RAPPORTSERIE

Nr. 37 - Oslo 1987

A. ELVERHØI and A. SOLHEIM:

Shallow geology and geophysics of the Barents Sea

- with special reference to the existence and detection of submarine permafrost

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CONTENTS

INTRODUCTION;

The Barents Sea forms an epicontinental sea (1.3 mill km^2), bounded by the Arctic Ocean to the north, the Svalbard archipelago and the Norwegian - Greenland sea to the west, the Fennoscandian shield in the south and Franz Josef Land and Novaya Zemlya to the east (Fig. 1). It is characterized by northeast-south west trending basins (300-500 m water depth) and shallow banks (30-150 m water depth), and has an average water depth of 230 m, which is significantly deeper than most of the present day high arctic shallow (10-60 m deep) shelves outside North America and the USSR. The shelf depth is most likely a response to repeated glaciations in the Late Cenozoic (Elverhøi & Solheim 1983a; Solheim & Kristoffersen 1984), leaving only a thin (average < 15 m) sediment cover above the Mesozoic and Paleozoic bedrock. Thick Quaternary deposits (50-100 m) are only found locally in troughs and as till ridges. Thick deposits, 50 - > 400 m, are also observed in Bjørnøyrenna, an area which has been a major depocenter throughout the Late Cenozoicum (Solheim & Kristoffersen 1984). The boundary between the bedrock and its overlying sediments is in most areas defined as an angular unconformity, in principle the same boundary as found elsewhere on the Norwegian shelf.

The modern Barents Sea spans a range of sedimentary environments, from ice-proximal glaciomarine with cold Polar water in the north to year-round ice-free conditions and Atlantic water in the south (Elverhøi 1984; Pfirman 1985). In the north, sediments are supported directly from the calving glaciers with additional support by icebergs and sea-ice. The main sediment source is, however, from reworking on shallow banks by currents. The most extensive reworking is observed at Spitsbergenbanken. Here a lag of Late Weichselian glacially derived clasts has been left and mixed with Holocene bioclasts, forming the northernmost reported modern carbonate accumulation (Bjørlykke et al. 1978; Elverhøi 1984).

Our understanding of the shallow geology and geophysics in the Barents Sea is mainly based on investigations during the last 15 years, conducted by the Norwegian Polar Research Institute, Norwegian Petroleum Directorate and the Continental Shelf Institute.

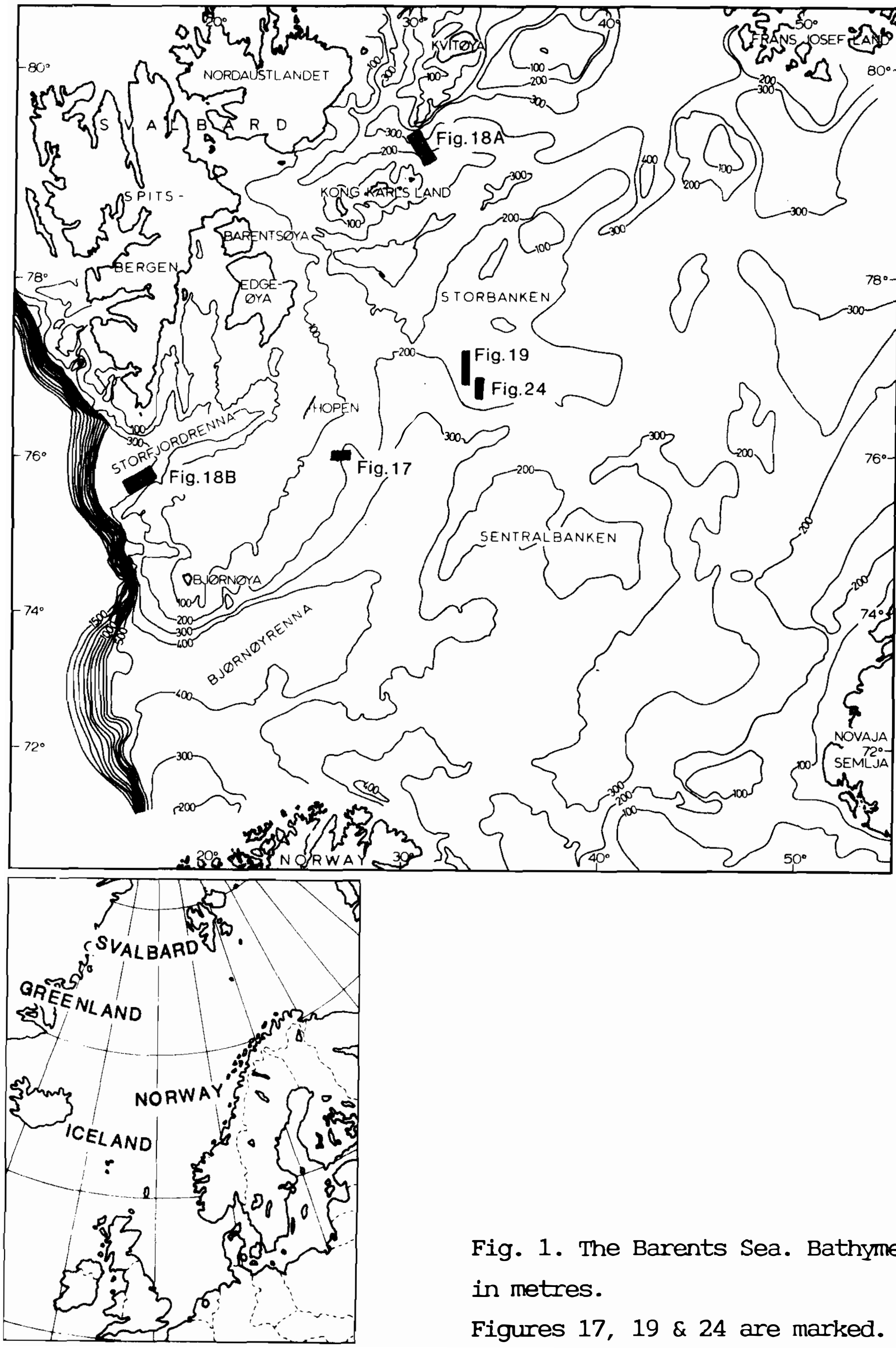


Fig. 1. The Barents Sea. Bathymetry in metres.
Figures 17, 19 & 24 are marked.

The main emphasis has been given to characterization of the regional pattern of sediment composition and distribution. The study of chronology and extension of the Quaternary glaciations has been a main topic, and still is. By understanding at least the last glaciation, a number of questions on sediment origin and properties could be more easily solved. Important aspects of high latitude shelf environment are still scarcely investigated, e.g. ice scour, or they have been essentially neglected, e.g. subsea permafrost.

Most of the work done so far has been published or is available in preprints, reports and theses (appendix I). The data can, however, be applied to a number of new studies and be reinterpreted for a range of purposes. In this report we summarize existing knowledge on essential topics of the sediments, their underlying bedrock and the physical settings of the region. The report will also include the limitations of the data and the need for new information. The northern and northwestern Barents Sea defined by the 35^{0}E and 74^{0}N is the main study area, while data from the northern part of Bjørnøyrenna south to 72^{0}N are included. Additionally, some data from fjords on the west coast of Svalbard are presented. The report also includes a discussion on subsea permafrost, - definitions, terminology, detection methods and possibilities for the existence of subsea permafrost in the Barents Sea region.

1. SEA ICE CONDITIONS

Sea ice information has been achieved from the Barents Sea during the last 80 years (e.g. Omdal 1953 and Vinje 1985 for a review). However, the use of satellite images (1966) and the introduction of automatic satellite-traced ice drift buoys (1975) represented a break-through in monitoring the sea-ice conditions and ice drift pattern (Vinje 1985).

In the winter time considerable parts of the Barents Sea are covered by sea-ice (Fig. 2), while the west coast of Svalbard may remain open. The fjords on the western and northern coast may also be kept open for long periods during the winter. The southern extention of the ice edge in the winter time follows the oceanic Polar front (see page 7). However, interannual variations are considerable. During the melt season the ice edge may retreat as far north as 81^{0}N, and especially north of Svalbard, there may be open water conditions until late November/December.

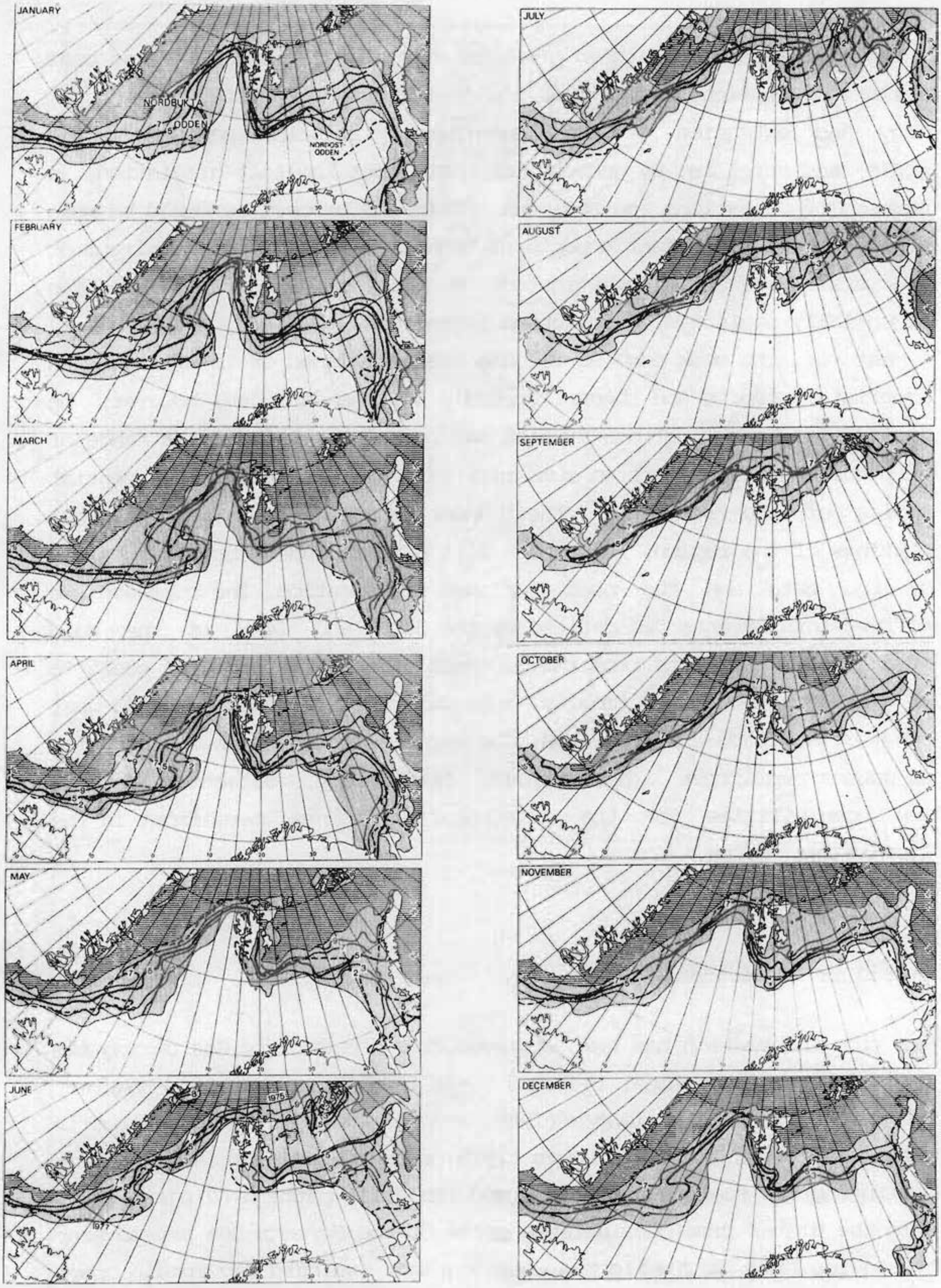


Fig. 2. Southern limit of sea ice concentrations greater than 4/10 at the end of each month of 1982 (broken line), together with the frequency distribution for the period 1971-1980 (given in tenths). From Vinje (1985).

The ice drift pattern is in general to the south, and wind is the dominant driving force (Vinje 1985). The major part of the Barents Sea ice is formed locally, while multiyear ice from the Arctic Ocean may pass through the passages east of Svalbard for shorter periods. The ice thickness is, in the southern parts, between 40 and 150 cm, and applying the concept of Lebedev (1938) of "degree days" (i.e. accumulation of days multiplied with the respective daily average of the negative temperature) the thickness in the northern areas is estimated to 165 cm (Vinje 1985).

Icebergs have only been systematically observed from Hopen and Bjørnøya with the maximum frequency of observations in April (Fig. 3). The size is normally less than 100 m, and as noted later, the present day maximum water depth of ice ploughing is approximately 100 m (Solheim et al. in press). Exceptionally large amounts of iceberg may, however, be produced during glacier surges (Vinje 1985).

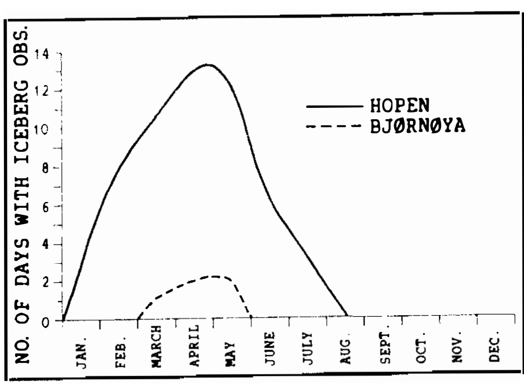


Fig. 3. Frequency of iceberg observations at Hopen and Bjørnøya 1970-1981. From Vinje (1985).

2. HYDROGRAPHY

It is to be noted that relatively little hydrographic information is available from the northern Barents Sea, and all data are limited to the summer. The Barents Sea and the shelf areas north and west of Svalbard are influenced by two different types of water masses. Atlantic water enters the area from the south, where one branch flows into the Barents Sea as the North Cape Current (Fig. 4) while another part continues northward along the west coast of Svalbard as the West

Spitsbergen Current (for a review of the Barents Sea hydrography, see Eide 1983 and Pfirman 1985). The Atlantic water continues into the Barents Sea as several currents. One splits off and flows up Bjørnøy-renna west of Sentralbanken and then northward, while the branch to the south of Sentralbanken continues east and northward as the Novaya Zemlja Current (Fig. 4).

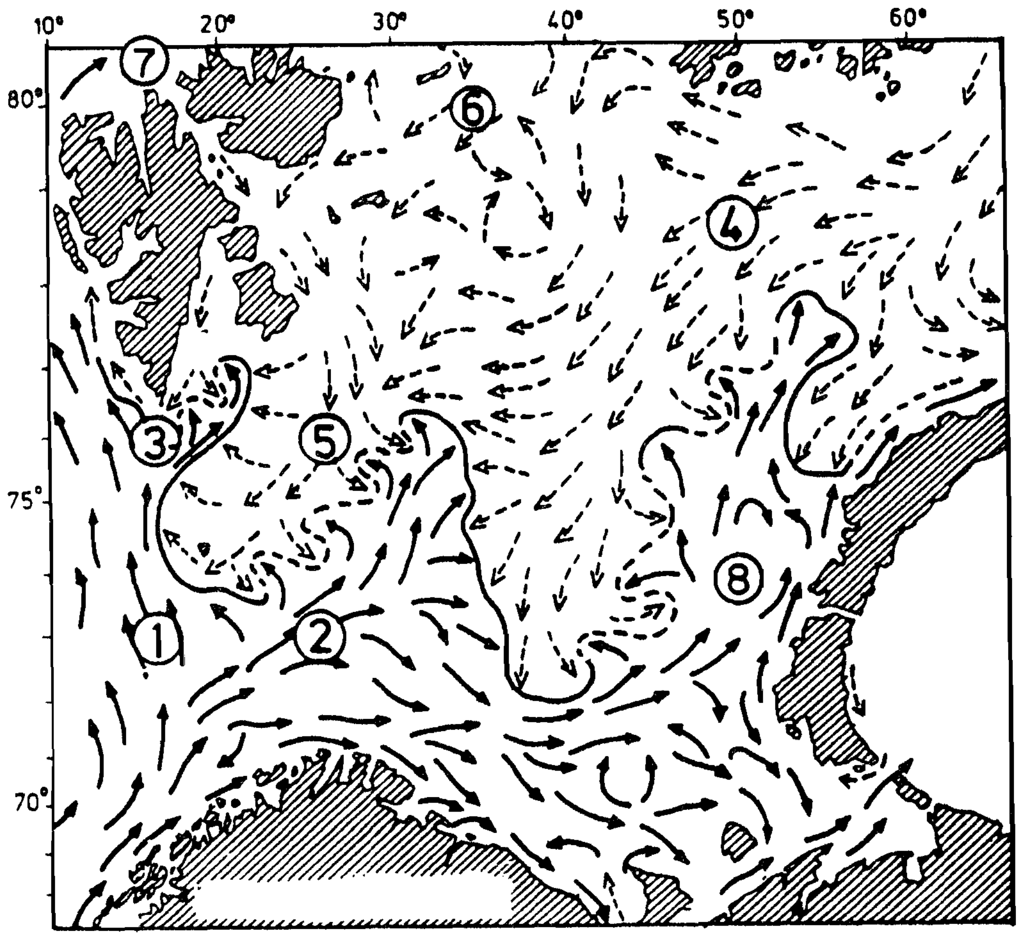


Fig. 4. General circulation map. Solid arrows denote warm water, broken arrows denote cold water. Heavy lines indicates Polar Front.
Labelled currents are:

1. West Spitsbergen Current
2. North Cape Current
3. South Cape Current
4. Persey Current
5. Hopen-Bjørnøya Current
6. East Spitsbergen Current
7. Arctic Atlantic Current
8. Novaya Zemlya Current

From Pfirman (1985).

The West Spitsbergen Current mainly follows the shelf break, sometimes entering the shelf itself (Gammelsrød & Rudels 1983). The Atlantic water is defined by T > 3^0C and S > 34,9 ‰. The inner shelf water may not be classified as Atlantic water. However, the temperature is well above freezing point, +1 to +3^0C (Gammelsrød & Rudels 1983). Sub zero temperatures have been revealed in Raudfjorden and in Van Mijenfjorden (Schei et al. 1979; Gammelsrød & Rudels 1983). But these water masses may be renewed periodically.

The West Spitsbergen Current turns eastward north of Svalbard and may enter the Barents Sea from the north through relatively deep throughs, 200-250 m (Pfirman 1985). Very few measurements on T-S and current velocities and directions have been undertaken north of Svalbard (e.g. Aagaard et al. 1983), but as on the western coast, the Atlantic water penetrates the shelf. Current measurements in Hinlopen-stretet indicate influence of Atlantic water in this area as well (Foldvik pers. comm. 1986). The Atlantic water or Atlantic influenced water may not permanently cover the entire northern shelf, but it is likely that they represent the dominating water masses (Foldvik pers. comm. 1986).

The second major water mass, Arctic Water or Polar Water is characterized by T < -1.0^0C and salinities of 34,2-34,5 ‰ (Pfirman 1985). These water masses are probably produced from a deep convection layer developed during sea-ice formation (see Pfirman 1985). The Arctic water is found at 30-100 m water depth, and the area where it meets the Atlantic water is known as the oceanic Polar Front (Fig.4).

Below the Atlantic water, cold deep water may be found, probably formed by cooling of Atlantic water near shallow banks (Loeng 1980) or by modification of arctic water (Pfirman 1985). The temperature of this water mass is slightly below zero (Fig. 5).

Except for very limited areas, the bottom water temperature is characterized by sub zero conditions (Fig. 6). As noted Atlantic water also penetrates into the northern and central Barents Sea from the north, seen as a core of warm water between Nordaustlandet and Kvitøya (Fig. 6). In the central areas, the Atlantic water is seen in

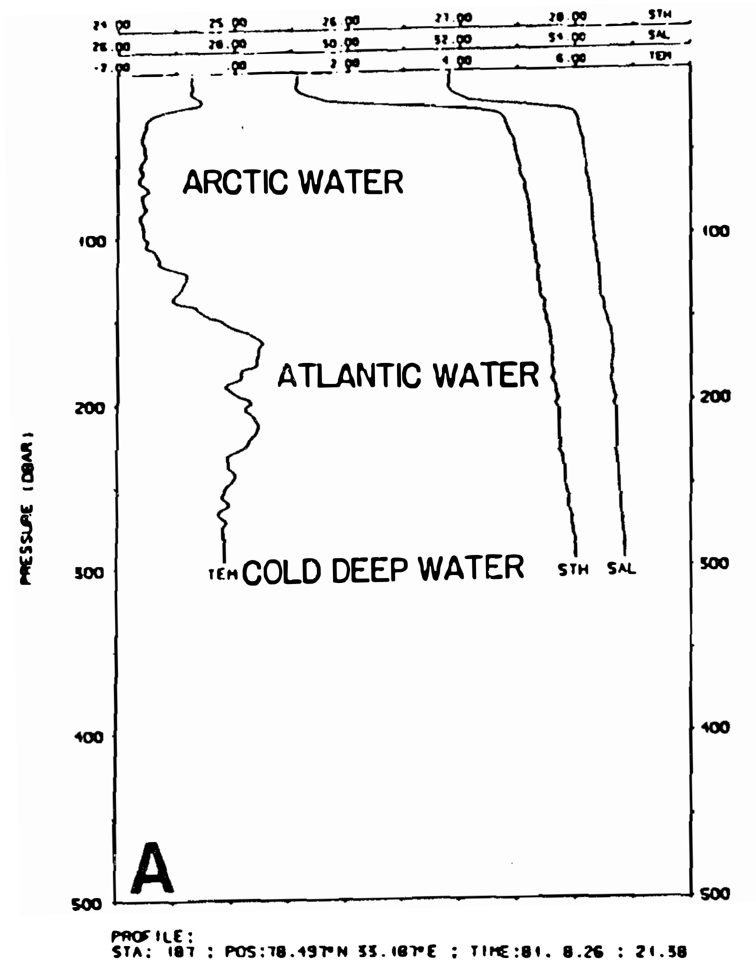


Fig. 5. Hydrographic station cast showing typical Barents Sea water masses.
From Pfirman (1985).

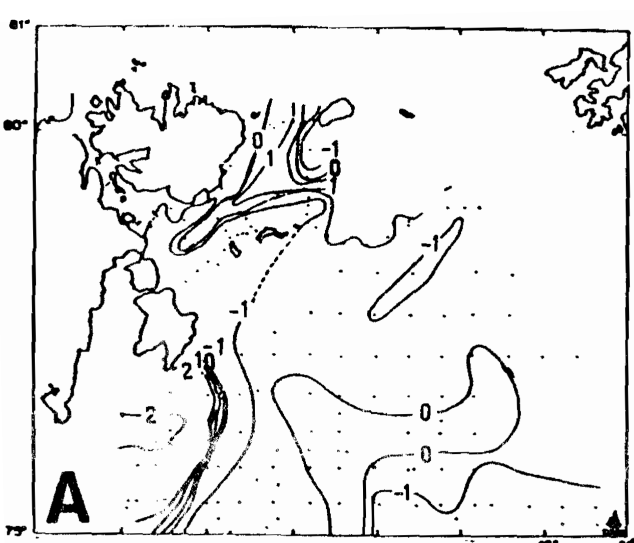


Fig. 6. Bottom water properties:

Property	Average	Standard Deviation
Depth	174.2	91.2m
Temp.	-0.11	1.19^0 C
Salinity	34.44	2.31‰
σ_t	27.67	1.86

From Pfirman (1985).

the strait between Storbanken and Sentralbanken, while sub zero temperatures have been measured as far south as 72^0N (see Eide 1983, p. 112). All the banks are covered by cold water, and sub zero water is found all the way along the east coast of Svalbard and down the plateau south of Edgeøya including Spitsbergenbanken. Approximately, the 100 m contour defines the deepest level for cold water extension in the western parts, while the 200 m contour defines the lower boundary in the central and northern parts (Eide 1983, p. 116; Pfirman 1985).

The general circulation pattern in the Barents Sea is characterized by the south and westerly flowing Polar water meeting the north and eastward moving Atlantic water, leading to the well known cyclonic circulation pattern (Pfirman 1985).

3. GEOLOGICAL AND GEOPHYSICAL DATA AND DATA ACQUISITION

The different cruises that have provided the data base are listed in Table 1. See also appendix II.
The principal sound source has been 1 kJ sparker with analogue recording via a single channel streamer. Additionally, high resolution data have been obtained by 3.5 kHz echo sounding, and in some very local areas side scan sonar has been applied (Solheim & Kristoffersen 1984; Elverhøi & Solheim 1983b).

Sediment samples are mainly obtained by dredge and grab in shallow, hard bottom areas, while a 3 m long gravity corer has been the main tool in deeper areas with soft sediments. Vibro cores and shallow rock cores have been recovered from a few stations (Elverhøi & Solheim 1983b). Bottom photographs are available from about 100 stations (Larsen 1982; Elverhøi & Solheim 1983b; Elverhøi & Solheim 1983c).

Institution Year	Survey area	Sound source	Energy (kJ)	Sampling equipment
NP/NTNFK 1971	Spitsbergen	Sparker	0.5-8.0	Gravity corer, grab, dredge, photo
NP-1977	NE & SE of Bjørnøya	Sparker	1.0	Gravity corer, dredge
NPD-1977	Central Barents Sea	Sparker	1.0	Gravity corer, dredge
NP-1978	Western margin & Bjørnøyrenna	Sparker	1.0	
NPD-1978	Central Barents Sea			Gravity corer, dredge
NPD-1979	Central, southern Barents Sea	Sparker	1.0	
NP/NPD-1980 WHOI	Northern Barents Sea	Sparker	1.0	Gravity corer, dredge, photo
NP-1981	Northern Barents Sea	3.5 kHz PDR		Gravity corer, photo
NPD-1981	Spitsbergen-banken	Sparker	1.0	
NP-1982	Northern Barents Sea	3.5 kHz PDR		
NP/NPD-1983	Northern Barents Sea	Sparker 3.5 kHz Side scan	1.0	Gravity corer, vibrocorer, rock core drill, photo
NP-1984 (NSKV)	South of Nordaustl.	Sparker 3.5 kHz		Gravity corer, photo
NP-1985 (NSKV)	South of Nordaustl.	Sparker 3.5 kHz side scan		Gravity corer, photo, grab

Table 1: Non-confidential shallow geological and geophysical data collected by Norwegian institutions in the Barents Sea.

BEDROCK GEOLOGY

Our knowledge of the bedrock geology in the central and northern Barents Sea is limited and mainly based on geophysical investigations and correlations with the geology of onshore areas and surface dredge samples (Eldholm & Talwani 1977; Dibner 1978; Rønnevik et al. 1982; Faleide et al. 1984; Eldholm et al. 1984; Kristoffersen et al. 1984; Elverhøi & Lauritzen 1984).

The geology of the southern Barents Sea (south of 74^{0}N) is not discussed in this report. Due to the thin sediment cover above the bedrock in the area north of 74^{0}N shallow geological and geophysical surveys can be applied in regional stratigraphic studies (Bjærke 1979; Elverhøi & Solheim 1983b; Kristoffersen et al. 1984; Elverhøi & Lauritzen 1984). These investigations combined with available deep seismic surveys seem to indicate the following:

- In the northernmost parts of the Barents Sea between Kvitøya and Nordaustlandet (Fig. 7) metamorphic rocks of Precambrian and Lower Paleozoic age (named Hecla Hoek) extend from the islands into the offshore areas.

- Permo-Carboniferous rocks outcrop in the southern part of Nordaustlandet. These rocks have been found to extend farther east, and rock core drilling on the southern tip of the Kvitøya Plateau confirmed the eastward extension (Elverhøi & Lauritzen 1984; Elverhøi & Solheim 1983b). The transition from crystalline rocks to the Upper Paleozoic sedimentary rocks is not apparent in the sparker data (Kristoffersen et al. 1984). However, the Upper Paleozoic is identified as a well defined reflector on the northern slope of Frans-Victoriarenna only covered by a 10 to 30 m thick sediment cover. The Upper Paleozoic sequence is also identified through its high velocity, 4.5 km/s, north of Kong Karls Land (Eldholm et al. 1984).

- Kong Karls Land and its surrounding areas mark the transition from the Upper Paleozoic to the Mesozoic rocks which cover most of the Barents Sea (Diebner 1978; Rønnevik et al. 1982). Based on dredged glacial clasts, sandstones dominate the lithology (Fig. 8). Around Kong Karls Land and south to Hopen, Triassic/Lower Jurassic rocks dominate, while there seems to be a southward younging towards Jurassic/Lower Cretaceous rocks in the Storbanken - Sentralbanken area (Fig. 7). Deep seismic surveys (Rønnevik et al. 1982; Faleide et al. 1984) also indicate extensive Triassic subcrop in the northern Barents Sea, while Jurassic-Lower Cretaceous rocks are confined to the southern part of Storbanken and Sentralbanken (Rønnevik et al. 1982). North of Kong Karls Land the strata tend to dip southeastward with slopes of 1-3^0, while the island itself apparently is located on a broad syncline with an anticline superimposed on its southern flank (Figs. 9 and 10). Farther south the bedrock is structurally more disturbed with a dip up to 7^0. In spite of the complexity of the area, there seems to be a regional southward dip of the strata (Kristoffersen et al. 1984).

- The information from Spitsbergenbanken is limited. High velocity rocks, 3.8-4.4 km/s (Eldholm & Talwani 1977) at the sea-floor cause limited penetration to deeper rocks. Studies of clast material, suggested to be of relatively local origin, indicate Triassic sediments towards Hopen and Bjørnøya, while Jurassic rocks may be present in the central part of the Spitsbergenbanken plateau (Edwards 1975; Bjørlykke et al. 1978). Southeast of Bjørnøya the Permian succession found on land seems to continue offshore down to a water depth of 300 m (Grønlie et al. 1980). (Fig. 7).

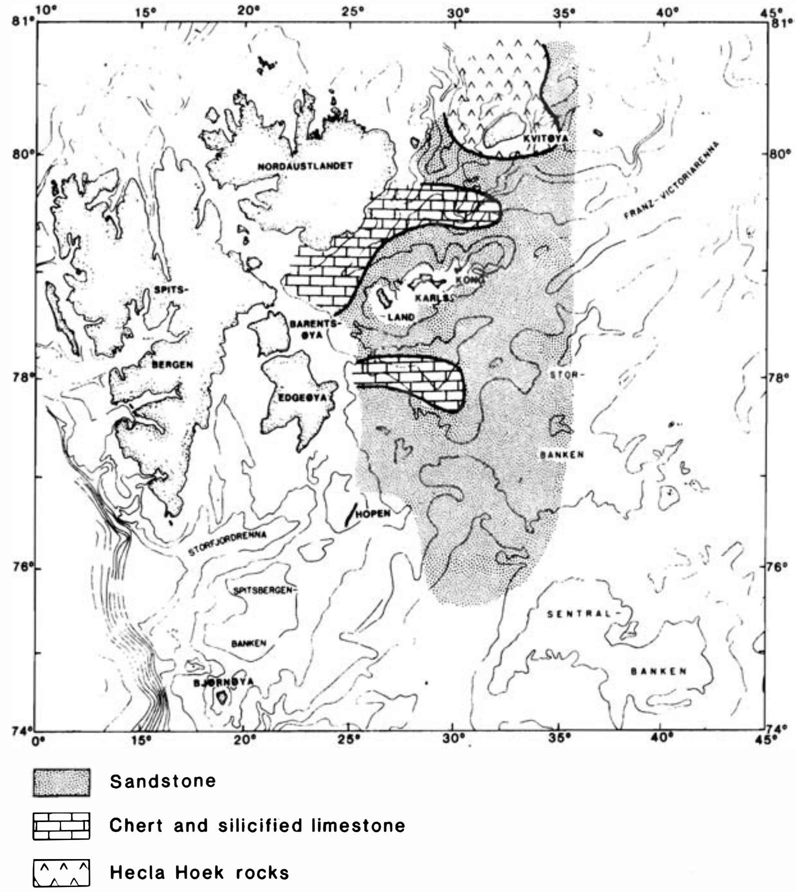


Fig. 7. Map showing distribution of predominant lithologies (> 50%) based on rock fragments in the Qarternary deposits. From Elverhøi & Lauritzen (1984).

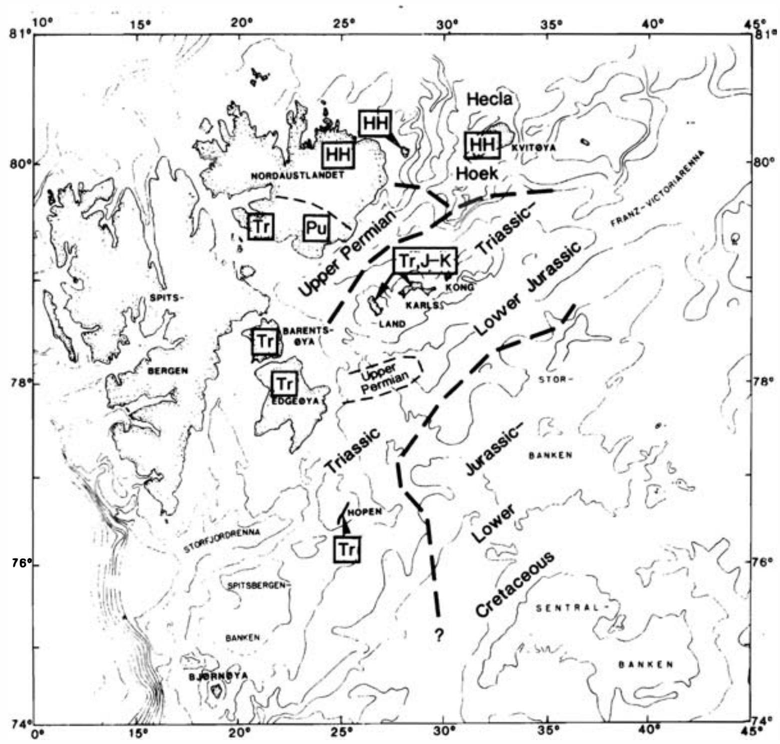


Fig. 8. Map showing stratigraphical provinces for the Quaternary sediments, which are suggested to reflect the underlying bedrock. Onland geology in adjacent areas is indicated in squares. From Elverhøi & Lauritzen (1984).

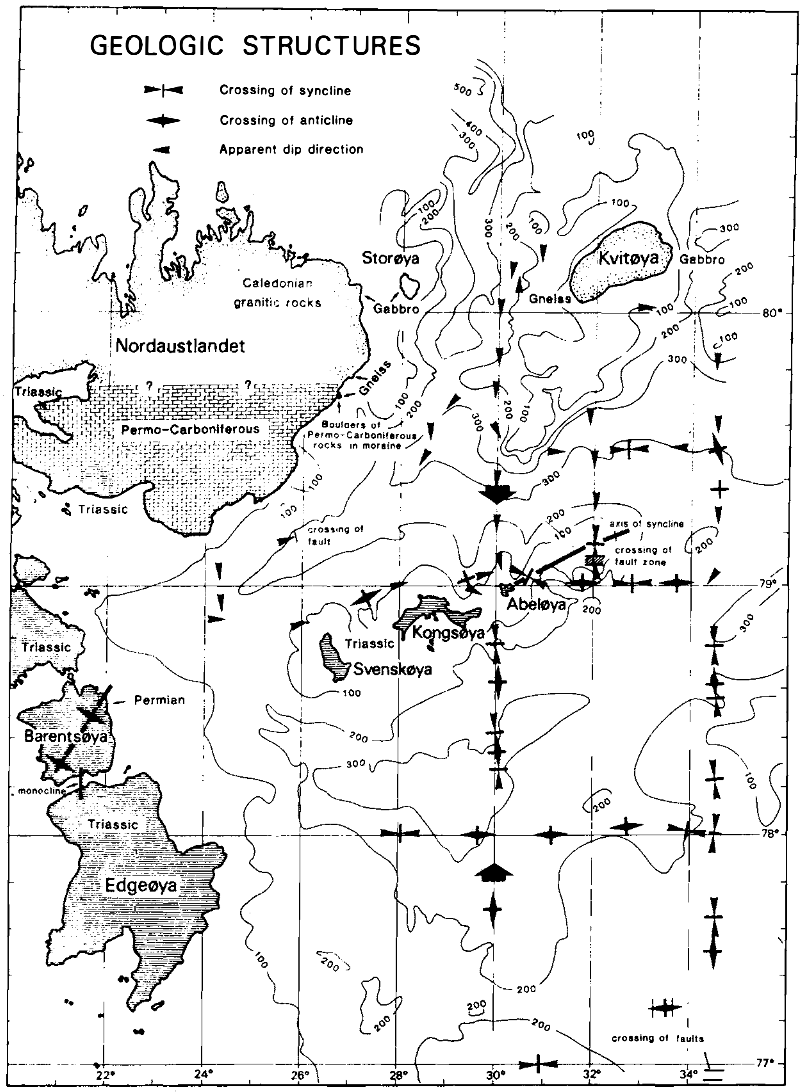


Fig. 9. Shallow geological structure data from the seismic reflection (sparker) data in the northern Barent Sea. From Kristoffersen et al. (1984).

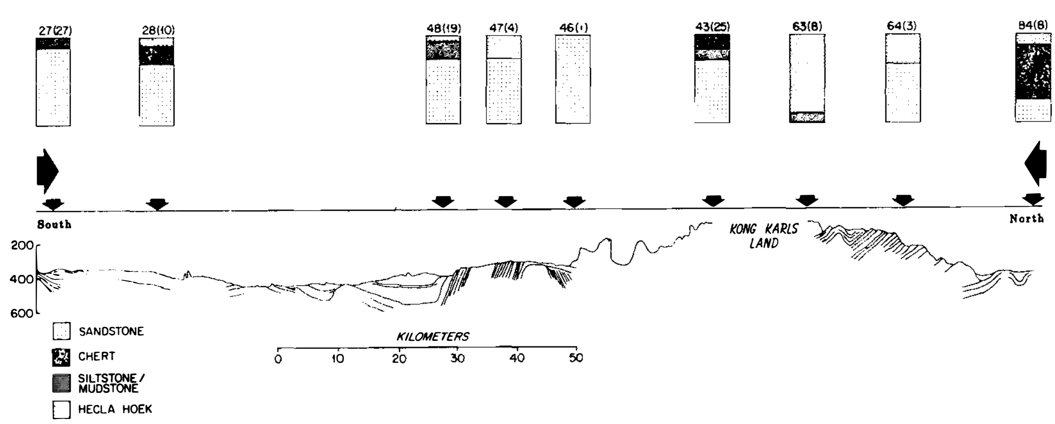


Fig. 10. Digitized shallow seismic record section along 30^0 East meridian from 78^0N-$79^0$30´N with lithology in dredge holes. From Kristoffersen et al. (1984).

Summary

The northern Barents Sea forms a shallow platform with crystalline rocks in its very northern parts. Successively younger rocks are found to the southeast, which may be due to erosion or non-deposition of Mesozoic and Tertiary rocks in the northern Barents Sea (Elverhøi & Lauritzen 1984). In the central Barents Sea and on Spitsbergenbanken Triassic and Jurassic - Lower Cretaceous rocks subcrop. In the western region high sea-floor seismic velocities of about 4.0-4.5 km/s are observed, while there is a decrease to 2.0-2.5 km/s towards the Kong Karls land area (Eldholm et al. 1984, Kristoffersen et al. 1984). The decrease in velocities may reflect an increase in bedrock porosity (Kristoffersen et al. 1984).

The northern areas are characterized by flat layers or a gentle regional dip of $1-3^0$ to the southeast. South of Kong Karls Land the structure is more complex. However, a regional southerly dip seems likely also here (Kristoffersen et al. 1984).

In general, our knowledge of the bedrock geology in the northern and northwestern Barents Sea is limited and severely suffers from lack of "ground truth". However, the thin cover of unconsolidated sediments makes the area suitable for shallow, stratigraphic drilling.

5. SEDIMENTS ABOVE BEDROCK

The boundary between the bedrock and the unlithified sediments is usually seen as a well-defined angular unconformity, but may be difficult to detect where bedrock layers are horizontal.

Composition and distribution

The various sediment types and their distribution (Fig. 11) and composition can be summarized as follows (Bjørlykke et al. 1978; Elverhøi & Solheim 1983a,b,c; Solheim & Kristoffersen 1984; Kristoffersen et al. 1984; Elverhøi 1984; Solheim & Pfirman 1985; Solheim et al. in press.) (Figs. 12, 13 and 14):

- Stiff pebbly mud (till and/or glaciomarine sediments overrun by glacier) covered by soft mud with pebbles (glaciomarine deposits). In areas with < 300 m water depth, the thickness of the two units are in general < 15 m and < 5 m, respectively.

- In areas with water depth < 300 m sediment accumulations occur locally as: 1) transverse moraine ridges around the banks and 2) acoustically transparent, probably glaciomarine deposits, in troughs and as ice proximal features on the shallow banks.

- In regions with > 300 m water depth, the glaciomarine sediments increase in thickness, to 15-20 m and are overlain by fine grained Holocene mud. The thickness of the Holocene mud is commonly < 1.5 m. The Holocene mud is also present in shallower areas, especially in depressions and as infill in ploughmarks.

- Large sediment accumulations are present in water depths exceeding 300 m in the western part of the major troughs Bjørnøyrenna and Storfjordrenna and exceed 500 m in thickness near the shelf edge. The sediment accumulations are most likely stiff pebbly mud, till and/or glaciomarine deposits overrun and reworked by glacier.

- On Spitsbergenbanken the glacial sediments are reworked by currents and mixed with Holocene bioclasts. Due to current erosion/non-deposition, conditions prevail on the southern flank of Spitsbergenbanken down to 300-400 m water depth.

- Adjacent to calving icefronts along the coast surge deposits may exist as sediment ridges of varying width and relief.

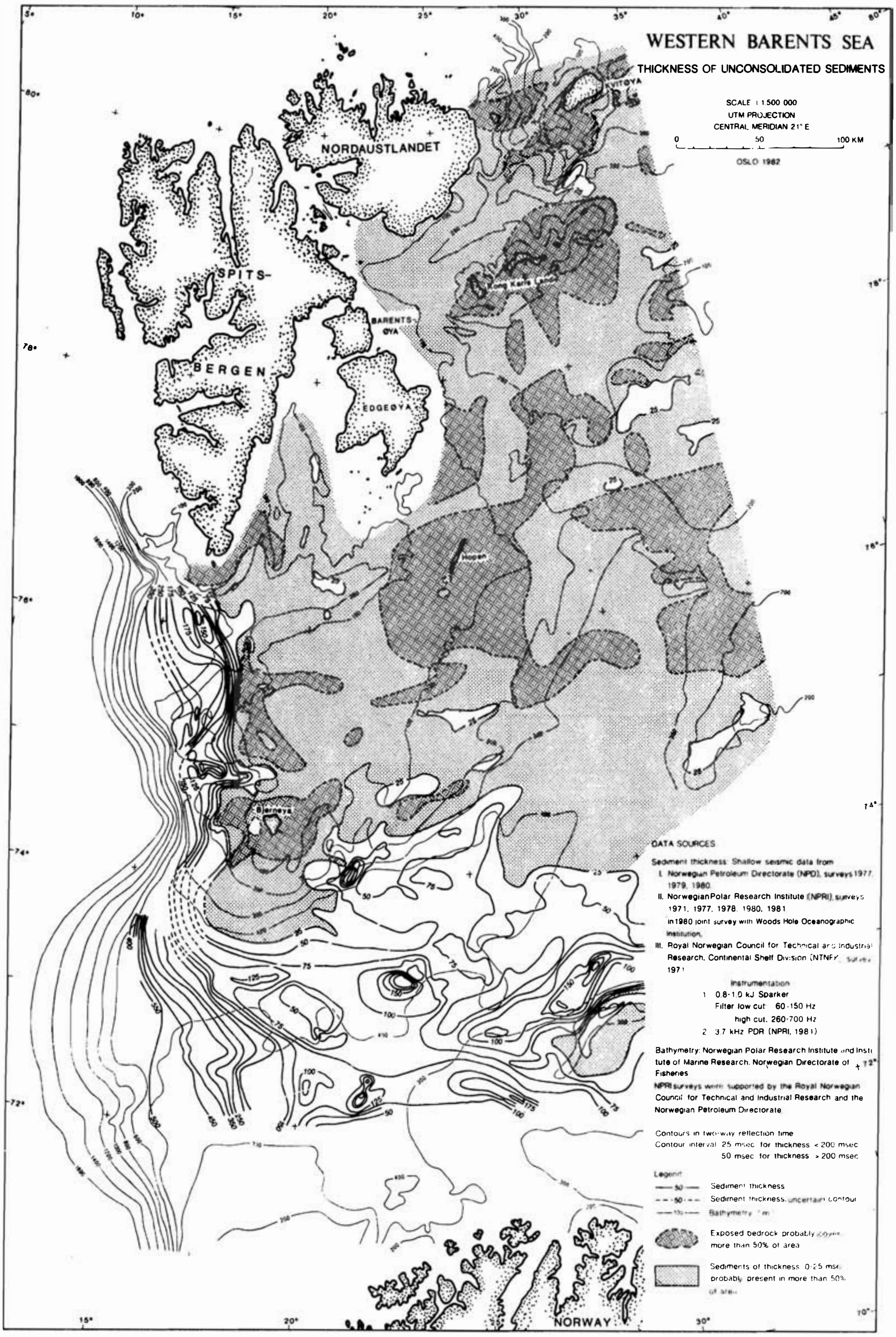


Fig. 11. From Solheim & Kristoffersen (1984).

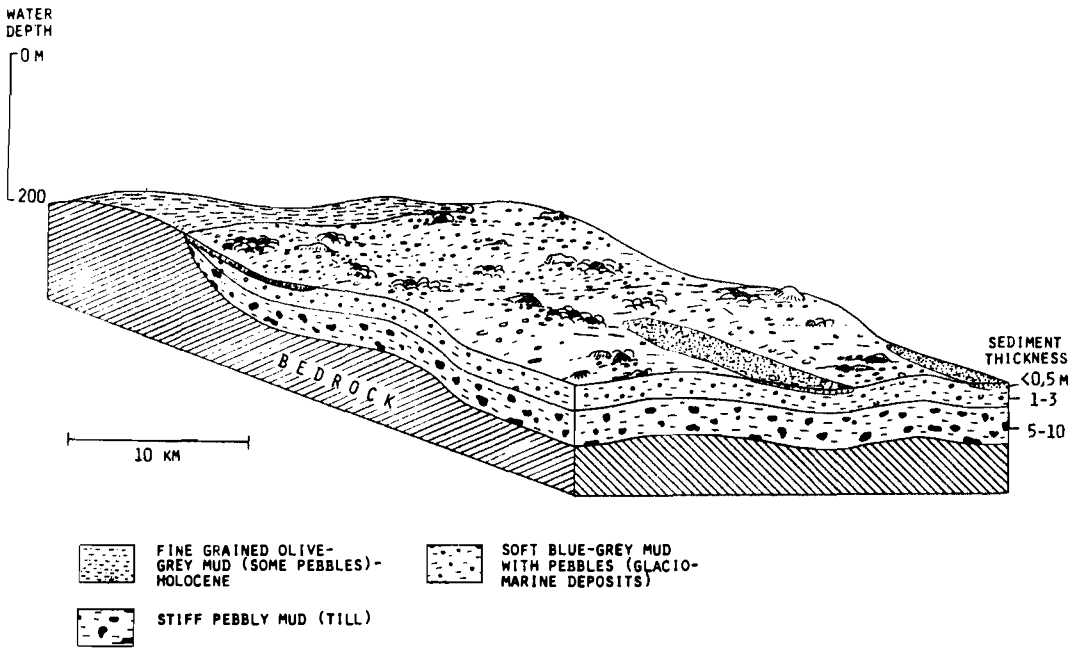


Fig. 12. Generalized block diagram illustrating the sediment distribution in the northern and central Barents sea. From Elverhøi & Solheim (1983a).

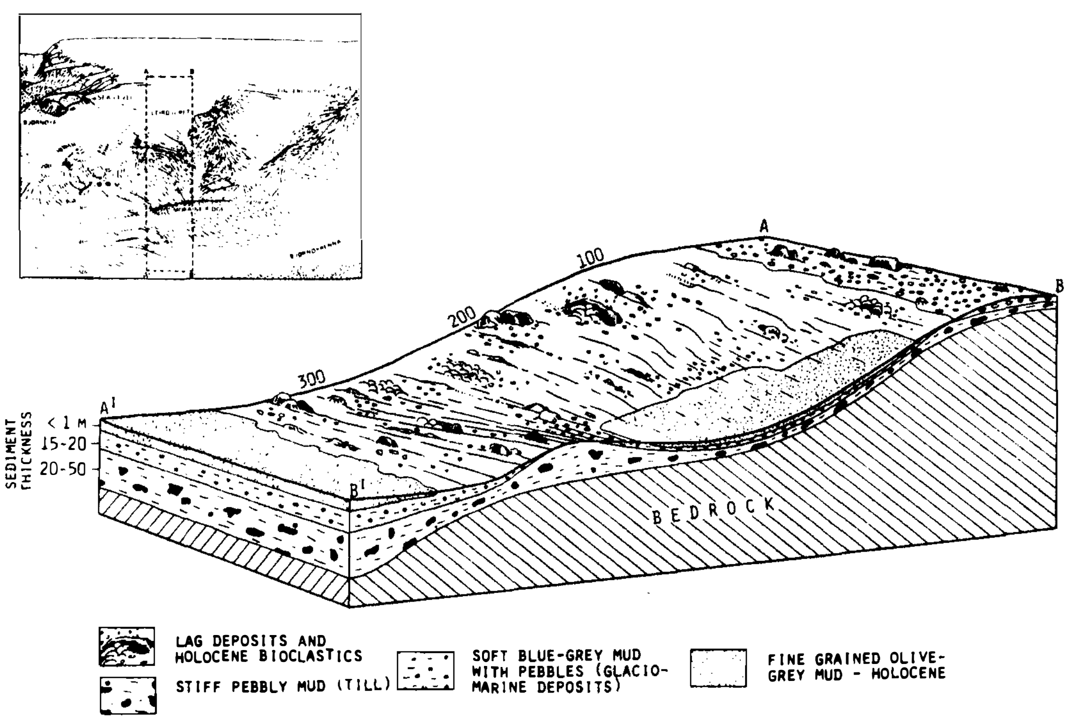
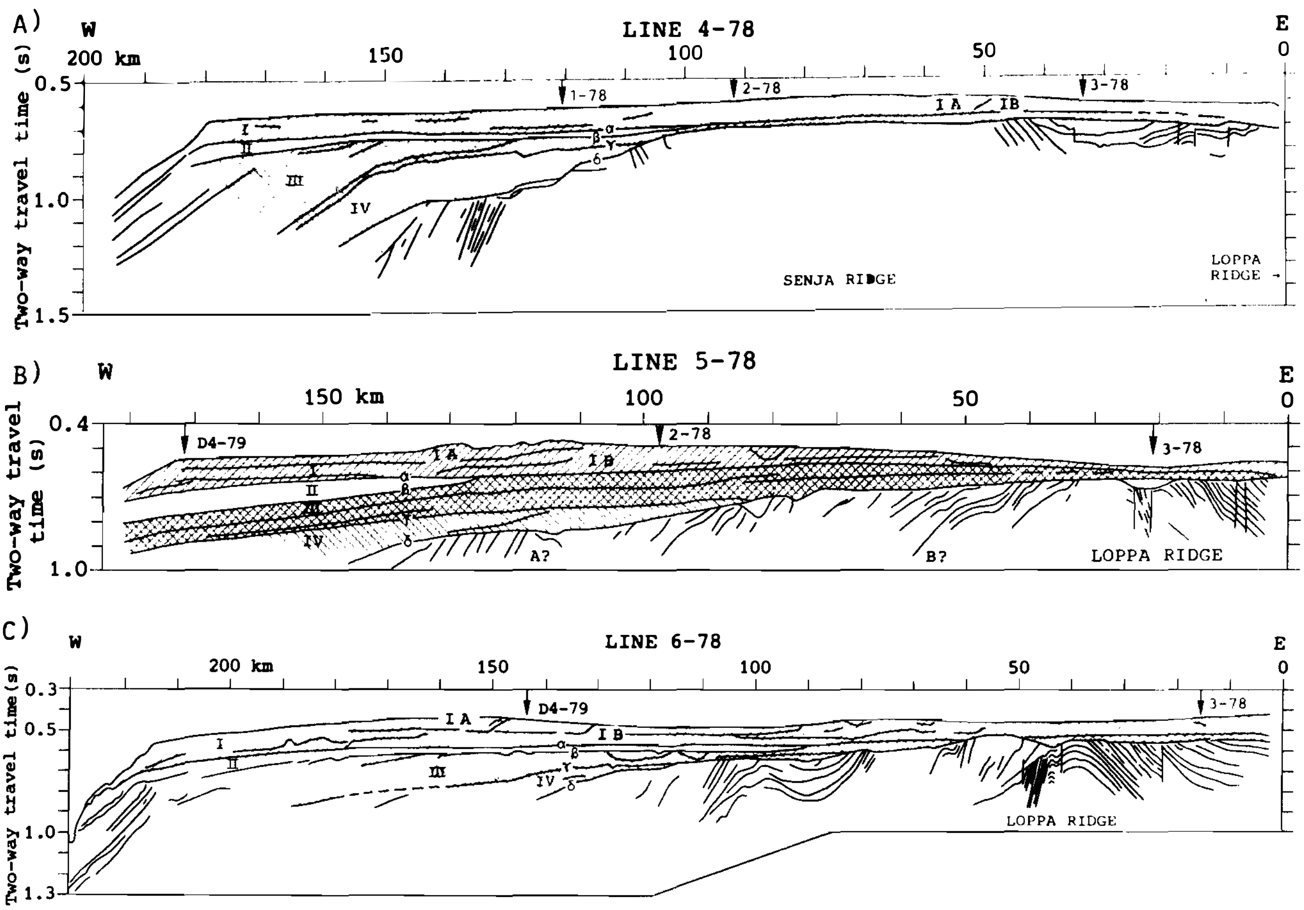


Fig. 13. Generalized block diagram illustrating the sediment distribution on the slope south of Spitsbergenbanken and northern part of Bjørnøyrenna. From Elverhøi & Solheim (1983a).



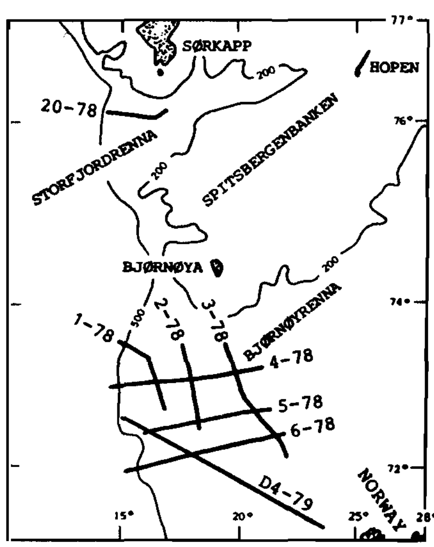


Fig. 14. Interpreted seismic (sparker) lines from Bjørnøyrenna. From Solheim & Kristoffersen (1984).

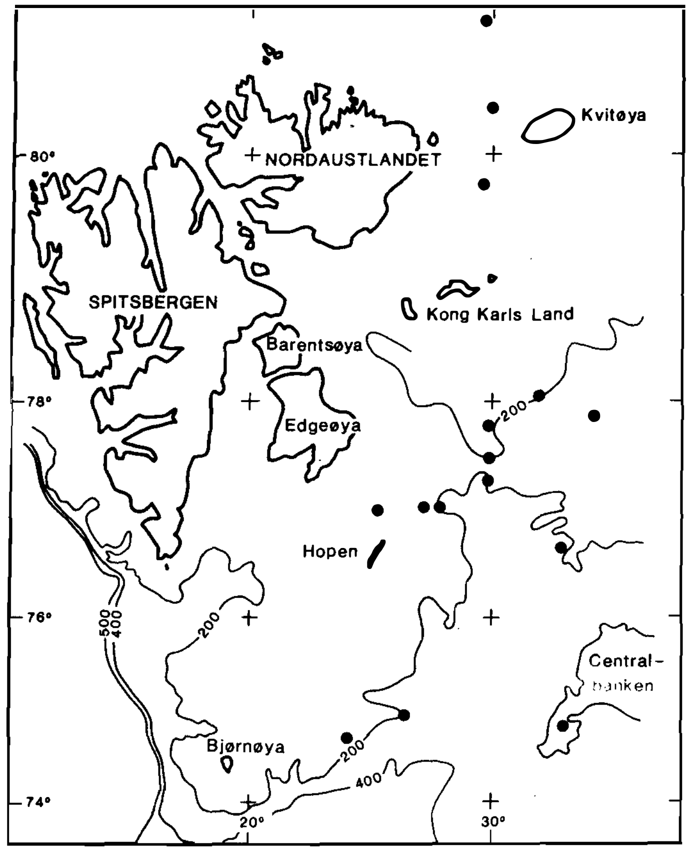
Stiff pebbly mud/till deposits

General description

The sampled stiff pebbly muds are unsorted sediments that have shear strength values in the range of 30-70 kPa (measured with fall-cone apparatus), and water content of 15-20% of dry weight (Fig. 15). Stiff sediments have been collected at 11 localities by means of a gravity corer, while 4 samples have been taken with vibrocorer (a grid of samples close to Nordaustlandet is not included) (Fig. 15).

In regions shallower than 300 m water depth the stiff pebbly mud seems to be very thin (less than 10 m). The sparker data show a general sediment thickness above bedrock less than 10-15 m. Sediment coring and 3.5 kHz echo sounding indicate a soft sediment thickness in the range of 3-8 m, consequently with a similar thickness for the stiff sediments. The thickness has been tested at 4 localities during shallow bedrock coring. On two sites on Storbanken the thickness was less than 3 m, and a similar thickness is also likely at the site south of Kong Karls Land. At the site at the southern tip of the Kvitøya plateau, the till was probably missing or present with a maximum thickness of < 0.5 m (Elverhøi & Solheim 1983b).

Stiff pebbly sediments are also suggested to form the major constituents of the ridge accumulations around Spitsbergenbanken. They are also suggested to underlie the glaciomarine (10 to 15 m thick) sediments in Bjørnøyrenna. The interpretation of deposition directly from a glacier is mainly based on the hummocky and ridge-like morphology of the accumulations and their acoustic character (Figs. 14 and 16). Especially, it is to be noted that the central outer part of Bjørnøyrenna and Storfjordrenna form a bathymetric hight of 50 m. These large-scale features can only be explained by glacial origin (Elverhøi & Solheim 1983a; Solheim & Kristoffersen 1984).



	FINE-GRAINED OLIVE-GREY MUD 0-20cm	>20 cm	SOFT BLUE-GREY MUD WITH SCATTERED PEBBLES	STIFF PEBBLY MUD
SHEAR STRENGTH T/M²	0.8-1.2	0.5-0.7	0.3-0.5	4-6
WATER CONTENT %	70-75	70-75	35-50	15-20

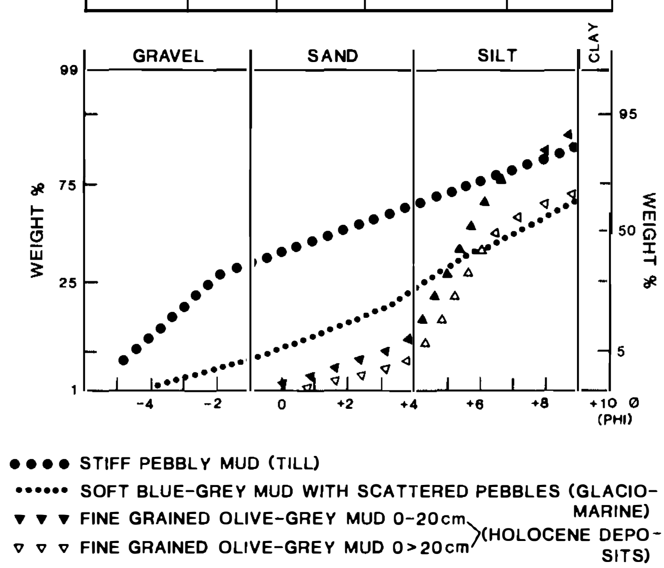


Fig. 15. Map showing localities where stiff, pebbly mud has been sampled. Physical parametres are indicated in the lower part of figure. From Elverhøi & Solheim (1983a).

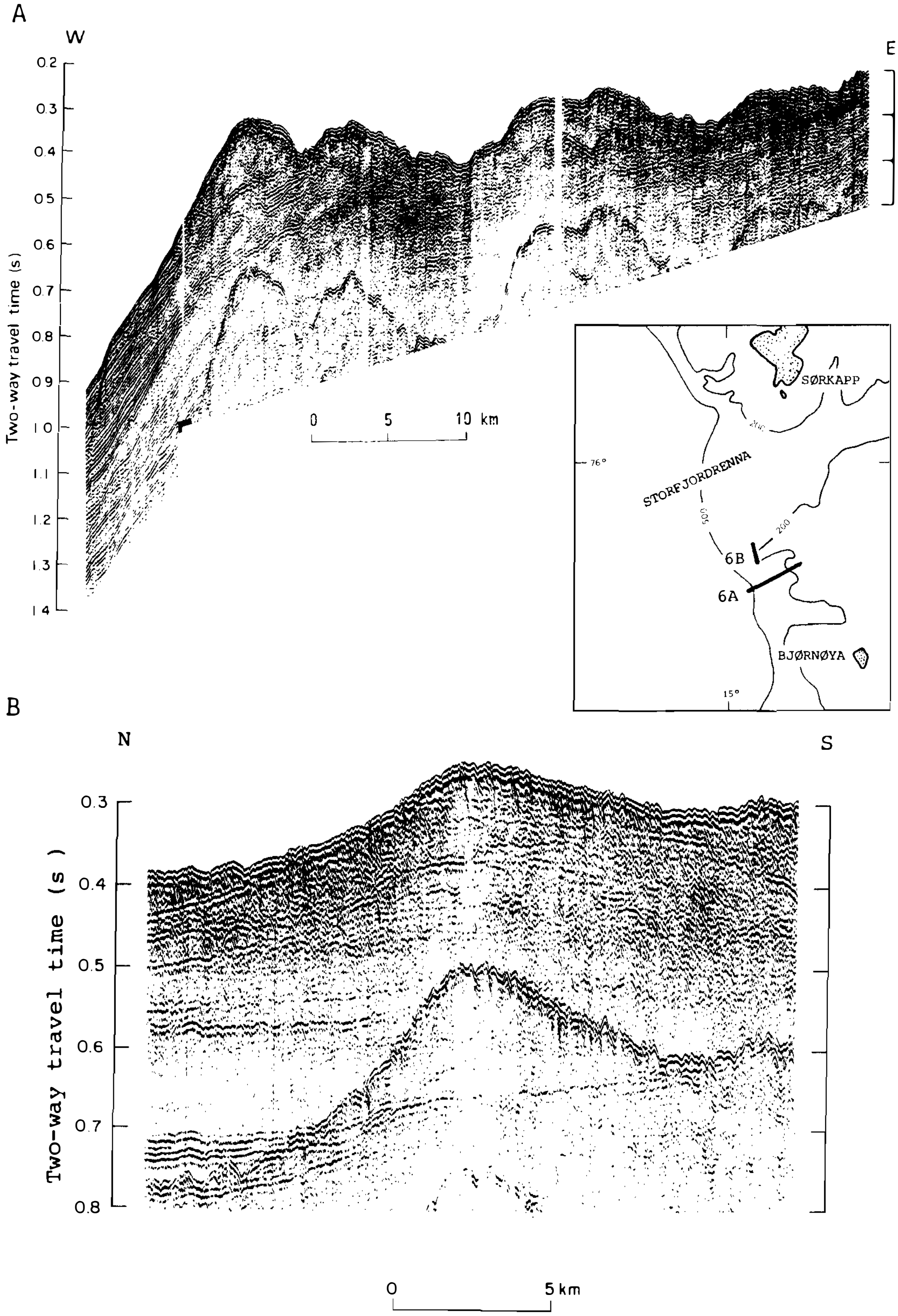


Fig. 16. Sparker lines showing till ridges west of Spitsbergenbanken. From Solheim & Kristoffersen (1984).

Depositional mechanism

The coarse grained and unsorted texture of the sediments is typical for till deposits. In areas shallower than 300 m, where the bedrock is close to the surface, the till is most likely a basal till derived from the underlying rocks. In the deeper parts, however, the thicker sequences may also consist of glaciomarine sediments (Elverhøi & Solheim 1983a; Solheim & Kristoffersen 1984).

Soft pebbly mud/glaciomarine sediments

General description

The soft pebbly mud is characterized by: 1) a blue-grey colour (except for the northernmost areas), a gravel content of < 10%, shear strength values in the range of 5-7 kPa (measured by fall-cone apperatus) and a water content of 35-50% (dry weight) (Fig. 15, 17). The clay mineralogy of the sediments is close to that found in the clasts, and is characterized by: illite, mixed-layer illite and smectite, kaolinite, chlorite (Bjørlykke & Elverhøi 1975; Elverhøi & Bomstad 1980; Forsberg 1983; Wensaas 1986).

In most parts of the central and northern Barents Sea the soft pebbly mud forms a relatively uniform layer of 2-5 m thickness (Fig. 17). In Bjørnøyrenna the thickness may increase to 15-20 m. However, this is only based on 3.5 kHz records southward from Spitbergenbanken, and the interpretation is not conclusive.

The soft pebbly mud may locally form 10-50 m thick accumulations. The interpretation of composition is mainly based on their acoustically transparent character (Figs. 18 and 19), and ^{14}C-dating of their upper parts of the accumulations in Storfjordrenna and in Franz-Victoriarenna shows that the sediments pre-date the Holocene (Elverhøi and Solheim 1983a).

Depositional mechanism

The bimodal textural composition combined with a uniform cold water foraminiferal fauna strongly suggest deposition from suspension combined with ice rafting (Elverhøi & Bomstad 1980; Elverhøi & Solheim 1983a; Elverhøi 1984; Solheim et al., in press.) The sediments recovered in gravity cores show no clear signs of hiatuses, and apparently the sediments represent one depositional episode.

The thick (10-50 m) accumulations are suggested to represent ice-proximal glaciomarine deposits (Elverhøi & Solheim 1983a,b; Kristoffersen et al. 1984; Solheim et al. in press). The accumulations in Storfjordrenna and in Franz-Victoriarenna are both found at approximately the same water depth, around 300 m. The accumulation on Storbanken was previously interpreted to be a till ridge (Elverhøi & Solheim 1983a; Kristoffersen et al. 1984). Recent studies show, however, that this complex more likely represents an ice marginal glaciomarine deposit, formed during the latest stage of the withdrawal of the Late Weichselian ice sheet in the Barents Sea (Solheim et al., in prep).

Characteristic of these thick glaciomarine sediments is rapid sedimentation, mainly supported by settling of sediment-loaded meltwater. Studies of recent glaciomarine sediments in fjords on the west coast of Svalbard (see below) and outside calving glaciers in Alaska show proximal depositional rates in the range of 10-500 cm/year (Elverhøi et al. 1983; Powell 1984). Similar rates may also occur for accumulations in the Barents Sea.

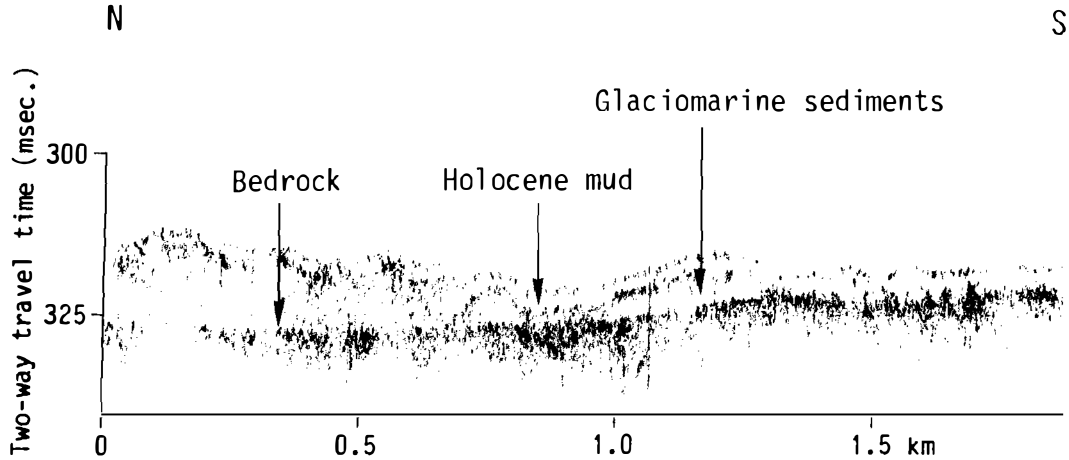


Fig. 17. Typical distribution of soft sediments in the northern Barents Sea (3.5 kHz data). From Solheim & Elverhøi (1985). For location, see Fig. 1.

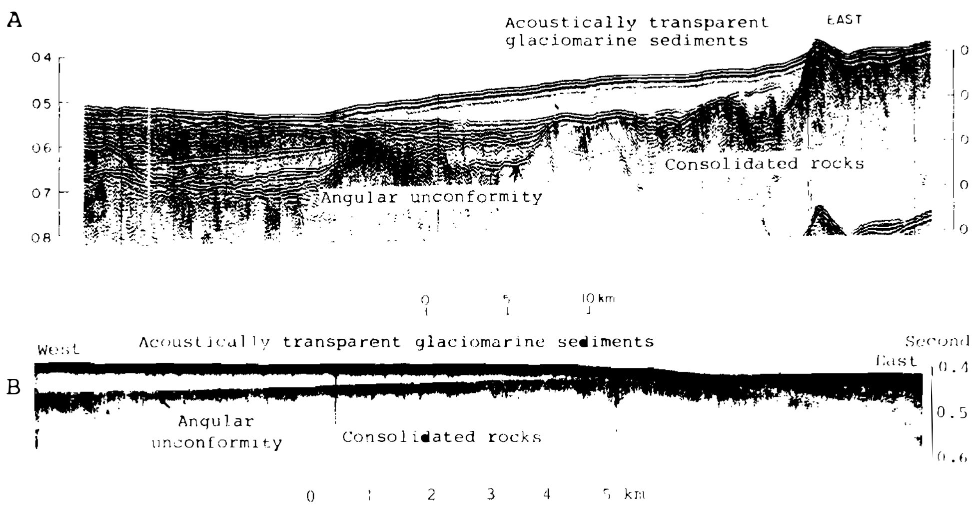


Fig. 18. Acoustically transparent sediments in the northern Barents Sea. From Elverhøi & Solheim (1983a). For location, see Fig. 1.

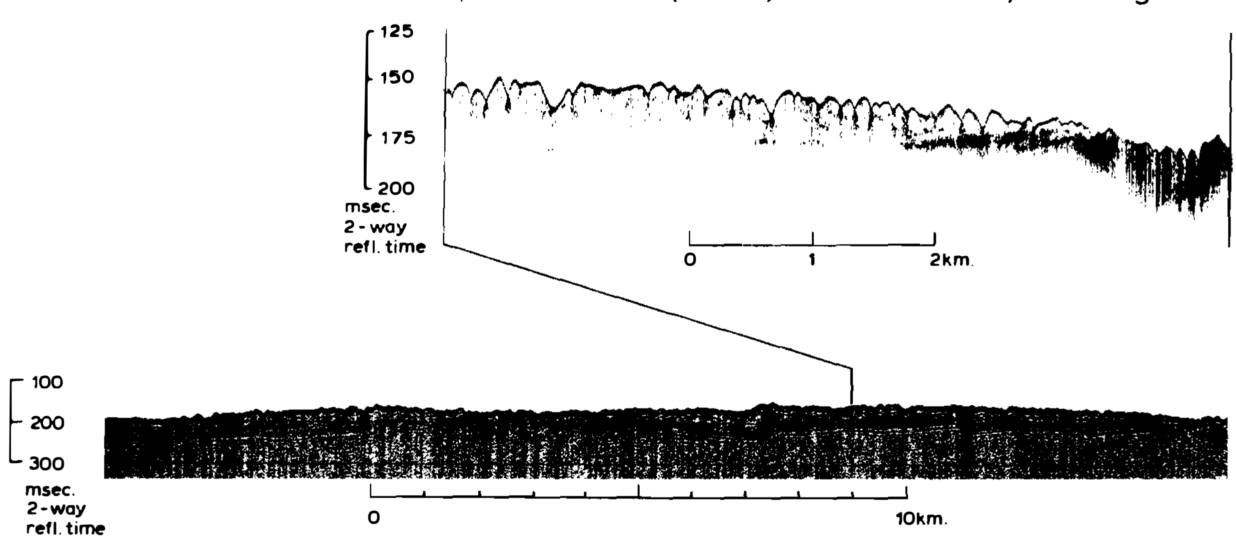


Fig. 19. 3.5 kHz (upper) and sparker (lower) records across acoustically transparent sediment accumulation on Storbanken. For location, see Fig. 1. From Solheim et al. (in press).

Surface sediment/Holocene sedimentation

Fig. 20 shows the regional pattern of the present day surface sediment distribution. The Holocene and recent sediments consist of the following three classes (for a summary of the surface sediment distribution, see Elverhøi & Solheim 1983c):

- Sand/gravel, almost mud-free
- Sandy/gravelly mud (diamicton)
- Fine grained mud with < 5% gravel.

Sand and gravel

Sandy and gravelly sediments are localized on Spitsbergenbanken down to a water depth of 60-100 m. Locally coarse-grained sediments may also dominate the sea-floor down to 300-400 m water depth on the southern slope of Spitsbergenbanken. On the shallower part of the bank carbonates, mainly barnacles and mollusc fragments, make up 80-90% of the sediments (Bjørlykke et al. 1978). Locally, pure biogenic sand is formed showing ripples. The carbonate deposits have only been cored through at one site, showing a thickness of 0.5 m (Elverhøi & Solheim 1983b). The clastic material is a lag deposit formed from winnowing of Late Weichselian glacigenic deposits (Bjørlykke et al 1978).

Sandy/gravelly mud

Sandy/gravelly mud is the dominant sediment type in intermediate water depths. Around Spitsbergenbanken the surface deposits are relicts of erosion/non-deposition and consist of Late Weichselian glaciomarine and till material. In the central Barents Sea east of Hopen, relict glacigenic sediments are also exposed on the sea-floor. Here, the Holocene sediments also contain > 5% gravel due to increased sea-ice and iceberg rafting (Forsberg 1983; Elverhøi 1984). In the northern parts off Nordaustlandet, the sandy/gravelly mud is modern glacio-marine deposits (Pfirman 1985; Solheim & Pfirman 1985).

Fine grained mud

There is a gradual decrease in grain size towards deeper water, and in water depth > 250-300 m olive grey fine grained mud dominates the surface sediments (Fig. 20). (It should be noted that the boundaries are gradual, despite the sharp appearance on the map). ^{14}C-dating shows Holocene sedimentation rates in the range of 3-5 cm/1000 year (Elverhøi & Solheim 1983a)

The clay mineralogy of the fine grained sediments differs only slightly from the Late Weichselian glacigenic deposits (Bjørlykke & Elverhøi 1975). However, in the northern areas the content of smectite, not observed in the underlying glaciomarine deposits, suggest input by sea ice rafting (Forsberg 1983).

Iron oxide crust

In some areas between 200-300 m water depth iron crust is frequently found on the sea-floor (Fig. 21). The crust consists of Fe(III)-cemented sandy/gravelly mud, and is originally formed by diagenetic precipitation of iron oxides beneath a cover of sediments which has later been removed by erosion (Forsberg 1983). The iron content of the crust varies from 10-20%. For a further discussion of the crust see Forsberg (1983) and Ingri (1985).

General characteristics of the Holocene/Modern sedimentation

Mineralogical and textural analyses show a close relationship between the Late Weichselian and Holocene sediments (Bjørlykke et al. 1978; Elverhøi & Bomstad 1980) leading to the idea of reworking of sediments from shallower parts of the Barents Sea. The lack of mud components on Spitsbergenbanken strongly supports the concept of submarine reworking.

The reworking on Spitsbergenbanken is related to the shallowness and the close position to the Oceanic Polar Front with mixing of cold Polar and warm Atlantic water masses (Bjørlykke et al. 1978). The present day conditions with hard bottom fauna developed in Mid/Late Holocene, according to ^{14}C-dating. They were probably a response to change in the regional current pattern and to some extent enhanced by the general glacio-isostatic rebound of the area (Bjørlykke et al 1978).

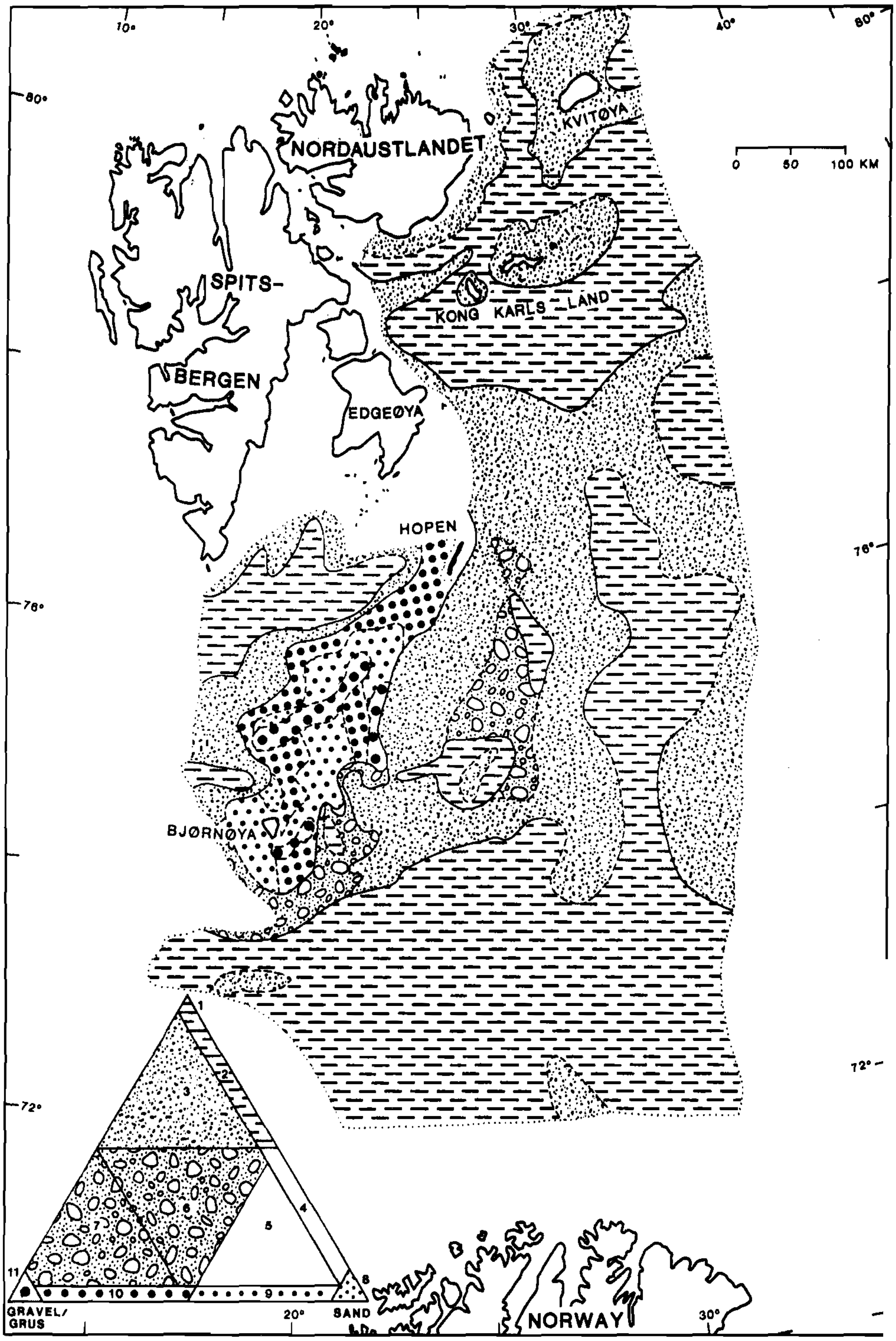
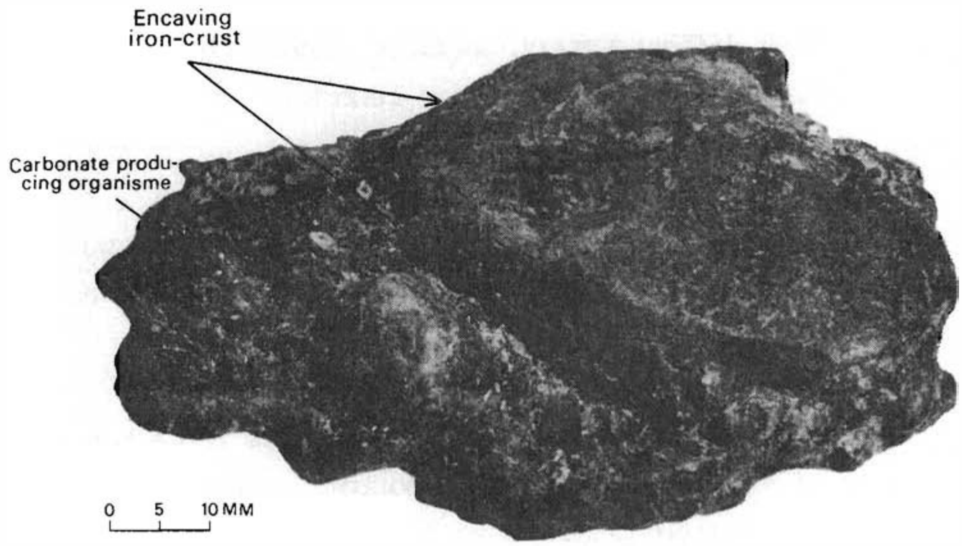


Fig. 20. Barents Sea surface sediment distribution. From Elverhøi (1984).



Photograph of iron-crust from the sea bottom (200—480 m water depth) southeast of Bjørnøya. White spots are carbonate producing organisms as foraminifera a.s.

Main element geochemistry of iron-crust at the sea-bottom (200—480 m water depth) south east of Bjørnøya. X-ray analyses showed only quartz. Analyses on Fe^{III}/Fe^{II} showed 90 % Fe^{III}.

Element	Weight percent
SiO_2	62.89
TiO_2	0.39
Al_2O_3	9.24
Fe_2O_3	12.05
MgO	1.63
CaO	1.84
K_2'	1.64
Na_2O	2.25
MnO	0.12
Loss on ignition	8.70

Fig. 21. From Elverhøi & Kristoffersen (1978).

Light scattering measurements in the northern and central Barents Sea show a bottom nepheloid layer, reflecting the wide-scale process of resuspension (Pfirman 1985):

- In water depth < 100 m, a rough seafloor surface is created by iceberg gouging and the sediments are reworked by currents and wind-driven waves, leaving a lag deposit.

- Between 100 and 200 m, occasional storm-generated waves, superimposed on the mean current, winnow the fine-grained material.

- Mean currents are intensified in narrow straits and along the peripheries of basins, forming a bottom nepheloid layer, associated with sea-floor winnowing or non-deposition.

- Suspended sediments are advected downstream with the mean currents and also down slope in bottom nepheloid layers.

- Deposition of the resuspended fine-grained sediments occurs mainly in the interior of the numerous basins.

Conclusive remarks

The regional pattern and processes of modern sedimentation seem well established. However, more detailed knowledge is still lacking, for instance on trajectories for the suspended matter and the contribution from various sources; reworking, output from glaciers and sea ice/ icebergs. Such knowledge is essential for a better understanding of the effects of pollution and how the pollutants are transported and deposited (Thomas et al. 1983). Some of the problems concerning the sediment and pollutant transport processes could be solved by use of year round sediment traps combined with studies of geochemical mass balance also including the biomass production.

Sample density is low, especially in the northern regions, where there may be 10-30 km between individual samples. Thus, small scale variations will not be detected. Furthermore, geotechnical analyses are completely lacking. Bioturbation may be intensive in some regions south of Hopen (Elverhøi & Bomstad 1980), and the influence on the physical properties has not been studied.

Detailed understanding of the sedimentary environment throughout the Holocene is also relatively limited. Apparently there has been a change in the current pattern. The distribution of warm Atlantic water and cold Polar water is strongly controlled by the bathymetry (Pfirman 1985). Due to glacioisostatic rebound, a shallowing of 60-100 m has taken place in the central and northern Barents Sea during the Holocene (Hoppe 1970; Salvigsen 1981). Additionally, the climate was warmer in earlier Holocene, and the relative effects of these (shallowing and warmer climate) are not known. The stratigraphic resolution in Holocene sediments in the northern Barents sea is poor, and studies so far have not been conclusive for interpretation of Holocene environmental changes.

6. OUTLINE OF THE QUATERNARY GLACIATIONS

Pre Late Weichselian

Most likely at least 30 glacial episodes have occurred on the northern hemisphere during the last 1.6 Ma (Shackleton & Opdyke 1977). The general morphology of the Barents Sea, with till ridges and over-deepened regions, e.g. south of Kong Karls Land, reflects repeated action of glacial erosion and deposition. In Bjørnøyrenna four major unconformities are identified, interpreted to reflect at least four major glacial expansions reaching the shelf edge (Solheim & Kristoffersen 1984). Glacial erratics in DSDP site 344, off western Svalbard, may indicate glacial conditions at least in on-shore areas back to early Pliocene (Talwani et al. 1976). No datings are available, but extrapolating from Holocene sedimentation rates, the last major expansion that reached the shelf edge occurred more than 100 Ka BP. Quaternary material obtained during IKU´s shallow drilling in Bjørnøyrenna in 1984 and 1985 is being studied, and hopefully these data will provide a better outline of the late Cenozoic glaciations.

Late Weichselian

The Late Weichselian glaciation is still a subject for controversy.

An extensive glaciation covering Svalbard and the Barents Sea, with a coalescence with the Scandinavian ice sheet has been postulated (Denton & Hughes 1981). Its maximum extension is tentatively placed at 18 Ka BP. The opposite model is only a minor expansion of the present day Svalbard glaciers towards the end of the Late Weichselian, and in this minimum model the Barents Sea is suggested to have remained ice free (Boulton 1979). Essential for the discussion of an ice free Barents Sea have been high, undated beaches on Svalbard, especially on Kong Karls Land. Recent studies have, however, shown that the high beaches are of Holocene age, strongly suggesting the existence of a more widespread glaciation in the eastern Svalbard and northern Barents Sea (Salvigsen 1981).

Evidence for a "recent" glaciation in the Barents Sea is seen from the thin sediment cover, < 5 m, in large regions. The sediments consist, as noted, of till overlain by glaciomarine sediments with a thin top cover of Holocene mud. Such a sequence without apparent hiatuses strongly reflects the presence of a grounded ice sheet followed by a period of glaciomarine sedimentation during the deglaciation, grading into the present day sedimentary regime.

The maximum extent of the Late Weichselian Barents Sea ice sheet is not known. Till ridges and glaciomarine ice - proximal deposits indicate major stages during the retreat of an ice sheet covering Spitsbergenbanken and most of the northern Barents Sea (Fig. 22).

Isotope stratigraphy (O^{18}) of the glaciomarine sediments in the inner part of Bjørnøyrenna, but outside the outline of the mapped stages, indicates an age of 11,000 years BP at 2 m sediment depth. Total thickness of these sediments is 3-5 m, and it seems unlikely that the lower 1-3 m should represent almost the complete Weichselian. It is thus concluded that the ice margin extended farther out in Bjørnøyrenna during the Late Weichselian maximum (Solheim et al. in press, Johansen in prep.).

The Late Weichselian ice sheet was grounded below sea level, and its stability was mainly controlled by the sea level (Thomas 1979). Rising sea level towards the end of the Late Weichselian would cause a rapid decay of the ice sheet (Paterson 1981). Datings of raised beaches on Svalbard indicate that the major withdrawal has taken place before 10 Ka BP (Salvigsen 1981), but exact timing still remains a problem.

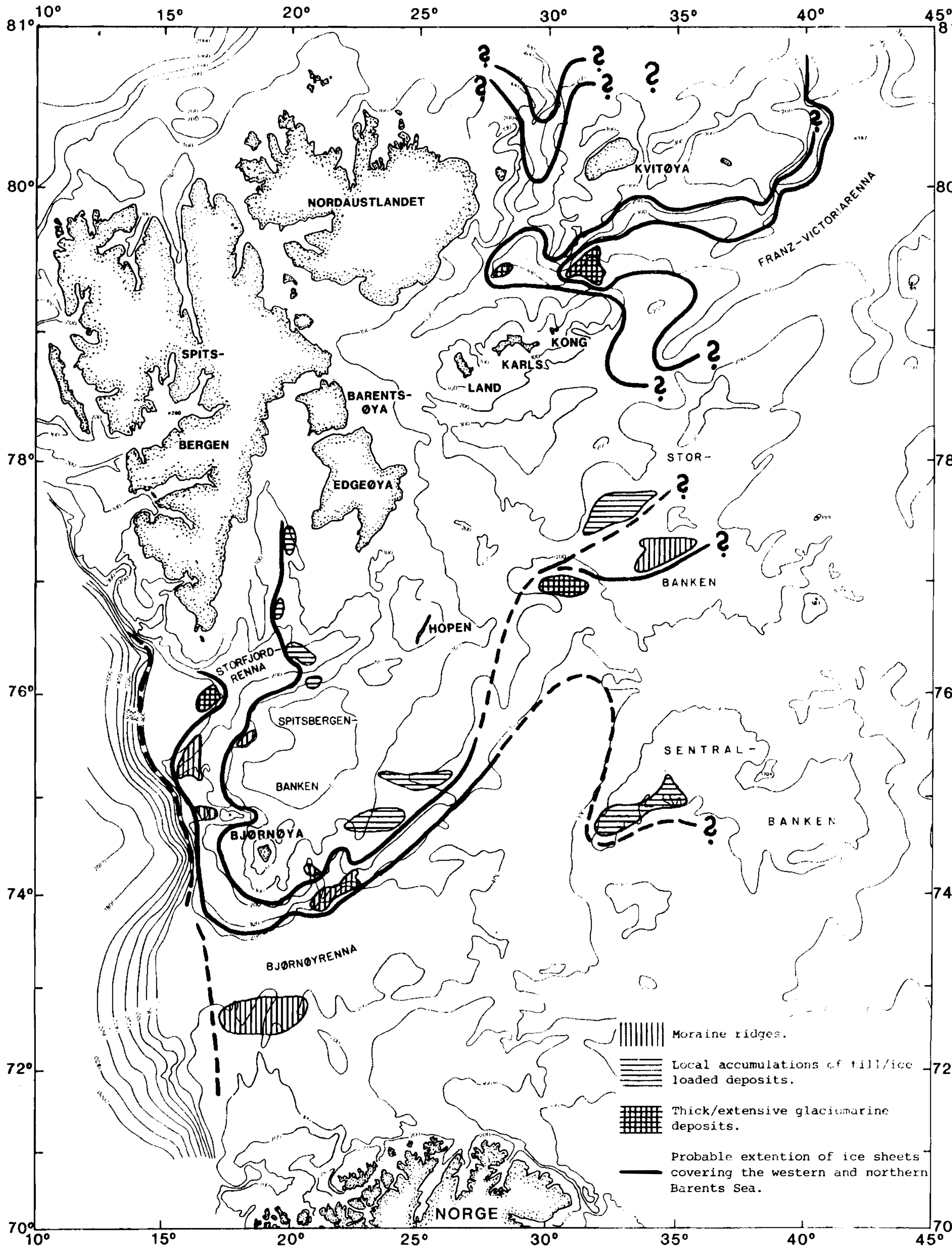


Fig. 22. Bathymetric map showing features related to former ice margins in the western and northern Barents Sea. From Elverhøi & Solheim (1983a).

Conclusive remarks

Studies of the timing and extent of the Late Weichselian glaciation are given high priority. Knowing its outline would largely increase our understanding of sediment properties in the region. The outline of the ice sheet and its basal temperature regime is essential for the discussion of processes of till deposition and subsea permafrost.

Until now very few samples of the till deposits have been analyzed and no datings exist of this material. Sampling of the till must be given priority. Their physical properties will be essential for engineering aspects in the northern Barents Sea. There is also a need for larger samples of the glaciomarine sequence in Bjørnøyrenna to date its lower part. Marine based ice sheets are very sensitive to sea level variations. Thus, different ice sheet configurations, based on field observations, should be modelled to see if they represent stable configurations.

7. SHORT SUMMARY OF SEDIMENTS AND SEDIMENTARY ENVIRONMENTS OF FJORDS ON THE WEST COAST OF SVALBARD

Sediments and sedimentary processes in Svalbard fjords have mainly been studied in Kongsfjorden with additional information from other fjords along the west coast. Only high resolution equipment has been applied and no information on bedrock and semi-consolidated sediments has been obtained. For a more extensive discussion of the fjord sediments, see Elverhøi et al. 1980 and 1983 (Fig 23).

In general the northern and western fjords of Svalbard have a blanket of 5-20 m acoustically transparent sediments consisting of soft homogeneous mud with ice rafted clasts. Coarser sediments are located on sills, slopes and towards the fjord-heads. The main depositional process is settling from the turbid sediment plume, combined with various types of sediment gravity flow. Material deposited from turbidity currents is probably of minor importance.
On shallow sills the sediments are reworked by icebergs. Sedimentation rates in the outer fjords are in the range of 0.1-1.0 mm/year, increasing to 100 mm/year close to the calving icefronts.

Surging is an important mode of glacier movement on Svalbard (Liestøl 1969), and advances up to 20 km in 1-2 years have taken place. During these events, sediment adjacent to the ice front is reworked and compacted. During the surge, considerable amounts of coarse-grained sediments are deposited in front of the ice margin (Solheim & Pfirman 1985).

Conclusive remarks

The high sedimentation rates outside calving glaciers cause very soft sediments, where underconsolidated conditions might be expected. However, geotechnical information is sparse, and for a better understanding of the stability and mass transport on fjord slopes, more studies are needed, combined with side scan sonar and high resolution seismic.

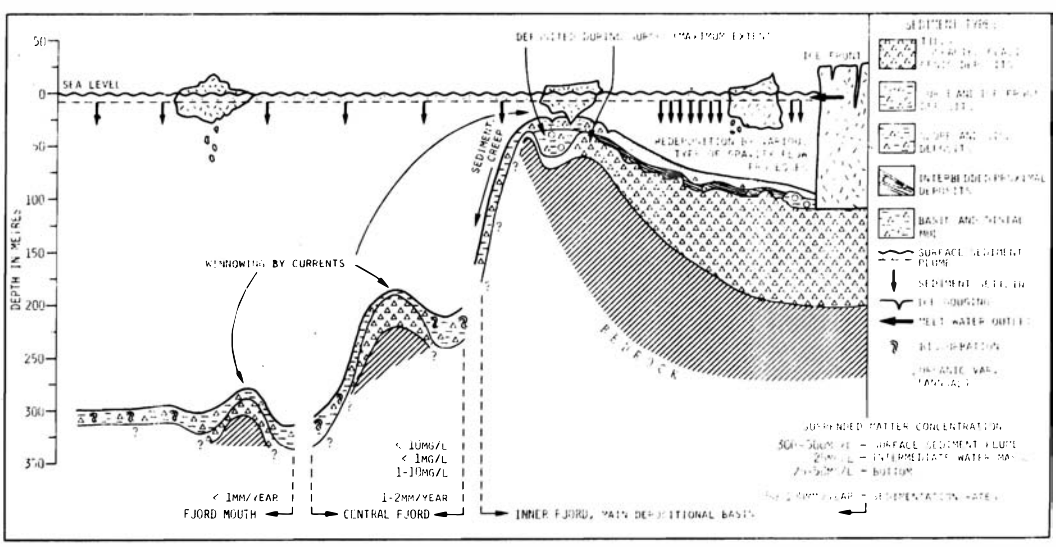


Fig. 23. Diagram illustrating sediment types and prosesses in a Spitsbergen fjord fed by a tidewaterglacier (based on data from Kongsfjorden). From Elverhøi et al. (1983).

7. ICEBERG SCOURING

Ice caps in eastern Svalbard and the larger valley glaciers terminating in the sea may form 10-30 m high icewalls and be grounded to a depth of up to 70-100 m. Calving is most intensive during the summer, and surging glaciers may produce a large number of icebergs during and shortly after surge periods.

The icebergs from glaciers on Svalbard are commonly irregular in shape. However, tabular bergs have also been observed (Lundquist pers. comm. 1986). Assessed from the height of Svalbard ice fronts, the size of observed icebergs and observations of sea-floor morphology, the lower limit of modern iceberg ploughing is approximately at 100 m water depth (Solheim & Elverhøi 1982; Solheim et al., in press). Special studies of iceberg ploughing have been limited, and extreme events with ploughing to a larger water depth may well occur (Solheim et al., in press). Relict iceberg plough marks are also frequently observed in water depths below 100 m, the deepest being at 450 m water depth in Bjørnøyrenna (Elverhøi & Solheim 1983b).

During a local survey on the southern part of Storbanken, areas were found where up to 100% of the sea-floor was affected by ploughing (Solheim et al., in press) (Fig. 24). The dimensions of the plough marks show a wide range of variation between two end members,
1) narrow straight marks, 15-30 m wide and up to several hundred metres long. Relief is typically 1-3 m; 2) wide, winding marks more than 100 m wide and with a relief of 2-5 m. Locally, some plough marks may have a relief of up to 8-9 m, and some may be traced up to 1-2 km. The depth of the plough marks is generally limited by the thickness of soft glaciomarine sediments. Fine grained sediment infill in the plough marks is mainly Holocene deposits.

Conclusive remarks

Investigations of plough marks in the Barents Sea have so far only been carried out in very limited areas showing similar ice plough features as found for other parts of the Norwegian continental shelf. In the Barents Sea, however, both modern and relict plough marks are present. Even though extensive research has been carried out in Canada and USA, it has not been possible to establish diagnostic criteria for differentiating the two types of ploughing. The best method is still repetitive mapping by side scan sonar, and such a programme could well be undertaken in a selected area in the northern Barents Sea. The problem is, however, that glacier surging creates anomalous conditions, and the effect of such events has to be monitored. Large surges took place in 1875 and in 1938 (Solheim & Pfirman 1985). Surge conditions have to be included in the calculation of the" "worst-case situation".

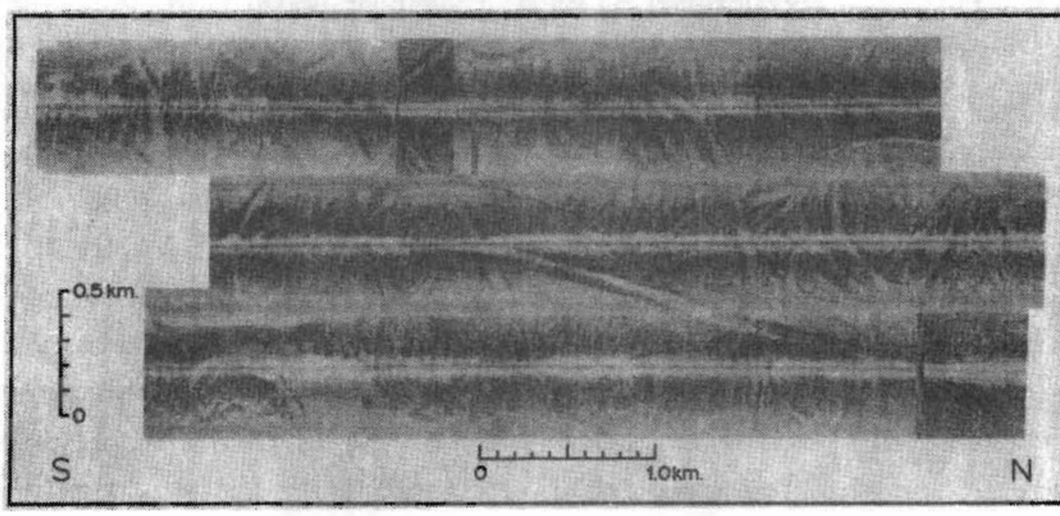


Fig. 24. Side scan sonar mosaic showing iceberg ploghing on Storbanken. From Solheim et al. (in press.).
For location see Fig. 1.

8. SHALLOW GAS/POCKMARKS

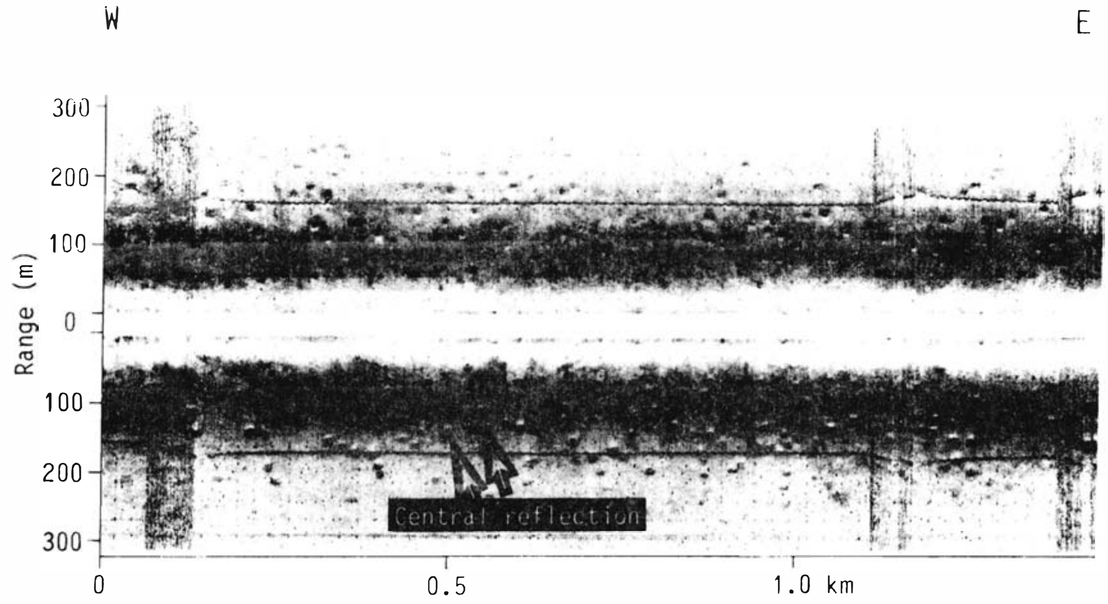
Systematic, specially designed investigations for shallow gas have not been carried out. All previous sparker data have been analyzed for gas indications under a NAVF-supported project, and regions with possible gas-related acoustic anomalies mapped (Solheim & Larsson 1987). However, the data quality is not adequate, and additionally, only regional coverage exist.

Detailed surveys by means of sparker, side scan sonar and 3.5 kHz echo sounder have only been undertaken in limited areas as part of site surveys for shallow rock core drilling. At one of these sites a pockmark field was encountered 50 km southeast of Hopen (Fig. 25). The pockmark features are small (10-20 m diameter) and shallow (< 1 m deep), and they may cover up to 25% of the sea-floor in local areas (Solheim & Elverhøi 1985). The pockmarks are located in an area with fine grained mud, and are also observed concentrated in plough marks.

The origin of pockmarks is most likely ascending gas. However, the thin sediment cover (< 3-6 m), mainly consisting of glacigenic deposits with only reworked Mesozoic organic matter, excludes this sediment as a gas source in the area. If the origin of the pockmarks is gas related, then most likely, the source is in the underlying Mesozoic rocks, which on Hopen include Triassic coaly shales. Similar rocks are also dredged in the area around the pockmark field.

Conclusive remarks

Shallow gas studies are commonly a part of the risk analyses ahead of offshore drilling operations. In the Barents Sea with limited sediment cover above bedrock and a probable petrogenic gas source, mapping of pockmarks could also be useful for exploration purposes. Also, shallow gas in the area would most likely exist in the upper bedrock, where pressure and thus risk may be higher. Until now, high quality data for more detailed studies of shallow gas are missing, and priority should be given to such data acquisition.



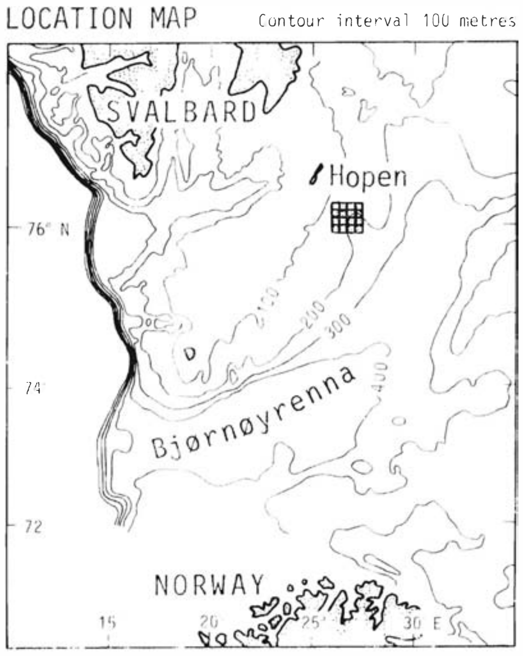


Fig. 25. Pockmarks southeast of Hopen. From Solheim & Elverhøi (1985).

9. SUBSEA PERMAFROST

Introduction

Offshore or subsea permafrost is a relatively recent discovery, initially described from the Siberian arctic shelf 1953 (Are 1976). Widespread occurrence of frozen sediments in the Beaufort Sea was evident from drilling and seismic surveys in the early seventies (Mackay 1972; Lewellen 1973, 1975; Hunter et al. 1976).

Permafrost is defined as materials or rocks with a temperature below 0^{0}C over a period of several years (Péwé 1974). In marine sediments with saline porewater and interstitial water, the brines cause depression of the freezing point (Harrison & Osterkamp 1982). Salinities about 25% higher than that of normal sea-water have been observed. Commonly the temperature in subsea soil is only slightly below freezing point, and subsea ice-bearing sediments are far less common than in onshore regions with similar temperature regimes.

Subsea permafrost has so far only been identified on shallow (< 60 m) arctic shelves (Sellman & Hopkins 1984), formed subaerially under cold surface conditions in periods of lower sea level, e.g. the Quaternary glacial maxima. Transgression of cold Polar water has sealed off the permafrost which is thus a relict feature. However, permafrost may form to a minor extent also under present day conditions, where fresh water percolates close to ice-bonded sediments. This permafrost can be regarded as an accretion type (O´Connor 1981). Maximum depth of observed subsea permafrost is about 600-700 m, and the frozen sediments are mainly restricted to fresh water bearing coarse grained deposits. Fine grained marine sediments are normally not ice-bearing (Blasco 1984; Sellman & Hopkins 1984).

Until now the possibility of permafrost in the Barents Sea has not been studied and no adequate data have so far been collected to make reliable tests. The present paper is the first attempt to discuss the probability of permafrost in the Barents Sea, based on the Late Quaternary history of the area and the present day oceanographic conditions.

Background

Definition/Nomenclature

The definition of permafrost is based on temperature alone (Péwé 1974). Salt porewater and temperatures only slightly below 0^0C cause the subsea sediments to remain unfrozen. Offshore permafrost is, due to the dependence on salt content in the water phase, much more complex than the onshore equivalent, and the terminology is more complicated. In literature on permafrost or frozen soil, the following terms are applied (Sellman & Hopkins 1984):

- Acoustic permafrost (APF), defined only from acoustic character.

- Ice - bonded; sediments containing ice that has sufficient bond with soil particles to cause a noticeable increase in strength properties.

- Ice - bearing; 1) a general term to indicate that ice can be expected to occur, or 2) indicating that ice quantity or bonding is not sufficient to influence strength properties.

The terminology can further be extended by use of terms like: well-bonded, partially bonded and unbonded for sediments without any apparent bonding.

Distribution and origin

Available and detailed literature on subsea permafrost is limited to North American high arctic shelves, and the following is a summary of papers by Harrison & Osterkamp (1982); Osterkamp & Harrison (1982); Blasco (1984); Sellman & Hopkins (1984).

Sea level lowering during the Quaternary glacial maxima led to subaerial conditions of the shallow arctic shelves. The shelves were exposed to cold surface conditions with development of permafrost. The fluvial drainage system extended across the shelf, eroding channels and depositing deltaic sequences towards and on the shelf edge. The extension of the inland ice sheet onto the exposed shelf is not well known, but till ridges of Late Weichselian age are apparently identified beyond the present day coastline. However, considerable parts of the Beaufort shelf would still have remained subaerially exposed.

In the Alaskan Beaufort Sea, three types of ice-bonded sediments are identified (Fig. 26). According to seismic studies, borehole and probe data, the general distribution is a patchy and irregular pattern and is closely related to the geological history of the area (Sellman & Hopkins 1983).

The shallow, ice-bonded permafrost is observed close to the sea-floor and may extend several km off the shore line. It is to be noted that shoreline erosion is fairly extensive in the area, up to 40 m/year, and thus, onshore permafrost areas are continuously transformed to marine areas.

The deep ice-bonded permafrost is identified at depths down to 200 m below sea-floor, and the common pattern for this type is rapidly increasing depth offshore.

The layered ice-bonded permafrost seems to be rather common when more detailed data are available.

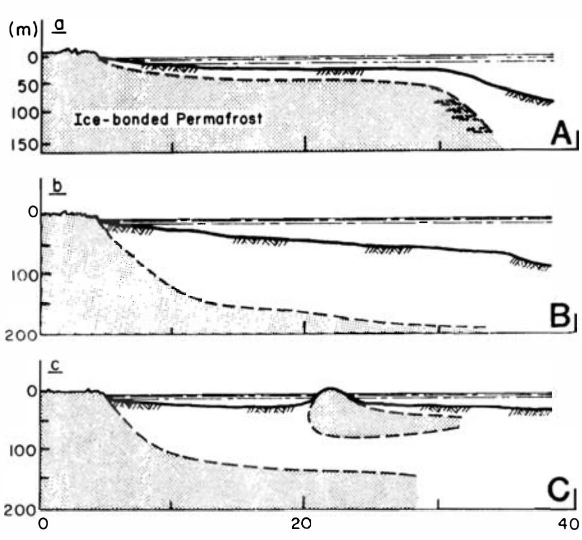


Fig. 26. Three subsea permafrost distribution patterns interpreted for the region studied in the Beaufort Sea: shallow relict permafrost, deep relict permafrost, and layered ice-bonded permafrost. From Neave & Sellman (1984).

The formation of the layered permafrost is related to two sedimentary processes:

1) River deltas where stratified sand, silt and clay have accumulated. Fresh water may penetrate the coarser beds, freeze, and additionally the fresh groundwater may freshen the saltwater, decreasing the freezing point of the brines. This type of permafrost is therefore mainly concentrated in ancient river valleys and demonstrates the importance of knowledge of the geological setting and history of the area to interpret the distribution pattern.
2) Migrating barrier islands and shoals can leave a trail of newly formed permafrost.

In the Canadian sector, the following three types or classifications are applied based on seismic reflection records:

a) Hummocky APF, associated with massive coarse grained sediments.
b) Stratigraphically controlled APF, related to discrete layers of sediment that show variations in the ice content and bonding.
c) Marginally ice-bonded APF, associated with coarse grained layers within fine grained sedimentary sequences.

The seismic character of these three types is discussed in the next section.

The offshore permafrost studies so far have demonstrated the need of integrated geological, geotechnical and geophysical studies. The apparently close relationship of permafrost distribution to material composition, depositional environment and groundwater flux, clearly states that understanding of the general geological setting is important for the applied studies.

Geophysical detection of submarine permafrost

This section deals with various surface geophysical methods for detection of submarine permafrost. Borehole measurements have not been included. However, it should be emphasized that borehole control is necessary for calibration of the geophysical results. The geophysical surveys are mainly used for regional reconnaissance purposes and to tie information from different wells.

The drilling process, however, may introduce effects on some of the physical properties, e.g. temperature and electrical resistivity that cause errors in borehole measurements. In this respect, geophysical measurements may also be used as a supplementary check of in-situ measured values (Blasco pers. comm. 1986).

Seismic methods

Seismic velocities of frozen soil

Soils and rocks containing water show different seismic velocity below the freezing point from that above it. The largest increase in compressional wave velocity from unfrozen to frozen state occurs in unconsolidated sediments (Komex Consultants Ltd. & Geotechnical Resource Ltd. 1983). It should be noted that there may be a distinction between ice-bearing permafrost and ice-bonded permafrost. As velocity enhancement primarily depends on the bonding effect, small amounts of ice, for instance observed during drilling, may produce no seismic velocity anomaly (Rogers & Morack 1980).

The increasing velocities with decreasing temperatures are illustrated in Figs 27a,b. The temperature, and hence the velocity changes need not be abrupt, but may pass through transitional zones between frozen and non-frozen sediments (Fig. 27). Fig. 1b, showing the differences between frozen and unfrozen state for different sediments, also shows that velocity information alone is not sufficient. Because the velocity of the unfrozen state of one sediment type may overlap with the frozen state of another, some information about sediment type is also necessary, particularly whether the sediment is fine-grained or coarse-grained (Rogers & Morack 1980).

Detailed information on seismic velocities of frozen soil can be obtained through laboratory tests.

The most common techniques include resonance and pulse transmission. Apart from wavelength differences, the latter methods are directly comparable to seismic travel time determinations. A compression review of laboratory testing techniques is given by Komex Consultants Ltd. & Geotechnical Resources Ltd. (1983).

Unless results from laboratory tests or borehole measurements are available, the velocity division between ice-bonded and non-ice bonded sediments may be difficult to establish. Various workers have used

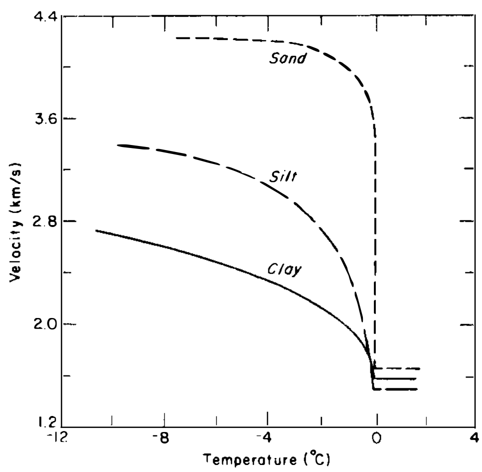


Fig. 27a. Velocity vercus temperature curves from laboratory observations, reported by King et al. (1982). From Neave & Sellman (1984).

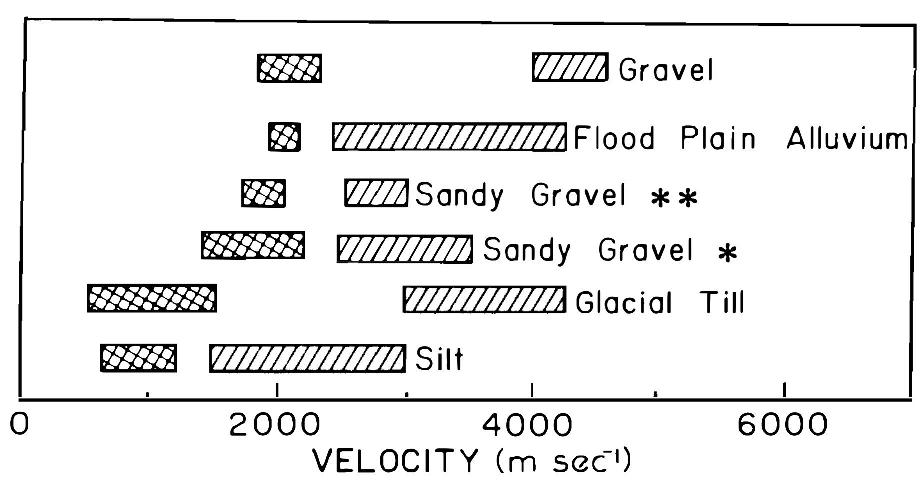


Fig. 27b. Compressional-wave velocities in unbonded(cross-hatched) and ice-bonded (slashed) materials. The data are from Roethlisberger (1972) except those marked * and **, which were taken by the authors on five offshore islands near Prudhoe bay and near Point Barrow, respectively. From Morack & Rogers (1984).

different values for different areas. Neave & Sellman (1984) used 2.0 km/s as the cut-off velocity, while Morack & Rogers (1982) chose 2.5 km/s. However, King (1984) published a set of theoretical curves (Fig. 28) relating compressional wave velocity, porosity and fraction of ice in the pores of unconsolidated material. This diagram gives a framework for interpretation, but should be extensively tested (Hunter 1984).

O´Connor (1977) introduced the term "acoustic permafrost" (APF) to describe permafrost delineated on the basis of only seismic techniques, rather than on the basis of temperature conditions.

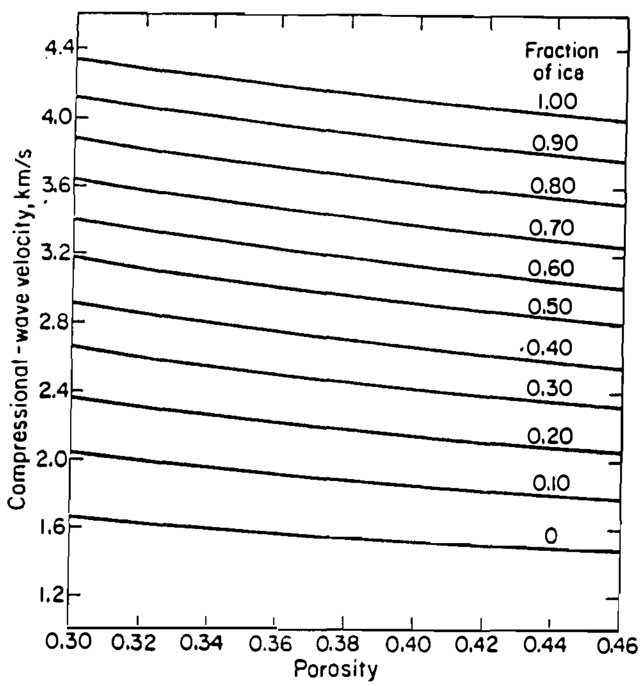


Fig. 28. Theoretical curves relating compressional wave velocities, porosities, and fraction of ice in the pores of unconsolidated material (after King, 1984). From Hunter (1984).

Seismic refraction

This is the most widely used method for detection of ice-bonded permafrost. The usual configuration is unfrozen sediments above frozen, ice-bonded sediments. This fully satisfies the requirements of standard seismic refraction techniques; a positive impedance contrast and the refractor being relatively continuous within the scale of the refraction spread. Only the top of the permafrost layer will be detected by seismic refraction, as going from a high velocity to a low velocity layer is by definition not a refractor (Dobrin 1976).

Standard refraction techniques for land work with geophones, and hammer or explosives as source have been used on barrier islands off Alaska (Morack & Rogers 1982).

Rogers & Morack (1980) used an airgun source and a 24 channel, 480 m long hydrophone streamer to detect the top of the ice-bounded permafrost down to a maximum of 50 m below the sea-floor. This type of refraction shooting was done underway, but to optimize signal/noise ratio, the ship´s engines were stopped during the 30 sec interval it took to shoot one spread. Reversed profiles were obtained by towing an additional airgun from a skiff at the streamer end that is fired by the radio link (Morak & Rogers 1982). Fig. 29 shows a typical data set for this type of refraction measurements.

To obtain regional coverage in parts of the Beaufort Sea area, Neave & Sellman (1984) used industry exploration seismic data, shot from ship or ice. As these data usually are processed for deeper targets, reprocessing of the upper part may be an advantage. To avoid costly processing, however, Neave & Sellmann (1982) played back the upper 2 seconds from the field tapes with expanded gain and printed the data in variable area format (Fig. 30). This type of data may provide good regional coverage, but may also suffer from effects that are avoided by use of specially designed permafrost surveys. The most severe effects are the rather low resolution of the deep seismic data, and the effect of dipping refractors. The latter is avoided by shooting reversed profiles, but may not be too severe even in single ended records if the dip is not too steep. A dip of 3% results in 5% velocity error and 2% error in depth determination.

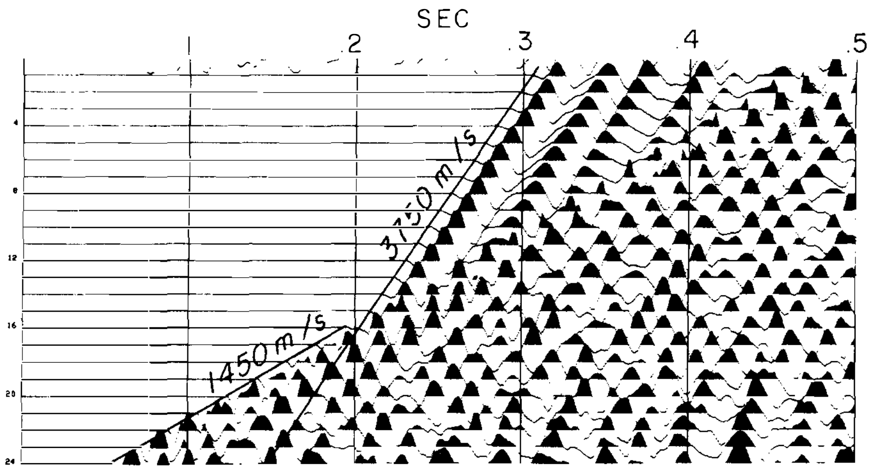


Fig. 29. A seismic refraction record from the Beaufort Sea transect line from an area of the Kugmallit trench between long. 134^0 and 132^{0}W showing a deep, high-veloctiy, ice bonded permafrost layer. From Morack & Rodgers (1982).

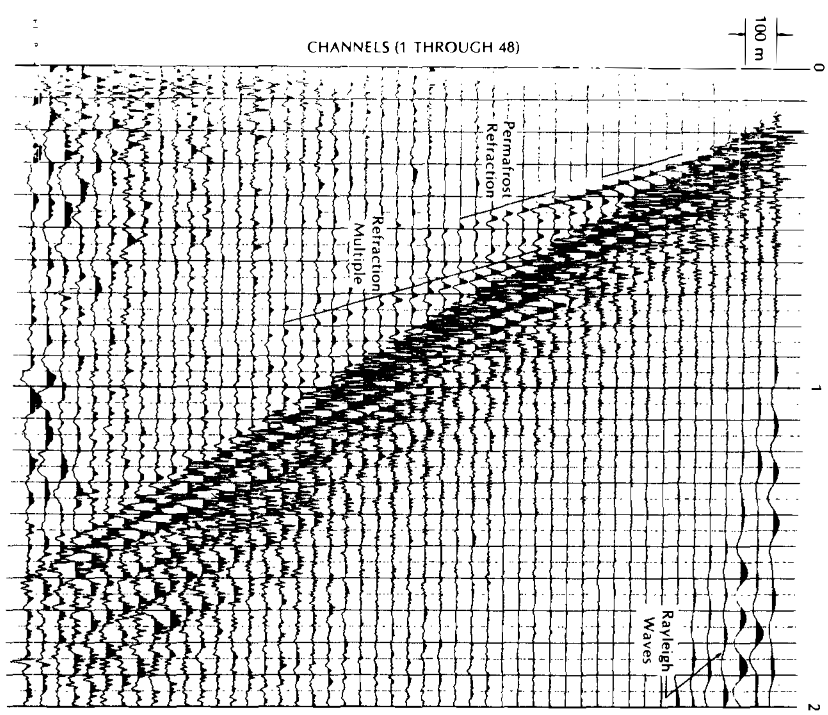


Fig. 30. High velocity record showing clear examples of refractors. From Neave & Sellmann (1984).

Seismic reflection

The impedance contrasts created on the boundary from unfrozen to frozen sediments also makes them a suitable target for continuous reflection profiling. Whereas refraction measurements give velocity/depth information in discrete points, seismic reflection profiling may give a continuous coverage of the depth to the ice-bonded permafrost. Without velocity information, however, acoustically defined permafrost (APF) must be confirmed by ties to borehole measurements.

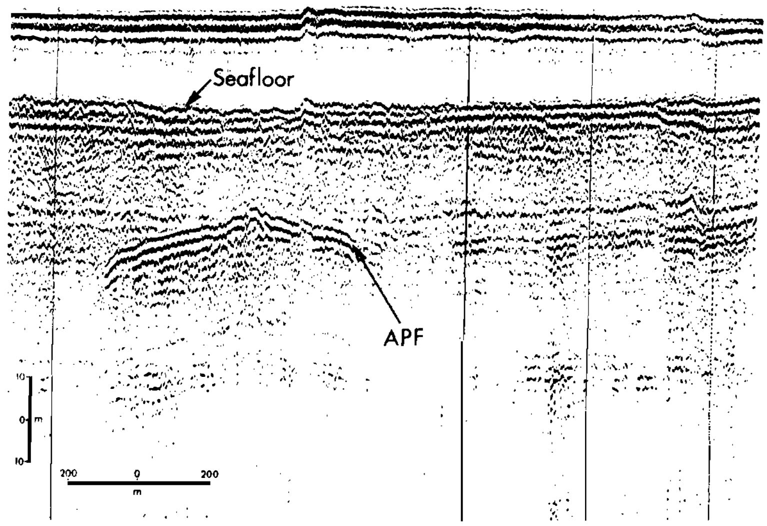
The most widely used data type is probably high resolution, single channel records. Based on this type of information, O´Connor (1977, 1981) described three types of shallow APF from the Beaufort Sea (Figs. 31a,b,c). These are also discussed by Blasco (1984).

Hummocky APF have strong amplitude anomalies, (" bright spot"), normal polarity and exhibit a characteristic hummocky shape. They are often associated with diffractions at their ends. They vary in size from a few tens of metres to several kilometres, laterally, and may occur as sporadic "islands" or in close proximity to one another. Each may be surrounded by zones of no apparent permafrost. They are usually thought to be limited in thickness, but some of the larger ones may be connected to deeper, thicker ice-bonded permafrost in depth.

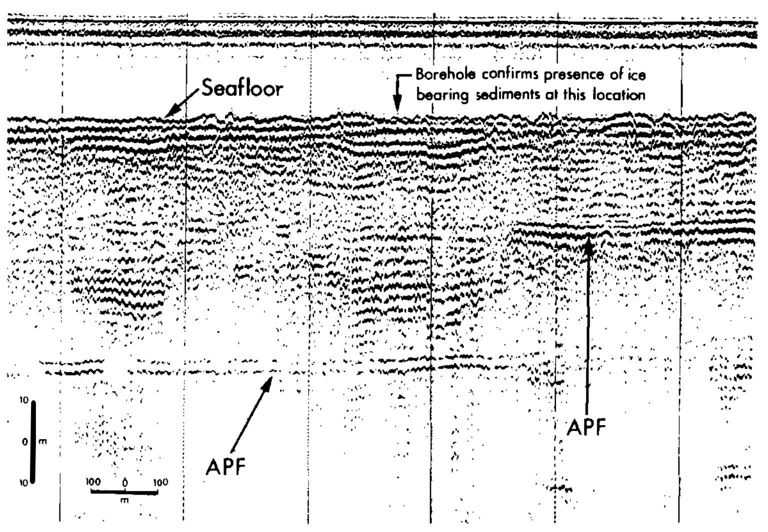
Stratigraphically controlled APF (Fig. 31) is most often connected to the presence of coarse grained layers in a fine grained sequence. The actual permafrost boundary may lie above the reflector in fine grained sediments, but due to the lithology, sufficiently high impedance contrast is not set up. Lateral lithological changes may enhance or reduce the impedance contrast, and the reflector may disappear or increase in strength along the line.

Marginally ice-bonded APF (Fig. 31) occurs where the distribution of ice within the sediments is so patchy that regional mapping of discrete horizons is difficult. This is common for highly laminated fine grained strata.

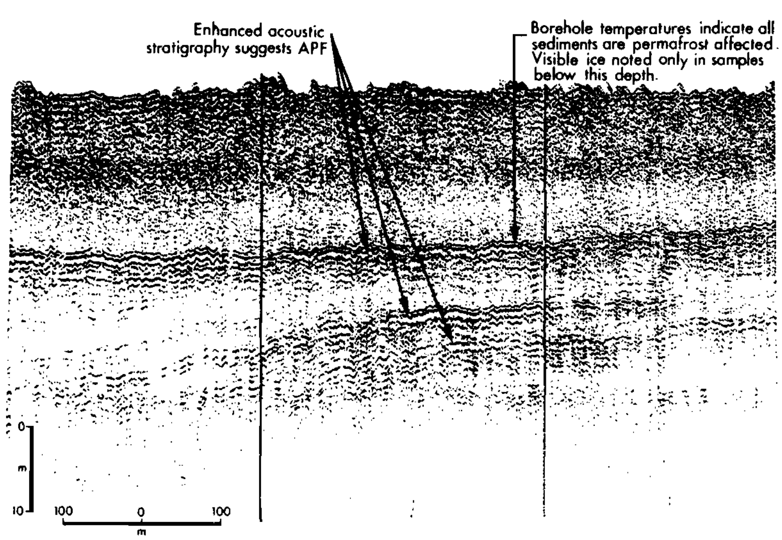
Again, it should be emphasized that in order to verify the nature of the reflectors mapped as APF, they need to be tied to well information or at least velocity measurements.



A) Hummocky acoustically defined permafrost (APF).



B) Stratigraphically controlled APF.



C) Typically seismic signature where shallow sediments are marginally or partially ice-bonded.

Fig. 31. Different types of acoustic permafrost. From Blasco (1984).

Electrical measurements

As the electrical resistivity of a sediment is largely dependent upon the pore fluid, the resistivity increases dramatically from an unfrozen to a frozen sediment. The resistivity ratio between frozen and unfrozen material is typically from 5:1 to 10:1 (Komex Consultants Ltd. & Geotechnical Resources Ltd. 1983), but may be as high as 100:1 (Corwin 1983). The variation is dependent on the material and its temperature and pore fluid salinity (Fig. 32). It is to be noted that the latter may exceed normal sea-water salinity by 25% (Harrison & Osterkamp 1982) and further enhance the resistivity contrast between thawed and frozen material.

The most important advantage of electrical methods to seismic methods is that seismic refraction (which is the most widely used method) only can detect the top of the permafrost layer, whereas the electrical methods can map both top and thickness of the permafrost. Also, it may be an alternative method in areas where interstitial, shallow gas attenuates seismic signals. Resistivity values do not appear to be significantly affected by small amounts of interstitial gas (Corwin 1983).

Resistivity values in the ground are usually measured from the surface by means of two different techniques: 1) Galvanic methods and 2) electromagnetic induction methods. Basic principles and different measurements configurations can be found in most textbooks on geophysical prospecting (e.g. Telford et al. 1976). Corwin & Conti (1973) used vertical electrical sounding (VES) a galvanic measuring method in the Bering Sea. The electrode array was built into towed streamers and quick measurements could be made both on the sea surface and on the sea-floor, the latter method giving a somewhat better resolution in the upper layers. The measurements were checked against well information, and excellent fits were obtained. The resolving power of the method also proved good, as a thin (2-3 m) layer of bonded permafrost was detected within a sequence of unbonded sediments.

Electromagnetic induction has been widely used for mapping permafrost on land (Sartorelli & French 1982), but few reports exist from the low resistivity marine environment. Ehrenband et al. (1983) did measurements from sea-ice in Prudhoe Bay. They were able to map top and bottom of deep (200-500 m) subsea permafrost in water depths exceeding 200 m. However, their instrumentation involved a

500 m x 500 m square transmitter loop, so the method does not seem convenient to use from ships at the present stage.

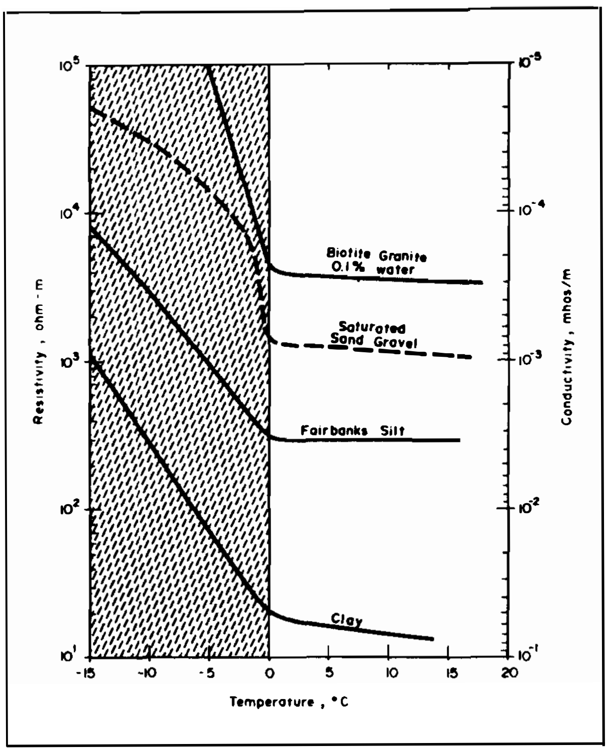


Fig. 32. Conductivity versus temperature. From Sartorelli & French (1982).

Applicability of the geophysical methods in the Barents sea

Most of the reported studies have been conducted in waters off Alaska and northern Canada. So far, no surveys designed for permafrost studies have been carried out in the Barents Sea. Two main differences between the two areas are:

- The Barents Sea is generally deeper.
- Sediment cover above bedrock is considerably thinner in the Barents Sea, and locally missing.

The latter difference is most likely the most important concerning methods for detection of submarine permafrost.

The majority of studies from Canada and USA are on unlithified sediments, but King (1976) and Pandit & King (1979) have reported laboratory tests on sandstones, shales and limestones. These papers show that both velocity and resistivity in general show a marked difference between the frozen and unfrozen state. However, the changes appear to be functions of factors like porosity, shale content and pore fluid salinity. Increasing shale content and decreasing porosity cause especially the velocity change to decrease, and for the tested shale samples, hardly any increase in compressional velocity was recorded in going from the thawed to the frozen state. Resistivity changes are also small in shales. These effects are mainly thought to arise from the fact that the pore fluid in the larger pore volumes undergo the liquid - solid phase change first, while this change takes place at lower temperatures for smaller pores. Increased salinity has similar effect.

Due to the thin cover of unlithified sediments in the northern Barents Sea, permafrost (if present) is likely to occur in sedimentary rocks. The problem of geophysical detection of permafrost in shales is mentioned above. Another problem arises from the fact that compressional velocities both in the Barents Sea (Kristoffersen et al. 1984) and in Svalbard sedimentary rocks (Elverhøi & Grønlie 1981) overlap with velocities of ice-bonded, unlithified sediments. Thus, seismic detection of submarine permafrost in these waters may be extremely difficult if the transition to the frozen material occurs just (depending on seismic resolution) above or below the boundary to the sedimentary rocks. Furthermore, a recorded high velocity layer may need to be tested by drilling or another method to state whether it represents ice-bonded permafrost or just the top of the sedimentary bedrock.

The only way to approach these problems will be to design special submarine permafrost surveys in Svalbard waters. Detailed geophysical measurements and sampling along profiles running offshore from the shoreline in areas of presently existing onshore permafrost should be undertaken.

Permafrost in the Barents sea - a discussion

Physical setting and geological history of the Barents Sea differ strongly from what have been found for the typical high arctic permafrost shelves. The basic elements in subsea permafrost formation can thus be summarized:

- 1) Permafrost is formed subaerially.
- 2) The permafrost is preserved due to transgression of cold, Polar water, inhibiting sediment thaw.

Late Pleistocene and Holocene history of the Barents Sea and probable conditions for formation of permafrost

As discussed previously, the Barents Sea and its islands have most likely been covered by grounded ice during the Late Weichselian, and the deposition of glaciomarine sediments above the till demonstrates only subglacial and submarine conditions. The ice extent across Spitsbergenbanken is, however, only tentatively outlined, and Bjørnøya may have, similar to the west coast of Svalbard, remained ice free during the Late Weichselian (Salvigsen & Østerholm 1982; Elverhøi & Solheim 1983a). In case of ice free conditions on Bjørnøya and its surrounding areas, permafrost may well have developed. However, so far no hard evidence for ice free conditions has been presented, and the sediment distribution in the offshore regions indicates glacial cover.

Subaerial exposure of present day shelf areas is, however, likely to have occurred on the western as well as the northern Svalbard shelf (Fig. 33). During the Late Weichselian the glacier margin was significantly beyond that of today, but most likely confined within the present day coast line (Salvigsen pers. comm.; Mangerud pers. comm. 1986). On the northern shelf the northernmost islands like Sjuøyane were also ice free (Salvigsen & Nydal 1981). Applying a simple estimate of sea level lowering of 130 m and ignoring isostatic effects

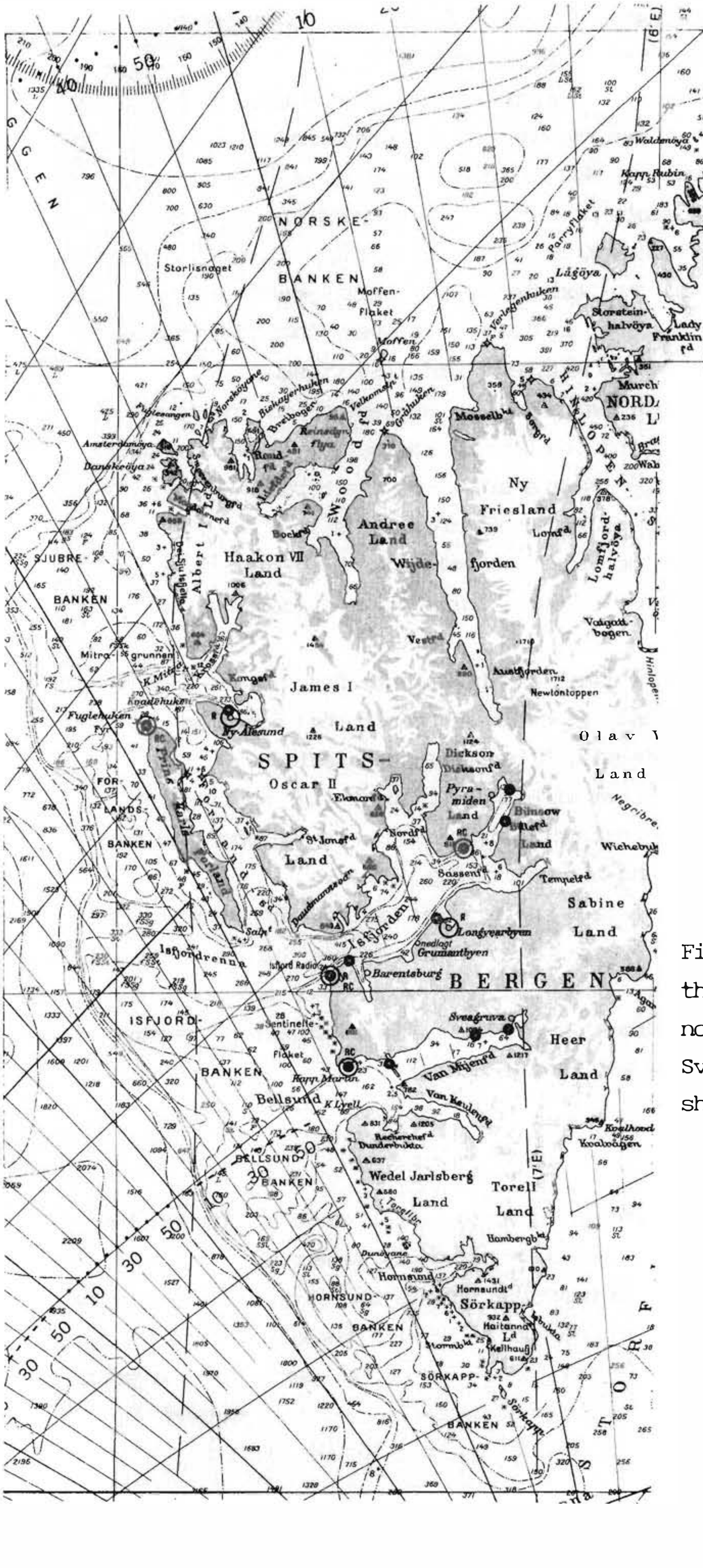


Fig. 33. Bathymetry of the western and northern coast of Svalbard. Note areas shallower than 100m.

of inland glaciations ("forebulge"), several bank-areas along the western and northern coast would have emerged, and permafrost may have developed similarly to what is found on land today.

Permafrost conditions may also exist at the base of a glacier. Temperature measurements at the base of the Greenland ice sheet showed -13^0C (Herron & Langway 1979). As on dry land, permafrost will extend downward into the sediments or rocks. The temperature conditions at the base of the Late Weichselian ice sheet in the Svalbard and Barents Sea region are unknown. The existence of well preserved pre Late Weichselian raised beaches indicates, however, that the temperature may have been below pressure melting point (Salvigsen pers. comm.). The extensive glaciomarine deposits suggested to represent ice marginal features are on the other hand indicating pressure melting point conditions in the marine areas. On Svalbard today the larger glaciers are all at their pressure melting points in their higher and thicker parts. During the Late Weichselian with a lower temperature, the glaciers may have been "colder", but so far no adequate data are available.

Stratigraphically, permafrost in the Barents Sea, in the fjords and at the shelf north and west off Svalbard, has to be confined to the pre Late Weichselian sediments. After this, the sediments were deposited in equilibrium with their present day environment. In the Barents Sea the permafrost, if present, will be confined to the very thin layer of till and its underlying bedrock.

On the northern and western shelf, very limited information exists on the sediment thickness and composition above bedrock. In the fjords, only the upper, soft deposits are mapped, and the boundary between sediments and bedrock is not known. In these areas permafrost may exist in sediments as well as in bedrock.

Preservation potential

Transgression of water masses with temperatures above 0^0C causes the sediments to thaw as the ground gets gradually warmer.

Except for areas in the northern Barents Sea (Fig. 33) relatively warm Atlantic or Atlantic influenced water with temperatures above 0^0C dominates bottom currents at least for some parts of the year. Permafrost formed under the Late Weichselian sea level lowstand should consequently have disappeared during the 10,000 years of Holocene "warm" water influence.

As shown in Fig. 6 freezing temperatures prevail for considerable parts of the northern Barents Sea, creating favourable conditions for permafrost preservation. Concerning the existence of permafrost, the two following problems have to be dealt with:

- The Holocene palaeoceanography and the possibilities of a northward migration of the oceanic Polar front and intrusion of "warm" Atlantic water into the northern Barents Sea in early and mid Holocene (see page 35).

- The basal temperature conditions of the grounded Late Weichselian ice sheet in the area.

The Holocene palaeoceanography is only sparsely studied, and biostratigraphical studies so far have not been able to conclude on whether present day conditions have prevailed or if there has been a different current system. However, the close relationship between water mass distribution and bathymetry may indicate a different current pattern in early Holocene with a significant (approximately 100 m) deeper northern Barents Sea due to glacio-isostatic depression.

The basal temperature conditions of the ice sheet are far more complicated to study. In the literature very few references to subglacial palaeotemperatures exist, and they are largely limited to terrestrial glaciations, based on detailed morphological studies (Sugden 1978). These results can not easily be applied to the very regionally spread morphological information from the Barents Sea.

<u>Conclusive remarks</u>

The Barents Sea differs strongly from the typical high arctic permafrost shelf for a number of reasons:

- The Barents Sea is almost 10 times deeper than other high arctic shelves, and except for shallow parts along the western and northern coast of Svalbard, the Barents Sea and its adjacent areas have not been subaerially exposed during the Weichselian eustatic sea level lowering, which could have caused permafrost development.

- Permafrost may have developed under the grounded Late

Weichselian ice sheet which covered the region. However, no data are available on this topic and the problem remains unsolved.

- In other high arctic shelves the permafrost is preserved due to transgression of cold Polar water. Such conditions are only found in the deeper parts of the Barents Sea, i.e. areas which have experienced submarine or subglacial conditions. Except for the western parts of Spitsbergenbanken and the region surrounding Bjørnøya, warm Atlantic water has transgressed areas which may have been subaerially exposed during Weichselian sea level low stands.

- In the Barents Sea most of the sediments above the bedrock are marine deposits (Holocene and Late Weichselian), providing unfavourable conditions for permafrost development. If permafrost is present, it is probably localized in the bedrock.

- Detection of permafrost in rocks is complicated by the fact that in low-porosity rocks which are typical of the northern Barents Sea, the ice content has only marginal influence on the physical properties of the rocks. Thus, standard geophysical methods for detection of permafrost in unlithified sediments may not be adequate. Drilling and rock tests will be the most favourable method, and these detailed studies may later be extended by geophysical surveys which are specially designed for the actual area and physical setting.

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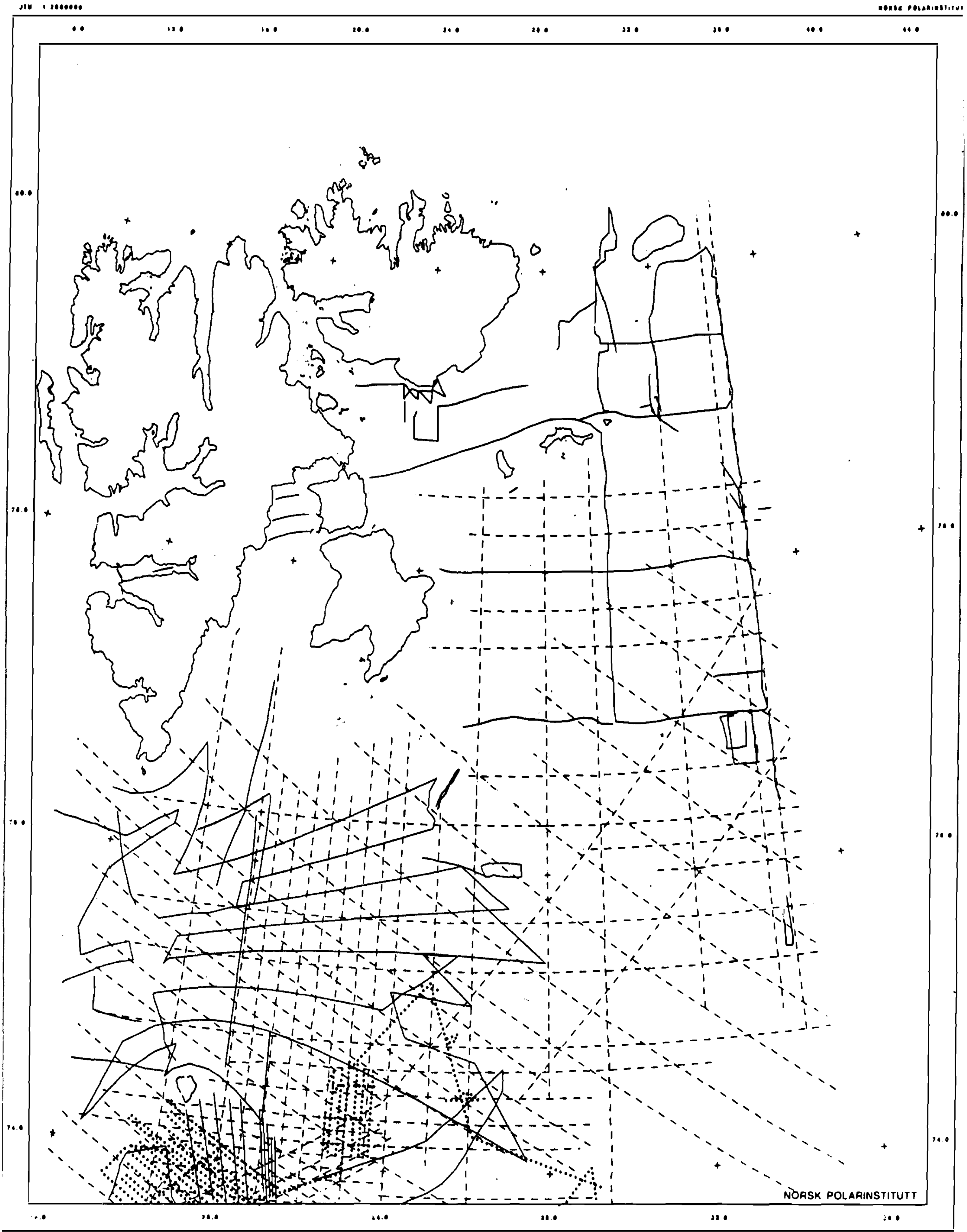
APPENDICES

The appendices show available shallow geological and geophysical data in the northern Barents Sea. In appendix 3B conducted analyses on the sediments are listed.

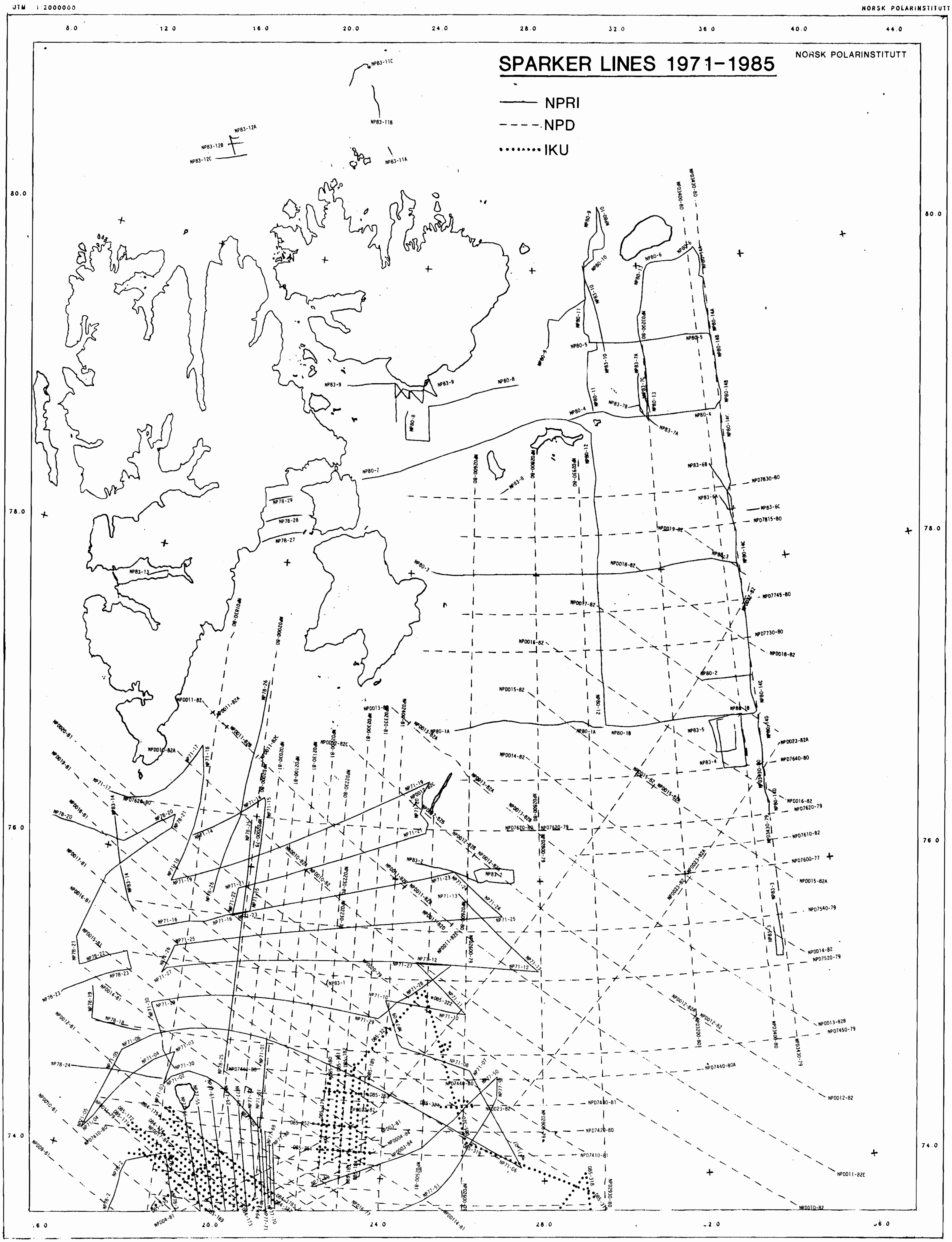


Appendix 1A - Sparker lines 1971-1985

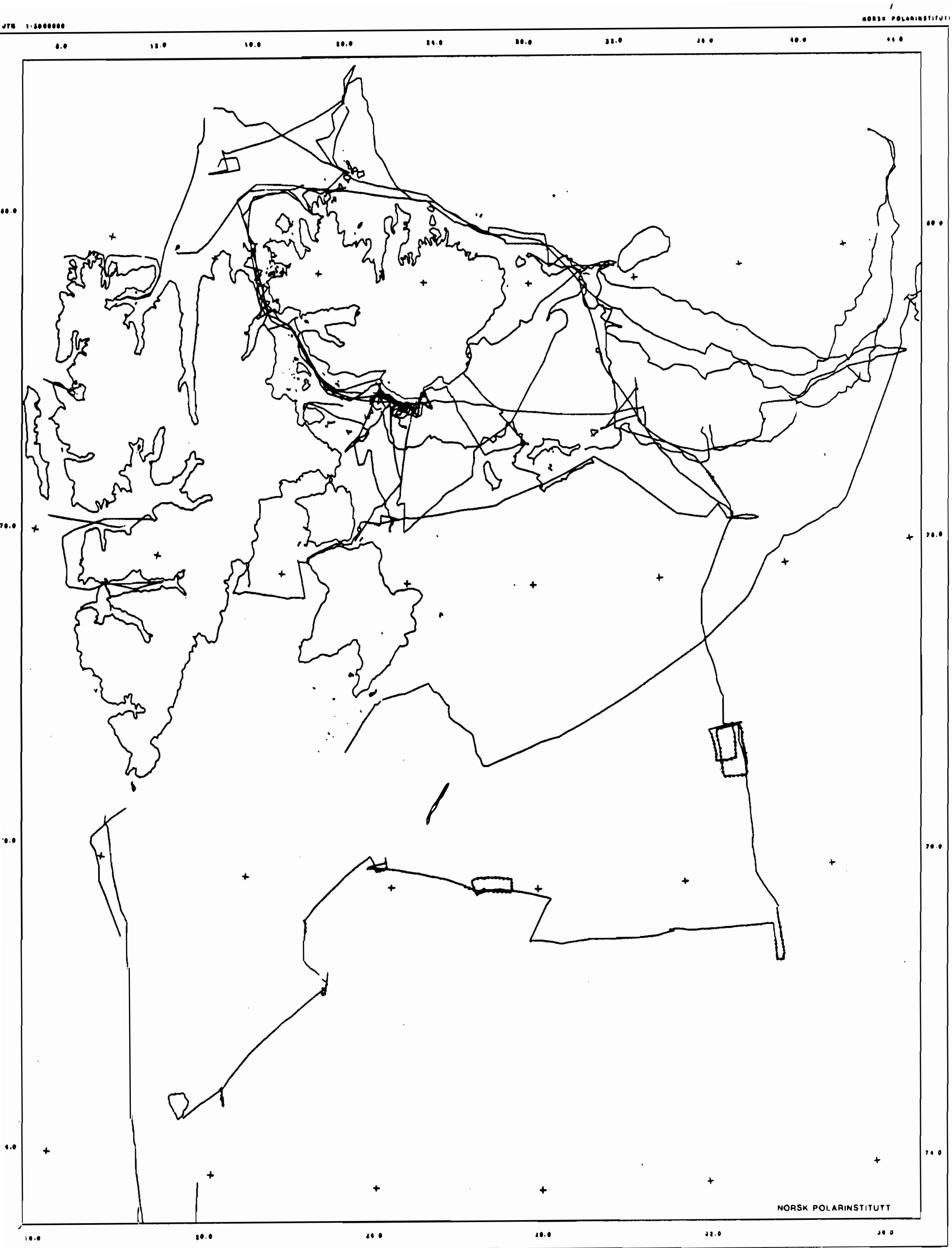
——— NPRI

- - - - NPD

.... IKU



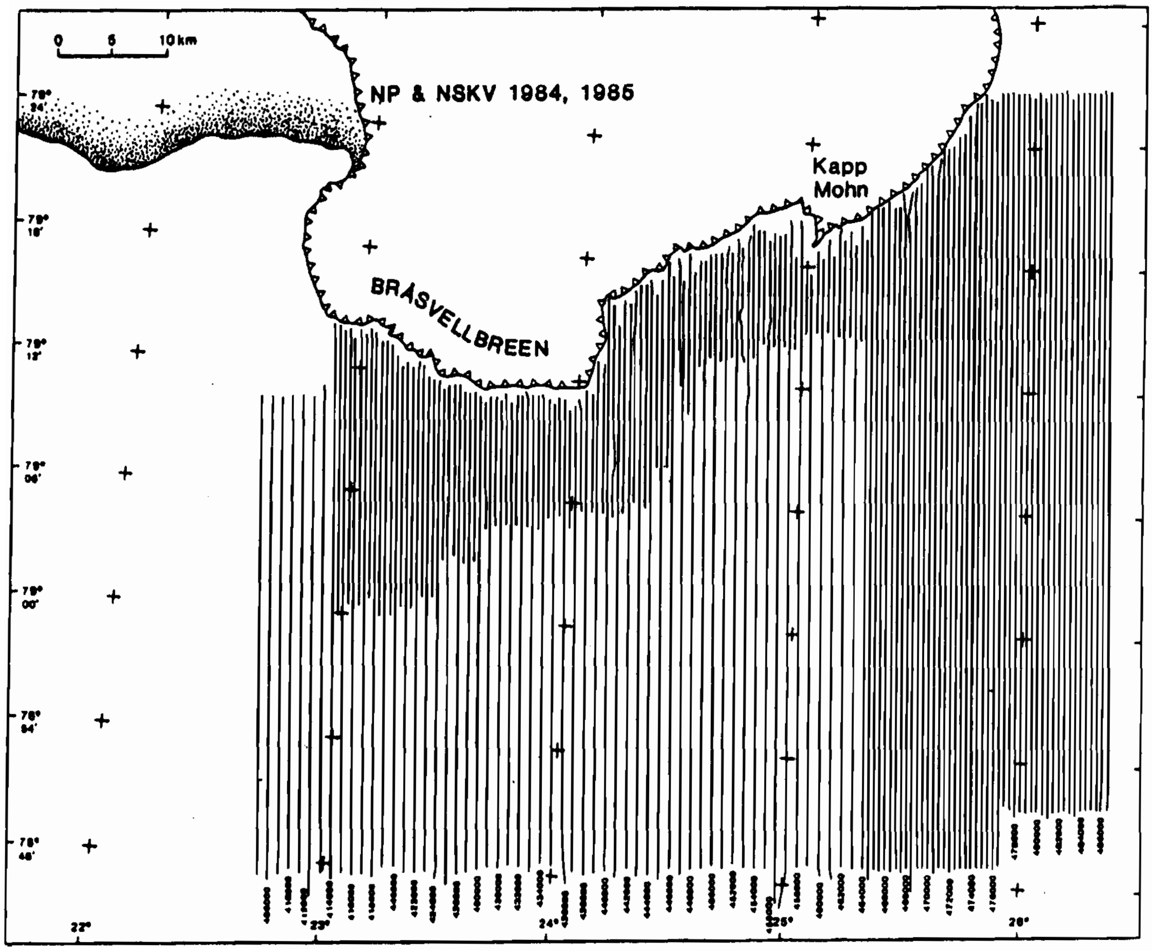
Appendix 1B - Sparker lines 1971-1985 (with indices)



Appendix 1C - 3.5 kHz PDR & Side scan sonar lines

—— PDR 1981-1983

——— Side scan sonar 1983



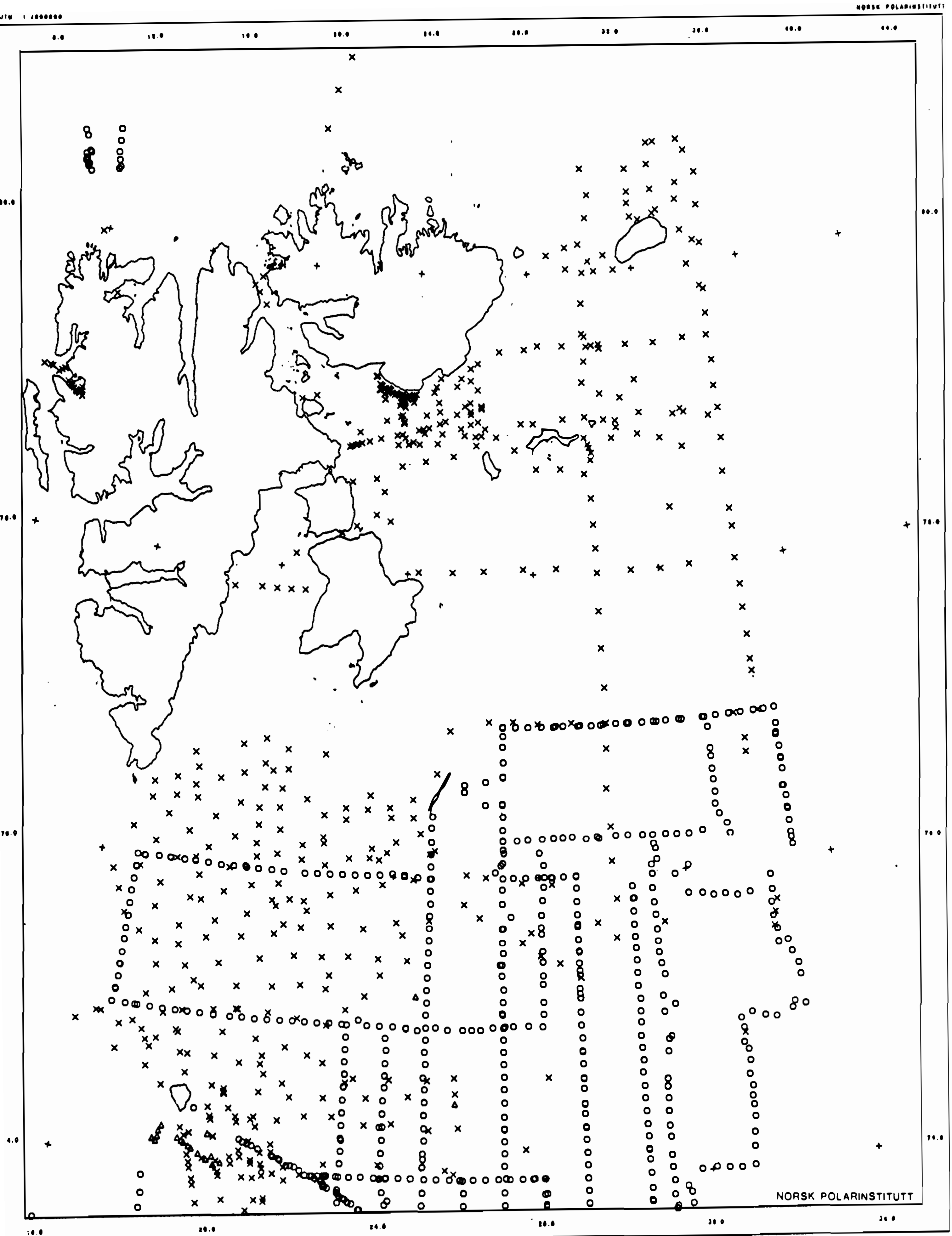
Appendix 1D - Survey in Erik Eriksenstredet 1984 and 1985

Conducted by NP and the Norwegian Hydrographic Survey (NSKV).

1984:		*1985:*			
Line spacing 500m		*Line spacing 1000m*			
PDR: All lines except	*475500*	*PDR: All lines except*	*409000*		*431000*
			424000		*436000*
Sparker:	*464500*		*432000*		*440000*
	468000		*433000*		*445000*
	471000		*434000*		*449000*
	474000		*435000*		*453000*
	478000		*444000*		*457000*
	481500		*446000*		*461000*
	483500		*448000*		
	486000		*456000*	*Side scan sonar:*	
			458000	*All lines exsept*	*430000*
Side scan sonar:	*464500*		*460000*		*434000*
	468000		*462000*		*435000*
	471000				*458000*
	474000	*Sparker:*	*407000*		*460000*
	478000		*412000*		*462000*
			416000		
			419000		
			423000		
			427000		
			428000		

In addition there are some short lines with 250m spacing (not included in the enclosed map) that have PDR data.map)

In addition, a number of short lines in the northern part, with 500m spacing have PDR and Side scan sonar data.



Appendix 2A - Bottom samples

× NPRI

o NPD

△ IKU

APPENDIX 3A

APPENDIX 3A

TABLE 1A. STATION DATA FOR SEDIMENT SAMPLING, (NP71-CORE:STDT)
NORSK POLARINSTITUTT, 1971.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
74.233	19.100	NP71-1	57	5				
74.206	19.333	NP71-2	70	5	X			
74.050	19.708	NP71-3	100	5				
74.050	21.116	NP71-4/2	310	1/6		1.0		
74.041	21.666	NP71-5	264	5				
74.001	22.066	NP71-6	452	5				
74.075	22.620	NP71-7	384	6	X			
74.088	23.933	NP71-8/2	425	3/6		1.0		
74.063	25.546	NP71-9/2	442	1/6		1.0		
74.038	25.750	NP71-10	438	6				
74.336	25.850	NP71-11/2	388	1/6		1.0		
74.321	25.133	NP71-12/2	370	5/6				
74.355	24.216	NP71-13/2	297	1/6				
74.341	23.550	NP71-14/2	231	5/6				
74.385	22.758	NP71-15	119	6				
74.378	22.083	NP71-16	196	6				
74.340	21.433	NP71-17	115	6				
74.350	20.848	NP71-18/3	208	1/6		1.0		
74.390	20.213	NP71-19/3	105	6				
74.383	19.716	NP71-20/2	73	5/6				
74.528	19.750	NP71-21/3	53	5/6	X			
74.513	20.053	NP71-22/2	73	5/6	X			
74.513	20.916	NP71-23/3	90	5/6	X			
74.495	21.683	NP71-24/2	159	1/6	X	1.0		
74.503	22.516	NP71-25/3	100	1/5/6		1.0		
74.515	23.565	NP71-26	180	1		1.0		
74.533	24.608	NP71-27/2	248	1/6		1.0		
74.558	25.766	NP71-28/2	310	1/6		1.0		
74.661	25.741	NP71-29/2	302	1/6		1.0		
74.641	25.066	NP71-30/2	260	1/6		1.0		
74.640	24.125	NP71-31/2	180	1/6	X	1.0		
74.638	23.233	NP71-32	125	6	X			
74.610	23.041	NP71-33	120	5	X			
74.591	19.058	NP71-34	52	6	X			
74.493	18.505	NP71-35/2	60	5/6	X			
74.606	18.058	NP71-36/3	110	6	X			
74.720	19.058	NP71-37	114	6	X			
74.725	19.731	NP71-38	49	6	X			
74.696	20.366	NP71-39	73	6	X			
74.633	21.000	NP71-40	80	6				
74.580	21.483	NP71-41/2	130	1/6	X	1.0		
74.780	22.050	NP71-42/3	135	1/5/6		1.0		
74.825	21.466	NP71-43/2	110	5/6	X			
74.866	20.716	NP71-44/2	52	5/6				
74.891	19.866	NP71-45/2	51	5/6	X			
74.855	18.750	NP71-47/3	150	5/6	X			
74.781	17.958	NP71-48/2	254	1/6		1.0		
74.893	17.566	NP71-49/2	236	5/6				
74.971	18.300	NP71-50/2	95	5/6	X			
75.003	18.786	NP71-51/2	53	5/6	X			
75.035	19.566	NP71-52/2	33	5/6	X			

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
75.051	20.183	NP71-53/2	27	6				
75.053	20.133	NP71-54	29	8				
75.048	20.966	NP71-55	43	6	X			
75.023	21.716	NP71-56	55	6	X			
74.988	22.466	NP71-57/2	82	6				
75.098	22.933	NP71-58	100	6				
75.196	23.391	NP71-59	120	6				
75.230	22.383	NP71-60	64	6	X			
75.246	21.716	NP71-61	45	6	X			
75.221	20.998	NP71-62	50	6	X			
75.203	20.083	NP71-63	36	6	X			
75.173	19.175	NP71-64	29	6				
75.130	18.450	NP71-65	45	6				
75.081	17.800	NP71-66	105	6				
75.283	17.941	NP71-67	86	6	X			
75.298	18.691	NP71-68	35	6	X			
75.208	18.966	NP71-69	23	8				
75.345	19.531	NP71-70/2	43	5/6	X			
75.401	20.600	NP71-71/2	35	5/6				
75.438	21.483	NP71-72/2	34	5/6	X			
75.443	22.216	NP71-73/2	53	5/6	X			
75.455	22.916	NP71-74/4	65	5/6				
75.446	23.700	NP71-75/2	82	5/6	X			
75.441	24.450	NP71-76/2	112	5/6	X			
75.615	24.315	NP71-77/2	102	5/6				
75.720	25.000	NP71-78/2	98	5/6				
75.700	24.133	NP71-79/3	95	5/6				
75.650	23.266	NP71-80/2	68	5/6				
75.658	22.391	NP71-81/2	58	5/6				
75.635	21.591	NP71-82/2	42	5/6				
75.646	21.133	NP71-83	38	8				
75.580	20.898	NP71-84/2	49	5/6				
75.540	20.040	NP71-85/2	72	5/6				
75.508	19.150	NP71-86	62	6				
75.438	18.450	NP71-87	70	6				
75.440	17.816	NP71-88	125	6				
75.496	17.350	NP71-89	148	6				
75.568	18.390	NP71-90	124	6				
75.630	19.301	NP71-91/2	80	1/6		1.0		
75.696	20.123	NP71-92/2	50	5/6				
75.766	20.875	NP71-93/2	30	5/6				
75.810	21.616	NP71-94/2	36	5/6				
75.816	21.225	NP71-95	32	8				
75.863	22.300	NP71-96/2	46	5/6	X			
75.903	23.000	NP71-97/2	60	5/6	X			
75.946	23.716	NP71-98/2	47	5/6	X			
75.986	24.541	NP71-99/2	70	5/6	X			
76.186	25.100	NP71-100	72	6	X			
76.300	24.695	NP71-101	56	5	X			
76.241	24.033	NP71-102/2	55	5/6				
76.188	23.373	NP71-103/2	42	5/6				
76.116	22.750	NP71-104/3	43	5/6				
76.058	22.100	NP71-105/2	58	5/6	X			
76.083	21.458	NP71-106/2	36	5/6	X			

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
76.208	22.033	NP71-107/2	87	5/6				
76.375	22.603	NP71-108/2	138	5/6				
76.450	23.200	NP71-109/2	104	1/6	X	1.0		
76.400	23.866	NP71-110/2	64	5/6	X			
76.403	24.481	NP71-111/3	45	5/6				
76.530	24.450	NP71-112/2	27	5/6				
76.463	23.816	NP71-113/2	56	5/6				
76.545	23.241	NP71-114/2	145	1/6	X	1.0		
76.458	22.583	NP71-115/2	176	1/6		1.0		
76.396	21.983	NP71-116/2	242	1/6	X	1.0		
76.248	22.000	NP71-117/2	160	1/6	X	1.0		
76.183	21.450	NP71-118/2	172	1/6	X	1.0		
76.110	20.775	NP71-119/2	176	1/6	X	1.0		
75.915	20.883	NP71-120/2	62	5/6	X			
75.801	20.766	NP71-121	34	8				
75.338	23.770	NP71-122/2	104	5/6	X			
75.886	20.166	NP71-123/3	34	6/8				
75.826	19.448	NP71-124	55	6	X			
75.758	18.583	NP71-125	82	6	X			
75.670	17.665	NP71-126	192	6	X			
75.603	16.891	NP71-127	207	6				
75.751	16.650	NP71-128	345	1		1.0		
75.830	17.725	NP71-129/2	226	1/6	X	1.0		
75.916	18.741	NP71-130/3	105	1/5/6	X	1.0		
75.990	19.516	NP71-131/2	113	5/6				
76.081	20.216	NP71-132/3	146	1/5/6	X	1.0		
76.168	20.181	NP71-133/2	182	1/6	X	1.0		
76.275	20.791	NP71-134/2	206	1/6	X	1.0		
76.425	20.723	NP71-135/2	210	1/6	X	1.0		
76.553	20.726	NP71-136/2	84	5/6	X			
76.681	20.851	NP71-137/2	88	1/6	X	1.0		
76.706	20.173	NP71-138/2	176	1/6	X	1.0		
76.550	20.233	NP71-139/2	172	1/6	X	1.0		
76.413	20.148	NP71-140	206	1		1.0		
76.295	20.175	NP71-141	242	1		1.0		
76.198	19.575	NP71-142	198	1		1.0		
76.435	19.596	NP71-143	262	1	X	1.0		
76.630	19.600	NP71-144	190	1	X	1.0		
76.581	18.958	NP71-145/2	101	5/6	X			
76.321	18.966	NP71-146	265	1		1.0		
76.103	18.883	NP71-147	195	1	X	1.0		
76.013	18.083	NP71-148/2	193	1/6	X	1.0		
76.201	18.300	NP71-149	232	1	X	1.0		
76.431	18.400	NP71-150	196	1		1.0		
76.630	18.316	NP71-151	185	1		1.0		
76.428	17.796	NP71-152	215	1		1.0		
76.298	17.665	NP71-153	260	1		1.0		
76.100	17.433	NP71-154	290	1		1.0		
75.923	17.111	NP71-155	306	1	X	1.0		
75.880	16.400	NP71-156	332	1	X	1.0		
76.033	18.583	NP71-157	334	1		1.0		
76.186	16.758	NP71-158	280	1		1.0		
76.393	17.133	NP71-159/2	112	5/6				
76.500	17.133	NP71-160	13	8				
76.551	17.751	NP71-161	200	6	X			

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
76.513	18.300	NP71-162	198	1	X	1.0		
76.728	18.166	NP71-163	200	1	X	1.0		
75.755	18.876	NP71-164/2	56	5/6	X			
76.816	19.490	NP71-165/2	144	1/6	X	1.0		
76.870	20.135	NP71-166/2	132	1/6	X	1.0		
76.811	20.793	NP71-167	40	5	X			
76.663	20.420	NP71-168	30	8				
76.496	21.450	NP71-169	218	1	X	1.0		
76.703	25.100	NP71-170/2	30	6/8	X			
76.163	24.966	NP71-171	74	5				
74.735	22.448	NP71-172	90	1	X	1.0		
76.798	21.881	NP71-173	136	1	X	1.0		
74.698	20.895	NP71-174	64	5	X			
74.755	20.916	NP71-175	80	6	X			
74.483	20.070	NP71-176	76	6	X			

TABLE 2A. STATION DATA FOR SEDIMENT SAMPLING, (NP77-CORE:STDT)
NORSK POLARINSTITUTT, 1977.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
73.196	23.364	NP77-1		1				
73.216	23.387	NP77-2		1				
73.217	23.326	NP77-3		5				
73.227	23.239	NP77-4		5				
73.170	23.288	NP77-5		5				
74.185	19.216	NP77-6		5/6				
74.063	19.341	NP77-7		5/6				
74.016	19.398	NP77-8		5				
73.980	19.430	NP77-9		5				
73.911	19.514	NP77-10		5				
73.872	19.550	NP77-11		5				
73.755	19.669	NP77-12		1				
73.656	19.782	NP77-13		1				
73.639	20.406	NP77-14		1				
73.798	20.253	NP77-15		1				
73.948	20.129	NP77-16		5				
73.973	20.104	NP77-17		5				
74.042	20.041	NP77-18		5				
74.198	19.912	NP77-19		5				
74.305	19.811	NP77-20		5				
74.325	19.780	NP77-21		5				
74.341	20.405	NP77-22		5				
74.309	20.441	NP77-23		5				
74.125	20.562	NP77-24		5				
74.086	20.599	NP77-25		5				
74.080	20.359	NP77-26		5				
74.038	20.393	NP77-27		5				
73.957	20.692	NP77-28		5				
73.741	20.851	NP77-29		1				
73.813	21.035	NP77-30		1				
73.956	20.939	NP77-31		5				

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
74.048	20.876	NP77-32		5				
74.069	20.870	NP77-33		5				
74.192	20.785	NP77-34		5				
74.122	21.083	NP77-35		1				
74.021	21.156	NP77-36		5				
73.977	21.164	NP77-37		1/5				
73.830	21.252	NP77-38		1				
73.809	21.253	NP77-39		1				
73.995	21.415	NP77-40		5				
74.133	21.345	NP77-41		5				
74.183	21.317	NP77-42		5				
74.288	20.911	NP77-43		5				
74.333	20.783	NP77-44		1				
74.721	18.875	NP77-45		5				
74.870	18.700	NP77-46		5				
74.799	18.224	NP77-47		1				
74.737	18.084	NP77-48		1				
74.843	17.833	NP77-49		1				
74.695	17.230	NP77-50		5				
74.863	17.244	NP77-51		1				
74.931	16.610	NP77-52		5				
74.931	16.728	NP77-53		5				
74.859	16.114	NP77-54		1				
73.959	21.697	NP77-55		5				
73.975	22.506	NP77-56		5				
73.206	23.252	NP77-57		5				
73.165	23.450	NP77-58		5				

TABLE 3A. STATION DATA FOR SEIMENT SAMPLING, (NP80-CORE:STDT)
NORSK POLARINSTITUT, 1980.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
71.611	16.657	NP80-1/2	350	1/4	X			
72.546	17.283	NP80-2/2	350	6	X			
73.192	23.285	NP80-3/2	350	4	X			
73.280	24.061	NP80-4/2	400	1	X	2.3		X
74.194	27.516	NP80-5/2	410	1	X	1.6		
74.656	28.116	NP80-6/3	365	1/4	X	1.0		X
75.318	29.024	NP80-7/3	335	1/4	X	1.4		
75.419	28.498	NP80-8/3	315	1/4	X	1.0		
75.474	27.990	NP80-9/4	265	1/4/6	X	1.0		
75.565	27.512	NP80-10/3	225	1/4	X	2.1		
75.739	26.363	NP80-11/3	125	1/4	X	0.4		
75.827	25.944	NP80-12/2	110	1/4	X	0.5		X
75.575	30.009	NP80-13/3	450	1/4	X	1.3		X
75.837	30.076	NP80-14/3	310	1/4	X	1.6		X
76.091	29.986	NP80-15/2	310	1/4	X	2.0		
76.322	30.013	NP80-16/3	280	1/4	X	2.1	X	X
76.581	29.941	NP80-17/2	280	1/4	X	0.8		

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
76.842	30.007	NP80-18/3	250	1/4	X	0.1	X	X
77.009	30.028	NP80-19/3	230	1/4/6	X	0.5		
76.984	25.472	NP80-20/3	52	1/4	X	0.2		
77.044	26.601	NP80-21/3	100	1/4	X	1.3		
77.042	27.309	NP80-22/3	140	1/4	X	0.7		
77.024	28.027	NP80-23/3	160	1/4	X	0.9	X	X?
77.024	29.016	NP80-24/3	230	1/4	X	1.6		
77.242	30.050	NP80-25/3	180	1/4	X	0.1	X	X
77.501	30.025	NP80-26/3	200	1/4	X	0.1		
77.742	30.020	NP80-27/2	250	1/4	X	0.1	X	X
77.994	30.033	NP80-28/2	275	1/4	X	0.1		
78.032	28.748	NP80-29/2	300	1/4	X	1.0	X	X
78.034	27.686	NP80-30/3	230	1/4	X	1.0		X
78.025	26.430	NP80-31/3	175	1/4	X	2.1	X	X
78.017	25.446	NP80-32/3	135	1/4	X	2.5		
78.015	24.361	NP80-33/3	46	1/4	X	0.5	X	X
78.585	22.057	NP80-34	22	4	X			
78.615	22.842	NP80-35	22	4	X			
78.706	23.664	NP80-36/2	125	1/4	X	2.2		
78.745	24.443	NP80-37/2	150	1/4	X	2.2		
78.784	25.392	NP80-38/2	120	1/4	X	0.8		
78.857	26.163	NP80-39/2	107	1/4	X	0.2		
78.911	26.835	NP80-40	55	4	X			
78.993	28.103	NP80-41	45	4	X			
79.021	29.150	NP80-42/2	100	1/4	X	0.6		
78.844	29.966	NP80-43	170	4	X			
78.821	30.005	NP80-44/2	130	1/4	X	0.5		
78.738	30.043	NP80-45	125	1	X	0.4		
78.649	29.797	NP80-46	230	4	X		X	X
78.591	29.963	NP80-47	260	4	X		X	X
78.481	29.976	NP80-48/3	280	1/4	X	2.0	X	X
78.309	30.002	NP80-49/2	315	1/4	X	2.5	X	X
78.153	30.033	NP80-50/3	325	1/4	X	2.4		
78.000	31.096	NP80-51/3	215	1/4	X			
77.994	32.050	NP80-52/3	200	1/4	X	0.2		
78.002	32.965	NP80-53/2	125	1	X	0.6	X	X
78.002	34.438	NP80-54/3	215	1/4	X	0.6		X
78.211	34.486	NP80-55/3	250	1/4	X	2.6	X	X
78.384	34.540	NP80-56/3	100	1/4	X	0.3		X
78.579	34.419	NP80-57/3	210	1/4	X	1.6	X	X
78.804	34.511	NP80-58/2	330	1/4	X	1.4		X
79.010	34.552	NP80-59/3	305	1	X	2.5	X	X
79.010	33.367	NP80-60/3	345	1/4	X	1.7	X	X
79.034	33.248	NP80-61/2	130	1/4	X	0.2		X
79.002	30.994	NP80-62/4	225	1/4	X	0.5	X	X
79.031	29.924	NP80-63/3	40	1/4	X	0.1	X	X
79.263	29.885	NP80-64/3	320	1/4	X	1.3	X	X
79.182	30.510	NP80-65/3	85	1/4	X	0.7		
79.151	23.657	NP80-66/2	80	1	X	1.4		
79.104	23.683	NP80-67	80	6	X		X	X
79.006	23.674	NP80-69	135	6	X			
78.873	24.014	NP80-71	178	6	X			
79.405	29.982	NP80-84/3	320	1/4	X	3.0	X	X
79.571	30.040	NP80-85/2	250	1	X	0.5		X
79.790	29.991	NP80-86/3	142	1/4	X	0.4	X	X

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
79.991	30.105	NP80-87/2	255	1/4	X	1.8		X
80.179	30.019	NP80-88/3	275	1/4	X	2.2		X
80.349	30.351	NP80-89/3	275	1/4	X	0.4		X
80.496	30.481	NP80-90/3	225	1/4	X	2.1		X
80.675	30.237	NP80-91/3	295	1/4	X	2.3	X	X
80.653	32.052	NP80-92/4	150	1/4	X	0		X
80.500	32.068	NP80-93/4	140	1/4	X	0.3		X
80.425	32.030	NP80-94	20	4	X			
80.336	32.094	NP80-95	175	4	X			X
80.312	32.408	NP80-96	119				X	X
80.344	32.988	NP80-97	32	4	X			X
80.363	33.140	NP80-98	98					X
80.500	33.006	NP80-99	36	4	X			X
80.666	32.967	NP80-100	125	4	X			X
80.808	33.054	NP80-101/3	170	1/4	X	0.7		X
80.811	33.329	NP80-102/3	170	1/6	X	0.6		X
80.808	34.278	NP80-103/3	164	1/6	X	0.6		
80.730	34.527	NP80-104/2	180	1/6	X			X
80.578	34.847	NP80-105/3	149	1/4/6	X	0.5		X
80.525	34.060	NP80-106/3	165	1/4/6	X	0.4		X
80.417	33.946	NP80-107/4	185	1/4/6	X	0.6		X
80.362	34.757	NP80-108/2	275	1	X	2.7	X	X
80.216	34.005	NP80-109/4	260	1/4	X	0.5		X
80.115	34.695	NP80-110/2	140	1/4	X		X	X
80.139	34.439	NP80-111/2	215	1	X	0.7		X
79.988	34.098	NP80-112/2	197	1/4	X	0.5		X
79.834	34.483	NP80-113/3	214	1/4	X	0.7	X	X
79.651	34.560	NP80-114/3	340	1/4	X	0.9		X
79.507	34.490	NP80-115/3	300	1/4	X	0.5	X	X
79.335	34.553	NP80-116/3	262	1/4	X	0.5	X	X
79.161	34.506	NP80-117/3	215	1/4	X	0.3		
79.510	33.616	NP80-118/3	280	1/4	X	1.1		
79.499	33.534	NP80-119/3	307	1/4	X	2.1	X	X
79.506	31.529	NP80-120/3	300	1/4	X	1.8		X
79.486	30.590	NP80-121/3	175	1/4	X	1.2	X	X
79.510	30.300	NP80-122	75	4	X			X
79.503	30.115	NP80-123/2	150	4	X		X	X
79.516	29.249	NP80-124/3	330	1/4	X	1.1	X	X
79.525	28.341	NP80-125/2	330	1/4	X	0.9		X
79.500	27.854	NP80-126/3	285	1/4	X	0.7		
79.490	26.969	NP80-127/3	130	1/4	X	0.8	X	X
80.021	29.502	NP80-128/2	265	1	X	0.6		X
79.996	30.565	NP80-130	125	4	X		X	X
79.998	31.286	NP80-131/3	115	1/4	X	0.3		X
79.006	32.972	NP80-132/2	120	4	X			
77.830	34.480	NP80-133/3	168	1/4	X	0.4		
77.675	34.492	NP80-134/3	165	1/4	X	0.6		
77.499	34.504	NP80-135/2	188	1/4	X	0.7		
77.337	34.503	NP80-136/2	160	1/6	X	0.7		
77.260	34.509	NP80-137/2	125	1/6	X	0.3		
77.000	34.516	NP80-138/2	127	1/2	X	1.6		
74.866	33.141	NP80-140/14	162	1	X	1.7		
73.676	28.003	NP80-141	382	1	X	2.3		
73.349	28.115	NP80-142	350	1	X	1.7		
73.000	28.020	NP80-143	335	1	X	2.2		

POSITION NORTH	 EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE- LENGTH (m)	WATER SAMPLES	SUSP
72.669	28.025	NP80-144	330	1	X	2.4		
72.339	28.006	NP80-145	285	1	X	2.5		
72.007	27.998	NP80-146	290	1	X	0.6		
71.527	23.034	NP80-147	420	1	X			
71.339	22.659	NP80-148	420	1	X			

TABLE 4A. STATION DATA FOR SEDIMENT SAMPLING, (NP81-CORE:STDT)
NORSK POLARINSTITUTT, 1981.

POSITION NORTH	 EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE- LENGTH (m)	WATER SAMPLES	SUSP
78.945	12.000	NP81-101	310	1		3.1		
78.938	12.050	NP81-102	295	1		1.8		
78.933	12.083	NP81-103	210	1		0		
78.923	12.150	NP81-104	135	1		0.6		
78.911	12.241	NP81-105	100	1		2.1		
78.905	12.288	NP81-106	71	1		1.2		
78.900	12.366	NP81-107	60	1		0.7		
78.901	12.400	NP81-108	31	1		0.4		
78.903	12.416	NP81-109	66	1		1.6		
78.883	12.516	NP81-110	71	1				
78.921	12.433	NP81-111	43	1		2.6		
78.940	12.433	NP81-112	50	1		2.7		
78.961	11.916	NP81-113	355	1		2.8		
78.976	11.800	NP81-114	188	1		0.8		
79.040	11.700	NP81-115	40	1		0.3		
79.038	11.683	NP81-116	139	1				
79.025	11.600	NP81-117	222	1			X	X
79.010	11.500	NP81-118	392	1		2.5		
79.036	11.250	NP81-119	261	1		1.4		X
79.040	11.166	NP81-120	325	1		1.7		
79.038	10.933	NP81-121	332	1		0.8		
79.136	23.579	NP81-136/2	109	1		1.0	X	X
79.150	23.580	NP81-137/3	112	1		1.2		
79.136	23.511	NP81-138/3	107	1		1.6		
79.172	23.558	NP81-139	82	1				
79.183	23.554	NP81-140/2	86	1		0.2		
79.194	23.560	NP81-141	94	1		0.2		
79.810	34.602	NP81-186	320	1		1.6		
79.187	22.928	NP81-216/2	81	1		0.6		
79.189	23.437	NP81-217/2	95	1/5				

TABLE 5A. STATION DATA FOR SEDIMENT SAMPLING, (NP82-CORE:STDT)
NORSK POLARINSTITUTT, 1982.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	
79.600	12.850	NP82-202	34		X			
79.825	17.803	NP82-215		2				
79.885	18.042	NP82-217	446	1				
79.782	18.007	NP82-218	414	1				
79.708	18.319	NP82-219	441	1				
79.307	22.633	NP82-224	21	2	X	0.1		
79.304	22.581	NP82-225	36	1		0.8	X	X
79.308	22.589	NP82-226	36	2				
79.153	22.962	NP82-229	55	1	X	0.5	X	X
79.211	23.124	NP82-230	81	1	X	0.5	X	X
79.223	23.089	NP82-231/4	83	1/2	X	0.4	X	X
79.194	23.785	NP82-232/2	82	1	X	0.3	X	X
79.178	23.787	NP82-233	101	1	X	0.3		
79.162	23.732	NP82-234/2	79	1	X	1.7	X	X
79.150	23.620	NP82-235	106	1		1.1	X	X
79.114	23.494	NP82-236	97	1			X	X
79.040	23.548	NP82-237	105	1		1.1		X
79.195	24.038	NP82-238	83	1	X			
79.164	23.914	NP82-239	87	1	X	0.4		
79.229	22.938	NP82-240	59	2				
79.220	22.892	NP82-241	57	2		0.5	X	X
79.215	22.743	NP82-242/2	39	1/2	X		X	X
79.184	23.273	NP82-243	79		X		X	X
79.147	20.558	NP82-246	83		X			
79.117	20.055	NP82-251	119	1	X			
78.921	22.174	NP82-253	124	1		0.8		
78.862	22.514	NP82-254	127		X			
78.530	23.125	NP82-256	44		X			
78.338	23.388	NP82-257	29		X			
78.377	22.918	NP82-258	23		X			
78.297	22.294	NP82-259	23		X			
78.246	21.837	NP82-260	39	1	X			
78.091	20.439	NP82-262	61		X			
77.856	20.830	NP82-264	65		X			
77.852	20.392	NP82-265	82		X			
77.850	19.945	NP82-266	82		X			
77.848	19.471	NP82-267	61		X			
77.834	18.630	NP82-269	99		X			
78.965	34.178	NP82-302	309		X			
78.780	33.168	NP82-303	258	1	X	1.7		
78.853	32.440	NP82-304	289		X			
78.894	31.695	NP82-305	135		X			
78.957	31.001	NP82-306	196		X			
78.878	30.799	NP82-307	122		X			
78.889	29.873	NP82-308	76		X			
78.786	30.093	NP82-309	193		X			
78.690	29.008	NP82-310	161		X			
78.692	28.209	NP82-311	150		X		X	X
78.824	27.481	NP82-312	99		X		X	
78.995	27.705	NP82-314	112		X		X	X
78.968	26.474	NP82-316	153		X		X	X
78.924	25.769	NP82-317	142	1	X	1.3		X
78.932	25.000	NP82-318	207		X			X

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	
78.898	23.735	NP82-320	181	1	X			
79.008	23.076	NP82-321	99	1	X	1.8		
79.254	22.754	NP82-323/2	39	2		1.1		
79.242	22.797	NP82-324	43	2		0.6		
79.241	22.823	NP82-325	49	2				
79.245	22.804	NP82-326	45	2		1.7		
79.253	22.737	NP82-327	44	2		0.5		
80.097	30.947	NP82-329	152		X			
80.065	30.352	NP82-330	231		X			
80.163	29.497	NP82-331	333		X			
80.116	28.774	NP82-332	101		X			
80.903	19.803	NP82-333	150		X			
81.162	20.063	NP82-334	318		X			
81.383	20.500	NP82-335	884	1				

TABLE 6A. STATION DATA FOR SEDIMENT SAMPLING, (NP83-CORE:STDT)
NORSK POLARINSTITUTT, 1983.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
74.493	20.050	NP83-1	81	2	X	1.2		
75.321	22.440	NP83-2/3	48	2/7	X	0.5/2.0B		
75.748	21.716	NP83-3	39	2	X	0.2		
76.110	23.573	NP83-4	40		X			
76.161	23.791	NP83-5/2	55	1	X	0		
76.120	23.320	NP83-6/3	40	2/7		0.1/5.5B		
76.023	25.996	NP83-8	133		X			
76.006	26.525	NP83-9	168		X			
75.966	27.516	NP83-11	237		X			
75.950	28.333	NP83-12	197		X			
75.633	27.750	NP83-13	245	1	X	0.7		
75.685	29.540	NP83-15	315		X			
75.663	31.325	NP83-16	353		X			
75.650	34.300	NP83-19	200	1		1.5		
75.558	34.233	NP83-20	174	1		1.3		
75.733	34.383	NP83-21/2	191	1/2	X	1.8		
76.825	34.043	NP83-23/4	130	1/2/7		0.6/4.5B		
76.735	34.020	NP83-24/3	127	2/7		0.7/5.5B		
77.001	33.811	NP83-25/2	165	1/7		1.5/4.5B		
79.191	23.976	NP83-26/2	70	2	X	0.8		
79.181	23.980	NP83-27	75	2	X	0.4		
79.168	23.948	NP83-28	73	2	X	3.0		
79.141	23.966	NP83-29	91	2	X	1.2		
79.200	23.353	NP83-30	76	2	X	0.5		
79.193	23.375	NP83-31	92	2		1.0		
79.216	23.138	NP83-32	54	2		0.5		
79.211	23.133	NP83-33	70	2		0.7		
79.208	23.103	NP83-34	78	2		3.2		
79.195	23.060	NP83-35	96	2		1.0		
79.228	23.053	NP83-36	78	2		0.8		
79.200	23.213	NP83-37/2	57	2		0.7		
79.240	22.815	NP83-38	42	2		2.7		

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	
79.221	22.771	NP83-39	43	2		0.5		
79.213	22.781	NP83-40	50	2		0.2		
78.331	34.481	NP83-41/3	114	2/7		0.0/5.5B		
79.261	31.735	NP83-42	155	2		1.0		
79.148	31.206	NP83-43/3	19	2/7	X	0.1/1.5B		
79.008	30.583	NP83-44	25	7		1.2B		
79.038	31.823	NP83-45/4	125	2/7	X	0.1/5.0B		
79.515	30.570	NP83-46/2	77	2/7		1.6/2.6B		

TABLE 7A. STATION DATA FOR SEDIMENT SAMPLING, (NP84-CORE:STDT)
NORSK POLARINSTITUTT, 1984.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
78.921	26.351	NP84-1	102	6	X			
78.916	26.144	NP84-2	110	6	X			
79.015	26.224	NP84-3	168	6	X			
78.997	25.969	NP84-4	172	6	X			
78.969	25.641	NP84-5	182	6	X			
79.067	25.491	NP84-6	219	6	X			
79.121	25.764	NP84-7	220	6	X			
79.102	26.347	NP84-8	232	6	X			
79.123	26.339	NP84-9	246	6	X			
79.112	26.342	NP84-10	260	6	X			
79.065	25.972	NP84-11	225	1	X	0.60		
79.086	25.968	NP84-12	236	1	X	0.85		
79.144	25.952	NP84-13	248	1	X	1.30		
79.232	26.203	NP84-14	266	6	X			
79.232	26.203	NP84-15	212	6	X			
79.255	25.465	NP84-16	124	6	X			
79.309	25.607	NP84-17	112	6	X			
79.377	25.936	NP84-18	128	6	X			
79.293	25.935	NP84-19	90	6	X			
79.411	26.182	NP84-20	68	6	X			

TABLE 8A. STATION DATA FOR SEDIMENT SAMPLING, (NP85-CORE:STDT)
NORSK POLARINSTITUTT, 1985.

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
78.819	21.870	NP85-1	50	6	X			
78.827	21.938	NP85-2	60	6				
78.833	22.070	NP85-3	71	6	X			
78.840	22.138	NP85-4	90	6				
78.848	22.266	NP85-5	110	6	X			
78.865	22.522	NP85-6	125	6				
78.885	22.905	NP85-7	141	6	X			

POSITION NORTH	EAST	STATION ID./NO. OF SAMPL.	WATER DEPTH (m)	SAMPLE TYPE	BOTTOM PHOTO	CORE-LENGTH (m)	WATER SAMPLES	SUSP
78.915	23.458	NP85-8	155	6	X			
78.922	23.630	NP85-9	170	6	X			
78.954	24.178	NP85-10	185	6	X			
78.962	24.329	NP85-11	200	6	X			
78.971	24.525	NP85-12	215	6	X			
79.183	23.468	NP85-13	91	6				
79.135	23.535	NP85-14	109	6	X			
79.050	23.602	NP85-15	105	6	X			
78.993	23.667	NP85-16	134	6	X			
78.856	23.848	NP85-17	178	6	X			
78.860	24.219	NP85-18	168	6	X			
78.865	24.834	NP85-19	164	6				
79.001	24.891	NP85-20	216	6				
79.056	24.430	NP85-21	158	6	X			
79.082	24.886	NP85-22	180	6				
79.212	24.667	NP85-23	134	6				
79.250	24.742	NP85-24	80	6	X			
79.308	24.874	NP85-25	52	6	X			
78.848	23.507	NP85-26	153	1				
78.933	24.378	NP85-27	202	1				
79.017	25.083	NP85-28	218	1				
79.143	24.843	NP85-29	157	1				

APPENDIX 3B

Legend at the end of each table.

APPENDIX 3B TABLE 1B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES COLLECTED BY NORSK POLARINSTITUTT, 1971. (NP71-CORE:ANDT)

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP71-1												
NP71-2												
NP71-3				X								3
NP71-4/2	0-3	X			C-----BULK-----RF	----BULK M/T---RF	F,O					1,2,4,5
NP71-5				X	------BULK-------							11
NP71-6												
NP71-7				X	------BULK-------							11
NP71-8/2												
NP71-9/2								X				
NP71-10												
NP71-11/2												
NP71-12/2	0-3	X		X	C-----BULK-------	----BULK M/T---RF						1,3,4
NP71-13/2							F,O					2,5
NP71-14/2	0-3	X			C-----BULK-----RF	----BULK M/T---RF						1,4
NP71-15					------BULK-----RF	----BULK M/T---RF						1,4
NP71-16	0-3	X			C-----BULK-------		F					1,2
	40-50	X			C-----BULK-------							1,2
NP71-17												
NP71-18/3												
NP71-19/3												
NP71-20/2	0-3	X			------BULK-------	----BULK M/T-----						1,4
NP71-21/3												
NP71-22/2												
NP71-23/3												
NP71-24/2												
NP71-25/3		X		X								3
NP71-26												
NP71-27/2												
NP71-28/2												
NP71-29/2												
NP71-30/2	0-3	X		X	C-----BULK-------	----BULK M/T-----						1,4,11
NP71-31/2												
NP71-32												
NP71-33		X		X					R			3
NP71-34												
NP71-35/2	0-3	X			------BULK-------	----BULK M/T-----		X				1,4
NP71-36/3				X								11
NP71-37	0-3	X			------BULK-------	----BULK M/T-----						1,4
NP71-38												
NP71-39	0-3	X			------BULK-------	----BULK M/T-----						1,4
NP71-40				X	------BULK-------							11
NP71-41/2	0-3	X										
	110-120	X										
NP71-42/3		X		X					R			3
NP71-43/2		X		X								3
NP71-44/2												
NP71-45/2												
NP71-47/3												
NP71-48/2												
NP71-49/2												
NP71-50/2												
NP71-51/2				X	------BULK------							
NP71-52/2												11
NP71-53/2												
NP71-54												
NP71-55												
NP71-56	0-3	X		X	------BULK-------	----BULK M/T-----						
NP71-57/2									R			1,3,4
NP71-58/2	0-3	X		X	------BULK-----RF	----BULK M/T---RF	F,O					2,5
												1,3,4,11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP71-59				X	------BULK-------							11
NP71-60				X	------BULK-------	RF						4,11
NP71-61												
NP71-62	0-3	X			------BULK-------	----BULK M/T-----						1,4
NP71-63				X				X				11
NP71-64		X		X					R			3,11
NP71-65												
NP71-66	0-3	X		X	C--BULK--X---X,RF	M M M,RF*	F					1,2,3,4
	7-10	X			------BULK-------	----BULK M/T-----						1,4
	10-20				------BULK-------	----BULK M/T-----						1,4
	20-30				------BULK-------	----BULK M/T-----						1,4
	30-40	X			C-----BULK-------	----BULK M/T-----						1,4
NP71-67												
NP71-68	0-3	X		X	------BULK-----RF	----BULK M/T---RF		X				1,3,4
NP71-69				X	------BULK-------							11
NP71-70/2												
NP71-71/2												
NP71-72/2	0-3	X		X	------BULK-----RF	----BULK M/T---RF	F					1,2,4,11
NP71-73/2												
NP71-74/4		X		X	------BULK-------				R			3,11
NP71-75/2					------BULK-----RF	RF						1,4
NP71-76/2		X		X								3,11
NP71-77/2		X		X	------BULK-------				R			3,11
NP71-78/2				X	------BULK-------							11
NP71-79/3				X	------BULK-------							?,11
NP71-80/2	0-3	X			C-----BULK-----RF	----BULK M/T---RF						1,4
NP71-81/2	0-3	X						X				1,4
NP71-82/2												
NP71-83												
NP71-84/2												
NP71-85/2							F,O					2,5
NP71-86	0-3	X		X	------BULK-----RF	----BULK M/T---RF		X				1,4,11
NP71-87				X	------BULK-------		F					2,11
NP71-88												
NP71-89					----- BULK-----RF	RF						1,4
NP71-90	0-3	X			C-----BULK-------	----BULK M/T-----	F					1,2,4
	3-10	X			C-----BULK-------	----BULK M/T-----						1,4
	30-40	X			C--BULK--X----X--	M M M *						1,4
NP71-91/2							F,O					2,5
NP71-92/2	0-3	X			------BULK-------			X				1,4
NP71-93/2	0-3	X			------BULK-----RF	----BULK M/T---RF		X				1,4
NP71-94/2												
NP71-95												
NP71-96/2	0-3	X			------BULK-----RF	----BULK M/T---RF	F					1,2,4
NP71-97/2		X		X	------BULK-------							3,11
NP71-98/2	0-3	X										?
NP71-99/2	0-3	X		X	C-----BULK-----RF	----BULK M/T---RF	F				X	1,2,3,4
NP71-100	0-3	X			C-----BULK-------							1
NP71-101												
NP71-102/2	0-3	X		X			F					2,11
NP71-103/2				X	------BULK-------							11
NP71-104/3				X								11
NP71-105/2												
NP71-106/2				X								11
NP71-107/2	0-3	X		X	C-----BULK-----RF	----BULK M/T---RF						1,4,11
NP71-108/2												
NP71-109/2	0-3					----BULK M/T-----	F					2,4
	80-90					----BULK M/T-----						4
NP71-110/2				X								11
NP71-111/3				X								11
NP71-112/2	0-3			X		----BULK M/T-----						4,11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP71-113/2				X								11
NP71-114/2												
NP71-115/2	0-10	X			C-----BULK-------	----BULK M/T-----	F					1,2,4
	100-110	X			C-----BULK-------	----BULK M/T-----						1,4
NP71-116/2							F					2
NP71-117/2												
NP71-118/2												
NP71-119/2												
NP71-120/2												
NP71-121												
NP71-122/2					------BULK-----RF							1
NP71-123/3				X								11
NP71-124												
NP71-125				X								11
NP71-126-1	0-3	X			C-----BULK-------	----BULK M/T---RF	F					1,4
	3-10	X			C-----BULK-----RF	----BULK M/T---RF						1,4
	20-30	X			C-----BULK-------	----BULK M/T---RF						1,4
NP71-126-2				X								11
NP71-127				X								11
NP71-128												
NP71-129/2												
NP71-130/3												
NP71-131/2												
NP71-132/3	0-3	X			C-----BULK-------	----BULK M/T---RF	F					1,2,4
	3-10	X			C-----BULK-------	----BULK M/T---RF						1,4
	100-110	X			C-----BULK-----RF	----BULK M/T---RF						1,4
NP71-133/2												
NP71-134/2												
NP71-135/2												
NP71-136/2				X								11
NP71-137/2												
NP71-138/2												
NP71-139/2	0-3	X			C-----BULK-------	----BULK M/T-----	F					1,2,4
	3-10	X			C-----BULK-------	M M M *						1,4
	100-110	X			C--BULK--X-------	M M M *						1,4
NP71-140												
NP71-141												
NP71-142												
NP71-143												
NP71-144												
NP71-145/2				X								11
NP71-146												
NP71-147	0-3					----BULK M/T---RF	F					2,4
	3-10					----BULK M/T---RF						4
	40-50				------BULK-----RF	----BULK M/T---RF						1,4
NP71-148/2												
NP71-149												
NP71-150												
NP71-151												
NP71-152	0-3	X			C-----BULK-------	M M *	F					1,4
	3-10	X			C--BULK--X----X--	M M M *						1,4
	100-110	X			C--BULK--X---X,RF	M M M *						1,4
NP71-153												
NP71-154							F,O					2,5
NP71-155	0-3	X			C-----BULK-------	M M *	F					1,2,4
	3-10	X			C-----BULK-------	----BULK M/T-----						1,4
	110-120	X			C-----BULK-------	M M						1,4
NP71-156							F,O					2,5
NP71-157												
NP71-158												
NP71-159/2				X								11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP71-160												
NP71-161												
NP71-162												
NP71-163							F,O					2,5
NP71-164/2												
NP71-165/2												
NP71-166/2	0-3	X			C-----BULK-------	----BULK M/T-----	F,O					1,2,4,5
NP71-167				X								11
NP71-168				X								11
NP71-169							F,O					2,5
NP71-170/2	0-3	X		X	------BULK-------	----BULK M/T-----			R			1,3,4
NP71-171				X	------BULK-------							11
NP71-172												
NP71-173												
NP71-174		X		X	------BULK-------				R			3,11
NP71-175												
NP71-176		X		X								3

NOTES:
*) ALSO ANALYSIS OF MAIN AND TRACE ELEMENTS ON BULK FRACTION.
SAMPLEINTERVAL IS NOT ALLWAYS GIVEN FOR SPECIFIC ANALYSES.
MINERALOGY: C = ANALYSIS OF CLAY-MINERALS
RF= ANALYSIS OF ROCK FRAGMENTS
GEOCHEMISTRY: RF= ANALYSIS OF ROCK FRAGMENTS
M = ANALYSIS OF MAIN ELEMENTS
T = ANALYSIS OF TRACE ELEMENTS
FOSSILS: F = FORAMINIFERAS
O = OSTRACODES

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TABLE 2B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES (NP77-CORE:ANDT)
COLLECTED BY NORSK POLARINSTITUTT IN 1977.

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP77-1																			
NP77-2																			
NP77-3																			
NP77-4																			
NP77-5																			
NP77-6																			
NP77-7																			
NP77-8																			
NP77-9																			
NP77-10																			
NP77-11																			
NP77-12																			
NP77-13	0-5	X											F			P			
	20-25	X											F			-			
NP77-14	0-5	X														-			
	55-61	X														P			
	95-100	X																	
	110-115	X														-			
NP77-15	0-4	X														-			
	8-11	X																	
	16-23	X														P			
	35-40	X																	
	55-60	X														-			
NP77-16																			
NP77-17																			
NP77-18																			
NP77-19																			
NP77-20																			
NP77-21																			
NP77-22																			
NP77-23																			
NP77-24																			
NP77-25																			
NP77-26																			
NP77-27																			
NP77-28																			
NP77-29	0-5	X														-			
	35-40	X														P			
	50-55	X																	
	110-115	X														-			
NP77-30	0-3	X																	
	31-37	X															W		
	60-65	X																	
NP77-31																			
NP77-32																			
NP77-33																			
NP77-34																			
NP77-35																			
NP77-36																			
NP77-37																			
NP77-38	0-5	X																	
	20-25	X																	
	75-80	X																	
NP77-39	0-3	X											F						
	15-18	X																	
	30-40																W		
	44-48	X															W		
	80-82	X																	
	90-96																W		

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	REF.
NP77-39	98-103	X																	
	105-120												F						
	115-120	X																	
NP77-40																			
NP77-41																			
NP77-42																			
NP77-43																			
NP77-44	0-5	X																	
	30-40																W		
	41-43	X																	
	60-65	X																	
	96-100	X																	
	110-113	X															W		
NP77-45																			
NP77-46																			
NP77-47																			
NP77-48	0-5	X														-			
	20-25	X														P			
	42-47	X														-			
NP77-49	0-7	X														-			
	48-53	X														P			
	80-85	X														-			
	110-112	X																	
NP77-50																			
NP77-51																			
NP77-52																			
NP77-53																			
NP77-54	0-3	X											F						
	10-20																W		
	15-20	X																	
	60-63	X																	
	90-100																W		
	100-105	X											F						
	120-130	X																	
NP77-55																			
NP77-56																			
NP77-57																			
NP77-58																			

NOTES:
UNPUBLISHED DATA, NORSK POLARINSTITUTT.

FOSSILS: F=FORAMINIFERAS
O=OSTRACODES
PHOTO: P=PHOTO OF CORE
R=RADIOGRAPHY OF CORE
GEOTECH.: W=WATER CONTENT
S=SHEAR STRENGTH
A=ATTERBERG LIMITS
D=BULK DENSITY
C=CONSOLLIDATION TEST (OEDOMETER)

TABLE 3B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES (NP80-CORE:ANDT)
COLLECTED BY NORSK POLARINSTITUTT IN 1980.

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-1													O							5
NP80-2-1	0-5												O				S			5
	91-94																S			
NP80-2/2																				
NP80-3/2																				
NP80-4-1	0-5																S			
	225-230																S			
NP80-4/2																				
NP80-5-2	0-5																S			
	275														X					
	BOTTOM																S			
NP80-6/3																	S			
NP80-7-2	0-5	X			X	X			M	M							S		X	7
	10-15	X			X	X			M	M									X	7
	22-25	X			X	X			M	M									X	7
	30														X					7
	50-52	X			X	X			M	M									X	7
	55-58				X	X			M	M									X	7
	58-61				X	X			M	M									X	7
	64-67				X	X			M	M									X	7
	69-70				X	X			M	M									X	7
	75-77	X			X	X			M	M									X	7
	89-90	X			X	X			M	M									X	7
	120-125	X			X	X			M	M									X	7
	140																S			
NP80-7-3	0-5			X	------BULK------												S			11
	67																S			
NP80-8-1	0-5																S			
	105																S			
NP80-8-2	0-5																S			
	62																S			
NP80-9-2	0-5																S			
	100																S			
NP80-10-1	0-3	X			X	X			M	M							S		X	7
	6-11	X			X	X			M	M									X	7
	15-20	X			X	X			M	M									X	7
	41-44	X			X	X			M	M									X	7
	65-70	X			X	X			M	M									X	7
	144-146	X			X	X			M	M									X	7
	194-196	X																		7
	195-200				X	X			M	M									X	7
	215																S			
NP80-10-2	0-5																S			
	170																S			
NP80-11-2	0-5																S			
	40																S			
NP80-11-3	0-5			X	------BULK-------												S			11
	35																S			
NP80-12-1	0-5																S			
	50																S			
NP80-12-2				X	------BULK-------															11
NP80-13-2	0-5	X			C				M	M						-	S		X	10
	45-50	X			C											R				10
	70-75	X			C															10
	123-128	X			C											-				10
NP80-13-3	0-5			X	------BULK-------												S			11
	105																S			
NP80-14-1	0-3	X		X	X--BULK--X-------				M	M						-	S		X	7,11
	115																S			

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-14-2	0-5	X			C				M		M					R	S		X	10
	15-20	X			C				M		M									10
	40															-				10
	45-50	X			C				M		M									10
	70-75	X			C				M		M									10
	130-135	X			C				M		M									10
	158-163	X			C				M		M						S			10
NP80-15-2	0-5	X		X	----X-BULK-------								0				S		X	5,8,11
	200												0				S			5
NP80-16-1	0-5			X	------BULK-------												S			11
	45-70														X					
	175-200														X					
	205																S			
NP80-16-2	0-3	X			X		X		M		M						S		X	7
	10-13	X																		
	16-19	X																		
	25-28	X																		
	74-78	X																		
	126-130	X																		
	193-197	X																		
	210																S			
NP80-17-1				X	------BULK-------											-				11
NP80-17-2	0-3	X			C				M		M					R	S		X	10
	10-15	X			C				M		M					-				10
	42-47	X			C				M		M					-				10
	55-60	X			C				M		M					R				10
	70-75	X			C				M		M					-				10
	85																S			10
NP80-18/3				X	------BULK-------															11
NP80-19-1	0-3	X		X	X--BULK--X-------				M		M		F						X	5,7,8,11
NP80-19-2	0-2	X															S			
	5-7	X																		
	9-11	X																		
	18-20	X																		
	55																S			
NP80-20/3				X	------BULK-------															11
NP80-21-3	0-5			X									0,F				S			5,11
	135																S			
NP80-22-1	0-5	X		X	------BULK-------								0				S			5,8,11
	30																S			
NP80-22-2	0-5																S			
	75																S			
NP80-23-2	0-3	X			C				M		M		0,F			R̄	S			5,10
	68-72	X			C				M		M					-				10
	86-91	X			C				M		M						S			10
NP80-23-3	0-5			X	------BULK-------												S			11
	20																S			
NP80-24-1	0-5			X	------BULK-------												S			11
	160																S			
NP80-25/3				X	------BULK-------															11
NP80-26/3				X	------BULK-------															11
NP80-27/2				X	------BULK-------															11
NP80-28/2				X	------BULK-------															11
NP80-29-1	0-3	X			C	X	X		M		M						S		X	7,8,10
	39-43	X			C				M		M									10
	72-76	X			C				M		M									10
	62-87															R				10
	95-100	X			C				M		M									10
	105																S			10
NP80-29-2				X	------BULK-------															11
NP80-30-3	0-5	X		X	----X--BULK------								0				S		X	5,8,11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-30-3	85															S			
NP80-31-1	0-5	X				X							0			S		X	5,8
	215															S			
NP80-31-2	0-5			X	------BULK-------											S			11
	200															S			
NP80-32-2	0-5	X				X							0,F			S		X	5,8
	200															S			
NP80-32-3	0-5			X	------BULK-------											S			11
	250															S			
NP80-33-1	0-5			X	------BULK-------								0,F			S		X	5,11
	50															S			
NP80-34				X															11
NP80-35				X	------BULK-------														11
NP80-36-2	0-5			X	---X--BULK------								0,F			S			5,8,11
	225															S			
NP80-37-1	0-5	X			X								0,F			S			5,8
	15-17				X														8
	53-59	X			X														8
	83-88	X			X														8
	107-113	X																	8
	143-147	X																	8
	147-151	X																	8
	155-158	X																	8
	182-186	X																	
	212-220	X																	
	225															S			
NP80-37-2				X															11
NP80-38-2	0-5	X		X	----X---BULK-----								0,F						5,8,11
NP80-39-2	0-5	X		X	----X---BULK-----								0,F			S			5,8,11
	25															S			
NP80-40				X	------BULK-------														11
NP80-41																			
NP80-42/2																			
NP80-43				X	------BULK-------														11
NP80-44-1	0-5	X											0,F			S			5,8
	55															S			
NP80-44-2	0-5	X														S			
	25															S			
NP80-45-1	0-5	X		X	------BULK-------								0,F			S			5,8,11
	40															S			
NP80-46	0-5	X														S			8
NP80-47				X															11
NP80-48-2	0-5			X	------BULK-------								F			S			5,11
	180															S			
NP80-48-3	0-3	X			C				M		M				-	S		X	10
	10-15	X			C				M		M								10
	50-53	X			C				M		M				R				10
	100-103	X			C				M		M								10
	150-153	X			C				M		M								10
	188-191	X			C				M		M				-				10
	200															S			
NP80-49-1	0-5															S			
	225															S			
NP80-50-2	0-5			X	------BULK-------								F			S			5,11
	145															S			
NP80-50-3	0-3	X			X	X	X		M		M							X	7,8
	13-14	X			X		X		M		M							X	7
	27-28	X			X		X		M		M							X	7
	41-42	X			X		X		M		M							X	7
	55-56	X			X		X		M		M							X	7
	96-97	X			X		X		M		M							X	7

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-50-3	151-152	X			X		X		M		M							X	7
	225-230				X		X		M		M							X	7
	229-230	X																	
NP80-51-1				X	------BULK-------											S			11
NP80-51-2																S			
NP80-52	0-5	X		X	------BULK-------								F					X	5,8,11
NP80-53-1	0-3	X			C				M		M		0,F		R̄	S		X	5,8,11
	50-53	X			C				M		M								10
	65														_	S			
NP80-53-2																			
NP80-54-2	0-5			X	------BULK-------								F			S			5,11
	65															S			
NP80-55-1	0-5	X											F			S			5,8
	250															S			
NP80-55-2	0-5															S			
	265															S			
NP80-56-2	0-5	X		X	------BULK-------								0,F			S			5,8,11
	35															S			
NP80-57-1	0-5	X											F			S			5,8
	160															S			
NP80-57-2				X												S			11
NP80-58-2	0-5	X											0,F			S			5,8
	145															S			
NP80-59-1	0-5	X		X									F			S			5,8,11
	255															S			
NP80-59-2	0-5															S			
	255															S			
NP80-60-2	0-5	X											F			S			5,8
	175															S			
NP80-60-3	0-5			X												S			11
	130															S			
NP80-61/2		X		X	------BULK-------								F						5,8,11
NP80-62-3	0-5	X											0,F			S			5,8
	55															S			
NP80-63-4	0-5															S			
	17															S			
NP80-63/3				X	------BULK-------														11
NP80-64-2	0-5	X		X		X							0			S			5,8,11
	130															S			
NP80-65	0-7	X											0,F						5,8
	7-13	X																	8
	23-28	X																	8
	33-38	X																	8
	48-53	X																	8
	60-64	X																	8
NP80-66-2	0-5	X				X							0,F			S			5,8
	140															S			
NP80-67	0-11	X											0,F						5,8
	0-7	X				X													8
	13-19	X																	8
	46-50	X																	8
	66-69	X																	8
NP80-69	0-10	X				X							0,F						5,8
	16-21	X																	8
	21-26	X																	8
	47-52	X																	8
	61-66	X																	8
	75-78	X																	8
NP80-71	0-5	X				X													8
NP80-84/3	0-5	X				X							0,F						5,8
NP80-85/2	0-5	X		X	----X--BULK------								0						5,8,11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-86-1	0-5	X				X							0			S		X	5,8
	38															S			
NP80-86-2	0-5			X	------BULK-------											S			11
	30															S			
NP80-87-2	0-5	X				X							0			S		X	5,8
	180															S			
NP80-88-1	0-5	X				X							0,F			S			5,8
	160															S			
NP80-88-3	0-5	X			C				M		M				-	S		X	8,10
	50-53	X			C				M		M				R				10
	122-125	X			C				M		M								10
	140-152	X			C				M		M				-				10
	190-193	X			C				M		M								10
	225															S			
NP80-89/3	0-5	X				X							0						5,8
NP80-90-2	0-5	X				X										S			8
	210															S			
NP80-90-3	0-5															S			
	40															S			
NP80-91-1	0-5	X											0,F			S			5,8
	230															S			
NP80-91-3	0-5															S			
	200															S			
NP80-92/4																			
NP80-93/4	0-5	X											0,F						5,8
NP80-94																			
NP80-95																			
NP80-96																			
NP80-97																			
NP80-98																			
NP80-99																			
NP80-100																			
NP80-101/3	0-5	X											F						5,8
NP80-102-1	0-5	X											0,F			S			5,8
	(55)															S			
NP80-102-2/3	0-5															S			
	(60)															S			
NP80-103-1	0-5															S			
	(60)															S			
NP80-104/2	0-5	X														S			8
NP80-105-2	0-5	X			C				M		M		0,F			S			5,8,10
	6-9	X			C				M		M								10
	14-17	X			C				M		M								10
	26													X					
	28-32	X			C				M		M								10
	41-44	X			C				M		M								10
	0-50														R				
	50															S			
NP80-105-3	0-5															S			
	(45)															S			
NP80-106-1B	0-5	X			C				M		M					S			10
	30-35	X			C				M		M			X					10
	(45)															S			
NP80-106/3	0-5	X		X	------BULK-------								0,F						5,8,11
NP80-107-4	0-5	X		X	------BULK-------								0,F			S			5,8,11
	(60)															S			
NP80-108-1	0-5	X											0,F			S			5,8
	275															S			
NP80-108-2	0-5															S			
	240															S			
NP80-109/4	0-5	X											F						5,8

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-110/2				X	------BULK-------											11
NP80-111/2	0-5	X		X						0,F						5,8,11
NP80-112/2	0-5	X		X	------BULK-------											8,11
NP80-113-1	0-5	X								0,F			S			5,8
	75												S			
NP80-113-2	0-5			X	------BULK-------								S			11
	35												S			
NP80-114/3	0-5	X		X	------BULK-------					0						5,8,11
NP80-115-1	0-5	X								0,F			S		X	5,8
	50												S			
NP80-115-3	0-5			X									S			11
	40												S			
NP80-116-1	0-5	X								0,F			S			5,8
	BOTTOM												S			
NP80-116-3	0-5			X									S			11
	55												S			
NP80-117/3				X	------BULK-------											11
NP80-118-2	0-5	X			C	M		M		0,F			S		X	5,8,10
	45-50	X			C	M		M								10
	90-95	X			C	M		M								10
	110-115	X			C	M		M					S			10
NP80-118-3	0-5			X	------BULK-------								S			11
	75												S			
NP80-119-2	0-5			X	------BULK-------					0			S			5,11
	40-160											R				
	210												S			
NP80-119-3	0-5	X			C	M		M					S		X	10
	25-27	X			C	M		M								8,10
	95-97	X			C	M		M								10
	127-129	X			C	M		M								10
	150-152	X			C	M		M								10
	165												S			
NP80-120-1	0-5												S			
	10										X					
	185												S			
NP80-120-2	0-5			X	------BULK-------								S		X	11
	165												S			
NP80-121-2	0-5	X		X	------BULK-------					0,F			S		X	5,8,11
	120												S			
NP80-122				X	------BULK-------											11
NP80-123/2				X	------BULK-------											11
NP80-124-2	0-3	X			C X	M		M		0						5,8,10
	15-17	X			C	M		M								10
	45-47	X			C	M		M								10
	80-82	X			C	M		M								10
	37-105											R				
NP80-124/3				X	------BULK-------											11
NP80-125-1	0-5	X		X	----X--BULK------					0			S		X	5,8,11
	95												S			
NP80-126-2	0-5	X			C X	M		M		0		-			X	5,8,10
	34-38	X														10
	46-48	X			C	M		M				R				10
	50-52	X			C	M		M								10
	60-62	X			C	M		M								10
	62-65	X			C	M		M				-				10
NP80-126-3	0-5			X	------BULK-------								S			11
	60												S			
NP80-127/3	0-5	X		X	----X--BULK------					F					X	5,8,11
NP80-128-2	0-5	X		X	X					0			S		X	5,8,11
	40												S			
NP80-130				X												11

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2	GEOCHEMISTRY <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC-TC	REF.
NP80-131/3	0-5	X		X	----X--BULK------			O,F						5,8,11
NP80-132/2				X										11
NP80-133/3				X	------BULK-------									11
NP80-134-1	0-5	X			------BULK-------			O,F			S		X	5,8,11
	60										S			
NP80-135/2				X	------BULK-------									11
NP80-136/2								F						5
NP80-137-2A	0-5	X		X	C	M	M	O,F					X	5,8,10,11
	8-10	X			C									10
	35								X					
	50								X					
	72-76	X			C	M	M							10
NP80-138-1	0-5			X				O,F			S			5,11
	60										S			
NP80-138-2	0-5										S			
	165										S			
NP80-140-6	0-5	X			C	M	M							10
	7-9	X												10
	10-12	X			C									10
	60-63	X			C	M	M							10
NP80-140-1	0-5			X	------BULK-------						S			11
	30										S			
NP80-140-2	0-5										S			
	30										S			
NP80-141-1	0-5										S			
	235										S			
NP80-142-1	0-5										S			
	170										S			
NP80-143-1	0-5										S			
	225										S			
NP80-144-1	0-5										S			
	240										S			
NP80-145														
NP80-146														
NP80-147														
NP80-148														

NOTES:

REFERENCES:

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10) WENSAAS, L. 1986: EN SEDIMENTOLOGISK OG MINERALOGISK UNDERSØKELSE AV BUNNSEDIMENTER (<63um) FRA DET NORDLIGE BARENTSHAVET. C.SCIENT THESIS, UIO.
11) ANTONSEN, P. AND FLOOD, B. IN PREP.: C.SCIENT THESIS, UIO.

OTHER DATA: UNPUBLISHED, NORSK POLARINSTITUTT.

MINERALOGY: C=ANALYSIS OF CLAY-MINERALS
GEOCHEMISTRY: M=ANALYSIS OF MAIN ELEMENTS
FOSSILS: F=FORAMINIFERA
O=OSTRACODES
GEOTECH.: W=WATER CONTENT
S=SHEAR STRENGTH
A=ATTERBERG LIMITS
D=BULK DENSITY
C=CONSOLLIDATION TEST (OEDOMETER)

TABLE 4B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES (NP81-CORE:ANDT)
COLLECTED BY NORSK POLARINSTITUTT IN 1981.

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP81-101																				
NP81-102																				
NP81-103																				
NP81-104																				
NP81-105																				
NP81-106																				
NP81-107																				
NP81-108																				
NP81-109																				
NP81-110																				
NP81-111																				
NP81-112																				
NP81-113																				
NP81-114																				
NP81-115																				
NP81-116																				
NP81-117																				
NP81-118																				
NP81-119																				
NP81-120																				
NP81-121																				
NP81-136-1	0-5	X																	X/X	
	10																		X/X	
	19																S			
	44-47																S,W			
	47-50	X															S			
	60																S		X/X	
	75-78																A			
	85-88																W			
	90-93	X															S			
	100																		X/X	
NP81-137-1	0-2																		X/X	
	4																S			
	8																S			
	20																		X/X	
	29-32																S,W			
	33-35																W			
	42-47	X																		
	50-55	X																		
	59-62	X																		
	68														X					
	70-75	X															W			
	90																		X/X	
	115-118																W			
	124																		X/X	
NP81-137-3	0-5																			
	11																S			
	29-32																S,W			
	42-47	X															S			
	50-55	X																		
	65-68																W			
	70-73	X																		
NP81-138-1	0-3																S			
	17-20																W			
	20-23	X																		
	25																S			

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP81-138-1	50-53																S,W			
	54-57	X																		
	75																S			
	79-82																W			
	82-85	X																		
NP81-138-3	0-3																		X/X	
	20																		X/X	
	33-35																W			
	50																		X/X	
	60-64																W,S			
	80-85			X																
	95-97	X																		
	98-100																W			
	120-122																W			
	152-154																W			
	163																		X/X	
NP81-139																				
NP81-140-1	16-19	X																		
NP81-141-1	0-7																S			
	10-13																W,S(?)			
NP81-186	0-3																		X/X	
	8																S			
	30																		X/X	
	45-50	X															W,S			
	90																S			
	100																		X/X	
	105																S			
	107-110	X															W			
	120-125	X															W,S			
	135-140	X															W			
	150-153	X																	X/X	
NP81-216-1	0-3	X																	X/X	
	3-6	X																		
	19-21																W			
	30-33	X																		
	37-40	X															W			
	44	X															W,A?			
	50	X?															W,S,A?			
	56	X?															W,A			
	60																		X/X	
NP81-217/2																				

NOTES:
UNPUBLISHED DATA, NORSK POLARINSTITUTT.

TABLE 58. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES COLLECTED BY NORSK POLARINSTITUTT IN 1982. (NP82-CORE:ANDT)

STATION	DEPTH IN CORE (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	MINERALOGY (XRD) <63	MINERALOGY (XRD) SILT	MINERALOGY (XRD) SAND	GEOCHEMISTRY <2	GEOCHEMISTRY <63	GEOCHEMISTRY SILT	GEOCHEMISTRY SAND	FOSSILS MIC	FOSSILS MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP82-202																				
NP82-215																R				
NP82-217																				
NP82-218																				
NP82-219																				
NP82-224	5-13	X			X	X										R	W,S	X	X/X	
NP82-225-2	0-5	X				X													X/X	8
	10																S			
	19																W			
	22-24																			
	28															R				
	30																S			
	54																W			
	3-60																	X		
	58-61														X				X/X	
	68-72	X				X											S			
	75																W			
NP82-226	0-10	X				X										R	W,A,S	X	X/X	
NP82-229-1	0-5	X				X													X/X	8
	0-22																	X		
	18-22	X			X	X										R	W,S		X/X	
	28-32																W,S	X		
	41-46	X			X	X											W,S	X	X/X	
NP82-230-2	0-5	X			X	X											W,S		X/X	8
	0-46																	X		
	30-35	X			X	X													X/X	
	36-37																W			
	40																S			
	50-55	X				X											W	X	X/X	
NP82-231-3	3																W,S			
	0-7	X				X												X		8
	7-13	X															S	X	X/X	
	14																S			
	16																W			
	17															R	W	X		
	19																W			
	22-23																A			
	23-30	X																	X/X	
	7-34																	X		
	32																	X		
	34-40	X				X											W,S	X	X/X	
NP82-232-1	5																	X		
	10-15																C			
	15															R		X		
	20																	X		
	22																S			
NP82-232-2	0-5	X				X													X/X	8
	6-8																W,A			
	18-20																W			
	26-30																W			
	31															R	S			
	33	X																X		
	38-42					X											W,S		X/X	
	42-46	X															A			
	48-50	X															W,S	X		
NP82-233-1	0-3	X				X													X/X	8
	25-29																W			
NP82-233-2																R				
NP82-234-1	0-3	X				X										-			X/X	8

STATION	DEPTH IN CORE (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP82-234-1	10																			
	20-24															R	W			
	26-27																S			
	40																			
	68-70															-	W,S			
	75																S			
	85-90																			
	96-103															R	W,S,A			
	105-108																W			
	125-130	X															S		X/X	
	138-139															-	W,S			
	0-140																	X		
	150																			
	155																W			
	160																			
	164	X															S		X/X	
NP82-234-2	0-5	X															W		X/X	
	15-18																W			
	20																	X		
	35															R	C			
	50																	X		
	88-92																W			
	97-100																	X	X/X	8
	100-103	X																		
NP82-235-1	0-5	X				X														
	8																S			
	12-15																W			
	20																	X		
	29																S			
	46-49															R		X		
	52-56																S	X		
	57-64	X															W			
	87-90	X															S	X	X/X	
	90-96																			
	100-102																W,S			
	103-107	X															W,S			
NP82-236																R				
NP82-237	0-5	X				X											W		X/X	8
	10																S			
	12-14																W			
	20																			
	20-35																C			
	37-39															R	S			
	43-49	X			X	X											W		X/X	
	60																			
	63-67																S			
	85-88																W			
	95-100	X			X	X													X/X	
	106																W			
	0-106																	X		
NP82-238																				
NP82-239-1	0-5	X				X											W		X/X	8
	10																S			
	20-23															R	W,S			
	25-29																A			
	30-35	X				X											S			
	37																W		X/X	
NP82-239-2	0-5	X				X														8
	25-30	X														R				
NP82-240																				
NP82-241-1	0-5	X				X											W,S			8

STATION	DEPTH IN CORE (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP82-241-1	15-18																W,S			
	18-23	X														R				
	24-29																W,A			
	46																W,S			
NP82-242/2																				
NP82-243																				
NP82-246																				
NP82-251																				
NP82-253-1	0-5	X				X														8
	15-17																S			
	18-22																W			
	40																S			
	53-57																W			
	61-68																S	X		
	70																S			
NP82-253-2	30																S			
	55																S			
	100																S			
	150																S			
	200																S			
	225																S			
NP82-254																				
NP82-256																				
NP82-257																				
NP82-258																				
NP82-259																				
NP82-260																				
NP82-262																				
NP82-264																				
NP82-265																				
NP82-266																				
NP82-267																				
NP82-269																				
NP82-302																				
NP82-303	0-5																W,S			
	18-21																S			
	22-26																W			
	70																S			
	140																S			
	160-163																W			
NP82-304																				
NP82-305																				
NP82-306																				
NP82-307																				
NP82-308																				
NP82-309																				
NP82-310																				
NP82-311																				
NP82-312																				
NP82-314																				
NP82-316																				
NP82-317-1	0-5	X				X													X/X	
	12-15																W,S			8
	27-30																A			
	33																S			
	55																S			
	60-63																W,S			
	95-100																S,W			
	100-105																A,S			
NP82-317-2	10-13																W,S			
	27																S			

STATION	DEPTH IN CORE (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP82-317-2	45-47																S			
	63-65																W			
	91																S			
	105-107																W			
NP82-318																				
NP82-320	0-5	X				X														8
NP82-321-1	0-5	X			X															8
	6-7				X															
	8-9				X															
	10-11				X															
	12-13				X															
	13-16				X										-		W			
	16-17				X										X					
	17-20														-					
	20-23	X			X												S			
	23-24				X												S			
	26-27				X															
	29-30				X															
	32-33				X															
	36-37				X															
	39-40				X															
	42-46																W,A,S			
	50-58														X					
	55-58	X														R				
	85																S			
	105-108	X																		
	113-116																W,S			
	140																S			
	150-153	X																		
	168-171																S			
	173-176	X															W			
NP82-321-2	0-5	X																		8
	13-15																W,S			
	24-33																	X		
	40-42																S			
NP82-323-1	0-3	X				X											S		X/X	8
	20																	X		
	22-26	X																	X/X	
	50															R		X		
	63-68	X																	X/X	
	80																	X		
	86-94	X																	X/X	
	94-103	X															W			
NP82-323-2	0-5	X				X											S			8
	13-17																W,S	X		
	58-62	X				X												X		
	80-83															R	A			
	84-87																W			
	90-95	X				X											S	X		
	106	X				X														
NP82-324-1	0-4	X																	X/X	
	11															R	W			
	50-53	X															W,S	X	X/X	
	58-63	X																	X/X	
NP82-324-2																R				
NP82-325																R				
NP82-326-1	0-3	X																		
	15-18	X																		
	27-30																W			
	30-33	X																		
	55-58	X																		

STATION	DEPTH IN CORE (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	MINERALOGY (XRD) <63	MINERALOGY (XRD) SILT	MINERALOGY (XRD) SAND	GEOCHEMISTRY <2	GEOCHEMISTRY <63	GEOCHEMISTRY SILT	GEOCHEMISTRY SAND	FOSSILS MIC	FOSSILS MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP82-326-1	60-63															R	W			
	78-80																W			
	80-85	X																		
	85-90	X																		
	100-103																W			
	105-109	X																		
	124-128	X																		
	167-172	X																		
NP82-327-1	0-5	X				X													X/X	
	12-15																W			
	31-36	X														R			X/X	
	45-48	X																	X/X	
	49-51	X				X											W		X/X	
NP82-329																				
NP82-330																				
NP82-331																				
NP82-332																				
NP82-333																				
NP82-334																				
NP82-335	10																S			
	40																S			
	73																S			
	96																S			
	140																S			
	172																S			
	180																S			

NOTES:

REFERENCES

8) PFIRMAN, S.L. 1985: MODERN SEDIMENTATION IN THE NORTHERN BARENTS SEA: INPUT, DISPERSAL AND DEPOSITION OF SUSPENDED SEDIMENTS FROM GLACIER MELTWATER. PH.D. THESIS. WHOI/MIT.

OTHER DATA: UNPUBLISHED, NORSK POLARINSTITUTT.

TABLE 6B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES (NP83-CORE:ANDT)
COLLECTED BY NORSK POLARINSTITUTT IN 1983.

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP83-1	60-65																W,A,D			
NP83-2/3																				
NP83-3																				
NP83-4																				
NP83-5/2																				
NP83-6/3																				
NP83-8																				
NP83-9																				
NP83-11																				
NP83-12																				
NP83-13	0-5																D			
	10																S			
	30-35																A			
	40																S			
	0-50																	X		
NP83-15																				
NP83-16																				
NP83-19	5-10																W,S,A			
	15-20																W,S,D			
	21-25																A			
NP83-20	0-5	X																		
	10-15																D			
	20-25																A			
	0-50															R				
	60-70	X															D,W			
	50-100															R				
	120-130	X																		
NP83-21-1	18-25																A,D			
	55-60																A			
	60-65																D			
NP83-21-2	0-5	X																		
	34-38	X																		
	0-37															R				
	60-65																A,D			
	67-70																W			
	37-86															R				
	87-95	X															A,D			
	95-100																W			
	125-130	X																		
	140-145																D			
NP83-23-1	0-3	X															S			9
	15																S			9
	18-22	X															W,D			9
	20-25																A,D			9
	35																S			9
	0-45															R				9
	5-43																	X		9
NP83-23-2	0-5	X																	X	9
	20-25	X																		9
	0-33															R				9
	33-41															R	S			9
	41-45	X														R	W,D			9
NP83-23-4A									----- BULK -----											10
NP83-24-1	0-5	X																		9
	2-17																	X		9
	12-18	X															W,D,S			9
	15-20	X																		9
	25																S			9

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP83-24-2	0-5	X																		9
	30-35	X																		9
	0-38															R				9
	60-63	X																		9
	38-76															R				9
NP83-25	0-5	X?															S			9
	10-12																W,D			9
	0-22																	X		9
	20-25	X															S			9
	22-40																	X		9
	40																S			9
	54-56	X?															W,D			9
	63																S			9
	58-61	X																		9
	40-65	X																X		9
	67-69	X?																		9
NP83-26/2	0-5	X																		
	15-18	X																		
	30-35	X																		
	60-65	X																		
NP83-27	0-5	X																		
	10-20																W,D,A			
	20																	X		
	30-35	X																X		
NP83-28	0-5	X																		
	42																W			
	40-50																A,D			
	40-65																	X		
	60-65																W			
	95																S			
	95-190																	X		
	100-105	X																		
	185-280																	X		
	250-255	X																		
	270-277																W,D,A			
NP83-29	0-6	X			X															
	10																S			
	25-30																W,S,D,A			
	22-35																	X		
	40-45	X			X												S			
	55-62																A,W,S,D			
	50-65																	X		
	60-65	X			X															
	80-110																	X		
	100-105	X			X															
	110-115																A,W,D			
NP83-30	10-15	X																		
NP83-31	0-5	X											F							
	30-35	X															W,S,D			
	51																S			
	63												F				S		X/X	
	50-75	X			X													X		
	73-75																W,A			
	78-82																W,A,S,D			
NP83-32	15																S			
	26																S			
	50																S			
	57																S			
	60-65																W,A,D			
	65-70	X			X								F				S		X/X	
	0-75															R				

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP83-33	40									D			
NP83-34	0-5	X					F						
	50-60	X								W,A,D			
	33-83										X		
	95									S			
	140-145									W,A			
	95-190										X		
	190									S			
	190-305										X		
	180-275									S			
	250-255	X											
NP83-35	0-5	X								S			
	15-20									W,A,S,D			
	30-35	X								S			
	70-75									W,A,S,D			
	85-90	X											
	0-78										X		
NP83-36	10									S			
	11-15									W,D			
	20-25									A,S			
	35-41							X		W,S,D			
	44-49									W,D			
	50-55									A,S			
	65-70									S			
	35-70										X		
NP83-37-1	5									S			
	22									S			
	0-30								R				
	25-30									W,D			
	40									S			
	30-60								R				
	65-70									W,D			
NP83-37-2	0-5	X					F						
	40-43									W,A,S,D			
NP83-38	0-5	X											
	30-40									W,A,D			
	0-50								R				
	50-90										X		
	50-95								R	S			
	85-95									W,A,S,D			
	100-105	X											
	115-120									W,A,D			
	120-150							X					
	195-215										X		
	215-225	X								S			
	225-228									W,D			
	239-243	X								W			
NP83-39	0-5	X											
	60-65	X											
NP83-40													
NP83-41	8-12									D			
	44-48									D			
	70-75	X											
	92-97									D			
	100-105	X											
NP83-42													
NP83-43/3													
NP83-44													
NP83-45/4													
NP83-45-C				X		----- BULK -----							10
NP83-46-I				X		----- BULK -----							10

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2 <63 SILT SAND	GEOCHEMISTRY <2 <63 SILT SAND	FOSSILS MIC MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP83-46-II				X		----- BULK -----							10
NP83-46	20-25									D,A			

NOTES:
REFERENCES:
9) SOLHEIM, A., MILLIMAN, J.D. AND ELVERHØI, A. IN PREP.: SEDIMENT DISTRIBUTION AND SEA FLOOR MORPHOLOGY OF STORBANKEN; IMPLICATIONS FOR THE GLACIAL HISTORY OF THE NORTHERN BARENTS SEA.
10) WENSAAS, L. 1986: EN SEDIMENTOLOGISK OG MINERALOGISK UNDERSØKELSE AV BUNNSEDIMENTER (<63um) FRA DET NORDLIGE BARENTSHAVET. C.SCIENT THESIS, UIO.
OTHER DATA: UNPUBLISHED, NORSK POLARINSTITUTT.

TABLE 7B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES COLLECTED BY NORSK POLARINSTITUTT IN 1984. (NP84-CORE:ANOT)

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP84-1	0-5	X																	X	
NP84-2	0-5	X																	X	
NP84-3	0-5	X																		
NP84-4	0-5	X																		
NP84-5	0-5	X																	X	
NP84-6	0-5	X																		
NP84-7	0-5	X																		
NP84-8	0-5	X																		
NP84-9	0-5	X																		
NP84-10	0-5	X																		
NP84-11	0-5	X			X														X	
	10														X					
	20-24	X			X															
	33-36	X			X															
NP84-12																				
NP84-13	0-4	X			X															
	10-13	X			X															
	30-33	X			X															
	45-48	X			X															
	51-54	X			X															
	61-64	X			X															
NP84-14	0-5	X																		
NP84-15	0-5	X																		
NP84-16	0-5	X			X															
NP84-17	0-5	X			X															
NP84-18	0-5	X			X															
NP84-19	0-5	X																		
NP84-20	0-5	X																		

NOTES:
UNPUBLISHED DATA, NORSK POLARINSTITUTT.

TABLE 8B. ANALYSES CARRIED OUT ON SEDIMENT SAMPLES (NP85-CORE:ANDT)
COLLECTED BY NORSK POLARINSTITUTT IN 1985.

STATION	INTER-VAL (cm)	GRAIN SIZE DISTR.	PETR. CLASS.	THIN SECT.	MINERALOGY (XRD) <2	<63	SILT	SAND	GEOCHEMISTRY <2	<63	SILT	SAND	FOSSILS MIC	MAC	14C-DAT.	PHOTO	GEOTECH.	VEL.	TOC/TC	REF.
NP85-1	0-3	X											F							
NP85-2	0-3	X											F							
NP85-3	0-3	X											F							
	5-10	X																		
NP85-4	0-3	X											F							
NP85-5	0-3	X											F							
NP85-6	0-3	X											F							
NP85-7	0-3	X											F							
NP85-8	0-3	X											F							
NP85-9	0-3	X											F							
NP85-10	0-3	X											F							
NP85-11	0-3	X											F							
NP85-12	0-3	X											F							
NP85-13	0-3	X											F							
NP85-14	0-3	X											F							
NP85-15	0-3	X											F							
NP85-16	0-3	X											F							
NP85-17	0-3	X											F							
	6-10	X																		
NP85-18	0-3	X											F							
NP85-19	0-3	X											F							
NP85-20	0-3	X											F							
NP85-21	0-3	X											F							
NP85-22	0-3	X											F							
NP85-23	0-3	X											F							
NP85-24																				
NP85-25	0-3	X											F							
NP85-26	0-4	X			X															
	7-8				X															
	10-13	X			X															
	17-18				X															
	20-21	X			X															
	23-24				X															
	27-28				X															
	30-36	X			X															
	40-41				X															
	46-50	X			X															
	60-63	X			X															
	80-85	X			X															
	120-123	X			X															
NP85-27																				
NP85-28	0-3	X			X								F							
	15-18	X			X															
	40-44	X			X															
NP85-29	0-3	X			X															
	18-22	X			X															
	33-37	X			X															
	60-64	X			X															
	80-85	X			X															
	100-105	X			X															

NOTES:
UNPUBLISHED DATA, NORSK POLARINSTITUTT.