GANE-1
GANE-1A

Well summary GANE-1 and GANE-1A grønArctic Nuussuaq Eqalulik, West Greenland. Report prepared for grønArctic energy inc., Calgary, Alberta, Canada, December 1995

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G E U S

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1.0 INTRODUCTION, PERTINENT WELL DATA, AND SUMMARY

1.1 Introduction

In May 1995 grønArctic Energy Inc. was awarded an exclusive licence to explore for hydrocarbons on the southern and western part of the Nuussuaq peninsula. As part of the work commitments under this licence three slim core holes were drilled in July and August 1995.

The Geological Survey of Denmark and Greenland (GEUS) carried out the geological services at the well sites which included the preparation of a preliminary geological description of the core and collection of samples. This is being followed by detailed analysis in Copenhagen of all samples of rock, oil and gases collected at the well site, along with the storage of all core and samples taken. As part of an agreement between the Mineral Resources Administration for Greenland (MRA) and grønArctic Energy Inc., all data from the well are confidential until April 1997 and GEUS is obliged to deliver a report to the operator including a geological log of the core, a preliminary sedimentological and stratigraphic analysis, and a description of organic geochemical results.

1.1.1 Location

The location of the GANE#1 (grønArctic Nuussuaq Eqalulik-1) well is on the southern side of the Aaffarsuaq valley and approximately 800 m south of the Kuussuaq river (Fig. 2). The headland Niaqornaarsuk is situated 7.5 km to the west-north-west and the well site is situated 3.5 km inland from the coast. The well is also approximately 9 km south-east of the Marraat-1 well drilled by GGU in 1993 and 10 km south-east of the GANW #1 well drilled by grønArctic in 1994. The elevation is approximately 114 m above mean sea level and the coordinates are 70°28.25′N, 54°00.40′W.

1.1.2 Objective

The objective of well GANE#1 was to penetrate the Tertiary volcanics exposed at surface and to intersect Lower Tertiary and Upper Cretaceous sediments below. It was then the intention to search for further accumulations of hydrocarbons within a Marraat-type play, i.e. with oil and/or gas generated from a Tertiary deltaic source rock and reservoired within Tertiary and/or Cretaceous sandstones. The well would also investigate the structural controls on such a play and provide information concerning the thermal maturity and pressure regime of the area.

1.2 Pertinent well data

Well:	GANE#1 (grønArctic Nussuuaq Eqalulik - 1) and GANE#1A
Well profile:	Vertical hole to 641.29 m. Side-track GANE#1A from 533.4 m to 707 m.
Location:	Approximately 800 m south of the Kuussuaq river (Fig.1). Southern West Nuussuaq.
Coordinates:	70°28.25′N, 54°00.40′W.
Elevation:	Ground level approximately 114 m above mean sea level.
Depths:	All depths are measured from drill floor. Elevation of drill floor above ground level approximately 2 m.
Total depth:	GANE#1, 641.29 m. GANE#1A, 707 m.
Hole diameter:	GANE#1: 114.3 mm (HW) from surface to 20 m, 96.0 mm (HQ) from HQ hole to 202 m, 75.7 mm (NQ) from HQ hole to 631 m, 60.0 mm (BQ) from NQ hole to 641.29 m. GANE#1A 60.0 mm (BQ) from kick-off point (533.4 m) to 707 m.
Core diameter:	GANE#1: 63.6 mm (HQ) from surface to 202 m, 47.6 mm (NQ) from HQ hole to 631 m, 36.5 mm (BQ) from NQ hole to 641.29 m. GANE#1A: 36.5 mm (BQ) from kick-off point (533.4 m) to 707 m.
Casing:	GANE#1: HW conductor casing to 20 m, O.D. 114.3 mm, I.D. 101.6 mm, NW surface casing to 202 m, O.D. 88.9 mm, I.D. 76 mm, NQ drill-rods to 631 m, O.D. 69.9 mm, I.D. 60.3 mm.
Drilling mud, fuel and additives:	Fresh water from supply tank (Sample 439017) Quik-trol polymer (Sample 439019) Diesel (Sample 439121) Jet-Fuel (Sample 439122)

	Hydraulic oil (Sample 439015)
	Rod grease (Sample 439003)
	Pipe Dope (Sample 439002)
Objective:	Structural Marraat-type prospect. Oil generated from Tertiary deltaic source rock, Tertiary and/or Cretaceous sandstone reservoir, structural/stratigraphic closure.

DRILLING PROGRAMME (see Appendix 1)

Date arrive GANE#1:	7th July, 1995
Date spudded:	9th July, 1995
Date drilling:	9th July, 1995
Date of TD:	6th August, 1995
Date released:	9th August, 1995
Days on location:	34

Well status:	Plugged and abandoned.
Conventional cores:	The hole was cored throughout with close to 100% recovery.
Drilling problems:	Whilst pulling out of hole for a bit change at a depth of 631 m the NQ rods became stuck at a depth of approximately 540 m. Repeated attempts to retrieve the string failed. Cement-in the NQ rods. Drill ahead with BQ rods. Become stuck at depth of 641.29 m. Kick-off Side-track well GANE#1A at 533.4 m. BQ rods repeatedly break-off from a depth of 690 m onwards. Excessive formation pressure prevents further drilling. Decide to terminate drilling at a depth of 707 m.
Operator:	grønArctic Energy Inc.
Drilling contractor:	Petro Drilling Limited
Drilling rig:	Diamond drill Longyear Fly-in model 44

Personnel on site during drilling:	Cam Hanna, operations manager, grønArctic Mark Renner, engineering student, grønArctic Kevin Bate, wellsite geologist, GEUS John Boserup, geotechnician, GEUS Helge Silvurberg, pilot, Greenland Air Ova Hansson, pilot, Greenland Air Sivert Olsen, mechanic, Greenland Air Finn Lennard, mechanic, Greenland Air Barry Mathews, foreman, Petro Drilling Lavern Pynn, driller, Petro Drilling Geoffrey Upward, driller, Petro Drilling Ken Piercey, helper, Petro Drilling Bronson Webber, helper, Petro Drilling Darin Oxford, mechanic, Petro Drilling Jakob Knudsen, cook, Greenland Contractors Ina Rosing, cook, Greenland Contractors
Company names and addresses:	*grønArctic Energy Inc.*, Suite 800 – 2nd Street SW, Calgary, Alberta T2P 2Y3, Canada *GEUS, The Geological Survey of Denmark and Greenland*, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark *Petro Drilling Company Ltd.*, PO Box 1021, Armdale, Halifax, Nova Scotia B3L 4K9, Canada *Greenland Air*, 3900 Nuuk, Greenland *Greenland Contractors*, Kristianiagade 1, DK-2100 Copenhagen Ø, Denmark

External communications:	Inmarsat B portable
Internal communications:	VHF radio

1.3 Summary

A total of 631 m of core was recovered from GANE#1 and 173.6 m from side-track well GANE#1A, with recovery close to 100%. The core was sampled, described, and subsequently shipped to Copenhagen. The core confirmed the presence of further oil shows within the Tertiary volcanics which are exposed at surface over a large part of the Nuussuaq peninsula. Preliminary geochemical analysis of the oil supports the concept that the oil has been generated from an early Tertiary deltaic source rock when at an early stage of thermal maturity.

The base of the volcanics (hyaloclastite breccias) was penetrated at a depth of 496.5 m at which point dark grey mudstones and siltstones were encountered. Field observations such as a lack of bioturbation and occasional graded beddding suggest that these sediments were deposited as turbidites possibly in Early Tertiary time. Between 582 m to 598 m the lithology is dominated by mudstone. At a depth of 598 m the lithology changed to predominantly sandstone. The character of this sandstone is clean, well sorted and cross-bedded with occasional plant debris and bioturbation. This may indicate that the sandstones are of a deltaic origin.

Whilst pulling out of hole at a depth of 631 m for a bit change, the NQ drill rods became stuck at a depth of approximately 540 m. Repeated attempts to retrieve the string failed and two attempts to cut the string and retrieve the fish were also unsuccessful. Eventually the NQ rods were cut immediately below the drill floor and cemented in the hole. Drilling proceeded using BQ rods. Drilling progressed to a depth of 641.29 m when the BQ rods broke off at a depth of 561 m possibly due to vibration in the overgauge NQ hole. The presence of gas under pressure entering the hole resulted in inefficient cementing. It was then decided to set a wedge and side-track the hole in an attempt to avoid this problematic section.

The wedge was set a depth of 533.4 m and side-track well GANE#1A proceeded using BQ rods. Drilling progressed until a depth of 685 m when formation gases entered the hole and flowed up the drill rods. The gas was circulated out through the choke manifold and flared off. Drilling resumed but at a depth of 689 m, the rods again broke off at a depth of 550 m. The fish was successfully retrieved from the well. Drilling continued to a depth of 695.5 m at which point the BQ rods once again sheared off. The fish was successfully retrieved from the hole. The hole was deepened to a depth of 707 m at which

point the rods once again broke off; they were successfully retrieved from the well. On running-in the hole it became impossible to progress past the wedge (set at 533.4 m) and it was decided to abandon the hole due to the abnormally high pressure in conjunction with technical problems in passing the wedge.

The formation intersected in GANE#1A has a close correlation with that drilled in GANE#1. The top of the deltaic sandstones was probably intersected at a depth of 598 m. Clean well-sorted sandstones containing pressured gas were intersected at a depth of 684.5 m. Following circulation of this gas to surface and flaring-off, an oily film was seen on the surface of water immediately below the flare-line. This may indicate the presence of condensate flowing from the formation. Gas was also observed bubbling from the core as it was retrieved from the core barrel.

2.0 OPERATIONS

2.1 Drilling history

Field work in the onshore part of the Cretaceous–Tertiary sedimentary basin in the Disko–Nuussuaq–Svartenhuk Halvø region was carried out by the Geological Survey of Greenland (GGU) in conjunction with the Geological Museum, Copenhagen, in the period 1990–1994 (Christiansen *et al.* 1994b; Christiansen *et al.*, 1995b). The main purpose of these expeditions was to gain an understanding of the stratigraphic, sedimentological and organic geochemical history of the area in order to assess the petroleum prospectivity of the basin.

During the course of this work a discovery of oil-impregnated vesicles within some of the lowermost Tertiary basaltic lava flows was made in August 1992 (Christiansen, 1993). Analysis of samples of the oil showed that the oil had only suffered minor biodegradation and no thermal alteration and that the oil had probably been generated from a Lower Tertiary deltaic source rock. The implications are significant because for the first time an oil-prone source rock could be demonstrated in West Greenland.

To investigate the oil impregnation in greater detail a borehole was drilled by GGU near Marraat Killiit using a wireline diamond drilling rig leased from Petro Drilling Company Ltd, Canada. This hole, Marraat-1, was drilled in the period 15th–21st August 1993 and reached a total depth of 446.85 m. The entire core consisted of Tertiary volcanics with the uppermost 86 m of core containing a series of porous zones which were filled with bitumen and liquid oil.

Following this important discovery a prospecting licence was granted to grønArctic Energy Inc. of Regina, Saskatchewan in August 1994 to enable the drilling of a further slim core hole onshore Nuussuaq, with grønArctic Energy Inc. as operator. During the period September 11th to October 5th 1994 the hole GANW#1 was drilled approximately 900 m north-west of the Marraat-1 well with Petro Drilling as the drilling contractor. A total of 800 m of formation was recovered which consists of Lower Tertiary volcanics and sediments of the Vaigat Formation. Oil impregnation and bitumen were seen at various intervals throughout the entire GANW#1 core.

Following on from the drilling of GANW#1 grønArctic Energy Inc. was awarded an exclusive licence in May 1995 to explore for hydrocarbons over a wider area of the Nuussuaq peninsula. As part of the work commitments under this licence grønArctic

Energy Inc. carried out a more extensive drilling programme in western Nuussuaq during the summer of 1995, the aim of which was to test the Marraat- and Serfat-type plays and to investigate the thermal and pressure regime of the area. Well GANE#1 was the first of these holes to be drilled.

2.2 Position of drill site

The borehole was positioned at a site where it was believed that the volcanic succession was relatively thin above a presumed structural high in the underlying sediments. The site was further constrained by availability of water and the fulfilment of requirements set out by the Mineral Resources Administration for Greenland (MRA) for containment of an oil-spill should any occur. It was also positioned close to a suitable position for the establishment of an operational base camp to facilitate smooth shift changes.

The rig was finally positioned approximately 800 m from the Kuussuaq river which is presumed to run along the position of a large fault, and 200 m from a the larger of two lakes to provide a water supply for both the drilling operations and the base camp. Adequate containment facilities were provided by a depression adjacent to the rig.

2.3 Drilling programme

The drilling of the GANE#1 and side-track GANE#1A wells took place in the period 9th July to 6th August (Fig. 3) with Petro Drilling Company Limited as drilling contractor. A wire-line diamond drilling rig (Longyear Fly-in model 44) was used enabling rapid helilifting of the rig to the drilling location. The rig has a theoretical capacity to drill to a depth of 1200 m and this was the planned depth for the well.

The drill was operated by four drillers working continuous twelve hour shifts of two men. Helicopter support was provided by Greenland Air using a Bell 212 and Bell 206LR under contract to grønArctic Energy Inc.. Fuel and supplies were stored on a support ship, the *Viking Naja*, moored offshore from the nearby coast. A base camp was established a few hundred metres away from the drill site.

Immediately upon drilling bedrock, a hyaloclastite basalt breccia, oil was seen bleeding (freely flowing) from vesicles and microfractures within the rocks. Drilling was temporarily stopped to allow accurate sampling of the the core. Drilling resumed and continued until the HW casing was set at a depth of 20 m. Upon resumption of drilling of the HQ hole the rate of penetration was maintained at a steady and high rate, with occasional traces of oil and solid bitumen identified in the core. At a depth of 109 m the transmission on the drilling rig failed which necessitated repair.

At a depth of 147 m further oil shows were seen with oil bleeding from vesicles and microfractures in the hyaloclastite. The oil has a light brown to red colour and a cream fluorescence which suggests a relatively light immature oil (API of approximately 25–35). Over the depth interval 152.50 m to 158.23 m the core was completely saturated in freely flowing oil with the same characteristics as that just described.

Drilling continued to a depth of 202 m at which point the the NW casing was run in the hole with the shoe set at a depth of 202 m. Following cementing of the casing the BOP, manifold and flare-line were rigged up and the blow out preventer (BOP) pressure tested. The drilling of the NQ section of hole began with the drilling of 2 m of new formation at which point a formation integrity test was performed. The leak-off pressure recorded at surface was 2068 kPa with a formation leak-off gradient of 20 kPa/m (EMW 2043 kg/m^3).

The NQ section of hole proceeded well except for occasional zones of lost circulation which was rectified by the pumping of fine sawdust around the hole. The base of the volcanics was penetrated at a depth of 496.5 m with the lithology changing to dark grey mudstones.

At a depth of 631 m the drill string was pulled out of hole for a bit change. As the rods were being pulled they became stuck at a depth of 539.6 m and all attempts to circulate and rotate the rods failed. At this point it was decided to run BQ rods down inside the stuck NQ rods and to cut the NQ rods at a depth of 525.5 m. The cutting of the rods was successfully performed but all attempts to retrieve the string failed. The BQ rods and cutting tool were run down the hole and the NQ rods were cut for a second time at a depth of 510.25 m. Unfortunately it was still impossible to rotate the NQ rods or to circulate around them. Sweet gas was detected percolating up through the drill rods but under little pressure at surface. Gas detection equipment did not register any indications of H_2S.

At this point it was decided to cement-in the NQ rods from surface to the NW casing shoe at 202 m and to continue to drill ahead using BQ rods. The landing ring on the NQ core barrel was then drilled through and new formation was drilled. At a depth of 638 m transmission failure interrupted progress. Upon completion of the repairs to the transmission it became evident that it was not possible to regain circulation in the well. The core barrel was retrieved from the well at which point gas was observed entering the drilling fluid. This gas was circulated out via the flare-line.

Drilling resumed and progressed to a depth of 641 m when it became impossible to retrieve the core barrel. The BQ rods were pulled out of hole and it became evident that the rods had sheared off at a depth of 560.83 m. The rods were successfully fished from the hole with gas levels remaining at a significant level, which were flared-off.

It was then decided to set a cement plug at the base of the hole and to set a wedge to kick-off a side-track well in an attempt to overcome the problematic section. However it became evident that the percolating gas had contaminated the cement and a further cementing of the hole was required. The wedge was set at a depth of 533.4 m and side-tracked hole, GANE#1A, was started using initially a bullnose bit to drill new formation before reverting to conventional coring.

Drilling of GANE#1A proceeded to a depth of 689 m at which point pump pressure was lost. The rods were pulled and it was discovered that the rods had sheared off at a depth of 550 m. The rods were fished from the hole. A new bit was put onto the string and run into the hole. Drilling resumed and continued to a depth of 695.5 m when it became impossible to retreive the core barrel. The rods were pulled out of hole and again the rods had sheared-off at a depth of 539.5 m. The rods were successfully fished from the hole. The string was rerun into the hole and gas circulated from the well. Circulation through the core barrel was unsuccessful and the rods were pulled from the hole.

The string was run back in the hole with a new core bit but it was unable to pass the top of the wedge. The rods were pulled from the hole and a bullnose bit put onto the string and the string successfully passed the wedge. The string was retrieved from the hole and a coring bit put onto the rods. Problems were again encountered in passing the wedge but were overcome by the manual rotation of the drill rods.

Drilling resumed at a depth of 695.5m and continued to a depth of 707 m when the rods sheared off once again. The rods were successfully fished from the hole. A further attempt at running in the hole proved unsuccessful due to the wedge obstructing the core barrel. The well was still flowing and formation water was blown from the well to a height of 10 m. The rods were then pulled from the hole.

At this point it was decided to abandon the well due to the abnormally high pressures encountered and the technical problems in passing the wedge. It was estimated that the circulation density of the drilling fluid required to drill ahead under controlled conditions (1850 kg/m^3) was beyond the capability of the drill rig. The well was cemented from surface to 707 m and classified as plugged and abandoned. The rig was then demobilised, the site cleaned and the rig helilifted to the next well site.

3.0 GEOLOGY

3.1 Setting and stratigraphy

The West Greenland margin is a rifted continental margin, developed during the opening of the Labrador Sea and Baffin Bay in late Mesozoic–early Cenozoic time. Along the continental break-up zone a number of rift basins developed in which Cretaceous and Tertiary sediments were deposited (cf. Chalmers *et al.*, 1993; Chalmers & Pulvertaft, 1993). On the mainland Cretaceous–Tertiary sediments overlain by volcanic rocks outcrop in the Disko–Nuussuaq–Svartenhuk Halvø region (69°–72°N). The sediments were laid down in a basin, the Nuussuaq Basin, which is bounded to the east by an extensional fault system (Rosenkrantz & Pulvertaft, 1969). Recently acquired seismic data indicate that the maximum thickness of sediments in the basin exceeds 7 km (Christiansen *et al.*, 1995b), but the age and character of the deepest sediments are not known.

The exposed Cretaceous sediments, which are of Albian to late Campanian or early Maastrichtian age, were deposited in a fluvial- and wave-dominated delta environment (Pedersen & Pulvertaft, 1992). The delta fanned out to the west and north-west from a point east of Disko island, reaching into deeper water in the position of present-day northern Nuussuaq and Svartenhuk Halvø. Pre- and syn-rift fluvial sandstones with minor mudstone and coal characterise the south and east of the outcrop area. To the north-west these give way to stacked, typical deltaic, coarsening-upwards successions, each starting with interdistributary bay mudstones and ending with coal, while still farther north-west dark mudstones were deposited in a purely marine environment.

Towards the end of the Maastrichtian the area became tectonically unstable. Phases of uplift were followed by incision of valleys in the underlying sediments. Conglomerates and both turbiditic and fluvial sands and mudstones of Late Maastrichtian to middle Paleocene age filled the valleys, while on the fault-controlled slope to the west more than 2.5 km of turbidite sands alternating with marine mudstones were deposited (Dam & Sønderholm, 1994).

The eruption of Early Tertiary basalts began in a subaqueous environment, so that the earliest basalts, which occur to the west, consist of hyaloclastite breccias that build up Gilbert-type delta structures with cross-bedded sets up to 700 m thick. The growing volcanic pile dammed up a lake to the east in which organic-rich lacustrine mudstones were deposited. As the volcanic edifice emerged above sea- or lake-level, eruption became sub-aerial, and plateau lavas spread into the east, finally overlapping onto Precambrian basement.

Field work in the area during the period 1990–1992 identified oil-impregnation in vesicles in basaltic lava flows within the hyaloclastic breccias at Marraat Killiit, Nuussuaq (Christiansen, 1993, 1994). Subsequent to this discovery the Marraat-1 well was drilled in 1993 to investigate the extent of the impregnation (Dam & Christiansen, 1994; Christiansen *et al.*, 1994a,b). In 1994 grønArctic Energy Inc. drilled the GANW#1 well 900 m north-west of Marraat-1 and confirmed further oil impregnation (Christiansen *et al.*, 1995a). The Marraat area is situated at the south-eastern margin of the major Itilli Fault Zone, which is centred in the Itilli valley (Dam & Sønderholm, 1994). The GANE#1 well is situated 9 km south-east of the Marraat-1 well.

The surface exposures at GANE#1 consist of hyaloclastites belonging to the oldest part of the Vaigat Formation (Pedersen, 1985). The volcanic rocks were extruded from local submarine eruption sites and redeposited by sedimentary processes in an aqueous environment during the Early Paleocene (Pedersen, 1985; Piasecki *et al.*, 1992; Christiansen *et al.,* 1995a).

The marine sediments exposed at Marraat Killiit contain a late Danian fauna composed of bryozoans, gastropods, pelecypods and spines of echinoderms (Rosenkrantz, 1970). Palynostratigraphy of the lower sedimentary units in the GANW#1 well gave indications of an age not older than middle Danian (Christiansen *et al.,* 1995a). The age of the sediments penetrated below the volcanic units in GANE#1 is therefore probably middle–Late Danian.

3.2 Lithology

At the well site a preliminary geological/sedimentological description was performed. Logging of the core was carried out at a scale of 1:50 and subsequently redrawn at a scale of 1:1250 (Fig.4).

The API of the any oil occurring within the core was tentatively determined by use of an UV-light with the colour of the fluorescence characteristic of the API gravity of the oil with the darker fluorescence generally indicating heavier crudes. Identification of gases escaping from the core and drilling fluids was performed by the drillers and/or GEUS personnel when the core was unloaded from the core barrel.

The rocks intersected in the well can be broadly divided into an upper volcanic unit underlain by a sedimentary succession (Fig. 4). The base of the volcanic interval was intersected at a depth of 495.5 m. The well terminated within the sedimentary succession at a depth of 707 m.

The volcanic interval consists predominantly of hyaloclastite breccias which are produced when magma either flows into or is extruded directly under water. The strong chilling effect of the water leads to quenching and disintegration into pillows with glass rinds and shards. These are then redeposited by sedimentary processes and often accumulate to produce thick deposits.

A preliminary examination of the hyaloclastites interesected in the well suggested the presence of a minimum of sixteen individual units. This is based on the recognition of differences in the size and shape of the clasts, the degree of sorting of the clasts and the colour and mineralogy of the matrix which reflect differences in the chemistry and petrography.

The clasts in all the hyaloclastites consist predominantly of light grey microcrystalline basalt with abundant small vesicles which have been filled with both calcite and quartz. However the size of the clasts and their degree of sorting is commonly highly variable which may indicate seperate flows. At various intervals the clasts are matrix supported whereas over other intervals the clasts are predominantly clast supported. A further diagnostic criteria for subdivision is colour of the matrix. Generally the matrix has a grey colour; however, over certain intervals the matrix has a strong to very strong green colouration which may reflect a higher concentration of chlorite. Often these zones of green matrix are softer and more crumbly than the hyaloclastite with a predominantly grey matrix which is probably due to alteration of the chlorite to clays. This resulted in a loss of circulation over these zones which was rectified by pumping sawdust around the hole to plug the formation.

At certain times it would appear that the hyaloclastites became emergent because a number of sub-aerial lava flows occur within the hyaloclastites. These are predominantly grey-green in colour, microcrystalline, with abundant vesicles filled with white calcite and/or quartz.

Intrusions, either dykes or sills, were identified at four positions in the well. These can be recognised by their sharp chilled margins and the micro- to meso-crystalline massive interior. These intrusions are predominantly grey-green to blue in colour, microcrystalline with occasional green phenocrysts, brittle and very hard.

The base of the volcanics was intersected at a depth of 496.5 m at which point sediments were intersected for the first time. Sediments continued until termination of GANE#1 at a depth of 640 m and TD of the side-track well GANE#1A at a depth of 707 m. A number of lithologies and facies associations can be recognised and an attempt has been made to adopt the same facies descriptions as those made for the well GANK#1. The facies associations are as follows: 1. Mudstone, 2. Thinly interbedded sandstone and mudstone, 3. Bioturbated thinly interbedded sandstone and mudstone, and 4. Sandstone and conglomerate. A further facies association recognised in GANE#1 but not in GANK#1 is 6. Clean sandstone (Facies association 5. Pebbly mudstone, was identified in well GANT#1 only).

3.3 Facies association description

Facies association 1: Mudstone

Description: This facies association consists of dark grey to black, non-calcareous, hard and brittle mudstone which is parallel laminated with occasional irregular lamination. A particularly interesting feature of this mudstone is that it commonly broke into 1–2 cm platelets the surfaces of which are very smooth and glass-like. This may be the result of the alignment of quartz and mica crystals reflecting a tectonic fabric.

Interbedded with this mudstone are occassional thin (1–2 mm) siltstone beds ranging from clean to argillaceous with abundant mica. Often these siltstones are slumped or disturbed.

Interpretation: The lack of bioturbation suggests that the mudstone was deposited in anoxic conditions probably in an abyssal or distal slope environment. The slumped character of the siltstone laminae may indicate that these beds were deposited rapidly.

Facies association 2: Thinly interbedded sandstone and mudstone

Description: This facies is similar to the mudstone of facies association 1, but the density of siltstone and sandstone beds is greater. The silty sandstones are very fine to medium grained, clean to argillaceous, hard, non-calcareous and micaceous, with individual beds ranging in thickness from 1–2 mm to 50 cm. The predominant structure is parallel lamination with occasional irregular lamination.

Interpretation: This facies was probably deposited in a more proximal position relative to facies association 1. The silty-sandstone beds were probably deposited from low-density turbidity currents.

Facies association 3: Bioturbated thinly interbedded sandstone and mudstone

escription: This facies association is present in the lower part of the well. The lithologies of the mudstone and sandstone are similar to facies associations 1 and 2. However, the thin sandstone beds show structures that could be related to burrowing organisms, and plant debris are evident within the mudstone intervals.

Interpretation: The presence of both bioturbation and plant debris within this facies association suggests that deposition occurred in relatively shallow marine conditions, possibly in a deltaic setting.

Facies association 4: Sandstone [and conglomerate]

Description: This facies association is restricted to the upper sedimentary section and consists of amalgamated sandstone beds exhibiting both coarsening-upwards and fining-upwards cycles. The sandstones are generally light grey and medium to occasionally coarse grained; grains are sub-angular to sub-rounded in shape and moderately well sorted. There is a siliceous cement. The sandstones are generally parallel laminated but occasionally the laminae are disturbed which may be due to dewatering of the sediments.

Interpretation: The disturbed bedding in the sandstone probably due to dewatering. The lack of bioturbation and indication of intermittent rapid sedimentation may suggest deposition in an anoxic environment with the sandstones introduced by turbidity currents. This is supported by the presence of both coarsening-upwards and fining-upwards cycles.

Facies association 5 : Pebbly mudstone

This facies association is only present in well GANT#1 and is absent in well GANE#1.

Facies association 6: Massive and cross-bedded sandstones with bioturbation

Description: This facies association is present in the lowermost section of the well and is not present in the GANK#1 well. The sandstones are light grey to grey but become more grey-blue with increasing depth. The grain size ranges from medium to coarse grained to very coarse in parts with the grains ranging from sub-angular to rounded. The reservoir properties of these sandstones (approximately 15–20% porosity) appear to be improved when compared to the sandstones over the depth range 540 m to 580 m. The cement is exclusively siliceous. The sandstones are generally massive but at certain depths there is evidence of cross-bedding, bioturbation and plant debris.

Interpretation: These sandstones exhibit improved porosity and have a less argillaceous nature than the sandstones between 540 m and 580 m. This in conjunction with the presence of cross-bedding, bioturbation and plant debris suggests deposition in a shallow marine, proximal setting such as in a deltaic environment.

3.4 Lateral correlation and depositional environment

A comparison between GANE#1 and the side-track hole GANE#1A (Fig. 4) demonstrates a very close similarity between the two holes. The vertical offset between the two holes is minor and in the order of 0.5 m. A comparison of the degree of dip of the bedding relative to the core from the two holes performed at the well site, demonstrated that there is no variation in angle of bedding to core between GANE#1 and GANE#1A.

A correlation of the well GANE#1 with GANK#1 however is more tenuous. The distance between these two wells approximately 6 km. A crude correlation between the two holes based on the depth to base hyaloclastites is presented (Fig. 5) but it must be stated that such a correlation is highly tentative due to the variability in behaviour of the hyaloclastite succession onshore Nuussuaq.

The sediments immediately below the hyaloclastites in both the GANE#1 and GANK#1 holes were deposited in a distal marine setting probably influenced by turbidity currents. This may place these sediments within the Maastrichtian to Lower Paleocene Kangilia Formation and Itilli succession (Dam & Sønderholm, 1994). The amount of sandstone intersected in the GANE#1 and GANE#1A holes within this deep marine interval is greater than that in GANK#1 and GANK#1A which may indicate that the GANE area was in a more proximal position. Alternatively the lateral facies variation could be the result of GANE#1 having drilled into a turbidite lobe while GANK#1 penetrated an interlobe section. A third possibility is that there is a large fault between the two wells.

The sediments intersected in the lower part of GANE#1A might have been deposited in a deltaic environment which if is the case may place them within the Atane Formation. These sediments were not intersected in the GANK#1 and GANK#1A holes.

3.5 Summary of hydrocarbon shows

Definitions

Impregnation	Obvious oil staining on surface and interior of core. Not freely flowing.
Bleeding	Freely flowing liquid oil from vesicles, microfractures and matrix.

Shows

GANE#1

03–10 m	Oil impregnation of hyaloclastite. Impregnation and bleeding of oil from both vesicles and microfractures within both clasts and matrix. Red to brown oil.
23 m	Large calcite vesicle bleeding oil.
32–34 m	Solid black bitumen impregnating large fractures.
46–47 m	Solid black bitumen impregnating large fractures.
147–150 m	Oil impregnation of hyaloclastite. Impregnation and bleeding of oil from both vesicles and microfractures within both clasts and matrix. Red to light brown oil with green to cream fluorescence, light API (25–35).

152.5–158.2m	Oil saturated hyaloclastite. Oil bleeding from vesicles and microfractures within clasts and from apparent porosity within matrix. Red to light brown oil with cream-blue fluorescence, light API (35–45).
163–164 m	Oil impregnation of vesicles within clasts and matrix. Red to light brown oil with blue to cream fluorescence, light API (35–45).
165–190 m	Isolated but persistent impregnation of vesicles and microfractures. Red to light brown oil with cream fluorescence.
240–270 m	As above but bleeding in parts.
281–308 m	Isolated but persistent impregnation of vesicles and microfractures. Red to light brown oil with cream fluorescence.
319–330 m	As above.
338–350 m	As above.
388–394 m	Impregnation of microfractures. Red to light brown oil with cream fluorescence.
414 m	Impregnation of microfractures and matrix. Red to light brown oil with cream fluorescence.
631 m	Sweet gas bubbling from wellhead.
633–638 m	As above.
641 m	Gas contaminated cement

GANE#1A

684–689 m	Gas kick. Gas identified bubbling from core. Wet gas and possibly condensate escaping from flare-line. Circulate-out gas through choke at 700 kpa at 26.5 litres/minute increasing to 45 litres/minute. Gas flare 10 m long.
696.5–702 m	Gas bubbling from core. Formation water flowing from well at 20 litres/minute at 350 kpa.

3.6 Cores

A total of 641 m of conventional core was recovered from GANE#1 and 173.6 m from side-track well GANE#1A (kick-off point @ 533.4 m, TD 707 m), with recovery close to 100%. Poor recovery over certain intervals was the result of heavily fracturing of the formation, and alteration of micas to clays producing washed-out zones. A list of the core boxes is given in Appendix III.

3.7 Samples

The sampling was approximately 2 samples every 3 m, which included one sealed tin sample (8 cm core piece wrapped in aluminium foil) for later gas analysis and detailed petrography, and one chip sample (1 cm core piece) for reference/lithology. A list of core samples taken at the well site is shown in Appendix IV.

Gas samples were taken directly into a steel cylinder or via plastic bags. Additional samples were taken of any potential and actual contaminants such as rod-grease, jet-fuel, transmission oil, and addtives to the drilling fluid. A summary of the samples taken at the well site is given in Table 1.

Table 1. Summary of samples taken at well site GANE#1 and #1A

GANE#1	Number of core boxes	205 (1–205 from 3.6–641 m)
	Number of chip samples	217
	Number of tin samples (sealed)	212
	Number of gas samples	2
	Number of miscellaneous samples	23
GANE#1A	Number of core boxes	52 (206–258 from 535.57–707 m)
	Number of chip samples	50
	Number of tin samples	50
	Number of gas samples	0
	Number of miscellaneous samples	16

3.8 Analytical methods

Part of the sample material has been analysed at the GEUS. The following analytical techniques have been applied:

1) Leco/RockEval pyrolysis
2) Vitrinite reflectance
3) Extraction with subsequent desaphalting and column separation into saturated and aromatic hydrocarbons and NSO compounds
4) Gas chromatography and gas chromatography/mass spectrometry of saturated hydrocarbons
5) Head space gas composition, C and H isotopes
6) Conventional core analysis: porosity, permeability and grain density
7) Water geochemistry, pH and alkalinity

At the time of writing the techniques listed above have not been completed for all samples. However the preliminary results indicate that the oil encountered in the hyalocastites is of a similar character to that intersected in the Marraat-1 well, i.e. is derived from an Early Tertiary source rock deposited within a deltaic environment. However the high levels of higher plant biomarkers suggests a higher terrigenous input in the organic matter which may in turn indicate a more proximal position of the source rock for the GANE#1 oil relative to that of Marraat-1. Furthermore, the geochemical analysis suggests that the source rock maturity at the GANE#1 well site is slightly lower than that at Marraat-1.

With regard the gas encountered in the deeper sections of the hole, the preliminary results of the gas analysis indicate a high content of methane with only minor indications of heavier gases. Therefore it would appear that the gas is of a very dry nature which in turn suggests that it has been generated within the gas window, i.e. from a source rock of far higher thermal maturity than that from which the oil was generated. The conclusion to be drawn from this is that the gas has been generated from a seperate source rock to that of the oil, at a much higher temperature (greater depth) and that it has migrated to this shallower depth.

The results and implications of these analyses will be presented in seperate reports upon completion and interpretation of the results.

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FIGURES

Fig. 1

Geological map of central West Greenland showing location of well sites. Map based on Pedersen & Pulvertaft (1992) and Dam & Sønderholm (1994).

Fig. 2

Topographic map of the Marraat area, west Nuussuaq, showing the location of well sites and localities with oil impregnation. Map based partly on Christiansen *et al.* (1995b).

Fig. 3

Plot of time vs progress of drilling, GANE#1 well.

Fig. 4

Simplified sedimentological log of the GANE#1 and GANE#1A cores. Scale 1:1250.

Fig.5

Simplified sedimentological logs of the GANE#1, GANE#1A, GANK#1 and GANK#1A cores.

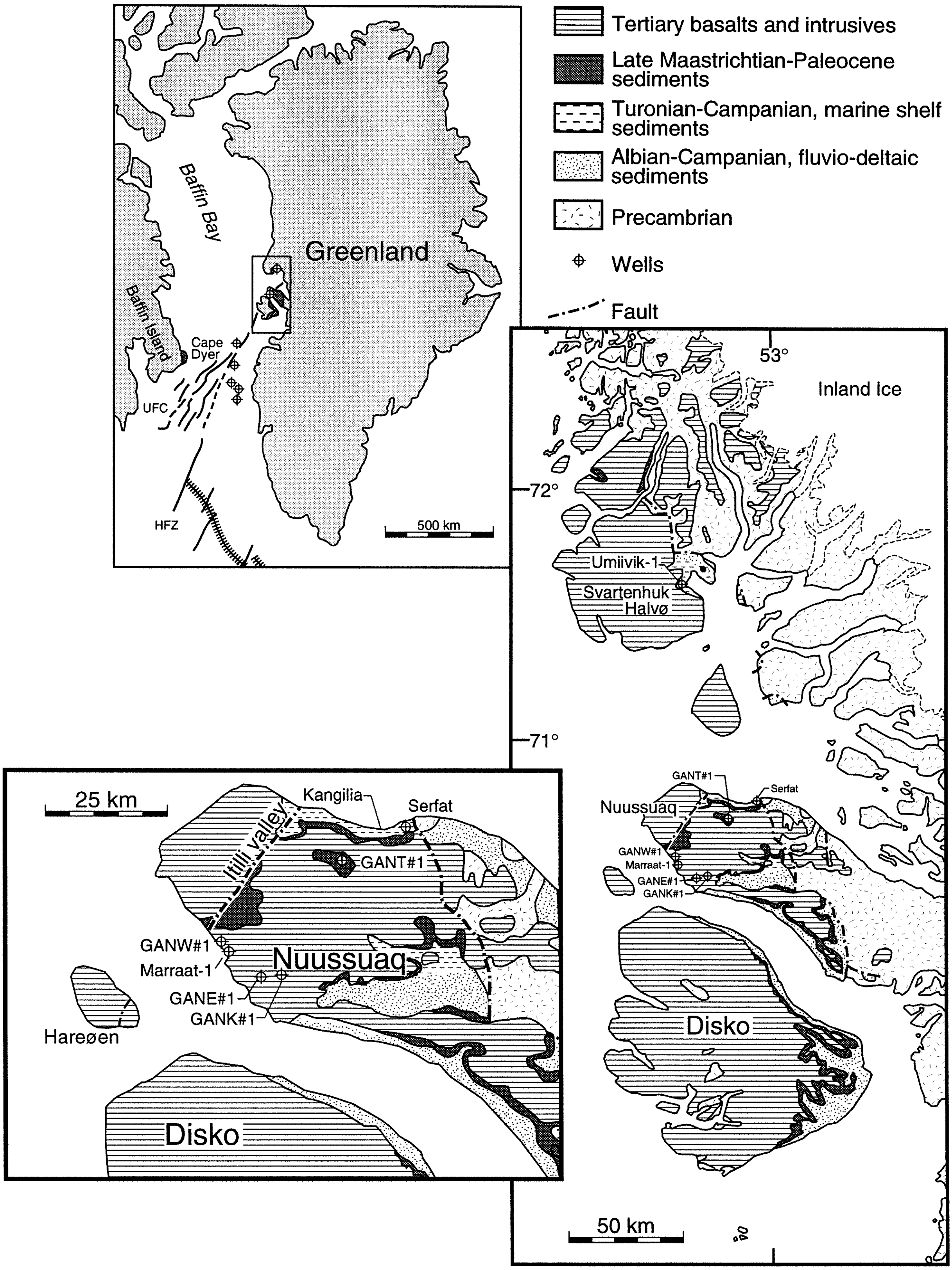
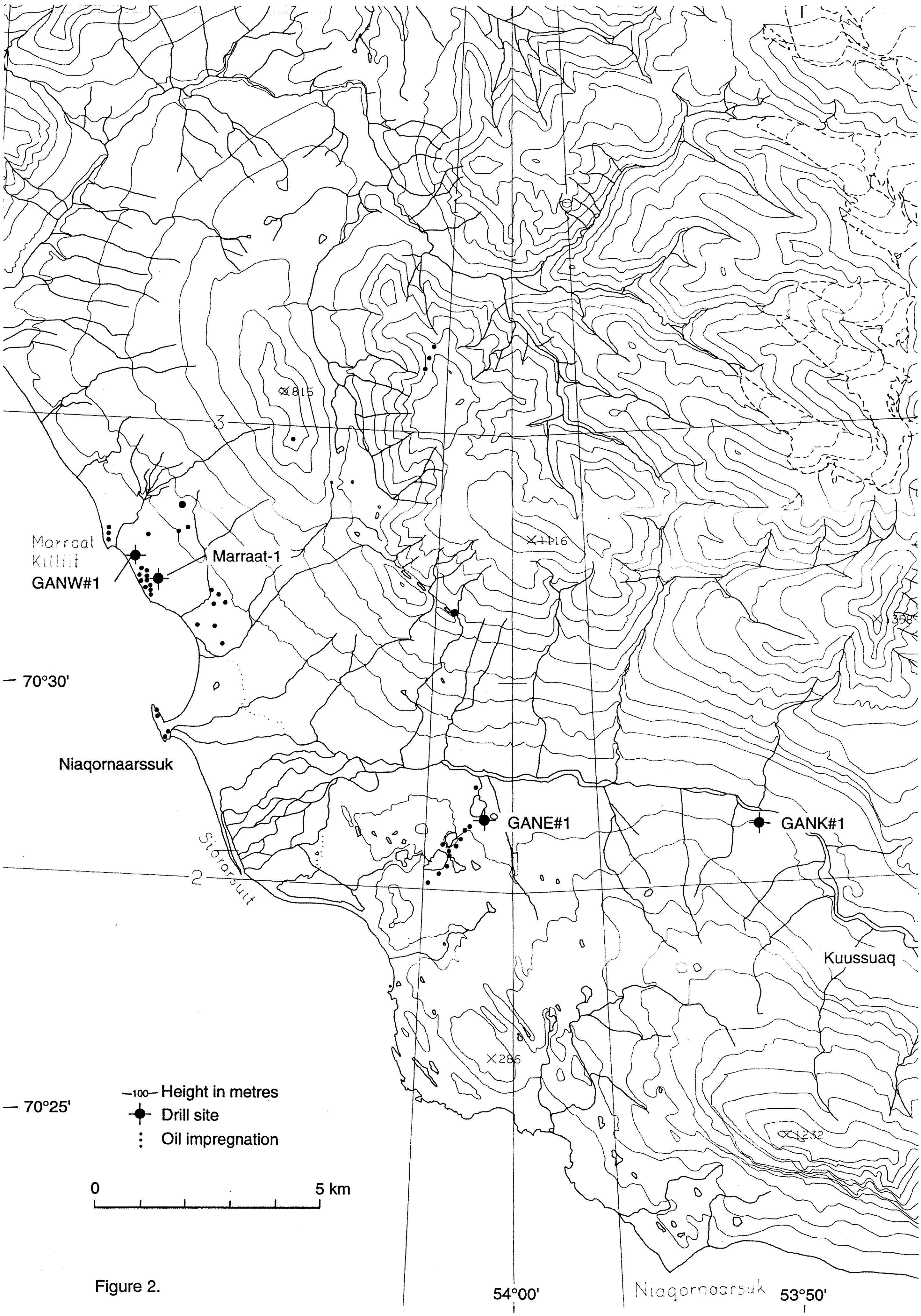


Figure 1. Geological map of central West Greenland showing location of well sites.



815
3
Marraat
Killiit
Marraat-1
GANW#1
1116
1358
— 70°30'
Niaqornaarssuk
Storarsuit
2
GANE#1
GANK#1
Kuussuaq
286
— 70°25'
100 Height in metres
Drill site
Oil impregnation
0
5 km
1232
54°00'
Niaqornaarsuk
53°50'

Figure 2.

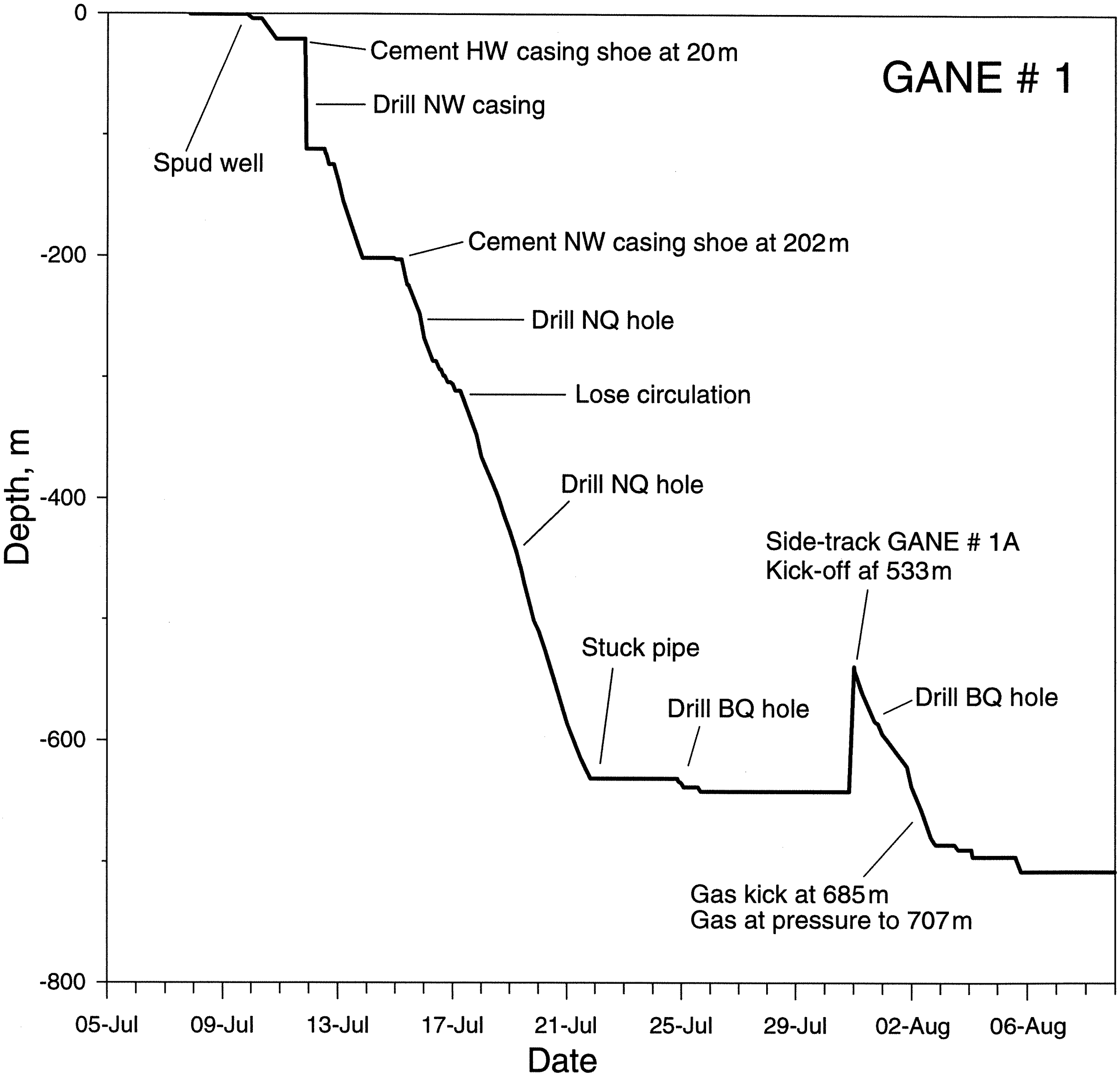
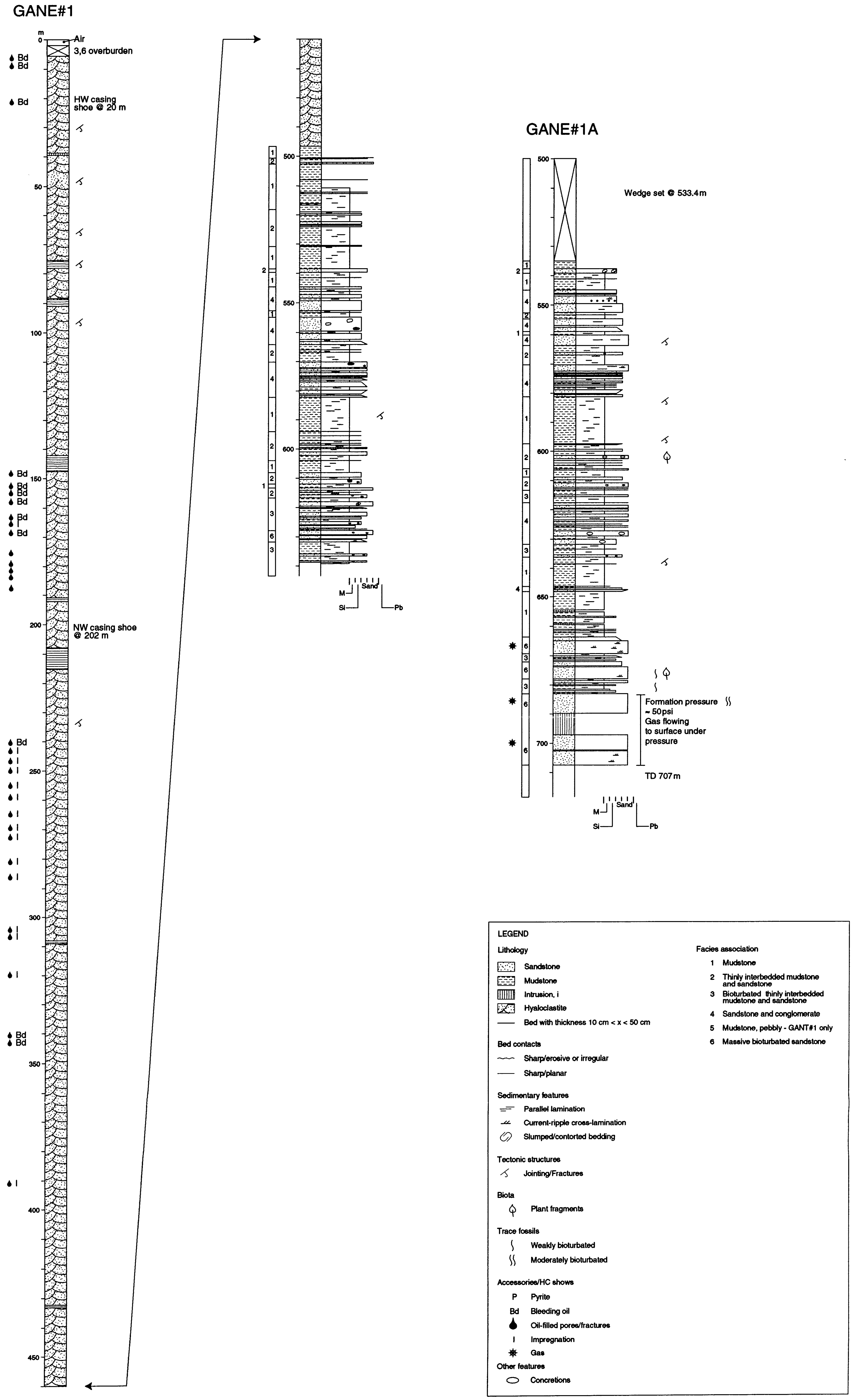


Figure 3. Plot of time vs progress of drilling, GANE#1 well.



G6.1-95.040-GANE#1-1A

Figure 4. Simplified sedimentological log of the GANE#1 and GANE#1A cores

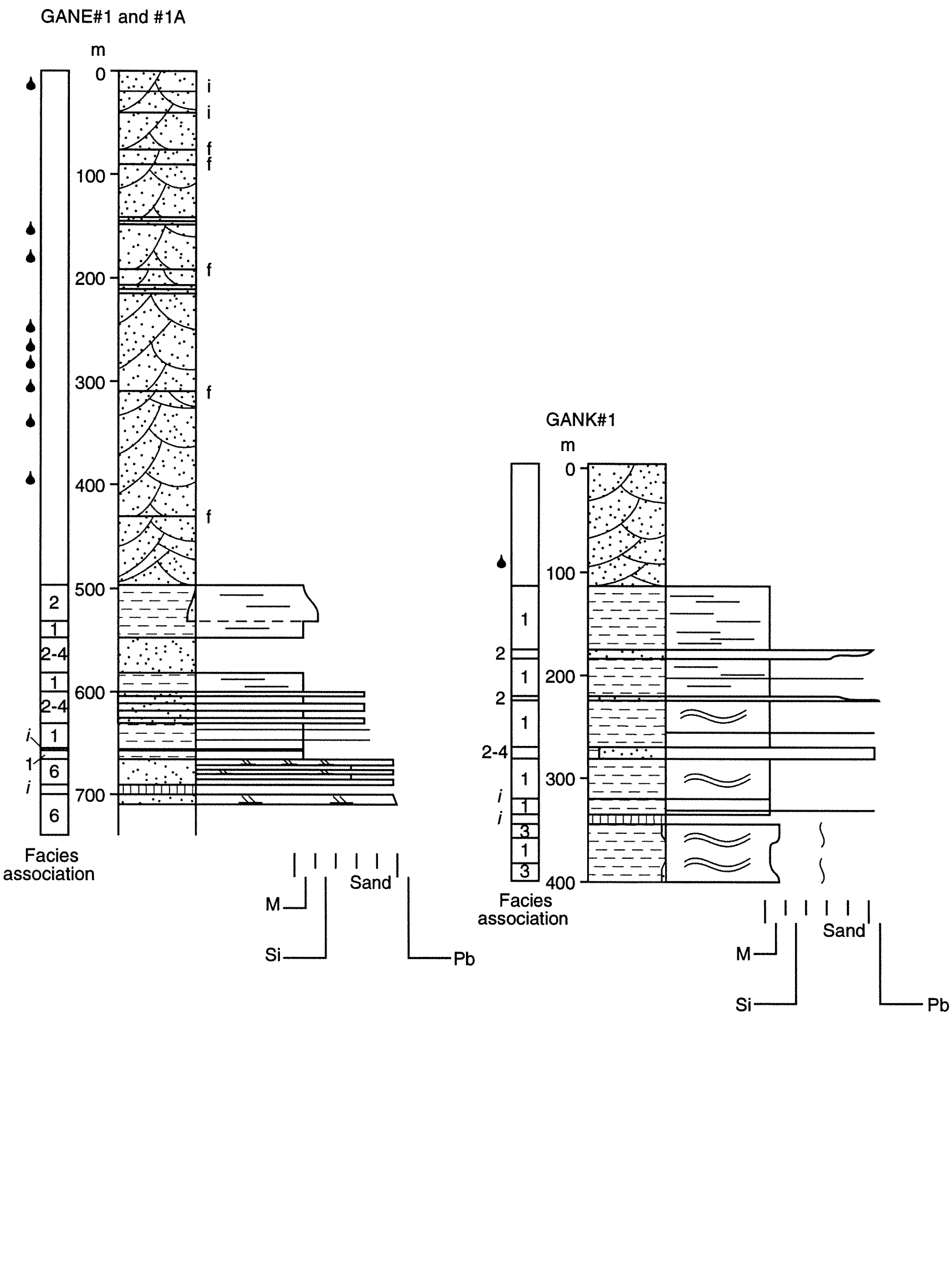


Figure 5. Simplified sedimentological logs of the GANE#1, GANK#1 and GANK#1A cores.

G6.1-95.30-CD

APPENDICES

Appendix I

Drilling programme

Drilling programme

Date	Time	Activities
07-July	20:00-24:00	Mobilise rig
08-July	00:00-20:00	Mobilise rig
	20:00-24:00	Mobilise rig
09-July	00:00-16:00	Mobilise rig
	16:00-20:00	Spud well GANE#1
	20:00-24:00	Drill HW conductor casing to 3.0 m
10-July	00:00-08:00	Drill HW conductor casing to 6.6 m
	08:00-20:00	Drill HW conductor casing to 20 m
	20:00-24:00	Pull HW conductor casing
11-July	00:00-08:00	Pull HW conductor casing
	08:00-09:00	Cement HW conductor casing. Displace cement to 20 m
	09:00-20:00	Wait on cement
	20:00-21:00	Drill NW casing
	21:00-24:00	Repair transmission
12-July	00:00-12:00	Repair transmission
	12:00-13:00	Drill NW casing to 115 m
	13:00-14:00	Replace fuel filter
	14:00-16:00	Drill NW casing to 124 m
	16:00-20:00	Grease rods
	20:00-24:00	Drill NW hole to 139 m
13-July	00:00-20:00	Drill NW hole to 202 m
	20:00-22:00	Run NW casing
	22:00-22:45	Mix & pump 20 sacks (800 kg) of Class A cement
	22:45-23:15	Displace cement with 1m^3 of water to casing shoe
	23:15-24:00	Wait on cement
14-July	00:00-11:00	Wait on cement
	11:00-17:00	Rig-up and pressure test BOP, mud manifold & choke manifold to 1000 psi for 10 min. Rig-up flare lines

	17:00-20:00	Wash contaminated cement from 178 m to 202 m
	20:00-22:00	Wash contaminated cement from 178 m to 202 m
	22:00-23:00	Pull drill rods and unplug core barrel. Run drill rods to casing shoe
	23:00-24:00	Perform formation integrity test. Leak-off pressure 2068 kpa. Formation leak-off gradient is 20 kpa/m
15-July	00:00-05:00	Replace bearing on transmission gear box
	05:00-10:00	Drill NQ hole to 223.4 m
	10:00-11:00	Unplug core barrel
	11:00-20:00	Drill NQ hole to 247 m
	20:00-24:00	Drill NQ hole to 267 m
16-July	00:00-07:00	Drill NQ hole to 285.6 m
	07:00-10:00	Lose circulation. Regain circulation by pumping 2 sacks of fine sawdust
	10:00-13:00	Drill NQ hole to 293 m
	13:00-14:00	Maintenence to BOP, mud & choke manifolds and flare lines
	14:00-16:00	Drill NQ hole to 298 m
	16:00-17:00	Lose circulation. Regain circulation by pumping 1 sack of fine sawdust
	17:00-20:00	Drill NQ hole to 303 m
	20:00-21:00	Pull drill rods for bit change
	21:00-22:00	Repair rod breaker
	22:00-23:00	Run rods in hole
	23:00-24:00	Drill NQ hole to 305.4 m. Lose circulation. Regain by pumping 1 sack of fine sawdust
17-July	00:00-02:00	Drill NQ hole to 310 m
	02:00-03:00	Lose circulation. Regain circulation by pumping 1 sack of fine sawdust
	03:00-06:00	Drill rods plugged. Unplug drill rods
	06:00-20:00	Drill NQ hole to 347 m
	20:00-24:00	Drill NQ hole to 365 m

18-July	00:00.20:00	Drill NQ hole to 416 m
	20:00-24:00	Drill NQ hole to 427 m
19-July	00:00-20:00	Drill NQ hole to 500 m
	20:00-24:00	Drill NQ hole to 509 m
20-July	00:00-20:00	Drill NQ hole to 572 m
	20:00-24:00	Drill NQ hole to 585 m
21-July	00:00-20:00	Drill NQ hole to 631 m
	20:00-21:00	Pull NQ rods for bit change
	21:00-24:00	Rods become stuck in hole at 539.6 m. Unable to free or circulate pipe
22-July	00:00-03:00	Helilift BQ rods & Bowen pipe cutters
	03:00-08:00	Pick-up and run BQ rods. Cut NQ rods at 525.5 m
	08:00-12:00	Pull BQ rods and remove cutter. Unable to pull, rotate or circulate NQ rods. Charging formation below 631 m to 2068 kpa. Sweet gas percolating
	12:00-20:00	Pick-up and run BQ rods. Cut NQ rods at 510.25 m
	20:00-24:00	Wait on fog
23-July	00:00-20:00	Wait on fog
	20:00-23:00	Wait on fog
	23:00-24:00	Helilift BQ core barrels, BQ rods, Jet fuel, diesel and cement
24-July	00:00-05:00	Helilift BQ core barrels, BQ rods, Jet fuel, diesel and cement
	05:00-08:00	Rack BQ rods in derrick
	08:00-09:00	Mix and pump 5 sacks of class A cement. Slurry volume 0.15 m^3. Squeeze cement from surface to 225 m
	09:00-15:00	Wait on cement
	15:00-16:00	Cut NQ rods 0.3 m below wellhead
	16:00-20:00	Run in with BQ rods and drill-out landing ring on NQ core barrel
	20:00-21:00	Drill-out landing ring in NQ core barrel

	21:00-22:00	Drill BQ hole to 633 m
	22:00-24:00	Drill BQ hole to 636.4 m
25-July	00:00-02:00	Drill BQ hole to 638 m
	02:00-09:00	Repair transmission
	09:00-14:00	Circulate-out gas via flare-line
	14:00-16:00	Drill BQ hole to 641 m
	16:00-17:00	Unable to retrieve core barrel. Pull rods
	17:00-20:00	Rods sheared at 560.83 m. Fish rods
	20:00-24:00	Pull rods with Bowen spear
26-July	00:00-08:00	Circulate well. Percolating gas
	08:00-11:00	Reverse circulate well
	11:00-12:00	Mix and pump 13 sacks (520 kg) class A cement. Slurry volume 0.45 m^3. Pull rods to 510 m
	12:00-14:00	Reverse circulate at 510 m. Shut-in well
	14:00-20:00	Wait on cement
	20:00-24:00	Wait on cement
27-July	00:00-10:00	Wait on cement
	10:00-12:00	Pull rods. Bottom 64 m of rods full of gas cut cement due to excessive gas pressure
	12:00-20:00	Wait on fog
	20:00-24:00	Wait on fog
28-July	00:00-08:00	Wait on fog
	08:00-10:00	Mix and pump 13 sacks of class A cement. Slurry volume 0.45 m^3.
	10:00-20:00	Wait on cement
	20:00-24:00	Run in hole with BQ rods
29-July	00:00-08:00	Run in hole with BQ rods
	08:00-12:00	Drill hard cement from 510 m to 540 m
	12:00-14:00	Pull rods to run bridge plug
	14:00-18:00	Run BQ bridge plug and set at 533.4 m
	18:00-20:00	Prepare kick-off sub
	20:00-24:00	Set wedge
30-July	00:00-20:00	Set kick-off sub
	20:00-24:00	Drill side-track BQ hole (well GANE#1A) to 538 m

31-July	00:00-20:00	Drill BQ hole to 585 m
	20:00-24:00	Drill BQ hole to 593.7 m
01-August	00:00-20:00	Drill BQ hole to 621 m
	20:00-24:00	Drill BQ hole to 637 m
02-August	00:00-20:00	Drill BQ hole to 685 m
	20:00-24:00	Gas kick at 685 m. Well flowing. Shut-in well. Shut-in drill pipe pressure (SIDPP) 1551 kpa. Shut-in casing pressure (SICP) 345 kpa. Circulate-out gas through choke manifold at 700 kpa at 26.5 litres/min. Gas flare 10 m long.
03-August	00:00-12:00	Circulate-out gas-cut formation water from well at 700 kpa at 41.5 litres/min. SIDPP 350 kpa, SICP 350 kpa.
	12:00-15:00	Drill BQ hole to 689 m
	15:00-17:00	Lose pump pressure. Pull rods. Rods sheared- off at 550 m
	17:00-20:00	Fishing with Bowen spear. Pull rods out of hole
	20:00-22:00	Pull rods out of hole
	22:00-23:00	Service annular preventers and gate valve
	23:00-24:00	Run in hole with new bit
04-August	00:00-02:00	Run in hole with new bit
	02:00-03:00	Drill BQ hole to 695.5 m
	03:00-04:00	Attempt to pull core tube. Unable to pass 539.5 m
	04:00-07:00	Pull rods. Rods sheared-off at 539.5 m
	07:00-08:00	Fish rods with Bowen spear
	08:00-09:00	Recover fish. Run rods in hole
	09:00-13:00	Run rods in hole. Circulate-out gas from well
	13:00-14:00	Unable to circulate through core barrel
	14:00-17:00	Pull drill rods. Worn bit
	17:00-20:00	Run new bit in hole
	20:00-22:00	Run new bit in hole but unable to pass kick-off wedge
	22:00-24:00	Pull out of hole and run-in with Pajari deviation tool
05-August	00:00-01:00	Run-in hole with Pajari deviation tool

	01:00-02:00	Pull rods and change to bull-nose bit
	02:00-03:00	Run-in hole with bull-nose bit
	03:00-04:00	Bull-nose passes wedge
	04:00-05:00	Pull out of hole
	05:00-07:00	Run-in hole with coring bit but unable to pass wedge
	07:00-11:00	Manually rotate rods and pass wedge
	11:00-13:00	Pull rods to 689 m and perform Pajari test
	13:00-14:00	Put-down Pajari tool
	14:00-19:00	Drill BQ hole to 707 m. Drill rods shear-off
	19:00-20:00	Repair foot clamp. Hydraulic oil leaking
	20:00-21:00	Repair foot clamp. Hydraulic oil leaking
	21:00-22:00	Pull rods from hole. Rods sheared at 542.5 m
	22:00-23:00	Fish with Bowen spear
	23:00-24:00	Pull rods out of hole
06-August	00:00-04:00	Pull rods out of hole
	04:00-05:00	Run-in holw with rods. Unable to pass kick-off wedge
	05:00-08:00	Manually rotate rods. Pass wedge
	08:00-13:00	Circulate well to 1100 kg/m^3. Well flowing from annulus at 20 liters/min with indications of gas and liquids on the returning water. Gas flare 1m long
	13:00-20:00	Pull rods out of hole
	20:00-21:00	Pull rods out of hole
	21:00-22:00	Prepare to abandon hole. Run rods to 30 m
	22:00-24:00	Mix and squeeze 64 sacks (2640 kg) 2m^3 of class a cement from surface to 707 m
07-August	00:00-01:00	Pull rods out of hole
	01:00-20:00	Wait on cement
	20:00-24:00	Wait on cement
08-August	00:00-20:00	Check well for flow and pressure. No flow. Tear out rig and prepare to move
	20:00-24:00	Wait on weather to helilift rig
09-August	00:00-20:00	Helilift rig to GANK#1

Appendix II

Lithological summary

The following is a summary of the core description

0–3.6 m Overburden

3.6–496.5 m Hyaloclastite. The clasts are predominantly grey to grey to dark grey, sub-angular to angular, ranging in size from 0.5 cm to 30 cm, microcrystalline, vessicular, predominantly matrix supported. Matrix predominantly grey to green-black, occasionally very green, occasional mafic minerals up to 2 mm, non-calcareous, abundant white white quartz and calcite veining.

370.0–372.0 m Heavily altered hyaloclastite. Very green, soft, crumbly resulting in disintegration of core.

373.5–375.0 m Heavily altered hyaloclastite. Very dark green, soft, crumbly resulting in disintegration of core.

407.0–408.5 m Heavily altered hyaloclastite. Very dark green, soft, crumbly resulting in disintegration of core.

410.5–412.0 m Heavily altered hyaloclastite. Very dark green, soft, crumbly resulting in disintegration of core.

16.16–17.25 m Intrusive. Light grey to green, microcrystalline, occasional dark mafic phenocrysts.

39.5–40.0 m Intrusive. Light grey to green, microcystalline.

74.5–77.0 m Lava flow. Very dark grey-green, microcystalline, massive, hard, non-calcareous, occasional fractures with calcite and chlorite.

81.0–81.5 m Lava flow. Dark green-grey, microcrystalline, hard, massive, non-calcareous.

88.7–90.5 m Lava flow. Green to blue-grey, mesocrystalline, hard, brittle, vessicular.

143.3–144 m Lava flow. Dark green-grey, microcrystalline, hard, brittle, non-calcareous.

144.5–147 m Lava flow. Dark green-grey, microcrystalline, hard, brittle, non-calcareous, abundant calcite filled micro-fractures.

193.2–194 m Lava flow. Grey to dark grey, micro to mesocrystalline, mafics, hard, calcite filled vessicles.

207.7–215.0 m Lava flow. Light grey to grey, microcrystalline, mafic phenocrysts up to 2 mm, brittle, hard, non-calcareous.

309.0–310.0 m Lava flow. Grey to dark green, microcrystalline, hard, brittle, non-calcareous.

431.7–434.2 m Lava flow. Grey to light green, microcrystalline, hard, occasional mafic phenocrysts, thin quartz veining.

496.6–500.5 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, non-swelling. Abundant thin (mm-scale) micaceous interbeds.

500.5–503.0 m Sandstone. Light brown to grey, fine to medium grained, calcareous in parts, micaceous, occasional clasts up to 4 cm, sub-rounded to sub-angular, highly disturbed and chaotic lamination.

503.0–518.7 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, non-swelling. Abundant thin (mm-scale) micaceous interbeds.

518.7–530.7 m Siltstone. Light grey to orange-brown, very fine grained, well sorted, argillaceous, micaceous, non-calcareous, hard, non-swelling.

530.7–538.5 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, non-swelling. Abundant thin (mm-scale) micaceous interbeds.

538.5–539.5 m Siltstone. Light grey to orange-brown, very fine grained, well sorted, argillaceous, micaceous, non-calcareous, hard.

539.5–544.5 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, non-swelling.

544.5–553.2 m Sandstone. Light grey, fine to medium grained, occasional clasts to 2.5 cm, non-calcareous, micaceous, hard. Abundant white volcanic fragments. Possible volcanic sand.

553.2–554.5 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, non-swelling.

554.5–564.0 m Sandstone. Light grey, fine to medium grained, occasional clasts to 2.5 cm, non-calcareous, micaceous, hard. Abundant white volcanic fragments. Possible volcanic sand. soft sediment deformation at base. Brown ankerite concretions.

564.0–570.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, non-swelling.

570.0–582.0 m Sandstone. Light grey to green, medium grained to occasionally coarse grained, sub-angular to sub-rounded, moderately well sorted, non-calcareous, hard.

582.0–593.8 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

593.8–604.0 m Interbedded Sandstone and Mudstone. Green, coarse grained, well sorted, sub-angular to sub-rounded, non-calcareous, hard. Occasional grey-blue clasts. Thin mudstone interbeds.

604.0–607.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

607.0–631.2 m Interbedded Sandstone and Mudstone. Grey, medium grained to coarse grained in parts, sub-angular to sub-rounded, abundant quartz, moderate porosity, non-calcareous, hard, rare cross-bedding. Occasional ankerite concretions. Thin mudstone interbeds.

631.2–635.2 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

635.2–636.0 m Sandstone. Grey, medium grained to coarse grained in parts, sub-angular to sub-rounded, abundant quartz, moderate porosity, non-calcareous, hard, rare cross-bedding. Occasional ankerite concretions.

636.0–638.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

638.0–638.5 m Sandstone. Light grey to grey, fine grained, clean to slightly argillaceous, well sorted, tight, non-calcareous, ankerite concretions.

638.5–641.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

Side-track well GANE#1A

Kick-off side-track well GANE#1A at 533.4 m. Vertical offset with respect to GANE#1 in the order of 0.5 m. Repetition of lithologies.

641.0–646.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

646.0–651.2 m Sandstone. Grey, medium grained to coarse grained in parts, sub-angular to sub-rounded, abundant quartz, moderate porosity, non-calcareous, hard, chaotic bedding. Occasional ankerite concretions.

651.2–654.2 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

654.2–655.0 m Intrusion. Light grey to blue-green, microcrystalline, brittle, non-calcareous.

655.0–656.5 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

656.5–658.3 m Sandstone. Dark grey, medium grained, poorly sorted, very argillaceous, non-calcareous.

658.3–658.7 m Intrusion. Light grey to blue-green, microcrystalline, brittle, non-calcareous.

658.7–660.8 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

660.8–662.0 m Sandstone. Dark grey, medium grained, poorly sorted, very argillaceous, non-calcareous.

662.0–663.6 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

663.6–677.3 m Sandstone. Light grey to grey, coarse grained, sub-angular to sub-rounded, moderat sphericity, clean, non-calcareous, moderate to very good porosity, cross-bedded in parts, occasional layers with abundant carbonaceous debris, bioturbation.

677.3–681.0 m Mudstone. Dark grey to black, non-calcareous, hard, brittle, parallel laminated, platey, glassy along plates, non-swelling.

681.0–683.2 m Sandstone. Light grey to light yellow, medium grained, sub-rounded, well sorted, friable, good porosity, clean, non-calcareous, bioturbation.

683.2–688.0 m Sandstone. Light grey to light yellow, medium grained, sub-rounded, well sorted, friable, good porosity, clean, calcareous, bioturbation.

688.0–689.5 m Sandstone. White to light grey, medium grained, sub-rounded, well sorted, friable, good porosity, clean, non-calcareous, bioturbation.

689.5–696.5 m Intrusion. Grey-green, microcrystalline, occasional mafic crystals (2 mm), chilled margins. Abundant thin quartz veins.

696.5–699.0 m Sandstone. Grey to blue, very coarse grained, sub-angular to sub-rounded, poorly sorted, polymict, occasional clasts up to 5 mm, argillaceous, non-calcareous, moderate porosity.

699.0–702.0 m Sandstone. Grey to brown, medium to coarse grained, sub-rounded, moderately well sorted, clean, non-calcareous, good porosity.

702.0–702.5 m Mudstone. Black, firm to occasionally soft, carbonaceous, coaly in parts, non-calcareous, non-swelling.

702.5–704.0 m Sandstone. Dark grey to black, fine to medium grained, moderately well sorted, tight to poor porosity, very argillaceous, non-calcareous.

704.0–707.0 m Sandstone. Light grey to grey, medium to coarse grained, sub-rounded, clean, non-calcareous, good porosity, cross-bedded.

Appendix III

Core box list

BOX	TOP	BOTTOM	
1	3,60	6,91	
2	6,91	11:20	
3	11:20	14:46	
4	14:46	17,66	
5	15:50	20,77	
6	20,77	23,88	
7	23,88	26,50	
8	26,50	28,86	
9	28,86	31,75	
10	31,75	34,91	
11	34,91	37,90	
12	37,90	40,93	
13	40,93	44,14	
14	44,14	47,22	
15	47,22	50,15	
16	50,15	53,25	
17	53,25	56,30	
18	56,30	59,36	
19	59,36	62,50	
20	62,50	65,70	
21	65,70	68,75	
22	68,75	72,07	
23	72,07	75,15	
24	75,15	78,33	
25	78,33	81,61	
26	81,61	84,66	
27	84,66	87,73	
28	87,73	91,05	
29	91,05	94,31	
30	94,31	97,48	
31	97,48	100,58	
32	100,58	103,95	
33	103,95	106,45	
34	106,45	110,32	
35	110,32	113,55	
36	113,55	116,72	
37	116,72	119,70	
38	119,70	122,56	
39	122,56	125,78	
40	125,78	128,97	
41	128,97	132,30	
42	132,30	135,35	
43	135,35	138,50	
44	138,50	141,56	
45	141,56	144,67	
46	144,67	147,76	
47	147,76	151,00	
48	151,00	154,14	
49	154,14	157,14	
50	157,14	160,31	
51	160,31	163,52	
52	163,52	166,60	
53	166,60	169,77	
54	169,77	173,00	

BOX	TOP	BOTTOM	
55	173,00	176,24	
56	176,24	179,43	
57	179,43	182,64	
58	182,64	185,95	
59	185,95	189,19	
60	189,19	192,25	
61	192,25	195,26	
62	195,26	198,56	
63	198,56	202,00	
64	202,00	203,74	
65	203,74	206,95	
66	206,95	210,55	
67	210,55	213,18	
68	213,18	216,42	
69	216,42	219,63	
70	219,63	222,00	
71	222,00	225,15	
72	225,15	228,57	
73	228,57	231,25	
74	231,25	234,47	
75	234,47	237,25	
76	237,25	240,98	
77	240,98	244,15	
78	244,15	246,35	
79	246,35	249,40	
80	249,40	252,70	
81	252,70	255,75	
82	255,75	258,97	
83	258,97	262,15	
84	262,15	265,35	
85	265,35	268,54	
86	268,54	271,74	
87	271,74	276,90	
88	276,90	278,18	
89	278,18	281,30	
90	281,30	284,77	
91	284,77	287,46	
92	287,46	290,46	
93	290,46	293,54	
94	293,54	296,75	
95	296,75	299,80	
96	299,80	303,20	
97	303,20	306,33	
98	306,33	309,47	
99	309,47	312,74	
100	312,74	315,05	
101	315,05	319,12	
102	319,12	322,24	
103	322,24	325,62	
104	325,62	328,94	
105	328,94	331,73	
106	331,73	334,80	
107	334,80	337,57	
108	337,57	340,64	

BOX	TOP	BOTTOM	
109	340,64	343,48	
110	343,48	346,88	
111	346,88	350,41	
112	350,41	353,81	
113	353,81	357,07	
114	357,07	359,81	
115	359,81	363,10	
116	363,10	366,13	
117	366,13	369,50	
118	369,50	372,57	
119	372,57	375,30	
120	375,30	377,83	
121	377,83	381,02	
122	381,02	384,33	
123	384,33	387,30	
124	387,30	390,41	
125	390,41	393,51	
126	393,51	396,68	
127	396,68	399,69	
128	399,69	402,77	
129	402,77	405,80	
130	405,80	408,90	
131	408,35	411,66	
132	411,66	414,36	
133	414,36	417,75	
134	417,75	420,85	
135	420,85	423,40	
136	423,86	426,86	
137	426,86	430,06	
138	430,06	433,55	
139	433,55	436,35	
140	436,35	439,65	
141	439,65	442,57	
142	442,57	446,19	
143	446,19	448,92	
144	448,92	452,08	
145	452,08	455,24	
146	455,24	458,51	
147	458,51	461,43	
148	461,43	465,00	
149	465,00	468,08	
150	468,08	471,63	
151	471,63	474,57	
152	474,57	477,62	
153	477,62	481,14	
154	481,14	484,32	
155	484,32	487,28	
156	487,28	490,43	
157	490,43	493,71	
158	493,71	496,70	
159	496,70	500,00	
160	500,00	502,82	
161	502,82	505,82	
162	505,82	507,60	

BOX	TOP	BOTTOM	
163	507,60	510,32	
164	510,32	513,11	
165	513,11	515,31	
166	515,31	518,10	
167	518,10	521,07	
168	521,07	524,56	
169	524,56	527,66	
170	527,66	530,40	
171	530,40	533,65	
172	533,65	537,30	
173	537,30	539,62	
174	539,62	542,38	
175	542,38	545,24	
176	545,24	548,22	
177	548,22	551,63	
178	551,63	554,55	
179	554,55	558,03	
180	558,03	561,31	
181	561,31	564,65	
182	564,65	566,53	
183	566,53	569,60	
184	569,60	572,33	
185	572,33	576,10	
186	576,10	579,00	
187	579,00	582,15	
188	582,15	584,97	
189	584,97	587,99	
190	587,99	590,98	
191	590,98	593,77	
192	593,77	596,68	
193	596,68	599,73	
194	599,73	602,52	
195	602,52	605,51	
196	605,51	608,03	
197	608,03	611,10	
198	611,10	614,71	
199	614,71	617,77	
200	617,77	620,48	
201	620,48	623,68	
202	623,68	626,85	
203	626,85	630,42	
204	630,42	636,62	
205	636,62	639,86	
206	535,57	538,80	GANE # 1
207	538,80	541,70	GANE # 1
208	541,70	546,15	GANE # 1
209	546,15	549,13	GANE # 1
210	549,13	552,58	GANE # 1
211	552,58	556,03	GANE # 1
212	556,03	559,46	GANE # 1
213	559,46	562,53	GANE # 1
214	562,53	565,70	GANE # 1
215	565,70	567,84	GANE # 1
216	567,84	572,10	GANE # 1

BOX	TOP	BOTTOM	
217	572,10	575,24	GANE # 1
218	575,24	578,67	GANE # 1
219	578,67	581,55	GANE # 1
220	581,55	584,86	GANE # 1
221	584,86	588,65	GANE # 1
222	588,65	592,01	GANE # 1
223	592,01	594,67	GANE # 1
224	594,67	597,60	GANE # 1
225	597,60	600,69	GANE # 1
226	600,69	603,77	GANE # 1
227	603,77	606,86	GANE # 1
228	606,86	609,54	GANE # 1
229	609,54	612,97	GANE # 1
230	612,97	616,49	GANE # 1
231	616,49	619,56	GANE # 1
232	619,56	623,29	GANE # 1
233	623,29	626,29	GANE # 1
234	626,29	629,03	GANE # 1
235	629,03	632,93	GANE # 1
236	632,93	636,02	GANE # 1
237	639,72	639,72	GANE # 1
238	639,72	642,69	GANE # 1
239	642,69	646,11	GANE # 1
240	646,11	649,30	GANE # 1
241	649,30	652,65	GANE # 1
242	652,65	655,99	GANE # 1
243	655,99	658,77	GANE # 1
244	658,77	662,00	GANE # 1
245	662,00	664,95	GANE # 1
246	664,95	668,51	GANE # 1
247	668,51	671,57	GANE # 1
248	671,57	675,18	GANE # 1
249	675,18	678,18	GANE # 1
250	678,18	681,10	GANE # 1
251	681,10	683,66	GANE # 1
252	683,66	682,61	GANE # 1
253	682,61	690,50	GANE # 1
254	690,50	693,84	GANE # 1
255	693,84	687,11	GANE # 1
256	697,11	700,12	GANE # 1
257	700,12	703,61	GANE # 1
258	703,61	706,68	GANE # 1

Appendix IV

Core sample list

Sample list

Sub-nr	Type	Depth, m	Date	Time	Core box no.
-135	Sample	2,72	13-Jul-95	19:00	1
-51	Chip	2,97	11-Jul-95	13:40	11
-20	Canned	3,01		02:15	11
-52	Chip	3,32		14:20	12
-21	Canned	3,37		02:45	12
-1	Canned	5,64	09-Jul-95	01:30	1
-2	Chip	5,74		01:35	1
-3	Canned	9,12	10-Jul-95	18:00	2
-4	Chip	9,16		18:00	2
-5	Canned	11,68		20:45	3
-6	Chip	11,73		20:45	3
-7	Canned	14,53		21:30	4
-8	Chip	14,56		21:30	4
-9	Canned	17,41		21:55	4
-10	Chip	17,44		21:55	4
-11	Canned	20,93		22:40	5
-12	Chip	20,98		22:40	5
-14	Chip	23,62		23:20	6
-13	Canned	23,65		23:20	6
-15	Canned	25,03		23:50	7
-46	Chip	25,07	11-Jul-95	10:00	7
-47	Chip	26,52		10:45	8
-16	Canned	26,56		00:15	8
-17	Canned	28,29		00:40	8
-48	Chip	29,72		11:55	9
-18	Canned	29,77		01:00	9
-19	Canned	32,61		02:00	10
-49	Chip	32,63		13:00	10
-50	Sample	33,55		13:08	10
-22	Canned	41,73		03:15	13
-53	Chip	41,77		14:45	13
-23	Canned	44,88		04:00	14
-54	Chip	44,93		16:05	14
-55	Sample	47,16		16:30	14
-24	Canned	47,82		04:40	15
-56	Chip	47,87		17:00	15
-25	Canned	50,86		05:20	16
-57	Chip	50,92		17:15	16
-26	Canned	53,91		06:00	17
-58	Chip	53,96		17:50	17
-27	Canned	56,96		06:20	18
-73	Chip	57,01		19:15	18
-28	Canned	60,01		06:45	19
-75	Chip	60,06		20:30	20
-74	Chip	60,06		20:15	19
-29	Canned	63,06		07:20	20
-30	Canned	66,10		07:45	21
-76	Chip	66,16		21:00	21
-77	Chip	69,20		21:25	22
-31	Canned	69,22		08:20	22
-32	Canned	72,19		08:45	23
-78	Chip	72,25	12-Jul-95	10:10	23
-79	Chip	75,30		10:30	24
-33	Canned	75,32	11-Jul-95	09:15	24

Sample list

-80	Chip	76,39	12-Jul-95	11:20	24
-34	Canned	78,30	11-Jul-95	09:50	24
-35	Canned	81,43		10:22	25
-81	Chip	81,49	12-Jul-95	11:45	25
-36	Canned	84,43	11-Jul-95	10:50	26
-82	Chip	84,44	12-Jul-95	13:00	26
-37	Canned	87,43	11-Jul-95	11:30	27
-83	Chip	87,49	12-Jul-95	13:45	27
-38	Canned	90,49	11-Jul-95	12:05	28
-84	Chip	90,54	12-Jul-95	13:35	28
-39	Canned	93,54		01:20	29
-85	Chip	93,59		13:55	29
-40	Canned	96,58		02:10	30
-86	Chip	96,64		14:15	30
-87	Chip	98,44		14:35	31
-41	Canned	98,49		03:15	31
-88	Chip	102,62		14:55	32
-42	Canned	102,68		04:14	32
-89	Chip	105,68		15:50	33
-43	Canned	105,74		05:10	33
-44	Canned	108,78		06:30	34
-90	Chip	108,83		16:08	34
-45	Canned	111,51		07:45	35
-91	Chip	112,41		17:05	35
-59	Canned	114,56		01:20	36
-92	Chip	114,62		17:25	36
-60	Canned	117,61		15:05	37
-93	Chip	117,74		21:15	37
-61	Canned	120,66		19:00	38
-94	Chip	120,72		22:00	38
-62	Canned	123,70		21:00	39
-108	Chip	123,76	13-Jul-95	10:30	39
-63	Canned	126,75	12-Jul-95	21:00	40
-109	Chip	126,81	13-Jul-95	10:45	40
-110	Chip	129,86		11:05	41
-64	Canned	130,12	12-Jul-95	21:35	41
-65	Canned	132,84		22:08	42
-111	Chip	132,91	13-Jul-95	11:35	42
-66	Canned	135,95	12-Jul-95	23:00	43
-123	Chip	136,26	13-Jul-95	12:40	43
-67	Canned	139,25	12-Jul-95	23:50	44
-124	Chip	139,31		13:00	44
-68	Canned	142,30		01:20	45
-125	Chip	142,36		13:20	45
-69	Canned	145,34		02:05	46
-126	Chip	145,40		13:40	46
-128	Sample	147,75		14:55	47
-129	Sample	147,82		16:00	47
-130	Chip	147,86		06:30	47
-70	Canned	148,40		03:45	47
-127	Chip	148,45		14:40	47
-131	Chip	151,50		17:00	48
-71	Canned	151,53		03:35	48
-132	Sample	152,96		17:05	48
-72	Canned	154,50		04:05	49

Sample list

-133	Chip	154,55		17:40	49
-106	Sample	156,81		08:30	50
-95	Canned	157,54		04:35	50
-134	Chip	157,60		18:00	50
-107	Sample	158,24		09:00	50
-96	Canned	160,58		05:15	51
-136	Chip	160,64		19:50	51
-97	Canned	163,64		06:15	52
-137	Chip	163,69		20:40	52
-98	Canned	166,69		06:45	53
-138	Chip	166,74		21:10	53
-99	Canned	168,54		07:55	53
-139	Chip	169,79		21:20	54
-100	Canned	172,78		09:10	54
-140	Chip	172,84	14-Jul-95	10:00	54
-101	Canned	175,82	13-Jul-95	10:15	55
-141	Chip	175,88	14-Jul-95	10:05	55
-102	Canned	178,88	13-Jul-95	11:05	56
-142	Chip	178,93	14-Jul-95	10:30	56
-103	Canned	181,93	13-Jul-95	12:10	57
-143	Chip	181,98	14-Jul-95	11:00	57
-144	Sample	182,43		11:25	58
-104	Canned	183,38	13-Jul-95	13:20	58
-145	Chip	183,42	14-Jul-95	11:35	58
-105	Canned	187,94	13-Jul-95	14:15	59
-146	Chip	188,08	14-Jul-95	12:00	59
-112	Sample	188,83	13-Jul-95	17:00	59
-113	Canned	189,25		15:15	60
-147	Chip	189,31	14-Jul-95	13:20	60
-114	Canned	194,04	13-Jul-95	16:25	61
-148	Chip	194,17	14-Jul-95	13:30	61
-115	Canned	197,17	13-Jul-95	17:30	62
-149	Chip	197,22	14-Jul-95	13:45	62
-150	Chip	200,16	14-Jul-95	14:20	63
-116	Canned	200,22	13-Jul-95	18:30	64
-117	Canned	203,26	15-Jul-95	05:15	64
-165	Chip	203,32		09:00	64
-118	Canned	206,31		05:40	65
-166	Chip	206,36		09:15	65
-119	Canned	209,36		06:20	66
-167	Chip	209,41		09:35	66
-120	Canned	212,40		06:25	67
-168	Chip	212,46		10:00	67
-169	Chip	215,51		11:40	68
-121	Canned	215,54		07:25	68
-122	Canned	218,50		08:15	69
-170	Chip	218,56		13:00	69
-151	Canned	221,54		08:30	70
-171	Chip	221,60		13:35	70
-152	Canned	222,05		09:00	71
-172	Chip	228,06		14:35	72
-153	Canned	228,53		12:00	72
-154	Canned	232,29		13:45	74
-173	Chip	233,49		15:40	74
-155	Canned	234,82		14:10	75

Sample list

-156	Canned	236,47		15:10	75
-157	Canned	238,52		16:10	76
-174	Chip	239,89		18:00	76
-477	Sample	241,07	22-Jul-95	09:30	77
-158	Canned	242,44	15-Jul-95	16:35	77
-191	Chip	243,41		19:45	77
-159	Canned	245,94		18:00	78
-192	Chip	245,99		22:15	78
-160	Canned	248,28		19:00	79
-193	Chip	249,04		22:35	79
-161	Canned	252,03		20:30	80
-194	Chip	252,08		23:10	80
-162	Canned	255,07		21:55	81
-195	Chip	255,13	16-Jul-95	08:45	81
-163	Canned	258,22	15-Jul-95	22:10	82
-196	Chip	258,27	16-Jul-95	09:15	82
-164	Canned	261,20	15-Jul-95	22:15	83
-197	Chip	261,23	16-Jul-95	10:00	83
-198	Chip	262,67		10:40	84
-175	Canned	264,22	15-Jul-95	23:55	84
-176	Canned	267,27		00:00	85
-201	Chip	267,32	16-Jul-95	13:10	86
-199	Chip	267,32		12:45	85
-200	Sample	267,79		13:00	85
-177	Canned	270,31		01:50	86
-178	Canned	273,37		02:00	87
-202	Chip	273,42		14:20	87
-179	Canned	276,42		03:50	88
-203	Chip	276,47		14:40	88
-180	Canned	279,46		04:00	89
-204	Chip	279,52		15:00	89
-181	Canned	282,51		05:45	90
-205	Chip	282,56		15:40	90
-182	Canned	285,55		06:00	91
-206	Chip	285,61		16:10	91
-183	Canned	288,00		10:00	92
-207	Chip	288,66		16:25	92
-184	Canned	291,66		12:15	93
-208	Chip	291,71		16:50	93
-185	Canned	294,46		15:00	94
-209	Chip	294,64		17:15	94
-210	Chip	296,66		17:20	95
-186	Canned	296,71		16:30	94
-221	Chip	299,54	17-Jul-95	09:10	95
-187	Canned	300,84	16-Jul-95	23:55	96
-222	Chip	300,85	17-Jul-95	10:00	96
-188	Canned	303,85	16-Jul-95	00:00	97
-223	Chip	303,90	17-Jul-95	10:20	97
-189	Canned	306,90		01:30	98
-224	Chip	306,95		10:40	98
-225	Chip	309,48		11:30	95
-190	Canned	309,94		01:35	99
-211	Canned	312,51		06:00	99
-226	Chip	312,57		11:45	99
-227	Chip	316,03		13:00	101

Sample list

-212	Canned	316,09		08:00	100
-213	Canned	316,13		09:00	101
-214	Canned	319,92		09:30	102
-244	Chip	319,97		14:00	102
-245	Chip	323,18		14:20	103
-215	Canned	325,58		10:00	103
-246	Chip	327,87		14:35	104
-216	Canned	328,31		10:35	104
-217	Canned	329,24		11:05	105
-247	Chip	330,55		15:15	105
-218	Canned	332,13		11:50	106
-248	Chip	332,18		15:40	106
-219	Canned	336,79		12:05	106
-249	Chip	339,54		17:50	108
-220	Canned	339,60		13:40	108
-228	Canned	343,47		16:00	109
-250	Chip	343,52		21:30	109
-229	Canned	346,51		16:25	110
-251	Chip	346,57		20:45	110
-230	Canned	349,57		20:45	111
-252	Chip	349,62		21:50	111
-231	Canned	352,62		21:00	112
-376	Chip	352,67	18-Jul-95	08:35	112
-232	Canned	355,35	17-Jul-95	22:50	113
-377	Chip	356,03	18-Jul-95	8;50	113
-378	Chip	358,46		09:15	114
-233	Canned	358,70	17-Jul-95	23:20	114
-234	Canned	361,45		00:00	115
-379	Chip	361,51	18-Jul-95	09:30	115
-380	Chip	364,86		09:45	116
-235	Canned	364,88		00:40	116
-236	Canned	367,86		02:30	117
-381	Chip	367,91		10:30	117
-237	Canned	370,89		02:35	118
-382	Chip	370,96		10:45	118
-238	Canned	373,95		03:45	119
-383	Chip	374,00		11:00	119
-239	Canned	377,00		04:00	120
-384	Chip	377,05		11:20	120
-240	Canned	380,05		06:30	121
-385	Chip	380,10		11:40	121
-241	Canned	382,41		07:30	122
-386	Chip	383,15		11:50	122
-242	Canned	386,12		09:00	123
-387	Chip	386,20		12:05	123
-243	Canned	388,15		10:00	124
-388	Chip	388,21		12:15	124
-589	Canned	390,68		11:30	125
-389	Chip	390,73		14:35	125
-390	Chip	393,42		14:45	126
-590	Canned	393,48		13:00	126
-591	Canned	397,29		13:45	127
-391	Chip	397,34		16:20	127
-393	Sample	399,73		17:05	128
-253	Canned	402,35		14:50	128

Sample list

-392	Chip	402,41		16:50	128
-254	Canned	403,90		15:40	129
-394	Chip	403,96		18:30	129
-255	Canned	405,57		16:40	129
-395	Chip	405,62		20:00	129
-256	Canned	410,54		17:10	131
-396	Chip	410,58		21:35	131
-397	Chip	413,63		21:55	132
-257	Canned	413,72		20:00	132
-258	Canned	417,15		20:45	133
-398	Chip	417,21	19-Jul-95	09:30	133
-399	Chip	420,01		10:00	134
-259	Canned	420,07	18-Jul-95	21:40	134
-260	Canned	422,47		22:45	135
-400	Chip	422,77	19-Jul-95	10:20	135
-401	Chip	425,82		10:35	136
-261	Canned	426,09	18-Jul-95	00:00	136
-402	Chip	428,87	19-Jul-95	10:50	137
-262	Canned	428,90		01:00	137
-263	Canned	431,78		02:30	138
-403	Chip	431,92		11:05	138
-264	Canned	434,91		03:00	139
-404	Chip	437,29		11:35	139
-265	Canned	437,96		04:30	140
-405	Chip	438,01		12:00	140
-266	Canned	441,01		05:00	141
-406	Chip	441,06		13:05	141
-407	Chip	444,11		13:15	142
-267	Canned	444,14		06:30	142
-408	Chip	447,16		13:35	143
-268	Canned	447,18		06:45	143
-269	Canned	450,10		07:20	144
-409	Chip	450,20		14:00	144
-410	Chip	452,97		04:10	145
-270	Canned	453,04		07:55	145
-271	Canned	454,10		08:50	146
-411	Chip	454,15		14:20	146
-272	Canned	458,77		09:25	147
-412	Chip	458,82		15:00	147
-273	Canned	459,46		10:15	147
-413	Chip	459,52		15:10	147
-274	Canned	465,38		10:45	149
-414	Chip	465,44		15:50	149
-275	Canned	467,05		11:35	149
-415	Chip	467,10		16:00	149
-276	Canned	470,80		12:30	150
-416	Chip	470,85		16:10	150
-277	Canned	473,80		13:20	151
-417	Chip	473,84		16:25	151
-418	Chip	477,17		16:40	152
-278	Canned	477,22		13:55	152
-279	Canned	477,67		14:55	153
-419	Chip	477,73		17:00	153
-280	Canned	483,24		15:55	154
-420	Chip	483,29		17:55	154

Sample list

-281	Canned	485,38		16:30	155	
-421	Chip	485,43		18:10	155	
-282	Canned	488,22		17:15	156	
-422	Chip	488,27		19:30	156	
-283	Canned	490,47		17:45	157	
-423	Chip	490,53		19:45	157	
-284	Canned	494,35		18:25	158	
-424	Chip	494,41		21:00	158	
-285	Canned	496,52		21:40	159	
-425	Sample	496,52		21:40	158	
-479	Sample	496,93	25-Jul-95	21:50	159	
-426	Chip	498,94	20-Jul-95	08:40	159	
-427	Chip	502,02		09:25	160	
-286	Canned	502,99	19-Jul-95	21:30	160	
-429	Sample	503,01	20-Jul-95	10:05	161	
-428	Chip	505,68		10:00	161	
-287	Canned	505,73	19-Jul-95	22:25	161	
-430	Chip	507,40	20-Jul-95	10:20	162	
-288	Canned	507,45	19-Jul-95	23:20	162	
-289	Canned	509,58	20-Jul-95	00:15	163	
-431	Chip	509,64		10:45	163	
-432	Chip	510,23	20-Jul-95	13:10	164	
-511	Sample	510,29	01-Aug-95	19:45	163	
-290	Canned	510,81	20-Jul-95	01:20	164	
-291	Canned	515,00		03:00	165	
-433	Chip	515,06		13:30	165	
-292	Canned	517,07		04:15	166	
-434	Chip	517,26		13:50	166	
-293	Canned	520,26		04:30	167	
-294	Canned	520,31		06:00	168	
-435	Chip	520,31		14:30	167	
-436	Chip	523,36		16:00	168	
-512	Sample	526,40	01-Aug-95	19:50	169	
-437	Chip	526,40	20-Jul-95	16:25	169	
-295	Canned	526,42		07:00	169	
-296	Canned	530,56		07:40	170	
-439	Chip	533,56		17:05	171	
-297	Canned	533,62		08:00	171	
-513	Sample	534,64	01-Aug-95	20:15	172	
-298	Canned	535,06	20-Jul-95	09:55	172	
-440	Chip	535,12		17:25	172	
-333	Canned	535,57	30-Jul-95	23:35	206	
-483	Chip	535,63	31-Jul-95	09:00	206	1
-334	Canned	537,42	30-Jul-95	23:45	206	
-299	Canned	537,42	20-Jul-95	10:55	174	
-484	Chip	537,47	31-Jul-95	09:30	206	2
-441	Chip	537,48	20-Jul-95	18:00	174	
-335	Canned	541,23	30-Jul-95	00:00	207	
-485	Chip	541,29	31-Jul-95	10:10	207	3
-486	Chip	542,04		10:30	208	4
-337	Canned	542,10		02:50	208	
-300	Canned	542,51	20-Jul-95	11:50	175	
-442	Chip	542,57		18:50	175	
-301	Canned	544,60		13:20	175	
-443	Chip	544,65		18:55	175	

Sample list

-338	Canned	545,63	31-Jul-95	03:30	208
-302	Canned	545,64	20-Jul-95	13:45	176
-487	Chip	545,68	31-Jul-95	10:40	208
-438	Chip	545,85	20-Jul-95	17:00	170
-303	Canned	548,91		14:00	177
-444	Chip	548,96		19:15	177
-488	Chip	549,76	31-Jul-95	11:15	210
-339	Canned	549,82		04:15	210
-480	Sample	550,94	26-Jul-95	09:00	177
-445	Chip	552,57	20-Jul-95	19:25	178
-304	Canned	552,62		14:20	178
-489	Chip	554,42	31-Jul-95	11:30	211
-446	Chip	554,46	20-Jul-95	19:35	178
-340	Canned	554,48	31-Jul-95	06:00	211
-305	Canned	554,51	20-Jul-95	14:45	178
-447	Chip	556,28		19:55	179
-490	Chip	556,47	31-Jul-95	11:45	212
-341	Canned	556,53		07:00	212
-306	Canned	557,92	20-Jul-95	16:00	179
-491	Chip	559,52	31-Jul-95	12:05	213
-342	Canned	559,57		07:15	213
-307	Canned	561,15	20-Jul-95	16:25	180
-448	Chip	561,22		20:45	180
-308	Canned	563,52		16:55	181
-449	Chip	563,57		21:00	181
-343	Canned	564,15	31-Jul-95	09:10	214
-514	Sample	564,68	01-Aug-95	20:25	182
-492	Chip	565,31	31-Jul-95	12:30	214
-450	Chip	565,49	20-Jul-95	21:15	182
-309	Canned	565,54		17:45	182
-493	Chip	567,75	31-Jul-95	13:40	215
-344	Canned	567,81		11:00	215
-310	Canned	568,43	20-Jul-95	20:00	183
-451	Chip	568,49		21:30	183
-494	Chip	570,19	31-Jul-95	14:40	216
-345	Canned	570,24		13:40	216
-311	Canned	571,46	20-Jul-95	20:00	184
-452	Chip	571,52	21-Jul-95	08:35	184
-495	Chip	572,34	31-Jul-95	15:20	216
-346	Canned	572,39		14:30	216
-312	Canned	575,11	20-Jul-95	21:35	185
-453	Chip	575,17	21-Jul-95	08:50	185
-496	Chip	575,37	31-Jul-95	16:55	218
-347	Canned	575,42		14:45	218
-313	Canned	578,17	20-Jul-95	21:50	186
-454	Chip	578,22	21-Jul-95	09:05	186
-497	Chip	578,42	31-Jul-95	17:00	218
-348	Canned	578,47		15:30	218
-314	Canned	579,39	20-Jul-95	23:20	187
-455	Chip	579,44	21-Jul-95	09:20	187
-498	Chip	581,46	31-Jul-95	17:20	219
-349	Canned	581,51		15:45	219
-315	Canned	582,23	20-Jul-95	23:35	188
-456	Chip	582,49	21-Jul-95	09:50	188
-499	Chip	584,41	31-Jul-95	21:15	220

Sample list

-350	Canned	584,47		18:15	220
-500	Chip	584,96	01-Aug-95	08:00	221
-316	Canned	585,12	21-Jul-95	01:50	189
-457	Chip	587,36		10:45	189
-351	Canned	587,46	31-Jul-95	21:15	221
-501	Chip	588,07	01-Aug-95	08:30	221
-352	Canned	588,62	31-Jul-95	21:40	221
-317	Canned	590,90	21-Jul-95	02:45	190
-459	Sample	590,95		11:10	190
-458	Chip	590,95	21-Jul-95	11:05	190
-353	Canned	591,12	31-Jul-95	23:15	222
-502	Chip	591,18	01-Aug-95	08:35	222
-354	Canned	591,87		00:15	222
-503	Chip	591,93		08:40	222
-460	Chip	591,94	21-Jul-95	11:25	191
-318	Canned	591,97		03:45	191
-319	Canned	593,42		04:30	191
-461	Chip	593,46		11:30	191
-355	Canned	596,16	01-Aug-95	01:30	224
-504	Chip	596,22		11:30	224
-320	Canned	596,43	21-Jul-95	05:45	192
-462	Chip	596,51		11:40	192
-321	Canned	597,97	21-Jul-95	06:30	193
-463	Chip	598,03		11:50	193
-356	Canned	599,15	01-Aug-95	02:50	225
-505	Chip	599,21		11:50	225
-322	Canned	599,58	21-Jul-95	07:40	194
-357	Canned	600,34		09:30	226
-506	Chip	600,39	01-Aug-95	13:00	226
-481	Sample	601,05	26-Jul-95	09:30	194
-464	Chip	601,08	21-Jul-95	12:50	194
-323	Canned	603,87		08:35	195
-465	Chip	603,92	21-Jul-95	13;15	195
-358	Canned	604,08	01-Aug-95	11:50	227
-507	Chip	604,13		15:00	227
-324	Canned	605,97	21-Jul-95	09:35	196
-466	Chip	606,87		13:25	196
-508	Chip	607,62	01-Aug-95	16:30	228
-359	Canned	607,67		14:30	228
-360	Canned	610,83	01-Aug-95	16:00	229
-509	Chip	610,83		19:10	229
-325	Canned	610,91	21-Jul-95	10:15	197
-467	Chip	610,97		13:45	197
-326	Canned	612,71		10:55	198
-468	Chip	613,27		14:05	198
-361	Canned	613,69	01-Aug-95	18:20	230
-510	Chip	613,88		19:25	230
-515	Sample	614,97	01-Aug-95	20:35	192
-469	Chip	616,32	21-Jul-95	14:20	199
-327	Canned	616,35		12:00	199
-362	Canned	616,88	01-Aug-95	18:30	231
-516	Chip	616,93		21:00	231
-363	Canned	617,29	01-Aug-95	20:10	231
-517	Chip	617,34		21:30	231
-471	Sample	617,88	21-Jul-95	16:35	200

Sample list

-472	Sample	619,06		16:45	200
-328	Canned	619,32	21-Jul-95	13:20	200
-470	Chip	619,37		16:30	200
-474	Sample	621,80		17:20	201
-329	Canned	622,36		15:00	201
-473	Chip	622,42		17:10	201
-364	Canned	623,60	01-Aug-95	20:45	233
-532	Chip	623,65	02-Aug-95	08:15	233
-365	Canned	625,16		21:15	233
-475	Chip	625,66	21-Jul-95	18:50	202
-330	Canned	625,71		15:20	202
-534	Chip	627,09	02-Aug-95	08:40	234
-533	Chip	627,11		08:20	233
-366	Canned	627,14	01-Aug-95	21:40	234
-331	Canned	627,84	21-Jul-95	16:50	203
-476	Chip	627,90		19:20	203
-478	Chip	630,84	25-Jul-95	09:50	204
-332	Canned	630,90	21-Jul-95	16:55	204
-535	Chip	631,87	02-Aug-95	09:00	235
-367	Canned	632,22	01-Aug-95	22:00	235
-536	Chip	633,68	02-Aug-95	09:40	236
-368	Canned	633,73	01-Aug-95	23:20	236
-537	Chip	635,40	02-Aug-95	10:35	237
-369	Canned	635,45		00:40	237
-482	Sample	639,82	26-Jul-95	09:35	205
-370	Canned	641,33	02-Aug-95	01:45	238
-538	Chip	641,38		10:50	238
-539	Chip	644,53		11:10	239
-371	Canned	644,58		02:45	239
-372	Canned	647,57		04:30	240
-540	Chip	647,63		11:20	240
-373	Canned	649,34		05:00	241
-541	Chip	649,40		11:35	241
-542	Chip	652,19		11:45	241
-374	Canned	652,24		06:00	241
-543	Chip	654,86		12:00	242
-375	Canned	654,92		06:50	242
-518	Canned	657,67		08:25	243
-544	Chip	657,77		13:10	243
-519	Canned	660,32		09:50	244
-545	Chip	660,52		13:30	244
-547	Sample	662,78		14:15	245
-546	Chip	663,45		13:45	245
-520	Canned	663,45		11:15	245
-548	Chip	666,48		14:25	246
-521	Canned	666,54		12:50	246
-549	Sample	667,49		14:35	246
-550	Chip	669,54		15:00	247
-522	Canned	669,60		13:00	247
-523	Canned	672,66		14:30	248
-551	Chip	672,71		15:30	248
-552	Chip	673,93		16:35	249
-554	Sample	674,70		17:20	249
-555	Sample	674,80		17:25	249
-553	Chip	675,12		17:00	249

Sample list

-525	Canned	675,17		16:35	249
-524	Canned	675,68		14:50	249
-526	Canned	679,78		16:45	250
-556	Chip	679,84		19:00	250
-559	Sample	683,40	03-Aug-95	10:00	251
-527	Canned	683,48	02-Aug-95	18:30	251
-558	Chip	683,53		21:40	251
-557	Sample	684,84	02-Aug-95	19:00	251
-528	Canned	686,07		14:25	252
-560	Chip	686,12		14:45	252
-561	Sample	686,54		14:50	252
-562	Sample	686,94	03-Aug-95	15:00	252
-581	Sample	688,22	04-Aug-95	09:45	253
-529	Canned	688,81	03-Aug-95	14:30	253
-579	Chip	688,86	04-Aug-95	09:00	253
-530	Canned	689,79	03-Aug-95	15:00	253
-580	Chip	689,84	04-Aug-95	09:05	253
-582	Chip	693,00		10:00	254
-531	Canned	694,59	05-Aug-95	03:20	255
-583	Chip	695,14		17:30	255
-584	Chip	698,01		17:45	256
-563	Canned	698,07		16:15	256
-585	Chip	701,86	06-Aug-95	08:30	257
-564	Canned	701,92		16:20	257
-586	Chip	704,21		21:40	258
-565	Canned	704,26		21:25	258
-588	Sample	706,61		21:50	258
-587	Sample	706,63		21:45	258

Appendix V

Additional samples, water, contaminants etc.

Additional						
				GANE # 1		
GGU no 43						
GGU no	Depth, m	Time	Date	Type	Container	Comments
439001						GANE # 1
439002		13:00	13-Jul-95	Contamination	Foil	Pipe dope taken from the drill pipe as supplied from the factory
439003		13:00	13-Jul-95	Contamination	Foil	Thread grease from drill pipe
439004						
439005						
439006	400,00	11:00	18-Jul-95	Contamination	Canned	Rag grease, a mixture of Rod grease and hydraulik oil
439007	631,00	13:15	22-Jul-95	Gas	L-press tube	Gas sample
439008	640,00	09:00	21-Jul-95	Contamination	Canned	Cement, contaminated with gas
439009	684,60	21:20	02-Aug-95	Gas	L-press tube	Gas sample
439010	684,60	09:30	03-Aug-95	Water	Canned	Water, taken from below flare line
439011	684,60	10:00	03-Aug-95	Water	Canned	Sludge and water, taken from below flare line
439012	684,60	10:00	03-Aug-95	Water	Canned	Water, taken from below flare line
439013	689,00	20:00	03-Aug-95	Water	Canned	Water, taken from below flare line
439014	695,00	09:00	04-Aug-95	Water	Canned	Water, taken from below flare line
439015	400,00	11:00	18-Jul-95	Contamination	Canned	Hydrailik oil
439016	400,00	11:00	18-Jul-95	Contamination	Canned	Quik-Trol and drilling water
439017	507,50	21:00	19-Jul-95	Water	Canned	Water sample from the supply tank
439018	539,50	10:00	04-Aug-95	Contamination	Canned	Pipe dope,
439019	539,50	10:00	04-Aug-95	Contamination	Canned	Quik-Trol, dry powder
439020	707,00	17:00	06-Aug-95	Water	Canned	Water from the wellhead, (Formation water?)
439021	707,00	17:00	06-Aug-95	Water	Canned	Formation water from below flare line
439022	707,00	17:00	06-Aug-95	Water	Canned	Water from below flare line