Geological Well Report

Hag GT-01

Den Haag, The Netherlands

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Attachments

Attachment # 1 Masterlog 1:500

Pertinent Well Data

WELL NAME:	HAG GT-1
COUNTRY:	Netherlands
MUNICIPALITY:	The Hague
WELL TYPE:	Geothermal
OPERATOR:	Aardwarmte Den Haag VOF
SUFRACE COORDINATES:	x= 78210.955 m y= 452500.55 m
PRIMARY TARGET:	Delft Sandstone
TARGET COORDINATES:	x= 79207.00 m y= 452598.00 m Latitude: 54.55.46.541 Longitude: 09.50.17.664 Top TVD RT: 2196.27 m (Delft Sandstone)
TARGET TOLERANCE:	300 m x 100 m (Rectagle, centred on target)
ROTARY TABLE ELEVATION:	8.24 m
GROUND LEVEL ELEVATION:	0.23 m above NAP
DEPTH REFERENCE:	Rig floor @ 8.24 m above ground level
SPUD DATE:	16.05.2010
TD DATE:	11.09.2010
TOTAL DEPTH:	2702 m MD / 2306.44 m TVD
CASING DEPTHS:	13 3/8" at 262 m 10 3/4" at 1248 m 7" top at 1120.0 m at 2467.5 m WWS 4 ½" top at 2431.2 m at 2690.6 m
RIG:	LOC-400
OFFSET WELLS:	HAG-01, HAG-02,

Contractor Services

DRILLING:	NDDC
MWD	HALLIBURTON
DIRECTIONAL DRILLING	HALLIBURTON
MUD-LOGGING	PETROLOG International B.V.
MUD CHEMICALS	SCOMI-OIL TOOLS (EUROPE) LTD
CEMENT	Schlumberger
CASING	NDDC, Odfjel

1. CONCISE DRILLING SUMMARY

1.1. General

The Hag GT-1 geothermal well was spudded on 16 July 2010, using the Heismann LOC-400 “No limit -1” rig. TD was reached at 1702 m on 11 September 2010.

The primary target of the Hag GT-01 has been reached on 8th of September 2010. Top of the Delft Sandstone was reached at 24549m MD BRT / 2187.87m TVD SS. Assumed 40m thickness of clear (not interbedded by Claystone layers) Sandstone formation, had been satisfied – 70m. The drilling stopped in the Delft Sandstone Mb. One type of WBM systems were applied in the Hag GT-01 well: KCL – Glycol/Polymer (266 – 2702 m). For well test, mud was displaced with brine.

2. MUD-LOGGING AND GEOLOGICAL PROCEDURES

2.1. Geological Monitoring

Geological duties were carried out according to the project requirements elaborated by WPMi

Mud-logging services were performed by PETROLOG under the agreement with WPMi. PETROLOG mudlogging crew at the HAG GT-01 location consisted of: Krzysztof Gudz, Przemyslaw Hamankiewicz, Marek Jamka, Bartlomiej de Lorme, Miroslaw Ochwat, Tomasz Pachciarek, Tomasz Przybycien, Jacek Sawicz, Andrzej Spinczyk, Wojciech Tomsia,

2.2. Mudlogging Equipment

- OnLine air-conditioned logging unit with suitable workspaces, benches, electricity/water supply connections fully compatible with international safety standards
- Microscope, hot plates, cuttings trays, spot plates, probes, chemicals and all other necessary tools and ware for proper cuttings examination and analysis
- FID gas detection and fast THC sensor
- H2S sensor
- GeoWellPower software package integrating online parameters for following displays and calculations:

  ⇒ Selected parameters on continuous display in graphical and/or numerical format on three monitor screens.
  ⇒ Online updating of geological Masterlog and continuous screen display of the same
  ⇒ Continuous Data storage time and depth dependant (every 2 sec / 20cm)
  ⇒ Time or depth based technical / engineering log with user defined lay out
  ⇒ Visualization of actual rig operation with smart alarms (drilling, tripping, survey)

- Mudlogging Crew responsible for the following duties:

  ⇒ Cuttings sampling, washing, packaging and dispatching of samples. Intervals and packaging as per the sampling program
  ⇒ Lithological analysis and descriptions
  ⇒ Stratigraphical interpretation
  ⇒ Daily reporting as required by the Client and/or the circumstances
  ⇒ Continuous computer update of Masterlog, displaying lithology, formation tops, total gas, and selected drilling parameters against depth.
  ⇒ Continuous monitoring and interpretation of online drilling parameters, assistance to the drilling personnel as per normal drilling practice and as the circumstances may require

The configuration of monitoring equipment appeared to be fully sufficient for relevant mudlogging services and onsite data processing with respect to the required scope of work.

The use of the FID gas detector and rate of penetration allowed recognition and pinpointing of the zones of high content of hydrocarbon gases. Moreover, fast THC sensor supplied hydrocarbon gas level readings to Petrolog and rig monitoring system in real time (no gas line lag).

The observation of the ROP and LWD curve during drilling allowed for accurate interpretation of lithological changes.

Pump stroke counters were essential at calculating the lag time, which in turn enabled correlation of cuttings lithology to depth.

2.3. Hardware and Software

The following software was used for the preparation and elaboration of the geological data:

2.3.1. Windows XP - operating system on-line computer
2.3.2. MS Office 2000 – daily geological reports, other documents,
2.3.3. GeoWellPower - preparing logs, graphics, tables of drilling parameters,
2.3.4. Drilling and Petroleum Engineering Package
2.3.5. WITS protocol software

The following hardware was used for the drilling and geological data presentation:

2.3.6. Main PC computer in mudlogging unit (Controller PC)
2.3.7. Three PC computers connected to the Main PC (Geoserv PC, Backup PC and Geology PC)
2.3.8. One remote computer (company representative) with Well View visualisation

2.4. Cuttings Sampling

2.4.1. Cutting samples were taken from shale shakers at intervals varying from 5 m to 2 m for archival records.

Hag GT – 1 main hole sampling frequencies:

From depth (m MD)	To depth (m MD)	Sampling frequency (m)
270	2505	5
2505	2702	2

Two sets of ditch unwashed cutting samples (packed first in cloth bags then in plastic bags) and two sets of washed and dried ones (packed in plastic bags) were collected.

A small fraction of each cutting sample was washed on the sieve, dried and examined under the microscope. Basic features were described for each lithological type.

When the bit approached the depth of the next expected formation top, spot-samples were taken more often. This enabled proper identification of formation lithology and accurate definition of the lithological transitions.

These additional samples were not stored; they were used only for microscopic examination.

All samples were marked and packed into plastic boxes (see table # 2).

2.5. Data Reporting

Geological data acquired while drilling were classified as reports and documents according to the instructions of operator representatative, in order to secure constant information indispensable for their current work.

2.5.1. Daily Basis Data Reporting

Following reports were daily delivered in electronic version

2.5.1.1. Daily geological report,
2.5.1.2. Geological profile (GeoWellPower software),
2.5.1.3. 24 hours Well View visualisation of 8 main parameters (1 min resolution)

3. STRATIGRAPHY AND LITHOLOGY

3.1. Stratigraphy

The stratigraphy of the drilled well was established on the basis of the profile lithology analysis, field identification of the main correlation markers and the correlation with the lithosections of the previously drilled well HAG-1, HAG-2.
The table below presents tops, names and chronostratigraphy of formations recognized while drilling.
See table #4

6. Lithology Hag GT-1

Tertiary (not picked) – 266 m MD / not picked – 266 m TVD

North Sea Group

266 – 270 m	**Sand** (40 %), clear, fine – medium grains, rarely coarse, transparent, minor translucent, subspherical, subangular – rounded, moderately sorted, single foraminifera **Clay** (40 %), grey, very soft, plastic, slightly sticky, calcareous, sandy **Cement** (20 %)
270 – 275 m	**Sand** (60 %), clear, fine grains, occasionally medium grains, transparent, minor translucent, subspherical - spherical, subangular – rounded, well sorted, shell fragments **Clay** (40 %), grey, minor beige, very soft, plastic, slightly sticky, calcareous, sandy
275 – 280 m	**Sand** (50 %), clear, fine – medium grains, rarely coarse, transparent, minor translucent, subspherical, subangular – rounded, moderately sorted, single foraminifera, traces glauconite **Clay** (50 %), as above
280 –285 m	**Sand** (40 %), clear, fine – medium grains, rarely coarse, transparent, minor translucent, subspherical, subangular – rounded, moderately sorted, single foraminifera, glauconite, traces foraminifera, shell fragments **Clay** (60 %), as above
285 – 290 m	**Sand** (70 %), as above **Clay** (30 %), as above
290 – 295 m	**Sand** (20 %), as above **Clay** (80 %), grey, minor beige, very soft, plastic, slightly sticky, calcareous, sandy, shell fragments

295 – 305 m **Sand** (40 %), as above
Clay (60 %), as above

305 – 310 m **Sandstone** (80%), light grey – olive, moderately hard to hard, fine to medium grained, moderately sorted, mainly subrounded, calcareous cement, slightly argillaceous, big fragments of shells, Glauconite
Clay (20 %), as above
Traces of **Amber**

310 – 315 m **Sandstone** (60 %), as above
Clay (40 %), as above

315 – 320 m **Sandstone** (50 %), light grey, fine grained, well sorted, subrounded, rarely subangular, Glauconite and Pyrite, occasionally black pieces – Lignite?
Claystone (50%), grey, light grey, soft, firm, calcareous, molusca, foraminifera

320 – 325 m **Sandstone** (70 %), light grey, fine grained, well sorted, subrounded, rarely subangular, Glauconite, Mica and Pyrite, occasionally black pieces – Lignite?
Claystone (30%), grey, light grey, soft, firm, calcareous, sandy and silty, molusca, foraminifera

325 – 330 m **Claystone** (80%), grey to dark grey, soft, strongly calcareous to marly, sandy and silty.
Sandstone (70 %), light grey, fine to very fine grained, well sorted, subrounded, Glauconite, Mica.

330 – 360 m **Claystone** (80%), grey to dark grey, soft, strongly calcareous to marly, sandy and silty.
Sandstone (20 %), light grey, fine to very fine grained, well sorted, subrounded, Glauconite, Mica.

360 – 365 m **Claystone** (80 %), grey, soft, sandy and silty, calcareous, marly
Marl (10 %), light brown, beige, soft, firm, sticky, silty
Sandstone (10%), light grey, fine to very fine grained, well sorted, subrounded, fossils, Mica, mainly milled to loose Quartz grains.

365 – 375 m **Claystone** (40 %), as above
Marl (50 %), as above
Sandstone (10%), as above

375 – 380 m **Claystone** (20 %), as above
Marl (80%), as above
Sandstone in traces

380 – 385 m **Claystone** (50 %), as above
Marl (30%), as above
Sandstone (20%), as above

385 – 390 m **Claystone** (70 %), dark grey, soft, plastic and sticky, subblocky, calcareous, sandy and silty.
Sandstone (30%), as above
Marl in traces

390 – 395 m **Claystone** (100 %), as above

395 – 400 m	**Claystone** (90 %), as above **Sandstone** (10%), as above
400 – 405 m	**Claystone** (100 %), grey to dark grey, soft, plastic and sticky, silty and sandy, strong calcareous, grading to Marl
405 – 410 m	**Marl** (95 %), beige, light brown, soft, plastic, subblocky, slightly sandy. **Sandstone** (5%), as above
410 – 415 m	**Claystone** (100 %), grey-greenish, soft, plastic and sticky, slightly sandy and silty, weak dolomitic, subblocky. Traces of **Sandstone** and **Marl**
415 – 420 m	**Claystone** (100 %), dark brown, soft, firm, subblocky, non-calcareous, slightly sandy.
420 – 435 m	**Claystone** (100 %), predominantly brownish-grey and dark brownish, soft, firm, dolomitic, silty, rarely **Claystone**, grey, soft, marly, silty
435 – 440 m	**Marl** (70 %), light grey – greenish, soft – firm, amorphous **Sandstone** (30 %), grey, very fine – fine grained, soft, argillaceous, glauconitic, very well sorted, subspherical, subangular – subrounded
440 – 445 m	**Marl** (15 %), as above **Sandstone** (25 %), as above, but mostly as loose grains **Claystone** (60 %), beige, very soft, slightly calcareous Traces of **Pyrite** and **Cherts** (brown, transparent, very hard, angular)
445 – 450 m	**Marl** (80 %), beige – light brownish, occasionally light grey – greenish, soft – firm, amorphous **Sandstone** (20 %), as above, but mostly as loose grains Traces of **Pyrite** and **Cherts** (brown, transparent, very hard, angular)
450 – 455 m	**Marl** (80 %), beige – light brownish, light grey – greenish, soft – firm, amorphous **Sandstone** (20 %), as above, but mostly as loose grains Traces of **Pyrite** and **Chalk** (off white, slightly argillaceous, soft)
455 – 460 m	**Marl** (40 %), as above **Sandstone** (55 %), grey, very fine – fine grained, rarely medium grained, soft, argillaceous, moderately sorted, subspherical, subangular - subrounded, Glauconite, commonly Pyrite, foraminifera **Limestone** (5 %), off white, very soft, mudstone – wackstone, slightly argillaceous
460 – 465 m	**Sandstone** (30 %), grey, very soft, fine grained, very argillaceous, very well sorted, subspherical, subangular - subrounded, Glauconite, commonly Pyrite, commonly grading to sandy Claystone **Claystone** (70 %), grey, very soft, sandy, commonly Pyrite and micro Pyrite
465 – 470 m	**Sandstone** (80 %), as above, but mainly as loose grains **Claystone** (20 %), grey, soft - firm, calcareous, commonly Pyrite and micro Pyrite
470 – 475 m	**Sandstone** (40 %), as above

Claystone (60 %), as above
Traces of **Pyrite** and **Chalk** (off white, slightly argillaceous, soft)

475 – 485 m **Sandstone** (50 %), as above
Claystone (50 %), grey, soft – firm, Pyrite dispersed, calcareous

485 – 490 m **Sandstone** (30 %), as above
Claystone (70 %), as above + Glauconite dispersed
Traces of **Chalk**

490 – 495 m **Marl** (75 %), medium grey, firm – moderately hard
Sandstone (20 %), as above
Claystone (5 %), as above + Glauconite dispersed

495 – 505 m **Marl** (85 %), light grey, firm – moderately hard
Sandstone (15 %), as above

Cretaceous

Upper Cretaceous

Chalk group

Omellanden Formation : 505.2 – 724.7 m MD / 496.73 – 715.93 m TVD SS

505 – 510 m **Chalk** (50 %), white, soft - firm
Marl (40 %), as above
Sandstone (10 %), as above

510 – 520 m **Chalk** (90 %), as above
Marl (traces), as above
Sandstone (10 %), as above

520 – 550 m **Chalk** (95 %), as above, commonly fossils
Sandstone (5 %), as above

550 – 580 m **Chalk** (95 %), white, soft – firm, commonly fossils and Cherts
Sandstone (5 %), as above

580 – 605 m **Chalk** (100 %), white, soft – firm, amorphous, commonly fossils and Cherts
Sandstone in traces

605 – 615 m **Chalk** (100 %), as above
Limestone (traces), white-bluish, soft, wackstone texture, slightly sandy, with Pyrite

615 – 670 m **Chalk** (100 %), white, soft – firm, occasionally moderately hard to hard, amorphous, commonly Cherts (brown, clear, very hard, angular)
Sandstone in traces

670 – 690 m **Chalk** (100 %), white, soft – firm, occasionally moderately hard to hard, amorphous, rare Cherts (brown, clear, very hard, angular) and fossils

690 – 705 m **Chalk** (95 %), as above

Limestone (5%) white, hard, massive, calcarenite, with fossils
Sandstone (traces) grey, fine grained, well rounded, poorly sorted, hard

705 – 710 m **Chalk** (100 %), white, soft – firm, occasionally moderately hard to hard, amorphous, rare fossils
Limestone (traces) white, hard, massive, calcarenite, with fossils
Sandstone (traces) grey, fine grained, well rounded, poorly sorted, hard

710 – 715 m **Chalk** (100 %), as above

715 – 720 m **Chalk** (100 %), white, pale greenish in places, soft – firm, occasionally moderately hard, amorphous, rare fossils

Texel Formation

Plenus Marl Mb : 724.7 – 727.1 m MD / 715.93 – 718.33 m TVD SS

720 – 725 m **Chalk** (40 %), as above
Marl (60 %), green, greenish, beige, soft – firm, occasionally moderately hard, glauconitie, sandy, grading to glauconitic Sandstone in places

725 – 730 m **Chalk** (20 %), as above
Marl (80 %), as above
Traces of **Pyrite**

Texel Marlstone Mb : 727.1 – 815.1 m MD / 718.33 – 805.23 m TVD SS

730 – 735 m **Chalk** (5 %), as above
Marl (35 %), grey, soft – firm, common Glauconite, Pyrite
Limestone (20 %), greenish – beige, moderately hard, packstone – grainstone, sandy
Sandstone (40 %), light grey, very hard, very fine grained, well sorted, dolomitic cement, common Glauconite and Feldspar

735 – 740 m **Marl** (90 %), as above
Sandstone (10 %), as above
Traces of **Chalk** and **Pyrite**

740 - 745 m **Marl** (60 %), grey, soft - firm, very silty, sandy, glauconite
Sandstone (40 %), light grey, very fine grained, firm – hard, crumbly in places, calcareous cement, Glauconite, commonly grading to sandy Siltstone, often bit mashed

745 – 750 m **Marl** (30 %), as above
Sandstone (70 %), as above

750 – 755 m **Marl** (80 %), as above
Sandstone (20 %), as above

755 – 760 m **Marl** (90 %), as above
Sandstone (10 %), as above

760 – 765 m **Marl** (40 %), as above
Sandstone (60 %), as above

765 – 770 m **Marl** (80 %), as above
Sandstone (20 %), as above

770 – 780 m **Sandstone** (80 %), light grey, very fine grained, moderately hard to hard, calcareous cement, Glauconite, commonly grading to Siltstone
Siltstone (20%) light grey to grey, moderately hard, locally grading to very fine sandstone, calcareous

780 – 790 m **Siltstone** (60%) light grey to grey, moderately hard, locally grading to very fine sandstone, calcareous
Sandstone (40 %), light grey, very fine grained, moderately hard to hard, calcareous cement, Glauconite, commonly grading to Siltstone

790 – 795 m **Sandstone** (60 %), light grey, very fine grained, moderately hard to hard, calcareous cement, Glauconite, commonly grading to Siltstone
Siltstone (40%) light grey to grey, moderately hard, calcareous, sandy

795 – 800 m **Siltstone** (80%) light grey to grey, moderately hard, calcareous
Sandstone (20 %), light grey, very fine grained, moderately hard to hard, calcareous cement, Glauconite, commonly grading to Siltstone

800 – 820 m **Siltstone** (100%) light grey to grey, moderately hard, calcareous and marly, Pyrite

Texel Greensand Mb : 815.1 – 830.5 m MD / 805.23 – 820.33 m TVD SS

820 – 825 m **Sandstone** (80 %), light grey to greenish-grey, fine to very fine grained, moderately hard to hard, calcareous cement, with Glauconite
Siltstone (20%) light grey to grey, moderately hard, calcareous and marly,
Glauconite

825 – 830 m **Sandstone** (100 %), light grey to greenish-grey, fine to very fine grained, moderately hard to hard, calcareous cement, with Glauconite

Lower Cretaceous

Rijnland group

Holland Formation :

Upper Holland Marl Mb : 830.5 – 1112.9 m MD / 820.33 – 1082.23 m TVD SS

830 – 835 m **Sandstone** (100 %), light grey to whitish-grey, fine to very fine grained, moderately hard to hard, calcareous cement, Glauconite

835 – 840 m **Sandstone** (30 %), light grey, fine to very fine grained, moderately hard to hard, calcareous cement, Glauconite

Siltstone (70%) light grey to grey, moderately hard, calcareous and marly, Glauconite

840 – 855 m **Sandstone** (10 %), as above
Siltstone (90%) as above

855 – 885 m **Siltstone** (100 %), grey to light grey, fine to very fine grained, soft to moderately hard, friable, calcareous cement, marly, slightly sandy, mainly subblocky, Glauconite

885 – 890 m **Siltstone** (100 %), grey to light grey, soft to moderately hard, friable, calcareous, marly, mainly subblocky, occasionally Glauconite and Pyrite

890 – 920 m **Siltstone** (100 %), grey, soft to moderately hard, friable, calcareous, mainly subblocky, occasionally Pyrite, grading to **Claystone**

920 – 1040 m **Claystone** (100%)**,** grey, soft to moderately hard, calcareous and marly, silty, water-soluble, occasionally foraminifera. Single light brown Claystone grains form 970 m

1040 – 1055 m **Claystone** (100%)**,** as above
Traces of **Siltstone,** and **Pyrite**

1055 – 1070 m **Claystone** (100%), grey, soft to moderately hard, calcareous and marly, silty, water-soluble, foraminifera (among another things Epistomina and Lagena), very occasionally Pyrite

1070 – 1080 m **Claystone** (100 %), grey, soft to moderately hard, calcareous and marly, silty, water-soluble, occasionally foraminifera

1080 – 1085 m **Claystone** (100 %), grey, occasionally brownish-grey, soft to moderately hard, calcareous and marly, silty, water-soluble, also **Claystone**, grey, hard, platy and shaly, calcareous, with Mica

1085 – 1090 m **Claystone** (100 %) as above
Traces of **Marl**, reddish-brown and brownish grey, soft.

1090 – 1095 m **Marl** (60 %), variegated and brownish grey, soft, calcareous
Claystone (40 %) as above

1095 – 1105 m **Claystone** (80 %) as above
Marl (20 %), as above
Traces of non-calcareous fossils fragments

1105 – 1110 m **Claystone** (100 %) as above
Traces of **Pyrite**, variegated **Marl** and **Siltstone**, greenish, brown, moderately hard, calcareous and argillaceous

Middle Holland Claystone Mb:1112.9–1273 m MD / 1082.23 – 1209.93 m TVD SS

1110 – 1115 m **Claystone** (100 %) as above

1115 – 1125 m **Claystone** (90 %) as above

Claystone (10 %) dark grey, moderately hard, calcareous, strong glauconitic.
Traces of variegated **Marl**

1125 – 1130 m **Claystone** (100 %), grey, soft to moderately hard, with Glauconite and Pyrite.
Traces of reddish **Marl**

1130 – 1145 m **Claystone** (100 %), dark grey, moderately hard, calcareous, very glauconitic.
Traces of **Claystone**, green and greenish grey, soft to moderately hard, non-calcareous

1145 – 1150 m **Claystone** (90 %), grey to dark grey, soft, calcareous.
Siltstone (10 %), light grey to grey, moderately hard to hard, splintery, elongated, platy-shaly, calcareous, with Mica and Pyrite.
Traces of fine grained **Sandstone** and greenish-grey **Claystone**

1150 – 1155 m **Claystone** (80 %), as above
Siltstone (20 %), as above
Traces of **Pyrite**, greenish-grey **Claystone** and glauconitic **Sandstone**

1155 – 1160 m **Claystone** (95 %), light grey – grey – dark grey, minor light brown – brown, soft – firm, fine black carbonaceous matter dispersed in dark grey variety, calcareous, silty, Glauconite
Sandstone (5 %), light grey, hard – very hard, very fine grained, occasionally fine grained, moderately sorted, subspherical – spherical, subangular – subrounded, transparent, Glauconite, mainly as loose grains
Traces of **Pyrite** and **Foraminifera**

1160 – 1165 m **Claystone** (100 %), grey, occasionally light grey and dark grey, soft – firm, moderately calcareous - calcareous, fine organic matter dispersed in places, silty, grading to Siltstone in places
Traces of **Pyrite**

1165 – 1170 m **Claystone** (90 %), grey, dark grey, occasionally light grey, firm – moderately hard, slightly calcareous, black fine organic matter dispersed in places, silty to very silty, grading to Siltstone in places, common Mica
Sandstone (10 %), brownish, light grey, very fine – fine grained, crumble, moderately sorted, Glauconite, mainly as loose grains
Dolomite (traces), brown, microcrystalline, hard – very hard, translucent
Common Pyrite**.** Traces of **Glauconite**, **Foraminifera**, **Fossils**

1170 – 1175 m **Claystone** (100 %), as above
Traces of **Sandstone**, **Pyrite**

1175 – 1180 m **Claystone** (100 %), as above + single light brown grains
Traces of **Sandstone**, **Pyrite, Foraminifera**

1180 – 1185 m **Claystone** (95 %), grey, occasionally light grey, firm, minor moderately hard, slightly calcareous, black fine organic matter dispersed in places, silty to very silty, grading to Siltstone in places, common Mica
Sandstone (5 %), loose quartz grains, very fine, minor fine, transparent, moderately sorted, subspherical – spherical, subangular – subrounded
Traces of **Pyrite, Foraminifera**

1185 – 1190 m **Claystone** (95 %), as above

Sandstone (5 %), as above
Traces of **Pyrite**

1190 – 1195 m **Claystone** (90 %), as above, but soft, minor firm
Siltstone (10 %), grey, dark grey, soft – firm, slightly – non-calcareous, fine black carbonaceous matter dispersed
Common Pyrite

1195 – 1200 m **Claystone** (100 %), as above
Traces of **Siltstone**, **Dolomite**, **Pyrite**, **Fossils**, **Glauconite**

1200 – 1205 m **Claystone** (95 %), as above, but grey – dark grey
Sandstone (5 %), as above
Traces of **Pyrite**

1205 – 1210 m **Claystone** (100 %), grey, occasionally light grey, soft, minor firm, slightly calcareous, black fine organic matter dispersed in places, silty, grading to Siltstone in places, Mica
Traces of **Pyrite** and **Dolomite**

1210 – 1220 m **Claystone** (100 %), as above
Traces of **Pyrite, Dolomite, Glauconite** and **Foraminifera**

1220 – 1230 m **Claystone** (100 %), as above
Siltstone (traces), as above
Traces of **Pyrite, Dolomite, Glauconite**

1230 – 1235 m **Claystone** (95 %), as above
Sandstone (5 %), mainly as loose grains, fine grained, occasionally medium grains, subspherical – pherical, subrounded – rounded, moderately sorted, with Glauconite
Traces of **Pyrite, Dolomite, Glauconite**

1235 – 1240 m **Claystone** (100 %), as above
Sandstone (traces), as above
Traces of **Pyrite**, **Glauconite**, **Fossils**

1240 – 1245 m **Claystone** (95 %), as above
Sandstone (5%), as above
Traces of **Pyrite**, **Glauconite, Dolomite**

1245 – 1250 m **Claystone** (95 %), as above
Siltstone (10 %), light grey to grey, moderately hard to hard, splintery, platy-shaly, calcareous, with **Mica and Pyrite.**

1250 – 1255 m **Claystone** (100 %), medium grey, moderately hard, subblocky, non calcareous, common **Pyrite**, in places silty

1255 – 1260 m **Claystone** (100 %), medium grey, soft to firm, slightly silty, common **Glauconite and Pyrite**, weak calcareous, very poor Hydrocarbon shows

1260 – 1270 m **Claystone** (100 %), as above, silty, grading to **Siltstone**, also very fine sandy

Holland Greensand Mb : 1273 – 1332 m MD / 1209.93 – 1256.03 m TVD SS

1270 – 1275 m **Claystone** (60 %), dark grey to grey, plastic to soft, sub blocky to sub platy, locally amorphous, calcareous in part, washable in part, often silty and sandy.
Siltstone (30 %), grey, locally dark grey, soft to moderate hard, sub blocky, amorphous in part, moderate to weak calcareous, rare glauconitic, in part graded to **Sandstone**.
Sandstone (10 %), predominant loose Quartz, yellowish, translucent to transparent, very fine to fine, occasionally medium, sub rounded to rounded, well rounded in part.
Traces of **Limestone**, beige, creamy, moderate hard to hard, micro to crystalline.

1275 – 1285 m **Claystone** (50-55 %), as above.
Siltstone (35-40 %), as above.
Sandstone (10 %), as above. Also **Sandstone**, grey, brown-grey, soft to friable, very fine to fine, sub rounded to rounded, poor sorted, argillaceous, moderate calcareous, occasionally glauconitic. Poor oil shows.
Traces of **Limestone**, as above.
Traces of **Calcite and Pyrite**.

1285 – 1290 m **Claystone** (40 %), as above.
Siltstone (40 %), as above.
Sandstone (20 %), as above. Occasionally **Sandstone**, off white, white, friable to moderate hard, very fine, sub angular to sub rounded, poor sorted, glauconitic.
Weak oil shows:
5% of cuttings
Natural: weak odour
Fluorescence: direct: white to pale yellow cut: white, fast, stream
Traces of **Limestone**, as above.

1290 – 1300 m **Claystone** (45 %), as above.
Siltstone (40 %), as above.
Sandstone (15 %), as above.
Poor oil shows.
Traces of **Limestone,** as above.

1300 – 1305 m **Claystone** (20 %), as above.
Siltstone (40 %), as above.
Sandstone (40 %), predominant loose Quartz as above. In part Sandstone, grey, light brown – grey, soft to friable, very fine to fine, sub angular to sub rounded, poor to weak sorted, weak calcareous, rare glauconitic, occasionally nodules of Pyrite. Poor oil shows.

1305 – 1310 m **Claystone** (30 %), dark grey to grey, plastic to soft, sub blocky to sub platy, locally amorphous, calcareous in part, washable in part, often silty and sandy.
Siltstone (40 %), grey, locally dark grey, soft to moderate hard, sub blocky, amorphous in part, moderate to weak calcareous, rare glauconitic, in part grading to **Sandstone**

Sandstone (30 %), predominant loose Quartz as above. In part Sandstone, grey, light brown – grey, soft to friable, very fine to fine, sub angular to sub rounded, poor to weak sorted, weak calcareous, rare glauconitic, occasionally nodules of **Pyrite**.
Weak oil shows: 15% of cuttings, natural: weak odour, fluorescence: direct: white to pale yellow, cut: white, fast, cloudy

1310 – 1315 m **Siltstone** (45 %), grey, grey-brown, soft to moderately hard, sub-blocky, slightly calcareous, sandy,
Claystone (30 %), as above
Sandstone (25 %), as above
Traces of **Calcite**
Poor oil shows

1315 – 1320 m **Claystone** (40 %), as above,
Siltstone (45 %), as above,
Sandstone (15 %), as above
Traces of **Calcite**

1320 – 1330 m **Claystone** (25-30 %), as above,
Siltstone (55 %), as above,
Sandstone (15-20 %), as above
Traces of **Pyrite** and **Glauconite**
Rare traces of **Calcite**

Lower Holland Marl Mb : 1332 – 1619 m MD / 1256.03 – 1476.71 m TVD SS

1330 – 1335 m **Claystone** (40 %), medium grey, soft to plastic, subblocky, slightly calcareous, silty grading to
Siltstone (50 %), as above,
Sandstone (10 %), loose, very fine quartz grains, transparent and translucent, subangular to subrounded
Traces of **Glauconite**

1335 – 1340 m **Claystone** (50 %), medium grey, soft and plastic to firm, marly, silty and very fine sandy, grading to
Siltstone (50 %), as above.
Traces of **Glauconite**

1340 – 1345 m **Claystone** (60 %), grey to light grey, moderately hard to firm, subblocky to rare subplaty, marly, silty and very fine sandy
Siltstone (40 %), as above.
Traces of **Pyrite**

1345 – 1350 m **Claystone** (60 %), medium grey, soft and plastic, subblocky, marly, silty grading to **Siltstone** (40 %), as above
Traces of **Pyrite** and **Glauconite**

1350 – 1360 m **Claystone** (70-85 %), dark grey to grey, plastic to soft, locally moderate hard, amorphous to sub blocky, locally sub platy, slightly calcareous, marly, silty in places.
Siltstone (15-30 %), grey, rare dark grey, soft to moderate hard, sub blocky, none to weak calcareous, locally sandy.

Traces of Sandstone, loose, very fine Quartz grains, yellowish, transparent and translucent, subangular to subrounded.

1360 – 1365 m **Claystone** (85 %), dark grey to grey, plastic to soft, locally moderate hard, amorphous to sub blocky, locally sub platy, slightly calcareous, marly, silty in places.
Siltstone (15 %), grey, rare dark grey, soft to moderate hard, sub blocky, none to weak calcareous, locally sandy.

1365 – 1375 m **Claystone** (50 %), dark grey to grey, plastic to soft, also moderately hard, amorphous to sub blocky, locally sub platy, marly, silty in places
Argillaceous Marl (50 %), grey, locally light grey, plastic, sticky, washable, amorphous, moderate calcareous, rare spots of black organic material, graded to marly **Claystone**, as described above.

1375 – 1380 m **Claystone** (70%), medium grey, soft, amorphous and subblocky, silty, washable in part,
Claystone (20 %), medium to dark grey, moderately hard, predominantly subplaty, shaly in part, silty, micromicaceous, calcareous, with dispersed **Pyrite**
Argillaceous Marl, (10 %) as above

1380 – 1385 m **Claystone** (75 %), medium to dark grey, moderately hard, predominantly subplaty, shaly in part, silty, micromicaceous, calcareous, with dispersed **Pyrite**
Claystone (25%), medium grey, soft, amorphous and subblocky, silty, washable in part, calcareous

1385 – 1390 m **Claystone** (100 %), light to medium grey, soft to firm, amorphous to subblocky, silty, calcareous, also medium to dark grey, moderately hard as above

1390 – 1395 m **Claystone** (95 %), grey to dark grey, soft to firm, moderate hard in part, sub blocky tp sub platy, silty in places, occasionally marly, slightly to moderate calcareous.
Siltstone (5 %), dark grey, moderate hard, sub blocky, none to weak calcareous, rare black spots of carbonated material.

1395 – 1400 m **Claystone** (90 %), grey, light grey in part, soft to moderate hard, sub blocky to sub platy, sub fissile in part, weak to moderate calcareous, locally marly and silty.
Shale (10 %), dark grey, firm, fissile, slightly clacareous.

1400 – 1405 m **Claystone** (80 %), as described above.
Shale (15 %), as described above.
Siltstone (5 %), as described above.

1405 – 1410 m **Claystone** (85 %), as described above.
Shale (5 %), as described above.
Marl argillaceous (10 %), light grey to grey, plastic, sticky, amorphous, washable in part.
Traces of **Siltstone**, as described above.

1410 – 1415 m **Claystone** (85 %), grey, light grey in part, soft to moderate hard, sub blocky to sub platy, sub fissile in part, weak to moderate calcareous, locally marly and silty.
Marl argillaceous (15 %), light grey to grey, plastic, sticky, amorphous, washable in part.
Traces of **Siltstone**, as described above.

1415 – 1420 m **Claystone** (60 %), dark grey to grey, plastic to soft, locally moderate hard, amorphous to sub blocky, locally sub platy, slightly calcareous, marly, silty in places.
Shale (15 %), dark grey, firm, fissile, slightly clacareous.
Marl argillaceous 25 %), grey, locally light grey, plastic, sticky, washable, amorphous, moderate calcareous, rare spots of black organic material, graded to marly **Claystone**, as described above.

1420 – 1425 m **Claystone** (75 %), as above.
Shale (10 %), as above.
Marl argillaceous 15 %), as above.
Traces of **Siltstone**, dark grey, firm to moderate hard, sub blocky, with spots of carbonated material and glauconite.

1425 – 1430 m **Claystone** (85 %), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, glauconitic, common piryte, rare single fine quartz grains, locally grading to **Marl**.
Claystone (15 %), dark grey, moderately hard, platy, splintery, rare blocky, slightly calcareous, slightly silty.

1430 – 1450 m **Claystone** (70-100 %), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, rare glauconite grains, often grading to **Marl**.
Claystone (Traces-30%), dark grey, moderately hard, platy, splintery, rare blocky, slightly calcareous, slightly silty.

1450 – 1460 m **Claystone** (40-45 %), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, rare glauconite grains, often grading to **Marl**, occasionally grey to dark grey, sub fissille to sub platy garding to **Shale**.
Marl argillaceous (40-50 %), light grey, plastic, soft, washable, calcareous.
Siltstone (10-15 %) dark grey, blackish in part, firm to moderate hard, friable when sandy, sub blocky, sandy in part, slightly calcareous, occasionally black – carbonated spots.

1460 – 1465 m **Claystone** (45 %), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (40 %), light grey, plastic to soft, washable, calcareous.
Siltstone (10 %) dark grey, blackish in part, firm to moderate hard, sub blocky, sandy, slightly calcareous, occasionally black – carbonated spots.
Sandstone (10 %), predominant loose Quartz, yellowish, translucent to transparent, very fine, sub rounded to rounded, in part, light grey, occasionally beige, firm to friable, very fine, sub angular to subrounded, poor sorted, occasionally glauconitic, slightly calcareous, in transition to **Siltstone**.
Traces of Pyrite nodules.

1465 – 1470 m **Claystone** (35 %), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (60 %), light grey, plastic, soft, washable, calcareous.
Traces of **Siltstone**.

1470 – 1480 m **Claystone** (40-50%), grey, soft, sub blocky to platy, occasionally amorphous, calcareous, silty, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (45-55 %), light grey, plastic to soft, washable, calcareous.
Siltstone (5 %) dark grey, blackish in part, firm to moderate hard, sub blocky, sandy, slightly calcareous, occasionally black – carbonated spots.

1480 – 1500 m **Claystone** (40-65 %), grey, soft, amorphous to sub blocky, rare sub platy and sub fissille, calcareous, silty, occasionally sandy, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (35-60 %), as described before. Traces of **Siltstone**.

1500 – 1515 m **Claystone** (30-65 %), grey, soft, amorphous to sub blocky, rare sub platy and sub fissille, calcareous, silty, occasionally sandy, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (35-70 %), light grey, amorphous, plastic to soft, washable, calcareous, occasionally slightly sandy.
Traces of **Siltstone**.
Traces of loose **Quartz**, yellowish, transparent to translucent, very fine, sub rounded to rounded.

1515 – 1525 m **Claystone** (35 %), grey, soft, amorphous to sub blocky, rare sub platy and sub fissille, calcareous, silty, occasionally sandy, rare glauconite grains, often grading to **Marl**.
Marl argillaceous (60 %), light grey, amorphous, plastic to soft, washable, calcareous, occasionally slightly sandy.
Siltstone (5 %), dark grey, firm to moderate hard, sub blocky, occasionally glauconitic, rare pyritized.
Traces of loose **Quartz**, as described before.

1525 – 1535 m **Claystone** (20-25 %), as described before.
Marl argillaceous (75-80 %), as described before. Locally brownish shade.
Traces of **Siltstone**.
Traces of loose **Quartz**, as described before.

1535 – 1545 m **Claystone** (20-25 %), as described before.
Marl argillaceous (70-75 %), as described before.
Siltstone (5 %), as described before.
Traces of loose **Quartz**, as described before.

1545 – 1565 m **Claystone** (45 - 60 %), grey, soft to moderately hard, subblocky, often amorphous, rare sub platy and sub fissile, calcareous to moderately calcareous, slightly silty, very rare glauconite grains, visible pyrite nodules, often grading to **argillaceous Marl**.
Marl argillaceous (40-55 %), light grey to grey, amorphous, plastic to soft, washable, occasionally slightly silty.
Siltstone (Traces %), dark grey, firm to moderate hard, sub blocky, occasionally glauconitic, rare pyritized.

1565 – 1600 m **Claystone** (20 - 75 %), grey, soft, subblocky, often amorphous, rare sub platy, calcareous to moderately calcareous, slightly silty, in part grading to **argillaceous Marl**.
Claystone (5 – 80 %), dark grey, moderately hard, platy, tabular, often splintery, fissile, moderately to sightly calcareous.
Marl argillaceous (traces - 20 %), light grey to grey, amorphous, plastic to soft, washable, occasionally slightly silty.

Siltstone (traces), dark grey, firm to moderate hard, sub blocky, occasionally glauconitic, rare pyritized.

1600 – 1620 m **Claystone** (90-95 %), as described above.
Siltstone (5-10 %), dark grey, loccally blackish, firm to moderate hard, sub blocky, rare glauconitic, occasionally bituminous, sandy in places..
Traces of **Marl argillaceous,** as described above.

Vlieland Sandstone Formation

De Lier Member : 1619 – 1726.5 m MD / 1476.71 – 1560.32 m TVD SS

1620 – 1625 m **Claystone** (95 %), as described above, also dark grey, firm to moderate hard, sub blocky, weak calcareous, graded to **Siltstone**.
Siltstone (5 %), as described above.
Traces of **Sandstone**, light grey, friable, very fine, sub angular, poor sorted, slightlu glauconitic, slightly calcareous, in trasition to **Siltstone**.

1625 – 1630 m **Claystone** (95 %), as described above.
Siltstone (5 %), as described above.
Traces of **Sandstone**, as descibed above, also loose Quartz, yellowish, transparent to translucent, very fine, sub rounded to rounded.
Traces of **Dolomite**, beige, light brown, very hard, cryptocrystalline.

1630 – 1640 m **Claystone** (100 %), grey, firm, sub blocky, weak to slightly calcareous, locally black spots of carbonated material, silty, also light grey to grey, soft to firm, slightly sandy, weak to moderate calcareous, marly, also grey to dark grey, sub platy, sub fissile to fissile, slightly calcareous, grading to **Shale**.
Traces of **Siltstone**, as described above.
Traces of **Sandstone**, as described above.
Traces of **Dolomite**, as described above.

1640 – 1650 m **Claystone** (100 %), grey, firm, sub blocky, weak to slightly calcareous, locally bituminous, silty also light grey to grey, soft to firm, slightly sandy, weak to moderate calcareous, marly, also grey to dark grey, sub platy, sub fissile to fissile, slightly calcareous, grading to **Shale**.
Traces of **Siltstone**, as described above.
Traces of **Sandstone**, predominant loose Quartz, yellowish, transparent to translucent, very fine, sub rounded to rounded.
Traces of **Dolomite**, as descibed above.

1650 – 1660 m **Claystone** (100 %), grey to dark grey, moderately hard, firm, subblocky to subplaty, in part fissile, none calcareous, silty, in part grading to **silty Claystone.**

1660 – 1675 m **Claystone** (70 %), grey to dark grey, moderately hard, firm, subblocky to subplaty, in part fissile, none to slightly calcareous, silty, in part grading to **silty Claystone**.
Sandstone (30 %), grey, greenish grey, moderately hard, also friable, fine to very fine grained, poorly sorted, moderately cemented, silty, argillaceous, glauconitic, none to slightly calcareous, Qtz gr translucent, subrounded to subangular, subspherical, frosted luster, common pyrite coating, single

muscovite, visible intragranular porosity, traces of very weak oil shows. Often grading to **sandy Siltstone**.

1675 – 1685 m **Claystone** (100 %), grey to dark grey, also brownish grey, soft to moderately hard, firm, subblocky to subplaty, in part fissile, none to slightly calcareous, silty, in part grading to **silty Claystone**.
Sandstone (Traces), grey, greenish grey, moderately hard, also friable, fine to very fine grained, poorly sorted, moderately cemented, silty, argillaceous, glauconitic, none to slightly calcareous, Qtz gr translucent, subrounded to subangular, subspherical, frosted luster. Often grading to **sandy Siltstone**.

1685 – 1690 m **Claystone** (100 %), as described before.

1690 – 1705 m **Claystone** (100 %), as described before.
Traces of **Dolomite**, light brown to brown, very hard, cryptocrystalline.

1705 – 1710 m **Claystone** (95 %), as described before.
Siltstone (5 %), dark grey, blackish, moderate hard, sub blocky, locally bituminous, sandy in part.
Traces of **Sandstone**, predominant loose **Quartz,** yellowish, clear in part, translucent, very fine, moderate rounded, also **Sandstone**, light grey, frim, friable, very fine, sub angular to sub rounded, poor sorted, rare glauconitic, argillaceous.

1710– 1715 m **Claystone** (95 %), as described before.
Siltstone (5 %), dark grey, blackish, moderate hard, sub blocky, locally bituminous, sandy in part.

1715– 1720 m **Claystone** (100 %), grey to dark grey, also brownish grey, moderately hard, firm, sub blocky to sub platy, in part sub fissille to fissile, none to slightly calcareous, silty in part, locally grading to **Shale**. Also **Claystone**, grey to light grey, soft to firm, amorphous to sub blocky, weak to moderate calcareous, marly.
Siltstone (traces), dark grey, blackish, moderate hard, subblocky, locally bituminous, sandy in part.

Vlieland Claystone Fm: 1726.5 – 2148.5 m MD / 1560.32 – 1890.1 m TVD SS

1720– 1745 m **Claystone** (60 - 75 %), grey to dark grey, also brownish grey, moderately hard, firm, sub blocky to sub platy, in part sub fissille to fissile, none to slightly calcareous, silty in part, micaceous, locally grading to **Shale**. Subordinate **Claystone**, grey to light grey, soft to firm, amorphous to sub blocky, weak to moderate calcareous, marly.
Siltstone (25 -40%), grey, dark grey, occasionally blackish, moderate hard, friable, subblocky to subplaty, locally bituminous, argillaceous, glauconitic, sandy in part, locally grading to **silty Sandstone**, grey, light grey, very fine grained.

1745– 1760 m **Claystone** (40-50 %), grey to dark grey, also brownish grey, moderately hard, firm, sub blocky to sub platy, in part sub fissille to fissile, none to slightly calcareous, silty in part, locally grading to **Shale**. Subordinate **Claystone**, grey, soft to firm, amorphous to sub blocky, weak to moderate calcareous, rare marly.

Siltstone (50-60 %), grey, dark grey, occasionally blackish, locally browni shade, moderate hard, friable, sub blocky to sub platy, locally bituminous, argillaceous, glauconitic, sandy in part, locally grading to **silty Sandstone**, grey, light grey, very fine grained.
Traces of **Pyrite** nodules.

1760– 1775 m **Claystone** (70 %), as described above but mainly grey, soft, amorphous to subblocky, rare sub platy, slightly calcareous.
Siltstone (30 %), as described above.

1775– 1780 m **Claystone** (50%), light grey to grey, soft, subblocky, non calcareous, very silty and sandy
Claystone (30%), dark grey, moderately hard, subplaty, with mica, locally calcareous
Siltstone (20%), grey to dark grey, moderately hard, friable, subblocky, sandy, non calcareous, sparse glauconite

1780– 1790 m **Claystone** (85-90%), light grey to grey, soft, subblocky, non calcareous, silty to sandy
Siltstone (10-15%), grey to dark grey, moderately hard, friable, subblocky, sandy, non calcareous

1790– 1810 m **Claystone** (85-90%), light grey to grey, brown, soft, subblocky, non calcareous, alternating silty and sandy
Siltstone (10-15%), grey to dark grey, moderately hard, friable, subblocky, sandy, non calcareous
Traces of **Claystone**, brown-reddish, very hard, splintery, non-calcareous, with pyrite and glauconite

1810– 1815 m **Claystone** (90%), light grey to grey, brown, soft, subblocky to subplaty, non calcareous, sandy
Claystone (10%), dark grey, moderately hard, subblocky, non calcareous, often grading to **Siltstone**, moderate amount of quartz grains, piryte
Claystone (Traces), beige to light brown, hard, splintery to platy, non calcareous, moderately sandy.

1815– 1825 m **Claystone** (100%), light grey to grey, locally brown shade, soft, subblocky to subplaty, none calcareous, sandy also **Clayston**, dark grey, moderately hard, subblocky, non calcareous, often grading to **Siltstone**, moderate amount of quartz grains, piryte.

1825– 1835 m **Claystone** (95 %), light grey to grey, plastic to soft, amorphous to subblocky, none to very slightly calcareous, rare sandy, also traces of **Claystone**, dark grey, moderately hard, subblocky, none calcareous, in part grading to **Siltstone**.
Siltstone (5 %), dark grey, blackish in part, moderate hard, sub blocky, rare pyritized, black bituminous spots, in part graded to **Sandstone**, light grey, friable, very fine, sub rounded, poor sorted.

1835– 1850 m **Claystone** (100 %), light grey to grey, plastic to soft, amorphous to subblocky, none to very slightly calcareous, rare sandy, also traces of **Claystone**, dark grey, moderately hard, subblocky, none calcareous, in part grading to **Siltstone**.

1850– 1860 m **Claystone** (90-95 %), light grey to grey, brownish shade, occasionally greenish shade, plastic to soft, amorphous to subblocky, also **Claystone**, dark grey, firm, subblocky to subplaty, occasionally splintery, subfissile, none calcareous, in part grading to **Siltstone**.
Siltstone (5-10 %), dark grey, blackish in part, firm to moderate hard, sub blocky, locally subfissile, rare pyritized, black bituminous spots.
Traces of Sandstone, off white to light grey, occasionally greenish shade, firm to friable, very fine to fine, sub angular to sub rounded, moderate sorted, slightly calcareous, slightly glauconitic.

1860– 1870 m **Claystone** (90%), as described above also sandy in part, somewhat argillaceous **Sandstone**.
Siltstone (5%), as described above.
Sandstone (5%), predominant loose Quartz, translucent to transparent, occasionally yellowish to off white, very fine to fine, sub angular to sub rounded, rare rounded, in traces as described above. Often argillaceous, in transition to sandy **Claystone**, as above.

1870– 1900 m **Claystone** (100%), light grey to grey, brownish shade, occasionally greenish shade, plastic to soft, amorphous to subblocky, non calcareous, sparse quartz grains also **Claystone**, dark grey, firm to moderately hard, subblocky to subplaty, occasionally splintery, subfissile, none calcareous, rarely mica, in part grading to **Siltstone**.

1900– 1914 m **Claystone** (85-90%), light grey, beige, soft to firm, subblocky, non-calcareous, sandy.
Siltstone (10-15%), dark grey, brownish, firm to moderately hard, subblocky to splintery, locally grading to **Sandstone,** very fine grained, friable, moderately sorted, subangular, quartz transparent.

1914– 1930 m **Claystone** (70-95 %), light grey to grey, light brown in part, soft to plastic, firm in places, amorphous to subblocky, non to weak calcareous, sandy in part, also **Claystone**, grey to dark grey, firm to moderately hard, subblocky, non calcareous, in places graded to Siltstone, also **Claystone**, light grey, creamy to off white, plastic, amorphous, washable in part, weak calcareous, marly, also **Claystone**, light brown to brown, hard, sub platy, dolomitic.
Siltstone (5-30 %), grey to dark grey, rare blackish, friable to moderate hard, subblocky, none to slightly calcareous, occasionally sandy.
Traces of **Pyrite**.

1930– 1945 m **Claystone** (75-85 %), as described above.
Siltstone (10-15 %), as described above.
Sandstone (5-10 %), off white to light grey, beige in part, friable to moderately hard, very fine, subangular to subrounded, poorly to moderately sorted, moderately to strongly calcareous, slightly glauconitic, predominantly argillaceous, occasionally sillicaceous. No shows. In part as loose Quartz.

1945– 1965 m **Claystone** (65-85 %), light grey to grey, light brown in part, soft to plastic, firm in places, amorphous to subblocky, non to weak calcareous, sandy in part, also **Claystone**, grey to dark grey, firm to moderate hard, subblocky, non calcareous, in places graded to Siltstone, also **Claystone**, light grey, creamy to off white, plastic, amorphous, washable in part, weak calcareous, marly, also **Claystone**, light brown to brown, hard, subplaty, dolomitic.
Siltstone (5-20 %), grey to dark grey, rare blackish, friable to moderately hard, subblocky, non to slightly calcareous, occasionally sandy.

Sandstone (5-15 %), light brown to brown, beige, soft, friable, argillaceous, very fine, sub angular to subrounded, poorly sorted, mainly washed out to loose Quartz, occasionally off white to light grey, grey to dark grey, friable to moderately hard, subangular to subrounded, poorly to moderate sorted, sillicaceous, locally glauconitic, quartzic in places.

1965– 1970 m **Claystone** (90 %), predominantly creamy, light grey, soft to plastic, amorphous, non to very slightly calcareous, contains loose Quartz grains, also as described above.
Siltstone (5 %), as described above.
Sandstone (5 %), as described above.

1970– 1975 m **Claystone** (95 %), as described above.
Siltstone (5 %), as described above.
Traces of **Sandstone**, as described above.

1975– 1985 m **Claystone** (85 – 95%), light grey, soft, sub-blocky, non-calcareous, slightly sandy; **Claystone**, dark grey, friable to firm, calcareous, sub-blocky to subplaty.
Siltstone (5 – 10%), dark grey, moderately hard, subblocky, non-calcareous, with small amount of sand grains, with pyrite, grading to sandstone.
Sandstone (traces – 5%) off-white, light grey to dark grey, very fine to fine, friable to firm to moderately hard, poorly sorted, subangular to subrounded, no visible porosity, argillaceous in part, with sparse glauconite grains.

1985– 2010 m **Claystone**, (60 – 90%), light grey, soft, sub-blocky, non-calcareous, slightly sandy; **Claystone**, dark grey, friable to firm, calcareous, sub-blocky to subplaty.
Siltstone (traces – 20%), light to dark grey, moderately hard, subblocky to subplaty, sandy, with pyritic burrowings.
Sandstone (10 – 20%), off-white, light to dark grey, very fine to fine, mainly in the form of loose quartz grains, friable to firm, moderately sorted, subangular to subrounded, quartz grains transparent to translucent, argillaceous in places, with sparse glauconite.

2010– 2030 m **Claystone** (60 – 75%), light grey to grey, soft, sub-blocky, non-calcareous, sandy to very sandy.
Siltstone (20%), grey to dark grey, moderately hard, sub-blocky to sub-platy, containing pyrite and glauconite, non-calcareous, grading to sandstone.
Sandstone (5 – 20%), off-white, grey to dark grey, very fine to fine, friable to moderately hard, moderately sorted, quartz sub-angular to subrounded, calcareous in places, no visible porosity, grain supported

2030– 2055 m **Claystone**, (40 – 60%), light grey, soft, sub-blocky, non-calcareous, slightly sandy; **Claystone**, dark grey, friable to firm, calcareous, sub-blocky to subplaty.
Siltstone (10 – 15%), light to dark grey, moderately hard, subblocky to subplaty, sandy, with pyritic burrowings.
Sandstone (30 – 50%), off-white, light to dark grey, occasionally creamy, very fine to fine grained, commonly as loose quartz grains, friable to firm, non to very slightly calcareous, moderately cemented, grain supported, moderately sorted, argillaceous in places, sparse glauconite and mica, occasionally visible intragranular porosity, quartz grains transparent to translucent, angular to subangular, subspherical to spherical, common frosted luster

2055– 2060 m **Claystone**, (60%), as above
Siltstone (10%), as above
Sandstone (30%), as above, also light grey, creamy, medium grained, occasionally coarse – very coarse grained, hard, poorly sorted, well rounded, subspherical – spherical, siliceous matrix, slightly dolomitic, transparent - translucent

2060– 2065 m **Claystone**, (60%), as above
Siltstone (15%), as above
Sandstone (25%), as above, but traces of the second variety

2065– 2078 m **Claystone**, (60 - 70%), as above
Siltstone (20%), as above
Sandstone (10 – 20%), as above, but lack of the second variety

2078- 2100 **Claystone**, (70 – 80%), light grey, soft, sub-blocky, non-calcareous, slightly sandy; **Claystone**, dark grey, friable to firm, calcareous, sub-blocky to subplaty.
Siltstone (10 – 20%), light to dark grey, moderately hard, subblocky to subplaty, sandy.
Sandstone (5 – 10%), off-white, light to dark grey, occasionally creamy, very fine to fine grained, commonly as loose quartz grains, friable to firm, non- to very slightly calcareous, moderately cemented, grain supported, moderately sorted, argillaceous in places, sparse glauconite and mica, occasionally visible intragranular porosity, quartz grains transparent to translucent, angular to subangular, subspherical to spherical, common frosted luster.

2100- 2145 **Claystone**, (80 – 95%), light grey to grey, soft, sub-blocky, non to slightly calcareous, slightly sandy; **Claystone**, dark grey, greenish, moderately hard, firm, non-calcareous, subblocky to subplaty.
Siltstone (10 – 20%), grey to dark grey, moderately hard, friable, subblocky to subplaty, non-calcareous, sandy, sparse glauconite grains, often grading to **silty Claystone.**
Traces of **Pyrite.**

Vlieland Sandstone Formation

Berkel Sandstone Mb : 2148.5 – 2170.0 m MD / 1890.1 – 1905.79 m TVD SS

2145- 2175 **Claystone**, (50 – 70 %), light grey to grey, soft, subblocky, non- to slightly calcareous, slightly sandy; **Claystone**, dark grey, greenish, moderately hard, firm, non-calcareous, subblocky to subplaty.
Siltstone (15 - 20%), grey to dark grey, moderately hard, friable, subblocky to subplaty, non-calcareous, sandy, sparse glauconite grains, often grading to **silty Claystone.**
Sandstone (10 - 30%), light grey with brownish shade in places, occasionally brown, very fine – fine grained, moderately hard, very well sorted, spherical, subangular – subrounded, predominantly transparent, non- to moderately calcareous, calcareous to argillaceous cement, rarely glauconite, mainly as loose quartz grains.
Traces of **Siderite** and **Pyrite**

Berkel Sand-Claystone Mb: 2170.0 – 2381.5 m MD / 1905.79 – 2061.0 m TVD SS

2175 - 2195	**Claystone** (70 – 90%), light to dark grey to brown, soft to firm to moderately hard, subblocky to subplaty, non-calcareous, occasionaly calcareous, silty in places. **Siltstone** (10– 20%), dark grey, dark brown, firm, subblocky to subplaty, slightly sandy, occasionaly microlamination, sparse grains of organic material, sparse mica, sparse glauconite, non-calcareous, sandy in places. **Sandstone** (5 – 10%), off-white to beige, very fine, friable, subangular, subspherical, non-calcareous, no visible porosity; sandstone, dark grey, brown, very fine, firm to moderately hard, argillaceous, siliceous, grains angular, subspherical to elongated, grading to Siltstone; rock flour and loose quartz grains. Traces of **Siderite**: brown, hard, subplaty, splintery, traces of pyrite either as lumps of crystals or growths.
2200 - 2215	**Claystone** (100 %), light to dark grey, dark beige, soft to moderately hard, subblocky to platy, splintery, mainly non-calcareous, occasionally weakly to calcareous, sparse, tiny fragments of organic material Traces of **Siderite** and **Pyrite**. Shell fragments at 2210 m.
2215 - 2220	**Claystone** (90%), as above **Siltstone** (5%), dark grey, moderately hard, non-calcareous, with mica and glauconite **Sandstone** (5%), light grey, very fine – fine grained, moderately hard, well sorted, spherical, subangular – subrounded, transparent, with pyrite in places, non-calcareous, no visible porosity
2220 - 2235	**Claystone** (90%), light to dark grey, dark beige, soft to moderately hard, subblocky to platy, splintery, mainly non-calcareous, occasionally weakly to calcareous, sparse, tiny fragments of organic material. **Siltstone** (5%), dark grey, moderately hard, non-calcareous, with mica and glauconite. **Sandstone** (5%), light grey, very fine – fine grained, moderately hard, well sorted, spherical, subangular – subrounded, transparent, with pyrite in places, non-calcareous, no visible porosity.
2235 - 2240	**Claystone** (95%), light to dark grey, soft to moderately hard, subblocky, subplaty and splitery, non-calcareous, with sparse organic material, pyrite, sandy in places. **Siltstone** (5%), dark grey, firm to friable, subblocky, slightly calcareous, contains glauconite, sandy in places
2240 - 2245	**Claystone** (95%), light to dark grey, soft to moderately hard, subblocky, subplaty and splitery, non-calcareous, fine organic material in places, pyrite, silty in places **Siltstone** (5%), dark grey, firm to friable, subblocky, slightly calcareous, with glauconite, sandy in places, fine organic material dispersed **Sandstone** (traces), light grey, very fine – fine grained, moderately hard, well sorted, spherical, subangular – subrounded, transparent, with pyrite in places, calcareous cenent, argillaceous in places, no visible porosity. Traces of **Pyrite** and **Siderite**

2245 - 2255	**Claystone** (95%), light to dark grey, soft to moderately hard, subblocky, subplaty and splitery, non-calcareous, fine organic material in places, pyrite, silty in places **Siltstone** (5%), dark grey, firm to friable, subblocky, slightly calcareous, with glauconite, sandy in places, fine organic material dispersed **Sandstone** (traces), light grey, very fine – fine grained, moderately hard, well sorted, spherical, subangular – subrounded, transparent, with pyrite in places, calcareous cenent, argillaceous in places, no visible porosity. Traces of **Pyrite** and **Siderite**
2255 - 2275	**Claystone** (60 - 75%), as above **Siltstone** (20 - 25%), as above **Sandstone** (5 – 15%), as above Traces of **Pyrite**
2275 - 2280	**Claystone** (30), light to medium grey, soft to moderately hard, subblocky, subplaty, non-calcareous, fine organic material in places, pyrite, silty in places **Siltstone** (30%), medium grey, brownish - grey, firm to moderately hard, subblocky, slightly calcareous, sandy in places, with Pyrite **Sandstone** (40%), light grey to light beige grey, very fine – fine grained, moderately hard, well sorted, locally pyritic, calcareous cement, argillaceous in places Traces of **Pyrite**
2280 - 2285	**Claystone** (40%), as above **Siltstone** (40%), as above **Sandstone** (20%), as above Traces of **Pyrite**
2285 - 2295	**Claystone** (40 – 60%), light to medium grey, soft to firm, subblocky, subplaty, non-calcareous, fine organic material in places, pyrite, silty and sandy in places, micaceous **Siltston**e (30 – 50%), medium grey, light beige grey, brownish - grey, firm to moderately hard, rare hard, subblocky, argillaceous, also calcareous, sandy in places, locally pyritic **Sandstone** (10%), as above Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement
2295 - 2305	**Claystone** (70%), as above, also splintery **Siltstone** (20%), as above **Sandstone** (10%), as above Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement
2305 - 2325	**Sandstone** (30 – 60%), light grey to medium grey, brownish grey, firm to moderately hard, very fine grained grading to siltstone, well sorted, subblocky, often pyritic, slightly calcareous **Claystone** (30 – 60%), light to medium grey, firm, predominantly sub-platy and splintery, non-calcareous, **Siltstone** (10 %), as above Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement
2325 - 2350	**Claystone** (70 – 80%), light grey, soft and sticky, amorphous, slightly silty, none to weak calcareous, also medium grey, firm, sub-platy and splintery, non-calcareous

Siltstone (5 – 10 %), as above
Sandstone (15 - 30%), light grey to medium grey, brownish grey, firm to moderately hard, very fine grained grading to siltstone, well sorted, subblocky, often pyritic, slightly calcareous
Traces of **Pyrite**, traces of **Sideritic** concretions and cement

2350 - 2370 **Sandstone** (50 – 75%), light grey to medium grey, brownish grey, friable to moderately hard, very fine to fine grained, well rounded, transparent and translucent grains, grading to siltstone, well sorted, subblocky, often pyritic, none to very weak calcareous, traces of glauconite
Claystone (25 – 45%), light grey, soft and sticky, amorphous, slightly silty, none to weak calcareous, also medium grey, firm, sub-platy and splintery, non- calcareous
Siltstone (traces – 5%), as above
Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement

2370 - 2375 **Sandstone** (60%), light grey to medium grey, brownish grey, friable to moderately hard, very fine to fine grained, rare medium grains, well rounded, transparent and translucent grains, grading to siltstone, well sorted, subblocky, often pyritic, none to very weak calcareous, traces of glauconite
Claystone (40%), light grey, soft and sticky, amorphous, slightly silty, none to weak calcareous, also medium grey, firm, sub-platy and splintery, non-calcareous
Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement
Traces of **Calcite**

Rijswijk Mb: 2381.5 – 2444.2 m MD / 2061.0 – 2108.94 m TVD SS

2375 - 2390 **Sandstone** (70 – 80%), predominantly brownish grey, also light to medium grey, friable to moderately hard, very fine to fine, rare medium grains, predominantly well rounded, moderately to well sorted, weak calcareous, in places pyritic, traces of glauconite
Claystone (20 – 30%), as above
Traces of **Pyrite**, minor traces of **Sideritic** concretions and cement
Traces of **Calcite**

2390 - 2395 **Sandstone** (95%),
Claystone (5%), as above
Traces of **Pyrite**

2395 - 2410 **Sandstone** (95%), brownish grey, light to medium grey, friable to moderately hard, fine, medium – coarse loose grains, subspherical – spherical, subrounded - well rounded, moderately to poorly sorted, weak calcareous, pyrite in places, traces of glauconite, no visible porosity
Claystone (5%), as above
Traces of **Pyrite**

2410 - 2425 **Sandstone** (90 - 95%), light to medium grey, minor brownish grey, friable to moderately hard, fine, medium – coarse loose grains, subspherical – spherical, subrounded - well rounded, moderately to poorly sorted, weak calcareous, pyrite in places, traces of glauconite, no visible porosity
Claystone (5 - 10%), grey, moderately hard, silty in places, subplaty, non-calcareous
Traces of **Pyrite**

2425 - 2440 **Sandstone** (80%), light to medium grey, minor brownish grey, friable to moderately hard, fine - medium - coarse, subspherical – spherical, subrounded - well rounded, moderately to poorly sorted, weak calcareous, pyrite in places, traces of glauconite, no visible porosity
Claystone (20%), grey, moderately hard, silty in places, subplaty, non-calcareous
Traces of **Pyrite** and **Siderite**

2440 - 2445 **Sandstone** (60%), light to medium grey, minor brownish grey, friable to moderately hard, fine - medium - coarse, subspherical – spherical, subrounded - well rounded, moderately to poorly sorted, weak calcareous, pyrite in places, traces of glauconite, no visible porosity
Claystone (40 %), grey, moderately hard, silty in places, subplaty, pyrite, non-calcareous
Traces of **Pyrite** and **Siderite**

Schieland Group

Nieuwerkerk Formation

Rodenrijs Mb: 2444.2 m – 2545.9 m MD / 2108.94 – 2187.87 m TVD SS

2445 - 2455 **Claystone** (60 - 80%), grey, firm to moderately hard, silty in places, subplaty, splintery in part, pyrite, non-calcareous, also beige, soft to firm, sub-blocky to blocky, silty in part, with sparse organic material and glauconite
Sandstone (20 – 40%), as above
Traces of **Pyrite** and **Siderite**

2455 - 2460 **Claystone** (60 %), light grey to grey, light brown, firm to moderately hard, sub-platy to splintery, also beige, soft to firm, sub-blocky to blocky, silty in part, with sparse organic material and glauconite
Sandstone (40 %), as above
Siltstone (traces), light brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous
Traces of **Coal**

2460 - 2465 **Claystone** (80 %), light brownish - grey, medium grey, dark brown grey, moderately hard, predominantly sub-platy, also sub – blocky, in part elongated, silty in part, micromicaceous, dispersed pyrite, non- calcareous
Siltstone (15 %), light brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous
Sandstone (5%), as above
Traces of **Coal**

2465 - 2475 **Claystone** (90 %), as above
Siltstone (10 %), as above
Many traces of **Pyrite**
Traces of **Coal**

2475 - 2490 **Claystone** (40 – 50 %), as above
Siltstone (50 – 60 %), as above
Traces of **Coal/Lignite**

2490 - 2495	**Claystone** (55 %), grey, dark grey, light brown, firm to moderately hard, sub-blocky to platy, occasionally waxy, occasionally with mica and organic material particles, non-calcareous **Siltstone** (5 %), as above **Sandstone** (40 %), loose quartz, medium graines, moderately sorted, angular lu subrounded, subspherical to elongated, transrant and translucent Traces of **Pyrite**
2495 - 2500	**Claystone** (50 %), light brownish - grey, medium grey, dark brown grey, moderately hard, predominantly sub-platy, also sub – blocky, in part elongated, silty in part, micromicaceous, dispersed pyrite, non- calcareous **Siltstone** (50 %), light brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous
2500 - 2502	**Claystone** (70 %), brownish - grey, medium grey, dark brown grey, moderately hard, predominantly sub-platy, also sub – blocky, in part elongated, silty in part, micromicaceous, dispersed pyrite, non- calcareous **Siltstone** (30 %), brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous **Sample contaminated with previously drilled formations**
2502 - 2503	**Claystone** (70 %), brownish - grey, medium grey, dark brown grey, moderately hard, predominantly sub-platy, also sub – blocky, in part elongated, silty in part, micromicaceous, dispersed pyrite, non- calcareous **Siltstone** (30 %), brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous Traces of **Pyrite** **Sample contaminated with previously drilled formations** No junk found in sample.
2503 - 2504	**Claystone** (75 %), brownish - grey, medium grey, dark brown grey, moderately hard, predominantly sub-platy, also sub – blocky, in part elongated, silty in part, micromicaceous, dispersed pyrite, non- calcareous **Siltstone** (25 %), brown – beige, firm to moderately hard, argillaceous, dispersed pyrite, sparse organic matter, non- calcareous **Sample contaminated by technical cement.**
2504 - 2505	**Claystone** (85 %), light brown – grey, occasionally grey, friable to moderate hard, sub palty platy, sub fissile to fissile, splintery, grading to **Shale**, silty, in transition to **Siltstone** (15 %), light grey to grey, rare dark grey, moderate hard to hard, sub blocky to blocky, traces of organic material, slightly micaceous, locally pyritized, sandy in places. **Sample contaminated by technical cement.**
2505 - 2507	**Claystone** (80 %), as described above **Siltstone** (20 %), as described above Traces of **Sandstone**, white to off white, clear when quartzic, friable, very fine, rare fine, poor sorted, mainly sillicaceous, quartzic in places **Sample contaminated by technical cement.**
2507 - 2519	**Claystone** (75-85 %), as described above, also, in part brown to dark brown, locally grey **Siltstone** (15-25 %), as described above Traces of **Sandstone**, as described before

Sample contaminated by technical cement.

2519 - 2523 **Claystone** (85 %), grey, beige-grey, brownish-grey, locally dark grey, friable, subplaty-shaly, silty, sporadicaly slightly sandy, microPyrite in places, occasionally with carboniferous matter inclusions (Lignite?), non calcareous, grading to Siltstone.
Siltstone (15 %), as described above

2523 - 2525 **Claystone** (95 %), as above.
Siltstone (5%), as above.
Traces of **Coal** and sporadically **Lignite**
Note: adding $CaCO_3$ into mud system.

2525 - 2527 **Claystone** (90 %), as above.
Sandstone (5%), unconsolidated (probably milled by bit), Quartz grains are transparent, translucent, subrounded to subangular, moderately sorted.
Coal (5%), black, friable, locally **Lignite**.
Note: adding $CaCO_3$ into mud system.

2527 - 2529 **Claystone** (85 %), as above.
Sandstone (5%), as above.
Coal (10%), as above
Note: adding $CaCO_3$ into mud system.

2529 - 2531 **Claystone** (60 %), as above.
Sandstone (10%), as above.
Coal (30%), black, dark brown, friable, locally pyritized, offen argillaceous.

2531 - 2535 **Claystone** (80 %), as above.
Sandstone (10%), off white, friable, fine grained, subrounded, rarely subangular, well sorted, argillaceous (kaolinitic?) – siliceous cement, occasioanlly with Muscovite, non calcareous, non- to weak visible porosity.
Coal (10%), as above
Note: adding $CaCO_3$ into mud system.

2535 - 2545 **Claystone** (70-80 %), beige-grey, grey, light grey, grey-brownish, friable, subblocky to subplaty, occasionally Coal (Lignite?) inclusions, silty and locally sandy, non- calcareous, rare micro Pyrite.
Sandstone (20-30%), as above.
Traces of **Coal**
Note: adding $CaCO_3$ into mud system.

Schieland Group

Nieuwerkerk Formation

Delft Sandstone Mb: 2545.9 m MD – 2702 m / 2187.87 m – 2297.98 TVD SS

2545 - 2551 **Claystone** (60-70 %), beige-grey, grey, light grey, grey-brownish, friable, subblocky to subplaty, occasionally Coal (Lignite?) inclusions, silty and locally sandy, non- calcareous, rare micro Pyrite.
Sandstone (30-40%), off white, friable, fine grained, subrounded, rarely subangular, well sorted, argillaceous (kaolinitic?) – siliceous cement, occasioanlly with Muscovite, non calcareous, non- to weak visible porosity.

Traces of **Coal**
Note: adding $CaCO_3$ into mud system.

2551 - 2553 **Claystone** (60 %), beige-grey, grey, light grey, grey-brownish, friable, subblocky to subplaty, occasionally Coal (Lignite?) inclusions, silty and locally sandy, non- calcareous, rare micro Pyrite.
Sandstone (35%), off white, friable, fine grained, subrounded, rarely subangular, well sorted, argillaceous (kaolinitic?) – siliceous cement, occasioanlly with Muscovite, non calcareous, non- to weak visible porosity.
Traces of **Coal** (5 %), black, friable, locally **Lignite**.
Note: adding $CaCO_3$ into mud system.

2553 - 2557 **Claystone** (30-40 %), as described above.
Sandstone (60-70%), predominant loose Quartz, clear, off white in places, transparent to translucent, fine to medium, rare coarse, sub angular to sub rounded; when cemented, off white, creamy, friable to moderate hard, poor to moderate sorted, weak visible porosity, sillicaceous, occasionally argillaceous.
Traces of **Coal.**

2557 - 2559 **Claystone** (30 %), as described above.
Sandstone (70%), predominant loose Quartz, clear, off white in places, transparent to translucent, medium to coarse, locally fine, sub rounded to rounded; when cemented, off white, creamy, friable to moderate hard, poor to moderate sorted, none to weak visible porosity, sillicaceous, occasionally argillaceous.
Traces of **Coal.**

2559 - 2561 **Claystone** (25 %), as described above.
Sandstone (75%), predominant loose Quartz, clear, off white in places, transparent to translucent, medium to coarse, locally fine, sub rounded to rounded; when cemented, off white, creamy, friable to moderate hard, poor to moderate sorted, none to weak visible porosity, sillicaceous, occasionally argillaceous.
Traces of **Coal** and **Siltstone,** brownish-grey, friable to moderate hard, sub blocky, sandy, pyritized in places, occasionally carbonated material.

2561 - 2563 **Claystone** (35 %), as described above.
Sandstone (65%), predominant loose Quartz, clear, off white in places, transparent to translucent, very fine to coarse, sub rounded to rounded; when cemented, off white, creamy, locally light brown, friable to moderate hard, predominant poor sorted, occasionally moderate sorted, none to weak visible porosity, sillicaceous, occasionally argillaceous.
Traces of **Coal** and **Siltstone.**

2563 - 2567 **Claystone** (60-70 %), light brow, grey-brown, occasionally light grey to grey, firm to moderate hard, sub platy to platy, sub fissile to fissile, splintery in places, somewhat **Shale**, silty, locally pyritized, micaceous in places, occasionally carbonated material, in part graded to **Siltstone**.
Sandstone (30-40%), predominant loose Quartz, clear, off white in places, transparent to translucent, very fine to medium, sub rounded; when cemented, off white, creamy, locally light brown, friable to moderate hard, predominant poor sorted, rare moderate sorted, poor porosity, sillicaceous, occasionally argillaceous. In places, off white, milled by bit quartz – rock flour.
Traces of **Coal** and **Siltstone.**

2567 - 2573	**Claystone** (30-35 %), as described above. **Sandstone** (65-70%), predominant milled by bit to rock flour, in part clear, off white, friable, fine to medium, sub rounded, rare sub angular, moderate sorted, poor to fair visible porosity. Traces of **Siltstone.**
2573 - 2575	**Claystone** (30 %), as described above. **Sandstone** (70 %), as descrbed above, but very fine to medium, poor visible porosity, increase of rock flour.
2575 - 2577	**Claystone** (15 %), light grey to grey, rare light brown, soft to firm, sub blocky to sub platy, silty in part. **Sandstone** (85%), predominant loose Quartz, clear, fine to coarse, sub rounded, when cemented, poor to moderate sorted, poor visible porosity, quartzic. Traces of **Coal**
2577 - 2583	**Claystone** (20-25 %), as described above, carbonated in places **Sandstone** (65-75%), as described above, also light brownish, firm to friable, very fine to fine, poor sorted, sub angular to sub rounded, argillaceous. **Coal** (5-10 %), black, bright, brittle.
2583 - 2585	**Claystone** (20 %), as described above. **Sandstone** (70%), as described above, also, sub rounded to rounded - loose Quartz grains, moderate to well sorted, predominant fair visible porosity – cemented grains. **Coal** (10 %), as described above.
2585 - 2587	**Claystone** (55 %), brownish-brown, grey in part, firm to moderately hard, sub platy to platy, locally subblocky, silty. **Sandstone** (45%), as described above. Traces of **Coal**
2587 - 2589	**Claystone** (65 %), as described above. **Sandstone** (35%), as described above.
2589 - 2593	**Claystone** (65 %), as described above. **Sandstone** (25%), as described above. **Coal** (10 %), as described above.
2593 - 2597	**Claystone** (15 %), grey, grey-brownish, beige, friable to moderately hard, occasionally with micro Pyrite, subplaty to subblocky, non- calcareous. **Sandstone** (80%), off white, friable to moderately hard, very fine to fine grained, rarely medium grains, subrounded, moderately sorted, argillaceous-siliceous cement, non- calcareous, fair visible porosity, mainly milled to loose Quartz grains, transparent and translucent, sporadically milky. **Coal** (5 %), black, brittle, shiny lustre, Lignite in parts.
2597 - 2599	**Claystone** (15 %), as described above. **Sandstone** (75%), off white, friable to moderately hard, fine to medium grained, rarely coarse grains, subrounded, poorly sorted, argillaceous-siliceous cement, non- calcareous, fair visible porosity, mainly milled to loose Quartz grains, transparent and translucent, sporadically milky. **Coal** (10 %), as described above.

2599 - 2603	**Claystone** (15 %), as described above. **Sandstone** (80%), as described above. **Coal** (5 %), as described above.
2603 - 2605	**Claystone** (15 %), as described above. **Sandstone** (80%), off white, friable to moderately hard, very fine to medium grained, subrounded, moderately sorted, argillaceous-siliceous cement, non-calcareous, fair visible porosity, mainly milled to loose Quartz grains, transparent and translucent, sporadically milky. **Coal** (5 %), as described above.
2605 - 2607	**Claystone** (10%), as described above. **Sandstone** (90%), as described above. Traces of **Coal**
2607 - 2609	**Claystone** (10%), as described above. **Sandstone** (85%), as described above. **Coal** (5 %), as described above.
2609 - 2617	**Claystone** (10%), grey-brownish, beige, grey, friable to moderately hard, occasionally with micro Pyrite, subplaty to subblocky, locally carbonaceous matter inclusion, non- calcareous. **Sandstone** (90%), off white, friable to moderately hard, fine to medium grained, occasionally coarse grains, subrounded, poorly to moderately sorted, argillaceous-siliceous cement, non- calcareous, fair visible porosity, mainly milled to loose Quartz grains, transparent and translucent, sporadically milky. Traces of **Coal**
2617 - 2621	**Claystone** (5%), as described above. **Sandstone** (85%), loose Quartz grains, transparent and translucent, sporadically milky, medium to fine grained, subrounded, subspherical, moderately to well sorted. **Coal** (10 %), as described above.
2621- 2623	**Claystone** (5%), grey-brownish, beige, grey, friable to moderately hard, occasionally with micro Pyrite, subplaty to subblocky, locally carbonaceous matter inclusion, non- calcareous. **Sandstone** (90%), loose Quartz grains, transparent and translucent, sporadically milky, medium to fine grained, subrounded, subspherical, moderately to well sorted. **Coal** (5 %), black, brittle, shiny lustre.
2623 - 2631	**Claystone** (10%), as described above. **Sandstone** (90%), as described above. Traces of **Coal**
2631 - 2637	**Claystone** (10-15%), as described above. **Sandstone** (85-90%), predominant loose Quartz, clear, off white in places, transparent to translucent, fine to medium, rare coarse, sub angular to sub rounded; when cemented, off white, creamy, friable, moderate sorted, rare well sorted, fair to poor visible visible porosity, quartzic, locally sillicaceous.
2637 - 2641	**Claystone** (15 %), as described above.

Sandstone (85%), loose Quartz, clear, milky, transparent to translucent, fine to coarse, sub angular to subrounded, rounded in places; when cemented, moderate to well sorted, fair to poor visible porosity, quartzic.

2641 - 2645 **Claystone** (30-35 %), as described above.
Sandstone (65-70%), loose Quartz, clear, milky, transparent to translucent, very fine to medium, sub angular to subrounded; when cemented, moderate to poor sorted, poor visible porosity, occasionally fair visible porosity, quartzic, partly milled by bit – rock flour.
Traces of **Coal** black, bright.

2645 - 2647 **Claystone** (25 %), as described above.
Sandstone (75%), loose Quartz, clear, milky, transparent to translucent, fine to medium, sub angular to subrounded; when cemented, moderate to poor sorted, poor to fair visible porosity, quartzic.
Traces of **Coal**.

2647 - 2649 **Claystone** (20 %), as described above.
Sandstone (80%), loose Quartz, clear, milky, transparent to translucent, fine to coarse, subrounded; when cemented, moderate sorted, poor to fair visible porosity, quartzic.
Traces of **Coal**, pyritized in places.

2649 - 2653 **Claystone** (10-20 %), as described above.
Sandstone (80-85 %), loose Quartz, clear, milky, transparent to translucent, fine to coarse, subrounded; when cemented, moderate to poor sorted, poor to fair visible porosity, quartzic.
Coal (traces-5 %), as described above.

2653 - 2655 **Claystone** (10 %), as described above.
Sandstone (90 %), loose Quartz, clear, milky, transparent to translucent, very fine to medium, subrounded, occasionally elongated; when cemented, poor to moderate sorted, poor to fair visible porosity, quartzic.
Coal traces, as described above.

2655 - 2659 **Claystone** (10-15 %), as described above.
Sandstone (85-90%), predominant loose Quartz, clear, very fine to medium, sub angular to sub rounded, when cemented, poor to moderate sorted, poor to fair visible porosity, quartzic.
Traces of **Coal**.

2659 - 2661 **Claystone** (10 %), as described above.
Sandstone (90%), predominant loose Quartz, clear, fine to coarse, sub angular to sub rounded, when cemented, poor to moderate sorted, fair visible porosity, quartzic.
Coal (traces), black, bright, lustre.

2661 - 2667 **Claystone** (10-30 %), as described above.
Sandstone (65-90%), predominant loose Quartz, clear, very fine to coarse, predominant medium, sub angular to sub rounded, when cemented, mainly moderate sorted, locally poor sorted, fair to good visible porosity, quartzic.
Coal (traces-5 %), black, bright, lustre.

2667 - 2671 **Claystone** (35-45 %), brownish-grey, grey, firm, sub platy to platy, locally sub blocky, rare fissile, silty in places, occasionally carbonated.

Sandstone (45-55%), predominant loose Quartz, clear, very fine to medium, sub angular to sub rounded, when cemented, moderate to poor sorted, poor to fair visible porosity, quartzic.
Coal (traces), as described above.

2671 - 2675 **Claystone** (60 %), beige, grey, brownish, friable to moderately hard, subplaty, shally, rarely subblocky, locally micro Pyrite, with Coal (Lignite?) inclusions, non- calcareous.
Sandstone (40 %), as described above.
Traces of **Coal**.

2675 - 2685 **Claystone** (80 %), as described above.
Sandstone (20 %), as described above.
Traces of **Coal**.

2685 - 2687 **Claystone** (70 %), as described above.
Sandstone (30 %), as described above.

2687 - 2689 **Claystone** (40 %), as described above.
Sandstone (60 %), loose Quartz grains, fine to medium grained, subangular to subrounded, subspherical, moderately to well sorted, Quartz grains are transparent and translucent.

2689 - 2690 **Claystone** (30 %), as described above.
Sandstone (70 %), as described above.

2690 - 2691 **Claystone** (45 %), grey, brownish grey, beige, friable to moderately hard, micaeous, silty.
Sandstone (55 %), lose Quartz grains, fine to medium grained, rare coarse, subangular to subrounded, sub spherical, moderately to well sorted, Quartz grains are transparent and translucent.
Sample contaminated by mud chemicals -$CaCO_3$ (up to 80%).

2691 - 2702 **Claystone** (70-90 %), grey, brownish grey, beige, friable to moderately hard, micaeous, silty.
Sandstone (10-30 %), lose Quartz grains, fine to medium grained, subangular to subrounded, sub spherical, moderately to well sorted, Quartz grains are transparent and translucent.
Coal (traces-5 %), black, brtight, lustre.
Sample contaminated by mud chemicals -$CaCO_3$ (up to 80%).

Well Total Depth at 2702m MD / 2297.98m TVD SS

4. SUMMARY OF HYDROCARBON SHOWS

4.1. Mud gas samples were continuously analyzed by FID gas chromotograph. The FID gas chromotograph gave reflections of continous qualitative and quantitative drilling fluid gas analyses (C1 – C5). Its main advantage is precise and continous

measurement, it can be considered as a main instrument in kick detection and determining intervals containing hydrocarbons.

Gas shows				
From [m] / To [m]:		Max. readings C1 [ppm]	BG gas [ppm]	Remarks
262	465	900	100	Formation gas
465	505.2	720	100	Formation gas
505.2	724.7	2380	110	Formation gas
724.7	815.1	2790	170	Formation gas
815.1	830.5	2260	1000	Formation gas
830.5	1112.9	2010	190	Formation gas
1112.9	1273	3300	200	Formation gas
1273	1332	2560	200	Formation gas
1332	1619	2050	210	Formation gas
1619	1726.5	2780	650	Formation gas
1726.5	2148.5	2790	340	Formation gas
2148.5	2170	1900	500	Formation gas
2170	2381.5	3800	360	Formation gas
2381.5	2442.2	4020	60	Formation gas
2442.2	2545.9	5500	1000	Formation gas
2545.9	2702	970	300	Formation gas

5. WIRELINE LOGGING

No logging run was conducted at the HAG GT-01 well

6. Drilling Highlights

8 1/2" section.

- Date: 21/08/2010. Mud losses at 2415 m. Losses rate – 26 m3/ h at flow rate of 2000 l/min
- Date: 25/08/2010. Unable to pass 2300 m while running 7" liner. Casing was POOH and the hole reamed. 11 centralizers left remained downhole.
- Date: 27/08/2010. RIH with ream BHA. 20 t weight loss at 1665m. Ream to bottom.
- Date: 02/09/2010. RIH with 7'' liner. Tight spot at 2390m. Continue to RIH with slow rate circulation. Impossible to go deeper than 2467.5m. Set casing point at this depth.

6'' section.

- Date: 06/09/2010. Ream from 2467m to 2503m. POOH. RIH, resistance ar 2467m. Wash down to 2485m.
- Date: 09/09/2010. Wash down and ream from 2466m to 2504m. POOH. From 2689m to 2507m over pull – 10 T at 2680m – 25 T. Increas of stand pipe pressure to177 bar.
- Date: 10/09/2010. RIH. Wash down from 2490m to 2520m. Ream from 2573m to 2588m; from 2632m to 2642m; from 2659m to 2668m. Next RIH. Ream down from 2467m to 2504m.
- Date: 11/09/2010. POOH. Wash and back ream from 2690m to 2467m. From 2662m to 2651m. Over pull 25 T. RIH. Wash down from 2470m to 2562m. From 2597m to 2630m. From 2649m to 2690m. POOH. Over pulls. At 2690m – 15T. At 1665m, 2644m, 2616m – 10 T. At 2580m, 2577m – 20 T.
- Date: 12/09/2010. RIH. Ream from 2466m.