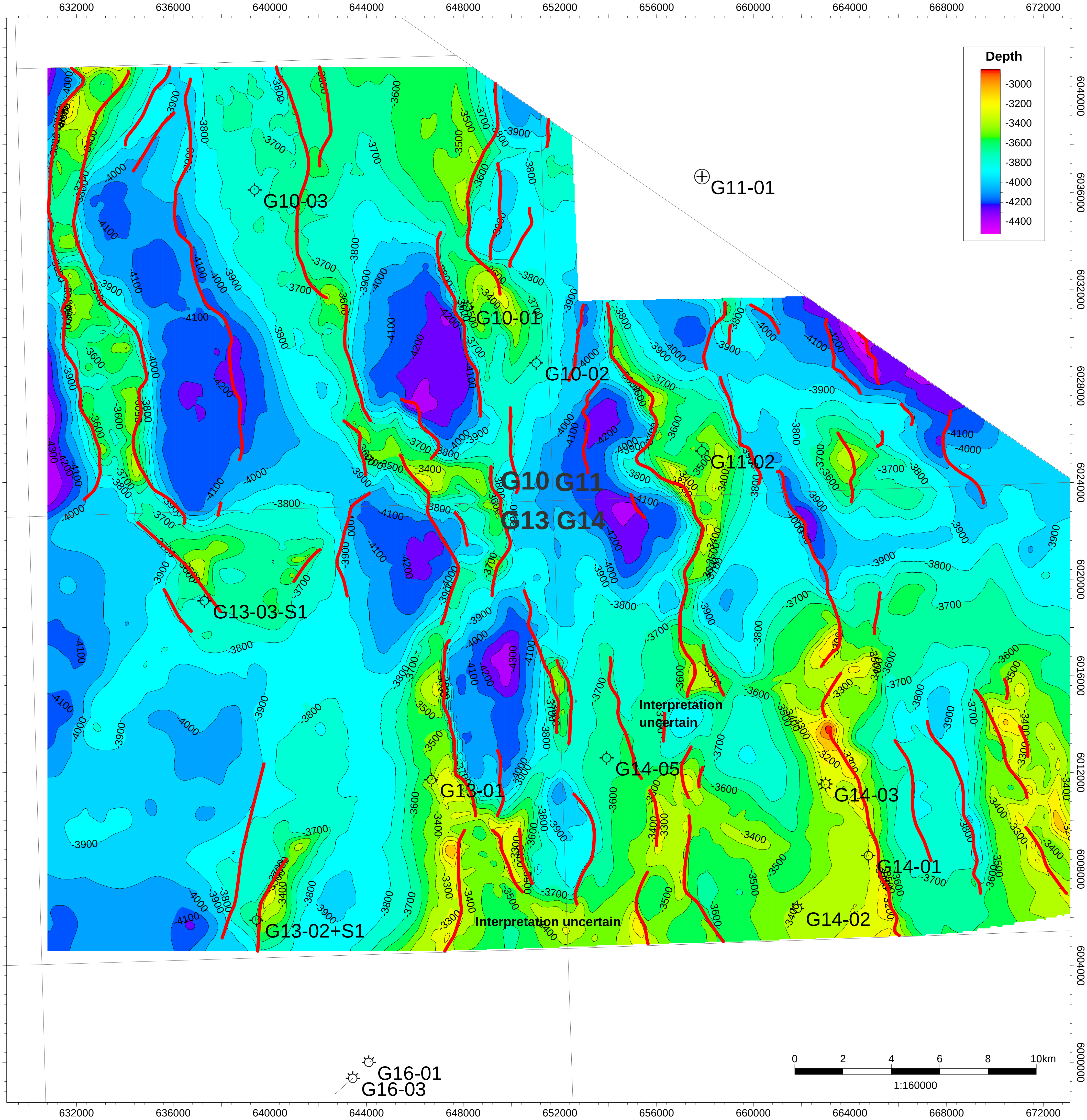
Appendix 11.

Depth Triassic



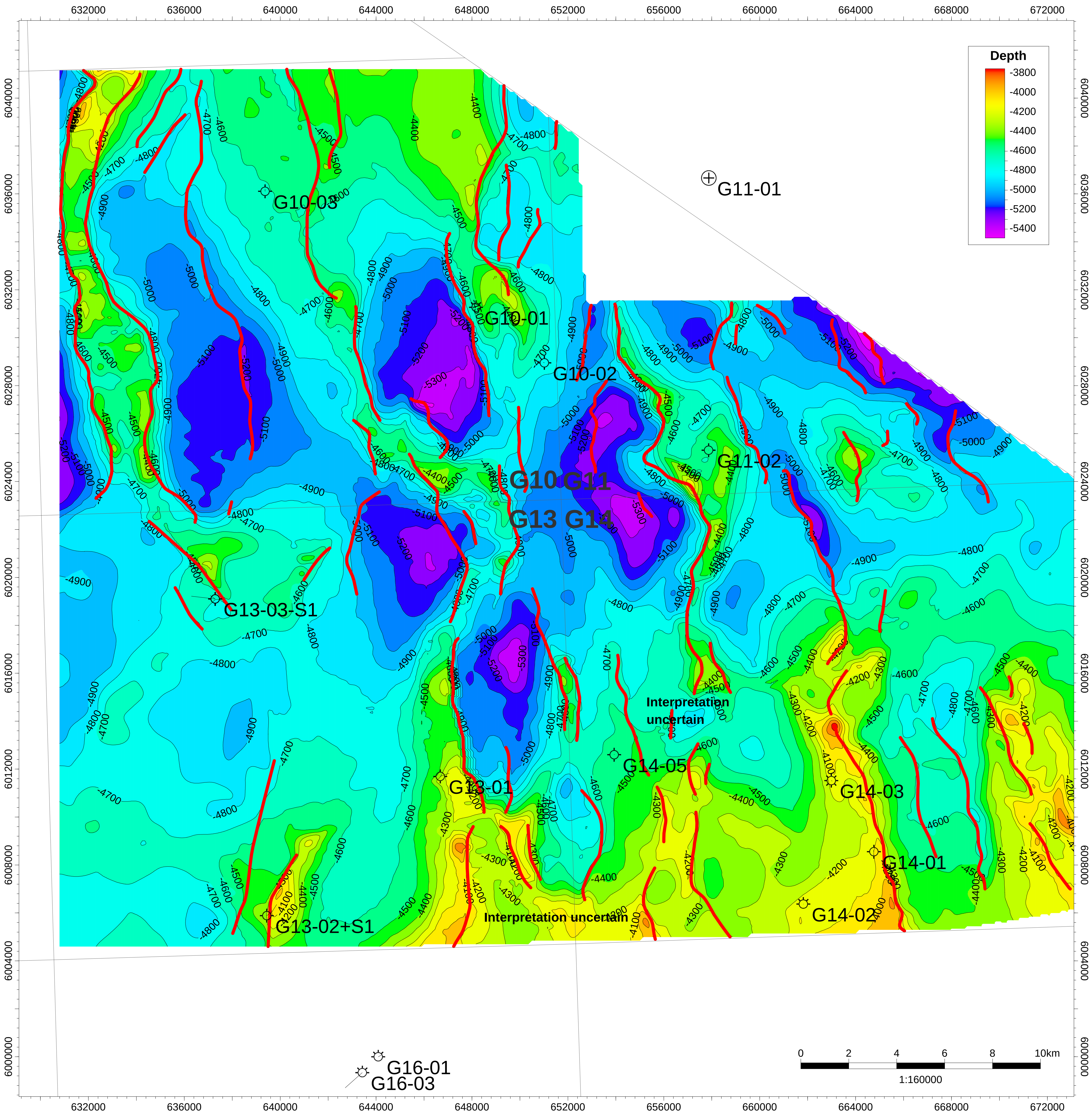
Appendix 12.

Depth Zechstein



Appendix 13.

Depth Rotliegend



Appendix 14.

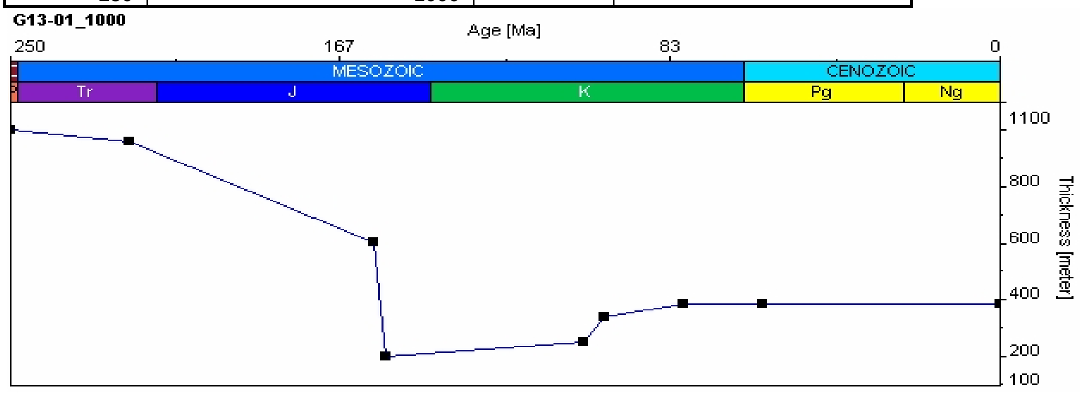
Input G13-01 Petromod: Burial history model

Boundary conditions:

Water depth (m)		Sediment-Water-Interface-Temperature (°C)		Heatflow (mW/m_2)	
age (Ma)	depth	age (Ma)	Temperature (°C)	age (Ma)	Heatflow (mW/m_2)
325	5	325	24	325	50
318	0	318	25	318	50
311	0	311	25	311	50
258	10	258	22.49	258	50
255	20	255	22.97	255	50
250.5	20	250.5	23.55	250.5	50
245	20	245	24	245	50
242	10	242	24	242	50
241	30	241	24	241	50
240	50	240	24	240	50
231	50	231	24.09	231	50
212	100	212	21.71	212	50
156	20	156	23.32	156	50
140.7	100	140.7	23.57	140.7	50
121	100	121	24.98	121	50
97	200	97	23.25	97	50
60.5	100	60.5	20.93	60.5	50
35	80	35	19.37	35	50
23.3	70	23.3	18.27	23.3	50
5.2	60	5.2	8	5.2	50
1.64	50	1.64	6.38	1.64	50
0	0	0	7.3	0	50

Salt flow input:

time (Ma)	Thickness salt layer ZESAU (m)	Time (Ma)	Thickness salt layer ZE (m)
0	387	0	290.5
60	387	90	290.5
80	387	99	290.5
100	341.94	154	0
105	250	158.75	0
155	200	248	0
158	600		
220	960		
250	1000		



Lithology:

Scenario maximum original sediment thickness R and AT:

Formation	depth top	depth bottom	thickness	eroded thickness	deposition age top	deposition age bottom	erosion time (bottom)	erosion time top)	Lithology
NU	0	903	903		20.1	0			49 sh, 49 sst, 2 coal
NMRF	903	1004	101		35.4	28.6			75 sh, 25 slt_01
NLFFB	1004	1057	53		42	37.9			100 SHALE
NLFFM	1057	1130.5	73.5		50.2	42			50 sh, 50 marl
NLFFY	1130.5	1449	318.5		55.1	50.2			100 SHALE
NLFFT	1449	1459	10		55.4	55.1			SHALEtuff petromod EGM
NLLFC	1459	1502	43		57.8	55.1			100 SHALE
CKEK	1502	1557	55		65.5	61.7			100 LIMESTONE
CKGR	1557	2171	614		92.9	65.5			100 LIMESTONE
CKTXM	2171	2201.5	30.5		99.1	92.9			100 LIMESTONE
KNGLU	2201.5	2266.5	65		104.8	99.1			50 marl, 50 lime
KNGLM	2266.5	2270	3.5		112.9	104.8			100 MARL
KNGLL	2270	2280	10		121.8	112.9			100 SHALE
KNNC	2280	2458	178		140.2	121.8			25 sh, 75 marl
SGGSS	2458	2467.5	9.5		142.2	140.2			100 SHALE
AT	2467.5	2467.5	0	1200	208	160	158	156.5	75 sh, 25 sd_CM
R	2467.5	2467.5	0	1200	250	208	156.5	155	45 sh, 25 sst, 25 silt, lime 5_CM
ZE	2467.5	2758	290.5		250	248			100 SALT
RBSHM	2758	2970	212		251	250			75 sh, 25 slt_01
ZEUC	2970	2989	19		251.6	251			100 SHALE
ZESAU	2989	3376	387		253.6	251.6			10 sh, 85 salt, 5 dolo
ZEZ3A	3376	3437	61		253.8	253.6			10 sh, 10 dolo, 80 anh
ZEZ3C	3437	3439.5	2.5		254.3	253.8			100 DOLOMITE
ZEZ3G	3439.5	3440.5	1		254.6	254.3			100 SHALE
ZEZ2T	3440.5	3441.5	1		254.96	254.6			100 ANHYDRITE
ZEZ2H	3441.5	3477	35.5		255.32	254.96			100 SALT
ZEZ2A	3477	3483.5	6.5		255.68	255.32			100 ANHYDRITE
ZEZ2C	3483.5	3496	12.5		256.4	255.68			75 ls, 25 do_01
ZEZ1W	3496	3521.5	25.5		257.4	256.4			100 ANHYDRITE
ZEZ1C	3521.5	3535	13.5		257.8	257.4			100 LIMESTONE
ZEZ1K	3535	3536	1		258	257.8			100 SHALE
ROCLU	3536	3613.5	77.5		259	258			50 SHALE&SILT
ROCLE	3613.5	4348.5	735		265	259			30sh, 30silt, 40salt
ROCLL	4348.5	4465	116.5		267.5	265			50 SHALE&SILT
ROSLL	4465	4471.5	6.5		268	267.5			100 SANDSTONE
DC	4471.5	4471.5	0	600	307.9	300	290	280	60 sh, 40 sst_CM
DCHP	4471.5	4535	63.5		308.7	307.9			75 sh, 25 sd_01
DCCU	4535	4751	216		312.3	308.7			80 sh, 15 sst, 5 coal
DC	4751	5387.5	636.5		316	312.3			80 sh, 15 sst, 5 coal
basement	5387.5	5487.5	100		320	316			BASEMENT
	5487.5								

source rock: DCCU:	TOC	3%
	HI	250 mgHC/gTOC
	Kinetic:	Burnham 1989_T3

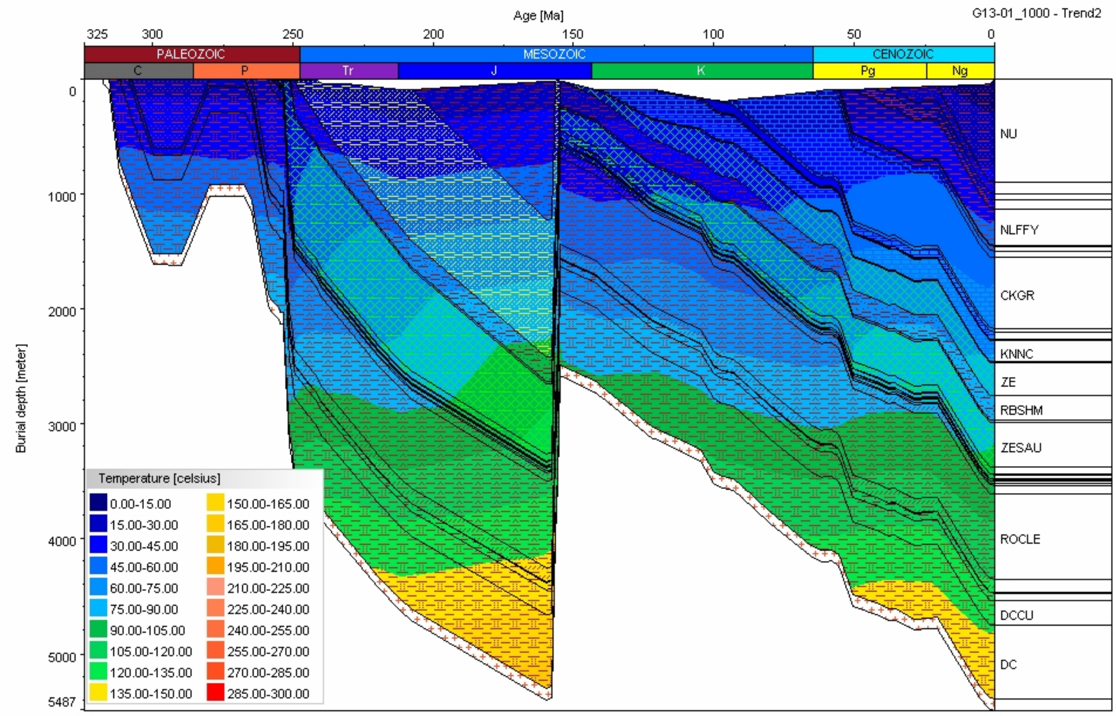
Scenario minimum original sediment thickness R and AT

Formation	depth top	depth bottom	thickness	eroded thickness	deposition age top	deposition age bottom	erosion time (bottom)	erosion time top)	Lithology
NU	0	903	903		20.1	0			49 sh, 49 sst, 2 coal
NMRF	903	1004	101		35.4	28.6			75 sh, 25 slt_01
NLFFB	1004	1057	53		42	37.9			100 SHALE
NLFFM	1057	1130.5	73.5		50.2	42			50 sh, 50 marl
NLFFY	1130.5	1449	318.5		55.1	50.2			100 SHALE
NLFFT	1449	1459	10		55.4	55.1			SHALEtuff petromod EGM
NLLFC	1459	1502	43		57.8	55.1			100 SHALE
CKEK	1502	1557	55		65.5	61.7			100 LIMESTONE
CKGR	1557	2171	614		92.9	65.5			100 LIMESTONE
CKTXM	2171	2201.5	30.5		99.1	92.9			100 LIMESTONE
KNGLU	2201.5	2266.5	65		104.8	99.1			50 marl, 50 lime
KNGLM	2266.5	2270	3.5		112.9	104.8			100 MARL
KNGLL	2270	2280	10		121.8	112.9			100 SHALE
KNNC	2280	2458	178		140.2	121.8			25 sh, 75 marl
SGGSS	2458	2467.5	9.5		142.2	140.2			100 SHALE
AT	2467.5	2467.5	0	700	208	160	158	156.5	75 sh, 25 sd_CM
R	2467.5	2467.5	0	1000	250	208	156.5	155	45 sh, 25 sst, 25 silt, lime 5_CM
ZE	2467.5	2758	290.5		250	248			100 SALT
RBSHM	2758	2970	212		251	250			75 sh, 25 slt_01
ZEUC	2970	2989	19		251.6	251			100 SHALE
ZESAU	2989	3376	387		253.6	251.6			10 sh, 85 salt, 5 dolo
ZEZ3A	3376	3437	61		253.8	253.6			10 sh, 10 dolo, 80 anh
ZEZ3C	3437	3439.5	2.5		254.3	253.8			100 DOLOMITE
ZEZ3G	3439.5	3440.5	1		254.6	254.3			100 SHALE
ZEZ2T	3440.5	3441.5	1		254.96	254.6			100 ANHYDRITE
ZEZ2H	3441.5	3477	35.5		255.32	254.96			100 SALT
ZEZ2A	3477	3483.5	6.5		255.68	255.32			100 ANHYDRITE
ZEZ2C	3483.5	3496	12.5		256.4	255.68			75 ls, 25 do_01
ZEZ1W	3496	3521.5	25.5		257.4	256.4			100 ANHYDRITE
ZEZ1C	3521.5	3535	13.5		257.8	257.4			100 LIMESTONE
ZEZ1K	3535	3536	1		258	257.8			100 SHALE
ROCLU	3536	3613.5	77.5		259	258			50 SHALE&SILT
ROCLE	3613.5	4348.5	735		265	259			30sh, 30silt, 40salt
ROCLL	4348.5	4465	116.5		267.5	265			50 SHALE&SILT
ROSLL	4465	4471.5	6.5		268	267.5			100 SANDSTONE
DC	4471.5	4471.5	0	600	307.9	300	290	280	60 sh, 40 sst_CM
DCHP	4471.5	4535	63.5		308.7	307.9			75 sh, 25 sd_01
DCCU	4535	4751	216		312.3	308.7			80 sh, 15 sst, 5 coal
DC	4751	5387.5	636.5		316	312.3			80 sh, 15 sst, 5 coal
basement	5387.5	5487.5	100		320	316			BASEMENT
	5487.5								

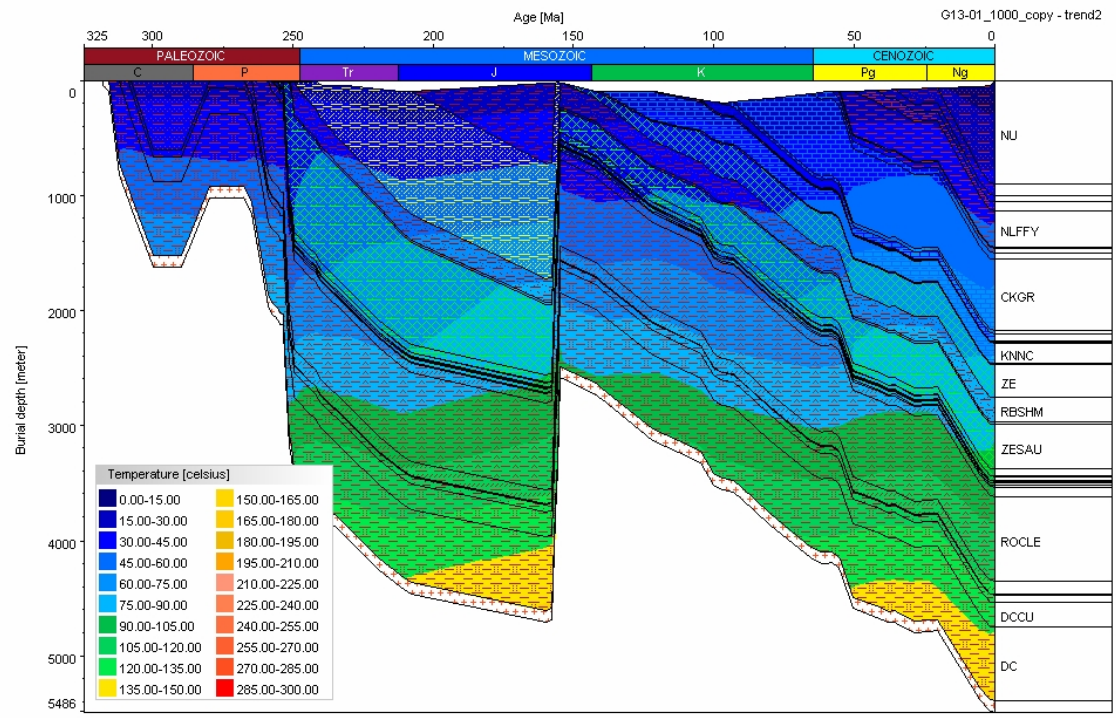
source rock: DCCU:	TOC	3%
	HI	250 mgHC/gTOC
	Kinetic:	Burnham 1989_T3

Output: burial depth:

Scenario maximum original sediment thickness R and AT:



Scenario minimum original sediment thickness R and AT:



Appendix 15.

Structure name	Prospect name	status of structure	reservoir code (ref. Stratigraphic Nomenclature of the Netherlands)	Perimeter (m)	Area (m^2)	X centre point prospect (UTM31)	Y centre point prospect (UTM31)
G10_3	G10_3_CK/N	prospect	CK	5906	1696177	641659	6037392
G10_NW	G10_northwest_CK/N	prospect	CK	21893	13619535	631974	6037570
G11_E	G11_east_CK/N	prospect	CK	13929	12603050	664566	6024680
G13_1	G13_1_CK/N	prospect	CK	29819	18241058	647354	6018104
G10_3	G10_3_RBMVL	prospect	RBMVL	23446	7487682	641084	6031414
G10_central	G10_central_RBMVL	prospect	RBMVL	28295	35677315	644926	6032794
G10_NW	G10_NW_RBMVL	prospect	RBMVL	7749	1041657	633541	6039838
G10_W	G10_southwest_RBMVL	prospect	RBMVL	12248	2912686	633688	6031293
G11_2	G11_2_RBMVL	prospect	RBMVL	24809	9748931	658056	6026046
G11_E	G11_east_RBMVL	prospect	RBMVL	28972	12845126	664617	6025005
G13_1	G13_1_RBMVL	prospect	RBMVL	10079	1539705	646761	6009287
G13_2	G13_2_RBMVL	prospect	RBMVL	14285	3340792	641278	6009018
G13_SW	G13_SW_RBMVL	prospect	RBMVL	24169	21743199	633603	6010913
G10_3	G10_3_SG/SL/ZECP	prospect	SG/SL/ZECP	25973	7631432	642402	6029703
G10_NW	G10_northwest_SG/SL/ZECP	prospect	SG/SL/ZECP	22594	8172187	631014	6035671
G10_SW	G10_SW_SG/SL/ZECPwest	prospect	SG/SL/ZECP	8020	1466014	631973	6027545
G10_W	G10_SW_SG/SL/ZECPeast	prospect	SG/SL/ZECP	16200	5947151	634592	6025330
G11_E	G11_east_SG/SL/ZECP	prospect	SG/SL/ZECP	14014	10498948	665163	6024639
G13_NE	G13_northeast_SG/SL/ZECP	prospect	SG/SL/ZECP	18186	11229573	11229573	11229573
G10_E	G10_east_CK/N	Dry structure	CK	35431	27921559	648782	6032688
G11_2	G11_2_CK/N	Dry structure	CK	19553	15212707	658128	6024665
G13_2	G13_2_CK/N	Dry structure	CK	7257	3630781	638977	6005543
G13_3	G13_3_CK/N	Dry structure	CK	28498	26928687	639126	6018561
G10_E	G10_east_RBMVL	Dry structure	RBMVL	28613	16711500	650537	6028647
G13_3	G13_3_RBMVL	Dry structure	RBMVL	42082	27836500	639128	6022774
G10_E	G10_east_SG/SL/ZECP	Dry structure	SG/SL/ZECP	18669	9078653	648723	6030156
G11_2	G11_2_SG/SL/ZECP	Dry structure	SG/SL/ZECP	20171	10058757	658116	6023503
G13_1	G13_1_SG/SL/ZECP	Dry structure	SG/SL/ZECP	33916	18687579	646970	6013218
G13_2	G13_2_SG/SL/ZECP	Dry structure	SG/SL/ZECP	5930	2448666	639023	6005427
G13_3	G13_3_SG/SL/ZECP	Dry structure	SG/SL/ZECP	13816	20348818	636987	6018975

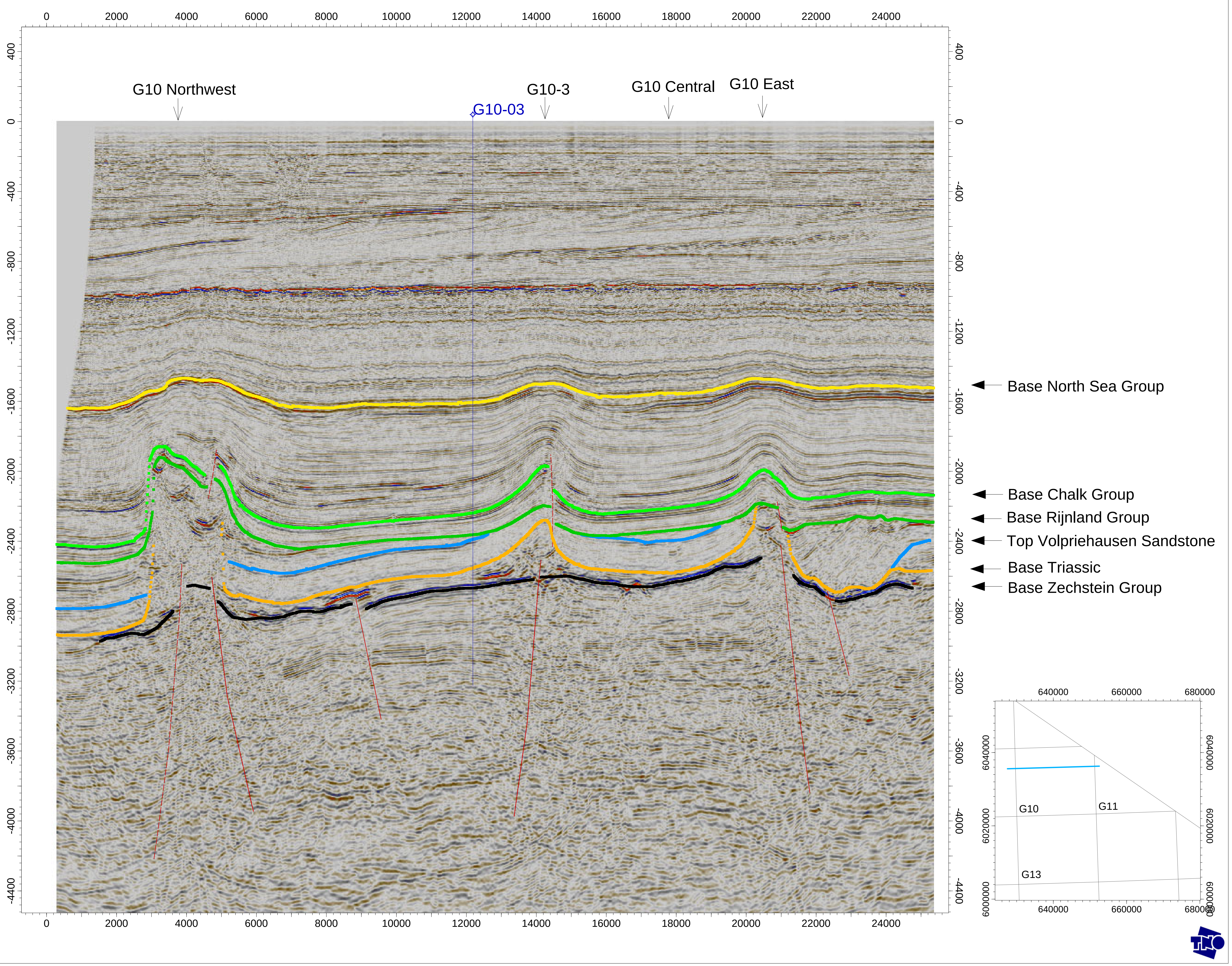
Prospect name	low est. porosity (%)	mid est. porosity (%)	high est. porosity (%)	low est. net to gross (%)	mid est. net to gross (%)	high est. net to gross (%)	low est. gross (m)	mid est. gross (m)	high est. gross (m)	low est. gas saturation (frac)	mid est. gas saturation (frac)	high est. gas saturation (frac)	low est. expansion factor	mid est. expansion factor	high est. expansion factor
G10_3_CK/N	10	25	30	70	90	100	50	80	120	0.30	0.40	0.50	128	148	168
G10_northwest_CK/N	10	25	30	70	90	100	50	80	120	0.30	0.40	0.50	128	148	168
G11_east_CK/N	10	25	30	70	90	100	50	80	120	0.30	0.40	0.50	120	140	160
G13_1_CK/N	10	25	30	70	90	100	50	80	120	0.30	0.40	0.50	128	148	168
G10_3_RBMVL	14	16	18	80	90	95	25	35	45	0.76	0.81	0.86	213	233	253
G10_central_RBMVL	15	17	19	79	89	94	27	37	47	0.77	0.82	0.87	221	241	261
G10_NW_RBMVL	14	16	18	77	87	92	25	35	45	0.75	0.80	0.85	202	222	242
G10_southwest_RBMVL	14	16	18	80	90	95	25	35	45	0.76	0.81	0.86	217	237	257
G11_2_RBMVL	16	18	20	77	87	92	31	41	51	0.79	0.84	0.89	211	231	251
G11_east_RBMVL	15	17	19	79	89	94	30	40	50	0.77	0.82	0.87	207	227	247
G13_1_RBMVL	14	16	18	81	91	96	25	35	45	0.76	0.81	0.86	202	222	242
G13_2_RBMVL	14	16	18	81	91	96	25	35	45	0.76	0.81	0.86	211	231	251
G13_SW_RBMVL	14	16	18	81	91	96	26	36	46	0.76	0.81	0.86	220	240	260
G10_3_SG/SL/ZECP	10	14	18	30	50	60	8	12	18	0.60	0.70	0.75	200	220	240
G10_northwest_SG/SL/ZECP	10	14	18	30	50	60	1	8	10	0.60	0.70	0.75	190	210	230
G10_SW_SG/SL/ZECPwest	10	14	18	30	50	60	1	8	10	0.60	0.70	0.75	194	214	234
G10_SW_SG/SL/ZECPeast	10	14	18	30	50	60	1	8	10	0.60	0.70	0.75	204	224	244
G11_east_SG/SL/ZECP	10	14	18	30	50	60	1	8	10	0.60	0.70	0.75	195	215	235
G13_northeast_SG/SL/ZECP	10	14	18	30	50	60	1	8	10	0.60	0.70	0.75	196	216	236
G10_east_CK/N															
G11_2_CK/N															
G13_2_CK/N															
G13_3_CK/N															
G10_east_RBMVL		19			85			43							
G13_3_RBMVL		17			90			40							
G10_east_SG/SL/ZECP															
G11_2_SG/SL/ZECP		8			50			6							
G13_1_SG/SL/ZECP		13			60			9							
G13_2_SG/SL/ZECP															
G13_3_SG/SL/ZECP															

Prospect name	low est. recovery factor (frac)	mid est. recovery factor (frac)	high est. recovery factor (frac)	low est. Gross Rock Volume (m3)	mid est. Gross Rock Volume (m3)	high est. Gross Rock Volume (m3)	low est. Gas in Place (bcm)	mid est. Gas in Place (bcm)	high est. Gas in Place (bcm)	Low Succes Volume (bcm)	Mean Success Volume (bcm)	High Success Volume (bcm)	Expectation (MSV x POS) (bcm)	Possibility of Success (frac)
G10_3_CK/N	0.50	0.60	0.70	1281920	1602400	1762640	0.01	0.02	0.02	0.01	0.01	0.01	0.00	0.04
G10_northwest_CK/N	0.50	0.60	0.70	170984800	213731000	235104100	1.55	2.29	3.04	0.93	1.38	1.85	0.09	0.06
G11_east_CK/N	0.50	0.60	0.70	270721600	338402000	372242200	2.34	3.45	4.58	1.36	2.07	2.79	0.13	0.06
G13_1_CK/N	0.50	0.60	0.70	201313600	251642000	276806200	1.80	2.68	3.58	1.09	1.62	2.17	0.05	0.03
G10_3_RBMVL	0.60	0.70	0.80	189234400	236543000	260197300	5.47	6.26	7.08	3.76	4.39	5.05	0.32	0.07
G10_central_RBMVL	0.60	0.70	0.80	496576000	620720000	1228200000	16.94	22.79	30.01	11.64	15.93	20.96	2.01	0.13
G10_NW_RBMVL	0.60	0.70	0.80	25230480	31538100	34691910	0.62	0.71	0.81	0.43	0.50	0.58	0.05	0.10
G10_southwest_RBMVL	0.60	0.70	0.80	40736800	50921000	91542000	1.26	1.65	2.10	0.88	1.15	1.48	0.18	0.16
G11_2_RBMVL	0.60	0.70	0.80	260184000	325230000	357753000	8.06	9.22	10.41	5.50	6.44	7.40	0.37	0.06
G11_east_RBMVL	0.60	0.70	0.80	138805600	173507000	434450000	4.59	6.76	9.52	3.20	4.76	6.61	0.90	0.19
G13_1_RBMVL	0.60	0.70	0.80	37052000	46315000	50946500	1.01	1.15	1.30	0.69	0.81	0.93	0.13	0.16
G13_2_RBMVL	0.60	0.70	0.80	79714400	99643000	109607300	2.24	2.56	2.90	1.53	1.80	2.06	0.52	0.29
G13_SW_RBMVL	0.60	0.70	0.80	508609600	635762000	699338200	14.80	16.94	19.16	10.13	11.85	13.69	1.14	0.10
G10_3_SG/SL/ZECP	0.40	0.50	0.60	48839200	61049000	67153900	0.43	0.58	0.73	0.21	0.29	0.37	0.03	0.11
G10_northwest_SG/SL/ZECP	0.40	0.50	0.60	52303200	65379000	71916900	0.45	0.59	0.75	0.22	0.30	0.38	0.03	0.10
G10_SW_SG/SL/ZECPwest	0.40	0.50	0.60	9381120	11726400	12899040	0.08	0.11	0.14	0.04	0.05	0.07	0.00	0.04
G10_SW_SG/SL/ZECPeast	0.40	0.50	0.60	38060400	47575500	52333050	0.35	0.46	0.58	0.17	0.23	0.30	0.01	0.04
G11_east_SG/SL/ZECP	0.40	0.50	0.60	67195120	83993900	92393290	0.58	0.78	0.98	0.29	0.39	0.50	0.04	0.09
G13_northeast_SG/SL/ZECP	0.40	0.50	0.60	71865040	89831300	98814430	0.62	0.84	1.06	0.31	0.42	0.54	0.04	0.08
G10_east_CK/N														
G11_2_CK/N														
G13_2_CK/N														
G13_3_CK/N														
G10_east_RBMVL														
G13_3_RBMVL														
G10_east_SG/SL/ZECP														
G11_2_SG/SL/ZECP														
G13_1_SG/SL/ZECP														
G13_2_SG/SL/ZECP														
G13_3_SG/SL/ZECP														

Prospect name	drilled_by	column_length (m)	depth_top (m)	Lowest Closing Contour (m)	Nitrogen content (%)	Carbon Dioxide content (%)	Gross Heating Value	pressure@LCC (bara)	temp@LCC (oC)
G10_3_CK/N		9	1450	1459	8.64	1.80	37.10	145.90	52.15
G10_northwest_CK/N		38	1420	1458	9.70	2.03	36.47	145.80	52.11
G11_east_CK/N		73	1290	1363	8.40	0.59	38.13	136.30	48.98
G13_1_CK/N		33	1415	1448	8.23	1.07	37.88	144.80	51.78
G10_3_RBMVL		410	2700	3110	8.65	1.68	37.18	311.00	106.63
G10_central_RBMVL		400	3000	3400	8.64	1.62	37.28	340.00	116.20
G10_NW_RBMVL		140	2750	2890	9.75	2.05	36.44	289.00	99.37
G10_southwest_RBMVL		400	2860	3260	8.60	1.96	36.99	326.00	111.58
G11_2_RBMVL		480	2650	3130	8.29	0.61	38.14	313.00	107.29
G11_east_RBMVL		400	2500	2900	8.38	0.59	38.13	290.00	99.70
G13_1_RBMVL		432	2450	2882	8.56	0.66	37.98	288.20	99.11
G13_2_RBMVL		185	2950	3135	8.07	1.27	37.75	313.50	107.46
G13_SW_RBMVL		123	3250	3373	7.89	1.40	37.61	337.25	115.29
G10_3_SG/SL/ZECP		120	2600	2720	8.67	1.62	37.22	272.00	93.76
G10_northwest_SG/SL/ZECP		280	2200	2480	9.66	2.00	36.50	248.00	85.84
G10_SW_SG/SL/ZECPwest		123	2450	2573	8.60	1.88	37.03	257.30	88.91
G10_SW_SG/SL/ZECPeast		320	2500	2820	8.62	1.68	37.15	282.00	97.06
G11_east_SG/SL/ZECP		343	2250	2593	8.40	0.58	38.13	259.30	89.57
G13_northeast_SG/SL/ZECP		425	2200	2625	8.09	1.19	37.85	262.50	90.63
G10_east_CK/N	G10-01		1425	1478					
G11_2_CK/N	G11-02		1350	1388					
G13_2_CK/N	G13-02		1460	1480					
G13_3_CK/N	G13-03		1520	1576					
G10_east_RBMVL	G10-02		2800	3298					
G13_3_RBMVL	G13-03		2800	3293					
G10_east_SG/SL/ZECP	G10-01		2600	2764					
G11_2_SG/SL/ZECP	G11-02		2550	2705					
G13_1_SG/SL/ZECP	G13-01		2350	2625					
G13_2_SG/SL/ZECP	G13-02		2650	2725					
G13_3_SG/SL/ZECP	G13-03		2700	2931					

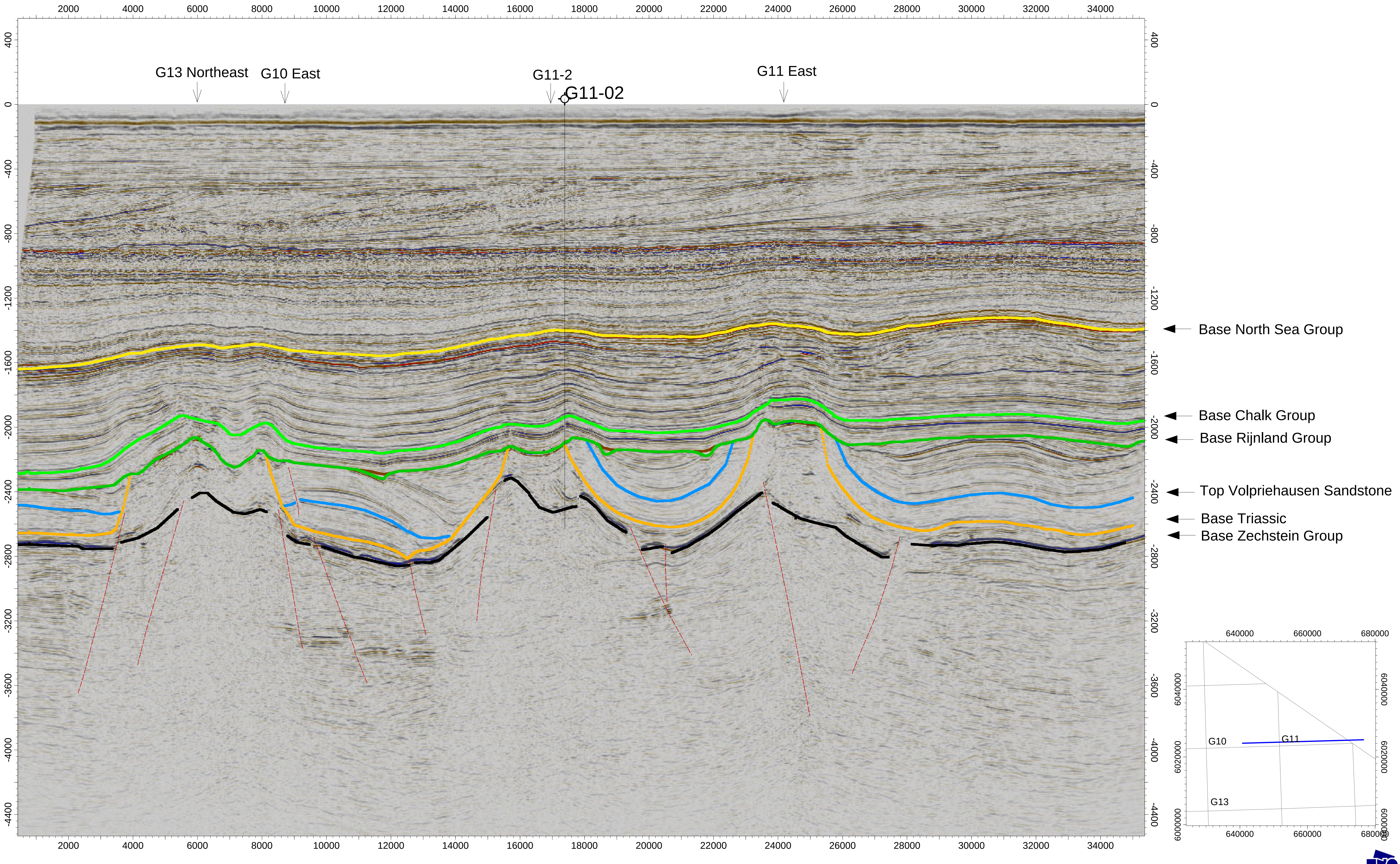
Appendix 16.

E-W seismic line in G10



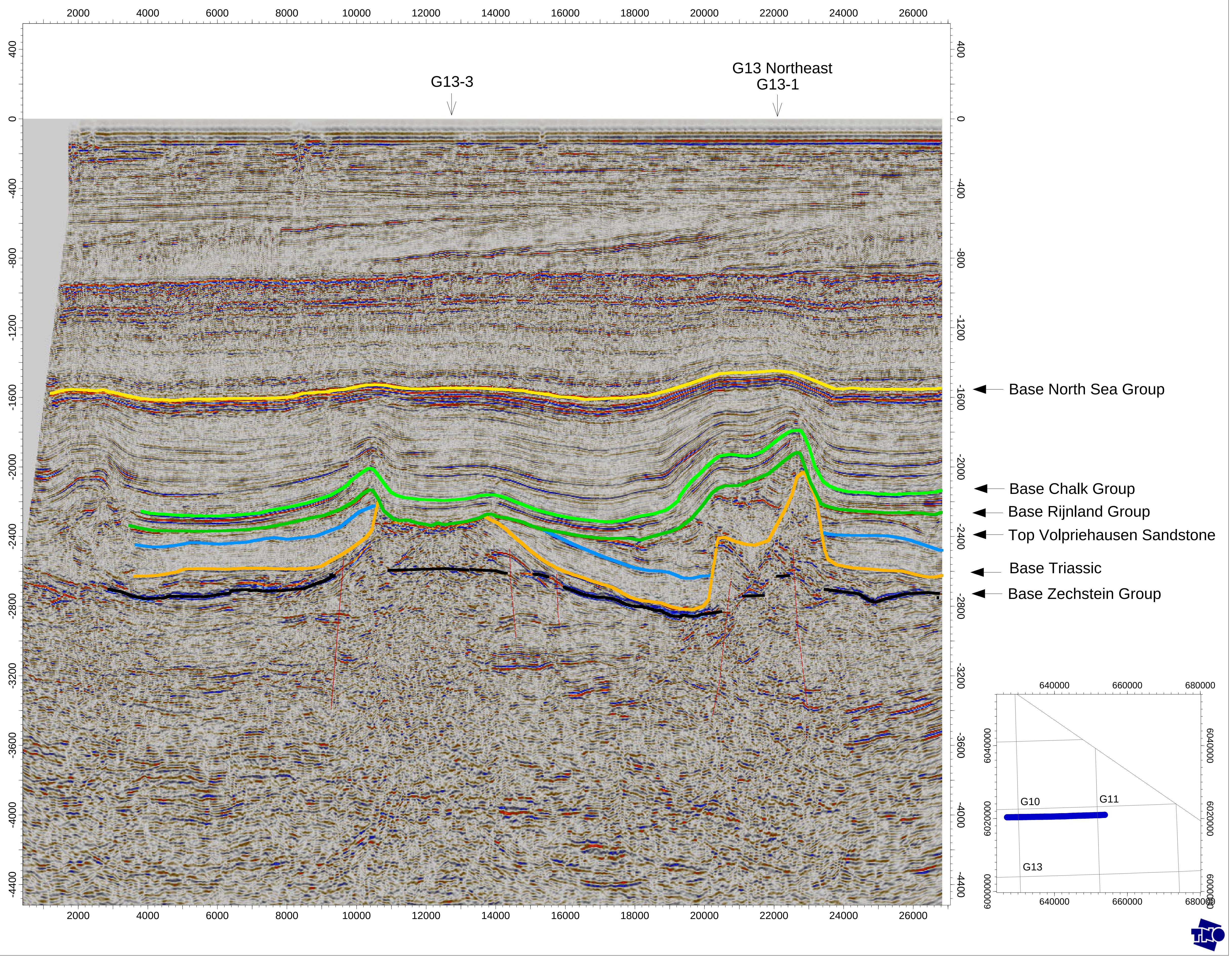
Appendix 17.

E-W seismic line in G10 and G11



Appendix 18.

E-W 2D seismic line in G13



19. Prospect summary sheets

- Information sheet G10-03
- Information sheet G10-centre
- Information sheet G10-east
- Information sheet G10-northwest
- Information sheet G10-southwest
- Information sheet G11-02
- Information sheet G11_east
- Information sheet G13-01
- Information sheet G13-02
- Information sheet G13-03
- Information sheet G13-northeast
- Information sheet G13-southwest

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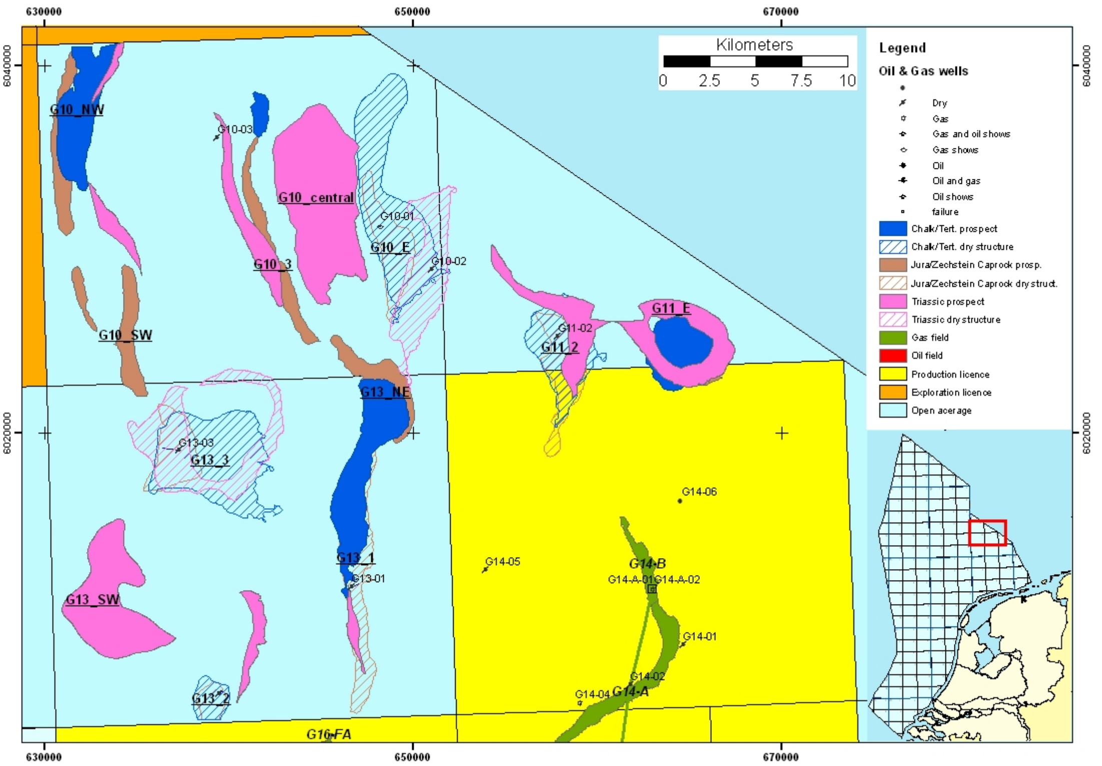
Summary sheet G10-3



Location map of the G10-3 prospects

General information

The G10 block is at this moment open acreage. The last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The first well, G10-01 drilled 1990, penetrated the objectives Jurassic Scruff Sandstone (formerly interpreted as Vlieland Sandstone) and Zechstein caprock. Although in the Scruff sandstones encouraging gas shows were encountered, the Jurassic reservoir was absent and the Zechstein caprock reservoir was tight. The well was subsequently plugged and abandoned. The wells G10-02 and G10-03, drilled respectively in 1993 and 1997, found the target, Main Buntsandstein sandstones, water bearing and were subsequently plugged and abandoned.

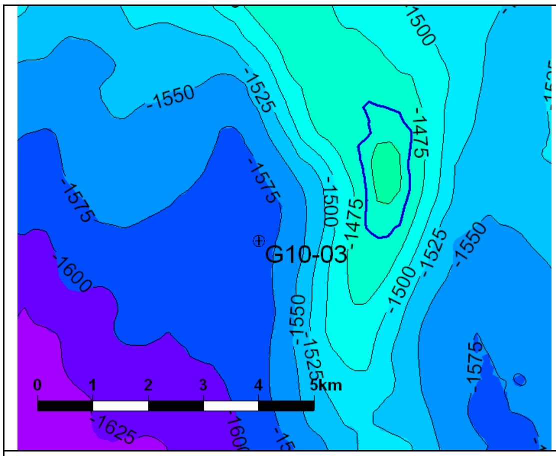
Sequence of events

Date	Event
1987	6th round application awarded to Elf Petroland
1990	Well G10-01 drilled (EPTL)
1993	Well G10-02 drilled (EPTL)
1993	Partial relinquishment
1997	Well G10-03 drilled (EPTL)
1997	License expired

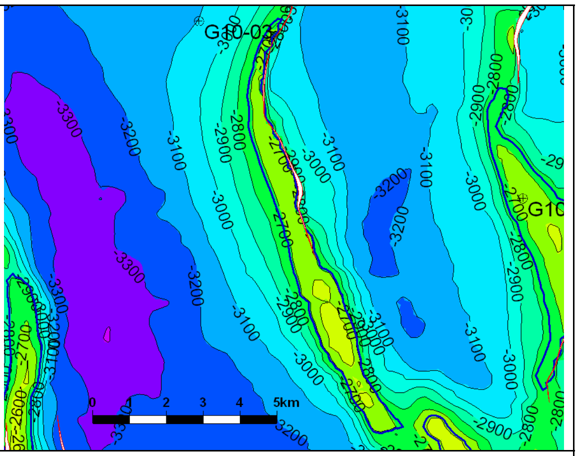
Structure

The G10-3 structure was drilled by one exploration well. G10-03 targeted the Jurassic reservoir and the Volpriehausen reservoir. Both were found water bearing. The well location is located off-structure with respect to the defined prospects. The updip potential structures may be described as follows:

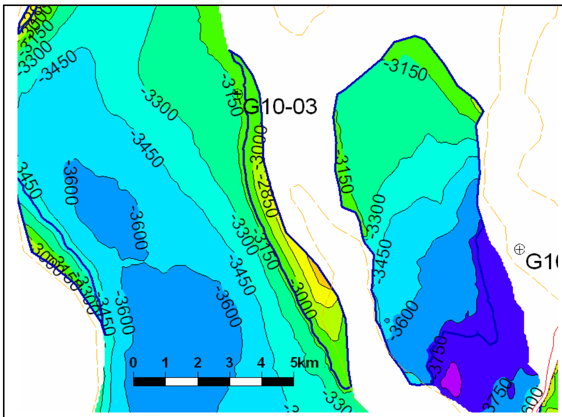
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a faulted dip closure.
3) Lower Volpriehausen reservoir truncated in the south against a saltdome (lateral seal) and in the north against the base Rijnland unconformity with the top seal formed by the Vlieland Claystone.



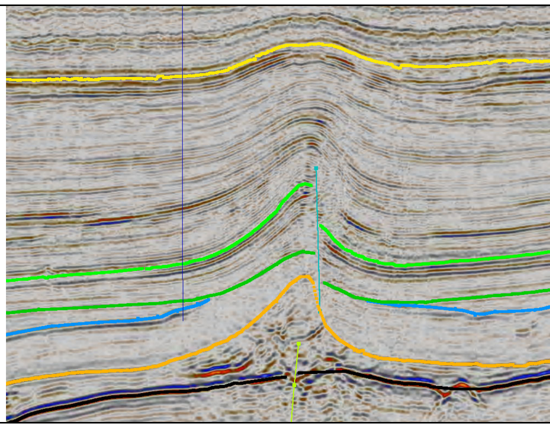
Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 1221
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure maps of the G10-3 prospect

Contacts

G10-3 structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1450	1459
Lower Cretaceous/Upper Jurassic	2600	2720
Lower Volpriehausen	2700	3110

Reservoir data

G10-3 structure	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Chalk*	1.6	80	90	25	40	148
Upper Jurassic (Scruff) (G10-03)**	61	12	39	13	70	220
Lower Volpriehausen (G10-03)**	236	35	90	16	81	233

* Average from public dataset of surrounding wells (www.nlog.nl)
** Derived from well measurements

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Chalk	0.0	0.0	0.0	0.0	0.0	0.0	4
Upper Jurassic (Scruff)	0.4	0.6	0.7	0.2	0.3	0.4	11
Lower Volpriehausen	5.5	6.3	7.1	2.8	4.4	5.1	7

Hydrocarbon specifications

Reservoir	**N2 %**	**CO2 %**	**GHV** (MJ/m^3)
All*	9	2	37.1

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G10_3 prospect reservoir***	***POS***
Reservoir Chalk	Permeability probably low	20%
Seal Chalk	No major faults observed on seismic	80%
Structure Chalk	Well defined	90%
Charge Chalk	High risk due to timing and migration path	30%
Total POS Chalk		**4%**
Reservoir Scruff/Zechstein	Reservoir is expected to be present because it is encountered in the G10-3 well drilled off structure. Low thickness and low porosity is expected	60%
Seal Scruff/Zechstein	Faulted seal	50%
Structure Scruff/Zechstein	Well defined	90
Charge Scruff/Zechstein	High risk due to timing and migration path	40%
Total POS Scruff/Zechstein		**11%**
Reservoir Volpriehausen	Salt plugging might be a risk in the southern part. High amplitudes in the northern part might indicate a high porosity	80%
Seal Volpriehausen	Scruff thiefzone	20%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**7%**

-

Infrastructure

The closest platform, G14-A in the G14 block lies at a distance of approximately 27 km

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

Composite log G10-03. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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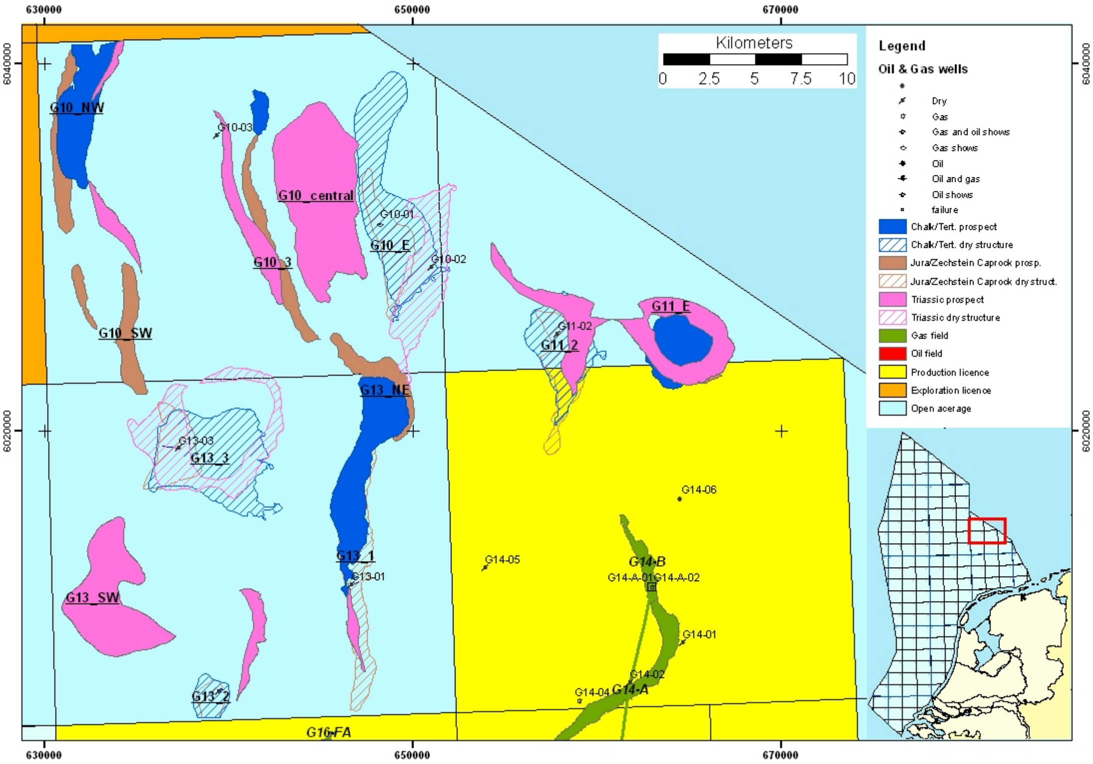
Summary sheet G10 Central



Location map of the G10 Central prospect

General information

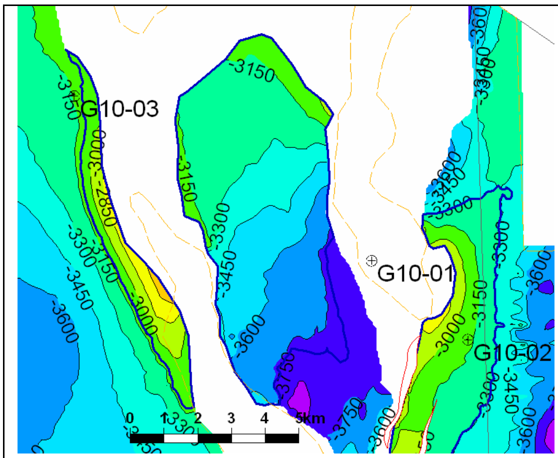
The G10 block is at this moment open acreage. The last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The first well, G10-01 drilled 1990, penetrated the objectives Jurassic Scruff Sandstone (formerly interpreted as Vlieland Sandstone) and Zechstein caprock. Although in the Scruff sandstones encouraging gas shows were encountered, the Jurassic reservoir was absent and the Zechstein caprock reservoir was tight. The well was subsequently plugged and abandoned. The wells G10-02 and G10-03, drilled respectively in 1993 and 1997, found the target, Main Buntsandstein sandstones, water bearing and were subsequently plugged and abandoned.

Sequence of events

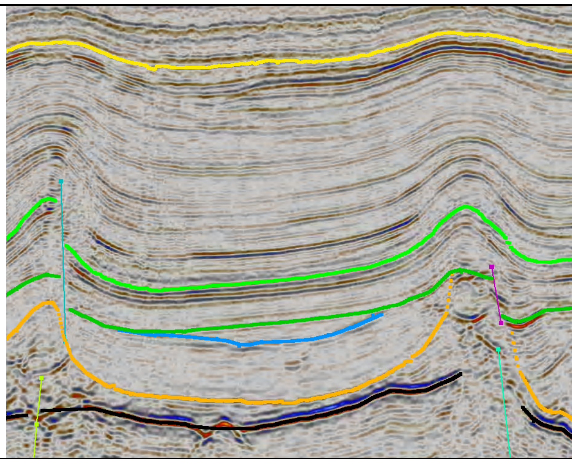
Date	Event
1987	6th round application awarded to Elf Petroland
1990	Well G10-01 drilled (EPTL)
1993	Well G10-02 drilled (EPTL)
1993	Partial relinquishment
1997	Well G10-03 drilled (EPTL)
1997	License expired

Structure

The Lower Volpriehausen reservoir is held within a southward dipping structure in between two N-S running saltdomes. To the north, east and west the reservoir is in truncation trap configuration against the Vlieland Claystone seal. The seat seal of the reservoir, especially to the north, is provided by the claystones of Lower Buntsandstein.



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 1221
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure map of the G10 central prospect

Contacts

G10-Central structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Lower Volpriehausen	3000	3780

Reservoir data

G10-Central prospect reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Lower Volpriehausen **	621	37	88	17	80	240

**Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Lower Volpriehausen	16.9	22.8	30.1	11.6	15.9	21.0	13

Hydrocarbon specifications

Reservoir	N2 %	CO2 %	GHV (MJ/m^3)
Lower Volpriehausen*	9	2	37.3

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	*G10-Central prospect reservoir*	*POS*
Reservoir Volpriehausen	Porosity of the Volpriehausen reservoir is estimated to be good. The amplitude anomaly map shows relatively high porosities which favor the interpretation of the presence good porosity	70%
Seal Volpriehausen	Scruff sand stringers, if present, act as a thiefzone. Seat seal is provided by Lower Buntsandstein and will probably be integer	40%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**13%**

Infrastructure

The closest platform, G14-A, lies at a distance of approximately 28 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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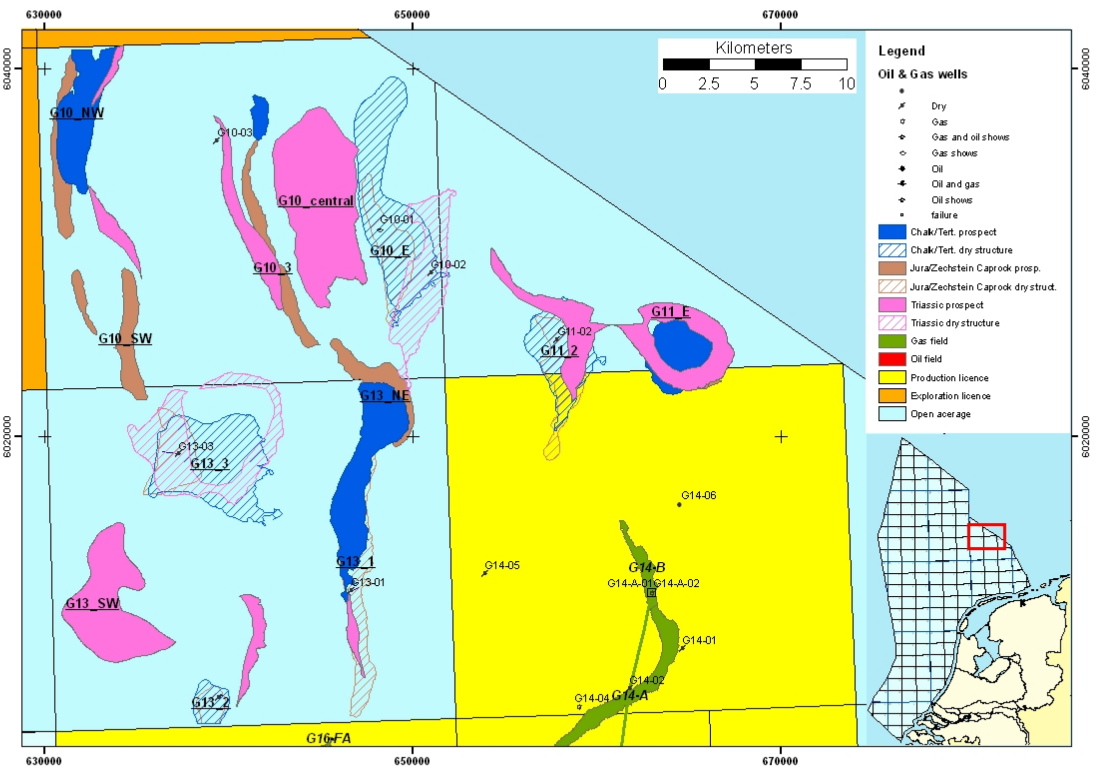
Geological Survey of the Netherlands

Post Mortem sheet G10 East



Location map of the G10 East structure

General information

The G10 block is at this moment open acreage. The last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The first well, G10-01 drilled 1990, penetrated the objectives Jurassic Scruff Sandstone (formerly interpreted as Vlieland Sandstone) and Zechstein caprock. Although in the Scruff sandstones encouraging gas shows were encountered, the Jurassic reservoir was absent and the Zechstein caprock reservoir was tight. The well was subsequently plugged and abandoned. The wells G10-02 and G10-03, drilled respectively in 1993 and 1997, found the target, Main Buntsandstein sandstones, water bearing and were subsequently plugged and abandoned.

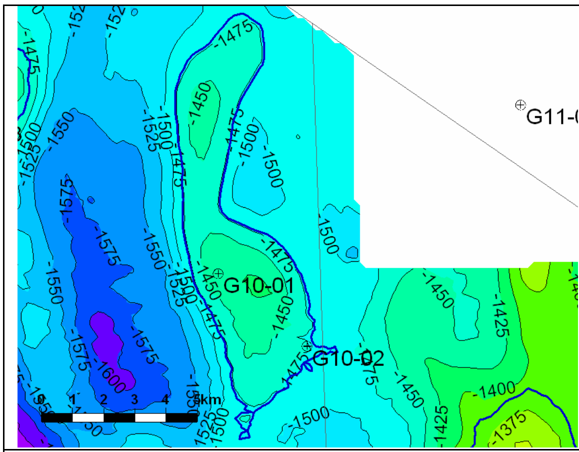
Sequence of events

Date	Event
1987	6th round application awarded to Elf Petroland
1990	Well G10-01 drilled (EPTL)
1993	Well G10-02 drilled (EPTL)
1993	Partial relinquishment
1997	Well G10-03 drilled (EPTL)
1997	License expired

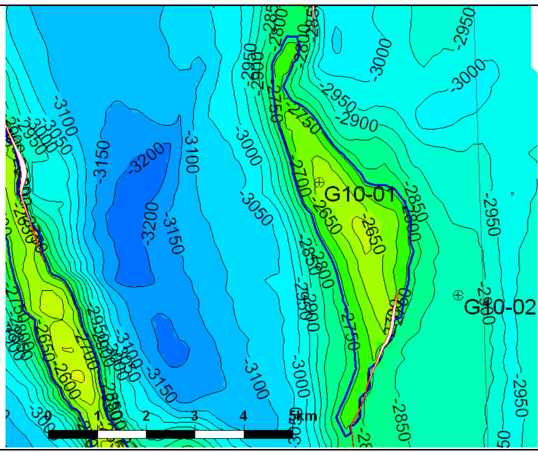
Structure

The G10-East structure was drilled by two exploration wells. G10-1 primarily targeted the Jurassic and Zechstein Caprock reservoirs. As secondary target the Chalk reservoir was explored. This well failed to encounter economic volumes of hydrocarbons; only gas shows were seen in the Jurassic reservoir. G10-2 targeted the Triassic reservoirs of which the Lower Volpriehausen Sandstone was the prime target. The drilled structures may be described as follows:

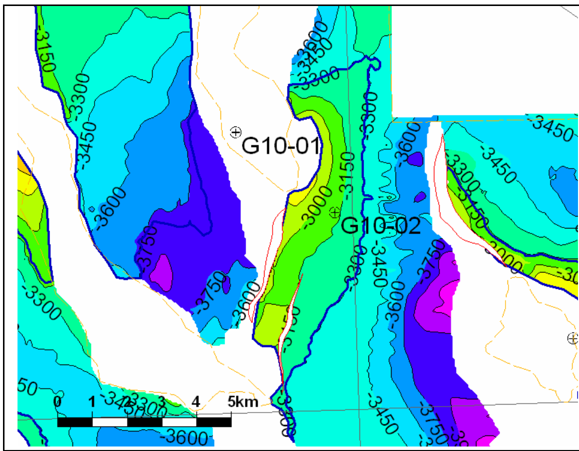
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way top of dome dip closure.
3) Lower Volpriehausen reservoir in a three way dip closure on its westward high side partially truncated against a saltdome and a fault (lateral seal) and partially truncated against the base Rijnland unconformity. The southern part of the reservoir is bounded by a fault. In case this fault is not sealing the reservoir is juxtaposed against Top Triassic series.



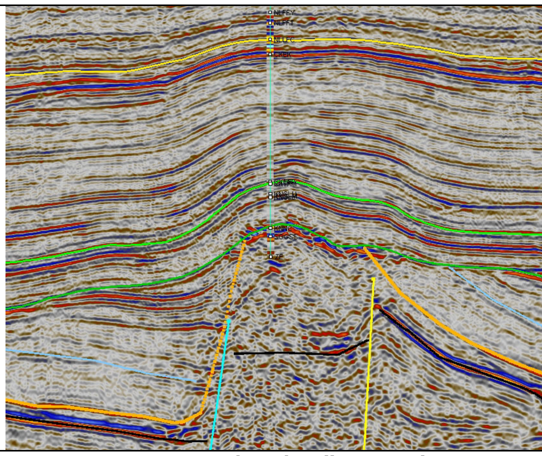
Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section through well G10-1, inline 1417
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure maps of the G10-East structure

Contacts

G10-East structure	Top structure (m TVD/MSL)	LCC (m TVD/MSL)
Chalk	1425	1478
Lower Cretaceous/Upper Jurassic	2600	2764
Lower Volpriehausen	2800	3298

Reservoir data

G10-East reservoir	GRV (10^6 m³)	Gross (m)	N/G (%)	Av. Por. (%)	Sg (%)	Expansion factor
Chalk (G10-01/G10-01-S1)	606	-	-	-	0	-
Upper Jurassic (Scruff) (G10-01/G10-01-S1)	63	15	0	0	Gas shows 40000/60000ppm	-
Lower Volpriehausen (G10-02)	521	45	85	19	0	-

Hydrocarbon specifications

G10-East structure	N2 %	CO2 %	GHV (MJ/m^3)
Upper Jurassic (Scruff) (G10-01/G10-01-S1)	7.91	1.24	37.89

Post Mortem evaluation

Risk	***G13 Southwest prospect reservoir***	***POS***
Reservoir Chalk (G10-01)	-	-
Seal Chalk (G10-01)	No major faults observed on seismic	-
Structure Chalk (G10-01)	Well defined	-
Charge Chalk (G10-01)	No access to charge	-
Results Chalk	**Dry hole**	**-**
Reservoir Scruff/Zechstein (G10-01)	Poor reservoir	-
Seal Scruff/Zechstein (G10-01)	The Vlieland Claystone acts as a seal as proven by the gas shows in well G10-1	-
Structure Scruff/Zechstein (G10-01)	Well defined	-
Charge Scruff/Zechstein (G10-01)	Limited access to charge	-
Total POS Scruff/Zechstein	**Encouraging gas shows, not economic**	**-**
Reservoir Volpriehausen (G10-02)	Reservoir is well developed	-
Seal Volpriehausen (G10-02)	Seal failure. The southern part of the reservoir truncated against a fault with Top Triassic/reservoir juxtaposition. Scruff thiefzone can also be present. The fault as well as the top seal in the southern area could cause leakage.	-
Structure Volpriehausen (G10-02)	Well defined	-
Charge Volpriehausen (G10-02)	Gas shows in G10-01 proof that this structure is on a gas migration path	-
Total POS Volpriehausen	**Dry well**	**-**

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

Composite well log G10-1. *On open file*

Composite well log G10-2. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

Ministry of Economic Affairs

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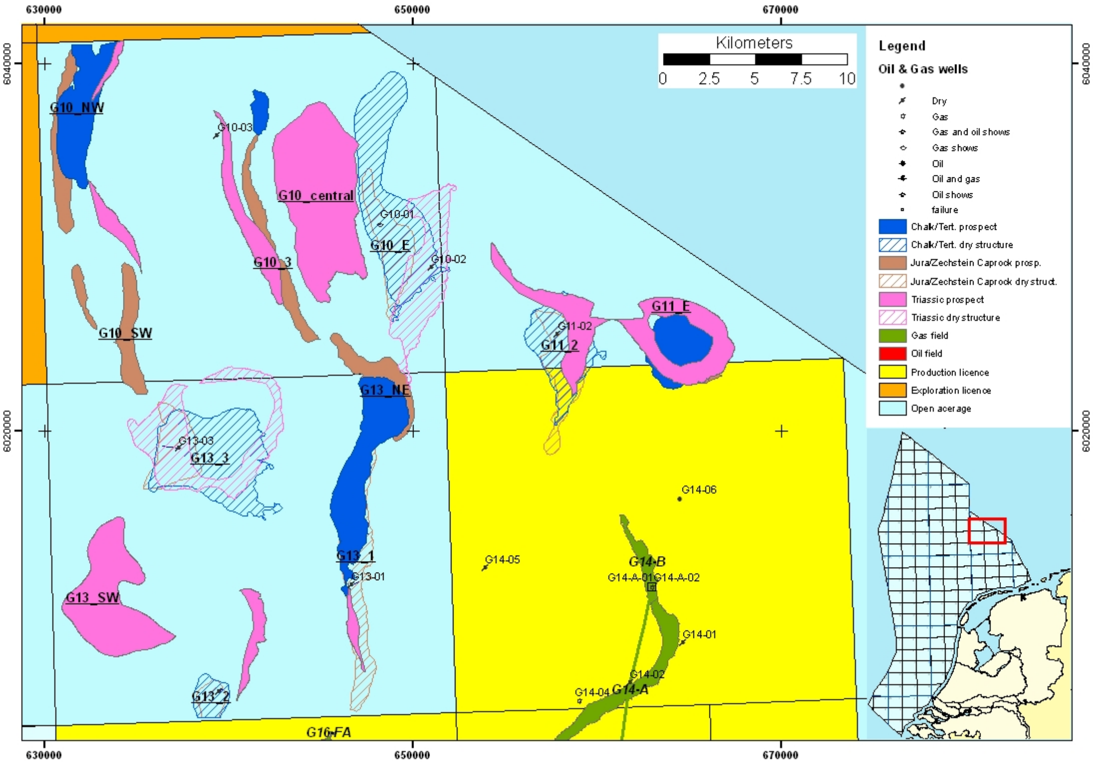
Geological Survey of the Netherlands

Summary sheet G10 Northwest



Location map of the G10 Northwest prospects

General information

The G10 block is at this moment open acreage. The last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The first well, G10-01 drilled 1990, penetrated the objectives Jurassic Scruff Sandstone (formerly interpreted as Vlieland Sandstone) and Zechstein caprock. Although in the Scruff sandstones encouraging gas shows were encountered, the Jurassic reservoir was absent and the Zechstein caprock reservoir was tight. The well was subsequently plugged and abandoned. The wells G10-02 and G10-03, drilled respectively in 1993 and 1997, found the target, Main Buntsandstein sandstones, water bearing and were subsequently plugged and abandoned.

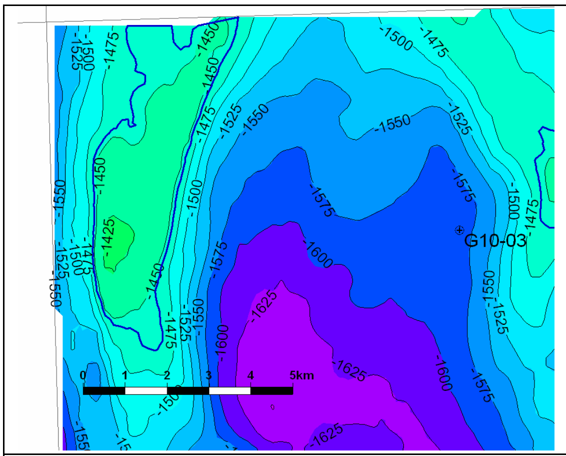
Sequence of events

Date	Event
1987	6th round application awarded to Elf Petroland
1990	Well G10-01 drilled (EPTL)
1993	Well G10-02 drilled (EPTL)
1993	Partial relinquishment
1997	Well G10-03 drilled (EPTL)
1997	License expired

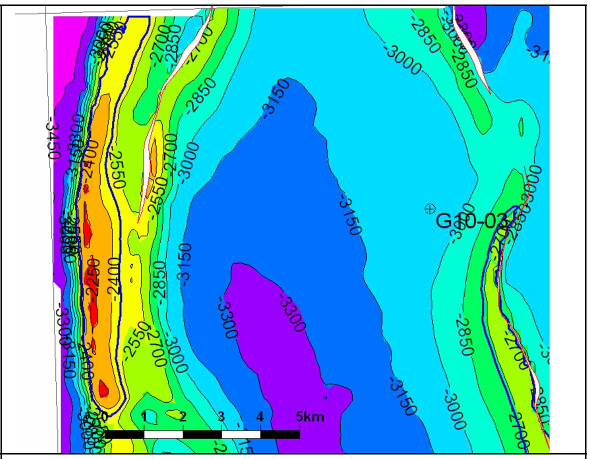
Structure

The G10 Northwest structure has not been drilled. The prospects continue into the northern G7 block along with the underlying saltridge. The structures may be described as follows:

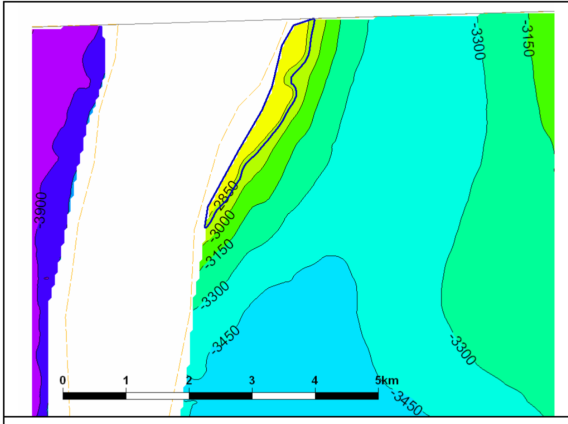
1) Chalk reservoir sealed by clays of the North Sea Group in an elongated four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in an elongated four way top of dome dip closure.
3) Lower Volpriehausen reservoir in a dip closure which is on its westward high side partially truncated against a saltdome and a fault (lateral seals being the Zechstein salt and the Vlieland Claystone). The main part of the reservoir is truncated against the base Rijnland unconformity. In this case the top seal is formed by the Vlieland Claystone.

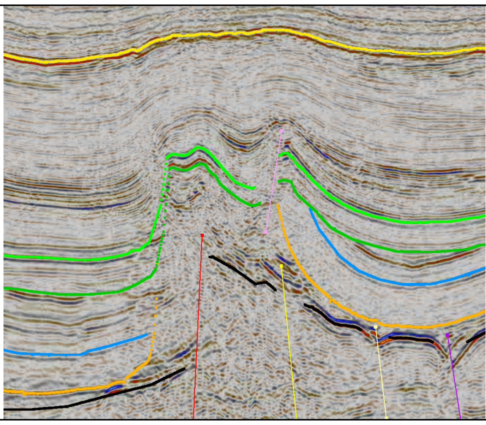


Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)





Top Volpriehausen Reservoir	E-W seismic cross-section, inline 1061
Dotted yellow line indicates Triassic subcrop	yellow = b. North Sea Group light green = base Chalk dark green = base Rijnland unconformity blue = t. Volpriehausen reservoir orange = t. Zechstein black = b. Zechstein

Structure maps of the G10 Northwest prospect

Contacts

G10 Northwest structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1420	1458
Lower Cretaceous/Upper Jurassic	2200	2480
Lower Volpriehausen	2750	2890

Reservoir data

G10 Northwest reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Chalk*	214	80	90	25	40	148
Upper Jurassic (Scruff)*	65.4	8	50	14	70	210
Lower Volpriehausen **	31.5	35	87	15.5	80	222

* Average from public dataset of surrounding wells (www.nlog.nl)
** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Chalk	1.6	2.3	3.0	0.9	1.4	1.9	6
Upper Jurassic (Scruff)	0.5	0.6	0.8	0.2	0.3	0.4	10
Lower Volpriehausen	0.6	0.7	0.8	0.4	0.5	0.6	10

Hydrocarbon specifications

Reservoir	**N2 %**	**CO2 %**	**GHV (MJ/m^3)**
All*	10	2	36.5

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G10 Northwest prospect reservoir***	***POS***
Reservoir Chalk	Permeability probably low, though irregular character may point to resedimentated Chalk facies with enhanced permeability	30%
Seal Chalk	No major crestal faults observed on seismic	80%
Structure Chalk	Well defined	90%
Charge Chalk	High risk due to timing and migration path	30%
Total POS Chalk	**High reservoir and charging risk**	**6%**
Reservoir Scruff/Zechstein	Reservoir is expected to be encountered (G10-03), quality hard to predict	60%
Seal Scruff/Zechstein	Extensive doming could have damaged the seal, though no major faults are observed on seismic	60%
Structure Scruff/Zechstein	Well defined	90%
Charge Scruff/Zechstein	High risk due to timing and migration path. The trajectory of the migration path from the Triassic reservoirs to the Scruff reservoir involves migration through a fault zone where the Vlieland Claystone is juxtaposed against the saltdome.	30%
Total POS Scruff/Zechstein	**High charging risk**	**10%**
Reservoir Volpriehausen	Porosity of the Volpriehausen reservoir might be deteriorated due to salt cementation. The seismic signal of the reservoir is disturbed due to it’s steep dip, therefore no amplitude anomaly could be observed	80%
Seal Volpriehausen	Lateral seal (Vlieland Claystone and Zechstein) are expected to be good. Scruff sand stringers could act as a thiefzone where the reservoir truncates against the unconformaty	30%
Structure Volpriehausen	Well defined	80%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen	**High sealing risk**	**10%**

Infrastructure

The closest platform, F15-A, lies at a distance of approximately 29 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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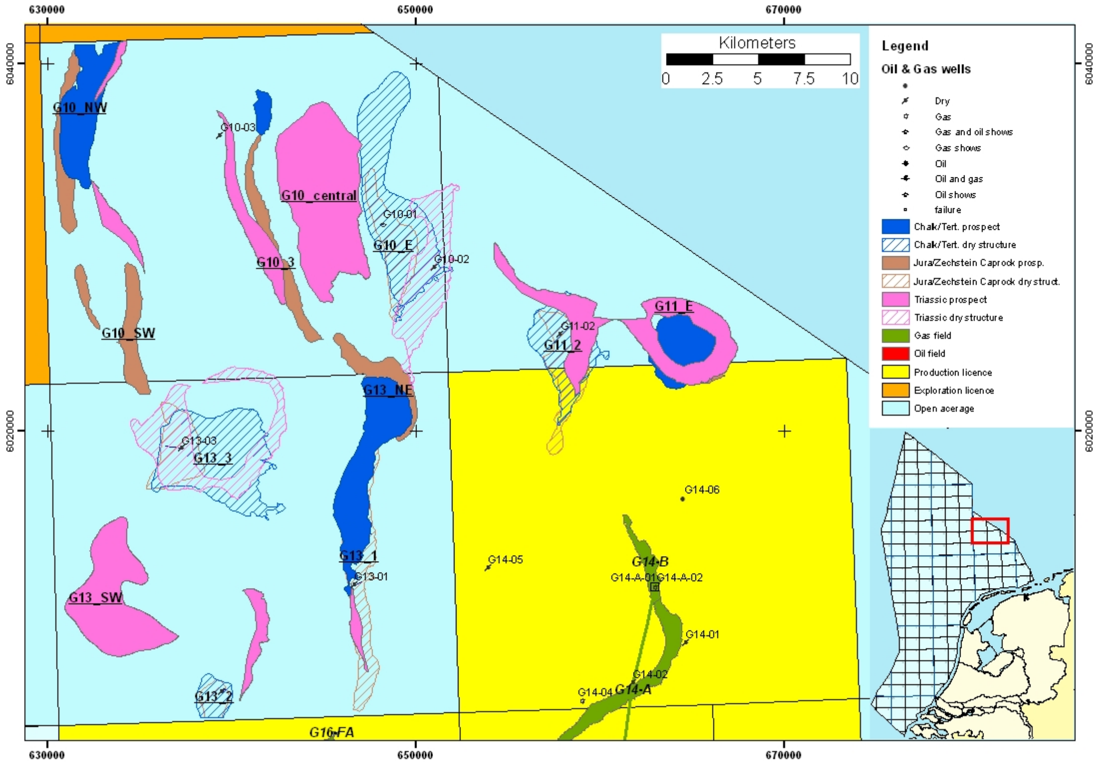
Summary sheet G10 Southwest



Location map of the G10 Southwest prospects

General information

The G10 block is at this moment open acreage. The last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The first well, G10-01 drilled 1990, penetrated the objectives Jurassic Scruff Sandstone (formerly interpreted as Vlieland Sandstone) and Zechstein caprock. Although in the Scruff sandstones encouraging gas shows were encountered, the Jurassic reservoir was absent and the Zechstein caprock reservoir was tight. The well was subsequently plugged and abandoned. The wells G10-02 and G10-03, drilled respectively in 1993 and 1997, found the target, Main Buntsandstein sandstones, water bearing and were subsequently plugged and abandoned.

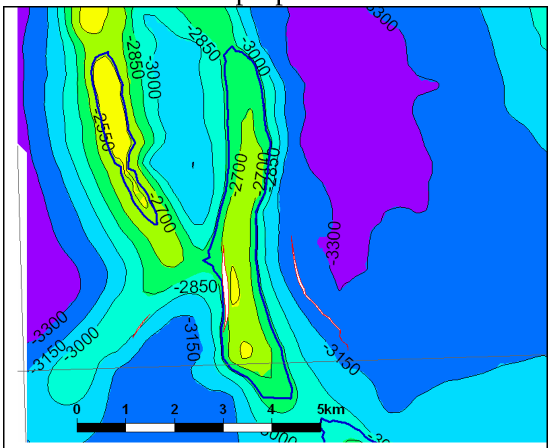
Sequence of events

Date	Event
1987	6th round application awarded to Elf Petroland
1990	Well G10-01 drilled (EPTL)
1993	Well G10-02 drilled (EPTL)
1993	Partial relinquishment
1997	Well G10-03 drilled (EPTL)
1997	License expired

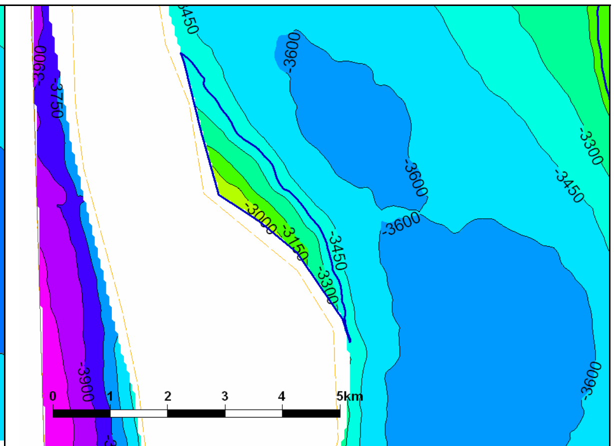
Structure

The G10 Southwest structure has not been drilled and is situated on and around two arms of a salt dome. The structures may be described as follows:

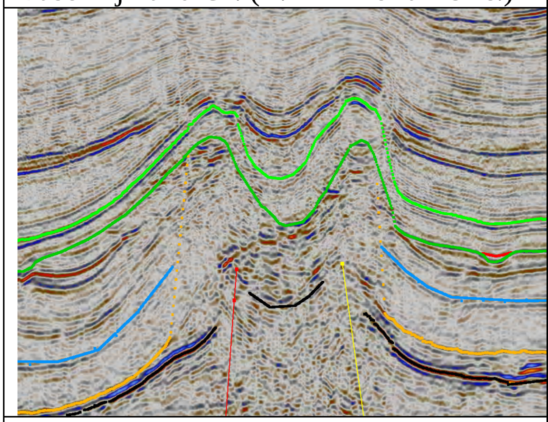
1) Two four way top of dome dip closures in the Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone. The Eastern arm of the structure is has a major fault in the south. In case the fault is non sealing the spill point is around 2700m.
2) Lower Volpriehausen reservoir in a one way dip closure on its westward high side truncated against both the base Rijnland unconformity and the flank of a saltdome. The Vlieland Claystone forms the top seal and the Zechstein salt the lateral updip seal.



Base Rijnland Gr. (L. Kimmerian Unc.)

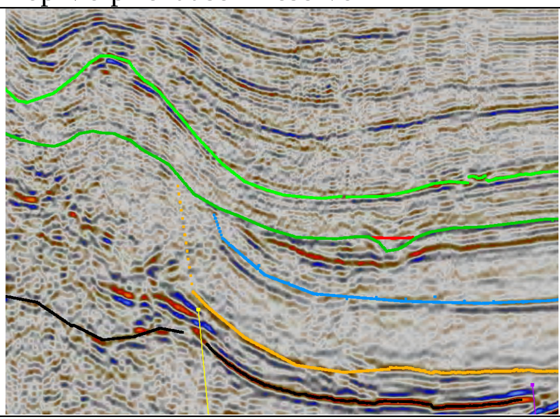


Top Volpriehausen Reservoir



E-W seismic cross-section, inline 1601

Dotted yellow line indicates Triassic subcrop.
yellow = b. North Sea Group; light green = base Chalk



E-W seismic cross-section, inline 1439

dark green = base Rijnland unc.; blue = t. Volpriehausen reservoir; orange = t. Zechstein; black = b. Zechstein

Structure maps of the G10 Southwest structure

Contacts

G10 Southwest structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Lower Cretaceous/Upper Jurassic (western arm)	2450	2573
Lower Cretaceous/Upper Jurassic (eastern arm)	2500	2820
Lower Volpriehausen	2860	3372

Reservoir data

G10 Southwest reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Upper Jurassic (Scruff) (western arm)*	11.7	8	50	14	70	214
Upper Jurassic (Scruff) (eastern arm)*	47.6	8	50	14	70	224
Lower Volpriehausen **	50.9	35	90	16	81	238

* Average from public dataset of surrounding wells (www.nlog.nl)
** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Upper Jurassic (Scruff)(western arm)	0.1	0.1	0.1	0.0	0.0	0.0	4
Upper Jurassic (Scruff)(eastern arm)	0.4	0.5	0.6	0.2	0.2	0.3	4
Lower Volpriehausen	1.3	1.7	2.1	0.9	1.2	1.5	16

Hydrocarbon specifications

Reservoir	N2 %	CO2 %	GHV (MJ/m^3)
All*	9	2	37.0

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G10 Southwest prospect reservoir***	***POS***
Reservoir Scruff/Zechstein	The presence and quality of the reservoir is a high risk. G13-03 was drilled on the flank of a salt ridge and did not encounter any Scruff Sandstone. G10-03, also drilled near a saltridge, did encounter Scruff Sandstone	30%
Seal Scruff/Zechstein	One major fault is present in the Southern part of Eastern arm where the risk of Chalk/reservoir juxtaposition is present	50%
Structure Scruff/Zechstein	Four way dip closure. Eastern arm is bounded by a fault.	90%
Charge Scruff/Zechstein	High risk due to timing and migration path	30%
Total POS Scruff/Zechstein		**4%**
Reservoir Volpriehausen	Porosity of the Volpriehausen reservoir might be deteriorated due to salt cementation. The seismic signal is disturbed due to it’s steep dip, therefore no amplitude anomaly could be observed	70%
Seal Volpriehausen	Scruff thiefzone	50%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**16%**

Infrastructure
The closest platform, F15-A, lies at a distance of approximately 22 km.

Public References
RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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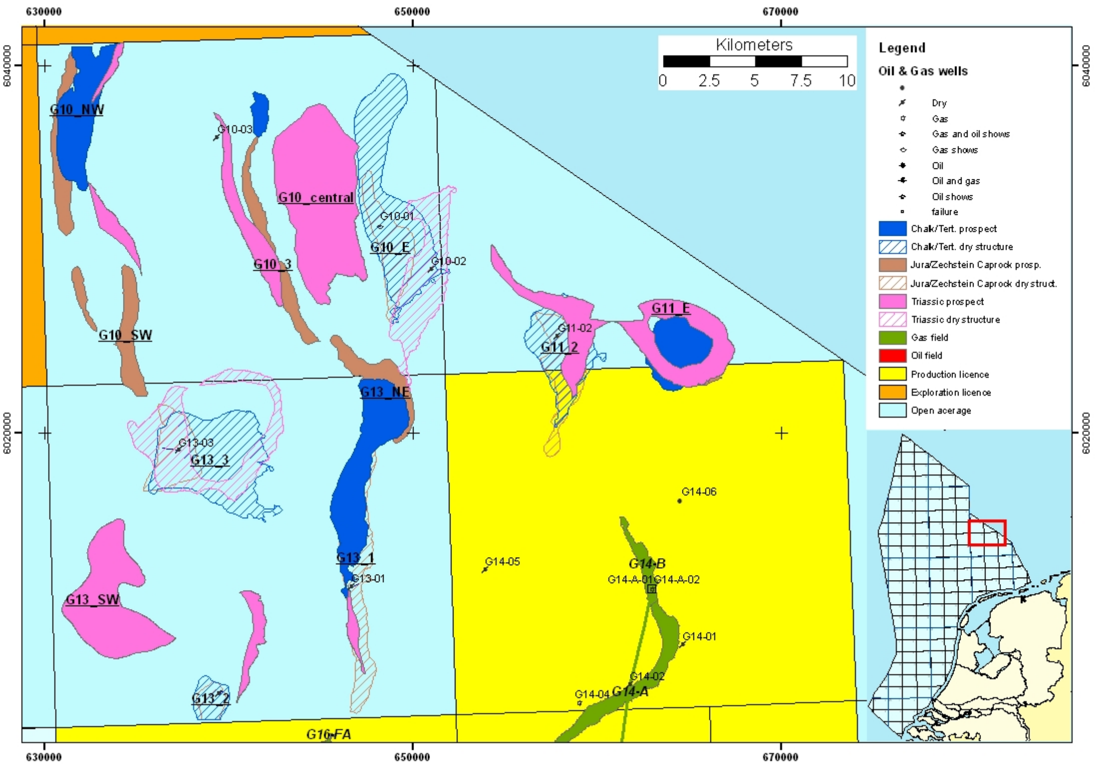
Summary sheet G11-2



Location map of the G11-2 prospect

General information

The G11 block is at this moment open acreage. Last exploration license was relinquished in 2001 by Total/Fina/ELF. One exploration well, G11-02 was drilled in the block (the G11-01 well lies in the German territorial waters). This well found the target horizon water bearing and was subsequently plugged and abandoned.

Sequence of events

Date	Event
1979	4th round application award to Mobil
1985	Partial relinquishment
1985	NAM farm in exploration license G11
09/06/1988	Spud date well G11-2 (NAM)
21/07/1988	Completion date well G11-2 (NAM)
1989	Relinquishment of remainder of exploration license G11
1997	Award 9th round exploration license to ELF Petroland
2001	Relinquishment by Total/Fina/ELF

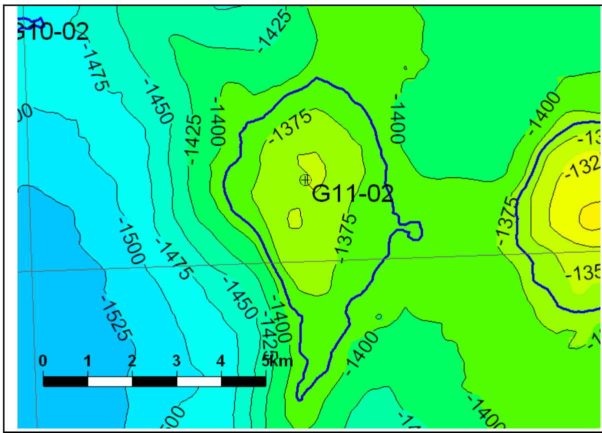
Structure

The G11-2 structure was drilled by one exploration well. G11-02 primarily targeted the Jurassic and Zechstein Caprock reservoirs, which were of poor quality, were found water bearing. The drilled structures may be described as follows:

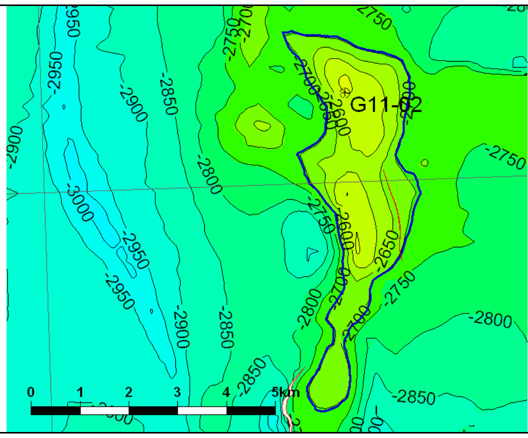
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way top of dome dip closure.

The Volpriehausen prospect has not been explored and may be described as follows:

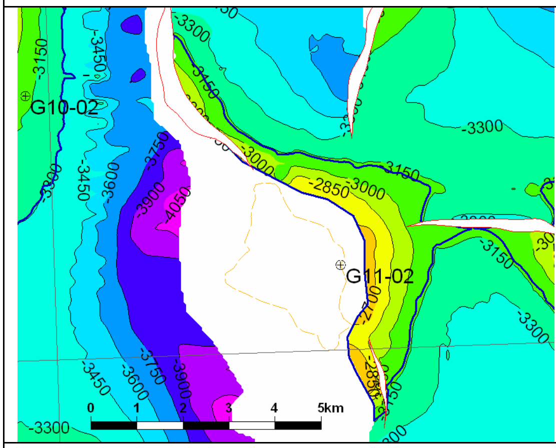
1) Lower Volpriehausen reservoir in a three way dip closure which is on its westward high side partially truncated against a saltdome and a fault (lateral seal) and partially truncated against the base Rijnland unconformity. In the latter case the top seal is formed by the Vlieland Claystone.



Base North Sea Group (top Chalk)

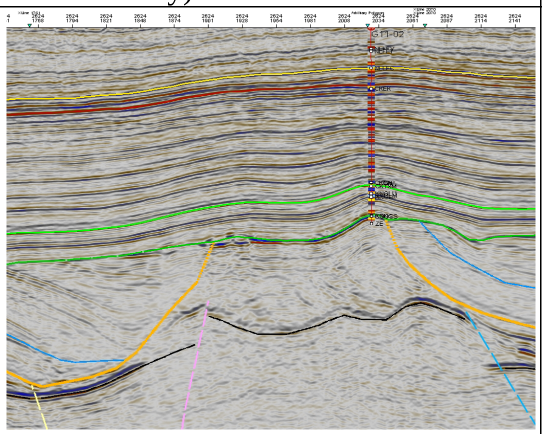


Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir

Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 2624

yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure maps of the G11-2 prospect

Contacts

G11-2 structure	Top structure (m TVD/MSL)	LCC (m TVD/MSL)
Chalk	1350	1388
Lower Cretaceous/Upper Jurassic	2550	2705
Lower Volpriehausen	2650	3130

Reservoir data

G11-2 reservoir	GRV (10^6 m³)	Gross (m)	N/G (%)	Av. Por. (%)	Sg (%)	Expansion factor
Chalk (G11-02)	238	-	-	-	0	-
Upper Jurassic (Scruff) (G11-02)*	81	6	50	8	0	-
Lower Volpriehausen **	325	41	87	18	84	231

* Derived from well measurements
** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	GIIP in 10^9 Nm^3			Reserves in 10^9 Nm^3			
	Low GIIP	Med GIIP	High GIIP	LSV	MSV	HSV	POS
Lower Volpriehausen	8.1	9.2	10.4	5.5	6.4	7.4	6

Hydrocarbon specifications

Reservoir	N2 %	CO2 %	GHV (MJ/m^3)
Lower Volpriehausen*	8	1	38.1

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Post Mortem evaluation and risk evaluation of Volpriehausen prospect

Risk	*G11-2 prospect reservoir*	*POS*
Reservoir Chalk	-	-
Seal Chalk	Assumed to be intact	-
Structure Chalk	Well defined	-
Charge Chalk	No access to charge	-
Results Chalk	**Dry**	**-**
Reservoir Scruff/Zechstein	Poor reservoir quality	-
Seal Scruff/Zechstein	Good	-
Structure Scruff/Zechstein	Well defined	-
Charge Scruff/Zechstein	No access to charge	-
Result Scruff/Zechstein	**Dry**	**-**
Reservoir Volpriehausen	Porosity of the Volpriehausen reservoir may be deteriorated due to salt cementation in the south, though only a small part in of the reservoir is in contact with the saltdome. No high amplitudes are observed because of the steep dips of the reservoir	70%
Seal Volpriehausen	A 6m layer of Scruff sandstone is encountered above the salt dome in G11-02, which may extend to the top of the prospect and act as a thiefzone. Faults in the northern and southern part of the prospect could cause leakage	30%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path, no gas shows in Scruff reservoir in G11-02, which may be explained by an efficient seal of the Volpriehausen Claystone trapping the gas and thus stopping the gas migration towards the Scruff reservoir. Alternatively, no gas shows in G11-02 Scruff can be the result of having no access to charge. The latter is seen as a high risk	30%
Total POS Volpriehausen		**6%**

Infrastructure
The closest platform, G14-A, lies directly south of the prospect at a distance of approximately 13 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50
Composite log G11-02. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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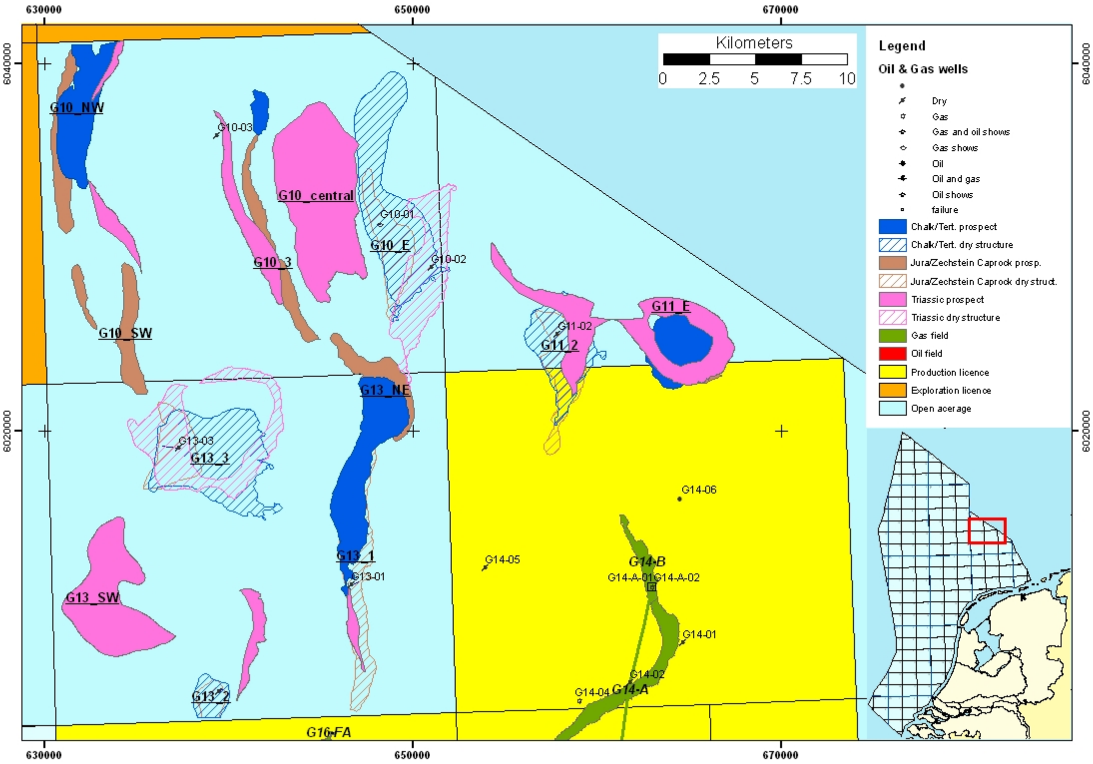
Summary sheet G11 East



Location map of the G11 East prospects

General information

The G11 block is at this moment open acreage. Last exploration license was relinquished in 2001 by Total/Fina/ELF. One exploration well, G11-2 was drilled in the block (the G11-1 well lies in the German territorial waters). This well found the target horizon water bearing and was subsequently plugged and abandoned.

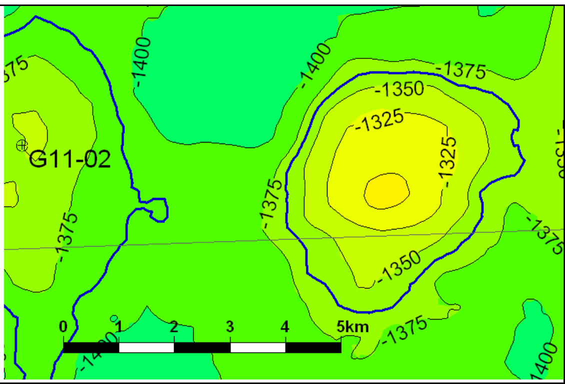
Sequence of events

Date	Event
1979	4th round application award to Mobil
1985	Partial relinquishment
1985	NAM farm in exploration license G11
09/06/1988	Spud date well G11-2 (NAM)
21/07/1988	Completion date well G11-2 (NAM)
1989	Relinquishment of remainder of exploration license G11
1997	Award 9th round exploration license to ELF Petroland
2001	Relinquishment by Total/Fina/ELF

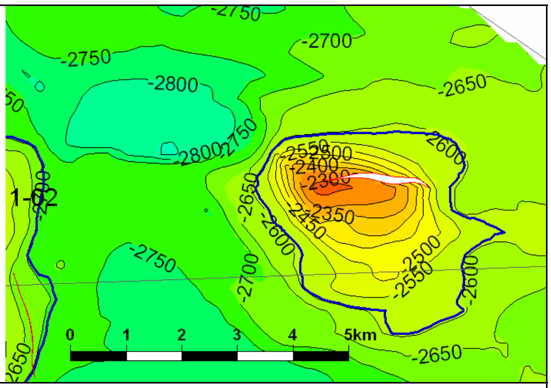
Structure

The G11 East structure has not been drilled. The structures may be described as follows:

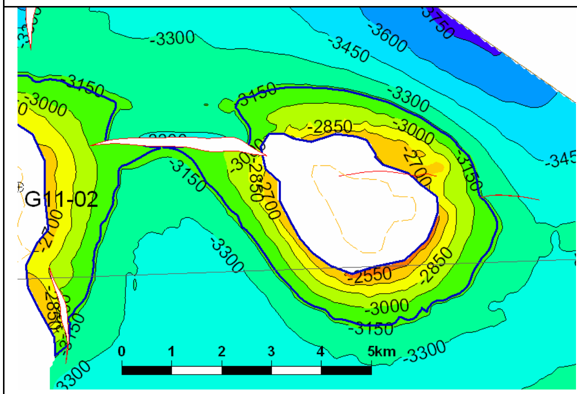
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way top of dome dip closure.
3) Lower Volpriehausen reservoir in a four way doughnut type dip closure truncated against the base Rijnland unconformity sealed by the Vlieland Claystone.



Base North Sea Group (top Chalk)

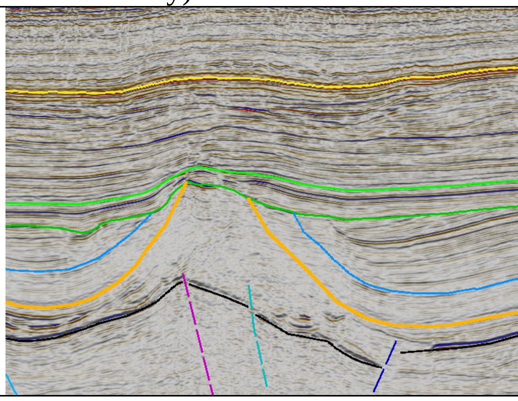


Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir

Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 2624

yellow = b. North Sea Group; light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir; orange = t. Zechstein
black = b. Zechstein

Structure maps of the G11-East prospect

Contacts

G11 East structure Geological unit RGD & NOGEPA (1993)	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1290	1363.5
Lower Cretaceous/Upper Jurassic	2250	2593
Lower Volpriehausen	2500	3130

Reservoir data

G11 East reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Chalk*	338	80	90	25	40	140
Upper Jurassic (Scruff)*	84	8	50	14	70	215
Lower Volpriehausen **	174	40	89	17	82	227

* Average from public dataset of surrounding wells (www.nlog.nl)
** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Chalk	2.3	3.5	4.6	1.4	2.1	2.8	6
Upper Jurassic (Scruff)	0.6	0.8	1.0	0.3	0.4	0.5	9
Lower Volpriehausen	4.6	6.8	9.5	3.2	4.8	6.6	19

Hydrocarbon specifications

Reservoir	**N2 %**	**CO2 %**	**GHV (MJ/m^3)**
All*	8	1	38.1

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G11 East prospect reservoir***	***POS***
Reservoir Chalk	Permeability probably low	20%
Seal Chalk	No major crestal faults observed on seismic	90%
Structure Chalk	Well defined	90%
Charge Chalk	High risk due to timing and migration. A major fault from the Triassic series up to Top Chalk level could be used as a migration path	40%
Total POS Chalk		**6%**
Reservoir Scruff/Zechstein	Low quality reservoir is encountered in well G11-02	50%
Seal Scruff/Zechstein	Major fault on top of structure	40%
Structure Scruff/Zechstein	Well defined	90%
Charge Scruff/Zechstein	High risk due to timing and migration path	50%
Total POS Scruff/Zechstein		**9%**
Reservoir Volpriehausen	No saltdome juxtaposition. The seismic signal is disturbed due to it steep dips and multiples, therefore no amplitude anomaly could be observed	70%
Seal Volpriehausen	Scruff sand stringers could act as a thiefzone.	60%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**19%**

Infrastructure

The closest platform, G14-A, lies directly south of the prospect at a distance of approximately 13 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

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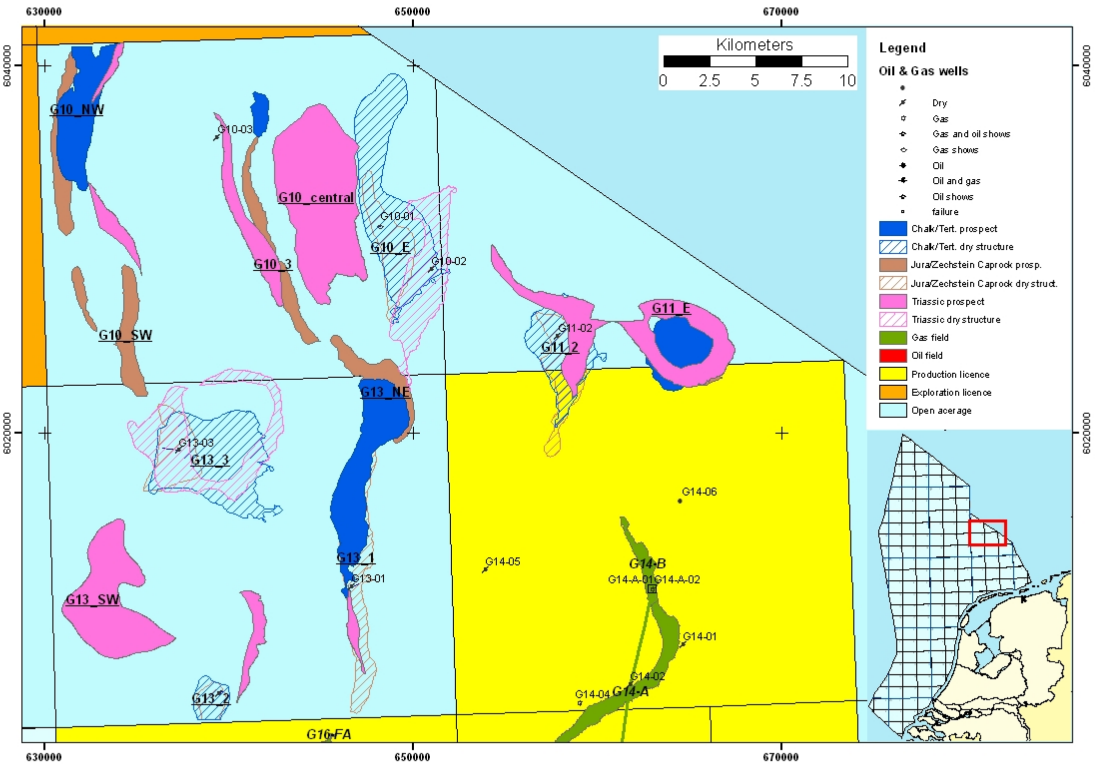
Summary sheet G13-1



Location map of the G13-1 prospects

General information

The G13 block is at this moment open acreage. Last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The main objective of the well G13-01, drilled in 1987, was the Carboniferous with the Jurassic Scruff Sandstone and Zechstein caprock as secondary target. Although the well G13-02, drilled in 1987, reached the Carboniferous as well due to a compulsory drilled depth of 4350m, its main target was Jurassic Scruff Sandstone and Zechstein caprock (formally interpreted as Vlieland Sandstones). The Carboniferous reservoir was found tight in both wells. In well G13-01 the Jurassic Scruff Sandstone and Zechstein caprock reservoir was found water bearing, while in well G13-02 this target was not encountered. Both wells were plugged and abandoned. The well G13-03, drilled in 1996, aimed for the Jurassic Sandstones, which were not present as well for the Main Buntsandstein Sandstones, which were found water bearing.

Sequence of events

Date	Event
1979	4th round application awarded to Mobil
1985	Block split, exploration license of G13 part b relinquished
1987	Major farm-in by NAM in exploration license of G13 part a by drilling well G13-01
1987	Exploration license G13 part b awarded to Unocal
1989	Exploration license expired of G13 part a
1991	Well G13-02 drilled in G13 part b (Unocal)
1992	Major farm-in in exploration license of G13 part b by Elf Petroland, Eurafrep, Corexland
1992	Exploration license of G13 part a awarded to Mobil, Energie Versorgung Weser-Ems
1993	Partly relinquishment of exploration license G13 part b
1994	Relinquishment of exploration license G13 part a
1996	Well G13-03 drilled in G13 part b (EPTL)
1997	Remainder of exploration license G13 part b expired

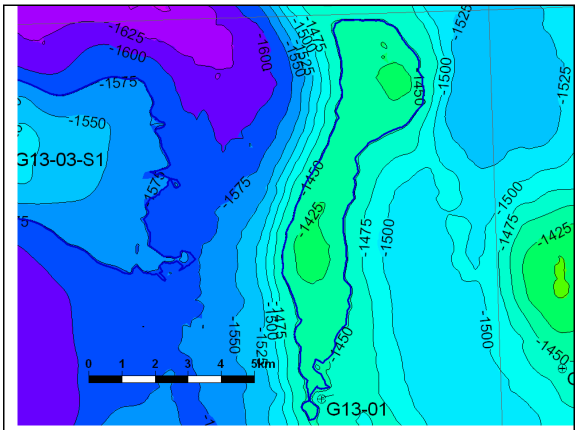
Structure

The G13-1 structure was drilled by one exploration well. G13-01 primarily targeted the Carboniferous reservoir, which was found tight and secondarily the Jurassic and Zechstein reservoir which was found water bearing. The well location is located off-structure with respect to the defined Volpriehausen and Chalk prospects. The updip potential structures may be described as follows:

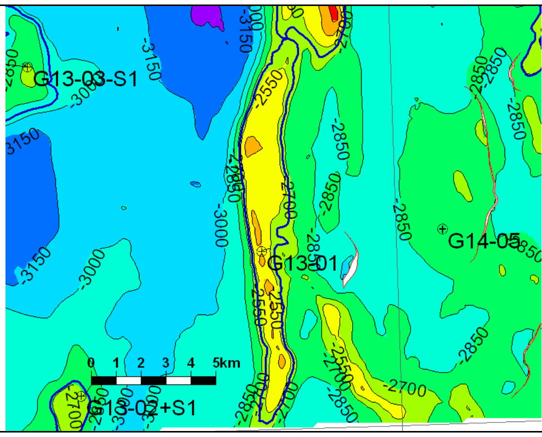
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Lower Volpriehausen reservoir in a three way dip closure on its eastward high side partially truncated against a saltdome and a fault (lateral seal) and partially truncated against the base Rijnland unconformity. In the latter case the top seal is formed by the Vlieland Claystone. The well G13-01 missed the reservoir because it was truncated just east of the well location.

The drilled structure may be described as follows:

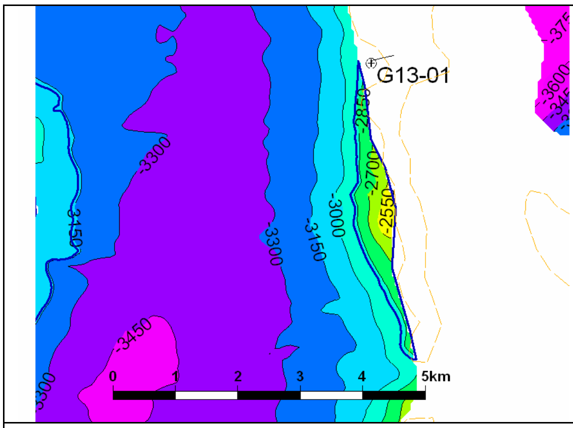
1) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way top of dome dip closure.



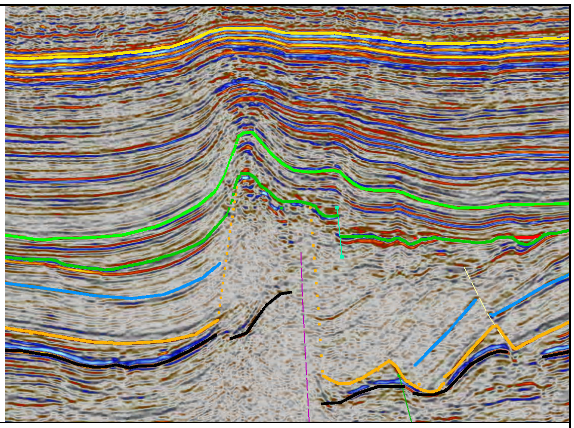
Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 1930
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure maps of the G13-1 prospect

Contacts

G13-1 structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1415	1448
Lower Cretaceous/Upper Jurassic	2350	2625
Lower Volpriehausen	2450	2882

Reservoir data

G13-01 reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Chalk***	252	80	90	25	40	148
Upper Jurassic (Scruff)*	150	9.5	88	11	0	-
Lower Volpriehausen **	46	35	91	16	81	222

* Derived from well measurements
** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)
*** Average from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Chalk	1.8	2.7	3.6	1.1	1.6	2.2	3
Lower Volpriehausen	1.0	1.2	1.3	0.7	0.8	0.9	16

Hydrocarbon specifications

Reservoir	**N2 %**	**CO2 %**	**GHV (MJ/m^3)**
All*	8	1	38

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Most Mortem and risk evaluation

Risk	***G13-1 prospect reservoir***	***POS***
Reservoir Chalk	Permeability probably low	20%
Seal Chalk	No major crestal faults are observed on seismic	80%
Structure Chalk	Well defined	90%
Charge Chalk	High risk due to timing and migration path	20%
Total POS Chalk		**3%**
Reservoir Scruff/Zechstein (G13-01)	Poor reservoir quality	-
Seal Scruff/Zechstein (G13-01)	No major crestal faults are observed on seismic	-
Structure Scruff/Zechstein (G13-01)	Well defined	-
Charge Scruff/Zechstein (G13-01)	No access to charge	-
Result Scruff/Zechstein	**Dry well**	**-**
Reservoir Volpriehausen	Porosity of the Volpriehausen reservoir may be deteriorated by salt cementation	70%
Seal Volpriehausen	Zechstein lateral seal is likely to be efficient, though at some locations the reservoir truncates at the unconformity. Scruff thief zone is likely to be present (G13-01).	50%
Structure Volpriehausen	Well defined	90%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**16%**

Infrastructure

The closest platform, G16A-A, lies at a distance of approximately 14 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

Composite log G13-1. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

Ministry of Economic Affairs

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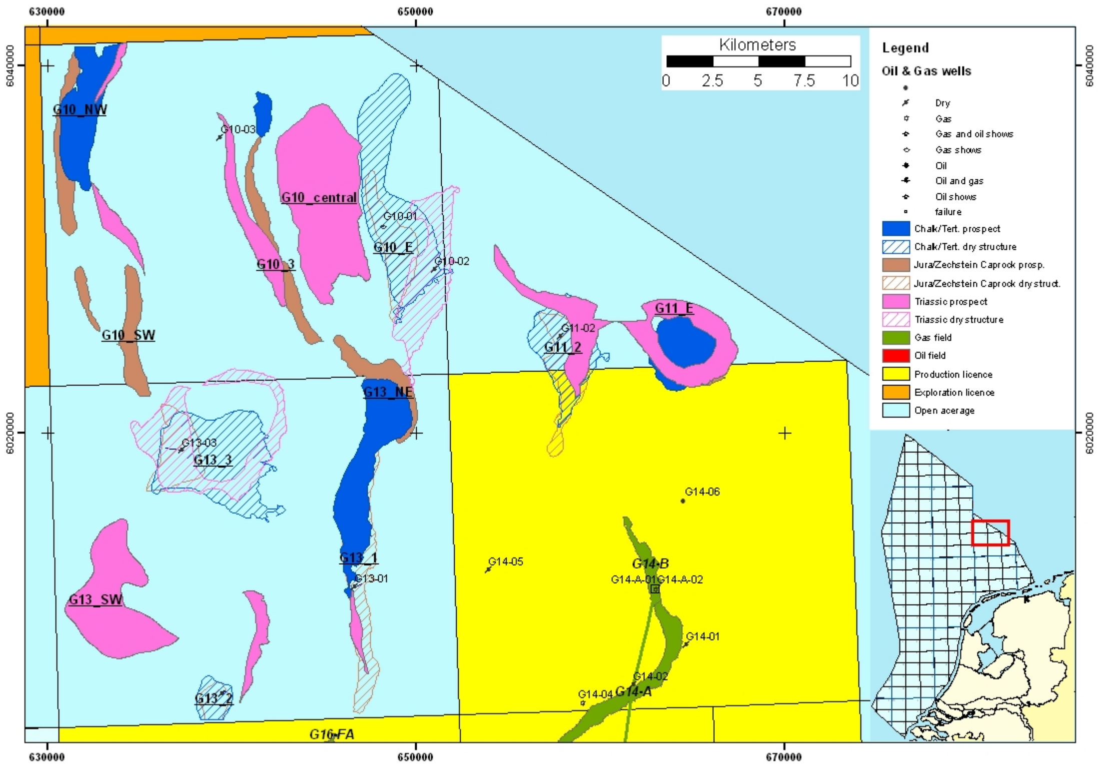
Summery sheet G13-2



Location map of the G13-2 prospect

General information

The G13 block is at this moment open acreage. Last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The main objective of the well G13-01, drilled in 1987, was the Carboniferous with the Jurassic Scruff Sandstone and Zechstein caprock as secondary target. Although the well G13-02, drilled in 1987, reached the Carboniferous as well due to a compulsory drilled depth of 4350m, its main target was Jurassic Scruff Sandstone and Zechstein caprock (formally interpreted as Vlieland Sandstones). The Carboniferous reservoir was found tight in both wells. In well G13-01 the Jurassic Scruff Sandstone and Zechstein caprock reservoir was found water bearing, while in well G13-02 this target was not encountered. Both wells were plugged and abandoned. The well G13-03, drilled in 1996, aimed for the Jurassic Sandstones, which were not present as well for the Main Buntsandstein Sandstones, which were found water bearing.

Sequence of events

Date	Event
1979	4th round application awarded to Mobil
1985	Block split, exploration license of G13 part b relinquished
1987	Major farm-in by NAM in exploration license of G13 part a by drilling well G13-01
1987	Exploration license G13 part b awarded to Unocal
1989	Exploration license expired of G13 part a
1991	Well G13-02 drilled in G13 part b (Unocal)
1992	Major farm-in in exploration license of G13 part b by Elf Petroland, Eurafrep, Corexland
1992	Exploration license of G13 part a awarded to Mobil, Energie Versorgung Weser-Ems
1993	Partly relinquishment of exploration license G13 part b
1994	Relinquishment of exploration license G13 part a
1996	Well G13-03 drilled in G13 part b (EPTL)
1997	Remainder of exploration license G13 part b expired

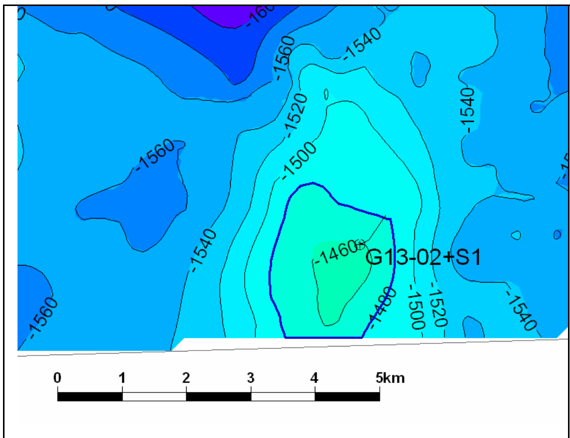
Structure

The G13-2 structure was drilled by one exploration well. G13-02 primarily targeted the Jurassic and Zechstein reservoir but the reservoir was not encountered. The secondary target, the Carboniferous reservoir, was found tight. The Volpriehausen prospect has not been explored. This potential structure may be described as follows:

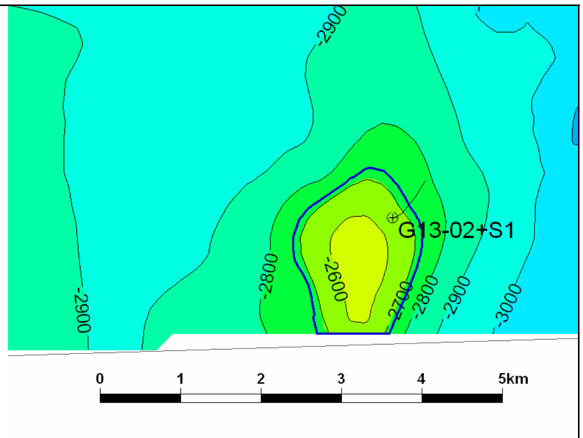
1) Lower Volpriehausen reservoir truncated against Rijnland unconformity with the top seal formed by the Vlieland Claystone.

The drilled structures may be described as follows:

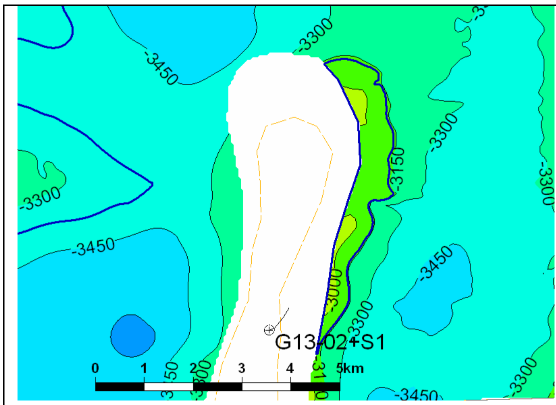
1) Chalk reservoir sealed by clays of the North Sea group in a four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way top of dome dip closure.
3) Carboniferous reservoir sealed by Silverpit claystone a four way dip closure maybe laterally sealed by faults.

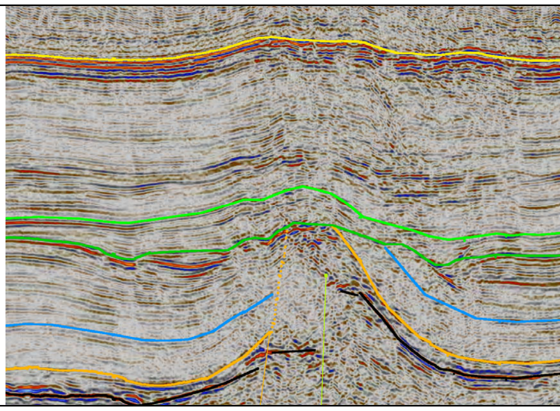


Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)





Top Volpriehausen Reservoir	E-W 2D seismic line 06
Dotted yellow line indicates Triassic subcrop	yellow = b. North Sea Group light green = base Chalk dark green = base Rijnland unconformity blue = t. Volpriehausen reservoir orange = t. Zechstein black = b. Zechstein

Structure maps of the G13-2 prospect

Contacts

G13-2 structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1460	1480
Lower Cretaceous/Upper Jurassic	2650	2725
Lower Volpriehausen	2950	3135

Reservoir data

G13-2 reservoir	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Chalk	49	-	?	?	0	-
Upper Jurassic (Scruff) (G13-02)*	20	3	0	?	0	-
Lower Volpriehausen **	100	35	91	16	81	231
Carboniferous	-	Low	Low	Low	-	-

* Derived from well measurements

** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Lower Volpriehausen	2.2	2.6	2.9	1.5	1.8	2.1	29

Hydrocarbon specifications

Reservoir	**N2 %**	**CO2 %**	**GHV (MJ/m^3)**
Lower Volpriehausen*	8	1	37.8

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Post Mortem and risk evaluation

Risk	*G13-2 prospect reservoir*	*POS*
Reservoir Chalk (G13-02)	Porosity probably high, permeability probably low	-
Seal Chalk (G13-02)	Minor faults are observed on seismic	-
Structure Chalk (G13-02)	Well defined	-
Charge Chalk (G13-02)	No access to charge	-
Results Chalk	**Dry well**	**-**
Reservoir Scruff/Zechstein (G13-02)	Scruff Sandstone encountered in well G13-02 is 3m thick, with no net reservoir	-
Seal Scruff/Zechstein (G13-02)	Probably good	-
Structure Scruff/Zechstein (G13-02)	Well defined	-
Charge Scruff/Zechstein (G13-02)	No access to charge	-
Results Scruff/Zechstein	**Dry well**	**-**
Results Carboniferous	**Poor reservoir: low permeability and low N/G**	**-**
Reservoir Volpriehausen	Salt cementation is not considered to be a risk. The seismic signal is disturbed due to steep dips, therefore no amplitude anomaly could be observed. Good reservoir quality is expected	90%
Seal Volpriehausen	No Scruff thiefzone expected	80%
Structure Volpriehausen	Well defined	80%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**29%**

Infrastructure

The closest platform, G16A-A, lies directly at a distance of approximately 7 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

Composite log G13-2. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: www.nlog.nl

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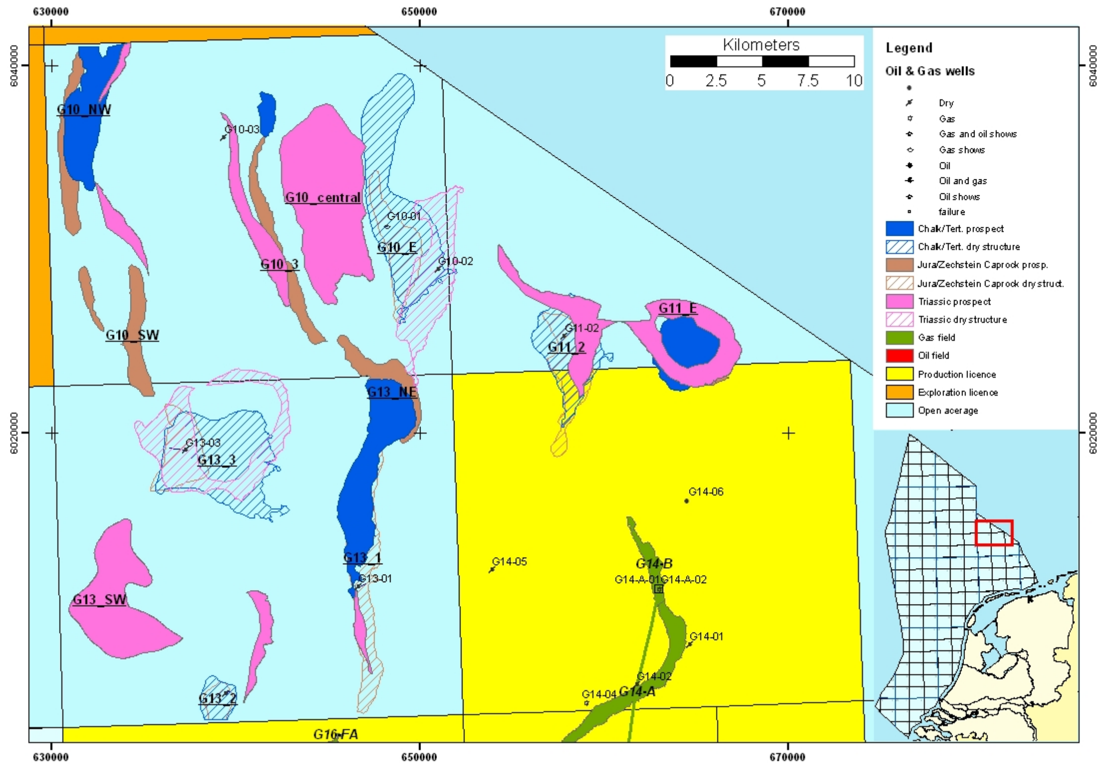
Post Mortem sheet G13-3



Location map of the G13-3 structure

General information

The G13 block is at this moment open acreage. Last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The main objective of the well G13-01, drilled in 1987, was the Carboniferous with the Jurassic Scruff Sandstone and Zechstein caprock as secondary target. Although the well G13-02, drilled in 1987, reached the Carboniferous as well due to a compulsory drilled depth of 4350m, its main target was Jurassic Scruff Sandstone and Zechstein caprock (formally interpreted as Vlieland Sandstones). The Carboniferous reservoir was found tight in both wells. In well G13-01 the Jurassic Scruff Sandstone and Zechstein caprock reservoir was found water bearing, while in well G13-02 this target was not encountered. Both wells were plugged and abandoned. The well G13-03, drilled in 1996, aimed for the Jurassic Sandstones, which was not encountered as well for the Main Buntsandstein Sandstones, which were found water bearing.

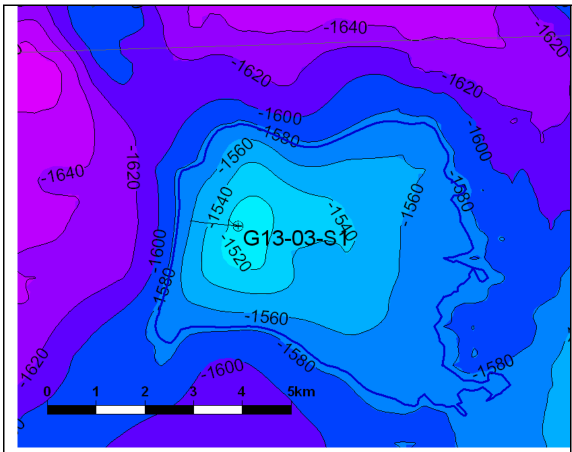
Sequence of events

Date	Event
1979	4th round application awarded to Mobil
1985	Block split, exploration license of G13 part b relinquished
1987	Major farm-in by NAM in exploration license of G13 part a by drilling well G13-01
1987	Exploration license G13 part b awarded to Unocal
1989	Exploration license expired of G13 part a
1991	Well G13-02 drilled in G13 part b (Unocal)
1992	Major farm-in in exploration license of G13 part b by Elf Petroland, Eurafrep, Corexland
1992	Exploration license of G13 part a awarded to Mobil, Energie Versorgung Weser-Ems
1993	Partly relinquishment of exploration license G13 part b
1994	Relinquishment of exploration license G13 part a
1996	Well G13-03 drilled in G13 part b (EPTL)
1997	Remainder of exploration license G13 part b expired

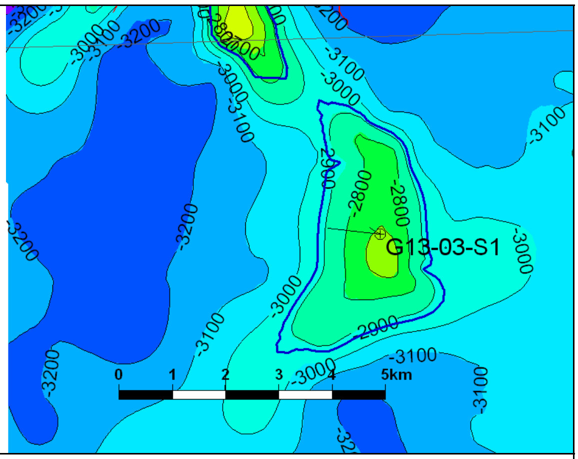
Structure

The G13-3 structure was drilled by one exploration well. G13-03 did not encounter the Jurassic reservoir and found the Volpriehausen reservoir water bearing. The drilled structures may be described as follows:

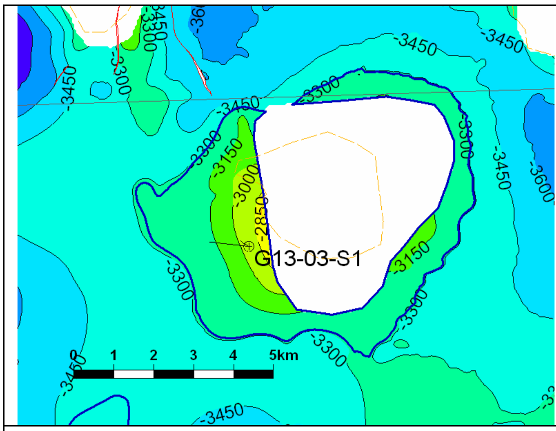
1) Chalk reservoir sealed by clays of the North Sea Group in a four way top of dome dip closure.
2) Lower Cretaceous/Upper Jurassic reservoir and Zechstein Caprock sealed by the Vlieland Claystone in a four way dip closure. The structure is offset with respect to the centre of the dome.
3) Lower Volpriehausen reservoir in a doughnut type three way dip closure partially truncated against a saltdome and a fault (lateral seal) and partially truncated against the base Rijnland unconformity. In the latter case the top seal is formed by the Vlieland Claystone.



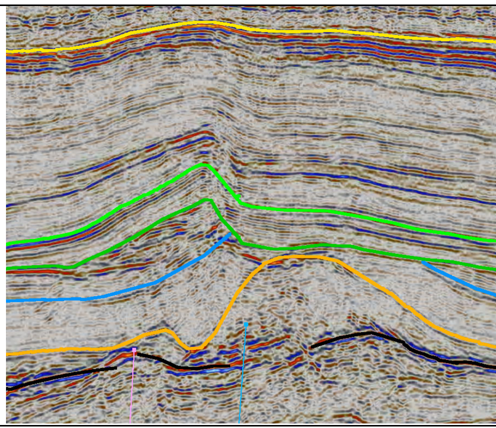
Base North Sea Group (top Chalk)



Base Rijnland Group (Late Kimmerian Unconformity)



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W 2D seismic line 20
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure maps of the G13-3 structure

Contacts

G13-3 structure	**Top structure** (m TVD/MSL)	**LCC** (m TVD/MSL)
Chalk	1520	1576
Lower Cretaceous/Upper Jurassic	2700	2931
Lower Volpriehausen	2800	3293

Reservoir data

G13-3structure	**GRV** (10^6 m³)	**Gross** (m)	**N/G** (%)	**Av. Por.** (%)	**Sg** (%)	**Expansion factor**
Lower Volpriehausen (G13-03) *	597	40	90	16.5	0	-

* Derived from well measurements

Post Mortem evaluation

Risk	***G13-3 prospect reservoir***	***POS***
Reservoir Chalk (G13-03)	Permeability probably low	-
Seal Chalk (G13-03)	No major crestal faults observed on seismic	-
Structure Chalk (G13-03)	Well defined	-
Charge Chalk (G13-03)	No access to charge	-
Results Chalk	**Dry well**	**-**
Reservoir Scruff/Zechstein (G13-03)	No reservoir has not been encountered	-
Seal Scruff/Zechstein (G13-03)	Probably good	-
Structure Scruff/Zechstein (G13-03)	Uncertain due to poor seismic quality on 2D seismic	-
Charge Scruff/Zechstein (G13-03)	-	-
Results Scruff/Zechstein	**Reservoir not present**	**-**
Reservoir Volpriehausen (G13-03)	Good reservoir	-
Seal Volpriehausen (G13-03)	Possible Scruff sand stringers	-
Structure Volpriehausen (G13-03)	Well defined	-
Charge Volpriehausen (G13-03)	No access to charge	-
Results Volpriehausen	**Dry well**	**-**

Infrastructure
The closest platform, F15-A, lies at a distance of approximately 20 km.

Public References
RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

Composite log G13-03. *On open file*

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

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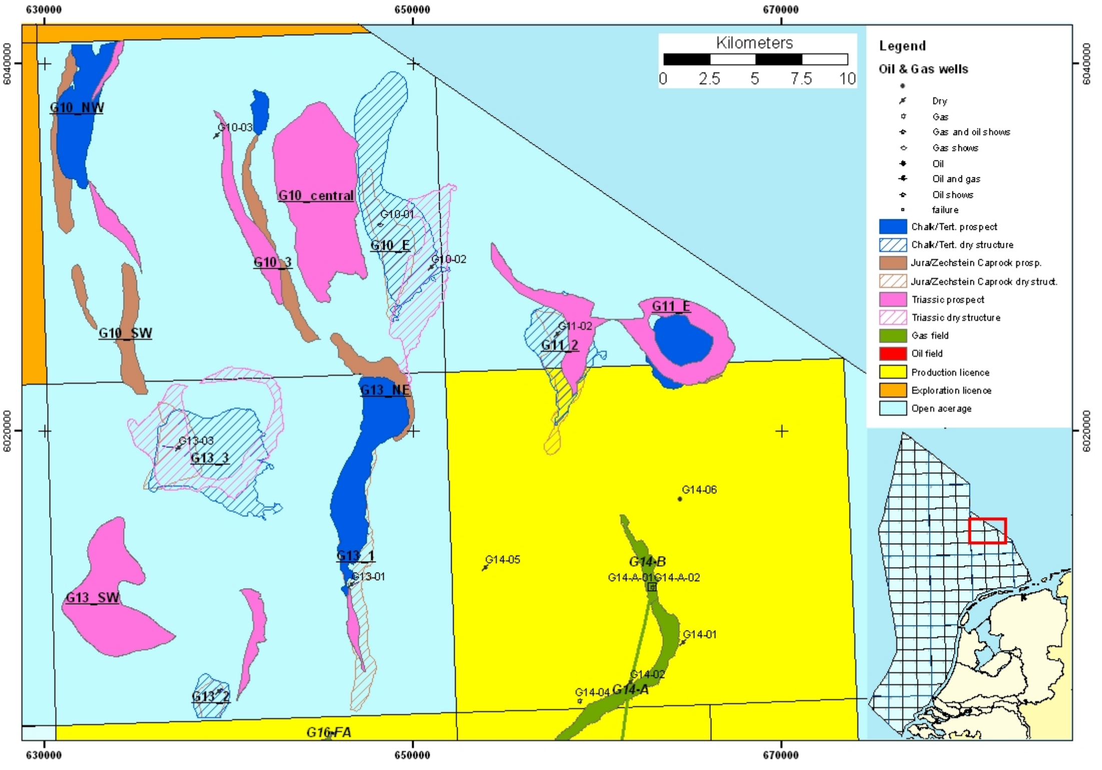
Summary sheet G13 Northeast



Location map of the G13 Northeast prospect

General information

The G13 block is at this moment open acreage. Last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The main objective of the well G13-01, drilled in 1987, was the Carboniferous with the Jurassic Scruff Sandstone and Zechstein caprock as secondary target. Although the well G13-02, drilled in 1987, reached the Carboniferous as well due to a compulsory drilled depth of 4350m, its main target was Jurassic Scruff Sandstone and Zechstein caprock (formally interpreted as Vlieland Sandstones). The Carboniferous reservoir was found tight in both wells. In well G13-01 the Jurassic Scruff Sandstone and Zechstein caprock reservoir was found water bearing, while in well G13-02 this target was not encountered. Both wells were plugged and abandoned. The well G13-03, drilled in 1996, aimed for the Jurassic Sandstones, which were not present as well for the Main Buntsandstein Sandstones, which were found water bearing.

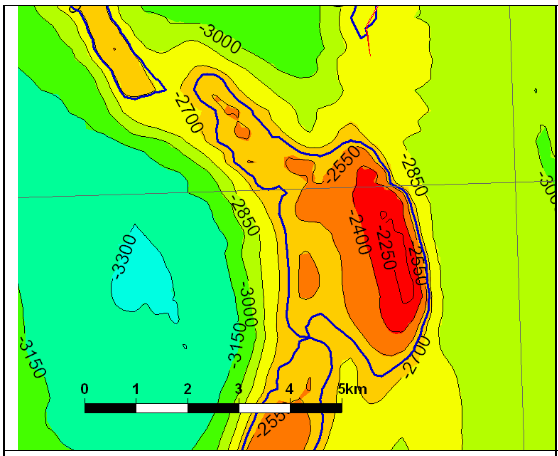
Sequence of events

Date	Event
1979	4th round application awarded to Mobil
1985	Block split, exploration license of G13 part b relinquished
1987	Major farm-in by NAM in exploration license of G13 part a by drilling well G13-01
1987	Exploration license G13 part b awarded to Unocal
1989	Exploration license expired of G13 part a
1991	Well G13-02 drilled in G13 part b (Unocal)
1992	Major farm-in in exploration license of G13 part b by Elf Petroland, Eurafrep, Corexland
1992	Exploration license of G13 part a awarded to Mobil, Energie Versorgung Weser-Ems
1993	Partly relinquishment of exploration license G13 part b
1994	Relinquishment of exploration license G13 part a
1996	Well G13-03 drilled in G13 part b (EPTL)
1997	Remainder of exploration license G13 part b expired

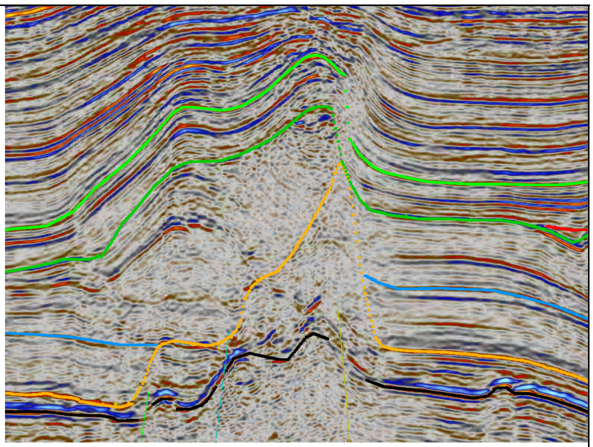
Structure

The prospect is situated above a salt dome. The dome did not fully break through the Triassic sequences, except in the most northern part of the structure. The structure may be described as follows:

1) Lower Cretaceous/Upper Jurassic reservoir sealed by the Vlieland Claystone in a four way top of dome dip closure. The Zechstein caprock might not be present in this structure, since the Zechstein has probably not been exposed.



Base Rijnland Group (Late Kimmerian Unconformity)



E-W seismic cross-section, inline 2470
light green=base Chalk
dark green=base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure map of the G13 Northeast prospect

Contacts

G13-Northeast structure	Top structure (m TVD/MSL)	LCC (m TVD/MSL)
Lower Cretaceous/Upper Jurassic	2200	2625

Reservoir data

G13 Northeast reservoir	GRV (10^6 m³)	Gross (m)	N/G (%)	Av. Por. (%)	Sg (%)	Expansion factor
Upper Jurassic (Scruff)*	89.8	8	50	14	70	216

* Average from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	**GIIP** in 10^9 Nm^3			**Reserves** in 10^9 Nm^3			
	Low GIIP	**Med GIIP**	**High GIIP**	**LSV**	**MSV**	**HSV**	**POS**
Upper Jurassic (Scruff)	0.6	0.8	1.1	0.3	0.4	0.5	8

Hydrocarbon specifications

Reservoir	N2 %	CO2 %	GHV (MJ/m^3)
Upper Jurassic (Scruff)*	8	1	37.9

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G13 Northeast prospect reservoir***	***POS***
Reservoir Scruff/Zechstein	Presence and quality of reservoir hard to predict.	50%
Seal Scruff/Zechstein	Good	70%
Structure Scruff/Zechstein	Uncertainty in exact shape of structure due to disturbed seismic signal	80%
Charge Scruff/Zechstein	High risk due to timing and migration path	30%
Total POS Scruff/Zechstein		**8%**

Infrastructure

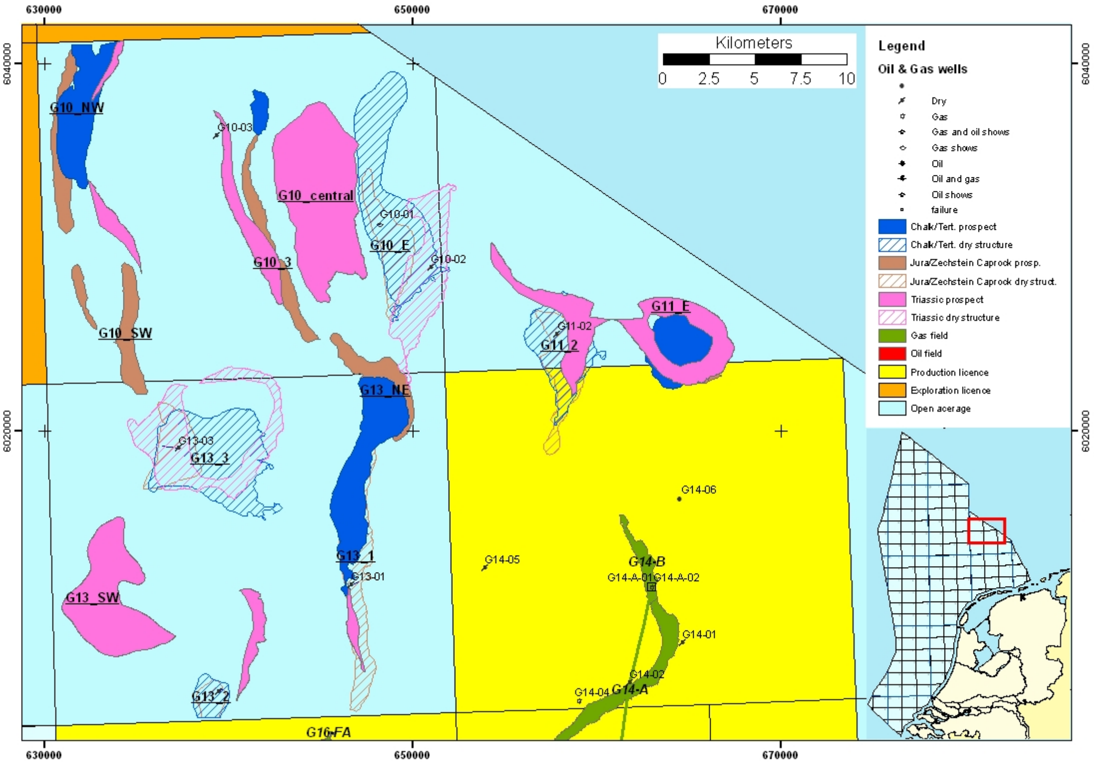
The closest platform, G14-A, lies at a distance of approximately 18 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*

Summary sheet G13 Southwest



Location map of the G13 Southwest prospect

General information

The G13 block is at this moment open acreage. Last exploration license of Elf Petroland expired in 1997. Three exploration wells were drilled in the block. The main objective of the well G13-01, drilled in 1987, was the Carboniferous with the Jurassic Scruff Sandstone and Zechstein caprock as secondary target. Although the well G13-02, drilled in 1987, reached the Carboniferous as well due to a compulsory drilled depth of 4350m, its main target was Jurassic Scruff Sandstone and Zechstein caprock (formally interpreted as Vlieland Sandstones). The Carboniferous reservoir was found tight in both wells. In well G13-01 the Jurassic Scruff Sandstone and Zechstein caprock reservoir was found water bearing, while in well G13-02 this target was not encountered. Both wells were plugged and abandoned. The well G13-03, drilled in 1996, aimed for the Jurassic Sandstones, which were not present as well for the Main Buntsandstein Sandstones, which were found water bearing.

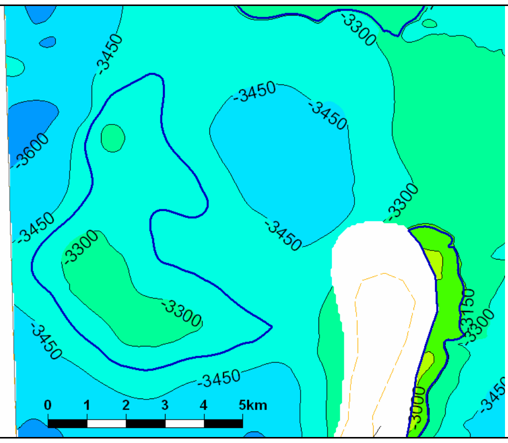
Sequence of events

Date	Event
1979	4th round application awarded to Mobil
1985	Block split, exploration license of G13 part b relinquished
1987	Major farm-in by NAM in exploration license of G13 part a by drilling well G13-01
1987	Exploration license G13 part b awarded to Unocal
1989	Exploration license expired of G13 part a
1991	Well G13-02 drilled in G13 part b (Unocal)
1992	Major farm-in in exploration license of G13 part b by Elf Petroland, Eurafrep, Corexland
1992	Exploration license of G13 part a awarded to Mobil, Energie Versorgung Weser-Ems
1993	Partly relinquishment of exploration license G13 part b
1994	Relinquishment of exploration license G13 part a
1996	Well G13-03 drilled in G13 part b (EPTL)
1997	Remainder of exploration license G13 part b expired

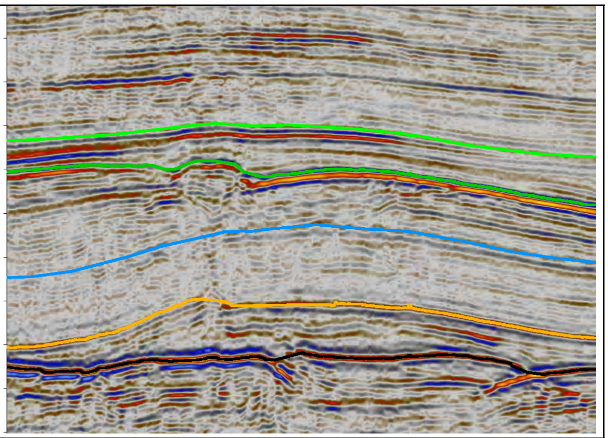
Structure

The G13 Southwest structure has not been drilled. The prospect is situated on top of a subtle salt pillow. The structure may be described as follows:

1) Lower Volpriehausen reservoir sealed by clays of the Volpriehausen claystone in a four way dip closure.



Top Volpriehausen Reservoir
Dotted yellow line indicates Triassic subcrop



E-W seismic cross-section, inline 2470
yellow = b. North Sea Group
light green = base Chalk
dark green = base Rijnland unconformity
blue = t. Volpriehausen reservoir
orange = t. Zechstein
black = b. Zechstein

Structure map of the G13 Southwest prospect

Contacts

G13 Southwest structure	Top structure (m TVD/MSL)	LCC (m TVD/MSL)
Lower Volpriehausen	3250	3372.5

Reservoir data

G13 Southwest reservoir	GRV (10^6 m³)	Gross (m)	N/G (%)	Av. Por. (%)	Sg (%)	Expansion factor
Lower Volpriehausen **	636	36	91	16	81	240

** Derived from maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Volumes

Reservoir	GIIP in 10^9 Nm^3			Reserves in 10^9 Nm^3			
	Low GIIP	Med GIIP	High GIIP	LSV	MSV	HSV	POS
Lower Volpriehausen	14.8	16.9	19.2	10.1	11.8	13.7	10

Hydrocarbon specifications

Reservoir	N2 %	CO2 %	GHV (MJ/m^3)
Lower Volpriehausen*	8	1	37.6

* Derived from gas quality maps based on data points from public dataset of surrounding wells (www.nlog.nl)

Risk evaluation

Risk	***G13 Southwest prospect reservoir***	***POS***
Reservoir Volpriehausen	Reservoir is expected to be good	80%
Seal Volpriehausen	Seal is expected to e efficient	80%
Structure Volpriehausen	Poor definition of the structure because of low density in 2D seismic coverage and limited quality of 2D seismic lines	30%
Charge Volpriehausen	High risk due to timing and migration path	50%
Total POS Volpriehausen		**10%**

Infrastructure

The closest platform, F15-A, lies at a distance of approximately 14 km.

Public References

RGD & NOGEPA 1993, Stratigraphic nomenclature of the Netherlands, Mededelingen Rijks Geologische Dienst, Nr. 50

For more information on exploration and production issues and data check the Dutch Oil and Gas Portal: *www.nlog.nl*