DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE **RAPPORT 2020/28**

Capture, Storage and Use of CO_2 (CCUS)

Reservoir data – Stenlille area (Part of Work package 6)

Lars Kristensen

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND UTILITIES

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Preface

Late 2019, GEUS was asked to lead research initiatives in 2020 related to technical barriers for Carbon Capture, Storage and Usage (CCUS) in Denmark and to contribute to establishment of a technical basis for opportunities for CCUS in Denmark. The task encompasses (1) the technical potential for the development of cost-effective CO_2 capture technologies, (2) the potentials for both temporary and permanent storage of CO_2 in the Danish subsurface, (3) mapping of transport options between point sources and usage locations or storage sites, and (4) the CO_2 usage potentials, including business case for converting CO_2 to synthetic fuel production (PtX). The overall aim of the research is to contribute to the establishment of a Danish CCUS research centre and the basis for 1-2 large-scale demonstration plants in Denmark.

The present report forms part of Work package 6 and focuses on evaluation of reservoir data and reservoir subdivision. A comprehensive dataset exists from the Stenlille area, and this dataset has been used to predict and extrapolate reservoir parameters to the Havnsø structure. The overall objective is to examine the possibilities of CO_2 storage in sandstone reservoirs like the Stenlille Gassum Formation. Hence, the existing log and core analysis data acquired in the Stenlille wells have been evaluated, addressing the clay content, porosity, and permeability.

Dansk sammendrag

GEUS har udført en petrofysisk evaluering af loggene fra Stenlille boringerne. Evalueringen er foretaget med henblik på at bestemme den bjergartsmæssige sammensætning af Gassum og Fjerritslev formationerne. Desuden har formålet været at vurdere ler-indholdet og porøsiteten i de sandstenslag, der udgør potentielle lagerzoner (reservoir-zoner). Herudover er variationer i permeabiliteten estimeret ud fra målinger på kernemateriale. Stenlille reservoiret anses for at være sammenligneligt med reservoiret i Havnsø strukturen, og Stenlille data kan derfor bruges som forlæg for vurderingen af reservoiregenskaberne ved Havnsø. Baseret på den nuværende geologiske viden forventes Gassum Formationen ved Havnsø i nogle intervaller at have lidt færre og tyndere sandstenslag, og desuden forventes det, at sandstenene har lidt lavere porøsiteter end ved Stenlille. Dermed forventes formationens Net-gross forhold også at være lidt lavere ved Havnsø. Net-gross forholdet angiver den forventede andel af sand med *gode reservoiregenskaber* set i forhold til den samlede tykkelse af formationen, se herunder:

	Formations-tykkelse (m)	Net/gross	Gennemsnits-porøsitet (%)
Stenlille, log tolkning	150	0,69	24
Havnsø, prognose	200	0,67	22

Til trods for de lidt lavere Net/gross- og porøsitetsværdier ved Havnsø er tallene positive med hensyn til Gassum Formationens egnethed som reservoir til at lagre CO_2. De prognosticerede reservoirparametre peger på, at sandstenlagene i Havnsø strukturen med stor sandsynlighed vil være egnede for CO_2 lagring. Det skal dog bemærkes, at usikkerheden på den forventede formationstykkelse ved Havnsø er relativ stor på grund af ringe kvalitet af de eksisterende seismiske data (cf. Gregersen et al., 2020). Denne usikkerhed vil kunne reduceres ved indsamling af nye seismiske data af høj kvalitet (3D data).

Summary

A petrophysical evaluation of the Stenlille wells is presented, based on log and core data – and it includes a lithological interpretation along with determination of reservoir parameters. It is assumed that the geological development of the Havnsø structure, including the depositional pattern of the Gassum Formation, share similarities with the development of the Stenlille structure and the Gassum Formation. Accordingly, the reservoir zonation of the Gassum Formation at Stenlille may to a large extend also apply to Havnsø and presumably, the Stenlille reservoir parameters can be credibly extrapolated to the Havnsø area. The seismic interpretation indicate that the Gassum Formation is found at similar depths at Stenlille and Havnsø, but the position in the sedimentary basin is somewhat different, as the Havnsø structure may be located in a more distal position in the basin compared to Stenlille. This difference means that the number of sandstone beds, their individual thicknesses as well as their porosities and permeabilities may be slightly lower at Havnsø in some intervals. With respect to generalized reservoir parameters for the Gassum Formation Zones, reference is made to **Table 3**. The data analysis points to the following overall reservoir parameters:

	Gross thickness (m)	Net/gross	Avg. Porosity (%)
Stenlille, log evaluation	150	0.69	24
Havnsø, prognosis	200	0.67	22

The Stenlille structure has proven suitable for gas storage, and the prognosed reservoir parameters for the Havnsø structure (as listed above) suggest that the Gassum Formation sandstone reservoir at Havnsø is suitable for CO_2 storage. However, the prognosed Gross thickness at Havnsø is associated with considerable uncertainty due to rather low quality of the existing seismic data (Gregersen et al., 2020). Acquisition of new 3D seismic data covering the Havnsø structure is required to reduce this uncertainty.

Introduction

The present study focuses on evaluation of reservoir data and reservoir subdivision. The objective is to examine the possibilities of CO_2 storage in sandstone reservoirs similar to the Stenlille Gassum Formation reservoir. A comprehensive dataset exists from the Stenlille area, and this dataset has been used to predict and extrapolate reservoir parameters to the Havnsø structure. Hence, the existing data acquired in the Gassum Formation in the Stenlille wells have been evaluated, addressing e.g. the porosity and clay content – and in addition, a permeability estimate is derived. The permeability is based on porosities interpreted from wireline log data combined with information from porosity-permeability relations. The permeability has not been logged in any Stenlille well, meaning that an artificial permeability log must be generated prior to addressing the reservoir properties. The interpretation of the clay content (shale volume) is based on the gamma ray log, and the porosity is calculated from the neutron-density logs combined with the shale volume estimate.

Database

The ‘Stenlille database’ consists of cuttings descriptions, cores, core analysis data, wireline logs along with well completions reports and information from well test reports.

The locations of the Stenlille wells are shown in **Figure 1** along with a top Gassum Formation depth structure map. The Stenlille structure, with a total of 20 wells, have 6 deviated wells out of the 19 reaching into the reservoir in the Gassum Formation. One well (Stenlille-3) has TD above the reservoir and is used for monitoring purposes in a sandstone layer in the overlying seal formation of the Fjerritslev Formation. The Stenlille-19 well has TD as deep as 2570 m and apart from the Fjerritslev and Gassum formations, this well also tests the underlying Bunter Sandstone Formation.

The Gassum Formation has been **logged** in most Stenlille wells, whereas the Fjerritslev Formation only has been logged in a limited number of wells.

The Gassum Formation is partly **cored** in the Stenlille-1, -2, -4, -5, -6, -10, -12, -13, -14, -15, -17 and -19 wells. The Stenlille-19 well penetrates the deep-lying Bunter Sandstone Formation as stated above, and parts of the Bunter Sandstone Formation are cored in this well.

Results

The locations of the Stenlille wells are shown in **Figure 1.** At Stenlille, the Gassum Formation forms a gas storage reservoir, and the Gassum Formations has been subdivided into 6 storage zones (**Figure 2**).

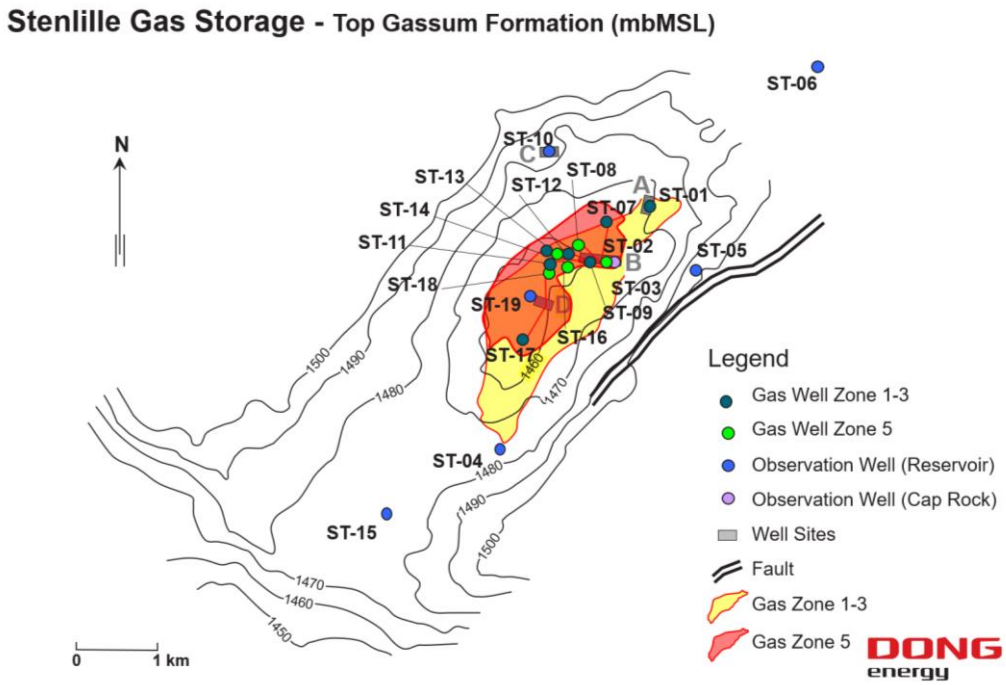

***Figure 1**: Stenlille Structure. Well locations and a simplified top Gassum Formation depth structure map (metres b. MSL). Figure provided by DONG Energy.*

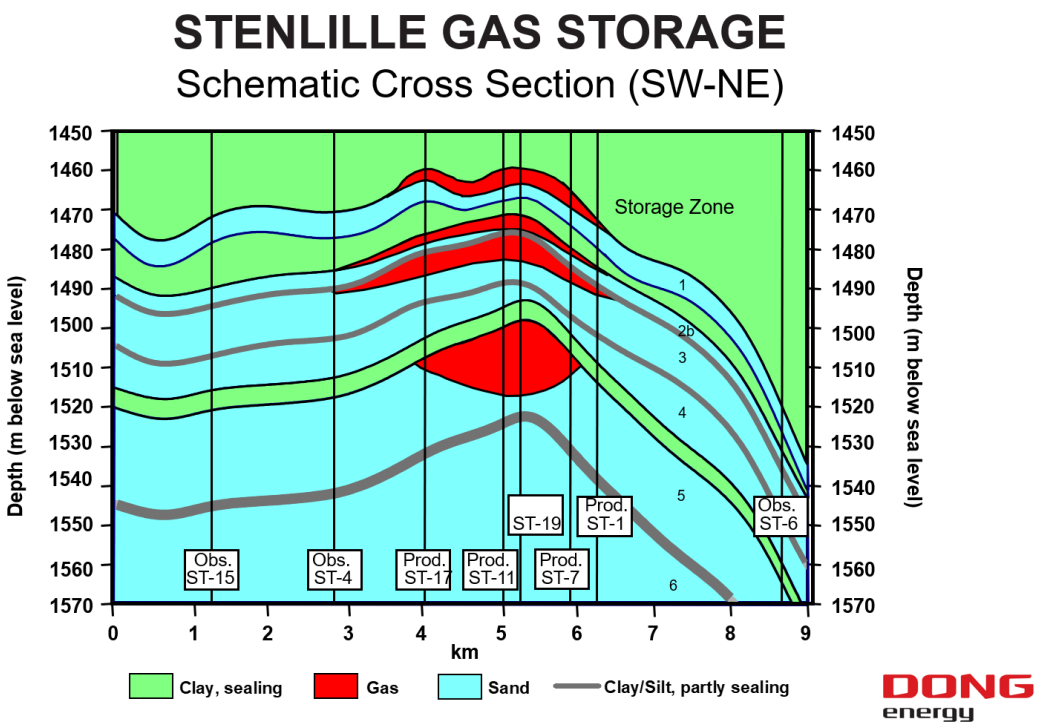

***Figure 2**: The gas storage facility at Stenlille. Gas is stored in selected zones within the Gassum Formation. The top of the Gassum Formation is found within the depth range 1450–1550 m b. MSL. The distribution of sandstone layers suitable for gas storage, and sealing clay beds, are shown. Figure provided by DONG Energy.*

Formation tops and reservoir subdivision

Apart from top and base Gassum Formation, the Stenlille wells also penetrate overlying lithostatigraphic picks. These well tops form the overall and general framework of the GEUS Stenlille model (**Table 1**). The following lithostatigraphic surfaces have been interpreted from wireline log data combined with seismic data, if relevant data material is available from the database:

- Top Chalk Group
- Base Chalk Group
- Top Fjerritslev Formation
- Top Karlebo Member (lowermost part of the Fjerritslev Formation)
- Top Gassum Formation
- Base Gassum Formation

DONG Energy suggests subdividing the reservoir section (Gassum Formation) into 6 major Storage Zones, some of them also including sub-zones of clayey non-reservoir intervals (cf. **Figure 2**). The DONG zonation is based primarily on differences in log motifs:

- Zone 1
- Zone 2; further subdivided into 2a and 2b.
- Zone 3
- Zone 4
- Zone 5; further subdivided into 5_clay, 5_sand.
- Zone 6; further subdivided into 6_clay, 6_sand and 6_base.

Each storage zone is assigned reservoir parameters, including net sand thicknesses along with zonal averages for porosity, shale volume, and permeability (**Table 2**). The porosity, shale volume and permeability values result from a petrophysical evaluation carried out by GEUS using primarily log and core data. Prior to calculating reservoir parameters, cut-offs were applied to disregard clayey parts. Thus, the calculated values presume minimum 15% porosity and maximum 30% shale.

Reservoir parameters

The shale volume and porosity are interpreted from wire-line log data, whereas the permeability is estimated from the log-derived porosity combined with core analysis data.

Porosity-permeability relationships

The core porosity and core permeability data provide reasonable porosity-permeability relations that can be used for estimating the permeability when the porosity is known. The porosity-permeability relations that has been established for the Gassum Formation in the Stenlille area is illustrated in **Figure 3**. The conventional core analysis data point to the presence of more relationships as the depositional environment varies throughout late Triassic–early Jurassic times, and hence the grain size and clay content of the Gassum Formation sandstones vary with depth. Accordingly, two distinct poro-perm models are suggested: one relation for the Upper sandstone layers (corresponding to Zones 1–5), and one relation for the Lower sandstone layers (i.e. Zone 6 incl. sub-zones).

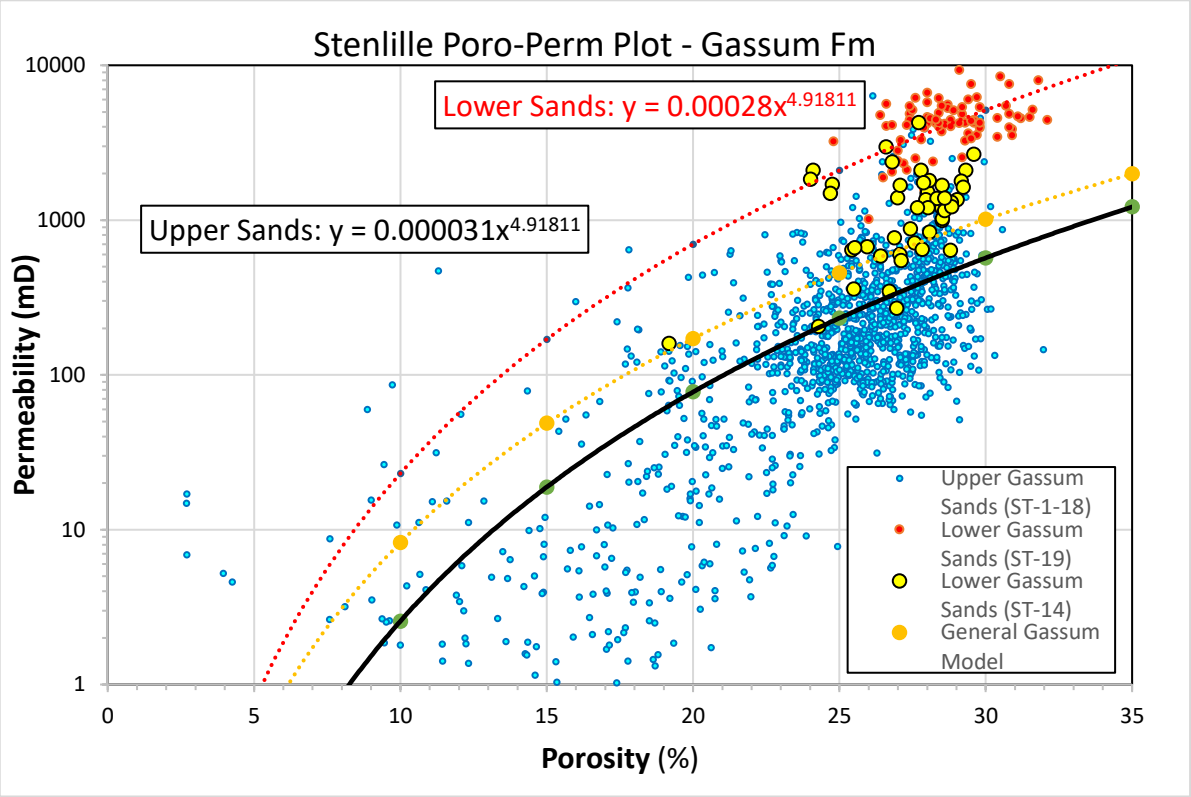

***Figure 3**: Porosity-permeability relationships for the Gassum Formation sandstones. Based on conventional core analysis data from cored Stenlille wells. The **black** line represents the upper part of the Gassum Formation, the **red** line represents the lower part of the Gassum Formation. Permeability values are gas permeabilities measured in a core laboratory (GEUS, COREX etc.). The data points in orange and the orange trend line refer to the General GEUS Poro-Perm Model representing the Gassum Formation **outside** the Stenlille area (included for comparison).*

The data in **Figure 3** are based on gas (air) permeabilities measured on plug samples in the laboratory. The liquid permeability has been determined on samples from more Stenlille wells, suggesting that the liquid permeability can be estimated from the gas permeability by multiplying by a factor between 0.2 and 0.6 (**Figure 4**). Based on information from this figure, it is suggested to apply an average factor of 0.5. The modelling of the fluid flow at reservoir conditions is to be based on liquid permeabilities.

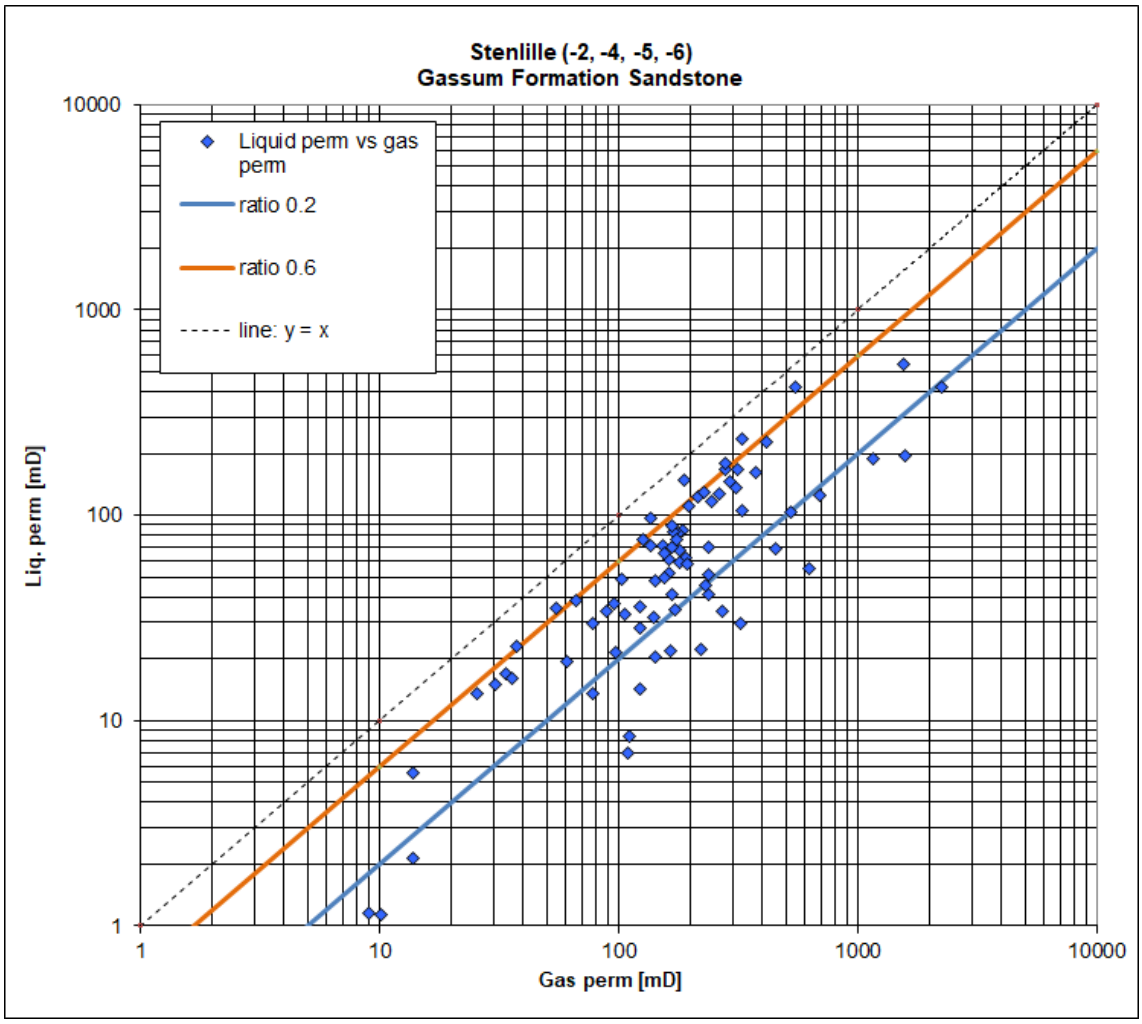

***Figure 4**: Relationship between gas permeability and liquid permeability. Based on core analysis data from the Stenlille-2, -4, -5 and 6 wells.*

Examples of petrophysical evaluation result displays (CPI plots) are presented in **Figure 5**. Each plot includes a lithological interpretation of the Gassum Formation along with interpreted porosities and permeabilities. Furthermore, the reservoir zonation and a number of raw logs (gamma-ray, sonic, neutron-density and caliper) are plotted as well.

The DONG Zonation and corresponding reservoir parameters

As described above, the reservoir parameters as interpreted from the wireline log data are listed in **Table 2**. In short, the storage zones of the Gassum Formation may be characterized by the following ***generalized*** reservoir parameters that give an indication of the average porosity, shale, and permeability distributions within the Gassum Formation at Stenlille (**Table 3**).

Table 3*: Generalized reservoir parameters for the Gassum Formation zones at Stenlille. Average porosity, shale, and permeability distributions. Based on well and core data. Zones may pinch out across the Stenlille structure and thus, the thickness of a particular zone varies in terms of well location. Similarly, the net sand thickness varies in terms of shale volume, porosity and well location.*

Zone (adapted from DONG)	**Net sand thickness** (m)	**Porosity** (%)	**Shale volume** (%)	**Permeability** (mD)
1	0 – 5	25	12	275
2a	0 – 4	20	14	100
2b	0 – 7	25	16	275
3	6 – 17	25	10	300
4	1 – 15	26	10	300
5_clay dominated	0 – 1	16	23	50
5_sand dominated	20 – 40	27	14	350
6_clay dominated	0 – 5	18	25	100
6_sand dominated	22 – 56	28	8	4000
6_sand/clay dominated basal unit	2 – 34	22	15	1000

A 2-layer model and corresponding reservoir parameters

The zones listed above are not fully imaged in the seismic data, and for modelling purposes it is suggested to use a simple 2-layer model that includes three well-defined seismic makers:

- Top Gassum Formation (Top Zone 1)
- Top near Zone 5 clay
- Base Gassum Formation (Base Zones)

Gassum	**Zones 1–4**
Formation	**Zones 5–6**

The net-to-gross ratio (N/G) for the two units were calculated for each well. '*Gross'* corresponds herein to **gross interval thickness,** whereas '*Net'* corresponds herein to **net sand thickness**. The net sand thickness is calculated on the basis of 30% Vshale cut-off and 15% porosity cut-off. The averaged net-to-gross ratios for the two units are estimated and listed below. The average N/G for the entire Gassum Formation is included for comparison.

Unit	Average N/G
Zones 1 – 4	0.46
Zones 5 – 6	0.76
Gassum Formation	0.69

Average porosities and permeabilities for the Zones are listed in Table 3. With respect to the 2-layer model, approximate average porosities and permeabilities for the two units are listed below. Parameters for the 2-layer model are - on a well-to-well basis - listed in **Table 4**.

Unit subdivision of the **2-layer** Stenlille model	Average Porosity (%) for net sand	Average gas Permeability (mD) for net sand
Zones 1 – 4	24	275
Zones 5 – 6	24	1200

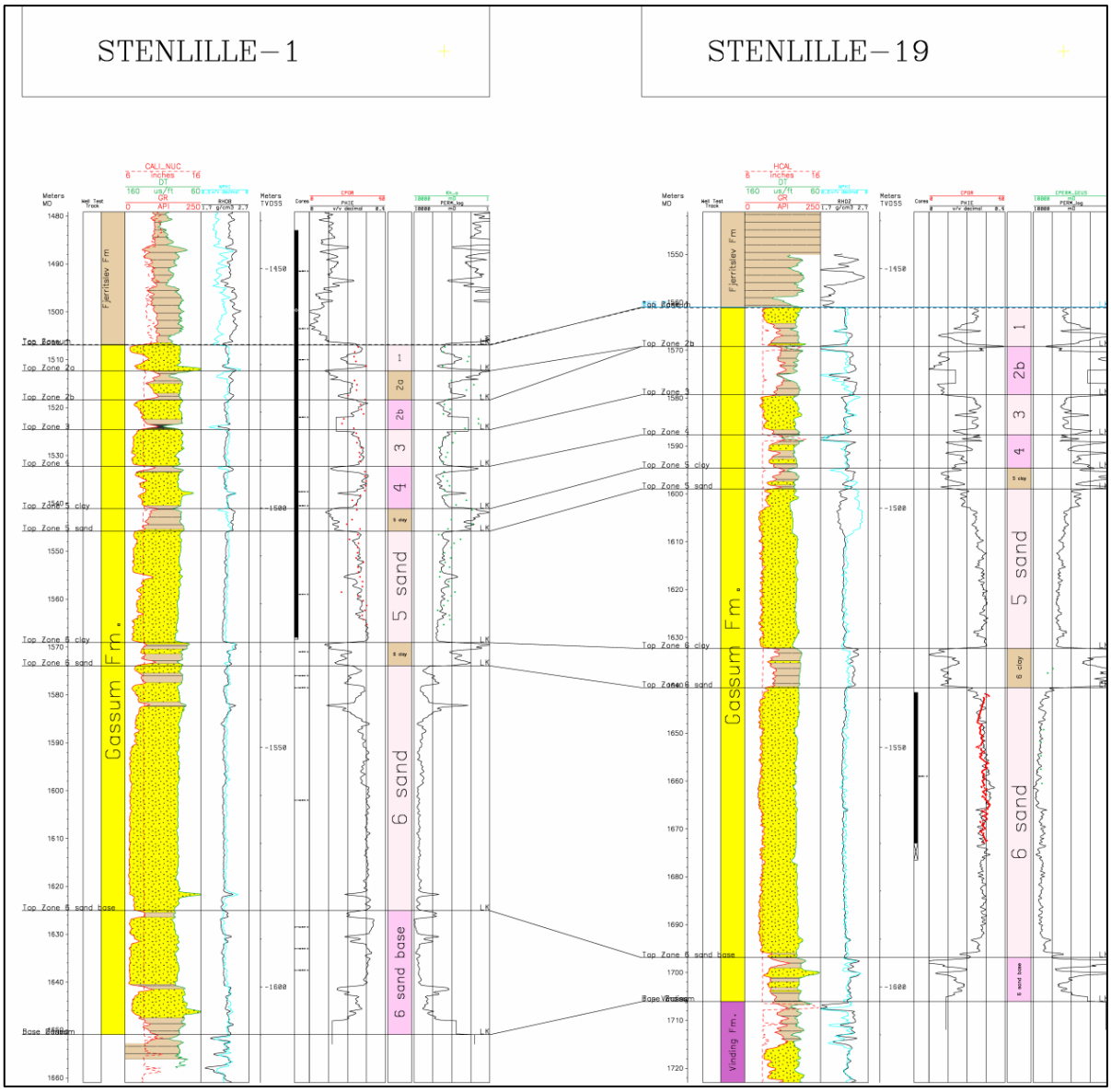

***Figure 5**. Log correlation and petrophysical evaluation of the Stenlille-1 and Stenlille-19 wells. The plot includes lithological interpretation, lithostratigraphy and subdivision into zones. Interpreted porosity (PHIE) and permeability (PERM_log) are illustrated by curves. Cored intervals indicated by black bars. Core porosity data (red dots, CPOR), and core permeability data (green dots, CPERM or gas permeability, right track) are also shown. Porosity scale: 0–40%, permeability scale: 10000–1 mD. The raw logs plotted are GR: Gamma-ray log, DT: Sonic log, CALI/HCAL: Caliper log, RHOB: Density log, NPHI: Neutron log.*

Future work

Throughout the Gassum and Fjerritslev formations, the current lithological interpretation presumes either a **sandstone** or a **clay** lithology. This interpretation is based on raw gamma-ray logs combined with neutron-density log responses, and the present evaluation meets the need for a standard petrophysical assessment of lithology and porosity. The current lithological interpretation is, however, very sensitive to the precision of the sand/shale baseline used for lithology determination. It is suggested, therefore, to carry out a more detailed Stenlille field study based on normalized gamma-ray logs to ensure that the variation in shale volume is consistently and accurately determined throughout the field/structure. The latter includes an adjustment of the sand/shale baseline. The distribution of sandstone and shale directly influences the variation in the net-to-gross ratio in the wells. Furthermore, the well data form the basis of determining a field scale net-to-gross ratio that may be used as a template for Havnsø structure evaluation.

A comprehensive core description study has been carried out as part of Workpage 6 in the CCUS project (Hovikoski & Pedersen 2020). The lithological interpretation of the Gassum and Fjerritslev formations presented herein may be improved by combining the core descriptions and the current (standard) petrophysical and lithological evaluation.

The present study – forming part of Workpage 6 in the CCUS project – focuses on evaluating Stenlille reservoir data. A more comprehensive integration with interpreted geological models and seismic data in the Stenlille–Havnsø area (Gregersen et al. 2020, Hovikoski & Pedersen 2020 and Vosgerau et al. 2020) may further improve the prognosticating of the sandstone-claystone distribution and reservoir properties of sandstones within the Gassum Formation in the Havnsø structure.

References

Gregersen, U., Vosgerau, H. Laghari, S., Bredesen, K., Rasmussen, R. & Mathiesen, A. 2020: Capture, Storage and Use of CO_2 (CCUS). Seismic interpretation of existing 2D and 3D seismic data around the Havnsø structure (Part of Work package 5 in the CCUS project). Danmark og Grønlands Geologiske Undersøgelse Rapport 2020/33, 60 pp.

Hovikoski, J. & Pedersen, G. 2020: Capture, Storage and Use of CO_2 (CCUS). Sedimentological description of cores from wells in the Stenlille area, with interpretations of depositional environments. (Part of Work package 6 in the CCUS project). Danmark og Grønlands Geologiske Undersøgelse Rapport 2020/42, 26pp.

Vosgerau, H., Gregersen, U. & Laghari, S., 2020: Capture, Storage and Use of CO_2 (CCUS). Seismic interpretation of existing 3D seismic data around the Stenlille structure within the framework of sequence stratigraphy and with focus on the Gassum Formation. (Part of Work package 6 in the CCUS project). Danmark og Grønlands Geologiske Undersøgelse Rapport 2020/34, 54pp.

Tables for documentation

Table 1: List of well tops (picks) in the Stenlille wells

Note that some wells are deviated. Position of surfaces and depths are interpreted by GEUS. MD: Measured depth. TVDKB: True vertical depth below Kelly Bushing (KB). TVDSS: true vertical depth below subsea.

WELL PICKS	Inter-preter	**MD (m)**	**TVDKB (m)**	**TVDSS (m)**	vertical/ deviated	**KB (m)**
STENLILLE-1						
PICK: Top Fjerritslev	LK	1247.5	1247.5	-1206.5	vertical	41
STENLILLE-1					vertical	
PICK: Top Gassum	LK	1506.8	1506.8	-1465.8	vertical	41
STENLILLE-1					vertical	
PICK: Top Chalk	LK	191.7	191.7	-150.7	vertical	41
STENLILLE-1					vertical	
PICK: Base Chalk	LK	1200.1	1200.1	-1159.1	vertical	41
STENLILLE-1					vertical	
PICK: Base Gassum	LK	1651.0	1651.0	-1610.0	vertical	41
STENLILLE-1					vertical	
PICK: Top Karlebo Mb.	LK	1369.3	1369.3	-1328.3	vertical	41
STENLILLE-10					vertical	
PICK: Top Fjerritslev	LK	1292.3	1292.3	-1250.8	vertical	41.5
STENLILLE-10					vertical	
PICK: Top Gassum	LK	1524.0	1524.0	-1482.5	vertical	41.5
STENLILLE-10					vertical	
PICK: Base Chalk	LK	1206.0	1206.0	-1164.5	vertical	41.5
STENLILLE-10					vertical	
PICK: Base Gassum	LK	1672.6	1672.6	-1631.1	vertical	41.5
STENLILLE-10					vertical	
PICK: Top Karlebo Mb.	LK	1403.9	1403.9	-1362.4	vertical	41.5
STENLILLE-11					vertical	
PICK: Top Fjerritslev	LK	1343.5	1343.5	-1303.5	vertical	40
STENLILLE-11					vertical	
PICK: Top Gassum	LK	1685.8	1685.8	-1645.8	vertical	40
STENLILLE-11					vertical	
PICK: Base Chalk	LK	1290.6	1290.6	-1250.6	vertical	40
STENLILLE-11					vertical	
PICK: Base Gassum	LK	1863.4	1863.4	-1823.4	vertical	40
STENLILLE-11					vertical	
PICK: Top Karlebo Mb.	LK	1540.2	1540.2	-1500.2	vertical	40

STENLILLE-12						
PICK: Top Gassum	LK	1576.4	1503.3	-1457.6	deviated	45.72
STENLILLE-12					deviated	
PICK: Base Chalk	LK	1259.8	1224.1	-1178.3	deviated	45.72
STENLILLE-12					deviated	
PICK: Base Gassum	LK	1753.1	1650.3	-1604.6	deviated	45.72
STENLILLE-13					deviated	
PICK: Top Gassum	LK	1642.8	1503.0	-1457.3	deviated	45.7
STENLILLE-13					deviated	
PICK: Base Chalk	LK	1308.0	1229.1	-1183.4	deviated	45.7
STENLILLE-13					deviated	
PICK: Base Gassum	LK	1824.8	1651.3	-1605.6	deviated	45.7
STENLILLE-14					deviated	
PICK: Top Gassum	LK	1614.6	1501.5	-1455.7	deviated	45.72
STENLILLE-14					deviated	
PICK: Base Chalk	LK	1288.4	1227.1	-1181.4	deviated	45.72
STENLILLE-14					deviated	
PICK: Base Gassum	LK	1785.8	1649.4	-1603.7	deviated	45.72
STENLILLE-15					vertical	
PICK: Top Fjerritslev	LK	1350.9	1350.8	-1298.0	vertical	52.8
STENLILLE-15					vertical	
PICK: Top Gassum	LK	1523.5	1523.4	-1470.6	vertical	52.8
STENLILLE-15					vertical	
PICK: Base Chalk	LK	1247.4	1247.3	-1194.5	vertical	52.8
STENLILLE-15					vertical	
PICK: Base Gassum	LK	1677.0	1676.8	-1624.0	vertical	52.8
STENLILLE-16					vertical	
PICK: Top Fjerritslev	LK	1270.2	1270.2	-1230.2	vertical	40
STENLILLE-16					vertical	
PICK: Top Gassum	LK	1508.7	1508.7	-1468.7	vertical	40
STENLILLE-16					vertical	
PICK: Base Chalk	LK	1218.8	1218.8	-1178.8	vertical	40
STENLILLE-16					vertical	
PICK: Base Gassum	LK	1679.1	1679.1	-1639.1	vertical	40
STENLILLE-16					vertical	
PICK: Top Karlebo Mb.	LK	1400.4	1400.4	-1360.4	vertical	40

STENLILLE-17						
PICK: Top Gassum	LK	1605.9	1502.9	-1455.3	deviated	47.55
STENLILLE-17					deviated	
PICK: Base Chalk	LK	1290.6	1195.8	-1148.2	deviated	47.55
STENLILLE-17					deviated	
PICK: Base Gassum	LK	1755.9	1649.7	-1602.1	deviated	47.55
STENLILLE-18						
PICK: Top Fjerritslev	LK	1288.0	1233.2	-1185.6	deviated	47.6
STENLILLE-18					deviated	
PICK: Top Gassum	LK	1564.1	1502.4	-1454.8	deviated	47.6
STENLILLE-18					deviated	
PICK: Base Chalk	LK	1247.5	1194.4	-1146.8	deviated	47.6
STENLILLE-18					deviated	
PICK: Base Gassum	LK	1713.8	1650.1	-1602.5	deviated	47.6
STENLILLE-18					deviated	
PICK: Top Karlebo Mb.	LK	1437.9	1378.5	-1330.9	deviated	47.6
STENLILLE-19					deviated	
PICK: Top Fjerritslev	LK	1275.6	1227.3	-1178.0	deviated	49.3
STENLILLE-19					deviated	
PICK: Top Gassum	LK	1561.1	1507.4	-1458.1	deviated	49.3
STENLILLE-19					deviated	
PICK: Top Chalk	LK	200.7	200.7	-151.4	deviated	49.3
STENLILLE-19					deviated	
PICK: Base Chalk	LK	1234.0	1188.4	-1139.1	deviated	49.3
STENLILLE-19					deviated	
PICK: Base Gassum	LK	1706.1	1652.3	-1603.0	deviated	49.3
STENLILLE-19					deviated	
PICK: Top Karlebo Mb.	LK	1471.9	1418.3	-1369.0	deviated	49.3
STENLILLE-2					vertical	
PICK: Top Fjerritslev	LK	1239.0	1239.0	-1191.3	vertical	47.7
STENLILLE-2					vertical	
PICK: Top Gassum	LK	1511.7	1511.7	-1464.0	vertical	47.7
STENLILLE-2					vertical	
PICK: Top Chalk	LK	204.3	204.3	-156.6	vertical	47.7
STENLILLE-2					vertical	
PICK: Base Chalk	LK	1197.8	1197.8	-1150.1	vertical	47.7
STENLILLE-2					vertical	
PICK: Base Gassum	LK	1652.8	1652.8	-1605.1	vertical	47.7
STENLILLE-2					vertical	
PICK: Top Karlebo Mb.	LK	1379.9	1379.9	-1332.2	vertical	47.7

STENLILLE-20						
PICK: Top Fjerritslev	LK	1349.4	1349.4	-1309.4	vertical	40
STENLILLE-20					vertical	
PICK: Top Gassum	LK	1626.1	1626.1	-1586.1	vertical	40
STENLILLE-20					vertical	
PICK: Base Chalk	LK	1306.8	1306.8	-1266.8	vertical	40
STENLILLE-20					vertical	
PICK: Base Gassum	LK	1785.4	1785.4	-1745.4	vertical	40
STENLILLE-20					vertical	
PICK: Top Karlebo Mb.	LK	1503.9	1503.9	-1463.9	vertical	40
STENLILLE-3					vertical	
PICK: Top Fjerritslev	LK	1234.1	1234.1	-1194.1	vertical	40
STENLILLE-3					vertical	
PICK: Top Gassum	LK	1488.4	1488.4	-1448.4	vertical	40
STENLILLE-3					vertical	
PICK: Base Chalk	LK	1194.7	1194.7	-1154.7	vertical	40
STENLILLE-3					vertical	
PICK: Base Gassum	LK	1657.1	1657.1	-1617.1	vertical	40
STENLILLE-3					vertical	
PICK: Top Karlebo Mb.	LK	1357.1	1357.1	-1317.1	vertical	40
STENLILLE-4					vertical	
PICK: Top Fjerritslev	LK	1224.7	1224.7	-1186.3	vertical	38.45
STENLILLE-4					vertical	
PICK: Top Gassum	LK	1514.2	1514.2	-1475.8	vertical	38.45
STENLILLE-4					vertical	
PICK: Base Chalk	LK	1166.7	1166.7	-1128.3	vertical	38.45
STENLILLE-4					vertical	
PICK: Base Gassum	LK	1655.5	1655.5	-1617.1	vertical	38.45
STENLILLE-4					vertical	
PICK: Top Karlebo Mb.	LK	1372.2	1372.2	-1333.7	vertical	38.45
STENLILLE-5					vertical	
PICK: Top Fjerritslev	LK	1285.1	1285.1	-1229.2	vertical	55.9
STENLILLE-5					vertical	
PICK: Top Gassum	LK	1550.6	1550.6	-1494.7	vertical	55.9
STENLILLE-5					vertical	
PICK: Base Chalk	LK	1210.6	1210.6	-1154.7	vertical	55.9
STENLILLE-5					vertical	
PICK: Base Gassum	LK	1694.8	1694.8	-1638.9	vertical	55.9
STENLILLE-5					vertical	

PICK: Top Karlebo Mb.	LK	1403.1	1403.1	-1347.2	vertical	55.9
STENLILLE-6						
PICK: Top Fjerritslev	LK	1293.1	1293.1	-1260.6	vertical	32.45
STENLILLE-6					vertical	
PICK: Top Gassum	LK	1563.7	1563.7	-1531.3	vertical	32.45
STENLILLE-6					vertical	
PICK: Top Chalk	LK	174.7	174.7	-142.2	vertical	32.45
STENLILLE-6					vertical	
PICK: Base Chalk	LK	1236.8	1236.8	-1204.4	vertical	32.449
STENLILLE-6					vertical	
PICK: Base Gassum	LK	1705.8	1705.8	-1673.4	vertical	32.45
STENLILLE-6					vertical	
PICK: Top Karlebo Mb.	LK	1420.5	1420.5	-1388.1	vertical	32.449
STENLILLE-7					vertical	
PICK: Top Gassum	LK	1645.7	1645.7	-1605.7	vertical	40
STENLILLE-7					vertical	
PICK: Base Gassum	LK	1798.8	1798.8	-1758.8	vertical	40
STENLILLE-8					vertical	
PICK: Top Gassum	LK	1562.7	1562.7	-1522.7	vertical	40
STENLILLE-8					vertical	
PICK: Base Gassum	LK	1735.5	1735.5	-1695.5	vertical	40
STENLILLE-9					vertical	
PICK: Top Fjerritslev	LK	1237.5	1237.5	-1197.5	vertical	40
STENLILLE-9					vertical	
PICK: Top Gassum	LK	1510.5	1510.5	-1470.5	vertical	40
STENLILLE-9					vertical	
PICK: Base Chalk	LK	1199.2	1199.2	-1159.2	vertical	40
STENLILLE-9					vertical	
PICK: Base Gassum	LK	1653.3	1653.3	-1613.3	vertical	40
STENLILLE-9					vertical	
PICK: Top Karlebo Mb.	LK	1372.6	1372.6	-1332.6	vertical	40

Table 2: Reservoir parameters for the Gassum Formation using the DONG zonation

The DONG zonation corresponds to Zones 1– 6. Depths based on information provided by DONG. Depths (top and base) are listed as true vertical depth subsea to account for the deviation the wells. Apart from interval thickness, net sand thickness (NET RES ROCK, m), avg. porosity (PHI, fraction), shale volume (VSH, fraction) and permeability (PERM_log, mD) are interpreted by GEUS. Cut-offs: The calculated values presume minimum 15% porosity and maximum 30% shale volume. AVG: Average.

STENLILLE-1

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log (mD)	NET RES ROCK (meters)	AVG PHI (fraction)	AVG VSH (fraction)	AVG PERM_log (mD)
1	-1465.929	-1471.289	5.360	0.000	------	------	------	----------	3.583	0.2499	0.1269	273.1395
2a	-1471.289	-1477.404	6.115	0.000	------	------	------	----------	4.234	0.2026	0.1235	91.2089
2b	-1477.404	-1483.602	6.198	0.000	------	------	------	----------	3.539	0.2546	0.1644	276.7711
3	-1483.602	-1491.224	7.622	0.000	------	------	------	----------	7.163	0.2634	0.1025	313.1658
4	-1491.224	-1500.103	8.879	0.000	------	------	------	----------	7.620	0.2593	0.0941	319.7062
5 clay	-1500.103	-1504.793	4.690	0.000	------	------	------	----------	0.381	0.1624	0.2288	21.1983
5 sand	-1504.793	-1528.079	23.286	0.000	------	------	------	----------	21.609	0.2686	0.1445	353.5746
6 clay	-1528.079	-1532.904	4.826	0.000	------	------	------	----------	1.930	0.1956	0.2567	74.7839
6 sand	-1532.904	-1584.044	51.139	0.000	------	------	------	----------	49.768	0.2844	0.0765	4333.9092
6 sand base	-1584.044	-1609.949	25.905	0.000	------	------	------	----------	20.952	0.2783	0.0773	4296.0420

STENLILLE-10

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1482.324	-1489.056	6.732	0.000	------	------	------	----------	1.981	0.2101	0.2560	103.5041
2a <1>	-1489.056	-1493.825	4.769	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1493.825	-1498.734	4.909	0.000	------	------	------	----------	1.375	0.1826	0.2582	50.7920
3 <1>	-1498.734	-1511.497	12.763	0.000	------	------	------	----------	12.646	0.2211	0.1234	132.4823
4 <1>	-1511.497	-1518.510	7.013	0.000	------	------	------	----------	2.896	0.2114	0.2206	112.1943
5 clay <1>	-1518.510	-1527.206	8.696	0.000	------	------	------	----------	1.195	0.1651	0.2210	28.2093
5 sand <1>	-1527.206	-1562.387	35.182	0.000	------	------	------	----------	34.924	0.2402	0.0888	199.7960
6 clay <1>	-1562.387	-1564.574	2.187	0.000	------	------	------	----------	0.007	0.1555	0.2575	-------
6 sand <1>	-1564.574	-1615.218	50.644	0.000	------	------	------	----------	50.339	0.2500	0.1005	2264.4409
6 sand base <1>	-1615.218	-1631.127	15.909	0.000	------	------	------	----------	8.176	0.2180	0.1606	1179.2166

STENLILLE-11

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1646.537	-1655.213	8.675	0.000	------	------	------	----------	3.045	0.2296	0.2181	161.1303
2a <1>	-1655.213	-1663.277	8.064	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1663.277	-1668.531	5.254	0.000	------	------	------	----------	1.728	0.2056	0.2608	103.5764
3 <1>	-1668.531	-1685.760	17.228	0.000	------	------	------	----------	16.713	0.2708	0.1136	434.2404
4 <1>	-1685.760	-1694.191	8.431	0.000	------	------	------	----------	1.676	0.2040	0.2739	92.7626
5 clay <1>	-1694.191	-1699.986	5.795	0.000	------	------	------	----------	0.762	0.1765	0.2229	43.8747
5 sand <1>	-1699.986	-1744.532	44.546	0.000	------	------	------	----------	44.501	0.2701	0.0900	372.5108
6 clay <1>	-1744.532	-1756.018	11.486	0.000	------	------	------	----------	3.353	0.2233	0.2024	144.8973
6 sand <1>	-1756.018	-1801.472	45.454	0.000	------	------	------	----------	44.806	0.2772	0.0652	3723.0769
6 sand base <1>	-1801.472	-1847.488	46.016	0.000	------	------	------	----------	22.098	0.2523	0.1017	2500.8411

STENLILLE-12

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1457.616	-1464.090	6.474	0.000	------	------	------	----------	0.582	0.2304	0.2744	165.4452
2a <1>	-1464.090	-1469.552	5.461	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1469.552	-1474.247	4.695	0.000	------	------	------	----------	0.638	0.2626	0.2910	349.6142
3 <1>	-1474.247	-1485.968	11.721	0.000	------	------	------	----------	9.946	0.2558	0.1200	278.3558
4 <1>	-1485.968	-1493.394	7.426	0.000	------	------	------	----------	1.658	0.2344	0.2838	169.4470
5 clay <1>	-1493.394	-1497.589	4.196	0.000	------	------	------	----------	0.000	------	------	-------
5 sand <1>	-1497.589	-1532.254	34.665	0.000	------	------	------	----------	34.483	0.2672	0.0944	356.6529
6 clay <1>	-1532.254	-1540.967	8.713	0.000	------	------	------	----------	0.710	0.2048	0.2369	80.5535
6 sand <1>	-1540.967	-1597.552	56.585	0.000	------	------	------	----------	56.315	0.2682	0.0767	3173.8057
6 sand base <1>	-1597.552	-1604.609	7.057	0.000	------	------	------	----------	3.888	0.2299	0.1375	1569.6311

STENLILLE-13

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1457.501	-1465.035	7.534	0.000	------	------	------	----------	1.371	0.2605	0.2438	346.6715
2a <1>	-1465.035	-1469.730	4.695	0.000	------	------	------	----------	0.000	------	------	--
2b <1>	-1469.730	-1474.644	4.913	0.000	------	------	------	----------	0.437	0.2362	0.2663	200.7445
3 <1>	-1474.644	-1487.407	12.763	0.000	------	------	------	----------	11.146	0.2602	0.1429	319.7736
4 <1>	-1487.407	-1494.490	7.083	0.000	------	------	------	----------	0.622	0.2209	0.2595	126.7630
5 clay <1>	-1494.490	-1498.848	4.359	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1498.848	-1534.373	35.525	0.000	------	------	------	----------	34.526	0.2534	0.1411	267.0372
6 clay <1>	-1534.373	-1543.309	8.936	0.000	------	------	------	----------	1.302	0.2254	0.2372	139.8216
6 sand <1>	-1543.309	-1578.606	35.297	0.000	------	------	------	----------	31.504	0.2676	0.0958	3173.4907
6 sand base <1>	-1578.606	-1605.557	26.951	0.000	------	------	------	----------	17.176	0.2721	0.1384	3745.1252

STENLILLE-14

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1455.717	-1463.132	7.416	0.000	------	------	------	----------	3.420	0.2384	0.2143	205.4295
2a <1>	-1463.132	-1468.032	4.900	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1468.032	-1473.727	5.694	0.000	------	------	------	----------	3.140	0.2214	0.2119	190.2681
3 <1>	-1473.727	-1485.380	11.653	0.000	------	------	------	----------	10.803	0.2606	0.0548	306.1109
4 <1>	-1485.380	-1492.531	7.151	0.000	------	------	------	----------	3.946	0.2142	0.2049	125.3320
5 clay <1>	-1492.531	-1497.298	4.767	0.000	------	------	------	----------	0.800	0.1775	0.2238	44.7349
5 sand <1>	-1497.298	-1532.523	35.225	0.000	------	------	------	----------	35.224	0.2621	0.0261	315.2384
6 clay <1>	-1532.523	-1541.263	8.740	0.000	------	------	------	----------	1.637	0.1886	0.2178	59.8811
6 sand <1>	-1541.263	-1577.406	36.142	0.000	------	------	------	----------	36.143	0.2631	0.0090	2810.7393
6 sand base <1>	-1577.406	-1603.807	26.401	0.000	------	------	------	----------	22.420	0.2586	0.0445	2797.1807

STENLILLE-15

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1470.585	-1480.272	9.687	0.000	------	------	------	----------	5.332	0.2401	0.2003	206.2912
2a <1>	-1480.272	-1485.412	5.140	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1485.412	-1493.311	7.899	0.000	------	------	------	----------	6.773	0.2016	0.2232	85.4644
3 <1>	-1493.311	-1506.017	12.706	0.000	------	------	------	----------	12.577	0.2576	0.1054	278.6544
4 <1>	-1506.017	-1515.263	9.246	0.000	------	------	------	----------	4.419	0.2257	0.1370	152.3747
5 clay <1>	-1515.263	-1520.376	5.113	0.000	------	------	------	----------	0.000	------	------	-------
5 sand <1>	-1520.376	-1547.605	27.229	0.000	------	------	------	----------	27.090	0.2564	0.0441	270.8439

6 clay <1>
Unit or interval does not exist for this well.

6 sand <1>
Unit or interval does not exist for this well.

6 sand base <1>
Unit or interval does not exist for this well.

STENLILLE-16

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1491.600	-1498.233	6.632	0.000	------	------	------	----------	0.000	------	------	--------
2a <1>	-1498.233	-1503.640	5.407	0.000	------	------	------	----------	0.000	------	------	--------
2b <1>	-1503.640	-1509.447	5.807	0.000	------	------	------	----------	0.072	0.3500	0.2557	--------
3 <1>	-1509.447	-1519.859	10.412	0.000	------	------	------	----------	8.919	0.2810	0.1577	624.6320
4 <1>	-1519.859	-1527.669	7.810	0.000	------	------	------	----------	0.000	------	------	--------
5 clay <1>	-1527.669	-1532.074	4.405	0.000	------	------	------	----------	0.000	------	------	--------
5 sand <1>	-1532.074	-1570.921	38.847	0.000	------	------	------	----------	35.182	0.2679	0.1452	371.7115
6 clay <1>	-1570.921	-1576.632	5.711	0.000	------	------	------	----------	0.023	0.1941	0.2662	--------
6 sand <1>	-1576.632	-1609.968	33.336	0.000	------	------	------	----------	31.851	0.2688	0.1100	3193.3066
6 sand base <1>	-1609.968	-1639.103	29.135	0.000	------	------	------	----------	9.449	0.2539	0.1338	2640.3027

STENLILLE-17

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1455.594	-1462.604	7.010	0.000	------	------	------	----------	1.193	0.2894	0.2012	543.4812
2a <1>	-1462.604	-1467.769	5.165	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1467.769	-1473.058	5.288	0.000	------	------	------	----------	1.926	0.2469	0.2488	249.0207
3 <1>	-1473.058	-1485.233	12.176	0.000	------	------	------	----------	9.407	0.2234	0.1624	140.9132
4 <1>	-1485.233	-1492.489	7.256	0.000	------	------	------	----------	0.000	------	------	-------
5 clay <1>	-1492.489	-1496.671	4.182	0.000	------	------	------	----------	0.000	------	------	-------
5 sand <1>	-1496.671	-1530.001	33.330	0.000	------	------	------	----------	31.432	0.2284	0.1359	158.0699
6 clay <1>	-1530.001	-1538.243	8.241	0.000	------	------	------	----------	0.182	0.1844	0.2364	37.1233
6 sand <1>	-1538.243	-1591.872	53.629	0.000	------	------	------	----------	47.372	0.2517	0.1114	2369.9651
6 sand base <1>	-1591.872	-1604.145	12.273	0.000	------	------	------	----------	1.396	0.2089	0.1430	1128.2106

STENLILLE-18

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1455.554	-1462.876	7.322	0.000	------	------	------	----------	2.521	0.2736	0.1934	416.9430
2a <1>	-1462.876	-1467.702	4.826	0.000	------	------	------	----------	0.000	------	------	--
2b <1>	-1467.702	-1473.695	5.992	0.000	------	------	------	----------	3.767	0.2441	0.2043	249.5906
3 <1>	-1473.695	-1484.879	11.184	0.000	------	------	------	----------	11.122	0.3025	0.0876	714.0610
4 <1>	-1484.879	-1492.057	7.178	0.000	------	------	------	----------	3.160	0.2143	0.2254	117.8460
5 clay <1>	-1492.057	-1496.731	4.674	0.000	------	------	------	----------	0.626	0.1803	0.2260	47.2362
5 sand <1>	-1496.731	-1531.285	34.554	0.000	------	------	------	----------	34.555	0.2506	0.0943	244.5047
6 clay <1>	-1531.285	-1539.632	8.347	0.000	------	------	------	----------	1.423	0.1724	0.2736	38.1653
6 sand <1>	-1539.632	-1591.751	52.118	0.000	------	------	------	----------	49.861	0.2641	0.0586	2907.3235
6 sand base <1>	-1591.751	-1602.475	10.724	0.000	------	------	------	----------	3.384	0.2041	0.1724	926.5645

STENLILLE-19

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1458.211	-1466.218	8.007	0.000	------	------	------	----------	3.123	0.2453	0.1858	215.7554
2a <1>	-1466.218	-1466.218	0.000	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1466.218	-1476.319	10.101	0.000	------	------	------	----------	0.000	------	------	-------
3 <1>	-1476.319	-1484.670	8.351	0.000	------	------	------	----------	6.551	0.2390	0.1613	201.5501
4 <1>	-1484.670	-1491.589	6.919	0.000	------	------	------	----------	0.000	------	------	-------
5 clay <1>	-1491.589	-1495.963	4.375	0.000	------	------	------	----------	0.305	0.1687	0.2755	34.0916
5 sand <1>	-1495.963	-1529.287	33.324	0.000	------	------	------	----------	31.995	0.2656	0.1114	351.8206
6 clay <1>	-1529.287	-1537.479	8.192	0.000	------	------	------	----------	0.271	0.1795	0.2740	24.1455
6 sand <1>	-1537.479	-1593.869	56.389	0.000	------	------	------	----------	55.340	0.2838	0.0861	4124.2378
6 sand base <1>	-1593.869	-1603.046	9.177	0.000	------	------	------	----------	0.305	0.1826	0.2845	450.1058

STENLILLE-2

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1463.506	-1469.691	6.185	0.000	------	------	------	----------	5.406	0.2363	0.1907	197.2560
2a <1>	-1469.691	-1475.336	5.644	0.000	------	------	------	----------	1.844	0.1897	0.2438	64.4414
2b <1>	-1475.336	-1481.908	6.572	0.000	------	------	------	----------	5.873	0.2469	0.1614	226.6356
3 <1>	-1481.908	-1488.557	6.650	0.000	------	------	------	----------	6.650	0.2694	0.0665	391.8328
4 <1>	-1488.557	-1497.217	8.660	0.000	------	------	------	----------	7.660	0.2429	0.1543	226.6738
5 clay <1>	-1497.217	-1501.624	4.407	0.000	------	------	------	----------	1.032	0.1637	0.2528	26.7006
5 sand <1>	-1501.624	-1522.500	20.876	0.000	------	------	------	----------	20.876	0.2638	0.0829	327.5770
6 clay <1>	-1522.500	-1530.310	7.809	0.000	------	------	------	----------	4.035	0.1974	0.1719	87.1445
6 sand <1>	-1530.310	-1573.531	43.222	0.000	------	------	------	----------	43.121	0.2646	0.0554	3120.9434
6 sand base <1>	-1573.531	-1605.077	31.546	0.000	------	------	------	----------	30.421	0.2404	0.1097	2183.4392

```
  Porosity  : PHIE -> PHIE:PETROWORKS:rC:NONE:v10
  Water Sat : SW -> SW:PETROWORKS:rC:NONE:v2
  Shale Vol : Vshale -> Vshale:PETROWORKS:rC:NONE:v8
  Optional  : PERM_log -> PERM_log:PETROWORKS:rC:NONE:v5
```

STENLILLE-20

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1585.874	-1592.710	6.837	0.000	------	------	------	----------	2.286	0.2840	0.2100	647.8419
2a <1>	-1592.710	-1600.319	7.609	0.000	------	------	------	----------	0.000	------	------	--------
2b <1>	-1600.319	-1601.643	1.323	0.000	------	------	------	----------	0.305	0.2176	0.2573	120.4648
3 <1>	-1601.643	-1615.647	14.005	0.000	------	------	------	----------	13.919	0.2686	0.1236	467.5144
4 <1>	-1615.647	-1622.043	6.396	0.000	------	------	------	----------	0.102	0.1952	0.2627	--------
5 clay <1>	-1622.043	-1626.123	4.080	0.000	------	------	------	----------	0.152	0.2524	0.2742	243.9965
5 sand <1>	-1626.123	-1663.947	37.824	0.000	------	------	------	----------	36.424	0.2828	0.1002	493.8963
6 clay <1>	-1663.947	-1669.461	5.514	0.000	------	------	------	----------	0.457	0.1623	0.2848	28.3149
6 sand <1>	-1669.461	-1724.195	54.734	0.000	------	------	------	----------	53.124	0.2666	0.0941	3026.4221
6 sand base <1>	-1724.195	-1745.169	20.974	0.000	------	------	------	----------	5.093	0.2216	0.0883	1343.5068

STENLILLE-3

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log

No Zones defined

STENLILLE-4

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1476.133	-1482.661	6.527	0.000	------	------	------	----------	1.829	0.2433	0.2449	208.8256
2a <1>	-1482.661	-1488.022	5.362	0.000	------	------	------	----------	0.000	------	------	--
2b <1>	-1488.022	-1493.229	5.207	0.000	------	------	------	----------	3.048	0.2200	0.1895	135.6613
3 <1>	-1493.229	-1505.973	12.744	0.000	------	------	------	----------	12.574	0.2529	0.1256	261.3950
4 <1>	-1505.973	-1513.044	7.071	0.000	------	------	------	----------	2.666	0.2292	0.2583	159.8594
5 clay <1>	-1513.044	-1518.872	5.828	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1518.872	-1545.604	26.731	0.000	------	------	------	----------	24.621	0.2719	0.0809	367.9083
6 clay <1>	-1545.604	-1552.442	6.838	0.000	------	------	------	----------	0.437	0.1960	0.2229	64.0836
6 sand <1>	-1552.442	-1605.749	53.307	0.000	------	------	------	----------	50.380	0.2697	0.1111	3390.2488
6 sand base <1>	-1605.749	-1617.095	11.345	0.000	------	------	------	----------	2.896	0.2106	0.2096	987.3021

STENLILLE-5

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1495.105	-1500.433	5.328	0.000	------	------	------	----------	2.438	0.2338	0.2210	184.3900
2a <1>	-1500.433	-1508.285	7.852	0.000	------	------	------	----------	0.333	0.1717	0.2674	36.0450
2b <1>	-1508.285	-1513.753	5.468	0.000	------	------	------	----------	0.896	0.2735	0.2237	836.3172
3 <1>	-1513.753	-1519.502	5.749	0.000	------	------	------	----------	2.581	0.2567	0.1058	256.8015
4 <1>	-1519.502	-1533.856	14.355	0.000	------	------	------	----------	2.743	0.2436	0.1946	226.0464
5 clay <1>	-1533.856	-1540.903	7.046	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1540.903	-1575.305	34.403	0.000	------	------	------	----------	24.071	0.2631	0.1418	322.2812
6 clay <1>	-1575.305	-1580.283	4.977	0.000	------	------	------	----------	4.063	0.2355	0.2167	180.3302
6 sand <1>	-1580.283	-1602.085	21.803	0.000	------	------	------	----------	21.548	0.2677	0.0265	3114.8650
6 sand base <1>	-1602.085	-1638.860	36.775	0.000	------	------	------	----------	11.582	0.2389	0.1097	2046.2917

STENLILLE-6

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1531.196	-1531.250	0.054	0.000	------	------	------	----------	0.000	------	------	--
2a <1>	-1531.196	-1538.261	7.065	0.000	------	------	------	----------	1.525	0.2206	0.1619	134.8891
2b <1>	-1538.261	-1543.166	4.905	0.000	------	------	------	----------	4.752	0.2241	0.1321	148.4678
3 <1>	-1543.166	-1553.531	10.366	0.000	------	------	------	----------	10.366	0.2491	0.0441	243.1441
4 <1>	-1553.531	-1571.547	18.015	0.000	------	------	------	----------	14.752	0.2144	0.1111	132.1908
5 clay <1>	-1571.547	-1574.660	3.113	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1574.660	-1603.820	29.160	0.000	------	------	------	----------	26.697	0.2630	0.0612	350.6345
6 clay <1>	-1603.820	-1608.827	5.008	0.000	------	------	------	----------	4.703	0.2078	0.0450	110.5722
6 sand <1>	-1608.827	-1638.770	29.942	0.000	------	------	------	----------	29.790	0.2665	0.0345	3081.1221
6 sand base <1>	-1638.770	-1673.305	34.535	0.000	------	------	------	----------	17.449	0.1887	0.2080	586.8921

STENLILLE-7

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1608.206	-1616.234	8.028	0.000	------	------	------	----------	0.000	------	------	--
2a <1>	-1616.234	-1622.796	6.562	0.000	------	------	------	----------	0.000	------	------	--
2b <1>	-1622.796	-1632.465	9.670	0.000	------	------	------	----------	1.067	0.2098	0.2539	99.4317
3 <1>	-1632.465	-1636.782	4.317	0.000	------	------	------	----------	0.152	0.1644	0.2937	29.5882
4 <1>	-1636.782	-1642.999	6.216	0.000	------	------	------	----------	0.915	0.1756	0.2610	43.1373
5 clay <1>	-1642.999	-1651.459	8.461	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1651.459	-1684.440	32.981	0.000	------	------	------	----------	20.422	0.2386	0.1961	210.0761
6 clay <1>	-1684.440	-1705.334	20.894	0.000	------	------	------	----------	3.657	0.2328	0.1439	179.1731
6 sand <1>	-1705.334	-1738.508	33.174	0.000	------	------	------	----------	32.537	0.2714	0.0765	3264.6833

6 sand base <1>
Unit or interval does not exist for this well.

STENLILLE-8

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1522.908	-1529.800	6.892	0.000	------	------	------	----------	0.000	------	------	--
2a <1>	-1529.800	-1535.798	5.997	0.000	------	------	------	----------	0.000	------	------	--
2b <1>	-1535.798	-1542.959	7.161	0.000	------	------	------	----------	1.123	0.1945	0.2781	57.5208
3 <1>	-1542.959	-1551.910	8.951	0.000	------	------	------	----------	6.954	0.2498	0.1343	303.7094
4 <1>	-1551.910	-1561.040	9.130	0.000	------	------	------	----------	2.743	0.2035	0.2627	85.4911
5 clay <1>	-1561.040	-1565.605	4.565	0.000	------	------	------	----------	0.000	------	------	--
5 sand <1>	-1565.605	-1608.302	42.697	0.000	------	------	------	----------	40.081	0.2425	0.1149	224.5754
6 clay <1>	-1608.302	-1618.059	9.757	0.000	------	------	------	----------	4.900	0.2043	0.1972	91.2877
6 sand <1>	-1618.059	-1654.759	36.699	0.000	------	------	------	----------	36.700	0.2687	0.0551	3126.2231
6 sand base <1>	-1654.759	-1694.930	40.171	0.000	------	------	------	----------	34.380	0.1982	0.0743	2380.1987

STENLILLE-9

UNIT	TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET PAY (meters)	AVG PHI	AVG SW	AVG VSH	AVG PERM_log	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log
1 <1>	-1470.668	-1476.593	5.925	0.000	------	------	------	----------	0.152	0.1637	0.2977	29.0256
2a <1>	-1476.593	-1482.003	5.410	0.000	------	------	------	----------	0.000	------	------	-------
2b <1>	-1482.003	-1487.413	5.410	0.000	------	------	------	----------	1.356	0.2523	0.2208	294.5245
3 <1>	-1487.413	-1498.040	10.627	0.000	------	------	------	----------	8.855	0.2490	0.0654	273.6619
4 <1>	-1498.040	-1505.640	7.600	0.000	------	------	------	----------	1.981	0.1808	0.2621	50.7602
5 clay <1>	-1505.640	-1510.535	4.895	0.000	------	------	------	----------	0.000	------	------	-------
5 sand <1>	-1510.535	-1544.540	34.006	0.000	------	------	------	----------	29.565	0.2445	0.1199	236.7739
6 clay <1>	-1544.540	-1551.432	6.891	0.000	------	------	------	----------	0.147	0.1537	0.2062	-------
6 sand <1>	-1551.432	-1586.725	35.294	0.000	------	------	------	----------	35.057	0.2733	0.0366	3517.7966
6 sand base <1>	-1586.725	-1613.063	26.338	0.000	------	------	------	----------	13.868	0.2410	0.0990	2214.8315

Table 3: Generalized reservoir parameters for the Gassum Formation zones

Average porosity, shale, and permeability distributions. Based on well and core data. Zones may pinch out across the Stenlille structure and thus, the thickness of a particular zone varies in terms of well location. Similarly, the net sand thickness varies in terms of shale volume, porosity and well location.

Zone (adapted from DONG)	**Net sand thickness** (m)	**Porosity** (%)	**Shale volume** (%)	**Permeability** (mD)
1	0 – 5	25	12	275
2a	0 – 4	20	14	100
2b	0 – 7	25	16	275
3	6 – 17	25	10	300
4	1 – 15	26	10	300
5_clay dominated	0 – 1	16	23	50
5_sand dominated	20 – 40	27	14	350
6_clay dominated	0 – 5	18	25	100
6_sand dominated	22 – 56	28	8	4000
6_sand/clay dominated basal unit	2 – 34	22	15	1000

Table 4: Reservoir parameters for the Gassum Formation using a 2-layer model

Depths (top and base) are listed as true vertical depth subsea to account for the deviation the wells. Apart from interval thickness, net sand thickness (NET RES ROCK, m), avg. porosity (PHI, fraction), shale volume (VSH, fraction) and permeability (PERM_log, mD) are interpreted by GEUS. Net to gross ration (N/G) calculated as NET RES ROCK thickness divided by GROSS INTERVAL thickness. Cut-offs: The calculated values presume minimum 15% porosity and maximum 30% shale volume. AVG: Average. Depths are given in metres TVDss. Parameters for the entire Gassum Fm are included for comparison. See text for further details on reservoir zonation.

STENLILLE-1

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	**Net to gross N/G**
Gassum Fm < -1465.93	-1609.95	144.02	120.778	0.2711	0.1006	2653.5242	**0.84**
Zones_1-4 < -1465.93	-1500.1	34.174	26.138	0.2493	0.1152	269.0895	**0.76**
Zones_5-Base Gassum Fm -1500.1	-1609.95	109.846	94.64	0.2771	0.0965	3310.1006	**0.86**

STENLILLE-10

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1482.32	-1631.13	148.803	113.538	0.2381	0.1127	1168.142	**0.76**
Zones_1-4 < -1482.32	-1518.51	36.186	18.898	0.2157	0.162	119.5497	**0.52**
Zones_5-Bas -1518.51	-1631.13	112.617	94.64	0.2425	0.1029	1377.526	**0.84**

STENLILLE-11

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1646.54	-1847.49	200.95	138.681	0.2655	0.0973	1784.3706	**0.69**
Zones_1-4 < -1646.54	-1694.19	47.653	23.162	0.2557	0.1499	348.388	**0.49**
Zones_5-Bas -1694.19	-1847.49	153.297	115.519	0.2675	0.0868	2070.4314	**0.75**

STENLILLE-12

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1457.62	-1604.61	146.993	108.221	0.2642	0.095	1851.7524	**0.74**
Zones_1-4 < -1457.62	-1493.39	35.778	12.824	0.2522	0.1567	263.2169	**0.36**
Zones_5-Bas -1493.39	-1604.61	111.215	95.397	0.2658	0.0868	2064.4294	**0.86**

STENLILLE-13

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1457.5	-1605.56	148.056	98.083	0.2614	0.1303	1813.6049	**0.66**
Zones_1-4 < -1457.5	-1494.49	36.989	13.576	0.2576	0.1624	308.2115	**0.37**
Zones_5-Bas -1494.49	-1605.56	111.067	84.507	0.262	0.1252	2055.45	**0.76**

STENLILLE-14

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1455.72	-1603.81	148.09	117.534	0.2566	0.0474	1532.3032	**0.79**
Zones_1-4 < -1455.72	-1492.53	36.814	21.309	0.2426	0.1313	238.5034	**0.58**
Zones_5-Bas -1492.53	-1603.81	111.276	96.225	0.2597	0.0288	1818.8114	**0.86**

STENLILLE-15

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1470.59	-1624.01	153.424	78.467	0.2375	0.1135	205.6113	**0.51**
Zones_1-4 < -1470.59	-1515.26	44.678	29.101	0.2365	0.155	201.2822	**0.65**
Zones_5-Bas -1515.26	-1624.01	108.746	49.365	0.2381	0.089	208.1634	**0.45**

STENLILLE-16

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1491.6	-1639.1	147.502	85.496	0.2681	0.1323	1700.7114	**0.58**
Zones_1-4 < -1491.6	-1527.67	36.068	8.992	0.2816	0.1585	634.5986	**0.25**
Zones_5-Bas -1527.67	-1639.1	111.434	76.505	0.2665	0.1292	1826.0115	**0.69**

STENLILLE-17

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1455.59	-1604.15	148.552	92.908	0.2406	0.1296	1302.387	**0.63**
Zones_1-4 < -1455.59	-1492.49	36.896	12.526	0.2333	0.1794	193.4447	**0.34**
Zones_5-Bas -1492.49	-1604.15	111.656	80.383	0.2417	0.1218	1475.1899	**0.72**

STENLILLE-18

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1455.55	-1602.48	146.921	110.419	0.2584	0.0927	1507.3516	**0.75**
Zones_1-4 < -1455.55	-1492.06	36.502	20.571	0.2747	0.1431	497.4367	**0.56**
Zones_5-Bas -1492.06	-1602.48	110.418	89.849	0.2546	0.0812	1737.2192	**0.81**

STENLILLE-19

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1458.21	-1603.05	144.835	97.891	0.2727	0.1043	2468.9343	**0.68**
Zones_1-4 < -1458.21	-1491.59	33.378	9.674	0.241	0.1692	206.0599	**0.29**
Zones_5-Bas -1491.59	-1603.05	111.457	88.216	0.2761	0.0972	2715.1462	**0.79**

STENLILLE-2

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1463.51	-1605.08	141.571	126.917	0.2515	0.0982	1694.7472	**0.90**
Zones_1-4 < -1463.51	-1497.22	33.711	27.432	0.2453	0.1477	252.3728	**0.81**
Zones_5-Bas -1497.22	-1605.08	107.86	99.485	0.2532	0.0845	2094.0801	**0.92**

STENLILLE-20

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1585.87	-1745.17	159.295	111.861	0.2698	0.1035	1733.0122	**0.70**
Zones_1-4 < -1585.87	-1622.04	36.17	16.611	0.2694	0.1388	482.3053	**0.46**
Zones_5-Bas -1622.04	-1745.17	123.126	95.25	0.2699	0.0973	1951.1338	**0.77**

STENLILLE-4

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1476.13	-1617.1	140.961	98.451	0.2629	0.1177	1900.4285	**0.70**
Zones_1-4 < -1476.13	-1513.04	36.911	20.117	0.2439	0.1637	225.0776	**0.55**
Zones_5-Bas -1513.04	-1617.1	104.05	78.334	0.2678	0.1059	2330.6765	**0.75**

STENLILLE-5

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1495.11	-1638.86	143.755	70.256	0.2566	0.1106	1445.8002	**0.49**
Zones_1-4 < -1495.11	-1533.86	38.751	8.992	0.245	0.1819	272.434	**0.23**
Zones_5-Bas -1533.86	-1638.86	105.004	61.265	0.2583	0.1001	1618.0106	**0.58**

STENLILLE-6

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1531.25	-1673.31	142.055	110.033	0.2397	0.0861	1062.8633	**0.77**
Zones_1-4 < -1531.25	-1571.55	40.297	31.394	0.2276	0.0946	170.6889	**0.78**
Zones_5-Bas -1571.55	-1673.31	101.758	78.639	0.2445	0.0826	1419.0398	**0.77**

STENLILLE-7

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1608.21	-1738.51	130.302	58.75	0.2547	0.1289	1893.019	**0.45**
Zones_1-4 < -1608.21	-1643	34.792	2.134	0.1919	0.2598	70.3131	**0.06**
Zones_5-Bas -1643	-1738.51	95.51	56.616	0.2571	0.124	1961.8069	**0.59**

STENLILLE-8

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm < -1522.91	-1694.93	172.022	126.881	0.2357	0.0955	1597.5312	**0.74**
Zones_1-4 < -1522.91	-1561.04	38.132	10.821	0.2323	0.1818	230.6187	**0.28**
Zones_5-Bas -1561.04	-1694.93	133.89	116.061	0.236	0.0874	1733.2687	**0.87**

STENLILLE-9

UNIT TOP (meters)	BASE (meters)	GROSS INTERVAL (meters)	NET RES ROCK (meters)	AVG PHI	AVG VSH	AVG PERM_log	
Gassum Fm <							
-1470.67	-1613.06	142.395	90.983	0.2539	0.0843	1802.0118	**0.64**
Zones_1-4 <							
-1470.67	-1505.64	34.971	12.345	0.2374	0.1169	237.07	**0.35**
Zones_5-Bas							
-1505.64	-1613.06	107.424	78.638	0.2565	0.0792	2047.6765	**0.73**