GANE-1
GANE-1A

Sedimentology of the GANE-1 and GANE-1A cores drilled by grønArctic Energy Inc., Eqalulik, Nuussuaq, West Greenland

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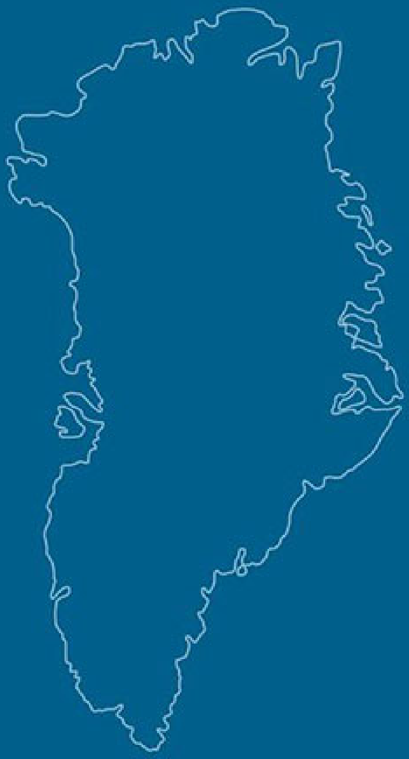

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
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Introduction

In May 1995 grønArctic Energy Inc., Canada was awarded an exclusive licence to explore for hydrocarbons on the southern and western part of the Nuussuaq peninsula, West Greenland. As part of the commitments under this licence three slim core holes (GANE#1, GANK#1 and GANT#1) were drilled in July and August 1995.

The GANE#1 well is situated at a number of small lakes at Eqalulik, about 6 km east of the outlet of the large river Kuussuaq at the western end of the Aaffarsuaq valley (Fig. 1). Drilling was carried out by Petro Drilling Company, Ltd., Canada. A wire-line diamond drilling outfit (Longyear Fly-in model 44) was used. The GANE#1 well was drilled to a total depth of 641.29 m. At this depth the drilling rods became stuck and a sidetrack well GANE#1A was kicked-off at 533.4 m. GANE#1A was terminated at a depth of 707 m (Bate, 1995). The sediment core diameter in GANE#1 is 47.6 mm (NQ rods) in the depth interval 495.5 m to 631 m and 36.5 mm from 631 m to 641.29 m and in GANE#1A is 36.5 mm (BQ rods) from 533.4 m to 707 m. A total of 807.40 m of core with a recovery close to 100% was drilled in GANE#1 and GANE#1A , but only 310.85 m of the core were sediments. The remaining part of the core was volcanics. All technical data from the drilling programme and drill site sampling programme are presented in Bate (1996).

The purpose of the GANE#1 well and its auxiliary GANE#1A was to penetrate the Tertiary volcanics exposed at the surface and to intersect the Cretaceous–Paleocene sediments below. The Geological Survey of Denmark and Greenland (GEUS) carried out the geological services at the well site which included preparation of a preliminary geological description of the cores and collection of samples (Bate, 1995). This was followed by detailed sedimentological and organic geochemical analyses in Copenhagen. The organic geochemistry of sediments, oils and gases of the wells has been reported by Christiansen *et al.* (1996), and the present report should be read together with this. The palynostratigraphy of the cores will be reported by September 1st, 1997. The aim of the present report is to present a detailed sedimentological analysis of the cores from GANE#1 and GANE#1A.

Geological setting

The margin of West Greenland was formed by extensional opening of the Labrador Sea in late Mesozoic–early Cenozoic time. A complex of linked basins stretch from the Labrador Sea to northern Baffin Bay (Rolle, 1985; Chalmers, 1991; Chalmers & Pulvertaft, 1993; Chalmers *et al.*, 1993). A conspicuous element of this tectonic framework is the Ungava transform fault system. It is a NE-trending zone of anatomising strike-slip faults which accommodated different amounts of extension and rotational opening of Labrador Sea and Baffin Bay (Fig. 1). At its north-eastern end, much of the strike-slip motion associated with the Ungava fault is dispersed across an array of smaller scale strike-slip faults which encompass Disko Island and Nuussuaq Peninsula. It has been suggested that the Nuussuaq Basin straddling Nuussuaq and northern Disko is a pull-apart basin formed by a wrench couple or releasing bend at the end of the Ungava fault zone (grønArctic, 1996).

The Albian–Danian succession is attributed to a protracted period of left-lateral wrench controlled subsidence (grønArctic, 1996). However, subsidence came to an abrupt end with regional uplift (Dam & Sønderholm, in press), followed by a short period of very rapid subsidence and extrusion of Paleocene hyaloclastites succeeded by flood basalts. The regional uplift has been attributed to either major plate and stress field reorganisation (cf. Roest & Srivastava, 1989; Chalmers *et al.*, 1993; Chalmers & Laursen, 1995) or the arrival of a mantle plume to the base of the lithosphere (cf. Lawver and Müller, 1994).

The GANE#1 well is situated in a volcanic terrain at Eqalulik, along a NW-trending structural complex of the southern margin of Nuussuaq and northern Disko (grønArctic, 1996). The well is probably located along a major fault-controlled Upper Cretaceous–Paleocene slope separating a platform to the east from basinal areas west of Itilli (Dam & Sønderholm, 1994). The closest exposed sediments to the well occur in the Itilli valley c. 10 km towards NW (Dam & Sønderholm, 1994), in the Aaffarsuaq valley c. 10 km towards E, and at Nuuk Killeq c. 10 km towards SE (Fig. 1).

Palynology and biostratigraphy

A palynological screening examination of eight samples from GANE#1 and GANE#1A has been carried out by Henrik Nøhr-Hansen, GEUS. A full palynological examination of the cores will be completed by September 1st, 1997. The eight samples are evenly scattered over the depth interval 503.9–649.4 m (Fig. 2). Twenty-two palynomorphs have been identified suggesting a middle Late Paleocene age of the sediments (upper dinocyst biozone 3 – lower dinocyst biozone 4) (H. Nøhr-Hansen, pers. comm., 1996). Reworked Cretaceous forms are common. In 570 m a belemnite occurs. It is bored and highly worn, suggesting that it is reworked.

Facies description

The sedimentary succession underlying the hyaloclastites in the Eqalulik area was cored in both GANE#1 (496.55–639.86 m) and GANE#1A (535.57–707 m), and a preliminary facies description based on the well site descriptions was presented in the well summary report by Bate (1995). After the cores arrived at GEUS in Copenhagen they were logged at scale 1:50 (Tables 1, 2). Six facies associations have been recognised (Fig. 2, Tables 1, 2). These are: 1) mudstone, 2) thinly interbedded sandstone and mudstone arranged in coarsening-upward successions, 3) interbedded muddy sandstones and thinly interbedded sandstone and mudstone, 4) amalgamated sandstone grading upward into thinly interbedded sandstone and mudstone, 5) chaotic beds, and 6) bioturbated thinly interbedded sandstone and mudstone.

Facies association 1: Mudstone

Description. This facies association is especially common in one interval (GANE#1, 581.55–597 m; GANE#1A, 581.1–597.5 m), that is 15.45–16.4 m thick (Fig. 2, Tables 1, 2), but also occurs in thin isolated beds up to 25 cm thick. The facies association consists of dark grey to black, parallel laminated mudstone containing less than 10 % sandstone. The mudstone is hard and brittle and is commonly broken into platelets, 1–2 cm thick, the surfaces of which are very smooth and glasslike. Calcite and ankerite/siderite concretions and thin fractures filled with calcite are common. Interbedded with the mudstone is occasionally very thin (1–2 mm thick) siltstone to fine-grained sandstone laminae. The laminae have a sharp base and are normal graded. Rarely, thicker normal graded fine- to coarse-grained sandstone beds up to 15 cm thick are interbedded with the mudstones. The sandstones have a sharp base and are massive or parallel laminated. TOC of the mudstone ranges from 1.9–2.7% and HI ranges from 65–102 (in a single sample with 188) (Christiansen *et al.*, 1996). All of the samples studied have very low total sulphur (TS) contents (ranges from 0.22–0.26%) (Christiansen *et al.*, 1996). Soft sediment folds occasionally occur in the mudstone.

Interpretation. The lamination of the mudstone interval suggests deposition from suspension and the absence of benthic dwelling invertebrates suggests restricted oxygen conditions at the bottom during deposition. However, due to the braking of the mudstone core into thin platelets, it cannot be ruled out that the lamination is the result of compaction or a tectonic fabric, or that some of the mudstone was deposited from debris flows or turbidite currents. The interbedded thin siltstone and sandstone streaks were probably deposited from distal low-density turbidite currents. The very low TS values, compared to the TOC values and to TS values in the rest of the cored succession, suggest a fresh to brackish water environment (cf. Berner & Raiswell, 1984). Marine dinoflagellates have, however, been recorded in one sample (H. Nøhr-Hansen, 1996), and a conclusive interpretation of the depositional environment of the mudstone must await a detailed palynofacies analysis.

Facies association 2: Thinly interbedded sandstone and mudstone arranged in coarsening-upward successions

Description. This association is common in the lower part of both wells (GANE#1, 634.15–639.86 m GANE#1A, 631.7–641.95 m; 649.75–654.3 m), associated with facies association 4 (Fig. 2, Tables 1, 2). It consists of sharply based graded laminae and beds of fine- to coarse-grained sandstone, capped by grey parallel laminated mudstone (Facies D of Mutti & Ricci Lucchi, 1972; Facies F of Mutti, 1992). The sandstones are generally less than 5 cm thick, but beds up to 55 cm do occur. The sandstones have sharp bases and show well-developed normal grading. Sorting is good, and small mudstone rip-up clasts frequently occur at the base or throughout the sandstones. Granules occur in some beds. Sedimentary structures include parallel lamination and cross-lamination, but in most of the thicker beds sedimentary structures are absent. Soft-sediment folds, siderite/ankerite concretions and plant debris are occasionally present. In unbroken parts, the mudstones are often arranged in thin graded laminae, less than 1 cm thick. The grading of the mudstones is mainly observed as small obvious colour changes. In most intervals there is a systematic upward increase in thickness of the sandstone laminae and beds; this is associated with an increase in grain-size (Fig. 2, Tables 1, 2). The coarsening-upward successions are 4–6 m thick.

Interpretation. The thinly interbedded sandstones and mudstones are interpreted as deposits of traction and fall-out processes associated with various stages of sedimentation from waning low-density currents. The presence of sharp, flat based, normally graded, massive sandstones suggests deposition from sand-rich turbulent flows (S_3 of Lowe (1982)). The upward coarsening and thickening of sandstone laminae and beds is interpreted as representing shallowing-upward cycles with distal turbidite laminae/beds overlain by more proximal turbidite beds.

Facies association 3: Interbedded muddy sandstone and thinly interbedded sandstone and mudstone

Description. This association occurs in two intervals (GANE#1, 609.55–620.05 m; GANE#1A, 609.55–620.15 m) and consists of massive muddy sandstone interbedded with thinly interbedded sandstone and mudstone. The thinly interbedded sandstone and mudstone is very similar to that of Facies association 2. It consists of sharply based graded laminae and beds of fine- to coarse-grained sandstone, capped by grey parallel laminated mudstone (Facies D of Mutti & Ricci Lucchi, 1972; Facies F of Mutti, 1992). The sandstones are generally less than 4 cm thick, but beds up to 60 cm do occur. The laminae and beds have sharp bases and show well-developed normal grading. Sorting is good, and small mudstone rip-up clasts frequently occur at the base or throughout the laminae and beds. Granules occur in some beds. Sedimentary structures include parallel lamination and cross-lamination, but in most of the thicker beds sedimentary structures are absent. Soft-sediment folds and finely disseminated plant debris are occasionally present.

The massive muddy sandstones are medium- to coarse-grained with a finely dispersed mud matrix fraction. The percentage of the mud fraction has not been calculated, but is probably in the range 10–20%. The sandstones are poorly sorted. The thickness of the beds ranges from 5 cm to 1.2 m and both the basal and upper contacts are sharp and planar. Grading is usually absent. Rounded to subrounded mudstone clasts, plant debris and small basement pebbles are common. The size of the mudstone clasts varies from few millimetres to several centimetres. They are floating in the matrix or in some cases concentrated towards the top of the beds. Occasionally mudstone clasts are aligned parallel to bedding planes producing a platy fabric. The massive beds generally occur isolated within the thinly interbedded sandstone and mudstone.

Interpretation. The thinly interbedded sandstones and mudstones are interpreted as deposits of traction and fall-out processes associated with various stages of sedimentation from waning low-density currents on the slope. The presence of normally graded, massive sandstones with sharp flat bases suggests deposition from sandrich turbulent flows (S_3 of Lowe (1982)). The massive muddy sandstones are interpreted as the deposits of sandy debris flows and not of high-density turbidite currents because of the sharp upper boundary of the beds, the finely dispersed mud within the sandstones and the generally lack of normal grading in the sandstone fraction (cf. Shanmugan &

Moiola, 1995). The isolated beds of debris flow deposits suggest that they formed as the result of localised sediment failure on the slope in a interdistributary area.

Facies association 4: Amalgamated sandstone grading upward into thinly interbedded sandstone and mudstone

Description. This association consists of amalgamated sandstone beds, grading upward into thinly interbedded sandstone and mudstone, and is the most common facies association of GANE#1 (545.6–548.45 m; 550.25–553.2 m; 554.75–563.95 m; 568.45–581.55 m; 602.8–609.55 m; 620.05–630.95 m) and GANE#1A (544.8–548.6 m; 549.5–552.45 m; 554.75–563.45 m; 569.35–581.05 m; 602.5–609.55 m; 620.15–631.7 m; 642.0–649.75 m; 655.05–677.75 m; 683.0–706.7 m). The association forms sharply based fining-upward units, up to 17 m thick. Internally the sandstone units are dominated by amalgamated, normally graded, coarse- to very coarse-grained sandstone beds (Fig. 2, Tables 1, 2). The beds are 0.1–5.8 m thick and have erosional bases. The beds generally show an overall thinning-upward trend and grade into thinly interbedded sandstone and mudstone. Rounded basement pebbles, up to 2 cm across, and angular mudstone rip-up clasts, up to 6 cm across, frequently occur. The graded sandstone beds have a predominantly massive appearance, often with floating mudstone rip-up clasts and plant debris. In some cases the uppermost part of the graded sandstone beds are internally stratified, showing parallel-lamination or cross-lamination. In two beds indistinct cross-bedding occur. Dish structures are occasionally present in the massive sandstones. The sandstones are occasionally burrowed with *Planolites* isp., and escape burrows are present in a few beds. *Helminthopsis horizontalis* has been recorded in one bed.

The amalgamated sandstone beds grade upward into thinly bedded sandstone and mudstone, showing an overall upward thinning and fining of the sandstone beds and laminae. Apart from the upward thinning and a fining of the sandstones, these deposits are similar to facies association 2.

Interpretation. Analogous fining-upward turbidite deposits have been observed in various turbidite basins and are characteristic of channel facies (e.g. facies A and B of Mutti & Ricci Lucchi, 1978; Surlyk & Hurst, 1984; Shanmugan & Moiola, 1985, 1991) and have also been described from outcrops of turbidite slope channels in the Nuussuaq Basin (Dam & Sønderholm, 1994). The sharp, scoured surface marking the lower boundary of each graded bed is evidence of erosion of the underlying sediment surface before deposition. This probably continued until peak discharge was reached and deposition of the massive sandstone with floating intraclasts took place. The massive sandstone with floating intraclasts is attributed to rapid suspension deposition from a sandy, high-density turbidity current (S_3 of Lowe (1982)). In some beds deposition from high-density turbidite currents was followed by deposition of well-developed parallel-laminated, cross-bedded and cross-laminated sandstones, attributed to a late stage, low-density turbidite current. The overall upward thinning of beds and transition into thinly interbedded sandstone and mudstone is attributed either to lateral shift of turbidite channels or channel abandonment.

Two scales of channel successions are recognised in GANE#1 and GANE#1A. In the lower part of GANE#1A a succession of thickly bedded coarse- to very coarse-grained sandstones, c. 17 m thick, was drilled (Fig. 2). Drilling was terminated before this succession was penetrated, but the grain-size and facies of the cored succession is very similar to the turbidite slope channels described in the Itilli valley area by Dam & Sønderholm (1994). These channel successions are up to 50 m deep and 1–2 km wide and are interpreted as major feeder channels on a fault-controlled slope. Similar channel facies have also been observed in the Aaffarsuaq valley during the GGU 1992 field season. The remaining channel successions in the two wells are 3–8 m thick, more heterolithic and thinner bedded (Fig. 2). Similar channels were also observed in the Aaffarsuaq valley during the GGU 1992 field season. The Aaffarsuaq channels are 4–20 m deep and probably no more than a few tens of metres wide. The channel fills are heterolithic and the sandstones are generally laminated and thinly bedded. These channel successions are interpreted as smaller distributary channels on the slope.

Facies association 5: Chaotic beds

Description. This association is characteristic of the upper part of the sedimentary section of both cores (GANE#1, 496.55–518.25 m, 527.8–545.6 m, 548.45–550.25 m, 553.2–554.75 m, 563.9–569.05 m, 597.0–602.8 m; GANE#1A, 535.55–544.9 m, 548.55–549.5 m, 552.45–554.75 m, 563.45–569.35 m, 597.7–602.5 m), and the first occurrence is associated with the first occurrence of volcanic clasts. The facies association consists of homogenised mudstones with evenly scattered sand grains, granules, volcanic clasts and concretions, interbedded with massive muddy sandstones and slumped mudstones. Occasionally turbidite sandstones occur. The sediments are in some cases bioturbated with *Planolites* isp.

The homogenised mudstones are dark grey to black and occur in beds up to 3 m thick. The mudstones are hard and brittle and are commonly broken into irregular platelets, 1–2 cm thick, of which the surfaces are very smooth and glasslike. Fine- to coarse-grained sand grains, granules, volcanic clasts and concretions are either evenly scattered or occur in thin stringers in the mudstones. A faint parallel lamination occurs in some cases. Occasionally slump folds occur in the mudstones.

The massive muddy sandstones are similar to those of Facies association 4. They are medium- to coarse-grained with a finely dispersed mud fraction, and rounded to subrounded mudstone clasts, plant debris, small basement pebbles and hyaloclastite clasts are common. The hyaloclastite clasts are up to 5 cm across. The size of the mudstone clasts are from few millimetres to several centimetres. They are floating in the matrix or in some cases concentrated towards the top of the beds. In some cases the platy mudstone clasts are aligned parallel to bedding planes producing platy fabric. The massive beds generally occur isolated within the thinly interbedded sandstone and mudstone (Tables 1, 2). The mud fraction has not been calculated, but probably ranges from 10 to 50%. The sandstones are poorly sorted. The thickness of the beds ranges from 5 cm to 50 cm and both the basal and upper contacts are sharp and planar. Grading is usually absent.

Interpretation. These sediments are interpreted as formed by downslope displacement of semi-consolidated sediments. The homogenised mudstones and massive muddy sandstones were probably deposited from debris flows, whereas the contorted mudstones were deposited from slumps. The merging between the introduction of hyaloclastite clasts and this facies association suggests that these major sediment failures were caused by regional and local tectonic activity as well as loading of the hyaloclastites, connected with the initiation of volcanic activity in the region.

Facies association 6: Bioturbated thinly interbedded sandstone and mudstone

Description. This facies association is present in one interval in GANE#1 (518.25–527.8 m) (Fig. 2, Table 1). It consists of moderately to heavily bioturbated thinly interbedded sandstone and mudstone. The only identifiable trace fossil is *Planolites* isp. The thinly interbedded mudstone and sandstone association is very similar to that of Facies association 2. It consists of sharply based graded laminae and beds of fine- to medium-grained sandstone up to 30 cm thick, capped by grey parallel laminated mudstone. The laminae and beds have sharp bases and show well-developed normal grading. Sorting is good, and small mudstone rip-up clasts frequently occur. Granules may occur in some beds. Sedimentary structures include parallel lamination and cross-lamination.

Interpretation. Planolites isp. was probably produced by infaunal organisms combining the activities of deposit-feeding and locomotion, thus producing endostratal pascichnia burrows. The dominance of these burrows suggests that the interstitial environment must have been characterised by at least some oxygen to allow respiration. The high degree of bioturbation of the sediment indicates relatively slow sedimentation, little physical reworking and abundant food supplies. The thinly interbedded sandstones and mudstones are interpreted as deposits of traction and fall-out processes associated with various stages of sedimentation from waning low-density currents.

Depositional environment

During the Early Paleocene the Eqalulik area was characterised by deposition in a marine turbidite system. However, geochemical data indicate a large input of terrestrial material (Christiansen, 1996). Depositional processes were dominated by low- and high-density turbidity currents, debris flows, slumps and fall-out from suspension. The facies can be grouped in different facies associations in a vertical arrangement that reflects a number of different morphological subenvironments on the slope. These subenvironments not only reflect morphological elements, but also the initiation of volcanism in the area.

The greater part of the succession consists of thinly interbedded sandstone and mudstone which is characteristic in four of the facies associations (Facies association 2, 3, 4 and 5). In Facies association 2 the thinly interbedded sandstone and mudstone occurs in coarsening-upward successions, 4–6 m thick, which are interpreted as shallowing-upward successions. The coarsening-upward successions are either overlain by a new coarsening-upward succession, or by amalgamated sandstone grading upward into thinly interbedded sandstone and mudstone (Facies association 4). These deposits have been interpreted as small distributary channels on the slope, suggesting that the coarsening-upward successions formed by progradation of small sandy lobes in front of the distributary channels (cf. Stow, 1985).

Two types of turbidite channel successions occur in the wells. In the lower part of GANE#1A a thick succession of amalgamated thickly bedded coarse- to very coarse-grained sandstone was drilled, without being penetrated before drilling was terminated. Grainsize and facies of the cored succession are very similar to the turbidite slope channels described in the Itilli valley area by Dam & Sønderholm (1994), and the basal succession in GANE#1A is interpreted as a major feeder channel on the slope. Similar channel facies have also been observed in the Aaffarsuaq valley during the GGU 1992 field season. Based on preliminary palynological dating, the coarse-grained channel succession is coincident with the major incised valley system of the Quikavsak Member along the south side of Nuussuaq peninsula. If this assumption is correct, the Quikavsak valley system may have sourced this turbidite feeder channel and a major unconformity may be present just underneath this channel sandstone. However, a better dating of the succession and further drilling is necessary to confirm this hypothesis.

The remaining channel successions in the two cores are 3–8 m thick, more heterolithic and thinner bedded. Similar channel successions were observed in the Aaffarsuaq valley during the GGU 1992 field season. In the Aaffarsuaq valley these channels are characterised by complex channelling; the channels cut into each other and are filled with amalgamated sandstone and interbedded sandstone and mudstone of the same type as those outside the channels. The Aaffarsuaq channels are 4–20 m deep and probably no more than a few tens of metres wide. These channel successions are interpreted as smaller distributary channels on the slope.

The first visible occurrence of volcanic clasts is at c. 601 m in both wells. They are associated with debris flow deposits, suggesting a destabilisation of the slope sediments. This debris flow succession is succeeded by a relatively thick succession of mudstones (Facies association 1). If not taking the total sulphur content into account, this mudstone would probably be interpreted as deposited in the lobe fringe area, and the mudstone could reflect a tectonically controlled relative sea-level rise. However, the very low total sulphur content, both compared to the rest of sedimentary succession and to the total organic content of the mudstone, suggests a fresh to brackish water depositional environment of the mudstone. This part of the basin may therefore have been sealed off from the marine part of the basin by a broad subaerial volcanic terrain during the initiation of volcanism in the area. A similar development has been described further east in the basin, where a large and deep lake, the Naajaat lake, was formed contemporaneously with the volcanic eruptions and was cut off from marine transgressions by a broad volcanic terrain (Pedersen *et al.*, in press). This lake developed in Mid-Paleocene (NP6-NP7) and is slightly younger than the mudstone in GANE#1 and GANE#1A (NP3–NP4).

The succession above the mudstone is still characterised by thin distributary channel deposits, but higher up chaotic beds become the dominant facies association (Facies association 5). These sediments are interpreted as formed by downslope displacement of semi-consolidated sediments. The homogenised mudstones and massive muddy sandstones were probably deposited from debris flows, whereas the contorted mudstones were deposited from slumps. This association does not occur below the first occurrence of hyaloclastite clasts and suggests that the morphological reorganisation and the major sediment failures were caused by regional and local tectonic activity as well as loading of the hyaloclastites, related to the initiation of volcanic activity in the region.

In the upper part of the sedimentary succession a single bioturbated thinly interbedded mudstone and sandstone interval occurs. The large degree of bioturbation in this part of the succession is generally not characteristic of ancient examples of turbidite systems. However, on the north coast of Nuussuaq, very thick successions of thinly interbedded turbidite sandstone and mudstone also show a very high degree of bioturbation with *Planolites* isp. (Dam & Nøhr-Hansen, 1995). This association indicates relatively slow sedimentation, little physical reworking, and abundant food supplies in an environment that was well-aerated.

A very good correlation occurs between GANE#1 and GANE#1A, where a bed by bed correlation is possible. A correlation based on lithology with GANK#1, situated c. 6 km east of the GANE#1 well, has not, however, been possible. The sedimentary succession cored in GANK#1 is c. 285 m thick and dominated by chaotic beds (Dam, 1996). No turbidite channel deposits occur in this well. Volcanic clasts occur throughout the cored succession in GANK#1, suggesting that the base of the GANK#1 is no older that the level with the first occurrence of volcanic clasts in GANE#1. A palynological screening examination suggests a Paleocene age of the GANK#1 sediments, probably the same age as GANE#1 (H. Nøhr-Hansen, pers. comm., 1996).

Hydrocarbon shows

During drilling bleeding oil and impregnation with oil were observed at several levels in the hyaloclastite cover (Bate, 1995). Moreover, sweet gas bubbled from the wellhead when penetrating the 631 m and 633–638 m intervals, and gas-contaminated cement occurred at 641 m in GANE#1 (Fig. 2). In GANE#1A a gas kick occurred in 684–689 m , with wet gas and possibly condensate escaping from the flare-line, and gas bubbled from the core at 696.5–702 m (Fig. 2). During relogging of the core in Copenhagen oil impregnation was also discovered in sediments in the interval from 635–650 m. It occurs in both the turbidite sandstone laminae and beds up to 55 cm thick, and dispersed in the interbedded mudstone of Facies association 2 (Fig. 2, Tables 1, 2). The organic geochemistry of the sediments, oils and gases is presented in Christiansen *et al.* (1996). During a recent conventional core analysis, oil was also discovered in three plugs in the amalgamated sandstones at the base of GANE#1A (686.1–704.1 m) showing oil saturation between 11 and 18% (Høier & Springer, 1996) (Fig. 2). The organic geochemistry of these oils is currently being investigated, but the preliminary results suggest an oil not previously recorded in the basin (F. G. Christiansen, pers. comm. 1996).

Core analysis

Thirty-one plugs with a diameter of 25 mm were taken for conventional core analysis. Porosity, grain density and gas permeability were measured on all the plugs (Høier & Springer, 1996). The porosity of the lower amalgamated sandstones in GANE#1A is fair and in the 7–15% range (average 10.5 %), whereas in the sandstones in the rest of the succession it is generally poor (range 0.3–12.4%, average 5.9%). The permeability of the lower amalgamated sandstones ranges from 0.02 md to 1.87 md (average 0.56 md). Even poorer reservoir properties characterise the remaining part of the sandstones in the succession. These show very low permeabilities ranging between 0.001 md and 0.27 md (average 0.06 md). A more detailed core analysis and diagenetic study of GANE#1 and GANE#1A is currently undertaken at GEUS.

Conclusions

Based on the sedimentological analyses of the GANE#1 and GANE#1A cores, the following main conclusions can be drawn.

- A bed by bed correlation between the GANE#1 and GANE#1A is possible, but a lithostratigraphic correlation between GANE#1 and GANK#1 has not been possible.
- A palynological screening examination suggests a middle Late Paleocene age and marine depositional environment for the sedimentary succession cored in GANE#1 and GANE#1A (upper dinocyst biozone 3 – lower dinocyst biozone 4; H. Nøhr-Hansen, pers. comm., 1996).

- The cored sediments can be divided into 6 facies associations: 1) mudstone, 2) thinly interbedded sandstone and mudstone, 3) interbedded muddy sandstones and thinly interbedded sandstone and mudstone, 4) amalgamated sandstone grading upward into thinly interbedded sandstone and mudstone, 5) chaotic beds, 6) bioturbated thinly interbedded sandstone and mudstone. The facies associations indicate that deposition took place in a marine slope environment, however, the organic geochemistry of the mudstones suggests a large terrestrial input. The depositional processes were dominated by low- and high-density turbidite currents, debris flow, slumps and fall-out from suspension. Deposition took place in major turbidite feeder channels, small distributary feeder channels, turbidite lobes, and unstable interdistributary areas characterised by retrogradational slumping. The facies associations not only reflect the morphological elements on the slope, but also major changes due to the initiation of volcanism in the area, which at least during one time interval probably created a land barrier that sealed off this part of the basin.

- During relogging of the sediments oil impregnation of the sediments was discovered in two intervals. The organic geochemistry of the oils is described by Christiansen *et al.* (1996).

- A conventional core analysis indicates that the turbidite feeder channel sandstones have a fair porosity, ranging between 7 and 15%, but poor permeabilities, ranging between 0.02 and 1.87 md. Other sandstone facies show even worse reservoir properties, with porosities ranging between 0.3 and 12.4 % and permeabilities ranging between 0.001 and 0.27 md.

Acknowledgements

Funding of the project was provided from the Greenland Home Rule Administration and the Danish State through the Government of Greenland Minerals Office and the Mineral Resources Administration for Greenland. Flemming G. Christiansen and Chris Pulvertaft are thanked for discussions and comments on an earlier version of the report. Henrik Nøhr-Hansen is thanked for placing his preliminary palynological data at my disposal. Jette Halvskov helped with the technical preparation of the report.

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Figures

Fig. 1. Geological map of central West Greenland showing location of the GANE#1 well and other wells in the area. Based on maps from the Geological Survey of Greenland.

Fig. 2. Generalised logs from the two cores that penetrate the sedimentary succession underneath the volcanic cover.

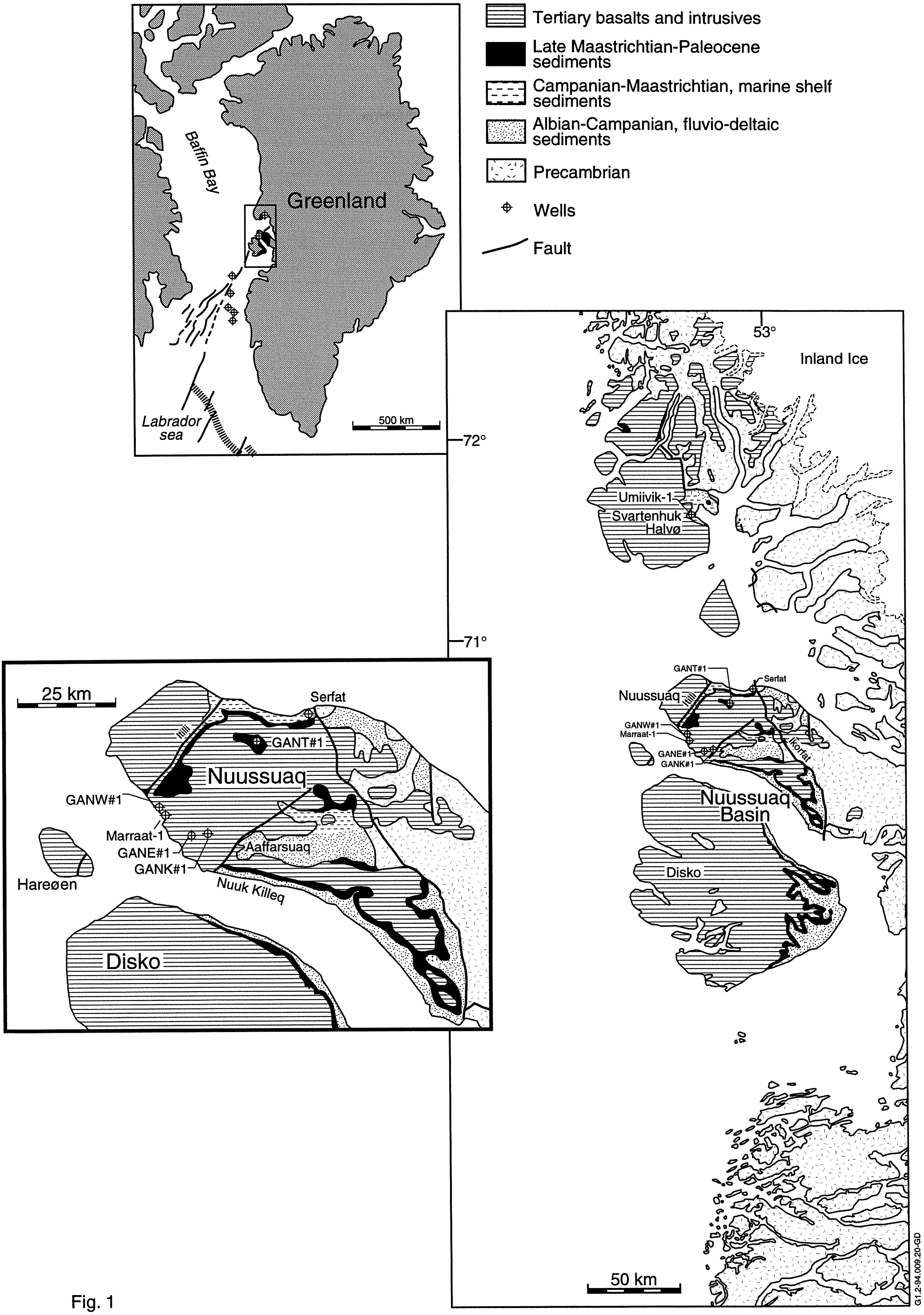

Tertiary basalts and intrusives
Late Maastrichtian-Paleocene sediments
Campanian-Maastrichtian, marine shelf sediments
Albian-Campanian, fluvio-deltaic sediments
Precambrian
Wells
Fault
Baffin Bay
Greenland
Labrador sea
500 km
53°
Inland Ice
72°
71°
Umiivik-1
Svartenhuk Halvø
GANT#1
Serfat
Nuussuaq
GANW#1
Marraat-1
GANE#1
GANK#1
Ikorfat
Nuussuaq Basin
Disko
50 km
25 km
Aaffarsuaq
Hareøen
Nuuk Killeq
G1.2-94.009.20-GD

Fig. 1

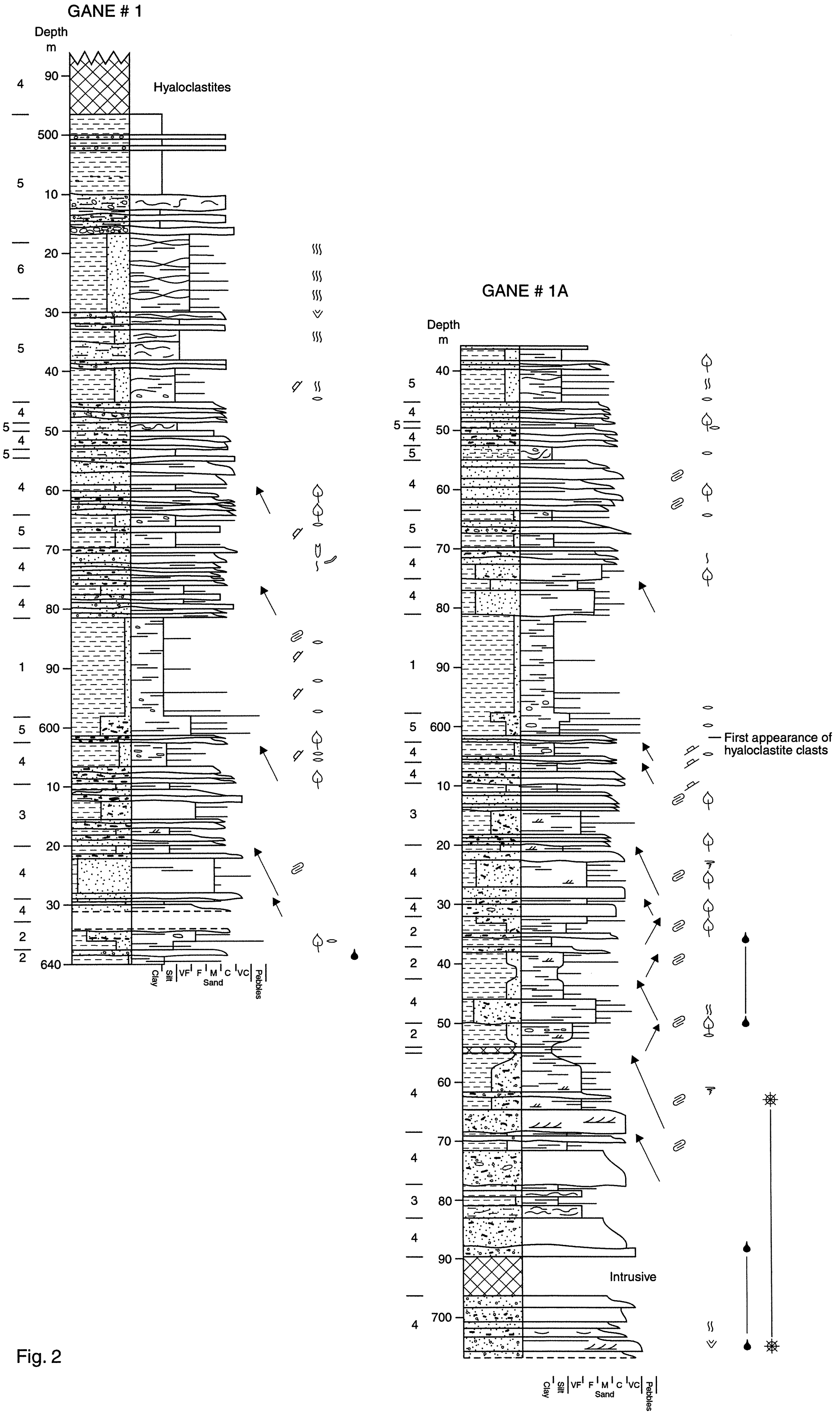

GANE # 1
Depth
m
Hyaloclastites
90
500
10
20
30
40
50
60
70
80
90
600
10
20
30
640
4
5
6
5
4
5
4
5
4
5
4
4
1
5
4
3
4
4
2
2
Clay
Silt
VF
F
M
C
VC
Sand
Pebbles
GANE # 1A
Depth
m
40
50
60
70
80
90
600
10
20
30
40
50
60
70
80
90
700
5
4
5
4
5
4
5
4
4
1
5
4
4
3
4
4
2
2
4
2
4
4
3
4
4
First appearance of hyaloclastite clasts
Intrusive
Clay
Silt
VF
F
M
C
VC
Sand
Pebbles

Fig. 2

LEGEND

Facies associations

1	Mudstone
2	Thinly interbedded sandstone and mudstone arranged in coarsening-upward successions
3	Interbedded muddy sandstones and thinly interbedded sandstone and mudstone
4	Amalgamated sandstone grading upward into thinly interbedded sandstone and mudstone
5	Chaotic beds
6	Bioturbated thinly interbedded sandstone and mudstone
▩	Volcanic sills and hyaloclastites
┄	Clay and siltstone
⁘	Sandstone with pebbles and mudstone clasts
▤	Parallel lamination
@	Disturbed bedding
⟋⟋	Cross-lamination
⋈	Bioturbation
⬭	Concretions
♠	Plant and wood fragments
∪	Belemnite
ʃ	Weakly bioturbated
ʃʃ	Moderately bioturbated
ʃʃʃ	Heavily bioturbated
~	*Planolites* isp.
≋	Psygmatic folds
⫽	Fractures
💧	Oil
✳	Gas
↗	CU-succession
↖	FU-succession

G6.1-96.018/GD

Table 1

Table 1. Detailed log of the sedimentary succession in the GANE#1 core.

SHEET 1 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

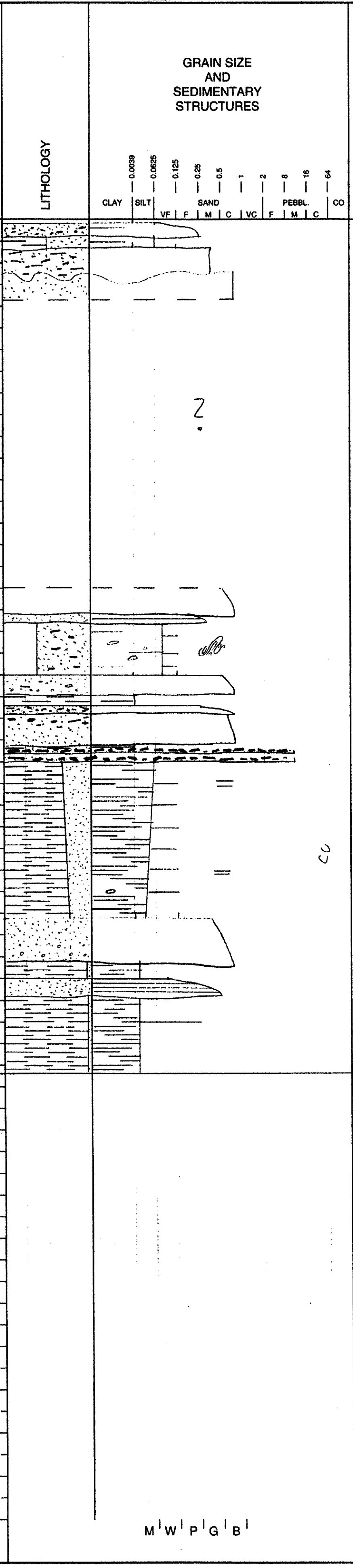
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 M

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

439001
WELL NO: GANE # 1
BOX NO:
CORE DIAMETER: NQ , BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 12/1-96 +16/1
GEOLOGIST: OD



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			630													
		630.42					Dark grey	Coal frag					4		648 647 332 478	
2070' 630.94			31													
			32													
			33													
		Box # 204	34													
			35					Coal frag Sid/Ank. con					Z			
			36					Coal frag							333 479	
2088' 636.42		636.62	37					Con								
2093' 637.95			38					⊗							648 647	
		Box # 205	39										Z		482	
		639.86	640													
			41													
			42													
			43													
			44													
			645													

SHEET 2 OF 10

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

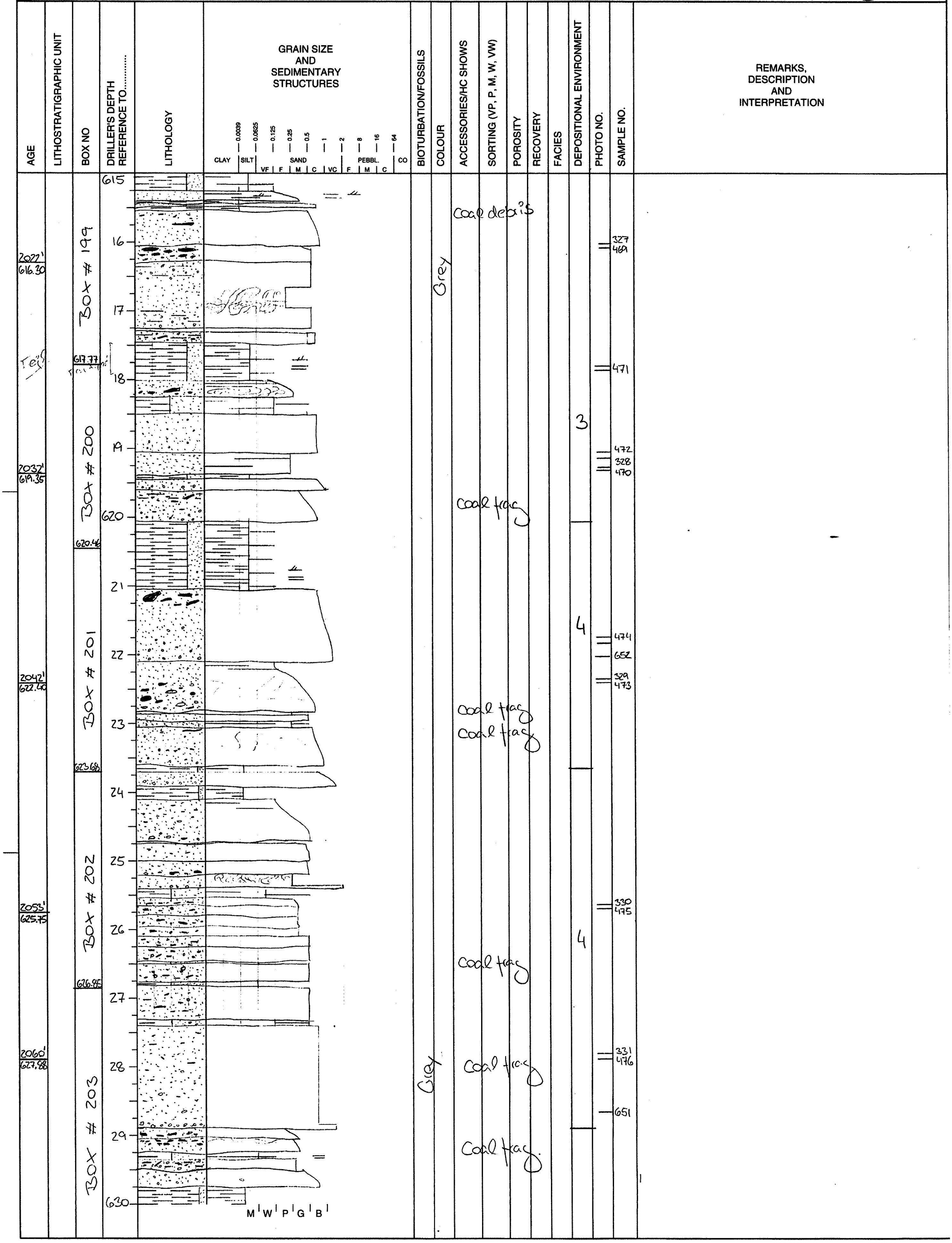
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 16/1-96
GEOLOGIST: GD



SHEET 3 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

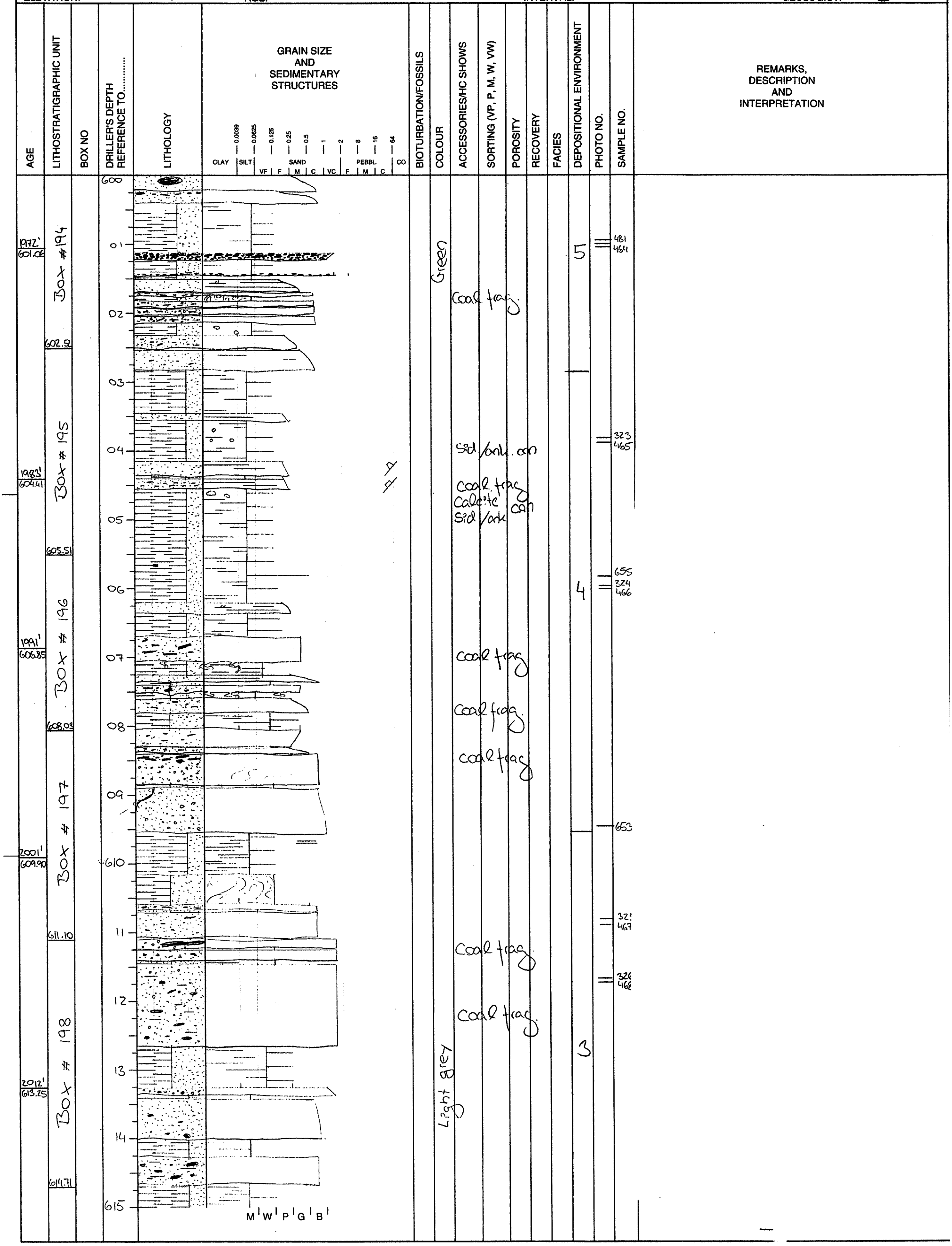
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N 54° 00' 40" W
UTM COORDINATES :
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE #1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 16/1 -96 +17/1
GEOLOGIST: GD



SHEET 4 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

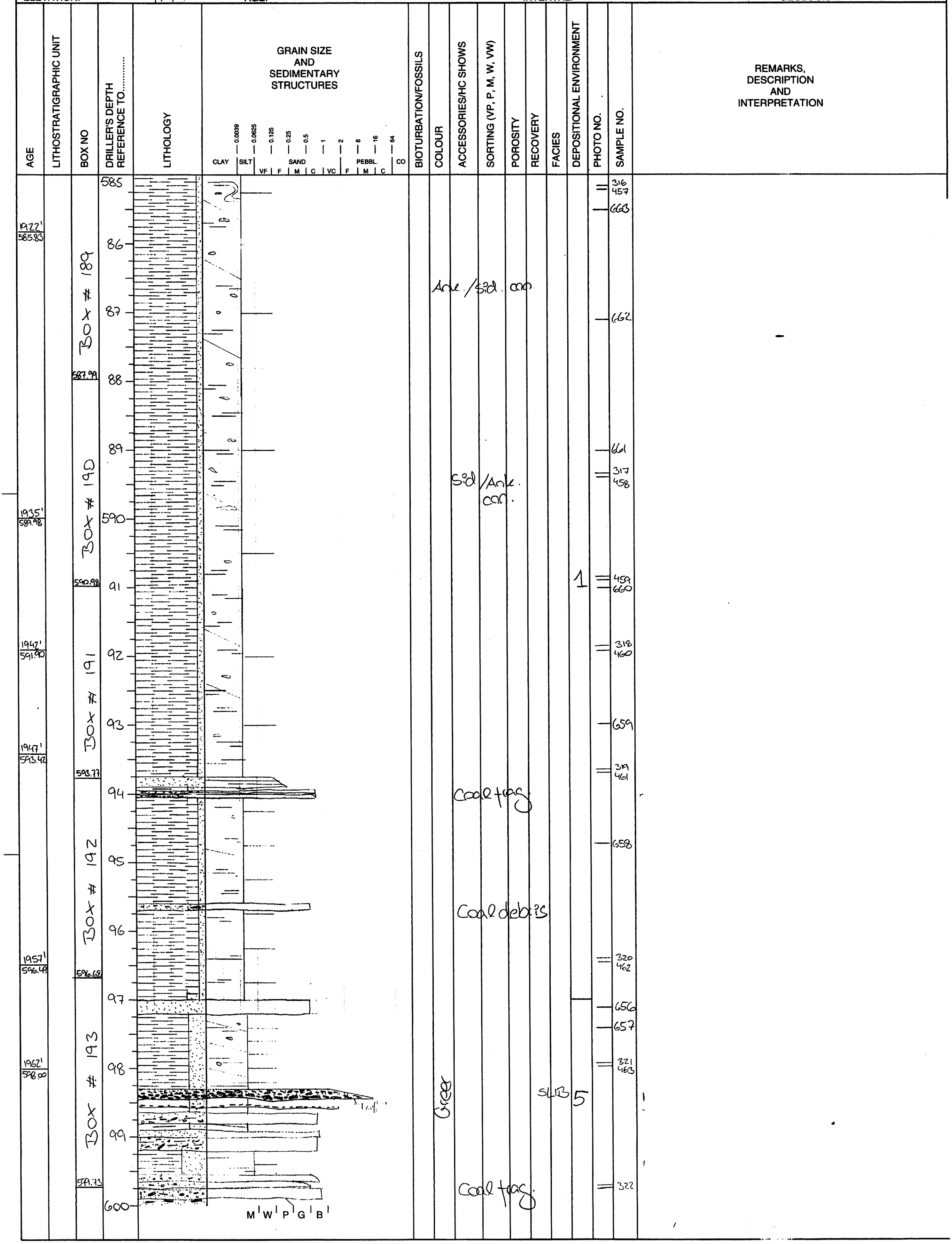
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 17/1-96
GEOLOGIST: GD



SHEET 5 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

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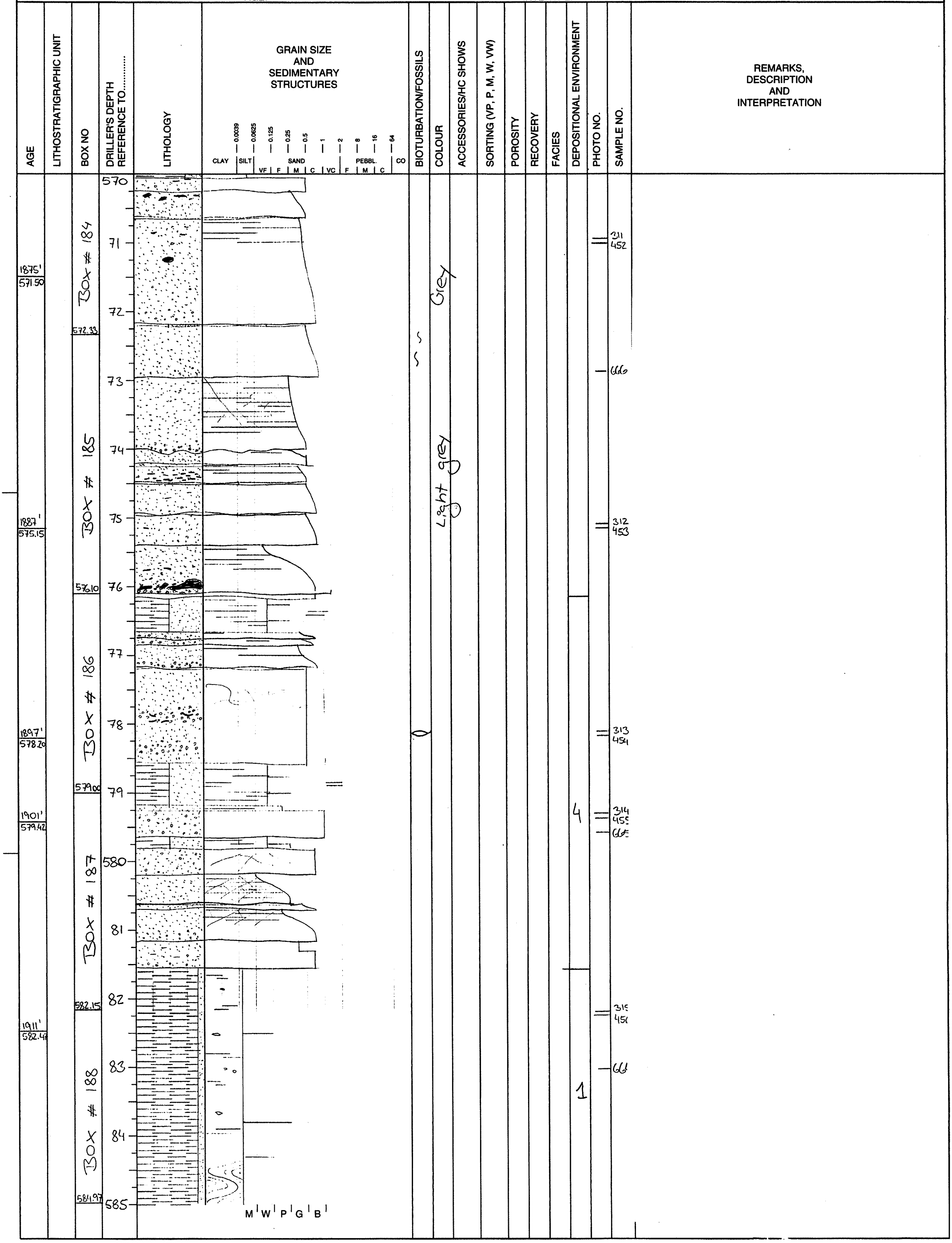
UTM COORDINATES: 54°00'40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE #1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 17/1-96
GEOLOGIST: GD



SHEET 6 OF 10

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

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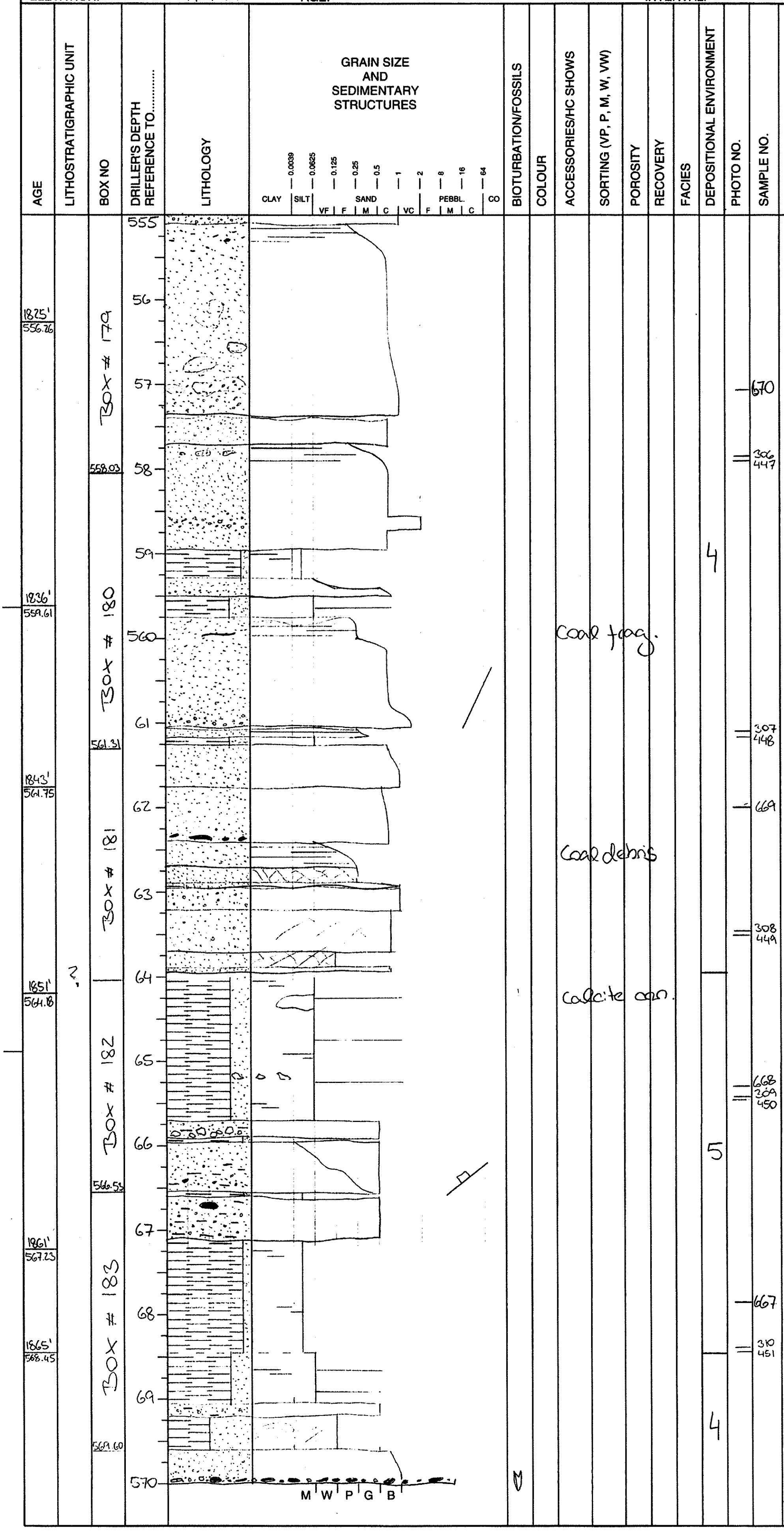
UTM COORDINATES: 54°00'40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 23/1-96
GEOLOGIST: GD



REMARKS, DESCRIPTION AND INTERPRETATION

SHEET 7 OF 10

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

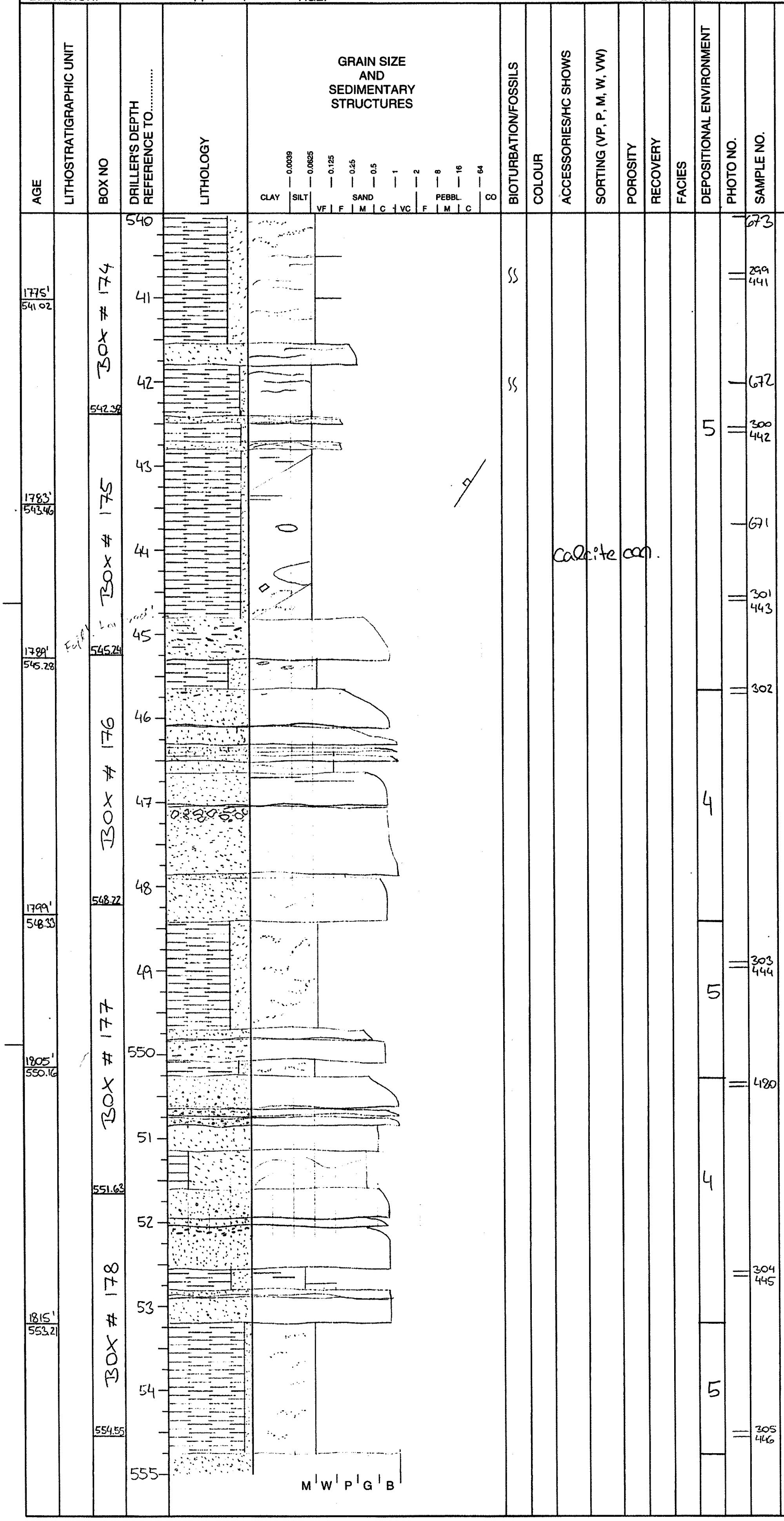
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 23/1-96 + 24/1
GEOLOGIST: GD



REMARKS, DESCRIPTION AND INTERPRETATION

SHEET 8 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

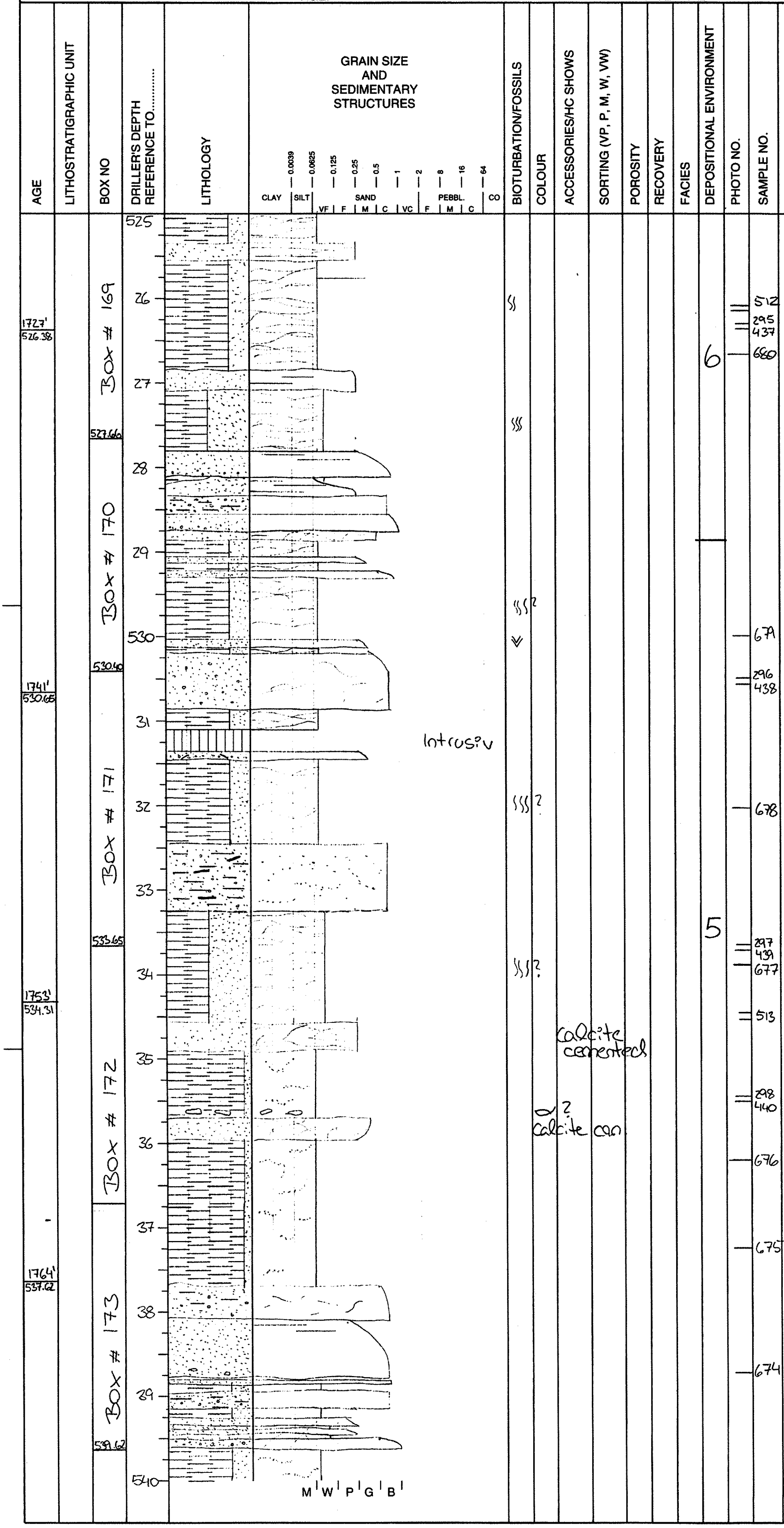
LOCALITY: 70° 28' 15" N 54° 00' 40" W
UTM COORDINATES :
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE #1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 24/1-96
GEOLOGIST: GD

AGE	LITHOSTRATIGRAPHIC UNIT	BOX NO	DRILLER'S DEPTH REFERENCE TO..........	LITHOLOGY	GRAIN SIZE AND SEDIMENTARY STRUCTURES	BIOTURBATION/FOSSILS	COLOUR	ACCESSORIES/HC SHOWS	SORTING (VP, P, M, W, VW)	POROSITY	RECOVERY	FACIES	DEPOSITIONAL ENVIRONMENT	PHOTO NO.	SAMPLE NO.	REMARKS, DESCRIPTION AND INTERPRETATION



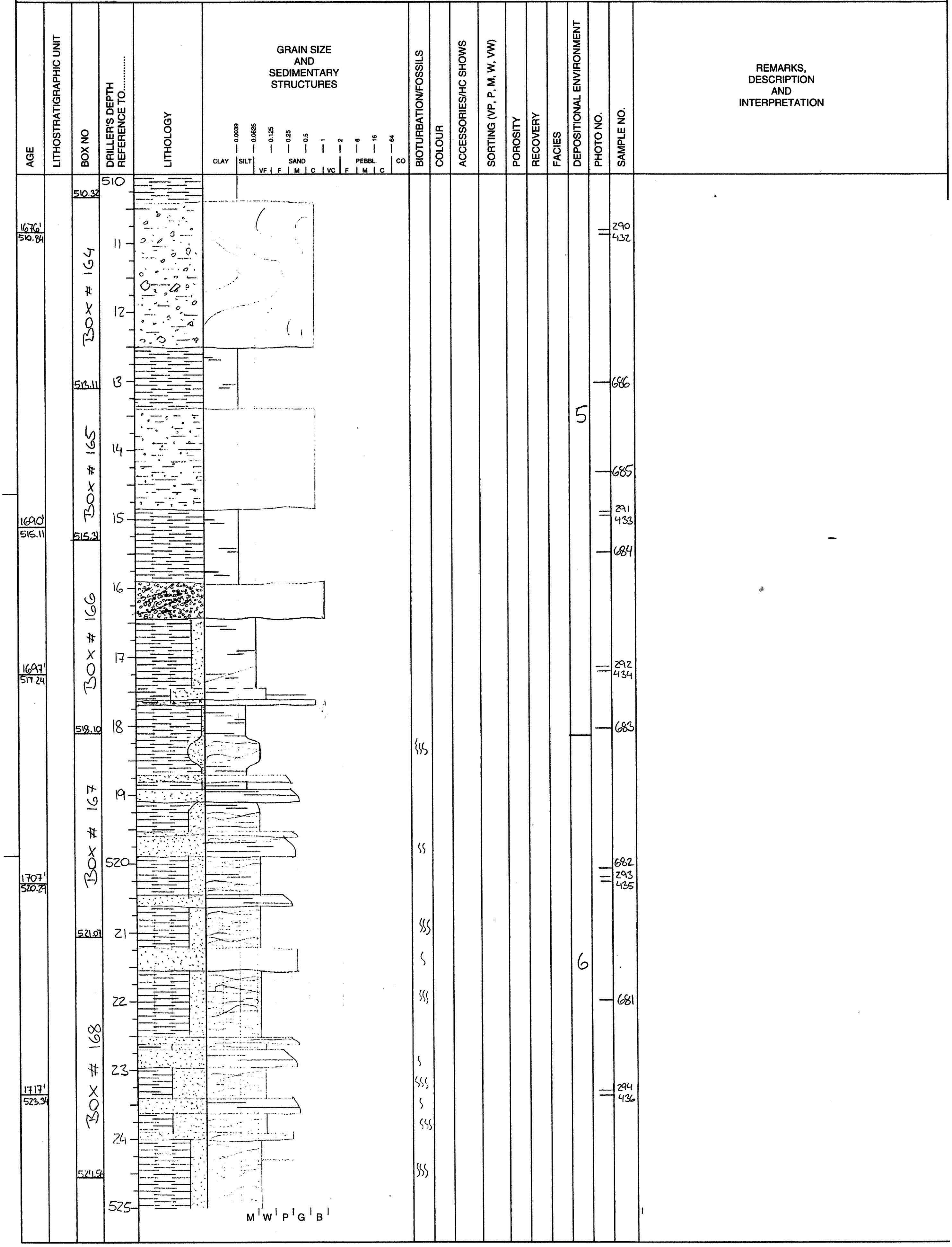
SHEET 9 OF 10

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15"N 54° 00'40"W
UTM COORDINATES:
ELEVATION: 114 m
ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:
WELL NO: 439001 GANE #1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:
SCALE: 1:50
DATE: 24/11-96
GEOLOGIST: GD



SHEET 10 OF 10

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70°28'15"N
UTM COORDINATES : 54°00'40"W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR
ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE #1
BOX NO:
CORE DIAMETER: (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 25/1-96
GEOLOGIST: GD

AGE	LITHOSTRATIGRAPHIC UNIT	BOX NO	DRILLER'S DEPTH REFERENCE TO........	LITHOLOGY	GRAIN SIZE AND SEDIMENTARY STRUCTURES	BIOTURBATION/FOSSILS	COLOUR	ACCESSORIES/HC SHOWS	SORTING (VP, P, M, W, VW)	POROSITY	RECOVERY	FACIES	DEPOSITIONAL ENVIRONMENT	PHOTO NO.	SAMPLE NO.	REMARKS, DESCRIPTION AND INTERPRETATION

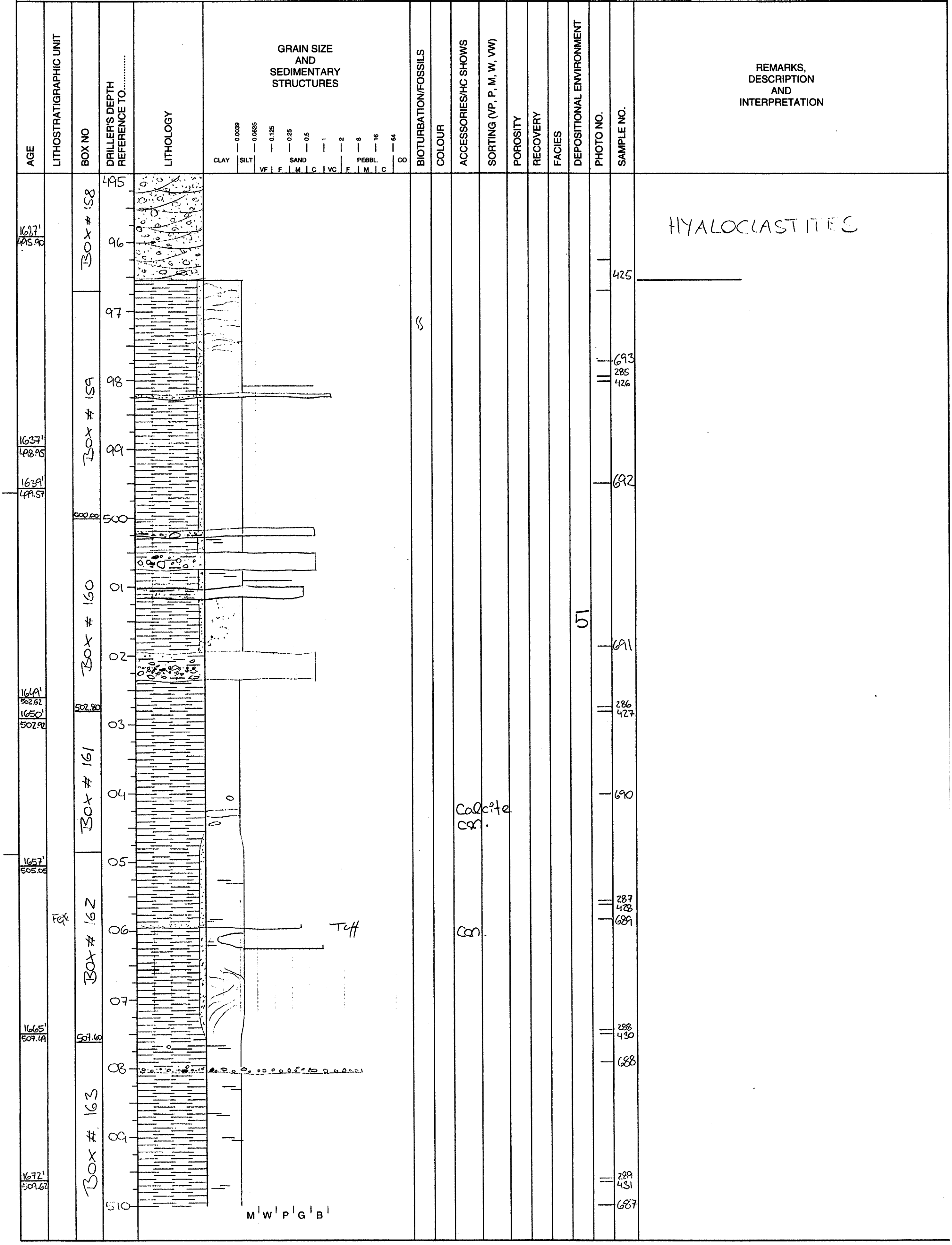


Table 2

Table 2. Detailed sedimentological log of the of the GANE#1A core.

SHEET 1 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

439001

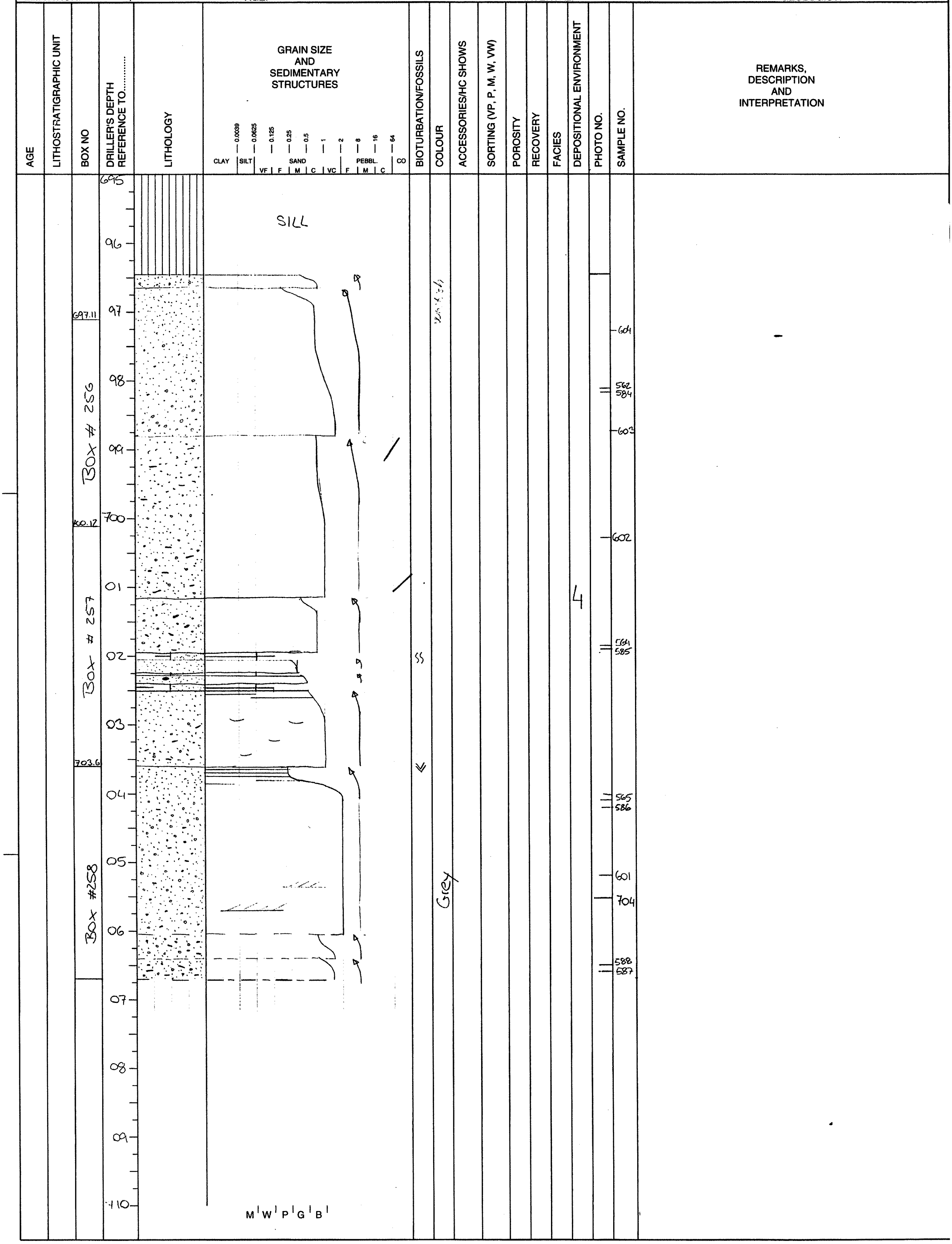
LOCALITY: 70°28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: GANE # 1A
BOX NO:
CORE DIAMETER: BQ
INTERVAL:

(cm/mm)

SCALE: 1:50
DATE: 4/1-96
GEOLOGIST: GD



SHEET 2 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

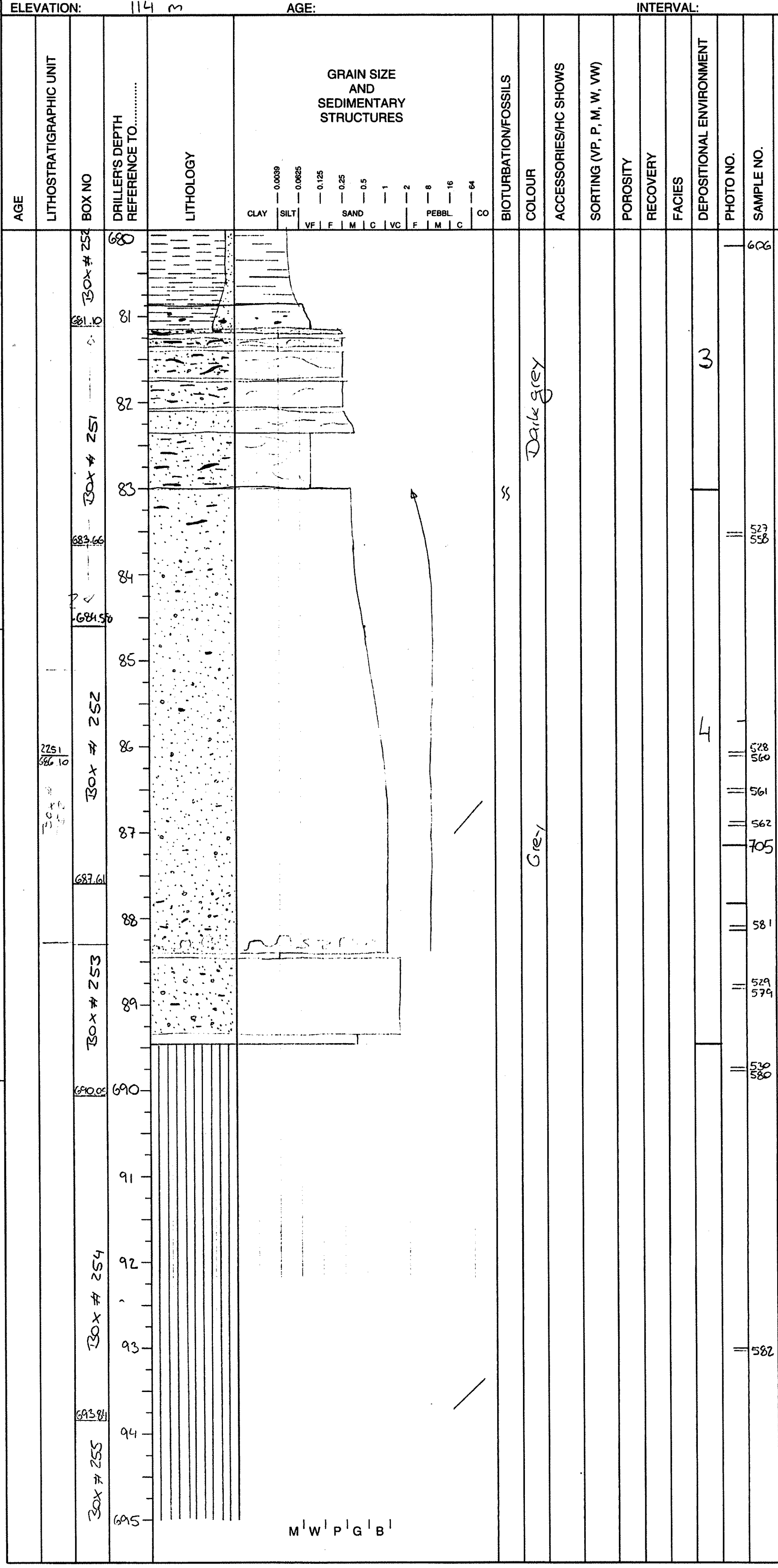
LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE #1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 4/1-96 + 5/1-96
GEOLOGIST: GD

AGE | LITHOSTRATIGRAPHIC UNIT | BOX NO | DRILLER'S DEPTH REFERENCE TO.......... | LITHOLOGY | GRAIN SIZE AND SEDIMENTARY STRUCTURES | BIOTURBATION/FOSSILS | COLOUR | ACCESSORIES/HC SHOWS | SORTING (VP, P, M, W, VW) | POROSITY | RECOVERY | FACIES | DEPOSITIONAL ENVIRONMENT | PHOTO NO. | SAMPLE NO. | REMARKS, DESCRIPTION AND INTERPRETATION



SHEET 3 OF 12

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

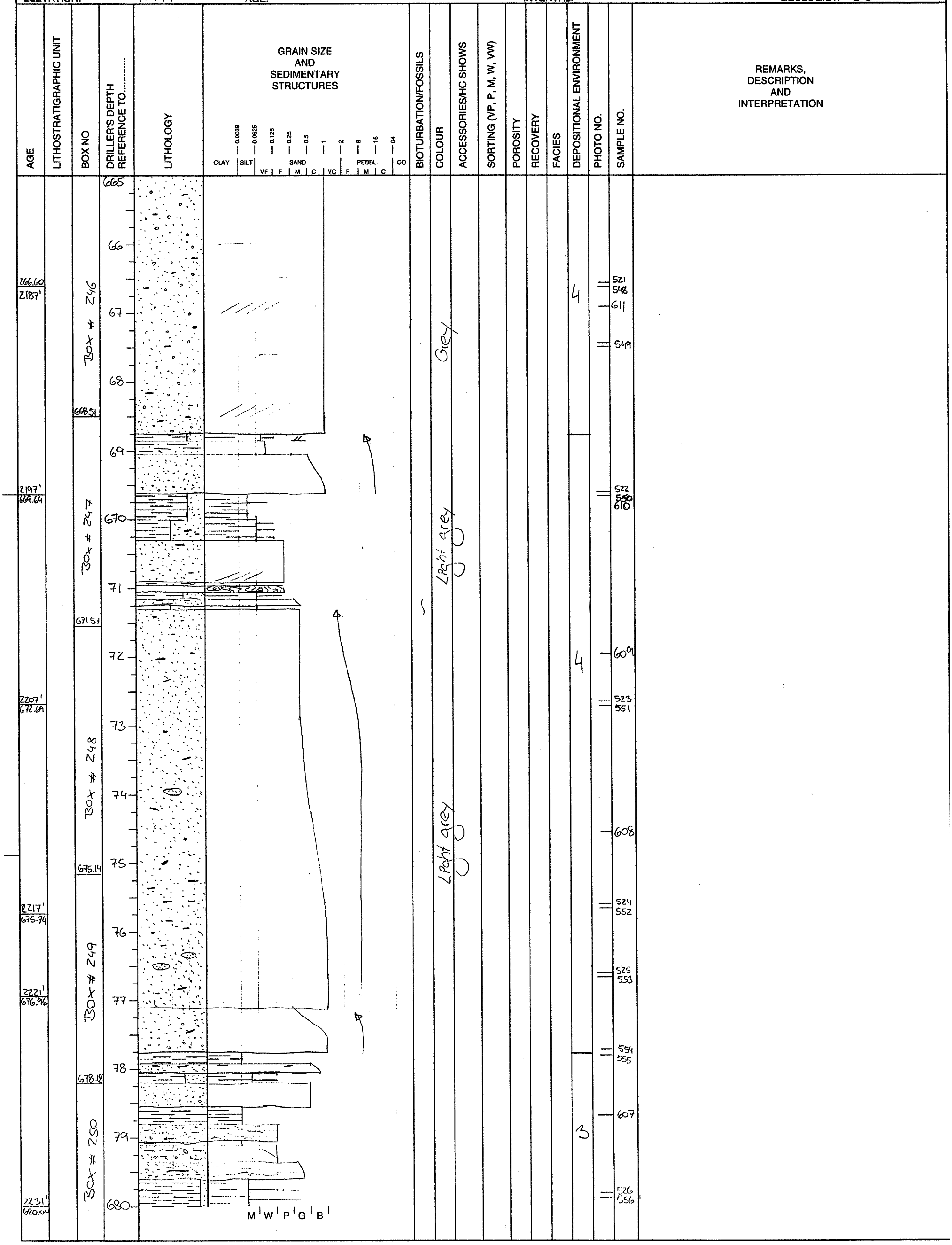
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 5/1-96
GEOLOGIST: GD



SHEET 4 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 M

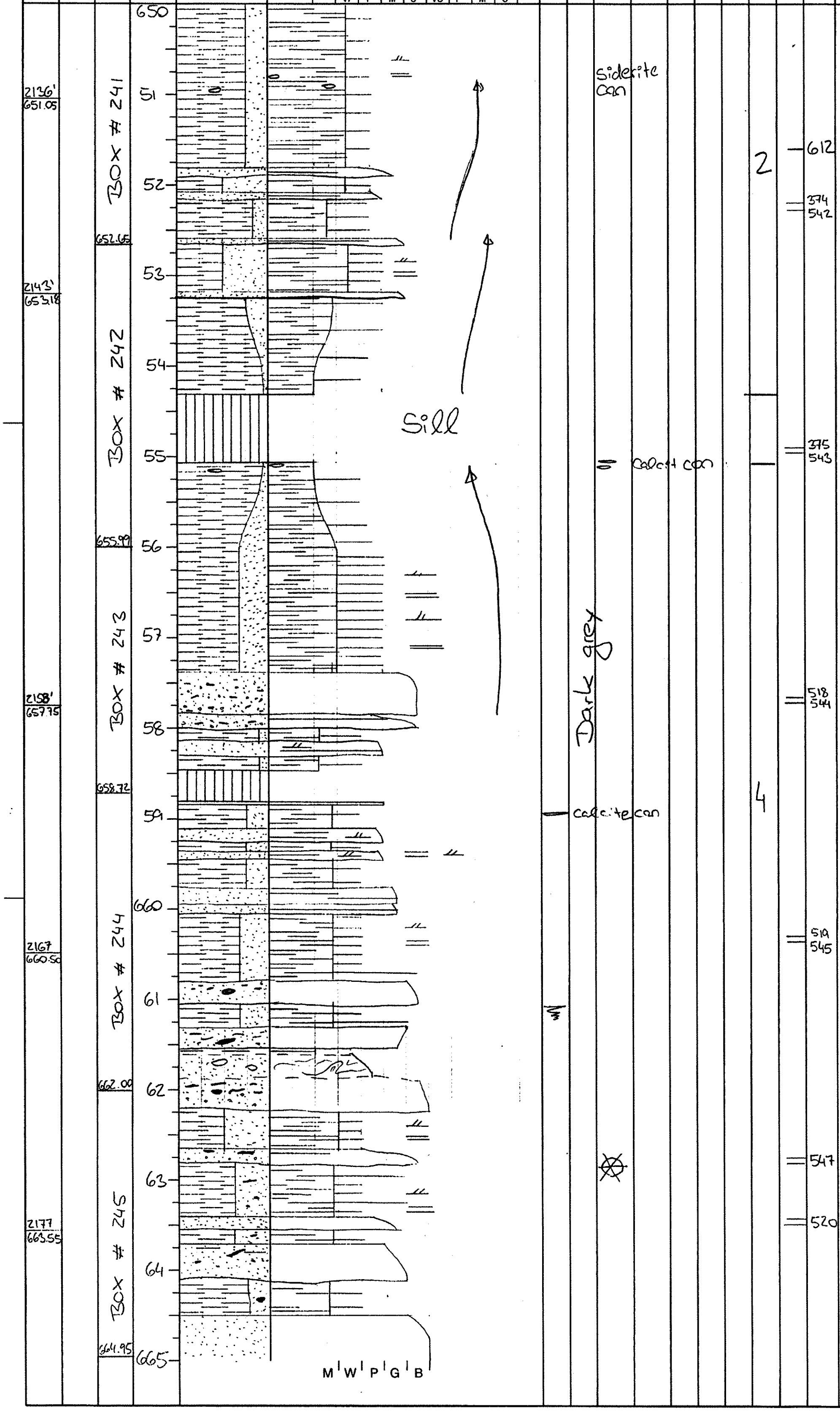
ELEVATION OF DRILL FLOOR
ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 5/1-96 & 9/1
GEOLOGIST: GD

AGE	LITHOSTRATIGRAPHIC UNIT	BOX NO	DRILLER'S DEPTH REFERENCE TO........	LITHOLOGY	GRAIN SIZE AND SEDIMENTARY STRUCTURES	BIOTURBATION/FOSSILS	COLOUR	ACCESSORIES/HC SHOWS	SORTING (VP, P, M, W, VW)	POROSITY	RECOVERY	FACIES	DEPOSITIONAL ENVIRONMENT	PHOTO NO.	SAMPLE NO.	REMARKS, DESCRIPTION AND INTERPRETATION

GRAIN SIZE scale: 0.0039 – 0.0625 – 0.125 – 0.25 – 0.5 – 1 – 2 – 8 – 16 – 64
CLAY | SILT | SAND: VF | F | M | C | VC | PEBBL.: F | M | C | CO



SHEET 5 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

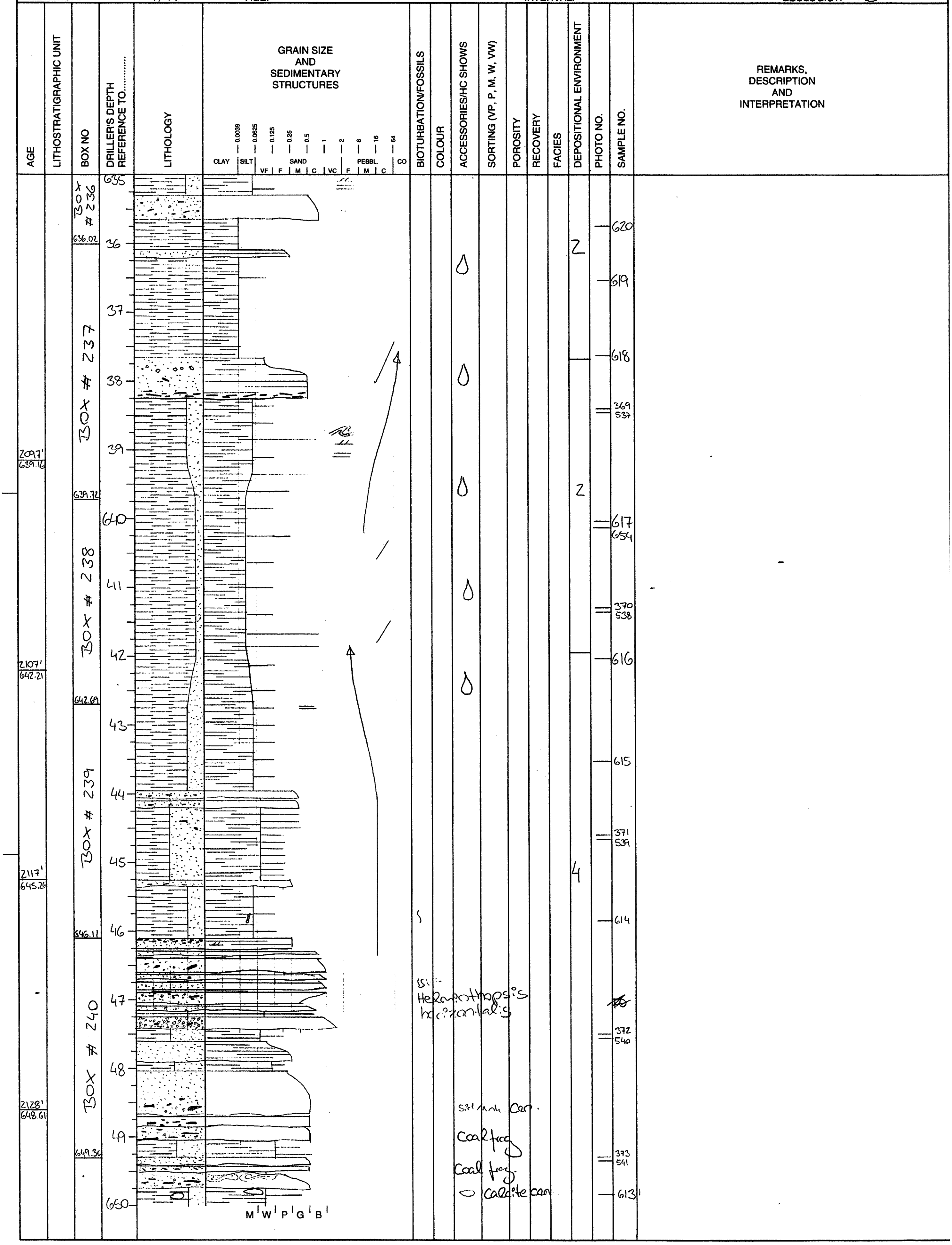
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70°28'15" N
UTM COORDINATES : 54°00'40"W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR
ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 9/1-96
GEOLOGIST: OD



SHEET 6 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

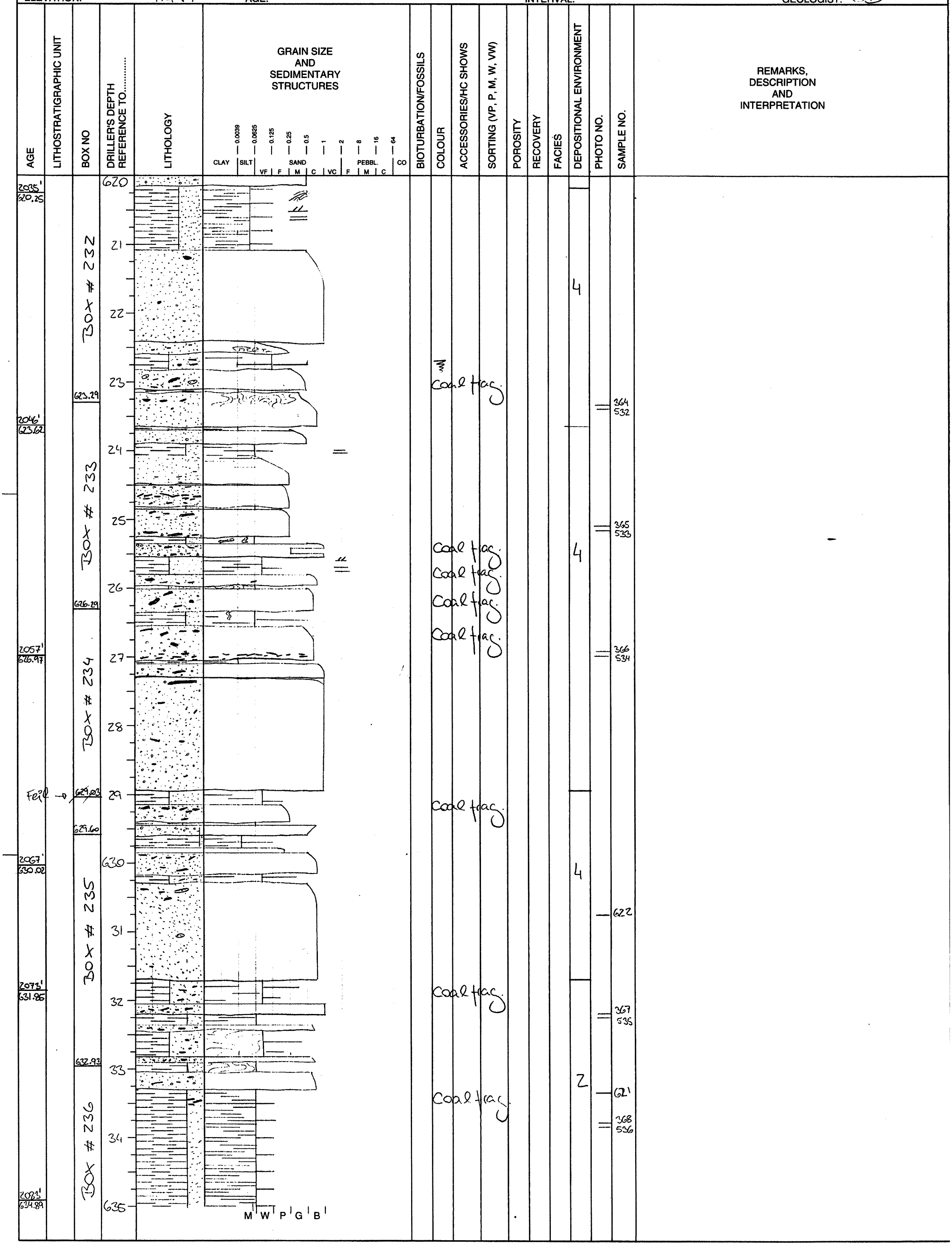
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70°28'15"N
UTM COORDINATES: 54°00'40"W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 9/1-96 +10/1
GEOLOGIST: GD



SHEET 7 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

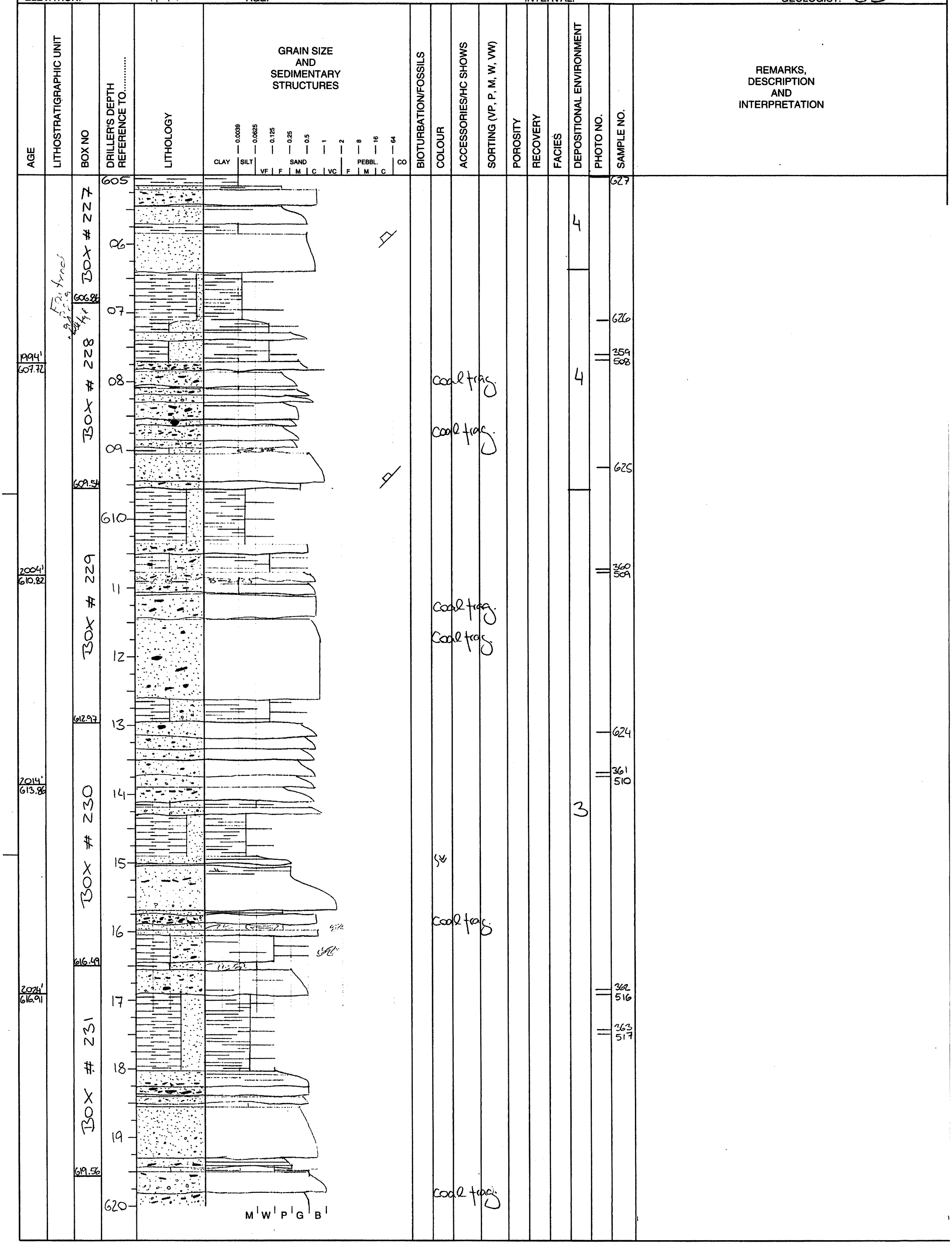
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 10/1-96
GEOLOGIST: GD



SHEET 8 OF 12

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

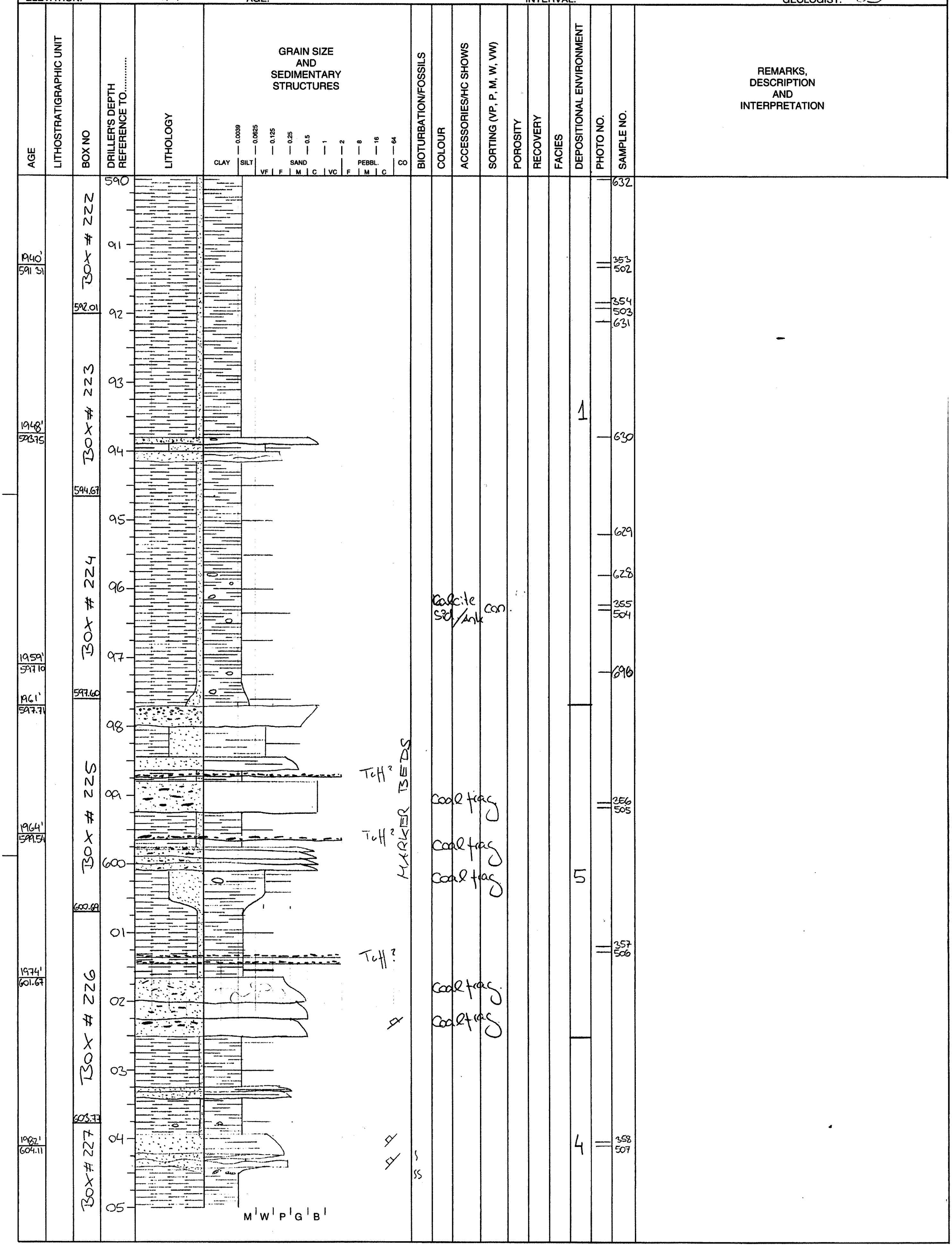
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES : 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR
ABOVE GROUND-LEVEL: 2m
UNIT:
AGE:

WELL NO: 439001 GANE #1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 10/1-96 + 11/1
GEOLOGIST: GD



SHEET 9 OF 12

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

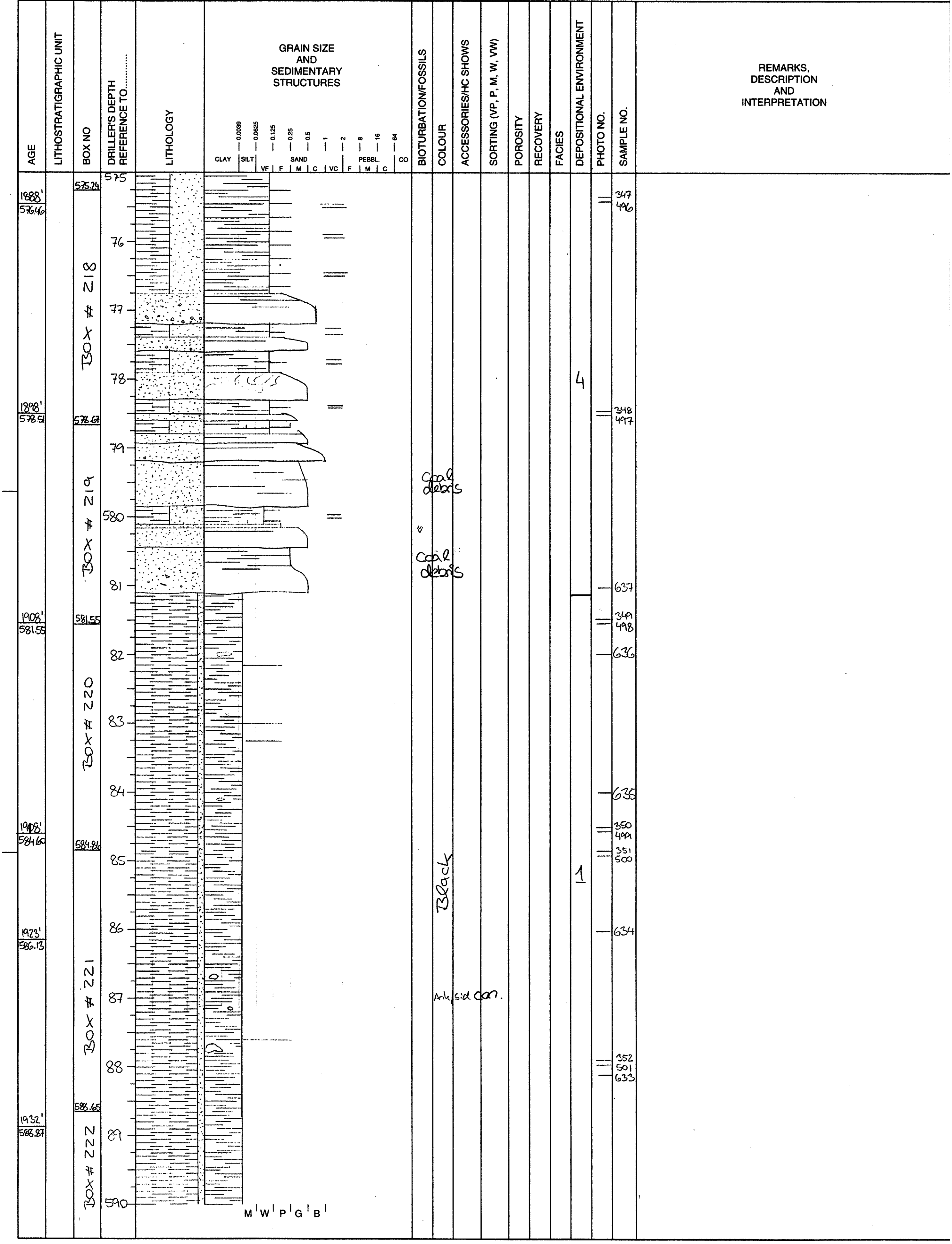
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N 54° 00' 40" W
UTM COORDINATES :
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 11/1-96
GEOLOGIST: GD



SHEET 10 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

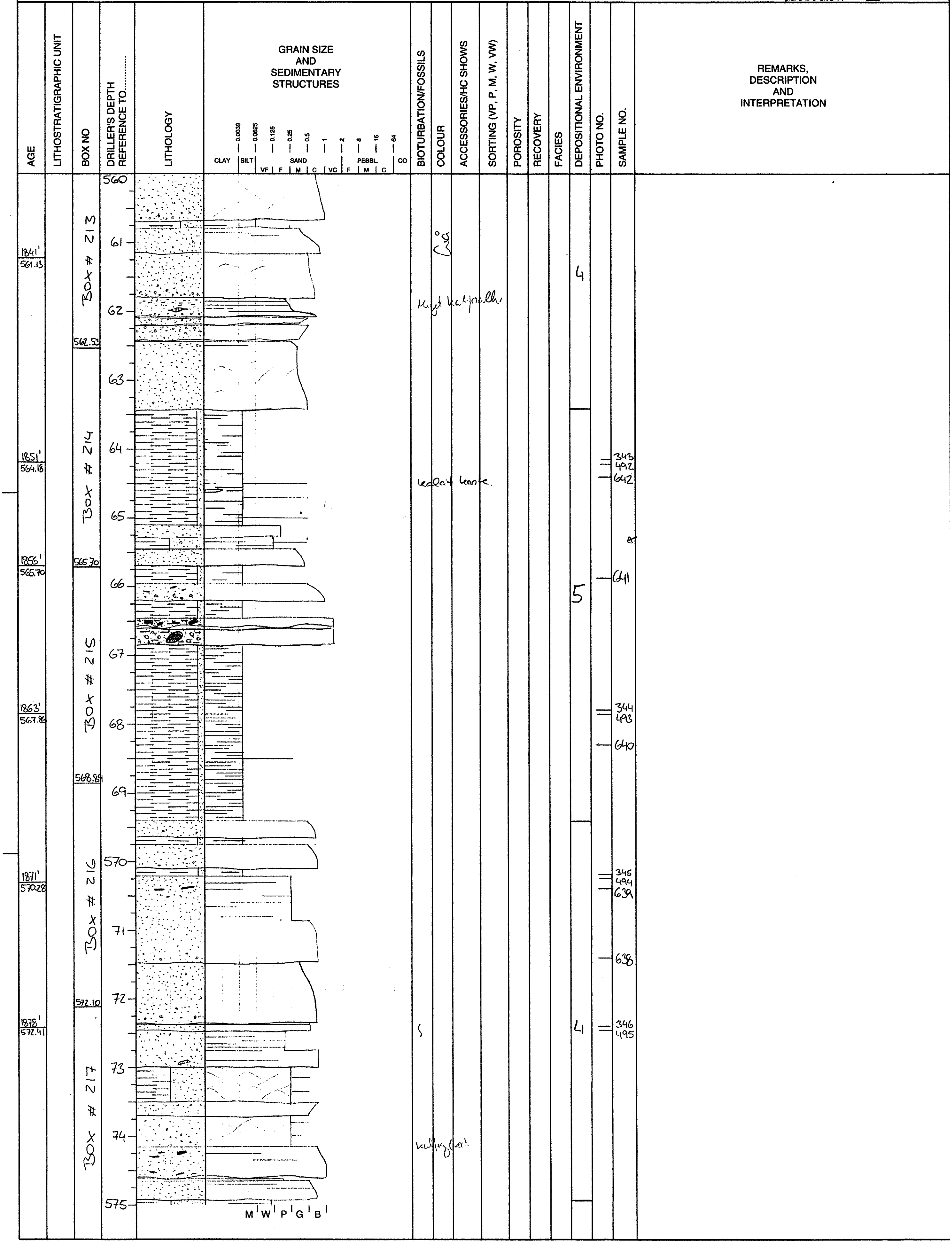
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 11/1-96 + 12/1
GEOLOGIST: GD



SHEET 11 OF 12

CORE DESCRIPTION
SEDIMENTOLOGICAL DATA SHEET

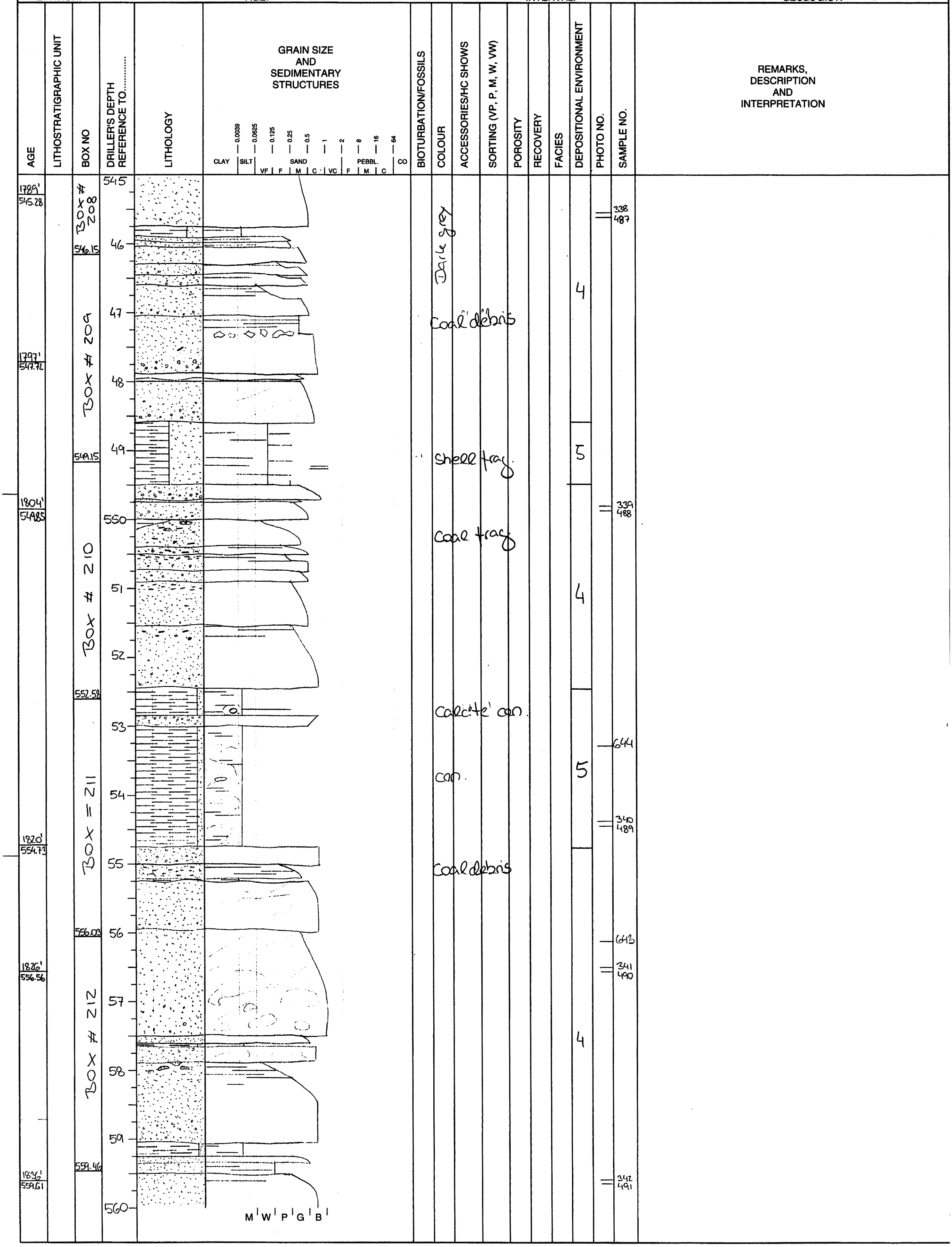
THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54° 00' 40" W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE # 1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 12/1-96
GEOLOGIST: GD



SHEET 12 OF 12

CORE DESCRIPTION

SEDIMENTOLOGICAL DATA SHEET

THE GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

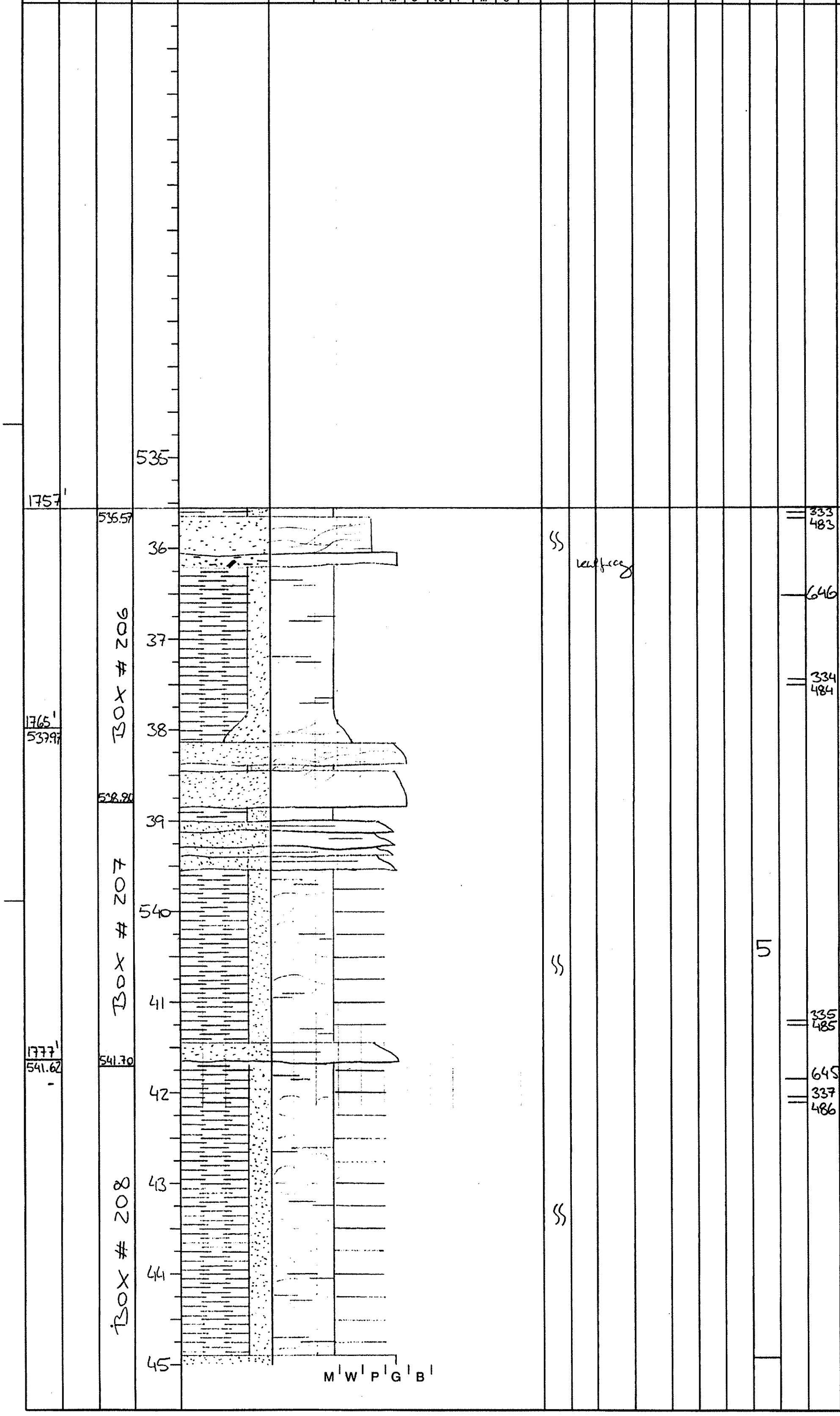
LOCALITY: 70° 28' 15" N
UTM COORDINATES: 54°00'40"W
ELEVATION: 114 m

ELEVATION OF DRILL FLOOR ABOVE GROUND-LEVEL: 2 m
UNIT:
AGE:

WELL NO: 439001 GANE #1A
BOX NO:
CORE DIAMETER: BQ (cm/mm)
INTERVAL:

SCALE: 1:50
DATE: 12/1-96
GEOLOGIST: GD

AGE	LITHOSTRATIGRAPHIC UNIT	BOX NO	DRILLER'S DEPTH REFERENCE TO........	LITHOLOGY	GRAIN SIZE AND SEDIMENTARY STRUCTURES	BIOTURBATION/FOSSILS	COLOUR	ACCESSORIES/HC SHOWS	SORTING (VP, P, M, W, VW)	POROSITY	RECOVERY	FACIES	DEPOSITIONAL ENVIRONMENT	PHOTO NO.	SAMPLE NO.	REMARKS, DESCRIPTION AND INTERPRETATION
					— 0.0039 — 0.0625 — 0.125 — 0.25 — 0.5 — 1 — 2 — 8 — 16 — 64 CLAY | SILT | SAND (VF | F | M | C | VC) | PEBBL. (F | M | C) | CO											



TOP GANE # 1A