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REPORT

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Title:
Norwegian Petroleum Directorate gravity cores from the Barents Sea - core quality assessment and list of cores transferred to NGU

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Summary:
The Geological Survey of Norway has taken over 252 Norwegian Petroleum Directorate (NPD) gravity cores.

This report is a compilation of different activities within the project. The following topics are included:

- A quality assessment report including four cores.
- A list of the cores transferred to NGU Geodata Centre from NPD December 2001.
- A digital map showing the locations of the retrieved gravity cores in the Barents Sea.
- A CD with all photo-documentation from the visits to the core storage facility in Stavanger.
- Correspondence with NPD staff was undertaken concerning the handling and use of cores after the cores had been sampled in 1976 – 1979.

The original purpose for the cores was exploration for oil and gas in the Barents Sea using surface organic geochemistry. Several hundred cores were taken during the period 1976 – 1979, and later submitted for geochemical hydrocarbon gas analysis at Horovitz Laboratory in Houston, Texas. Unfortunately NPD has not been able to track the results from these analyses.

The quality assessment report shows that the cores appear to be in good condition, which will allow use of the gravity cores for different types of investigations. The core material can be used for logging methods as well as geochemistry. The total of 252 cores vary from approx. 100 cm to approx. 200 cm in length. The cores encompass a large geographical area in the Barents Sea.

The transfer of the gravity cores to NGU and the assessment of core quality provide opportunities for future regional studies in the Barents Sea, without the need for a re-sampling programme. The cost of a new sampling programme to collect a similar number of gravity cores would be in the order of several Mill. Norwegian kroner.

Marine sampling	Barents Sea	Gravity cores
Quality assessment		

CONTENT

FIGURES

TABLES

APPENDIX

1. INTRODUCTION

In 2000, the Norwegian Petroleum Directorate (NPD) offered the Geological Survey of Norway (NGU) to take over a large number of gravity cores from the Barents Sea. These cores were sampled during the late 1970s during a campaign for oil and gas exploration. NGU for its part decided to undertake a quality assessment of the core material prior to taking over cores stored in a former bomb shelter in Stavanger city, in order to determine whether more than 20 years of storage had done harm to the cores.

This document includes the report on quality assessment of the cores undertaken by NGU together with the Geological Institute, University of Tromsø, a list of the 252 gravity cores transferred to NGU, and maps showing the sampling locations for the gravity cores in the Barents Sea. All 252 gravity cores transferred to NGU (Table 1.1) are now stored at NGU's Geodata Centre in Løkken, south of Trondheim.In addition, four of these cores were used for the quality assessment presented in Chapter 2.

Table 1.1. Overview of the 252 gravity cores taken over by NGU from the NPD for the sampling years 1976, 1977 and 1978.

Sampling year	Number of cores sealed in PVC tubes	Number of cores with co-ordinates
1976	79	67
1977	134	133
1978	39	39

The gravity cores have mainly been sampled along latitude and longitude lines, and have been labelled accordingly in most cases. Table 1.2 lists the different sampling lines and the number of cores collected from each line. The gravity core locations are shown on the maps in Appendix 1 - firstly on an overview map and thereafter on maps with line number and core number for the years 1976, 1977 and 1978 respectively. The complete list of gravity cores taken over by NGU is presented in Appendix 2.

Previous reporting from the NPD-cores is included in Elverhøi and Solheim (1983a, 1983b). These reports mainly deal with surface sediment distribution as well as Quarternary stratigraphy.

Table 1.2. Sampling year, sampling line and number of cores retrieved from each line. The name of the line and gravitation core numbers are shown in the maps in appendix 1.

Sampling year	Line	Number of cores
1976	T1	7
1976	T2	11
1976	T3	6
1976	Z1	17
1976	Z3	35
1976	No code	3
1977	BGR16	14
1977	BG2100	4
1977	BG2600	4
1977	BG2700	3
1977	BG2800	17
1977	BG2900	13
1977	BG3030	20
1977	BG6925	1
1977	BG7150	4
1977	BG7310	30
1977	BG7330	13
1977	BG7400	11
1978	2300	13
1978	2400	5
1978	2500	8
1978	2600	1
1978	2700	10
1978	VG 32	1
1978	VG 33	1

2. INVESTIGATIONS OF NORWEGIAN PETROLEUM DIRECTORATE GRAVITY CORES FROM THE BARENTS SEA

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August 2001

Introduction

The aim of the investigation of four selected Norwegian Petroleum Directorate (NPD) gravity cores from the Barents Sea has been to evaluate the quality of the cores after more than 20 years of storage under cold and moist conditions in a hard rock bomb shelter room. The gravity cores were sampled in the period from 1976 to 1979 from the Barents Sea. In total approximately 950 cores are stored in Stavanger in the bomb shelter owned by the municipality. The cores constitute unique Quaternary sample material from the Barents Sea, from the Finnmark coast in the south to Svalbard to the north. The potential value of the cores is several million NOK if sampling were to be carried out again.

The following features have been studied:

- Core recovery
- Core sealing
- The degree of alteration of sediments due to oxidation during storage
- Quaternary stratigraphy through application of different logging techniques
- Carbonate dissolution
- A first indication of how the gravity cores can be used in future projects

Application of up to date core logging techniques in collaboration between the Department of Geology, University of Tromsø and the Geological Survey of Norway have given good indications for what the sediments consist of as well as a qualitative evaluation of the core material.

Location

The Barents Sea is an Arctic epicontinental sea (Fig. 2.1) bounded by a Tertiary sheared and rifted margin to the west (Eldholm et al. 1984). The bathymetry of its southwestern part is characterised by a central broad, west-east channel called the Bear Island Trough, which reaches a depth of 500 m. To the north is the shallow (ca. 100m) Spitsbergenbanken and to the south are bank areas of 300 to 200 m depth separated by the Ingøydjupet Trough running perpendicularly to the Norwegian coast. A large fan is situated in the front of the Bear Island Trough, typical for many glaciated shelves (Vorren 1992). The Barents Sea has been repeatedly glaciated during the Quaternary. During this period considerable erosion occurred on the Barents Sea shelf and a correspondingly high sediment accumulation occurred on the continental margin. In the southern Barents Sea a total thickness of ca. 1-km was eroded.

The investigated sediment cores are located along the east-west axis of the Bear Island Trough in the western Barents Sea (Fig. 2.1).

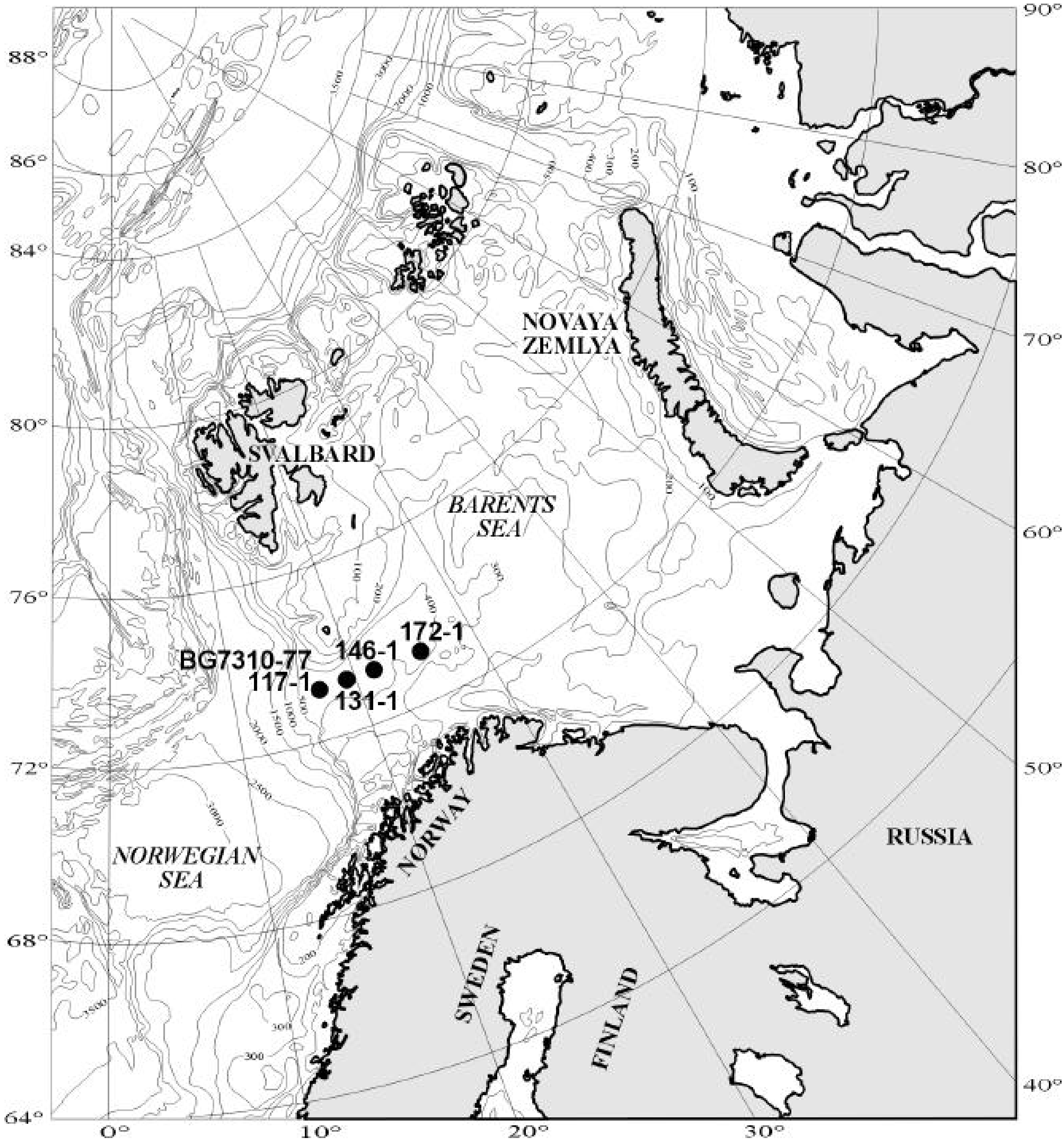

Fig. 2.1. Location map of the western Barents Sea showing the location of the investigated sediment cores. Bathymetry contours are in meters.

Material and methods

Four of the gravity sediment cores collected by the Norwegian Petroleum Directorate along 73º10' north latitude in 1977 were selected for the quality investigation (Table 2.1).

Core number	***Latitude (N)***	***Longitude (E)***	***Ocean depth (m)***	***Length (cm)***
BG7310-77 117-1	73º 11' 09.4"	16º 59' 41.8"	not reported	154
BG7310-77 131-1	73º 12' 45.5"	19º 19' 36.3"	not reported	118
BG7310-77 146-1	73º 12' 06.6"	21º 40' 41.1"	not reported	183
BG7310-77 172-1	73º 10' 09.7"	25º 42' 55.2"	not reported	201

Table 2.1. Investigated sediment cores from the western Barents Sea: latitude, longitude and core length.

The inner diameter of the gravity corer is 10 cm. The sealed cores were opened by splitting them longitudinally in two equal parts. One half was subjected to various geotechnical and sedimentological analysis: X-radiography; colour determination by using the Munsell Colour Charts; shear strength by the fall-cone test (Hansbo 1957); multi sensor core logging and investigation of the100-1, 000 µm fraction using a binocular microscope.

A Multi-Sensor Core Logger (MSCL) is an automated logging device that can measure p-wave travel time, bulk sediment density and magnetic susceptibility (Weber et al.1996; Gunn and Best 1998). P-wave velocity measurements are made by using simple transmission geometry with two vertically mounted compressional wave transducers located on opposite sides of the core. In order to derive sediment bulk densities the MSCL uses the technique of gamma ray attenuation. This method has the advantage of being non-destructive to the core. Magnetic susceptibility is a measurement of how easily a substance can be magnetised (Gunn and Best 1998). A loop sensor remains stationary as the core is moved through it. The sensor measures the magnetisation of the material. Susceptibility data may be used to detect structures and events that are not easily seen through visual inspeciton of the core.

Results

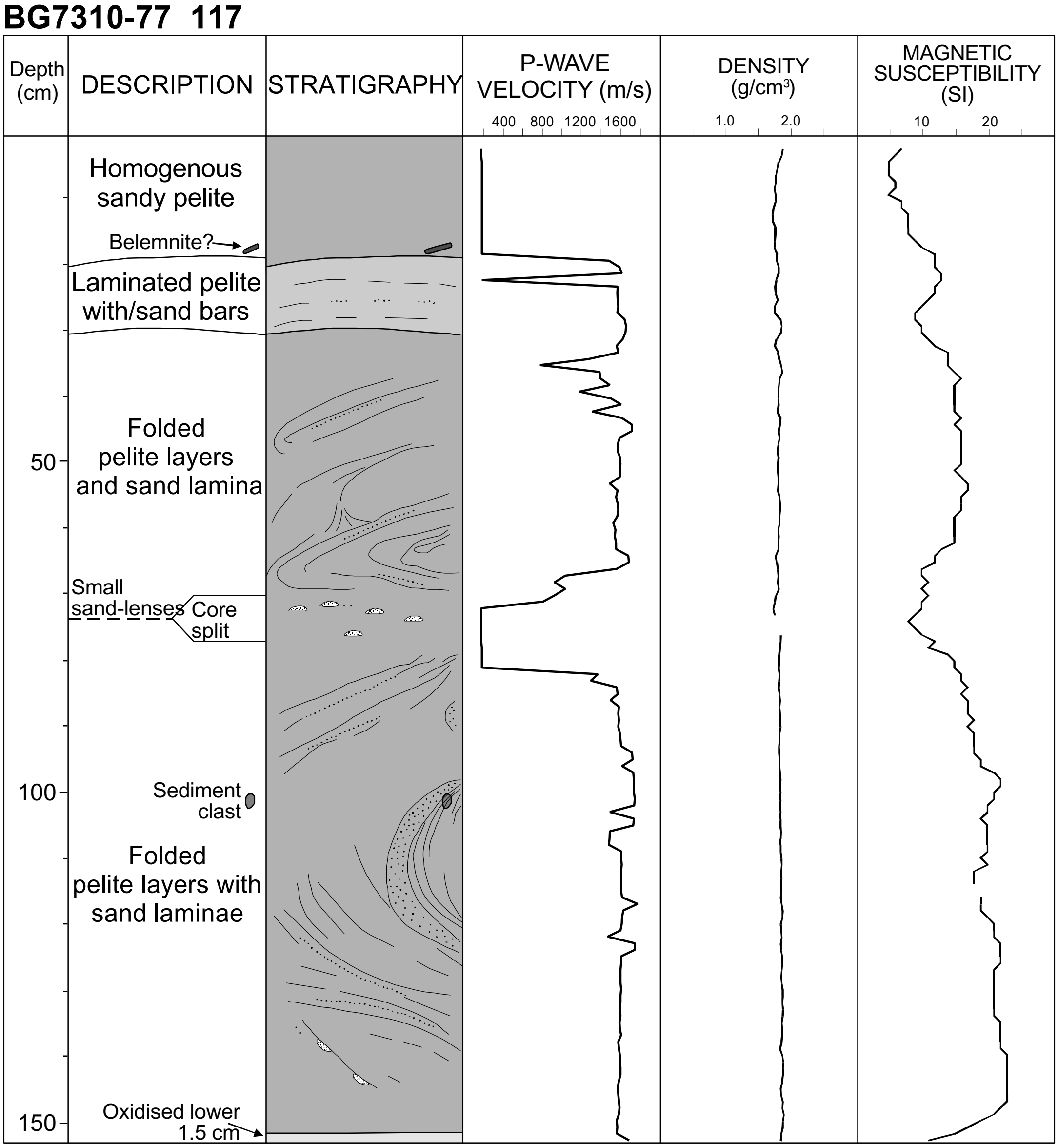

Fig.2. 2. Stratigraphy of sediment core BG 7310-77 117 including visual description, p-wave velocity, sediment density and magnetic susceptibility.

The sediment core is 154 cm long and can be divided into two main lithological units. The upper 30 cm consists of a sandy pelite with scattered clasts. The unit is laminated in the lower part. In the 15-20 cm interval a c. 2 cm long clast of sedimentary origin was observed. This clast contains fossil gastropods of unknown pre Quaternary age. Most probably this clast was eroded from pre Quaternary sedimentary strata in the Barents Sea. There is a marked boundary to the lower unit, which constitutes the rest of the core 30-154 cm. This lower unit is characterised by a pelite with scattered clasts and strongly folded sandy and pelitic layers. These structures were observed both by visual inspection of the core and in the X-radiographs (Fig. 2.3A, D).

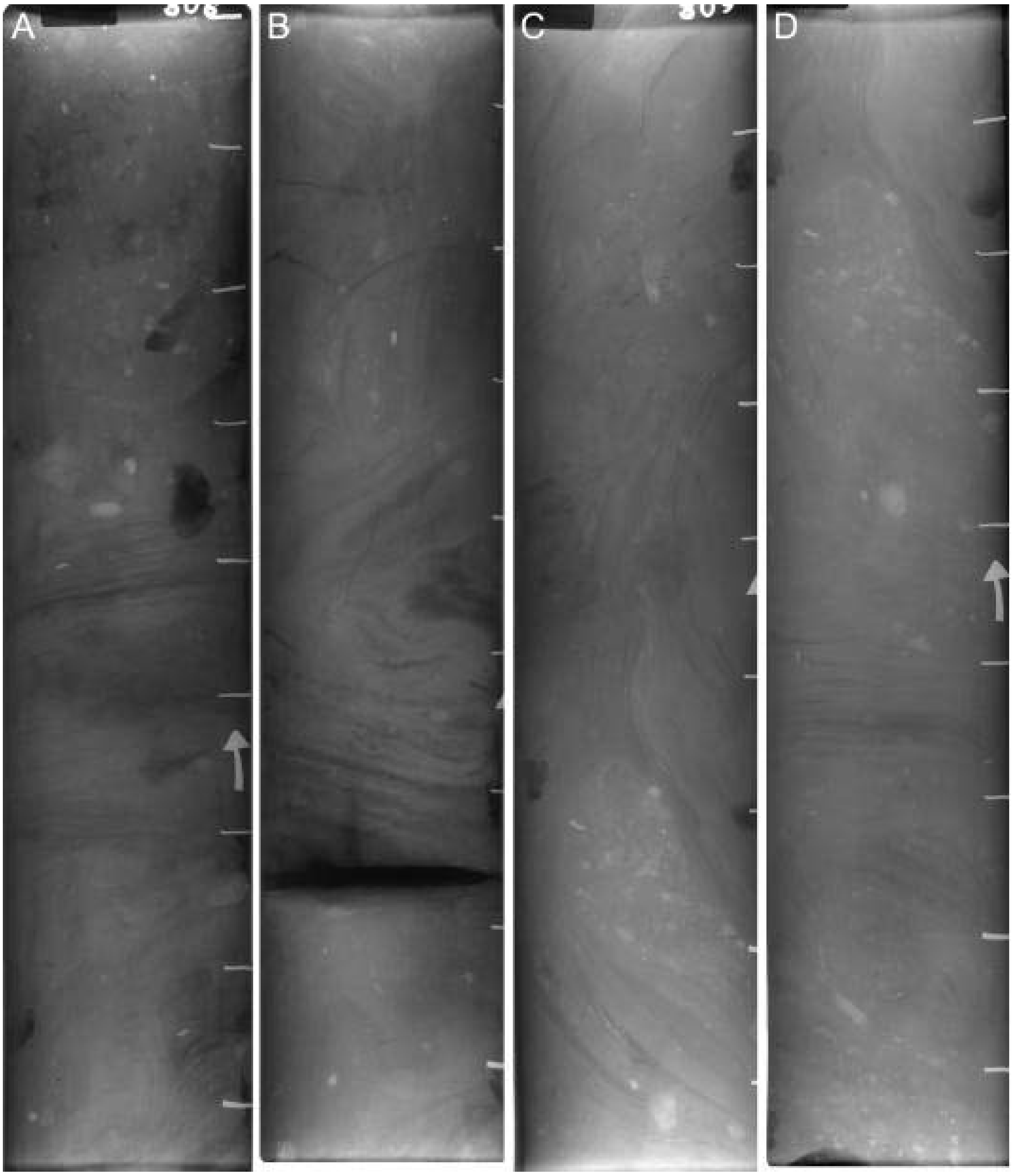

Fig.2. 3. X-radiographs of sediment core BG 7310-77 117-1. A) 0-45 cm core interval; B) 40-85 cm core interval; C) 80-125 cm core interval; D) 120-ca. 165 cm core interval.

The upper unit probably represents the Holocene relatively high energetic bottom environment during which the larger clasts are relicts from previous glaciogenic environments. The lower unit may represent either a glaciogenic and/or a gravity flow environment. The folding structures may be created e.g. during sediment gravity flows or by glaci-tectonism.

The sediments are slightly oxidised in the lower and upper part. In general it looks ”fresh” and shows no direct effects of the long (24 years) of storing.

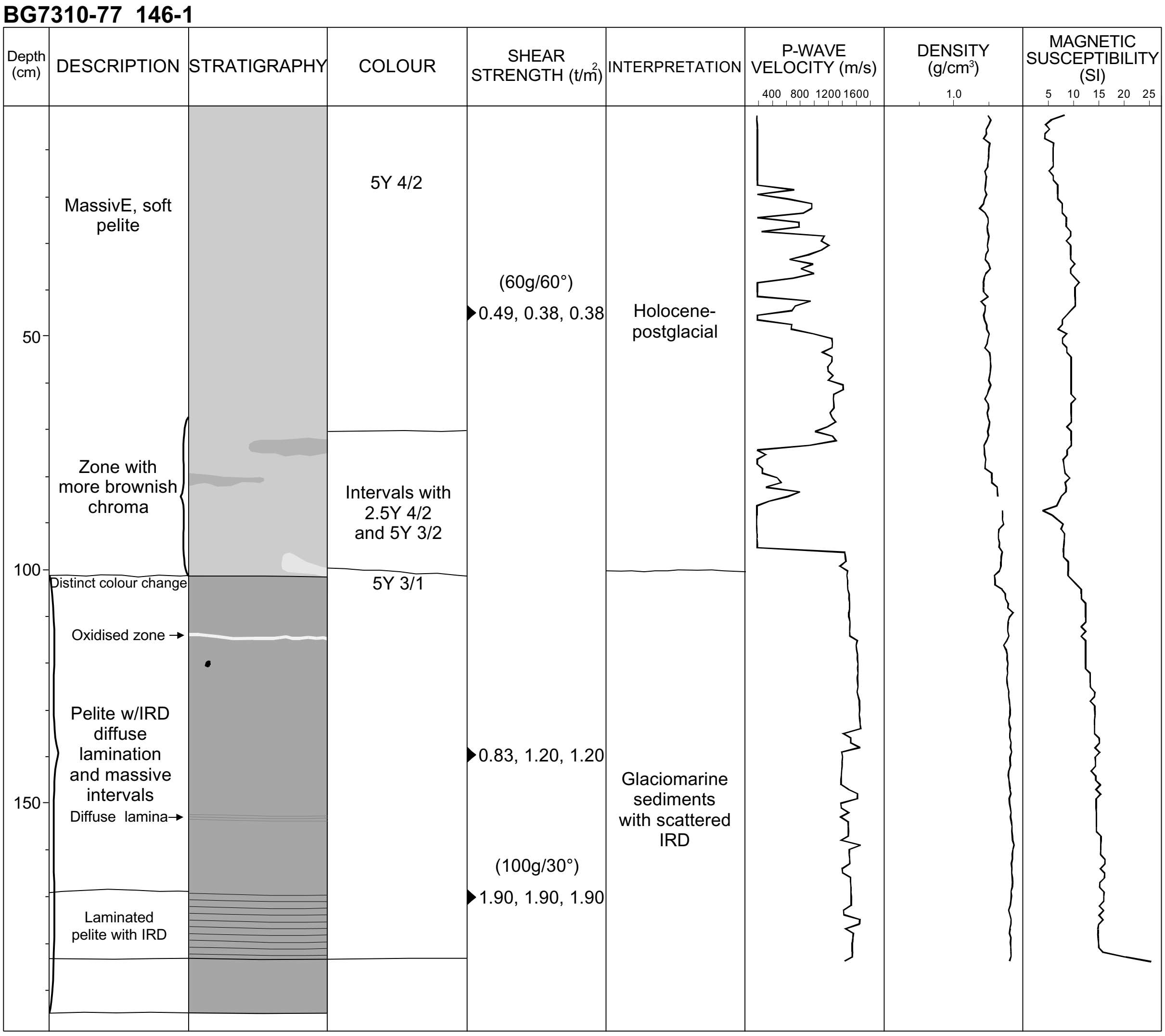

Fig.2.4. Stratigraphy of sediment core BG 7310-77 146-1 including visual description, colour, shear strength, p-wave, sediment density, magnetic susceptibility and interpretation.

This sediment core is 183 cm long and consists of two main lithologic units. The upper unit (0-100 cm) is a massive, bioturbated, soft, olive grey mud. Scattered zones with more brownish chroma, probably due to increased oxidation, are observed in the lower part of the unit. Magnetic susceptibility and shear strength are relatively low, P-wave velocity shows large variation. The lower unit is a laminated to massive very dark grey mud with scattered clasts (Fig. 2.5A-5E).

The boundary to the upper unit is sharp and lamination is particularly pronounced in the lower part. P-wave velocity shows stable values, magnetic susceptibility shows a down core increasing trend. Shear strength values are relatively low. The upper unit probably represents a post glacial environment in the Barents Sea, probably mainly the Holocene. The lower unit represents a glaciomarine environment, probably for the last deglaciation. The scattered clasts we assume are rafted by ice bergs originating from the waning Barents Sea Ice Sheet.

Most of the Barents Sea deglaciated between 15,000 and 10,000 ^{14}C years BP (Vorren and Laberg 1996).

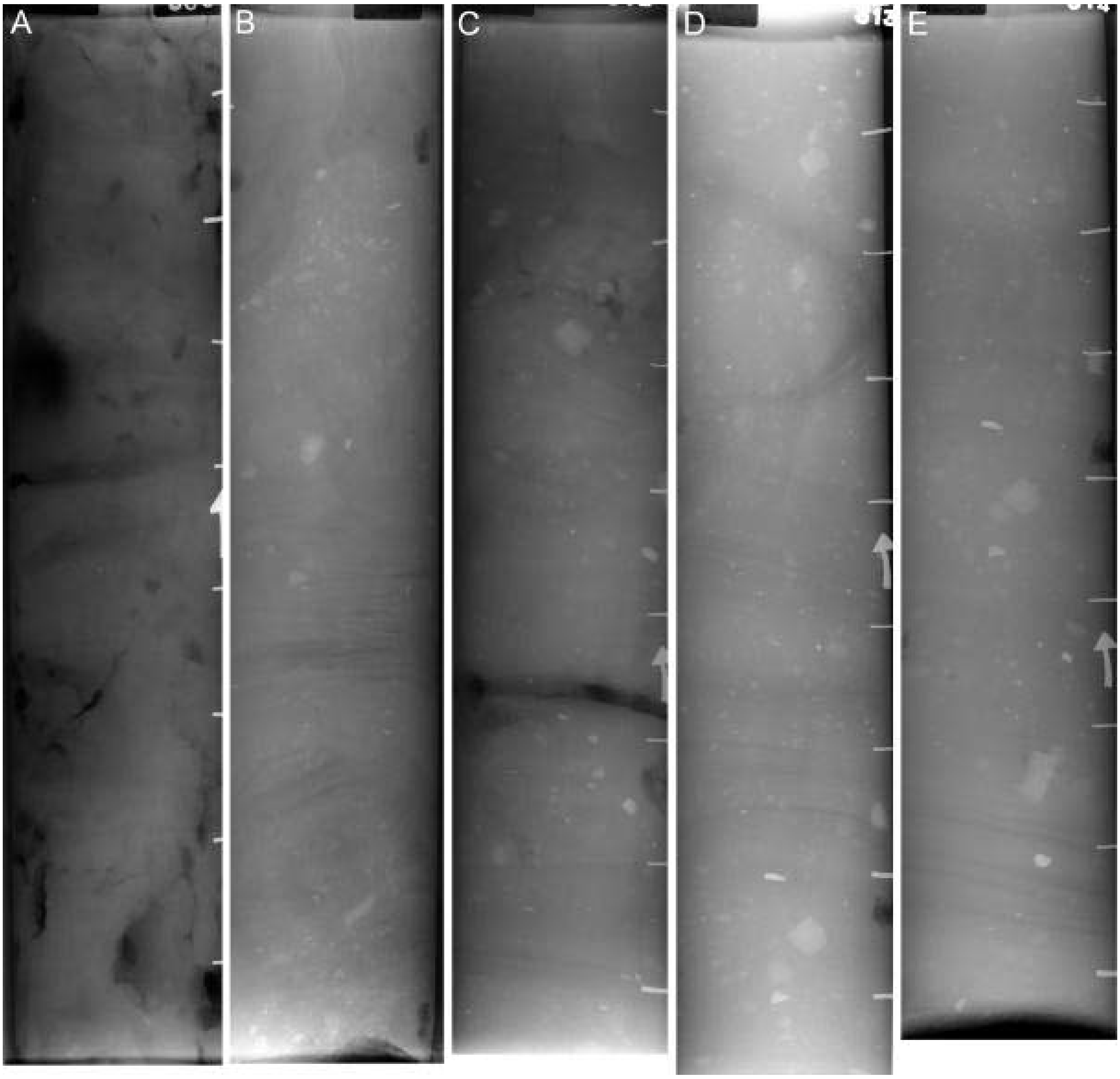

Fig.2. 5. X-radiographs of sediment core BG 7310-77 146-1. A) 0-45 cm core interval; B) 40-85 cm core interval; C) 80-125 cm core interval; D) 120-ca. 165 cm core interval, E) 140-180 cm core interval.

The sediments are slightly oxidised in the lower and upper part. In general it looks ”fresh” and shows no direct effects of the long (24 years) of storing.

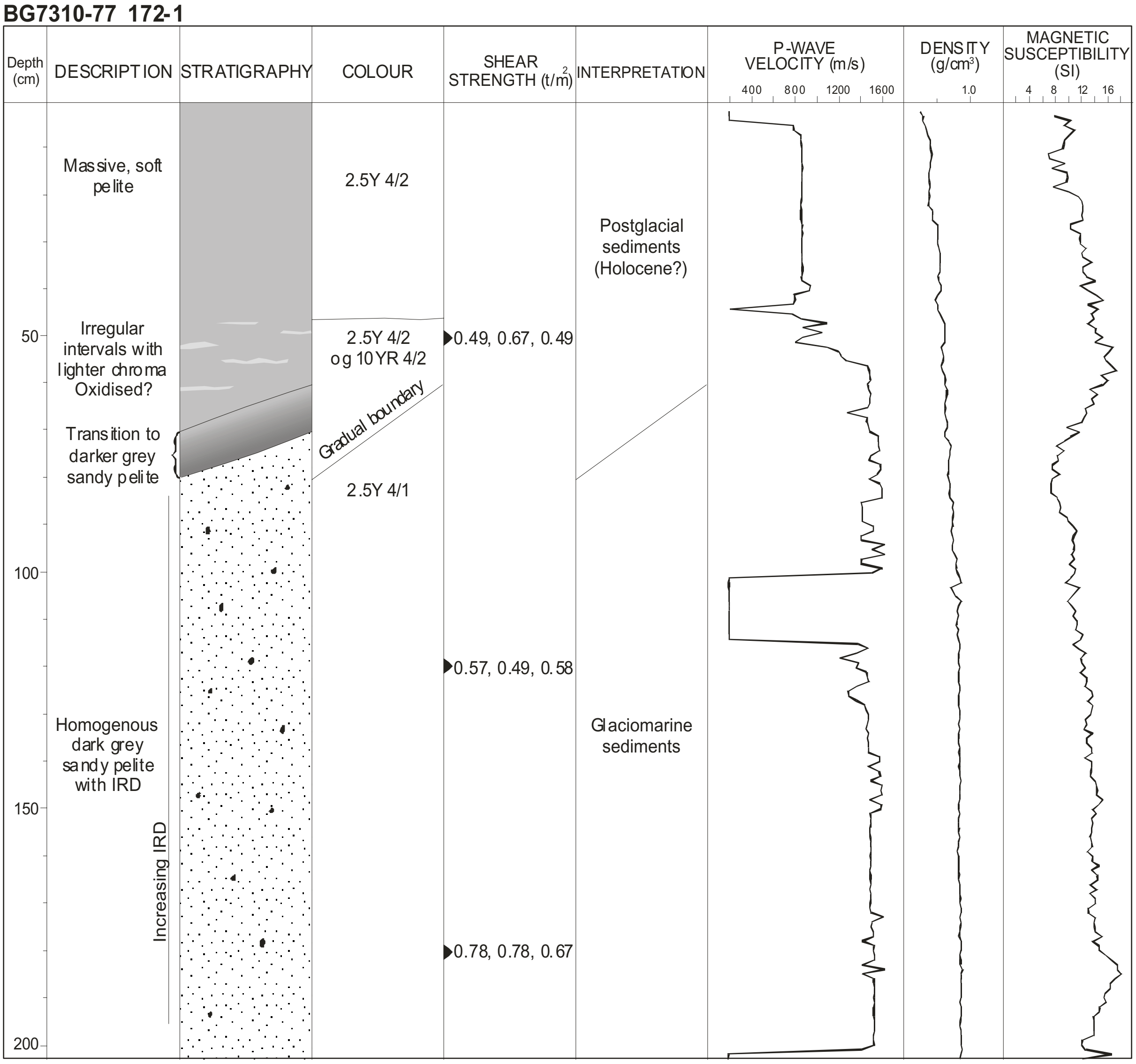

Fig. 2.6. Stratigraphy of sediment core BG 7310-77 172-1 including visual description, p-wave velocity, sediment density and magnetic susceptibility.

The sediment core is 201 cm long and consists of two lithologic units. The upper unit (0- ca. 80 cm) is a massive, bioturbated, soft mud. The upper 50 cm has a dark greyish brown colour. The lower part of this unit varies between dark greyish brown and dark grey colours. In the interval 60-80 cm there is a gradual transition towards the lower unit. This unit consists of massive, dark grey mud with scattered clasts. The frequency of clasts decreases up-core in the unit. P-wave velocity and magnetic susceptibility show slightly elevated values compared to the upper unit. The upper unit is interpreted to represent a post glacial environment and the lower unit a glaciomarine environment from the later part of the last deglaciation. The scattered clasts of the lower unit, interpreted to reflect ice berg rafting (IRD), appear to terminate at c. 40 cm in the core. The Barents Sea Ice sheet and the Fennoscandian ice sheet retreated to the fjord areas around 13,000 ^{14}C years BP of Svalbard and Norway respectively.

Younger Dryas cold spell (11,000.10,000 ^{14}C years BP). Thus, the 40 cm interval in this core may be close to the Weichselian/Holocene boundary.

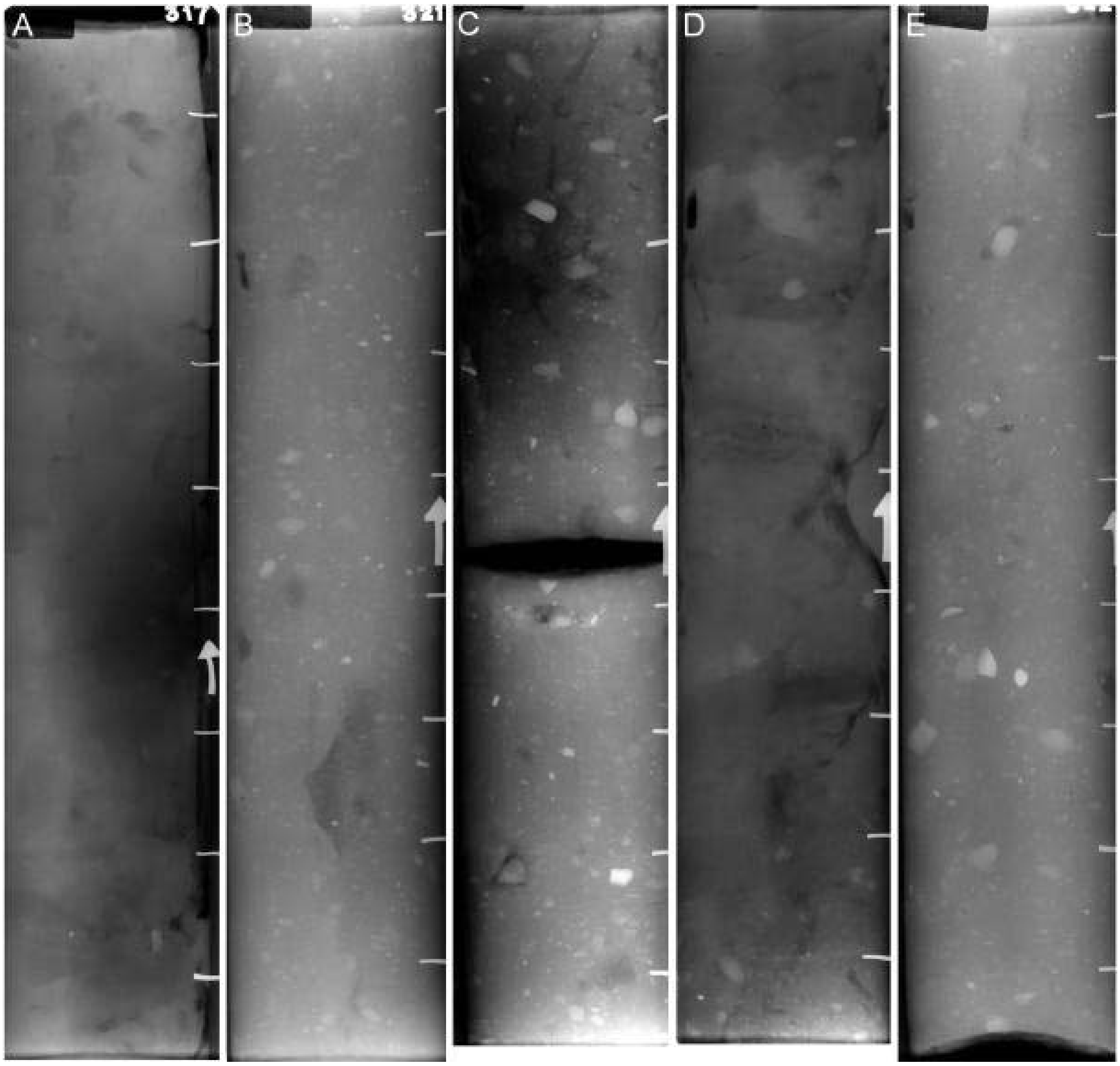

Fig.2. 7. X-radiographs of sediment core BG 7310-77 172-1. A) 0-45 cm core interval; B) 40-85 cm core interval; C) 80-125cm core interval; D) 120-ca. 165 cm core interval; E) 160-ca. 210 cm.

The lithostratigraphy of this core resembles that of core BG 7310-146 -1 (Fig. 2.4), although the latter has a somewhat coarser texture as is also indicated by the higher magnetic susceptibility values. The sediments are slightly oxidised in the lower and upper part. In general it looks ”fresh” and shows no direct effects of the long (24 years) of storing.

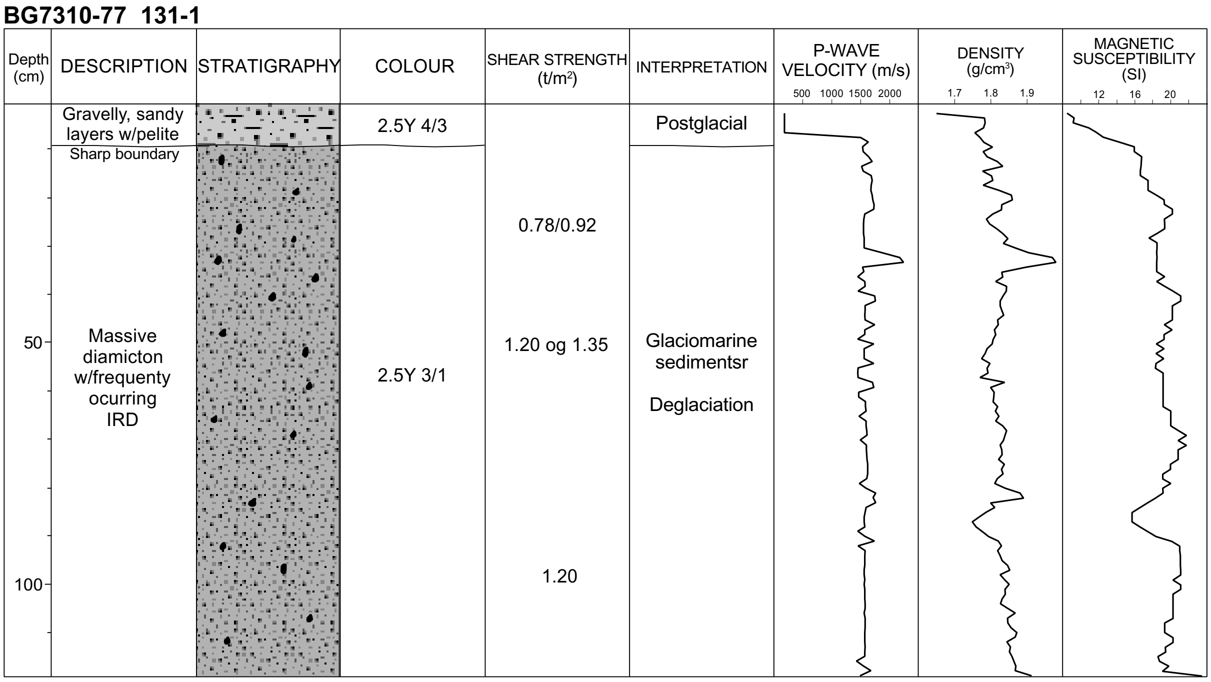

Fig. 2.8. Stratigraphy of sediment core BG 7310-77 131-1 including visual description, p-wave velocity, sediment density and magnetic susceptibility.

This core is 120 cm long and contains two lithologic units. The upper unit, 0-20 cm, is characterised by olive brown lag gravel, with a sandy to silty-clay matrix. There is a sharp boundary to the lower unit, which is a very dark grey, massive diamicton with frequent clasts = 1 mm in diameter. The shear strength values are moderate to high for glaciomarine sediments. The upper unit is evidently a lag deposit derived by winnowing of Quaternary glaciogenic diamictons. It contains both sediments from an earlier glacial environment as well as from the modern environment. This unit is typical from shallow to deep bank areas in the Barents Sea and on the Norwegian shelf (Vorren et al. 1978; 1984; Hald and Vorren 1984). This unit probably reflects an increasing bottom current energy regime established by the full onset of the West-Spitsbergen Current, a northern extension of the North Atlantic Current, since the early Holocene. The lower unit represents a glaciomarine environment, with frequent ice berg rafting, probably from the last deglaciation. The sharp boundary between the two units may represent a hiatus.

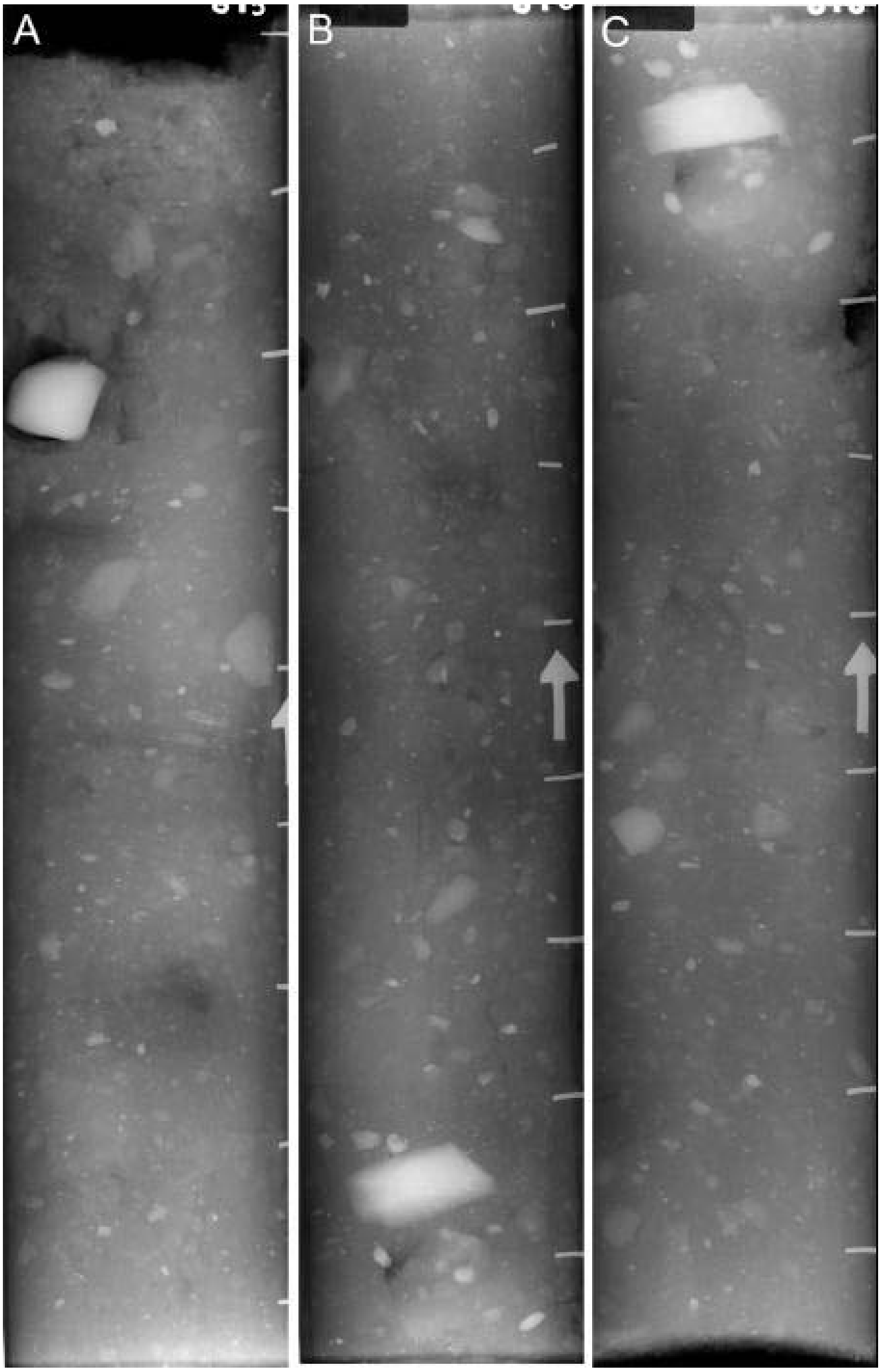

Fig. 2.9. X-radiographs of sediment core BG 7310-77 131-1. A) 0-45 cm core interval; B) 40-85 cm core interval; C) 75-120 cm core interval.

Microscopy of the 100-1000 μm fraction

The following sediment samples were sieved and the 100-1000 μm fraction was inspected using a binocular microscope:

BG7310-77 117-1, 0-2cm
BG7310-77 117-1, 100-102cm
BG7310-77 131-1, 50-52cm
BG7310-77 172-1, 20-22cm
BG7310-77 172-1,120-122cm
BG7310-77 146-1, 20-22cm
BG7310-77 146-1, 120-122cm
BG7310-77 146-1, 180-182cm

The inspection was done mainly to investigate if the long storing of the sediment cores had led to dissolution of the carbonate fossils (foraminifera, ostracodes, bivalve shells, etc.). Such dissolution is common in sediment cores from Arctic waters, if the sediments have been stored unsealed and exposed to room temperature (Hald et al. 2001). The inspected samples mainly consist of a minerogenic component dominated by quartz grains. A few benthic foraminifera were observed, but none of them showed any sign of carbonate dissolution. Thus we conclude that the long storing of the sediment cores have not led to increased carbonate dissolution, probably because the cores have been completely sealed within the PVC-tube.

Conclusions

Geo-scientific conclusions

Detailed stratigraphical studies including visual core description, shear strength, multi core sensor logging, x-radiography and microscopy of the sand fraction, show that the four sediment cores contain five lithostratigraphic units, representing various sedimentary environments. These are: Unit 1) Holocene/post glacial pelite; Unit 2) Sandy-gravely lag deposits; Unit 3) Bioturbated pelite with scattered IRD; Unit 4) Massive pelite with frequent IRD; Unit 5) Folded/deformed sediments. Unit 1, Holocene/postglacial pelite, represents the modern environment in low energetic settings on the shelf, for example glacial troughs. Unit 2, sandy-gravely lag deposits, is frequent on the shallower banks today in the Barents Sea area. Units 3 and 4 represent glaciomarine settings, probably from the last deglaciation. The deformation structures seen in Unit 5 may be formed by sediment instability such as mass wasting or they could be due to deformation by an overriding glacier.

Quality of the Barents Sea gravity cores

The quality evaluation suggests that the gravity cores can be used for geo-scientific projects. From a cost – benefit evaluation point of view it is concluded that a significant part of the cores should be stored under any circumstance due to that the cores represent a high value. If a similar set of samples were to be collected again from the Barents Sea, the costs would amount to several million NOK for a comparable sampling program. It is not likely that it will be possible to have a similar set of gravity cores available for use without any restrictions. Additionally, generation of new projects might attract external sources for funding if the existing NPD cores are included in new projects.

Recommendations

The investigations of the four gravity cores have so far shown, that the cores have not suffered particularly during more than 20 years of storage in a hard rock bomb shelter room with constant low temperature and moist conditions. The authors of the report therefore recommend that the NPD gravity cores should be considered as a highly valuable and useful sample material from the Barents Sea.

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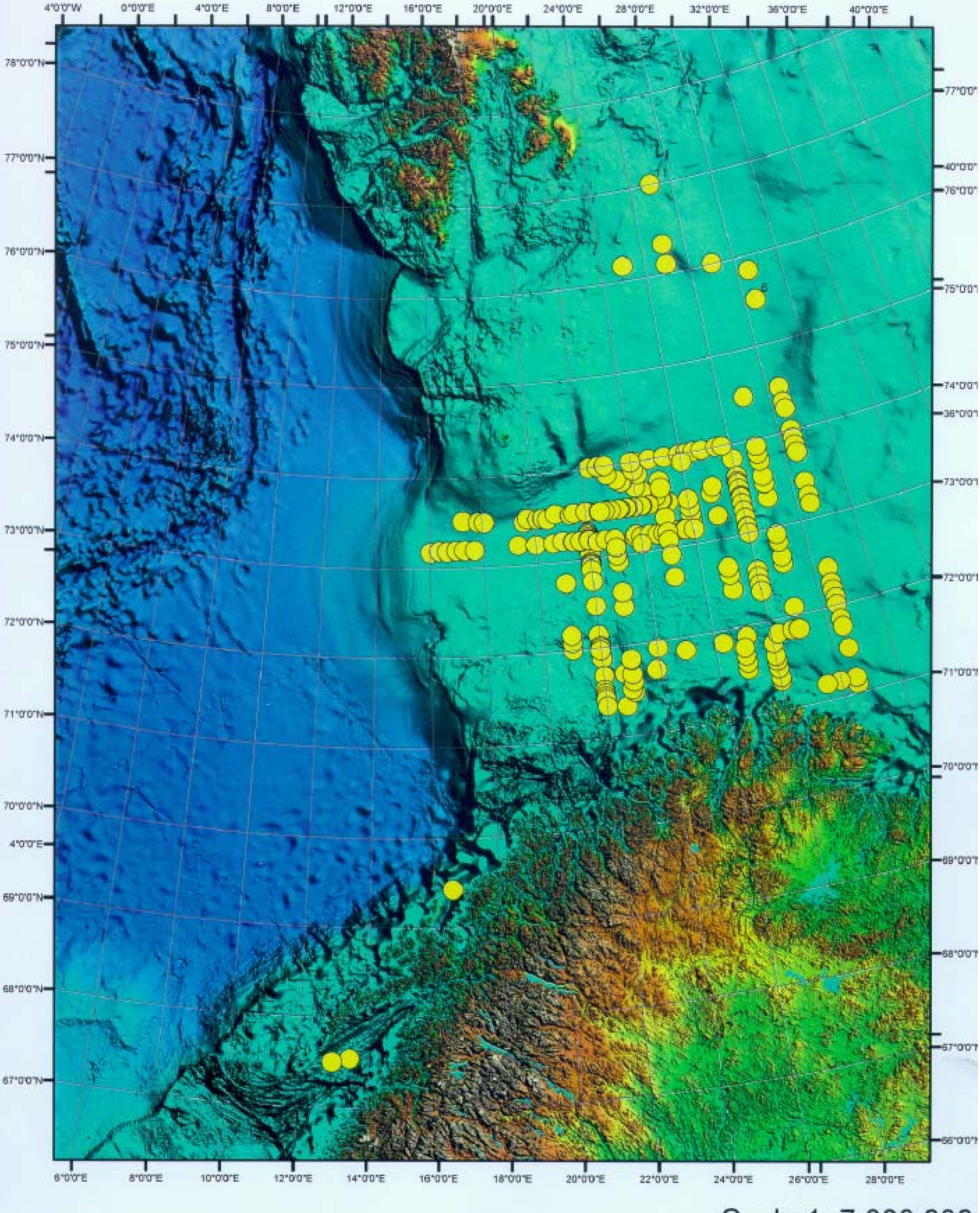
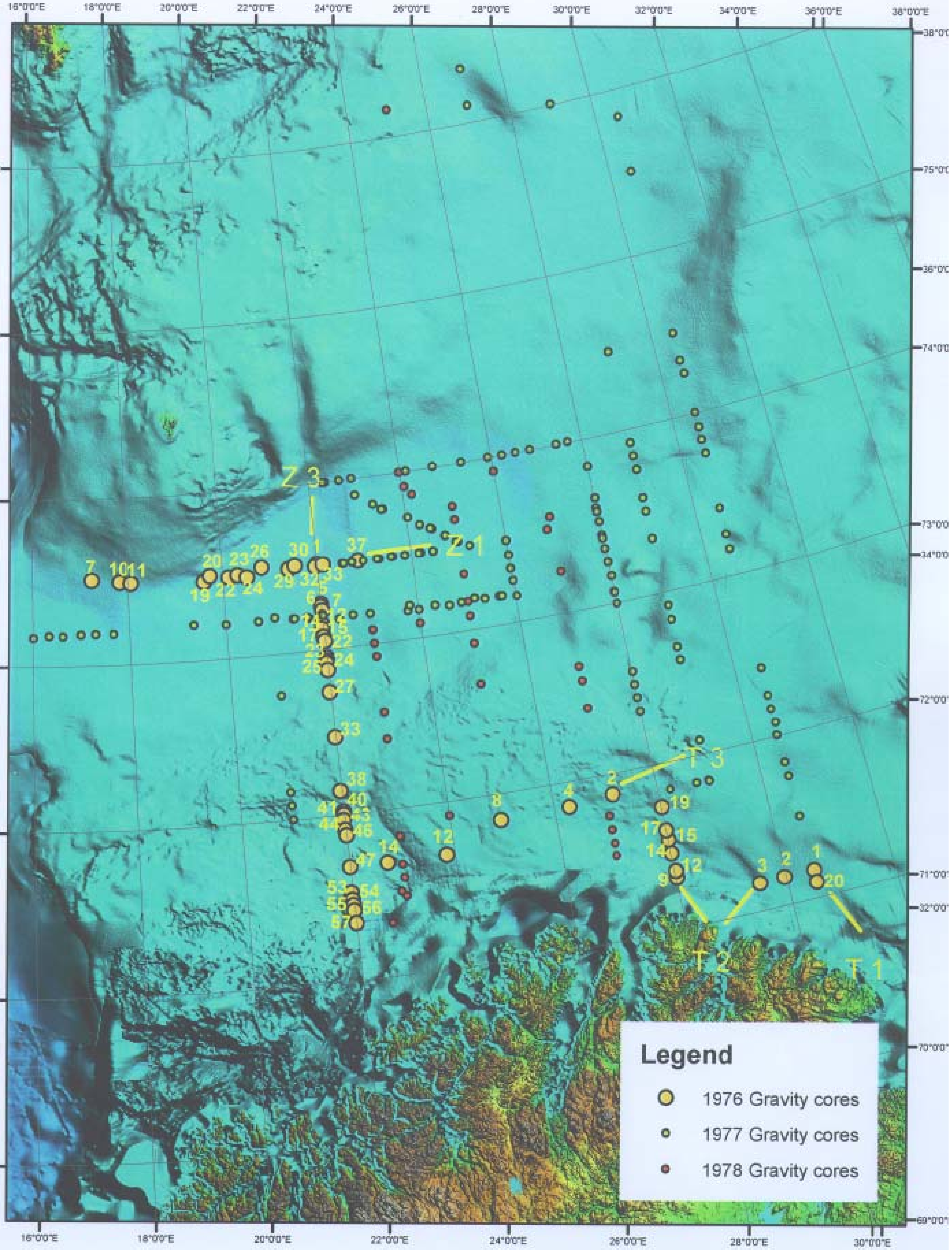
APPENDIX 1. Location map for the gravity cores taken over by NGU

Gravity core locations

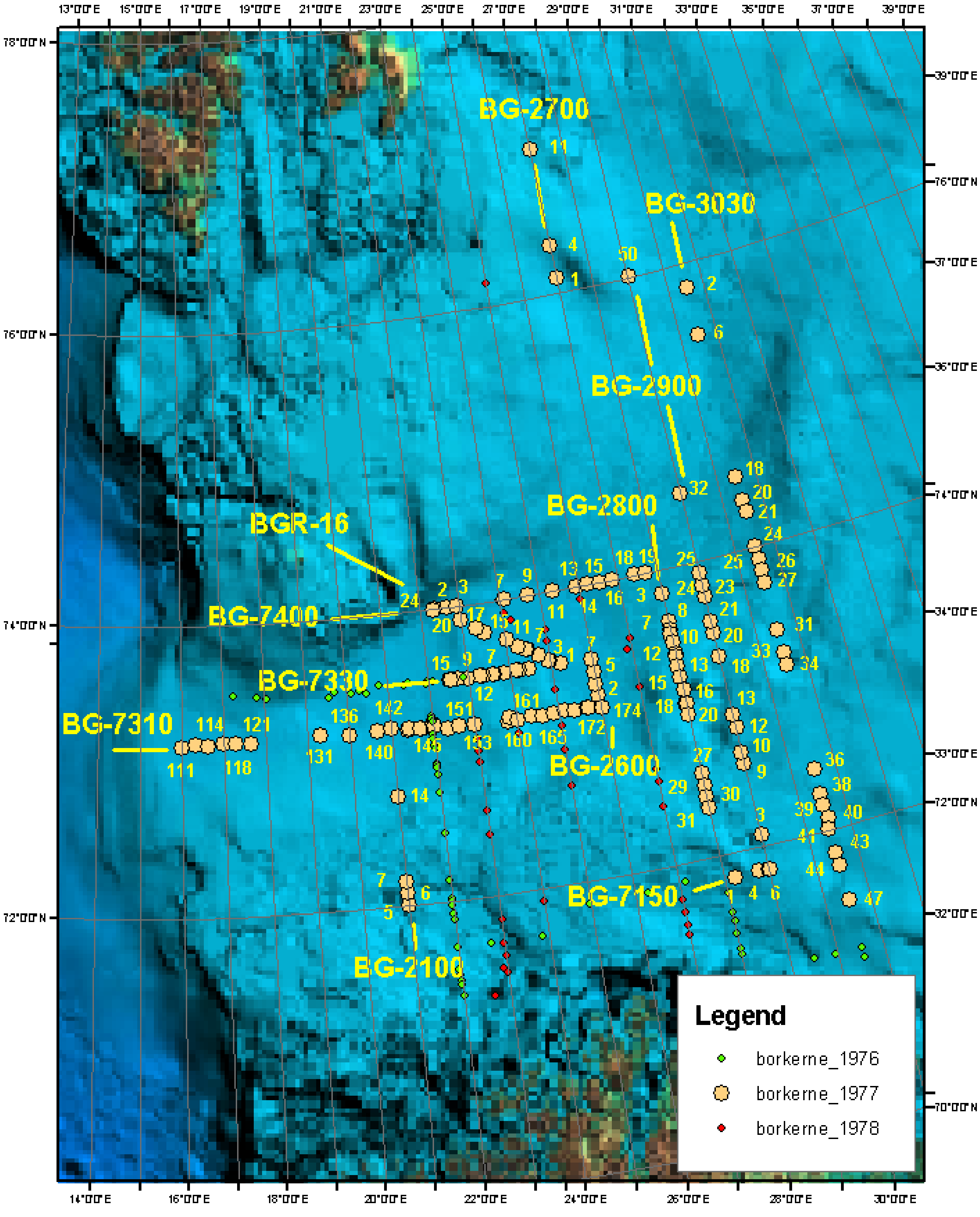


Scale 1: 7 000 000

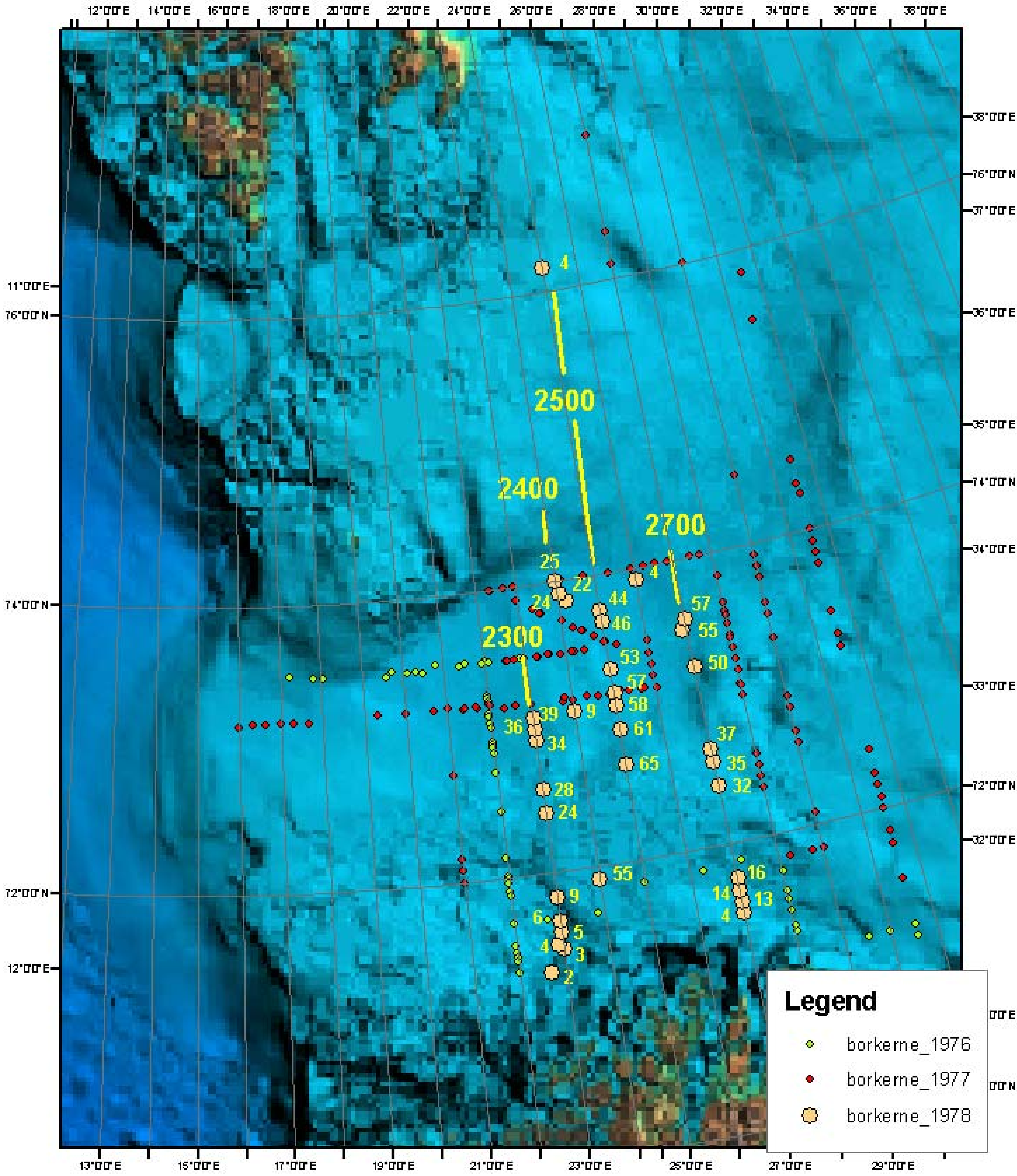
Gravity core locations, those sampled in 1976 are numbered.



Gravity core locations,
those drilled in 1977 are numbered



Gravity core location,
those drilled in 1978 are numbered



APPENDIX 2. List of cores taken over by NGU

Norwegian Petroleum Directorate Barents Sea gravity cores updated July 31st 2002

year	code	C ore no.	sub-no.	Latitude - N	Longitue - E	UTM zone 33 UTM - lat.	UTM - long.
1976	T1	15	1	no data	no data	no data	no data
	T1	15	2	no data	no data	no data	no data
	T1	16	missing	no data	no data	no data	no data
	T1	18	1	no data	no data	no data	no data
	T1	18	2	no data	no data	no data	no data
	T1	19	1	no data	no data	no data	no data
	T1	20	missing	71 05 30	30 31 00	1055792	7959561
1976	T2	1	missing	71 10 00	30 31 30	1053950	7967759
	T2	2	missing	71 10 00	29 58 00	1034400	7962716
	T2	3	missing	71 10 00	29 30 00	1018027	7958641
	T2	3	missing	71 10 00	29 30 00	1018027	7958641
	T2	9	2	71 18 30	28 01 30	962712	7962079
	T2	12	2	71 21 00	28 02 00	962006	7966695
	T2	14	1	71 27 30	28 01 00	958830	7978401
	T2	15	missing	71 32 30	28 01 00	956835	7987504
	T2	17	1	71 36 00	28 00 30	955150	7993813
	T2	17	2	71 36 00	28 00 30	955150	7993813
	T2	19	3	71 44 30	28 01 00	952041	8009349
1976	T3	2	2	71 52 30	27 09 00	919337	8017652
	T3	4	1	71 51 00	26 17 30	890558	8009130
	T3	4	3	71 51 00	26 17 30	890558	8009130
	T3	8	missing	71 50 30	24 57 30	844996	8000063
	T3	12	2	71 41 00	23 50 30	809159	7976527
	T3	14	missing	71 41 00	22 43 00	770028	7971121
	missing	13	2	no data	no data	no data	no data
	missing	19	3	no data	no data	no data	no data
1976	Z1	7	1	73 30 30	17 15 00	571282	8158755
	Z1	10	2	73 29 30	17 50 30	590103	8157697
	Z1	11	3	73 29 00	18 04 00	597279	8157121
	Z1	19	2	73 28 00	19 35 30	645725	8158366
	Z1	20	2	73 30 00	19 44 00	649918	8162425
	Z1	**22**	missing	73 29 00	20 07 30	662456	8161595
	Z1	23	1	73 29 30	20 19 00	668435	8163053
	Z1	24	missing	73 28 30	20 30 00	674399	8161726
	Z1	26	1	73 31 30	20 49 30	684132	8168257
	Z1	26	2	73 31 30	20 49 30	684132	8168257
	Z1	29	2	73 30 00	21 23 30	702283	8167315
	Z1	29	missing	73 30 00	21 23 30	702283	8167315
	Z1	32	2	73 30 00	21 57 00	719884	8169289
	Z1	33	missing	73 30 30	22 07 30	725286	8170865
	Z1	30	missing	73 31 00	21 31 30	706285	8169620
	Z1	37	missing	73 30 30	22 52 00	748619	8173809
	Z1	?		no data	no data	no data	no data
1976	Z3	1	1	73 31 00	22 00 00	721241	8171321
	Z3	1	2	73 31 00	22 00 00	721241	8171321
	Z3	5	1	73 16 30	21 59 30	724128	8144497
	Z3	6	1	73 15 30	21 59 00	724079	8142618
	Z3	7	1	73 14 00	22 00 00	724937	8139909
	Z3	12	1	73 09 00	21 58 00	724951	8130545
	Z3	12	2	73 09 00	21 58 00	724951	8130545
	Z3	14	1	73 07 30	21 57 30	725007	8127741
	Z3	14	2	73 07 30	21 57 30	725007	8127741
	Z3	15	missing	73 04 30	21 58 30	726193	8122261
	Z3	17	2	73 03 00	21 59 30	727056	8119552
	Z3	22	missing	72 57 00	21 59 30	728356	8108465
	Z3	23	2	72 56 00	21 58 30	728030	8106554
	Z3	24	2	72 55 00	21 58 30	728246	8104706
	Z3	25	missing	72 52 30	21 59 00	729059	8100118
	Z3	27	1	72 44 30	21 85 30	730514	8085303
	Z3	33	2	72 28 00	21 59 00	734353	8054845
	Z3	38	missing	72 08 30	21 58 00	737990	8018745
	Z3	40	2	no data	no data	no data	no data
	Z3	40	2	72 01 00	21 59 00	740173	8004951
	Z3	41	2	72 00 00	21 59 00	740388	8003103
	Z3	43	missing	71 58 00	21 58 00	740246	7999341
	Z3	44	1	71 54 30	21 58 30	741285	7992906
	Z3	44	2	71 54 30	21 58 30	741285	7992906
	Z3	45	2	71 54 30	21 58 30	741285	7992906

Explanation of columns and data

Year	Sampling year of the gravity cores
Code	each core has been sampled lines in the Barents Sea, which are shown in Appendix 1 in the report
Core no.	the gravity cores are numbered The core numbers are shown in appendix 1 together with the location
Sub-no.	sub-numbers are limitet to the cores taken in 1976.
Latitude N	Latitude north
Longitude E	Longitude in degrees, minutes and seconds
UTM-lat.	UTM latitude, zone 33
UTM-long.	UTM longitude, zone 33
no data	No information about co-ordinates for gravity cores
missing	number is missing on the core tube and lid.
datum	ED50 assumed to be the datum, however this is not verified from any of the reports and files NGU has received in this project (NGU project 289000)

	Z3	46	1	71 52 30	21 58 30	742290	7989277				
	Z3	43	2	71 58 00	21 58 00	740246	7999341				
	Z3	47	1	71 49 00	21 59 30	744765	7968026				
	Z3	49	missing	71 41 00	21 59 30	744765	7968026				
	Z3	53	1	71 31 30	21 57 30	745636	7950334				
	Z3	54	2	71 29 00	21 58 00	746464	7945748				
	Z3	55	2	71 27 00	21 58 30	747187	7942086				
	Z3	56	1	71 25 00	21 58 30	747615	7938390				
	Z3	57	1	71 20 30	21 59 30	749171	7930143				
	Z3	24/29	1	no data	no data	no data	no data				
	?	?	?	no data	no data	no data	no data				
1977	BGR 16	1		73 30 07,2	25 14 06,2	822997	8184454				
		3		73 32 03,9	24 59 53,8	814986	8186757				
		4		69 42 03,8	16 15 32,6	548747	7733244				
		5		73 35 00,5	24 45 27,7	806578	8190908				
		7		73 38 04,1	24 30 31,2	797911	8195268				
		8		73 38 18,9	24 28 31,7	796807	8195556				
		9		73 40 07,4	24 15 59,9	789793	8197853				
		11		73 43 25,2	24 01 44,5	781490	8202779				
		15		73 47 36,5	23 32 00	765024	8208217				
		16		73 47 32,9	23 30 05	764054	8207965				
		17		73 49 49,7	23 20 33,9	758565	8211470				
		20		73 53 56,6	22 58 15	746082	8217481				
		23		73 59 49,3	22 22 08,1	726241	8225942				
		24		73 59 49,3	22 19 01	724653	8225746				
1977	BG 2100	5		72 00 00,2	21 00 10,3	706745	7999468				
		6		72 05 01,4	20 59 56,8	705687	8008746				
		7		72 09 53,1	20 59 50,1	704724	8017738				
		14		72 44 51,3	20 59 43,3	698178	8082457				
1977	BG 2600	2		73 14 52,1	25 59 42	851938	8160799				
		3		73 19 25,6	25 59 20,7	850198	8169110				
		5		73 24 13,8	25 59 56,5	848874	8177961				
		7		73 29 37,7	25 59 40	846890	8187817				
1977	BG 2700	1		76 06 02,1	26 59 33,1	819519	8479242				
		4		76 19 35,1	26 59 34,9	814434	8503956				
		11		77 00 17,2	26 59 58,6	799254	8578210				
1977	BG 2800	3		73 50 00,8	28 00 09,5	901186	8237637				
		7		73 38 25,3	28 00 45,8	906170	8216621				
		8		73 34 49,1	27 59 22,9	906913	8209909				
		9		73 33 28,8	27 59 26,6	907483	8207481				
		10		73 29 45,8	27 59 44,4	909132	8200754				
		11		73 24 53,3	27 59 32,3	910990	8191862				
		12		73 23 45,7	27 59 33,4	911452	8189814				
		13		73 19 54,1	27 59 35,6	913024	8182796				
		15		73 14 58,9	27 59 31,2	914964	8173836				
		16		73 09 51,4	28 00 08,1	917348	8164583				
		18		73 04 02,6	27 59 15,3	919218	8153903				
		19		73 03 43,4	28 00 01,2	919752	8153410				
		20		72 59 34,9	27 59 58,1	921389	8145869				
		27		72 34 29,9	28 01 04,7	932059	8100358				
		29		72 29 41,8	27 59 58,1	933378	8091486				
		30		72 24 51	28 00 02,7	935362	8082675				
		31		72 19 58,7	28 00 01,7	937304	8073807				
1977	BG 2900	3		72 05 01,4	29 00 32,9	977139	8054323				
		9		72 34 55,7	28 59 59,7	963945	8108489				
		10		72 39 41,5	29 00 03,5	961924	8117136				
		12		72 49 40,2	29 00 35,4	957900	8135298				
		13		72 54 57,2	29 00 27,4	955544	8144861				
		18		73 19 47,6	28 59 54,9	944512	8189828				
		20		73 29 45,1	29 00 04,5	940281	8207900				
		21		73 34 43	29 00 04,2	938126	8216900				
		23		73 45 10	29 00 48,3	933966	8235931				
		24		73 50 08,5	29 00 36,5	931706	8244923				
		25		73 55 01,7	29 00 40,4	929616	8253788				
		32		74 28 52,6	28 59 31,6	914333	8314990				
		50		76 00 11,2	29 00 20,4	874836	8480474				
1977	BG 3030	2		75 49 54	30 32 10,4	919939	8472226				

		6		75 29 51,2	30 30 30,4	928905	8435945				
		18		74 29 38,1	30 29 43,6	957590	8327417				
		20		74 19 38,8	30 29 28,3	962270	8309392				
		21		74 14 51,3	30 30 57,8	965303	8300955				
		24		73 59 57,6	30 31 14	972602	8274159				
		25		73 54 39,8	30 31 21,5	975211	8264634				
		26		73 50 00,5	30 30 41,2	977112	8256158				
		27		73 44 54,8	30 31 01,3	979728	8247023				
		31		73 24 34,6	30 30 52,1	989408	8210356				
		33		73 14 52,3	30 30 54,8	994083	8192872				
		34		73 09 32,8	30 30 42,4	996526	8183245				
		36		72 25 11,5	30 31 10,1	1017977	8103347				
		38		72 14 59,3	30 30 21,6	1022401	8084830				
		39		72 09 59,4	30 30 24,6	1024810	8075823				
		40		72 04 45,1	30 31 57,2	1028162	8066601				
		41		72 00 11,6	30 29 30,6	1028973	8058020				
		43		71 50 08,7	30 30 19,6	1034209	8040015				
		44		71 45 00,5	30 30 23,3	1036686	8030757				
		47		71 30 06,4	30 31 06,8	1044180	8003981				
1977	BG 6925	6		69 25 00	16 33 00	560814	7701797				
1977	BG 7150	1		71 50 03,8	28 14 44,7	957620	8021206				
		4		71 50 20,1	28 46 06,6	975287	8025758				
		6		71 50 20,1	29 00 06	983207	8027618				
		7		71 50 04,5	29 00 43,6	983673	8027230				
1977	BG 7310	111		73 10 12,9	16 00 43,3	532706	8119972				
		113		73 10 54,2	16 20 02,9	543085	8121456				
		114		73 10 37,3	16 37 45,1	552626	8121168				
		117		73 11 09,4	16 59 41,8	564404	8122520	Examined by Geological Institute, University of Tromsø			
		118		73 11 11,2	17 17 48,9	574146	8122925				
		121		73 11 01,9	17 35 56	586053	8123131				
		131		73 12 45,5	19 19 36,3	639381	8129466	Examined by Geological Institute, University of Tromsø			
		136		73 12 02,4	20 00 01,5	661151	8129826				
		140		73 12 18,9	20 39 35,7	682302	8132229				
		142		73 13 02,3	21 00 50,7	693541	8134681				
		143		73 12 03,6	21 23 01,6	705592	8134104				
		144		73 12 03,3	21 24 57,5	706626	8134206				
		145		73 11 46,8	21 42 39,3	716146	8134740				
		146		73 12 06,6	21 40 41,1	715024	8135232	Examined by Geological Institute, University of Tromsø			
		147		73 12 47,9	22 00 00,9	725206	8137690				
		148		73 12 04	22 00 49,1	725794	8136388				
		149		73 10 21,5	22 20 03,3	736459	8134472				
		151		73 11 13,7	22 37 38,7	745659	8137260				
		153		73 10 50,2	22 59 28,5	757412	8138068				
		157		73 10 06,8	23 45 25,7	782125	8140190				
		158		73 11 50,3	23 48 40	783381	8143622				
		160		73 09 59	23 59 44,4	789794	8141092				
		161		73 10 38,8	24 20 06,7	800460	8143989				
		163		73 09 51,5	24 37 06,4	809741	8143986				
		165		73 10 14,1	24 52 01,1	817564	8145982				
		168		73 10 59,3	25 09 28,9	826614	8148933				
		170		73 10 13,7	25 22 04,6	833546	8148699				
		171		73 10 09,1	25 39 35,8	842876	8150211				
		172		73 10 09,7	25 42 55,2	844637	8150548	Examined by Geological Institute, University of Tromsø			
		174		73 09 16,2	26 01 17,6	854690	8150707				
1977	BG 7330	1		73 30 04,1	24 27 42,9	798808	8180330				
		3		73 30 06,8	24 12 13,2	790700	8179137				
		4		73 30 06,8	24 09 40,8	789372	8178931				
		6		73 30 03,8	23 51 28,5	779868	8177392				
		7		73 30 11,3	23 36 17	771886	8176452				
		8		73 30 15,8	23 34 29,5	770929	8176454				
		9		73 30 04,5	23 19 18,6	763031	8174976				
		10		73 30 08,5	23 16 34,8	761584	8174899				
		12		73 30 06,5	22 58 27,5	752099	8173538				
		14		73 30 10,9	22 43 50,4	744419	8172660				
		15		73 30 04,4	22 31 41,4	738073	8171641				
		16		73 30 00,4	22 33 30	739038	8171639				
		18		no data	no data	no data	no data				
1977	BG 7400	2		73 59 53,4	22 40 25,5	735537	8227250				
		3		74 00 02,3	22 56 16,6	743566	8228587				
		7		74 00 03,1	24 07 52,1	779927	8233857				
		9		74 00 12,9	24 43 35,8	797988	8237048				

		11		74 00 05,9	25 20 13,7	816562	8239986				
		13		74 00 05,6	25 55 40,3	834472	8243209				
		14		74 00 05,5	26 14 04,6	843760	8244954				
		15		74 00 06,2	26 32 02	852809	8246728				
		16		74 00 07,2	26 51 12,2	862458	8248679				
		18		74 00 09,6	27 26 13,9	880060	8252397				
		19		74 00 10,9	27 41 27	887695	8254074				
1978	2300	2		71 19 08	22 40 12	773558	7930554				
		3		71 28 02,9	22 59 40,9	782891	7948499				
		4		71 30 00,9	22 54 47,9	779547	7951748				
		5		71 34 59	22 59 48,9	781264	7961302				
		6		71 39 53,9	22 59 30,9	779881	7970344				
		9		71 49 59	23 00 27	777939	7989018				
		10		71 49 34,9	23 01 12,9	778479	7988336				
		12		71 49 51,9	23 00 28	777978	7988801				
		24		72 25 06	22 59 57,9	768997	8053750				
		28		72 35 03,9	23 00 56	767069	8072201				
		34		72 55 17	23 00 22,9	761755	8109449				
		36		73 00 00	22 59 43	760227	8118099				
		39		73 04 57	22 59 58,9	759142	8127247				
1978	2400	9		73 05 03,9	23 59 04	790804	8131987				
		22		73 51 21	24 11 28	784241	8218136				
		24		73 54 37,9	24 02 59,9	778983	8223505				
		25		73 59 55	23 58 58,9	775456	8232918				
		55		71 54 48,9	23 59 44	810681	8002751				
1978	2500	4		76 09 38,9	25 00 14,9	765934	8475976				
		44		73 44 51,9	24 59 54	811013	8210253				
		46		73 40 04,9	25 00 16,9	812696	8201506				
		53		73 20 06,9	25 01 02	819291	8164922				
		57		73 10 09	25 01 12,9	822482	8146647				
		58		73 04 55	25 00 37	823787	8136986				
		61		72 55 00	25 00 12	826635	8118744				
		65		72 40 02,9	25 00 07,9	831222	8091288				
1978	2600	4		73 54 51,9	26 00 07,9	838511	8234058				
1978	2700	12		71 30 44	26 59 48,9	922136	7976840				
		13		71 35 07,9	27 00 36	920970	7984964				
		14		71 40 07	27 00 26	919037	7994048				
		16		71 45 12,9	27 00 21,9	917117	8003351				
		32		72 24 46,9	26 59 49,9	902204	8075538				
		35		72 34 48,9	27 00 04	898620	8093882				
		37		72 40 07	26 59 47	896502	8103530				
		50		73 14 55,9	27 00 12	883809	8167128				
		55		73 30 40	26 53 35	874528	8195152				
		57		73 34 59,9	26 59 56,9	876216	8203727				
1978	VG-32	5		67 32 30	13 28 27,9	434966	7492759				
1978	VG-33	15		67 29 57,9	12 57 43	412971	7488679				