Description of vibrocores from four well sites in the Danish North Sea

Geological description of vibrocores from the NINI-4, SIRI-5
CECILIE-2 and JETTE-1 well sites,
Store Fisker Banke area and northern
Tail End area, Danish North Sea

Peter Konradi

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND MINISTRY OF THE ENVIRONMENT



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Desription of vibrocores from four well sites in the Danish North Sea

Geological description of vibrocores from the NINI-4, the SIRI-5, the CECILIE-2 and the JETTE-1 well sites, Store Fisker Banke area and northern Tail End area, Danish North Sea

Location

The vibrocorings were carried out as part of a site surveys at the NINI-4, the SIRI-5, the CECILIE-2 and the JETTE-1 hydrocarbon well sites by Gardline Surveys Ltd. (2002a, 2002b, 2002c, 2002d) for Dong Efterforskning og Produktion A/S. The sites are indicated on the location map, Enclosure 1.

The cores have been delivered to GEUS by DONG according to law no. 293, § 34, of 10. June 1981 and no. 13 of 7. January 1991.

The positions of the vibrocores are indicated on the table below.

Site	Vibrocore no.	Northing	Easting
NINI-4	N 1	6278667.8	639757.1
	N 2	6279000.6	639993.4
	N 3	6279004	639464
	N 4	6278581	639321
SIRI-5	VC-1	6260970	622753
	VC-2	6261506	622286
	VC-3	6260997.5	621994.7
	VC-4	6360676	622347.9
	VC-5	6261384	622697
CECILIE-2	C-1	6252107.6	609487.5
	C-2	6252059.3	609026.0
	C-3	6252008.2	610015.9
	C-4	6252502.7	609504.7
	C-5	6251510.2	609455.8
JETTE-1	J-1	6215498	568080
	J-2	6215951	567586
	J-3	6215999	566993
	J-4	6216506	567996
	J-5	6215499	567497

Table 1. The positions of the investigated vibrocores (UTM 31 N, ED 50)

The NINI-4 site survey vibrocores

At this site four vibrocores were carried out. The positions of the cores are indicated in table 1 and on the map, Enclosure 2.

Geological setting

According to the industrial report (Gardline Survey Ltd. 2002a) the sea floor at the NINI-4 site is practically flat. The seismic investigations identified a first reflector at <1 m - 4 m below seabed and is suspected to represent a erosion surface. The sediment above is fine silty sand. Below the first reflector fine to medium sand is suspected with cobble and gravel lag sediment at base. A second reflector is identified undulating from 5 - 8 m below seabed. At the base of the reflector a channel is identified reaching till ~40 m below seabed. A weak reflector at ~97 m below seabed is expected to indicate "near base Quaternary".

Sedimentological core log

A legend to the lithologies of the cores is found in Enclosure 25.

The result of the geological description of core DGU no. **560510.10** (Gardline Survey NINI-4 N1) is given in Enclosure 3.

This core has a length of 3.36 m and the top 0.52 m is made up of bioturbated, heterolithic clay and sand. The rest of the core is faintly laminated fine sand with few clayey laminae and with few shells and shell fragments and few, fine charred organic particles.

The result of the geological description of core DGU no. **560510.11** (Havb 131-31-590021, Gardline Survey NINI-4 N2) is given in Enclosure 4.

This core is 4.11 m and the upper 0.50 m is made up of a bioturbated, heterolithic clay and sand followed by 10 cm of fine sand with clayey seams and shell fragments. The rest of the core is slightly silty, fine sand with clayey and silty laminae in the lower part and with few shells and shell fragments plus fine charred organic particles.

The result of the geological description of core DGU no. **560510.12** (Gardline Survey NINI-4 N3) is given in Enclosure 5.

The core is 2.09 m long and the upper 0.62 m is made up of a bioturbated silty, sandy clay becoming heterolithic in the lower part and with shells and shell fragments. It is followed by 0.15 m of fine sand with many shell fragments. The lower 1.32 m of the core is made up of faintly laminated, slightly silty, fine sand with few shells and shell fragments plus some charred, fine organic particles.

The result of the geological description of core DGU no. **560510.13** (Gardline Survey NINI-4 N4) is given in Enclosure 6.

This core is 4.77 m long and the upper 0.51 m is made up of a bioturbated, laminated, silty clay becoming heterolithic with fine sand downcore and with few shells and shell fragments. The lower 4.26 m of the cores is faintly laminated fine sand with few clayey seams and very few shell fragments plus laminae with charred, fine organic particles.

Correlation between the vibrocores at the NINI-4 site

All four cores correlate well and have an upper part of bioturbated clay, which is either heterolitic or it is becomming heterolitic downcore with fine sand. It holds shells and shell fragments. In the two cores 560510.11 and 560510.12 the heterolith is followed by 10 - 15 cm of fine sand with clay seams and shell fragments. The lower part of all four cores is made up of faintly laminated, fine sand with few shells and shell fragments and with charred, fine organic particles. This sand may hold clayey seams.

Interpretation of genesis

The upper bioturbated to heterolithic clay holds shells and is of marine origin, probably deposited under the present environmental conditions. The sand bed with many shells and clays seams or clasts in the cores 560510.11 and 560510.12 possibly represent a basal erosional event. The lower part of laminated, fine sands with few shells and occasional charred, fine organic particles is also marine and possibly deposited under deltaic or tidal flat conditions.

Correlation with seismics

The upper heterolithic part of the cores are expected to correlate to the upper unit in the seismics and the comparatively thin shelly sand bed below in two of the cores probably represent the basal erosional contact. The lower faintly laminated fine sand with possible clayey seams is the second identified seimic unit.

Nearby cores

A vibrocore from the NINI-2 site (Konradi and Czakó 2002a), about 1,25 km to the Eastnorth-east, include an upper clayey and sandy part with a gravely and shelly basal layer followed by laminated fine sand. The sediments in this core evidently correlate to the vibrocores at the NINI-4 site. Vibrocores at the NINI-3 site, about 9½ km to the Northeast, compare to the vibrocores at the NINI-2 site and thereby to the NINI-4 site.

Furthermore six vibrocores from the NOLDE-1 site, about 6 km to the West, correlates to the NINI-2 site and consequently to the NINI-4 site.

The SIRI-5 site survey vibrocores

At this site five vibrocores were carried out. The positions of the cores are indicated in table 1 and on the map, Enclosure 7.

Geological setting

According to the industrial report (Gardline Survey Ltd. 2002b) the sea floor at the SIRI-5 site is practically flat. The seismic investigations identified a first reflector at a depth of 2 - 4 m below seabed, which is suspected to represent an erosion event. The sediment above is silty clay and silty, fine sand with shells. Below the first reflector fine-grained silty sands is found with some clay and locally peat interbeds. A second reflector is expected to represent an erosion surface. Below the second reflector clayey and silty sands are expected. A third reflector is indicated at 18 m below seabed. A poorly defined channel is observed cutting the two lower units reaching 18 m below seabed. Three more channelling events are identified reaching 42 m, 89 m and 220 m below seabed respectively.

Sedimentological core log

A legend to the lithologies of the cores is found in Enclosure 25.

The result of the geological description of core DGU no. **560420.29** (Gardline Survey SIRI-5 VC1) is given in Enclosure 8.

This core has a length of 3.69 m. The upper 1.34 m is a bioturbated, laminated heterolith of silty clay and fine sand with shells and shell fragments. This is followed downcore by 0.36 m of sand, fine to medium with gravel and some stones plus few shells and many rounded shell fragments. Next comes 0.90 m of laminated sand, fine with downcore increasing number of laminae with medium sand and at base coarse sand. This sand is followed by 0.40 m of a heterolith of silty clay and clayey silt with a high content of organic material, and of fine sand. At the base of this a 0.14 m coarsening upwards section of clay, silt and sand with a high organic content is found. The lower 0.55 m of the core is made up of fine sand with laminae of medium to coarse sand.

The result of the geological description of core DGU no. **560420.30** (Havb 131-31-5840, Gardline Survey SIRI-5 VC2) is given in Enclosure 9.

This core is 3.34 m. The top of the core is made up of 10 cm of fine, silty sand with gyttja followed by 1.62 m of a laminated and strongly bioturbated heterolith of silty clay and fine sand with shells and shell fragments. At the base of this 0.14 m of silty, clayey fine sand is seen with shells and shell fragments. The lower 1.38 m of the core is made up of a very firm, slightly silty clay with rounded clasts of clay.

The result of the geological description of core DGU no. **560420.31** (Gardline Survey SIRI-5 VC3) is given in Enclosure 10.

The core is 2.40 m long and the uppermost 11 cm is a soft fine sand with shells and shell fragments followed by 1.60 m of a laminated and strongly bioturbated heterolithic silty clay and silty fine sand. Downcore this is followed by 0.21 m of soft fine sand with shells and shell fragments. Further downcore comes 0.24 m of faintly laminated, fine sand with gravel and pebble and many shells and shell fragments and a layer of shell hash. Next comes 5 cm of unsorted sand with clasts and many shell fragments. The lower 9 cm of the core is a firm, slightly silty clay with few clasts of charred organic material and traces of organic materials, possibly roots.

The result of the geological description of core DGU no. **560420.32** (Gardline Survey SIRI-5 VC4) is given in Enclosure 11.

This core is 2.60 m long and the upper 10 cm is soft fine sand with some gyttja and shells and shell fragments. It is followed by 1.34 m of a heterolith of silty clay and fine sand with shells and shell fragments. The lower part of the core is made up of 0.46 m of fine to very fine sand with few gravel size clasts and much shell hash and of 0.60 m of homogeneous fining upwards fine and silty, very fine sand with few clasts.

The result of the geological description of core DGU no. **560420.33** (havb 131-31-590019, Gardline Survey SIRI-5 VC5) is given in Enclosure 12.

The core is 4.08 m long and the uppermost 11 cm is a bioturbated, soft, fine sand with shells and shell fragments. This is followed by 1.99 m of a laminated and distinctly bioturbated heterolith of silty clay and silty, fine sand with few shells and shell fragments in upper part and an increasing number downcore. The lower part of the core made up of a 0.16 m bed of medium to coarse sand with gravel and stone clasts and many shell fragments, followed downcore by 1.82 m of fine and very fine sand with streaks and laminae of fine to medium sand.

Correlation between the vibrocores at the SIRI-5 site

All five cores have an upper part of a heterolith of laminated, bioturbated silty clay and silty, fine sand with shells and shell fragments. In four of the cores it is topped by an uppermost fine sand with gyttja, shells and shell fragments with a thickness of around 10 cm. Below the heterolith one or several beds of sand are found, often with medium sand laminae with gravel-size clasts as well as many, often rounded shell fragments or shell hash. Underneath this shelly and gravely beds fine and very fine sands are found sometimes with few odd sized clasts or with a high content of organic matter. In cores 560420.30 and 560420.31 the lower-most section in the core is a clay.

Interpretation of genesis

The upper heterolitic clay and fine sand with shells topped by an uppermost fine sand with gyttja probably reflects deposition in the recent marine environment where the top made up of fine sand with gyttja presumably represents the mobile layer. The underlying sands with gravel size clasts and rounded shell fragments possibly reflects deposition under a marine transgression. The fine and very fine sands below with a high content of organic matter is thought the have been deposited in a deltaic, lacustrine environment. The hard clay in the lowermost part of cores 560420.30 and 560420.31 possibly originates in a glacial environment.

Correlation with seismics

The upper heterolith including the top fine sand with gyttja correlates to the upper seismic unit, and the next section in the cores, made up of sands with gravel clasts, rounded shell fragments and shell hash, probably indicates the erosional surface of the first reflector. The fine and very fine sand below is the sediments of the seconds seismic unit. The clay in the cores 560420.30 and 560420.31 apparently do not show in the seismics (Gardline Ltd. 2002b).

Nearby cores

In the site survey reports from the nearby SIRI-1 site (Gardline Surveys 1995) as well as from the SIRI-2 site (Seateam 1996), about 4½ and 7 km to the West respectively, vibrocores are mentioned. They include an upper section of silty fine sands, which probably correlates to the heterolithic section of the present vibrocores. In the SIRI-1 and SIRI-2 vibocores the upper section is followed downcore by a shelly gravel which probably correlates to the sandy beds with clasts and rounded shells of the present site. The SIRI-1 and SIRI-2 vibocores have a basal unit with firm clay which probably correlate to the basal, firm clays of the SIRI-4 vibrocores 560420.30 and 560420.31.

At the SIRI-5 well site a geotechnical borehole were carried out till 31,38 m below seafloor (see Appendix, this report). The upper part of this borehole correlates with the vibrocores, VC3, VC4 and VC5.

The CECILIE-2 site survey vibrocores

At this site five vibrocores were carried out. The positions of the cores are indicated in table 1 and on the map, Enclosure 13.

Geological setting

According to the industrial report (Gardline Survey Ltd. 2002c) the sea floor at the CECILIE-2 site is practically flat. The seismic investigations identified a first reflector at a depth of 3m - 10 m below seabed with a shallow channel till 18 m below seabed. The sediment above is silty, fine sand with shells and localised peat horizons and possibly coarser sediments towards the base of the channel. Below the first reflector sandy and clayey sediments persist. A second reflector with a channel horizon is identified reaching down till ~38 m below seabed in laminated sediments of sand with minor clay interbeds and coarser lag sediments. The approximate base Quaternary is indicated at ~292 m below seabed.

Sedimentological core log

A legend to the lithologies of the cores is found in Enclosure 25.

The result of the geological description of core DGU no. **560420.24** (Gardline Survey CECILIE-2 C1) is given in Enclosure 14.

This core has a length of 2.73 m and is made up of well-sorted fine sand, which in the top is silty and include shells. A few streaks of clay are seen in the lower part.

The result of the geological description of core DGU no. **560420.25** (Gardline Survey CECILE-2 C2) is given in Enclosure 15.

This core is 3.40 m and is made up of well-sorted fine sand, which in the top is silty and holds shells. In the depth 1,50 - 2,12 m bioturbation is seen and at the depth 2.12 - 3.12 m many streaks of clay indicate lamination.

The result of the geological description of core DGU no. **560420.26** (Gardline Survey CECILIE-2 C3) is given in Enclosure 16.

The core is 1.62 m long and the upper 0.35 m is fine, silty sand with shells. The rest of the core is made up of faintly laminated well-sorted, fine sand.

The result of the geological description of core DGU no. **560420.27** (Gardline Survey CECILIE-2 C4) is given in Enclosure 17.

This core is 2.14 m long and the upper 0.55 m is fine, silty sand with shells. The core section to 1.80 m below top is faintly laminated, well sorted fine sand with one stone-sized clast. The lower 0.34 m of the cores is well-sorted fine and very fine sand.

The result of the geological description of core DGU no. **560420.28** (havb 131-31-590018, Gardline Survey CECILIE-2 C5) is given in Enclosure 18.

This core has the length of 4.00 m. The upper 1.00 m is very silty, fine sand with shells and the following 1.15 m downcore is well sorted, laminated fine sand with few streaks of shell fragments. The section 2.15 - 2.30 m is laminated fine sand and peat and the sec tion 2.30 - 2.85 m is laminated fine sand with clayey streaks. The lower part of the core is a laminated heterolith of silty clay and silty sand with few laminae of peat.

Correlation between vibrocores at the CECILIE-2 site

All five cores correlate well and have an uppermost part of silty, fine sand with shells followed by well-sorted fine sand with faint lamination. It may hold few clasts or shells and in places can show bioturbation. In core 560420.28 a hetertolithic clay and sand with few peat laminae underlies this sand.

Interpretation of genesis

The upper silty, fine sand with shells is thought to have been deposited under the present the marine environmental conditions. The underlying laminated fine sands are expected to have been deposited in a tidal flat or deltaic environment.

Correlation with seismics

The upper silty, fine sand with shells in the cores possibly is not identified in the seismics. The faintly laminated fine sand probably correlates to the upper seismic unit, while the second seismic unit apparently is not reached by the coring.

Nearby cores

At the CECILIE-1 site, located about 1100 metres Northwest of the CECILIE-2 site, two vibrocores were taken; both made up of silty, fine sand. They correlate reasonably well with the present vibrocores.

The JETTE-1 site survey vibrocores

Five vibrocores were presented from this site. The positions of the cores are indicated in table 1 and on the map, Enclosure 19.

Geological setting

According to the industrial report (Gardline Survey Ltd. 2002d) the sea floor at the JETTE-1 site is practically flat. The seismic investigations identified a first reflector at 1 - 3 m below seabed and is expected to represent a erosion surface. The sediment above is fine to medium, silty sand with suspected cobble and gravel lag sediment at base. Below the first reflector a sticky and hard clay is found with sand prone channels in top and possible internal sand prone pockets. A second undulating reflector is identified around 14 m below seabed. Below this clayey and silty sand with clay interbeds is expected with infilled channels, especially an intra Pleistocene channel with a base reflector around 117 m below seabed. An approximate base Quaternary reflector is interpreted at 380 - 435 m below seabed.

Sedimentological core log

A legend to the lithologies of the cores is found in Enclosure 25.

The result of the geological description of core DGU no. **560429.16** (Havb 131-31-590020, Gardline Survey JETTE-1 J1) is given in Enclosure 20.

This core has a length of 3.62 m and the upper 1.20 m is made up of fine to very fine sand, which, especially in the upper 20 cm, holds many shells and below that few shells and shell fragments. The next 0.61 m of the core is silty fine to very fine sand with few shells and shell fragments. The rest of the core is a firm, sticky, slightly silty clay with gravel- and pebble-sized clast of clay

The result of the geological description of core DGU no. **560429.17** (Gardline Survey JETTE-1 J2) is given in Enclosure 21.

This core is 3.72 m and the upper 2.06 m is made up of fine and very fine, slightly silty sand, which holds many shells in the upper part. To the depth 2.54 m faintly laminated fine to very fine sand occurs with shells and shell fragments, and to 3,59 m the very fine sand is silty and incude very few shell fragments. The lowermost 13 cm of the core is laminated clay with silt laminae.

The result of the geological description of core DGU no. **560429.18** (Gardline Survey JETTE-1 J3) is given in Enclosure 22.

The core is 2.25 m long and is made up of bioturbated, partly laminated, slightly silty, fine and very sand with few clasts and shells and shell fragments.

The result of the geological description of core DGU no. **560429.19** (Gardline Survey JETTE-1 J4) is given in Enclosure 23.

This 2.59 m long core is made up of bioturbated, slightly silty, fine and very fine sand with few clasts and shells and shell fragments especially in the uppermost part.

The result of the geological description of core DGU no. **560429.20** (Gardline Survey JETTE-1 J5) is given in Enclosure 24.

This core has the length of 1.44 m and consists of a bioturbated, slightly silty, fine and very fine sand with few clasts and, especially in the uppermost part, shells and the shell fragments.

Correlation between vibrocores at the JETTE-1 site

All five cores correlate well as they are made up of a bioturbated, slightly silty, fine and very fine sand, which include few clasts and shells and shell fragments especially in the uppermost part. In the cores 560429.16 and 560429.17 the sand is underlain by a firm clay.

Interpretation of genesis

The slightly silty fine and very fine sand is expected to reflect the recent marine environmental conditions at the JETTE-1 site. The firm clay in the cores 560429.16 and 560429.17 probably were deposited in a glacio-lacustrine environment.

Correlation with seismics

The slightly silty, fine and very fine sand making up the sediment in the five vibrocores must correlate to the upper unit in the seismics. The expected erosion surface at the base of the unit in the depth of 2 - 3 m below seabed is not identified in the cores. The firm clay identified in the cores 560429.16 and 560429.17 correlates to the second seismic unit.

Nearby cores

From a site named South Pod, situated about 14 km to the Southeast of the JETTE-1 site, five vibrocores from the site survey were described (Konradi and Czakó 2002b). They form a rather complex series of fine sands, heteroliths and clays. They do not immediately compare to the rather simple composition of the present cores. Nevertheless the slightly silty fine sands at the JETTE-1 site most probably correlate to the fine sands in the upper part of the cores at the South Pod site.

At the well site KIT-1x, situated approximately 8 km North of the JETTE-1 site, one cored, geotechnical borehole is described (Fugro Engineers 2001). The sediment is made up of 2.6 m of silty, fine sand overlying 4.9 m of firm to stiff clay becoming interbedded with silt and fine to medium sand the lower part. This is underlain by 13 m (limit of borehole) of very dense, silty, fine to medium sand with occasional seems of clay. The upper unit of silty, fine sand at the KIT-1x site most probably compares to the sediment at the JETTE-1site.

Core photos

The photos of core DGU no. 560510.11 are presented in Enclosure 26a & Enclosure 26b. The photos of core DGU no. 560420.28 are presented in Enclosure 27a & Enclosure 27b. The photos of core DGU no. 560420.33 are presented in Enclosure 28a & Enclosure 28b. The photos of core DGU no. 560429.16 are presented in Enclosure 29a & Enclosure 29b.

Correlation between lithologies

The lithologies of vibrocores from the sites NINI-4 and SIRI-5 correlate fairly well. Both sites include an upper part of bioturbated and heterolithic clay with shells. This section most probably correlate to the upper part of silty, fine sand with shells in the vibrocores from the CECILIE-2 site. They are expected also to correlate to the silty, fine sand with shells in the upper part of the cores from the JETTE-1 site, as they all are expected to represent the present sedimentation at the sites. In two of the cores from the NINI-4 site, 560510.11 and 560510.12, a sandy bed with clay seams and shell fragments underlies the upper heterolithic clay. These beds most probably correlate to the bed of medium sand with clasts and rounded shell fragments in the cores at the SIRI-5 site. The lower part of the cores from the NINI-4 site and the SIRI-5 site, as well as from the CECILIE-2 site is made up of laminated, fine sand and most probably correlate. This most probably also correlate to the lower part of the sandy section in the cores from the JETTE-1 site. This fine sand in the cores from the NINI-4 site and in one of the cores from the CECILIE-2 site, 560420.27, though, holds few shells and shell fragments as well as occasional charred fine organic particles. The fine sand in the cores from the SIRI-5 site include a few odd-size clasts and a high content of organic matter and the core 560420.28 from the CECILIE-2 site even include a peat layer and peaty seams.

The hard clay with sand pots forming the lowermost part of the cores 560420.30 and 560420.31 at the SIRI-5 site do not resemble the firm clay with clay clasts making up the base of the two cores 560429.16 and 560429.17 at the JETTE-1 site, and can not be correlated.

Interpretation of genesis

The upper section of the cores, the bioturbated, heterolithic clay in the cores from the SIRI-5 site and the NINI-4 site, as well as the silty, fine sand in the cores from the CECILIE-2 site and the JETTE-1 site are expected to represent the present marine sedimentation at the sites. The underlying medium sand with few clasts at the SIRI-5 site as well as the sandy bed with clay seams and shell fragments in two of the cores, 560510.11 and 560510.12, at the NINI-4 site represent an erosional event. The underlying fine sands with a content of fine organic matter in the SIRI-5 site cores are expected to have been deposited in a deltaic, lacustrine environment like the core 560420.28 from the CECILIE-2 site. The laminated fine sand with few shells in the NINI-4 site cores and the CECILIE-2 site cores as well as the fine sand with few shells in the JETTE-1 site cores are expected to have been deposited in deltaic tidal flat environment. The hard clay with sand pots found in two of the cores, 560420.30 and 560420.31, at the SIRI-5 site and the firm clay with small clay clasts found in two of the cores, 560429.16 and 560429.17, at the JETTE-1 site are thought to originate in glacial environments, though different glacial environments.

Conclusion and suggested correlation to stratigraphy

The upper section of the cores, the heterolithic clay and fine sand and the silty, fine sand, is suggested to represent the present sedimentation at the sites. It is expected to belong to the Late Holocene comparable to the Western Mud Hole Member of the Nieuw Zeeland Gronden Formation (Laban, C. et al. 1995). The next section of the cores, the medium to coarse sand with shells, is suggested to represent a marine transgression at the base of the Nieuw Zeeland Gronden Formation. The underlying laminated fine sand is expected to represent the Early Holocene tidal flat to deltaic lacustrine deposits of the Elbow Formation (Oele 1969). The lowermost hard clay with sand pots seen in two of the cores at the SIRI-5 site is thought to represent either a facies of the Late Weichselian Twente Formation (Cameron et al. 1989) or a facies of the Late Weichselian Dogger Bank Formation (Jeffery et al.1989). The lowermost firm clay with clay clasts seen in two of the cores from the JETTE-1 site is believed to represent a facies of the Late Weichselian Dogger Bank Formation (Jeffery et al.1989).

The existing generalised lihostratigraphy of the southern North Sea is given in table 2.

Holocene	Nieuw Zeeland Gronden Formation	Western Mud Hole Member
	Elbow Formation	
Weichselian	Twente Formation	
	Dogger Bank Formation	

Table 2. Generalised stratigraphy of the Late Weichselian and Holocene of the North Sea (after Cameron et al. 1989 and Jeffery et al.1989).

Stored cores

The photographed cores: DGU no. 560510.11,

DGU no. 560420.28, DGU no. 560420.33, DGU no. 560429.16

are stored at the GEUS core store for future comparison and stratigraphic investigation.

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Appendix

Geotechnical borehole at the SIRI-5 well site

GEUS was presented by 75 samples from a 31,38 m deep geotechnical borehole, named DGO2-SIRI-BH30-01, conducted by Norwegian Geotchnical Institute, at the SIRI-5 well site. This borehole is numbered: DGU no. 560420.34

The samples were described by Tibor Czáko, enclosure 30a - 30f.

The sediments include several alternating beds of sand and clay and some silt layers. Some sections of the borehole include shells or shellfragments.

At four levels samples were processed for foraminifer analysis. The results can be summarised as fellows:

Sample depth: 9.00-9.17 m: The fauna indicates deposition in an arctic environment. It is

expected to have been deposited in a glaciomarine setting

in the North Sea basin.

Sample depth: 15.22-15.43 m: Very impoverished fauna, probably reworked and non-

marine.

Sample depth: 21.00-21.18 m: The rich fauna indicate deposition under boreal environ-

mental conditions i.a. in an interglacial.

Sample depth: 25.00-25.14 m: This rich fauna also indicate deposition under boreal envi-

ronmental conditions i.a. in an interglacial.

Correlation to seismic:

In the industrial report (Gardline Survey Ltd. 2002b) an upper seismic unit is identified till 2-4 m below seafloor. This correlate to the upper clayey beds between 0-2,13 m. The second seismic unit correlate to the next section of the borehole, the fine and medium sand and the heterolithic clay and sand. The seismic reflector 3, at 18 m below seafloor, must be the gravel with shells occurring at 18.00-18.03 m, which is probably a regressions surface of the top of the interglacial marine sediments.

Stratigraphy and correlation:

The sample from the depth 9.00-0.17 m is most probably of Weichselian age and belong to the Dogger Bank Formation, and the sample from 15.22-15.43 m probably also belong to a non-marine interval of the Weichselian Dogger Bank Formation.

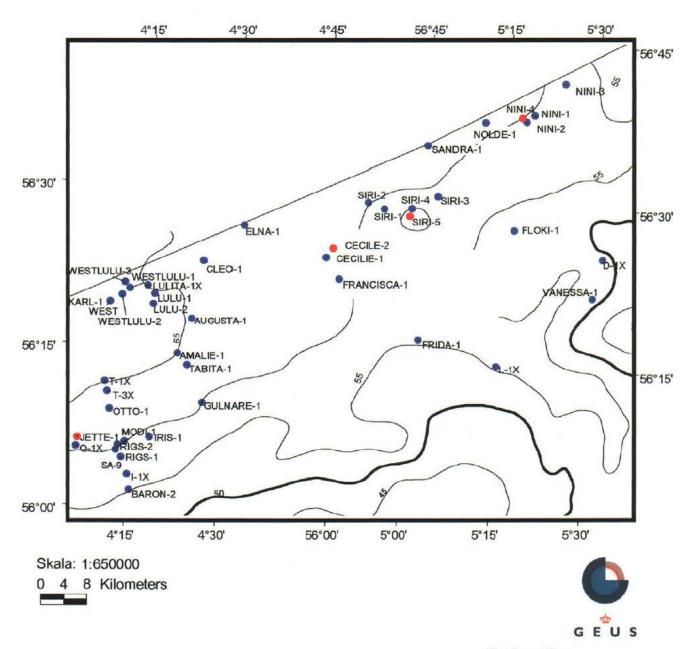
The samples from the intervals 21.00-21.18 m and 25.00-25.14 m respectively, must belong to the Eemian. Eemian deposits are found nearby in the North Sea at the Dan-site and the Roar-site (Knudsen 1985) and at the BH 89-7A, the Valdemar and the Dagmar sites (Salomonsen & Jensen 1994). In the SIRI-5 well site geotechnical borehole, though, the two species *Elphidium lidoense* and *E. transluscens*, usually said to indicate the Eemian, are not identified, like in the BH89-7A borehole.

Literature:

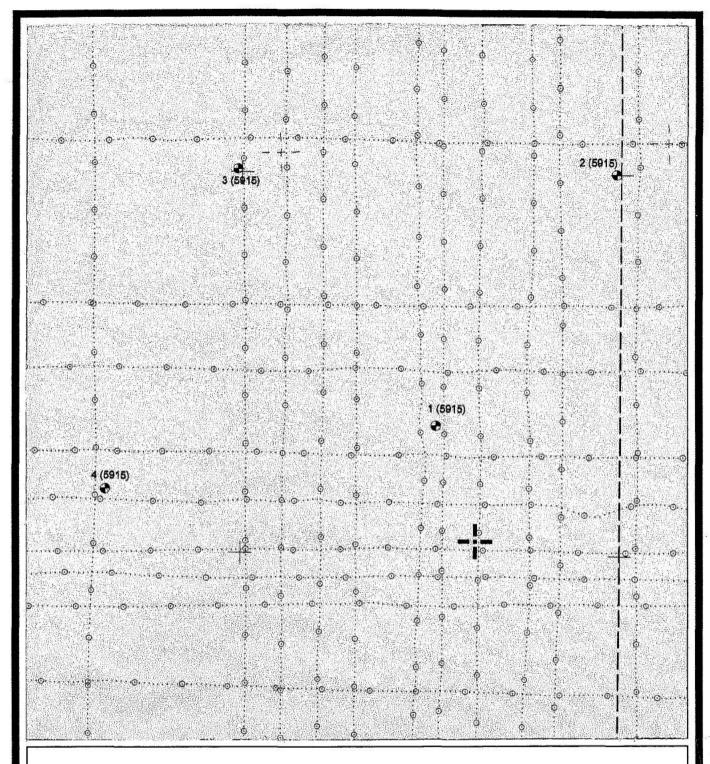
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Enclosures



Kort fremstilling: GEUS/Lotte Møller/maj 2003.



Seabed Features (Extract of Chart 5)



PROPOSED NINI-4 LOCATION (639 810E, 6 278 518N)
SIDESCAN SONAR TRACK DURING ECHO SOUNDER, SIDESCAN SONAR
AND DIGITAL SEISMIC LINES

LOW TO MODERATE REFLECTIVITY SEABED

CABLE- CLIENT SUPPLIED POSITION NOT OBSERVED DURING CURRENT SURVEY

1 (5915)

VIBRO CORE (STATION NUMBER WITH REPORT NUMBER)



Company: DONG, site survey NINI-4, BH N 1

Borehole id.:DGU nr. 560510.10

Water	depth: 5	9.4	m Position: 6278667.8 N 639		
Core	Core L depth -	_itho	Grain size & sediment structures	Description	Env iron
	m		Clay Silt Sand Gr Pb		& age
1	-			O.00-0.52: Heterolith: CLAY, silty and SAND, fine, few coarse sand-size clasts, laminated, bioturbated, shells and shell fragments, dark grey 5Y 4/1 - 3,36: SAND, fine and very fine, faintly laminated(?), very few shells and shellfragments, few charred organic particles,	HV
0.95	1.0—	uin,		at 1.05: clayey layer, at 3.32-3.36: clayey laminae with charred organic particles, grey 5Y 5/1	
11	-	,			
1.95	2.0—	`			
111	-				
2.95 IV 3.36	3.0—	`\ 			
	4.0—				
	5.0—				
	6.0—			Enclosus	

Date: 08.10.2002

Described by: CSL/PK



Company: DONG, site survey NINI-4, BH N 2

Borehole id.:DGU nr. 560510.11

Water depth: 58.8 m

Position: 6279000.6 N 639993.4E

havb 131-31-590021

Core	Core Litho	Grain siz	e & sed	iment s	tructu	res	Description	Env
	m m	Clay Silt	vf f	Sand m c	Gr vc	Pb		& age
I ²					and commented for each inches the all the desired	COMMENSACION CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR	0.00-0.51: CLAY, sligtly silty, soft, laminated, with laminae/lumps of sand, bioturbated, downcore: heterolithic: CLAY, slightly silty and SAND, few shells and shellfragments, worm tube, at base: layer of shell-hash, dark grey 5Y 4/1	HL/ HV
0.90		one of the second	oder * , water to the		and the second s		-0.61: SAND, fine, with clay clasts and -seams, shellfragments, dark grey 5Y 5/1	HS
0.50	1.0—	e de la constante de la consta			constitution addition (creterion		- 4.11: SAND, fine, slightly silty, few shells and shellfragments, at: 1.17, 1.38 and 1.65: laminae with shellfragments, from: 1.92: fine charred organic particles,	нѕ
11				nado presidente de consequencia de consequenci	serio como concesso de la como con concesso de decendo de la como concesso de la como		at: 3.56-3.60: CLAY, SILT, fine sand, laminated at: 3.65-3.70: oblique laminated fine-medium sand with organic particles, shell fragments and coarse sand-sized chert particles,dark grey 5Y 5/1	
1.82	2.0—	en var ennergen om sambet monommen	And the second s	em roug de resourcitée services de la compansion de	provedous describition productions of	The state of the s		
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Date: 08.10.2002

Described by: CSL/PK



Company: DONG, site survey NINI-4, BH N 3

Borehole id.:DGU nr. 560510.12

Water depth: 59.3 m

Position: 6279004.8 N 639494.1E

havb

Core	Core depth	Litho -logy	Gra	in siz	e &	sedi	mer	nt s	truc	tur	es	Description	Env
	m	,,,,,	Clay	Silt	vf	f S	and m	С	Vc	Gr	Pb		& age
Ι			I		===		en entre entre entre en entre	4 A D C C C C C C C C C C C C C C C C C C				0.00-0.62: CLAY, silty, sandy, laminated, bioturbated, upper 5 cm with gyttja, downcore: heterolithic CLAY, silty and SAND, very fine, silty, bioturbated, shells and shellfragments (Echinids sp.),dark grey 5Y 4/1 - 0.77: SAND, fine, slightly silty, faintly laminated, lens of clay,	HL HV
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	1.0—	ر ```ر	 		- - - -		CONTRACTOR SECURITION OF SECUR		assas energences	B		 2,09: SAND, fine and very fine, faintly laminated, few shells and shellfragments, some minute, charred organic particles, grey 5Y 5/1 	HS
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Date: 08.10.2002

Described by: CSL/PK



Company: DONG, site survey NINI-4, BH N 4

Borehole id.:DGU nr. 560510.13

Water depth: 60.4 m

Position: 6275581 N 639321E

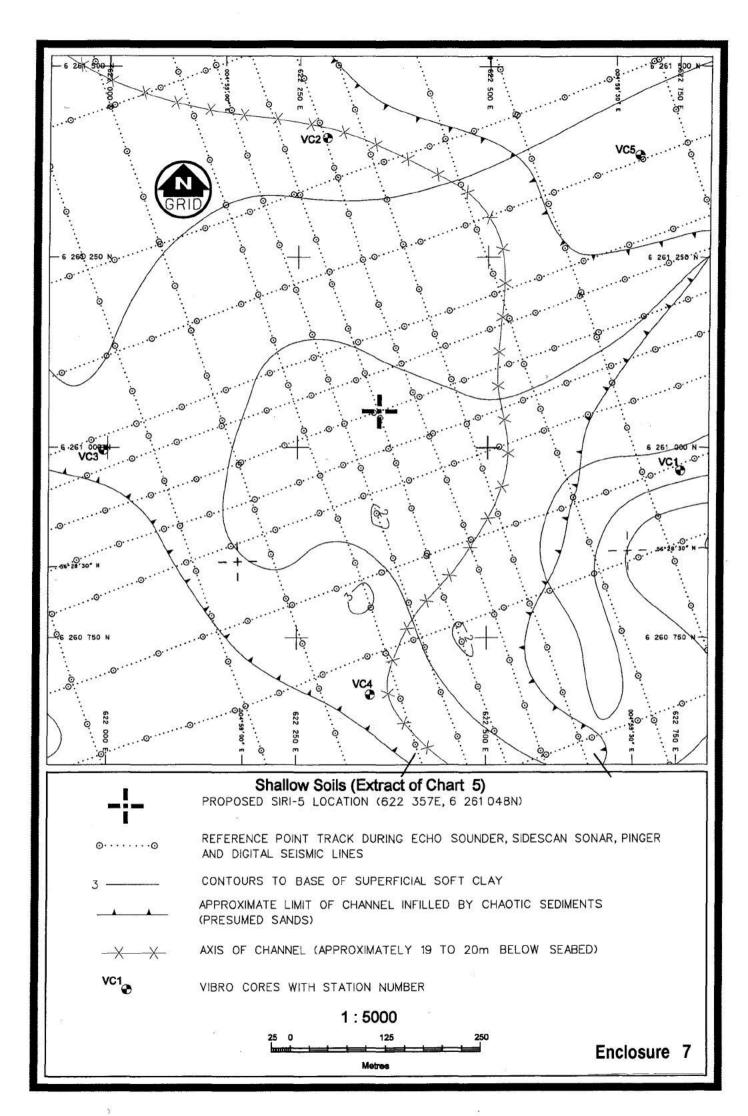
havb

Core	Co	re Lif	tho	Gra	in siz	e &	sed	imen	t s	ruc	tur	es	Description	Env
	m			Clay	Silt		f	and m	C	vc	Gr	Pb		& age
1		- //				1			Av. Alla di Al	AAAA AAAA AAAAA AAAAA AAAAAAAAAAAAAAAA			0.00-0.51: CLAY, silty, slightly sandy, soft, laminated with layers/lamina of sand, bioturbated, downcore: heterolithic: CLAY, slightly silty and SAND, very fine, silty, clayey, few shells and shellfragments, dark grey 5Y 4/1	HL
0.77	1.0				orania managama pata anta anta anta anta anta anta ant	Service of the stable tradelogues (TV) or seasons	er volatoredoce accessoriadada acessoriado	an in the second	The second set of the second s	manufacture and an experience of the control of the			- 4.77: SAND, fine and very fine, no visible lamination, bioturbated (?), shells and shellfragments, fine charred organic particles, spread and concentrated, twigs?, at 1.59: bended clay seam, below ~3.00: fine sand, faintly laminated, some laminae marked by fine charred	нѕ
н))			and the second section of the		полиненти общений полительной		and the second s			organic particles, at 4.57 and 4,75: clayey lenses, in lower part: few fine gravel-size clasts, very few shells (Mytilus sp.?), dark grey 5Y 4/1	
1.77	2.0		S :		Commence of the commence of th	AMOUNT TO BE A SECURE OF THE PARTY OF THE PA		proportial condition of the proportion of the pr	OCONOMIC COMPANY OF THE SECURITY OF THE SECURI	oden germali se appropriace, to before topological teles		The second secon		
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Date: 08.10.2002

Described by: CSL/PK





Company: DONG, site survey SIRI-5, BH VC 1

Borehole id.:DGU nr. 560420.29

Water depth: 58.8 m

Position: 6260970 N 622753 E

havb

Core	Core Litho	Grair	n size	& sediment	struct	ures	Description	Envi ron
	m		Silt	Sand f f m c		ar Pb		& age
1						-mercendy-dallaton million million million del (Economi (Ecolomi (0.00-1.34: Heterolith: SAND, very fine, slightly silty, clayey and CLAY, silty, laminated, bioturbated, shells and shellfragments,dark grey 5Y 5/1	HV
0.90	1.0—							
	- (.). - (.). - (.).					X X X	-1.70: SAND, fine to medium, with gravel and some stones, few shells and many shellfragments, some rounded, dark grey 5Y 4/1	HS
1.84	2.0-				Chambana and a second s	METEROLOGOVIO To John Co. A do A do A do La John A VIII METEROLOGO A M	-2.60: SAND, fine, downcore: increasing numbers of laminae with sand, fine to medium, at bottom: sand, fine to coarse, at 2,27: sand, very fine and clay laminae, at: 2.59: stone, grey 5Y 5/1	FS
111	——————————————————————————————————————			The second secon	Notice described and Auditorious Auditorio	WORKERS DOWNERS - MANAGEMENT - PARTIES - PARTIES	-3.00: Heterolith: laminated, CLAY, silty, high organic content, SILT, clayey, high organic content, SAND, fine with silt and	FV
2.84 IV	3.0				PRE OFFENDRE ABSOLUTE ABSOLUTE ABSOLUTE ASSOCIATIONS ASSOCIATIONS ASSOCIATION		SAND, fine black GLEY1 2.5/N, very dark grey 10YR 2/2 and GREY 5Y 5/1 -3.14: Coarsening upwards: CLAY and SILT with high organic content, and SAND, fine, black 10YR 2/1 and grey 5Y 5/1	FV
3.69	 				COOL CONTENNANT OF THE CONTENN	омайстингольная опроточного называют интератория.	-3.69: SAND, fine with laminae of sand, medium to coarse, at 3.59: lens of clay with a high organic content, grey 5Y 5/1	FS
	4.0		A MATERIAL PROPERTY AND			en den distrituto delevera sensovo e dell'era delevera sensora della senso è delementa della sensora e e e		
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Date: 09.10.2002

Described by: CSL/PK



Company: DONG, site survey SIRI-5, BH VC 2

Borehole id.:DGU nr. 560420.30

Water depth: 59.2 m

Position: 6261406 N 622286 E

havb

Core	Core depth	Litho	G	rain siz	e &	sed	lime	nt s	struc	ture	es	Description	Envi ron
5 /0 6 26	m		Cla	y Silt	vf	f	Sano	c	vc	Gr	Pb		& age
1	-									Lattaco dessapado de la 1800 de l		0.00-0.10: SAND, fine, slightly silty, with gyttja, bioturbated, shells and shellfragments, dark grey 5Y 5/1 -1.82: Heterolith: CLAY, silty and SAND, very fine, silty, laminated, strongly bioturbated, shells and shellfragments,	HS HV
0.89	1.0—											grey 5Y 5/1	55
11	-			The same of the sa						4			
1.85	2.0—									emocrete estendici ci cabilotti -		-1.96: SAND, fine, silty, clayey, shells and shellfragments, grey 5Y 5/1	HS
111						AND				is at introduction of the mediate production of the second		-3.34: CLAY, slightly silty, hard, homogeneous, with gravel-size clasts of silty clay, pods of sand with gravel-size clasts, very few clasts of rounded shell-umbo, uppermost part disturbed due to coring, dark greyish brown 10YR 4/2	TL
2.85 IV 3.34	3.0-				State of special control of the state of the				No. In a Color of Col	ecoconocia di care proposadore de 1900 di mano antenesso.			
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Date: 10.10.2002

Described by: CSL/PK



Company: DONG, site survey SIRI-5, BH VC 3

Borehole id.:DGU nr. 560420.31

Water depth: 59.1 m

Position: 6260997 N 621994 E

havb

Core	Core depth	Litho -logy	Grai	n siz	e & se	edimer	nt s	struc	ture	s	Description	Envi
	m		Clay	Silt	vf f	Sand m			Gr F	ъb		& age
0.90 II	1.0	3							APPOPARATION OF VICENTIAL STATES AND THE STATES AND		0.00-0.11: SAND, fine, silty, soft, shells and shellfragments, dark grey 5Y 5/1 -1.81: Heterolith: CLAY, silty and SAND, fine, silty, soft, laminated, strongly bioturbated, shells and shellfragments, grey 5Y 5/1	HV
1.86 III	2.0—		t					3 2	×		-2.02: SAND, fine, silty, clayey, soft, shells and shellfragments, dark grey 5Y 4/1 -2.26: SAND, fine, slightly silty, firm, faintly laminated, some gravel-	HS
2.40	=	777					3	Commence of the commence of th	×		and pebble-sized clasts, many shells and shellfragments, at 2.20-2.24: medium sand with several clasts and shells and shell hash, grey 5Y 5/1	
	_										-2.31: SAND, fine-medium-coarse, clasts, many shellfragments, grey 5Y 5/1	HS
	3.0— 										-2.40: CLAY, slightly silty, firm, sand pots, few clasts, few minute, charred organic particles, traces of organic material = roots?, dark greenish grey GLEY2 4/1	TL

Date: 10.10.2002

Described by: CSL/PK



Enclosure 10

Company: DONG, site survey SIRI-5, BH VC 4

Borehole id.:DGU nr. 560420.32

Water depth: 59.0 m

Position: 6260676 N 622348 E

havb

,, a.o.	depth: 59.0		Position: 626	00701	V	622348 E NAVO	
Core	Core Litho depth -logy	Grain size	& sediment stru	ucture	s	Description	Envi
	m logy	Clay Silt	Sand f f m c vo	Gr F	b		& age
1	- 7 1 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6					 0.00-0.10: SAND, fine and very fine, silty, slightly clayey, soft, with gyttja, shells and shellfragments, worm tubes, dark grey 5Y 5/1 -1.44: Heterolith: CLAY, silty and SAND, fine to very fine, silty, soft, at .6264 clay layer, shells and shellfragments, grey 5Y 5/1 	HS
0.93	1.0-						
II				×		-1.90: SAND, fine to very fine, slightly silty, few gravel-size clasts, much shell hash, grey GLEY1 5/N	HS
1.88	- 22						
Ш	2.0—			*	×	-2.60: SAND, fine to very fine, slightly silty in upper part, fining up, homogeneous, gravel-size clasts in upper 10 cm, at 2.05: one stone (8 cm), grey GLEY1 5/1	тѕ
2.60	= :::::		4				
	3.0-						
The contract of	4.0-						
	5.0						
	- - - 6.0—						

Date: 10.10.2002

Described by: CSL/PK



.

Company: DONG, site survey SIRI-5, BH VC 5

Borehole id.:DGU nr. 560420.33

Water depth: 59.3 m

Position: 6261384 N 622697 E

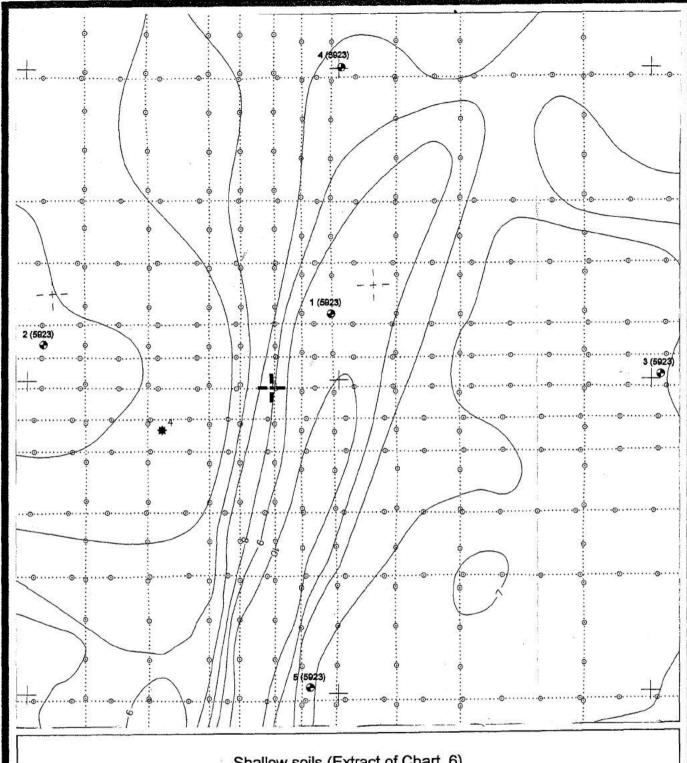
havb 131-31-590019

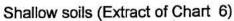
Core	Core depth	Litho -logy	Grain siz	e & sec	diment	structi	ures	Description				
	m		Clay Silt	vf f	Sand m c		r Pb		& age			
1	-	3	ŧ	3 3 3			AND THE PERSON OF THE PERSON	0.00-0.11: SAND, fine, silty and clayey, in upper 4 cm: with gyttja, bioturbated, shells and shellfragments, dark grey 5Y 5/1	нѕ			
0.80	-					is I the second of the second		-2.10: Heterolith: CLAY, silty, soft and SAND, very fine, silty, laminated, distinctly bioturbated, few shells and shellfragments, downcore: apparently more shells and shellfragments, grey 5Y 5/1	HV			
н	1.0— - - -	*: C:	La constant de la con			gi augropopo a territorio del materio poporo		oblique lower boudary due to coring				
1.66	- - - -	1, 5, 5, 5, 5							3			
111	2.0—	050				residence and residence and addressed and and actions are actions as a construction action actions are actionated actions action action action action action actions are actionated actions action actions action ac		-2.26: SAND, medium to coarse, fine and coarse gravel, two stones, many shellfragments, rouded, bed squeezed due to coring, dark grey 5Y 4/1	HS			
2.62	- - -					Value of the second of the sec		-4.08: SAND, fine and very fine, slightly silty, with streaks and laminae of sand, fine and sand, fine to medium with few coarse sand-sized particles, downcore: with beds of sand, fine to medium and fine gravel-size particles, many minute,	TS			
IV	3.0-					company of the state of the sta		charred , organic particles greenish grey GLEY 2 5/1 and grey 2.5Y 5/1				
3.60		••		=1	manus Manus Manus							
٧		•••				- Control of the Cont	Contract of the Contract of th					
4.08	4.0—	The state of the s							1111			
	5.0			INTERPORTATION OF THE PROPERTY					2			
	- 6.0—			THE PERSON AND ADDRESS OF THE PERSON ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON ADDRESS OF THE PE		A CONTRACTOR OF THE CONTRACTOR						

Date: 09.10.2002

Described by: CSL/PK







PROPOSED CECILIE-2 LOCATION (609 392E, 6 251 988N)

·····

REFERENCE POINT TRACK DURING ECHO SOUNDER, SIDESCAN SONAR, PINGER AND DIGITAL SEISMIC LINES

DEPTHS IN METRES BELOW SEABED (CONTOURED AT 1 METRE INTERVALS) TO MAPPED REFLECTOR 1

DISTINCT DIFFRACTION HYPERBOLA - PRESUMED BOULDER WITH DEPTH TO FEATURE IN METRES BELOW SEABED

1 (5923)

VIBROCORE WITH SAMPLE NUMBER (JOB NUMBER IN BRACKETS)



Company: DONG, site survey CECILIE-2, BH C 1

Borehole id.:DGU nr. 560420.24

Water depth: 60.5 m

Position: 6252107.6 N 609487.5 E

havb

Core	Core Litho depth -logy	Gr	ain si	ze & se	edimer	nt stru	ucture	s	Description	En
	m logy	Clay	Silt	vf f	Sand m	c v	Gı /C	Pb		& age
1	54.655			-		minopolycopy in problem and a constant			0.00-2.73: SAND, fine, wellsorted, upper .35 m: silty with shells, at bottom: streaks of clay, greyish brown 2.5Y 6/2	HS
1.00	1.0-			1. 2. 2. 1. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.						
11					STATES AND ADMINISTRATION OF THE STATES OF T	CONTRACTOR OF STREET,		The second control of		
2.00	2.0—									
	- - - -					and the financial section of the section of	PORT IN THE PROPERTY OF THE PR	odystyle damage and control of the c		
2.73	3.0—					and a b by the beside of the property of the party of the		as a second seco		
	=							Adding the second of the state of the second		
	4.0-					And the second s				
	- - -				mane ()/Jethylpad/selection (Profitese	10000				
	5.0— -				and the second s					
	=======================================			and a second and a second and a second as a second and a	O ODDOOLARAN O ORANDA ADAMAN EST ANNO.					
	- - 6.0—								Enclosure	

Date: 15.10.2002

Described by: TC/PK



Company: DONG, site survey CECILIE-2, BH C 2 Borehole id.:DGU nr. 560420.25

Water depth: 60.6 m Position: 6252059.3 N 609026.0 E havb

Core	Core Li	tho ogy			ze & se						Description	
	m		Clay	Silt	vf f	Sand	_	VC (Gr	Pb		&
I 1.00 II 3.00 IV 3.40	1.0—		Clay	Silt	vf f	Sand	C		Gr -	9	0.00-3.40: SAND, fine, wellsorted, upper .30 m: silty with shells, at 1.50-2.00: bioturbation, at 2.00-3.00: many streaks of clay (1-2 cm), lamination, grey 2.5Y 5/1	iror & age
	5.0—						The second secon				Encir	osure 15

Date: 15.10.2002

Described by: TC/PK



Company: DONG, site survey CECILIE-2, BH C 3

Borehole id.: DGU nr. 560420.26

Water depth: 60.2 m

Position: 6252008.2 N 610015.9 E

havb

ore	Core depth	Litho	Gr	ain si	ze & s	edime	nt st	ructur	es	Description	En iro
	m		Clay	Silt	vf	Sand f m	d C	vc G	r Pb		ag
1.00		1.51								0.00-0.35: SAND, fine, silty, shells, dark greyish brown 2.5Y 4/2 -1.62: SAND, fine, well sorted, faintly laminated, upper boundary sharp, grey 2.5Y 5/1	H
.62	1.0		- · · · · · · · · · · · · · · · · · · ·							5	
	2.0—			althought a stall thought of manner of the control							
	3.0										
	4.0-			monomorphism and plants of the state of the							
	5.0										
	6.0—				VPT 1000000000000000000000000000000000000			Commence of the second			osure 1

Date: 15.10.2002

Described by: TC/PK



Company: DONG, site survey CECILIE-2, BH C 4

Borehole id.:DGU nr. 560420.27

Water depth: 60.2 m

Position: 6252502.7 N 609504.7 E

havb

ore	Core Litho depth -logy	Grain size	& sediment structures	Description	Er
	m	Clay Silt v	Sand Gr Pb		8 ag
1	- 100 - 100 - 100			0.00-0.55: SAND, fine, silty, shells, greyish brown 2.5Y 5/2	Н
.00	1.0—			-1.80: SAND, fine, well sorted, faint lamination, few shells, at 1,75: stone (6 cm), upper boundary: gradual transition, grey 2.5Y 5/1	ł
00	2.0—	- WH W. 107	×	-2.14: SAND, fine and very fine, well sorted, upper boundary in colour only, dark grey 2.5Y 4/1	300
	3.0				
•	4.0—				
	1 1 1 1 1				
	5.0—				
	- - - - 6.0—				

Date: 15.10.2002

Described by: TC/PK



Geological Survey of Denmark and Greenland

Company: DONG, site survey CECILIE-2, BH C 5

Borehole id.:DGU nr. 560420.28

Water depth: 60.6 m

Position: 6251510.2 N 609455.8 E

havb 131-31-590018

Core	Core	Litho -logy	Gı	rain si	ze &	sedin	nent s	structi	ures	;	Description	Env
	m		Clay	Silt	vf		ind n c		Gr	Pb		& age
		1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.					And page 1915				0.00-1.00: SAND, fine, very silty, shells, upper .25 m: many shells, dark greyish brown 2.5Y 4/2	нѕ
1							and a constraint of the constr					
1.00	1.0-	2007				1	Commission of the Commission o	UNION CONTRACTOR OF THE PROPERTY OF THE PROPER			-2.15: SAND, fine, well sorted, laminated, streaks of silty sand, few streaks	HS
11	-						A STATE OF THE STA				with shell fragments, upper boundary gradual transition, grey 2.5Y 5/1	
2.00	2.0-						months of additional sections of the section of the	The sea is a facility of the sea			-2.30: SAND, fine and peat, horizontal laminated,	FS
ш		<u> </u>					oti asommonome propries di sissi	THE RESIDENCE OF THE PROPERTY			very dark greyish brown 2.5Y 3/2 -2.85: SAND, fine, clayey streaks, horizontal laminated, grey 2.5Y 5/1	FS
3.00	3.0										-3.60: Heterolith: CLAY, silty and SAND, silty, horizontal laminated, at 3.18: thin streaks of peat, dark greyish brown 2.5Y 4/2	FV
IV							morning annual property and a second					
4.00	4.0-										-4.00: SAND, fine, many streaks of clay, heterolithic, horizontal lamination, upper boundary sharp, dark greyish brown 2.5Y 4/2	FV
	-			To a reconstruction of the contraction of the contr			***************************************					
	-			Anna de la companya d								
	5.0-			N. Incaration of the Control of the	on the same and th	and communication of the second		Security (Section Committee) Committee	And a speciment of the second second second second			
	8				A	Consistence of common constitutions of the constitution of the con		ground bing season opensystem) in a disease.	and the second s			
	6.0-							-			Englanura	

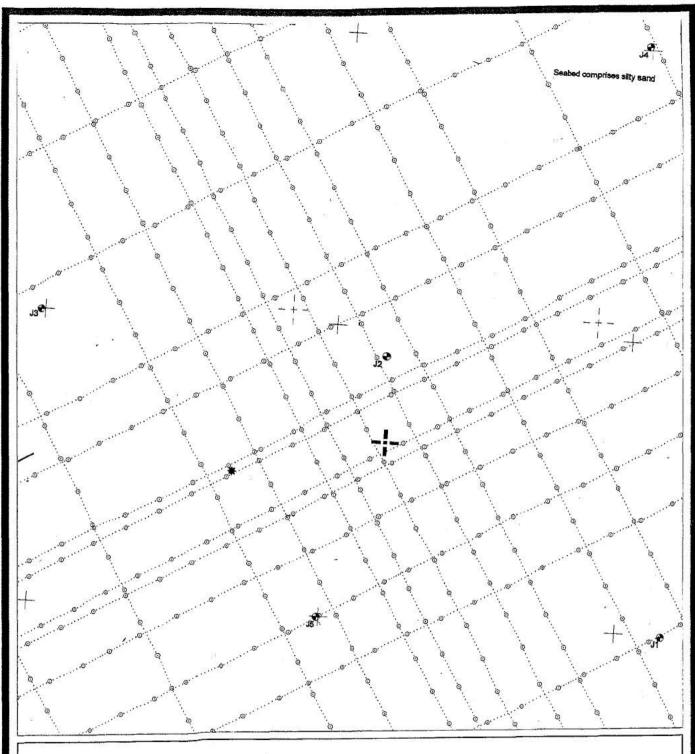
Enclosure 18

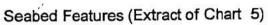
Described by: TC/PK

Date: 15.10.2002



Geological Survey of Denmark and Greenland





-¦-

PROPOSED JETTE-1 LOCATION (567 593E, 6 215 803N)

SIDESCAN SONAR TRACK DURING ECHO SOUNDER, SIDESCAN SONAR AND DIGITAL SEISMIC LINES



AREAS OF MODERATE REFLECTIVITY
EXPECTED TO COMPRISE AREAS OF SHELL

J1

VIBROCORE WITH STATION NUMBER

SEABED COMPRISING SILTY SAND

POINT CONTACT



Company: DONG, site survey JETTE-1, BH J 1

Borehole id.:DGU nr. 560429.16

Water depth: 60.1 m

Position: 6215498 N 568080 E

havb 131-31-590020

Core	Core Litho depth -logy	Grain si	ize &	sed	iment	stru			Description			
	m	Clay Sil	t vf	f	Sand m c	: Vo	Gr	Pb		& age		
ı		TO THE RESIDENCE OF THE PROPERTY OF THE PROPER	AND A STREET OF THE STREET OF	ACCOMMENSATION OF A PARTY OF THE ACCOUNT OF THE ACC	ACTION OF THE PROPERTY OF THE	A CONTRACTOR OF THE CONTRACTOR	***************************************		0.00-1.20: SAND, fine and very fine, slightly silty, few gravel-size clats, above 0.20: shells and shell fragments (<i>Arctica islandica</i> , a.o.), dark grey 5Y 4/1, below 0.20: few shells and shell fragments, dark grey 5Y 5/1	HS		
0.95	1.0—				DETECNACION NO COTO COTO DO COCO COMPACTORISTO TO COPPE DE CONTRACE SE		X X	IS NAVADABLED TENDON A CONSTRAIN CONTRIBANA CONTRIBANA,				
II	- Sun - Sun - Sun		STREET, AS A COLOR STREET, STR	COLO NOMO MARIA	ORNOLOGICAL TOTAL CONTRACTOR CONT		MANAGEM PANAGEM 1997 PANAGEM 19		- 1.81: SAND, fine and very fine, silty, few lenses of clayey sand, bioturbated, few shells and shellfragments, dark grey 5Y 4/1	нѕ		
1.95	- unc		Or the selve. As the selve of the selvent annual sources.				*	eses sele dito etto se battoro mattoroccommi edocommi	- ~2.00: CLAY, slightly silty, sticky, with fine gravel-size clasts of lighter clay, dark greyish brown 10YR 4/2	TL		
111					THE PRINCE PROPERTY OF THE SHAPE SHALLOW AND AN ARTHUR TO THE SERVICE THE SHAPE SHAP	THE CHAPT A LABORATORY CONTROL TO A STATE OF THE CHAPTER OF THE CH		SALOMONINA DALLA OPPRINTENSE A RESIDENCE DE LOS SELOS	- 3.62: CLAY, slightly silty, sticky, hard, many fine gravel-size clasts of lighter clay and coarse gravel-sizes clasts of dark clay, often witha rim of lighter colour, in lower part: clay-matrix with a little fine sand, few sand-sized clasts of Quarts, minute clasts of charred, organic particles, dark greyish brown 10YR 4/2	TL		
2.95	3.0—		AND THE PROPERTY OF THE PROPER		NOTION THE PROPERTY WAS AND ONE PROBLEMS OF THE STANDARD OF TH		WARE THE PARTY OF	de est (1880) TERMONETERMONOTERMONOTERMONETERMONOTERMONETERMONO		:		
1V 3.62	- ///	ell curvetterebetter to	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA		CHANNEL STORY MALES WALLES AND STORY STORY STORY STORY STORY OF STORY ST	A PRACTICAL PROPERTY OF A STATE OF STAT	*					
3.02	4.0—	NAMES OF THE PROPERTY OF THE P	AND THE OWNER WAS AND THE PARTY OF THE LEG OF THE OWNER WAS AND TH	Serger is the experience of the service of the serv	ALL THE PROPERTY OF THE PROPER			en e				
	- - - - -	en e			THE THE CONTROL OF THE PROPERTY OF THE PROPERT		A THE THE A SERVICE OF THE PROPERTY OF THE PRO	erdann men an				
	5.0—	LEGILLAGE TOUTH TOUTH TOUTH TWO COMMON MANAGEMENT	este de la reconstruit de la seconstruit de la reconstruit de la reconstruit de la seconstruit de la seconstruit	A TOTAL CONTRACTOR OF THE PROPERTY OF THE PROP	empression sur silvas en este ellas ellas ellas ellas (1802 algorizadas).	ALL TLANSMAN AND ARRAY (ARRAY ARRAY	VIOLENNA VIOLENTA PROGRAMMAN AND TOMOTOMIC AND	CANA, ANA ANA ANA ANA ANA ANA ANA ANA ANA				
	 	And the second s	ELTER) POT MANO, TO THE OWN CHAINS CHAIR SHOWS THE PROMET PROPERTY OF THE PROP	 — по температи предостава по температи по т	NO MINISTER (2000 ALACTOR I ALLIE FORME SILLE (TO AMELLIE A FORMETTI (1904)		TO WARRIER A MARKET SACRET STATES OF STATES AND STATES OF STATES O	A Molymorphism and the control of th				
	6.0—		Maria Constitution of the	Appropriate Control of	er er er er	\$185.000p	Management	Server and		1		

Date: 02.10.2002

Described by: CSL/PK



Company: DONG, site survey JETTE-1, BH J 2

Borehole id.:DGU nr. 560429.17

Water depth: 60.4 m

Position: 6215951 N 567586 E

havb

Core	Core	Litho l-logy	Gra	in siz	e & :	sedime	nt s	stru	ctu	res	Description	Env
	m	Jogy	Clay	Silt		Sano f m		vc	Gr	Pb		& age
0.93	1.0-			economic la company de la comp		THE	×		A		0.00-2.06: SAND, fine and very fine, slightly silty, upper 6 cm with gyttja, dark grey 5Y 3/1, above 0.4: shells and shellfragmets, at 0.35: few gravel-size clast, below 0.40: few shells and shell fragments, few coarse sand-size clasts, bioturbated?, minute charred organic particles, at base: clayey streaks and clayey layer, dark grey 5Y 5/1	нѕ
11		- - - - - - - - -		the analysis of the second			7		well CA concrete restricts deposit and analysis of			
1.93	2.0-		<u>-</u>				y Y		A DA Savarous and Classic Commence and the Commence of the Com	e 'access' annual de particular de manda mandria de la calaba	- 2.54: SAND, fine and very fine, faintly laminated, few coarse sand-sized clasts, shells and shellfragments, lower 10 cm laminated with clayey laminae/layers,	HS
Ш		_ _ _ _ _ _	=======================================		 	A CONTRACTOR OF THE PROPERTY O	y			Legal of the best of the base of the best of the base	at base: rouded shellfragments and coarse sand clasts dark grey GLEY 1 3/N and grey 5Y 5/1 - 3.59: SAND, very fine, silty, faintly laminated, few clayey laminae,	HS
2.93	3.0-					A CONTRACTOR OF THE CONTRACTOR					disturbed, few shell fragments, dissimated minute, organic particles, at: 3,40 - 3.55: clayey sand and clay layers, disturbed, greyish brown 10YR 5/2	
IV		- 1111111 - 1111111 - 1111111							concernio de de didritti filimentamente conservado e	A THE RESIDENCE OF THE PROPERTY OF THE PERSON OF THE PERSO	- 3.72: CLAY, laminated, silt laminae, layers of clayey fine sand, dark greyish brown 10YR 4/2	TL
3.72	4.0-	- <u>///</u> - - -				and the state of t		BOOK OF THE TOTAL				
	# 10 20 41	_	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						entities appropriate a a constructed date objeties (EU) is departured.	The second secon		
	5.0-	_ _ _ _ _		A STATE OF THE PROPERTY OF THE					AND THE PROPERTY AND THE STREET, THE STREET, S			
	3			WAY (Series and a constant and a co		Pi William contentamente conte			mai e- ministration e de la constante de la co			
	6.0-				and the same of th			-	Manager of Property			

Date: 03.10.2002

Described by: CSL/PK



Company: DONG, site survey JETTE-1, BH J 3

Borehole id.:DGU nr. 560429.18

Water depth: 60.5 m

Position: 6215999 N 566993 E

havb

Core	Core Litho depth -logy	Gra	in siz	e &	sedir	nent	stru			Description	Envi ron
	m	Clay	Silt	vf	Sa f r	and m c	vc	Gr	Pb		& age
0.91	1.0	/.					(WWW.Addition) (A.A.A.A.A Addit with Addition and William Community of a second			0.00-2.25: SAND, fine and very fine, slightly silty, upper 10 cm with gyttja, mottled and bioturbated, at 0.35 - 0. 40 and 1.28 - 1.29: oblique laminae with gravel-size clasts of rock- and shell- fragments, few gravel-size and coarse sand-sized clasts, at 1.30-1.40: more silty, lower 0.35 m: very few clasts, shells and shellfragmets, minute charred, organic particles, dark grey 10YR 4/1	нѕ
11		//	THE ANNIAL PRINCIPATION OF THE PRINCIPATION OF			TOP OFFICE LAND WANTED LAND TO THE CAME AND		× ×	Addition when the state of the		
1.91 III 2.25	2.0—		Mort-Polace may have made accessorate and the second accessorate accessorate and the second accessorate accessorate accessorate and the second accessorate acce	THE STATE OF THE S	TOTAL COLUMN TO THE COLUMN TO	н Вини Молен (Малани Майлена (МВ) долгон дени дени дени дени дени дени дени ден	A THE STATE OF THE	~ ×	ANN THE REAL PROPERTY OF THE P		
	3.0— 										

Date: 03.10.2002

Described by: CSL/PK



Company: DONG, site survey JETTE-1, BH J 4

Borehole id.:DGU nr. 560429.19

Water depth: 60.7 m

Position: 6216506 N 567996 E

havb

Core	Core Liti	no Gr	ain siz	e &	sedi	iment	struc	ctur	es	Description	Env
	m	Cla	y Silt	vf	f	and m c	vc	Gr	Pb		& age
1		C 2005 C				водинатичной пистананической подпасной подпасн		7		0.00-2.59: SAND, fine and very fine, slightly silty, upper 20 cm with gyttja and large shells (<i>Arctica islandica, Cardium echinatum, Astarte</i> sp., <i>Littorina</i> sp. a.o.), few gravel-size clasts, at 1,08, 1.81 and 1.89: shell hash, partly mottled = bioturbated, shells and shellfragments, dark grey 10YR 4/1	HS
0.94	1.0-5					иштанения принципального принципально		7	encondense states and	1.5	
II	- 12 - 23 - 33	5						¥			
1.94	2.0—	5							Samuel Control of the		
111	- 5	2	The state of the s			endustries des détait étaits	the state of the state and the	y			
2.59	3.0—			something control of the control of		halibacum auusi dennemaassaanan ennennementennessa					
				and and the second seco		оденцинизмадалет поднержение падалей применение			evillan anders to the end of the		
	4.0—		The contract of the contract o			полосителний представой однастичност			Andrew College and Market States		
	-		The second secon			одинализивання в принценти			en e		
	5.0—		As worst desires at 20			asin alijakasi ili ili jamenemennaa aa					
	- 6.0—										

Date: 03.10.2002

Described by: CSL/PK



Company: DONG, site survey JETTE-1, BH J 5

Borehole id.:DGU nr. 560429.20

Water depth: 60.4 m

Position: 6215499 N 567497 E

havb

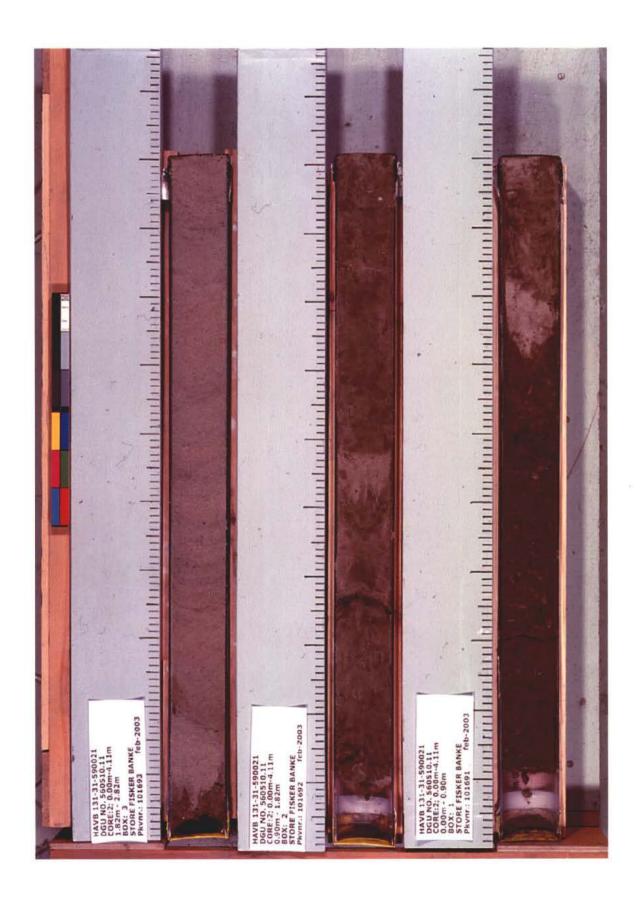
Core	Core Litho depth -logy	Grai	n size	e &	sedi	ment	stru	ıctu	res	Description	Env
	m	Clay	Silt	vf	f S	and m c	; vc	Gr	Pb		& age
1		очения выполняем пределава выполняем медалься выполняем полнения выполняем полнения выполняем полнения выполняем полнения выполняем выполнениям выста выполнениям выпо				п с бот на зного хургент так Антиность од вести декамент декаментальной выповальной перетопология			VERTILANDOMEN I DESCRIPTOR DE LA CONTROL DE	0.00-1.44: SAND, fine and very fine, slightly silty, upper 10 cm with gyttja and many large shells (<i>Arctica islandica</i> , <i>Cardium echinatum</i> , <i>Astarte</i> sp., <i>Littorina</i> sp. a.o.), few gravel-sized clasts of rock fragments, shells and shellfragments, mottled = bioturbated, at 1.40: shell hash, downcore fewer shells, dark grey 10YR 4/1	HS
0.91 II	1.0	осоны става и режендами, селонородине «ТОКТИНИМОМ		A CONTRACTOR OF THE CONTRACTOR		AND THE PROPERTY OF THE CONTRACT OF THE CONTRA	www.meanmana.co.co.ac.co.co.co.co.co.co.co.co.co.co.co.co.co		WITH THE THE THE THE THE THE THE THE THE T	dank groy Totti wi	
1.44	- \$\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot	mman and a contract of the con				AMANAGA SI SAMBINI SI	н даланы кадалана бітення на проценую пре предестава дорга	*	taka milili kata da manasasasa mpunap da da mahasasa mpun		
	2.0—	And Addition and the Additional distance and the second design of the se				ATTERNOTORIAN CONTRACTORIAN CONTRACTORIAN CONTRACTORIAN CONTRACTORIAN CONTRACTORIAN CONTRACTORIAN CONTRACTORIA		Метендиминацийминаций (метенда и обитот и и и и и и и и и и и и и и и и и и	MOON ON A MARK THAN A MARK THA		
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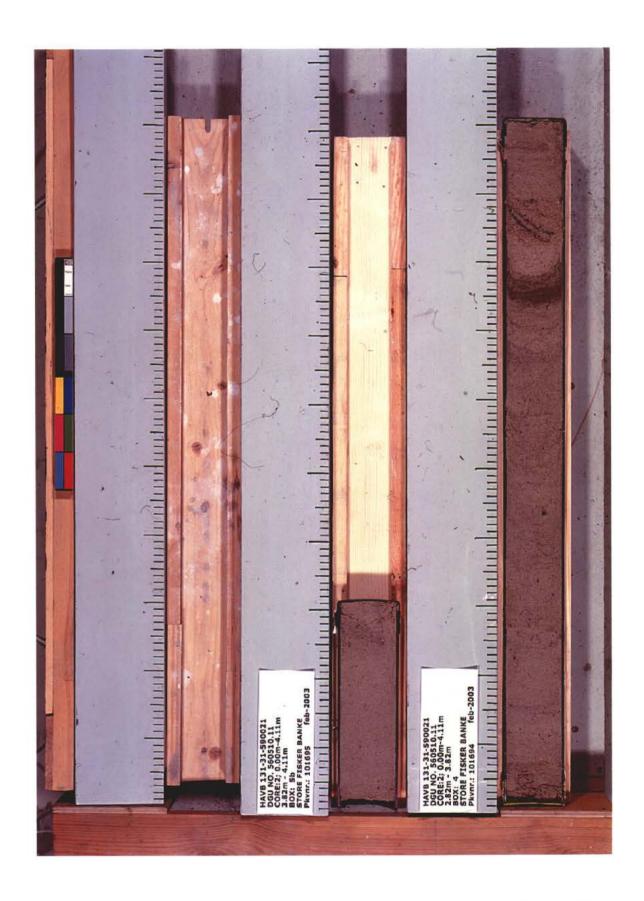
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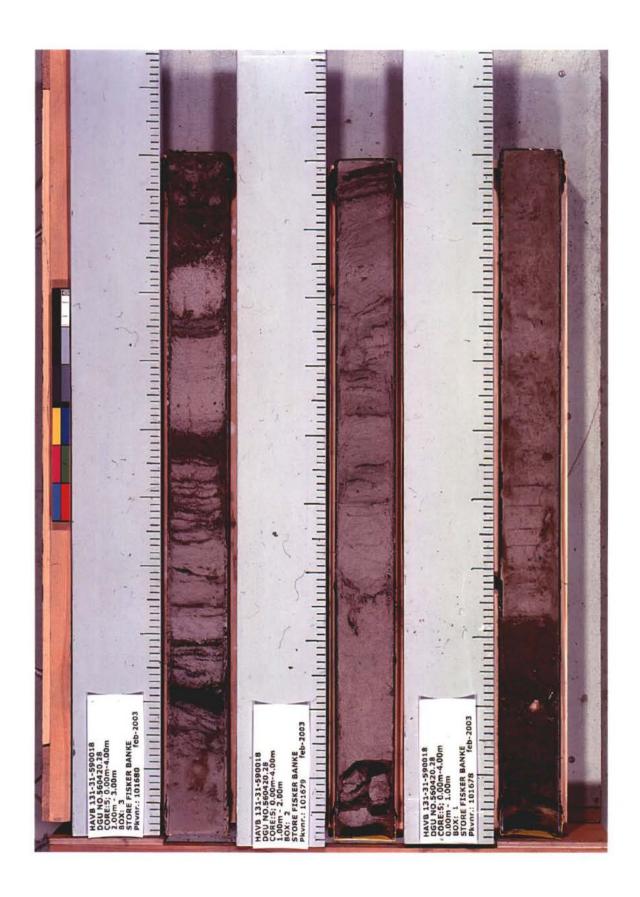
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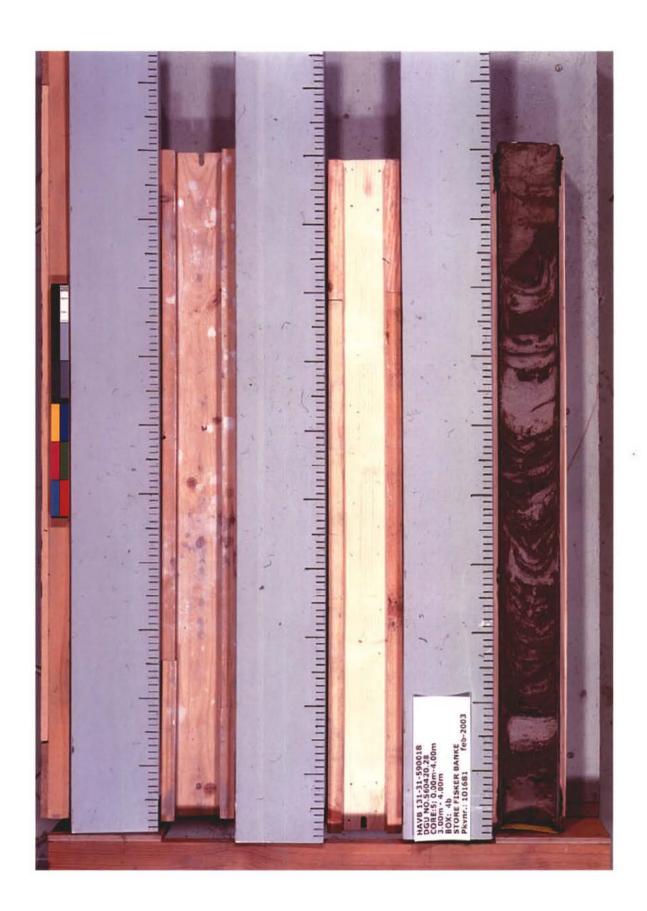


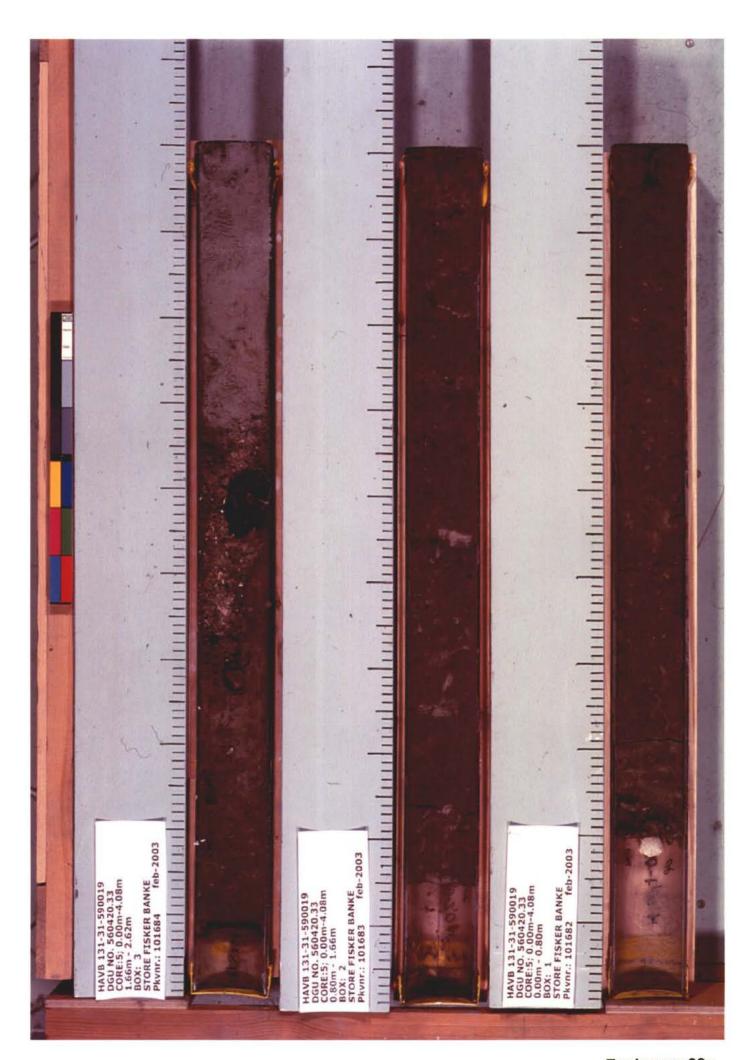
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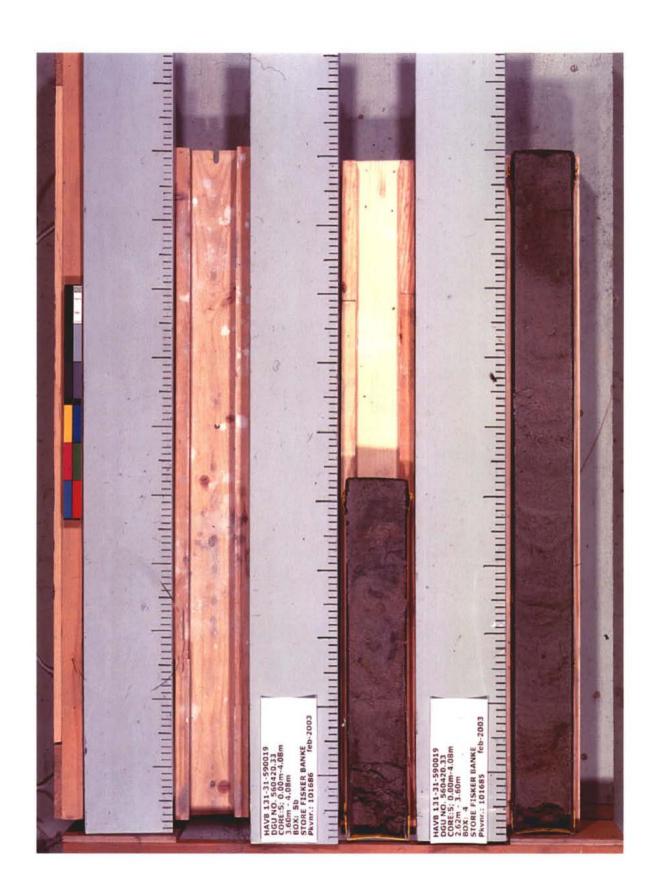


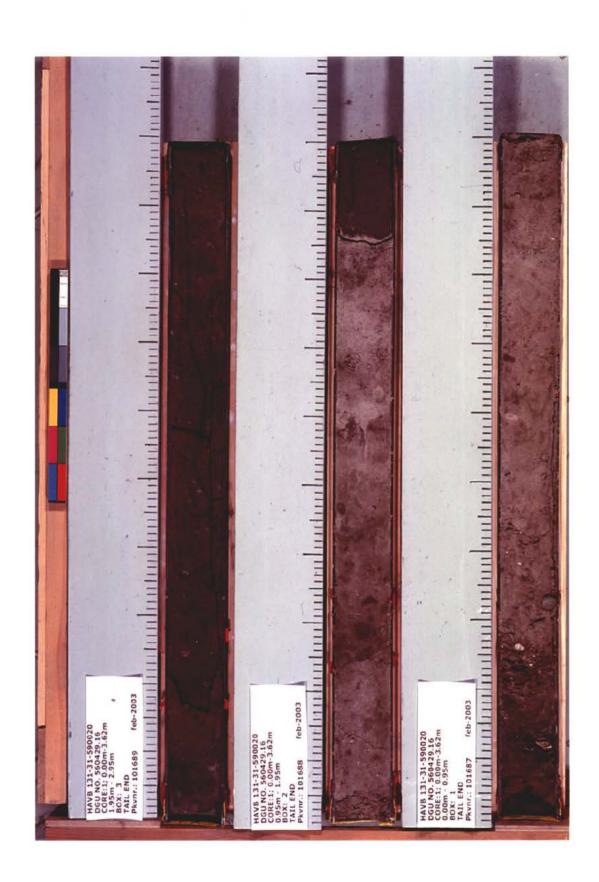


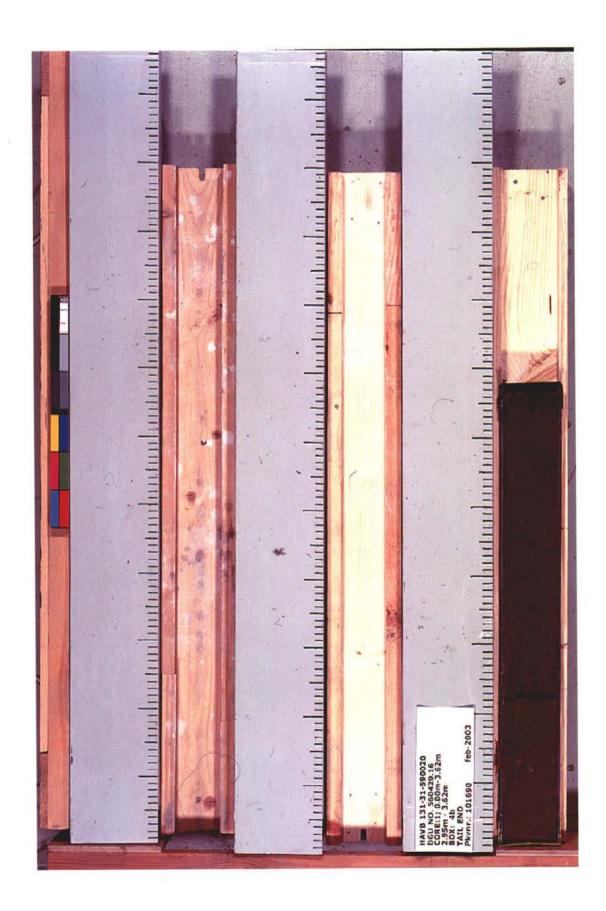












POSITION:

E622,324

N6.261.031

Water

depth:

58,3 m

CORE NO.: DGU no. 560420.34 SIRI-5 well site, BH30-01

Grain size and

POSITION: E622,324 N6,261,031

Water

depth:

58,3 m

CORE NO.: DGU no. 560420.34 SIRI-5 well site, BH30-01

Litho-

DN04.02K-001.04.01 - Master eng.

Grain size and

POSITION: E622,324 N6,261,031

Water

depth:

Description

58,3 m

CORE NO.: DGU no. 560420.34 SIRI-5 well site, BH30-01

Litho-

Lab.

POSITION: E622,324 N6,261,031

Water

depth:

58,3 m

CORE NO.: DGU no. 560420.34 SIRI-5 well site, BH30-01

