

**East Siberian Arctic Region Expedition '92:
The Laptev Sea –
Its Significance for Arctic Sea-Ice
Formation and Transpolar Sediment Flux**

by D. Dethleff, D. Nürnberg, E. Reimnitz,
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**Expedition to Novaja Zemlja and
Franz Josef Land with RV "Dalnie Zelentsy"**

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1. INTRODUCTION

It is generally accepted that the Arctic Ocean is a sensitive area for changes in the global climate. Unfortunately, the short- and long-term geological and climatological development of this area is only insufficiently known mainly due to major technological and logistical problems when reaching this permanently ice-covered region. First attempts to systematically investigate the geology of the Arctic Ocean area underline the importance of Eurasian shelves as potential source areas for sediments being deposited in the abyssal plains of the Central Arctic Ocean. It has been shown recently that Laptev Sea is a major area where shelf sediments are entrained in Arctic sea ice and subsequently transported through the entire Arctic Ocean via the Transpolar Drift. Whether these large amounts of sea ice sediments contribute to the deep sea sedimentation is disputable. From the comparison of sea ice and deep sea clay mineralogy, oceanic currents and/or gravity flows, turbidity currents etc. across the continental slopes also have to be considered as important steering mechanisms for the sedimentation of terrigenous material.

The invitation of the "Murmansk Institute of Marine Biology" (Russia) to take part into a ship expedition to the Barents Sea was consequently welcomed to reach areas on the Eurasian shelves, which are very difficult to enter due to logistical and political restrictions. The research vessel "Dalnie Zelentsy", an approximately 40 m long ship not suitable for ice conditions, worked in coastal areas along Novaja Zemlja and Franz Josef Land up to ca. 81 °N. Chief scientist was Dr. G. Tarasov from Murmansk Institute of Marine Biology. For the first time, western scientists were allowed to work along the coast of Novaja Zemlja, which served as a nuclear test area during the sixties and seventies. Franz Josef Land, much more glaciated than Spitsbergen and uninfluenced by the Norwegian-Atlantic Current, has fortunately been reached due to favorable ice conditions. Exactly 120 years ago, this group of islands has been discovered by an Austrian expedition. The archipelago is believed to be a potential source area for kaolinite occurrences, which have been found in the Central Arctic Ocean.

In view of a planned joint ship operation of RV "Polarstern" and RV "Dalnie Zelentsy" in 1993 on the Eurasian shelves, this year's expedition on "Dalnie Zelentsy" was additionally a good opportunity to test the ship's technical equipment for marine-geological work, especially the possibilities to handle heavy sampling gear provided by the German institutes.

2. BACKGROUND INFORMATION

Generally the Barents shelf is strongly influenced by glacial processes during the last glacial. According to MERKLIN et al. (1992) Quaternary deposits in the southern Barents Sea directly overlie the erosional top of the Upper Cretaceous sedimentary rocks. Glacial moraine deposits are of local distribution on the shelf areas and form extended ranges which mark the extension of glaciers from Novaja Zemlja, Spitsbergen, Franz Josef Land and Scandinavia (MERKLIN et al. 1992; PAVILDIS et al. 1992). Below ca. 200 m (see also PAVILDIS et al. 1992),

however, moraine debris is obviously absent being replaced by glaciomarine fine-grained sediments, which have been deposited under ice-covered marine environments. The onset of the Late Weichselian glaciation did not start before 22 ky BP according to ELVERHØI et al. (1992). During the last glacial maximum, the entire Barents Sea was covered by grounded ice being connected with the Fennoscandian Ice Sheet. Ice recession started not before 15 ky BP, and shallowest parts of the northern Barents Sea have not been completely deglaciated before 10 ky BP. Holocene sediments being of varying thicknesses are predominantly fine-grained marine sediments (MERKLIN et al., 1992).

The coastal areas of Novaja Zemlja are characterized by large glacier tongues sliding into the sea. According to LEVCHENKO et al. (1992) the sedimentary deposits in the corresponding bays show distinct differences from south to north. Southern bays are supposed to be estuaries with dark marine clay deposits. In the middle fjords, stratified soft marine and glacial-marine deposits lying in trough-like depressions dominate. Northernmost fjords are characterized by two main depositional types: semiliquid, elastic, light-gray, fine-grained ooze and dark-gray moraine deposits composed of dense sand loam with abundant gravel.

The Franz Josef Land area, consisting of ca. 75 islands at the northeastern edge of the Barents Shelf (total area of about 19,700.km²), generally shows horizontal sedimentary strata of Upper Triassic to Lower Cretaceous age with a capping of basaltic lavas (HORN 1930). The sedimentary deposits mainly consist of marine clayey shale intercalated with shale, bands of ironstone, and thin layers of lignite. Diabase sills and dykes probably intruded during Lower Cretaceous (DIBNER et al. 1992). The latest geologic history of the archipelago is characterized by postglacial uplift indicated by raised beach terraces, which have been found between sealevel and 30 m (and more!) above this level.

3. RESEARCH OBJECTIVES

Main objective during the RV "Dalnie Zelentsy" Leg 68 from August 15, 1992 to September 5, 1992 was the sampling of shelf bottom sediments including surface samples and long core sections from the coastal areas off Novaja Zemlja and Franz Josef Land as well as from the Barents Shelf. These samples will be added to an already existing sedimentological data base of seafloor sediments at AWI and GEOMAR from the Arctic Ocean being collected during RV "Polarstern" cruises ARK IV/3 and VIII/3, from the Laptev Sea area (E.S.A.R.E. '92 expedition to Kotelnyy Island), and from Fram Strait being sampled during different cruises during the last years. The sedimentological data will be used to reconstruct the paleoceanographic and paleoclimatic evolution of the Arctic areas during the Late Pleistocene and Holocene.

4. COURSE OF EXPEDITION

Starting at Murmansk (Russia) and having visited an Arctic research station of the Murmansk Institute of Marine Biology at Dalnie Zelentsy approximately 180 km east of Murmansk, the ship went straight to Novaja Zemlja where the geological sampling program started at about 73°N and 53°E (Fig. 1). Subsequently, 7 sampling sites (mostly shallower than 150 m) along the coastal

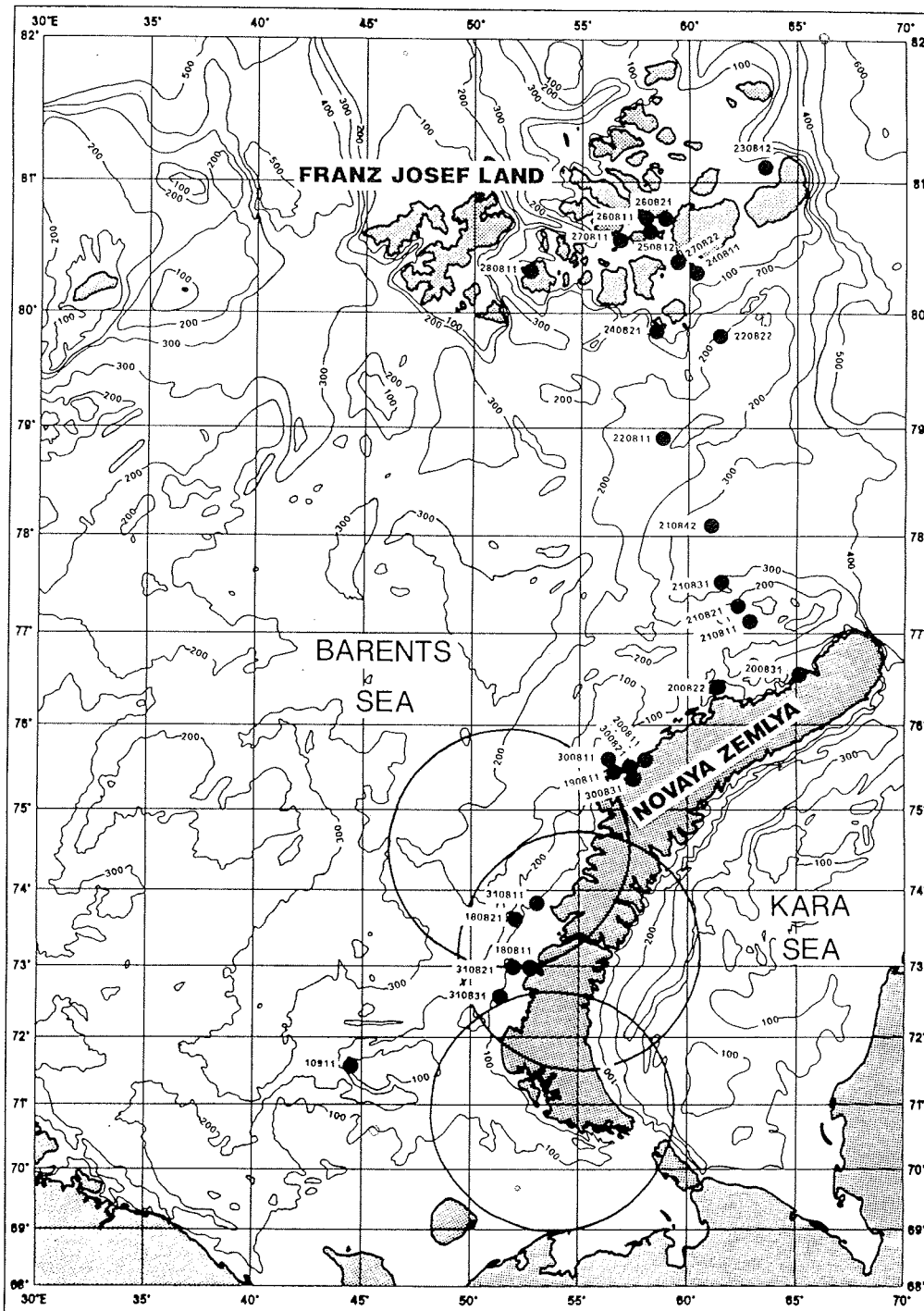


Fig. 1 Bathymetric chart of the eastern Barents Sea including Franz Josef Land and Novaya Zemlja areas. Sampling sites are indicated. Large circles show areas severely influenced by nuclear tests.

areas of Novaja Zemlja have been visited. On the way to Franz Josef Land, a profile of 5 sampling sites has been investigated. Deepest stations reached ca. 415 m. At ca. 78°N and 61°E a prolongation of the ice edge being SE-NW located has been met. The further north we went, the more large icebergs originating from the Franz Josef Land area could be seen. These icebergs were up to 200 m long and up to 40 m high. In the Franz Josef Land archipelago, 9 sites in the vicinity of 8 islands (Wilczek Land, Klagenfurt Island, Greem-Bell Land, Wilczek Island, Hooker Island, Champ Island, Wiener Neustadt Island, Chejsa Island) have been successfully sampled. Water depths here reach from 275 m to 31 m. The ice edge east of Greem-Bell Island has been situated at ca. 81°N and 65°E. Within the archipelago, manoeuvring was sometimes difficult since sea ice and iceberg drift within the fjords occur rapidly. On the way back, we stopped near by at Admiralty Peninsula (Novaja Zemlja) and gained samples from Nordenskiöld Bay in front of a large glacier system. While heading further south, samples have been achieved along the coast of Novaja Zemlja down to 71°35N, 44°24E.

5. METHODS

5.1 Sediment sampling equipment and procedures

For geological, geochemical and biological investigations on seafloor surface samples, box core and van Veen grab were used. For few longer sediment cores the gravity core device onboard RV "Dalnie Zelentsy" was applied (Table 1).

For the first time the box core usually used on German research vessels was operated onboard RV "Dalnie Zelentsy". The device (20 x 28 x 44 cm), which weighs approximately one ton, has been run successfully for 16 times down to water depths of 415 m. Except few attempts, the sediment surface gained by the box core was undisturbed being of considerable importance for the ongoing investigations. However, it has to be mentioned that the operation of such a heavy device is highly problematic and time consuming on a small ship as "Dalnie Zelentsy" is. At high wind speeds with considerable wave action it was impossible. Moreover, the winch system onboard RV "Dalnie Zelentsy" allows only safe operation of the box core down to water depths of approximately 200 m. Below that, strong efforts had to be undertaken to get the device back onboard since the winch system is too weak. For safe operation, at least 6 men including 2 crane operators are necessary. At three sites the core overpenetrated, however, the surfaces could still be used though they were compressed and disturbed. A few times the device did not work due to malfunctions of the trigger mechanism. In average, sediment cores gained by the box corer are 29 cm in length. Maximum core length was 40 cm, minimum is at 12 cm.

Beside the box core, the van Veen grab was applied 10 times to attain approximately 15 cm of seafloor surface sediments. The application of this device was mostly successful though a few malfunctions of the mechanism have been noted. These, however, could still be removed onboard.

Two attempts were made to get longer sediment cores by applying a simple 3 m-gravity corer, which belongs to RV "Dalnie Zelentsy". A removed or highly disturbed surface in addition to severely compression and marginal deformation of core material during sampling procedure, however, causes too many disadvantages for the ongoing analyses.

5.2 Water sampling

Water from 5 m and 50 m depth has been sampled at 17 stations, where geological work has also been performed. Water temperatures have in addition been measured (Table 2). Water samples will be investigated for PCB and oxygen isotopes.

5.3 Sedimentological investigations

The sediment cores gained during the cruise have been routinely photographed, intensively described and graphically displayed. Sediment colors were identified according to the "Munsell Soil Color Charts" (KOLLMORGEN INSTRUMENTS CORP., Newburgh, USA). Samples were coded by "Dalny Zelentsy" DS-numbers and a number code consisting of day, month, number of station and number of device (e.g. 23 08 2 1).

The upper 1 cm of the sediment surface has been systematically sampled for various purposes. The paleontological investigation will include macrobenthos, diatom, foraminifer, and coccolith analyses. Sedimentological work will focus on the grain size, coarse fraction, oxygen isotopes, total organic carbon and clay mineralogy. PCB measurements on surface sediments will be undertaken in conjunction to measurements already performed on Laptev Sea shelf sediments (see DETHLEFF et al. 1993).

The sediment column was sampled every 2 cm for paleontological, geochemical and sedimentological purposes. Syringes injected into the sediment will be used for bulk density measurements, total carbon and carbonate content analyses. Cores taken by the gravity corer have been split into 50 cm long pieces, and subsequently packed into plastic liners, which have not been opened yet.

6. PRELIMINARY RESULTS

6.1 Sedimentology

Along the coast of Novaja Zemlja, 13 shelf bottom samples have been taken. In general, the sediments, which lie in water depths not deeper than 150 m, do not differ significantly from each other. Comparatively coarse sediments, namely silty sand or sandy silts, have been found, which are severely bioturbated by benthic life. Worm tubes (*Polychaets*) have been observed to core depths of ca. 40 cm. Ophiuroideans and bivalves (*Helioptera*, *Cardium*) are common. Dropstones showing a size of more than 10 cm in diameter are abundant at the surface as well as in the entire sediment column. Dark organic rich laminae are visible in all cores down to the core bottoms, however, are mostly destroyed by bioturbation.

A few stations were situated in front of large glacier systems. The belonging sediments are more fine-grained, namely silty clay or clayey silt. A lamination, especially the black organic rich layers, is well evolved since benthic life is rare probably due to high sedimentation rates. According to Tarasov (pers. com.), a cyclic change from the green-gray silty clays or clayey silts to the black laminae can be observed in a few cores.

In the archipelago of Franz Josef Land, samples show a wide variability since they were taken from rather different depths (275 - 31 m). Shallowest stations have uneven sediment surfaces densely covered by ice-rafted detritus. Worm tubes (*Polychaets*) being present through all the sediment column are abundant. Benthic life including barnacles, ophiuroideans, bivalves and worms has drastically evolved. In general, sediments are silty sands or sandy silts showing somewhat lighter colors near the surface than 3-4 cm beyond. Sediments from deeper stations exhibit reduced benthic life and thus, a more intact layering.

6.2 Radioactive pollution

Novaja Zemlja has been test area for nuclear explosions for a long time. The chart "Barents Sea - Biological resources and human impact" prepared by MATISHOV (1991) outlines areas of atmospheric, marine or underground nuclear explosions on Novaja Zemlja. In 1990, GREENPEACE measured up to 40 $\mu\text{Sv/h}$ in an underground pit 3 km inland Novaja Zemlja, which is a quite high dose. According to SZCZYPA et al. (1992) radionuclides produced by nuclear explosions can rapidly be accumulated by plankton and algae. Since these organisms serve as food for higher trophic levels, radionuclides become concentrated in organisms such as oysters, clams, shrimp etc. The probability for incorporation of radionuclides into recent sedimentary deposits consequently was suspected.

Since the cruise was supposed to focus on this nuclear test area, a dose rate meter for Gamma radiation has been applied. Measurements have been undertaken on land, next to shelf bottom sediments and continuously in the atmosphere during the entire cruise (Table 1), especially in areas of atomic bomb tests indicated in the map of MATISHOV (1991).

The average value being measured is 0.071 $\mu\text{Sv/h}$. Next to shallow marine sediments, maximum radiation is about 0.106 $\mu\text{Sv/h}$ and lowest radiation is about 0.028 $\mu\text{Sv/h}$. The highest value of 0.179 $\mu\text{Sv/h}$ has been measured on Novaja Zemlja (Bezymannaya Bay) in the vicinity of the GREENPEACE working area. However, all measurements can be accounted for natural radiation, which is in the range of approximately 50 to 200 nSv/h (equals 0.05 to 0.20 $\mu\text{Sv/h}$). Our results are concordant with SZCZYPA et al. (1992), who could not detect unnatural high levels of radioactive radiation.

7. ACKNOWLEDGEMENTS

We would like to thank Prof. Dr. G. Matishov, Director of "Murmansk Institute of Marine Biology" (Russia) for inviting us to take part in the expedition to the Russian Arctic. Also, we thank Dr. G. Tarasov, chief-scientist onboard RV "Dalnie Zelentsy", who helped to solve all logistical problems. Without the crew of RV "Dalnie Zelentsy" and members of the "Murmansk Institute of Marine Biology" we would not have been able to gather this data set. For discussion we gratefully thank Dr. H. Kassens. Thanks are also due to Prof. Dr. D. Fütterer, Dr. Stein (AWI), and Prof. Dr. J. Thiede (GEOMAR), who encouraged this work.

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9. APPENDIX

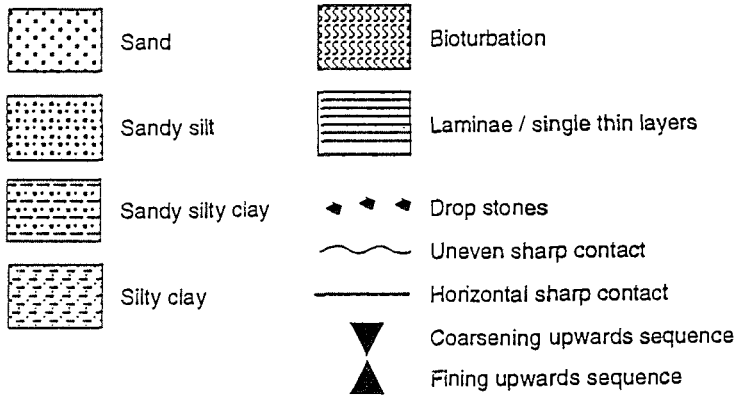
Table 1 Geographical locations and technical data of sediment cores and sediment surface samples gained during the cruise. Gamma radiation measured on sediment surfaces is indicated.

Sediment samples Station-#	DS-#	Locality	Latitude (°N)	Longitude (°E)	Water depth (m)	Radiation Sediment (μ Sv/h)	Sample type	Gain (cm)	Remarks
180811	68-1	Novaja Semliya	72°59.08	053°03.38	28	0.030-0.100	Box core	12.00	0.048-0.178 μ Sv/h on land
180821	68-2	off Novaja S.	73°35.98	052°16.48	137	no data	Box core	23.00	
180822	68-3	off Novaja S.	73°35.98	052°16.48	137	no data	Dredge		
190811	68-3	off Novaja S.	75°28.23	056°46.06	138	0.057-0.061	Box core	31.50	
200811	68-4	Velikitsky Bay	75°35.50	057°59.00	53	0.057	Box core	31.50	
200822	68-5	off Novaja S.	76°25.39	061°23.72	53	no data	Box core	ca. 20	
200831	68-6	Russian Bay	76°28.50	065°11.80	150	0.050	van Veen grab	ca. 15	
200833	68-6	Russian Bay	76°28.50	065°11.80	150	0.050	Gravity core	91.00	
210811	68-7	off Novaja S.	77°08.60	062°50.30	100	0.028-0.071	van Veen grab	ca. 15	
210821	68-8	off Novaja S.	77°19.40	062°16.90	219	0.078	Box core	29.00	
210831	68-9	off Novaja S.	77°33.20	061°30.70	320	no data	van Veen grab	ca. 15	
210833	68-9	off Novaja S.	77°33.20	061°30.70	320	no data	Gravity core	70.00	
210842	68-10	off Novaja S.	78°03.66	061°11.20	415	0.087	Box core	36.00	Not opened yet
220811	68-11	off Novaja S.	78°54.50	059°00.00	260	0.078	Box core	40.00	
220822	68-12	off FJL	79°50.00	061°29.00	145	0.093-0.064	Box core	21.00	
230812	68-13	Green Bell Island	81°07.11	063°31.57	275	no data	van Veen grab	ca. 15	First sight of ice edge
240811	68-15	Klagenfurt	80°20.57	060°19.94	37	0.079	van Veen grab	ca. 15	
240821	68-16	Wilczek Island	79°52.87	058°40.97	43	0.079-0.045	Box core	21.00	
250812	68-17	Chejsa Island	80°37.20	058°05.80	34	0.076	ca. 15	ca. 15	
260811	68-19	Wiener Neustadt	80°44.30	057°53.80	29	0.058	van Veen grab	ca. 15	
260821	68-20	Wiener Neustadt	80°43.90	058°52.90	160	0.087-0.057	Box core	40.00	No gain
270811	68-23	Camp	80°30.40	056°43.80	214	0.103-0.058	Box core	32.00	
270822	68-24	Wilczek Land	80°24.04	059°37.75	31	0.106-0.081	van Veen grab	ca. 15	
280811	68-25	Hooker Island	80°19.92	052°50.00	49	0.073-0.051	Box core	ca. 1	Over-penetrated
300811	68-31	Nordenskiöld Bay	75°33.3	056°26.70	165	0.060	Box core	31	
300821	68-32	Nordenskiöld Bay	75°28.50	057°10.00	120	0.058-0.068	Box core	28	
300831	68-33	Nordenskiöld Bay	75°21.50	057°35.80	45	0.066-0.060	Box core	31	
310811	68-35	off Novaja S.	73°00.00	053°00.00	120	0.077	van Veen grab	ca. 15	
310821	68-37	off Novaja S.	73°00.63	051°53.64	70		van Veen grab	ca. 15	
310831	68-38	off Novaja S.	72°36.90	051°21.90	85	0.081	van Veen grab	ca. 15	
109111	68-39	off Novaja S.	71°35.10	044°24.70	85	0.052	Box core	9.00	

Water samples								
Station-#	DS-#	Locality	Latitude (°N)	Longitude (°E)	Water depth (m)	Sample type	Water samples Depth (m)	Water temp. (°C)
190821	68-3	Velkitsky Bay	75°28,03	056°44,17	139	Water bottle	5,00	?
						Water bottle	10,00	?
						Water bottle	20,00	2,50
200821	68-5	off Novaja S.	76°25,39	061°23,72	53	Water bottle	50,00	1,00
						Water bottle	5,00	3,50
200832	68-6	Russian Bay	76°28,50	065°11,80	150	Water bottle	40,00	-
						Water bottle	5,00	2,00
210822	68-8	off Novaja S.	77°19,40	062°16,90	219	Water bottle	50,00	1,00
						Water bottle	5,00	0,50
210824	68-8	off Novaja S.	77°29,40	061°42,32	335	Water bottle	5,00	2,00
210841	68-10	off Novaja S.	78°03,66	061°11,20	415	Water bottle	5,00	3,00
220812	68-11	off Novaja S.	78°54,50	059°00,00	260	Water bottle	50,00	-1,00
						Water bottle	5,00	3,00
220821	68-12	off FJL	79°50,00	061°29,00	145	Water bottle	50,00	1,00
						Water bottle	5,00	1,25
230811	68-13	Green Bell Island	81°07,11	063°31,57	275	Water bottle	50,00	-1,00
						Water bottle	5,00	-1,50
240822	68-16	Wilczek Island	79°52,87	058°40,97	43	Water bottle	5,00	-1,25
250811	68-17	Chejsa Island	80°37,20	058°05,80	34	Water bottle	5,00	-0,50
260812	68-19	Wiener Neustadt	80°44,30	057°53,80	29	Water bottle	5,00	1,00
						Water bottle	34,00	-1,00
270821	68-24	Camp	80°24,04	059°37,75	40	Water bottle	5,00	-1,00
280812	68-25	Hooker Island	80°19,92	052°50,00	49	Water bottle	40,00	-1,20
						Water bottle	5,00	-1,00
300812	68-31	Nordenskiöld Bay	75°33,30	056°26,70	165	Water bottle	45,00	-1,00
						Water bottle	5,00	4,00
310822	68-37	off Novaja S.	73°00,63	051°53,64	70	Water bottle	50,00	3,25
						Water bottle	5,00	6,00
310832	68-38	off Novaja S.	72°36,90	051°21,90	85	Water bottle	50,00	4,25
						Water bottle	5,00	5,75
10912	68-39	off Novaja S.	71°35,10	044°24,70	85	Water bottle	50,00	6,00
						Water bottle	5,00	7,00
						Water bottle	50,00	-

Table 2 Geographical locations of water sampling sites. Water temperatures are indicated.

Legend



Rock colors

according to "Munsell Soil Color Charts" (Koilmorgan Instruments Corp., Newburgh, USA, 1990)

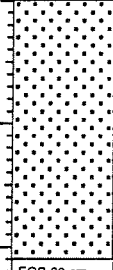
HUE 2.5Y	2.5Y2/0	Black
	2.5Y3/2	Very dark grayish brown
	2.5Y3/3	Dark olive brown
	2.5Y4/2	Dark grayish brown
	2.5Y4/3	Olive brown
HUE 5Y	5Y2.5/1	Black
	5Y2.5/2	Black
	5Y3/1	Very dark olive gray
	5Y3/2	Dark olive gray
	5Y4/1	Dark gray
	5Y4/2	Olive gray
HUE 10YR	5Y4/3	Olive
	5Y5/1	Gray
	10YR2/2	Very dark brown
HUE 7.5YR	10YR3/3	Dark brown
	7.5YR3/2	Dark brown

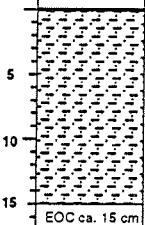
GKG Description		Core Number	Gear: Box core	
			Length:	12 cm
Lithology	Color Texture	Description, Remarks, etc.	Water depth: 28 m	
			Investigator	Date
		180811 - DS 68-1	Nürnberg/Groth	Aug. 18, 92
Surface	5Y2.5/2 5Y2.5/1 5Y3/1	fine to coarse sand with gravel up to 1 cm in diameter, only minor clay and silt portions, calcareous foraminifers, worm tubes (polychaets), ophiuroideans (reddish, -3 cm in diameter) common, in uppermost cm white clams (-1 cm in diameter), varying colors		
5 10	5Y2.5/2 5Y2.5/1 5Y3/1	fine to coarse sand with gravel up to 1 cm in diameter, only minor clay and silt portions, bioturbation through all the sediment column, worm tubes (polychaets, -1 cm in diameter and -5 cm in length) abundant down to core bottom, pelecypoda common in 5-8 cm depth, black organic rich laminated areas all over profile		
EOC 12 cm				

GKG Description		Core Number	Gear: Box core	
			Length:	23 cm
Lithology	Color Texture	Description, Remarks, etc.	Water depth: 137 m	
			Investigator	Date
		180821 - DS 68-2	Nürnberg/Groth	Aug. 18, 92
Surface	5Y3/2	sandy silt to silty sand, densely covered by dropstones (-30 cm in diameter, rounded and angular), pelecypod fragments (-3 cm) and worm tubes (polychaets) common, barnacles (-8 cm in length) dredge from same station shows rich benthic life: crabs, pelecypods, fish, sponges, ophiuroideans		
5	5Y3/2	sandy silt to silty sand, coarse material, dropstones		
10		sandy silt to silty sand, becoming more fine-grained with depth, areas of black organic rich laminae		
15		between 10 cm and 17 cm: oxidized reddish spots		
20		silty clay, very stiff		
EOC 23 cm				

GKG Description		Core Number	Gear:	Box core
		190811 - DS 68-3	Length:	31.5 cm
			Water depth:	138 m
			75°28.23 N 056°46.06 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
			Nürnberg/Groth	Aug. 19, 92
Surface	5Y3/1-3/2	clayey silt densely covered by dropstones (~2 cm in diameter, uneven surface, rich in worm tubes (polychaets) and pelecypods (~3 cm in length)		
5	5Y3/1-3/2	clayey silt to silty clay, bioturbation down to core bottom, black organic rich laminae		
10				
15				
20				
25	5Y3/1-3/2	at 23 cm - 31 cm: large angular dropstone		
30				
EOC 31.5 cm				

GKG Description		Core Number	Gear:	Box core
		200811 - DS 68-4	Length:	31.5 cm
			Water depth:	53 m
			75°35.50 N 057°59.00 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
			Nürnberg/Groth	Aug. 20, 92
Surface	5Y4/3	silty clay, uneven surface, only few ophiuroideans (glacier suspension)		
5	5Y4/3	silty clay, brownish oxydized speckles down to 20 cm core depth, black organic rich laminae all over the profile		
10				
15				
20				
25				
30				
EOC 31.5 cm				

GKG Description		Core Number	Gear: Box core	
		200822 - DS 68-5	Length:	20 cm
			Water depth:	52 m
		76°25.39 N 061°23.72 E		
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
Surface	5Y4/1	coarse sand with minor clay and silt portions, large dropstones (~3 cm in diameter) common, rich in biogenic fragments (clams), few ophiuroids core is severely damaged since the box core hit a large stone at the seafloor	Nürnberg/Groth	Aug. 20, 92
	5Y4/1	coarse sand with minor clay and silt portions, large dropstones (~3 cm in diameter) common, rich in biogenic fragments (clams), few ophiuroids		
EOC 20 cm				

BG Description		Core Number	Gear: van Veen grab	
		200831 - DS 68-6	Length:	ca. 15 cm
			Water depth:	150 m
		76°28.50 N 065°11.80 E		
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
Surface	5Y5/1 2.5Y2/0	silty clay, worm tubes (polychaets) and small pelecypods (up to 1 cm in diameter) common, surface is damaged	Nürnberg/Groth	Aug. 20, 92
	5Y5/1 2.5Y2/0	silty clay, worm tubes (polychaets) and small pelecypods (up to 1 cm in diameter) common, surface is damaged		
EOC ca. 15 cm				

Core Description		Core Number	Gear: Gravity core
		200833 - DS 68/6	Length: 91 cm
			Water depth: 150 m
			76°28.50 N 065°11.80 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 20, 92
0			
10	5Y5/1	clayey silt, homogeneous	
20		black organic rich laminae all over the profile, especially at 30-31 cm, 57-59 cm, 70-74 cm, 84-86 cm	
30			
40		dropstones (-2 cm in diameter) abundant at 40-42 cm	
50			
60			
70			
70	5Y5/1	clayey silt, becoming increasingly sandy at core bottom	
80			
90			
EOC 91 cm			

BG Description		Core Number	Gear: van Veen grab
		210811 - DS 68-7	Length: ca. 15 cm
			Water depth: 100 m
			77°08.60 N 062°50.0 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 21, 92
Surface	5Y3/2	silty fine sand disturbed surface densely covered by dropstones (-3 cm in diameter), ophuroidans (-3 cm) common, 1 echinoderm (5 cm), worm tubes (polychaets) all over the profile	
5	5Y3/2	silty fine sand worm tubes (polychaets) all over the profile, few dropstones all over sediment column	
10			
15			
EOC ca. 15 cm			

GKG Description		Core Number	Gear: Box core
		210821 - DS 68-8	Length: 29 cm
			Water depth: 219 m
			77°19.40 N 062°16.90 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 21, 92
Surface	5Y3/1 - 5Y3/2	clayey silt, surface densely covered by rounded and angular dropstones (0.5 - 2 cm in diameter), uneven surface, pelecypod fragments (Heliopora, 1.5 - 2 cm in length), ophiuroideans and polychaets common	
	5Y3/1 - 5Y3/2	clayey silt, pelecypod fragments (Heliopora, 1.5 - 2 cm in length), ophiuroideans and polychaets common	
5			
	5Y3/1 - 5Y3/2	sandy silt to silty sand, very stiff sediment	
10			
	5Y3/1 - 5Y3/2	black organic rich laminae all over the sediment column, mainly concentrated between 12 cm and 14 cm	
15			
		concentration of dropstones at 15-18 cm	
20			
		in general, dropstones and worm tubes (polychaets) appear all over the profile	
25			
		bioturbation down to core bottom, indicated by reddish, oxygenized colors	
30			
EOC 29 cm			

BG Description		Core Number	Gear: van Veen grab
		210831 - DS 68-9	Length: ca. 15 cm
			Water depth: 320 m
			77°33.20 N 061°30.70 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 21, 92
Surface	5Y4/3	silty fine sand uneven surface, only few ophiuroideans	
	5Y4/3	silty fine sand uneven surface, only few ophiuroideans	
5			
10			
15			
EOC ca. 15 cm			

GKG Description		Core Number	Gear: Box core
		210842 - DS 68-10	Length: 38 cm
			Water depth: 415 m
		78°03.66 N 081°11.20 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Date
			Nürnberg/Groth
			Aug. 21, 92
Surface	10YR3/3	<p>silty clay, light brown colors with black patches</p> <p>sediment surface is highly disturbed and compressed since core overpenetrated, however, surface is not missing</p>	
5	10YR3/3	silty clay, light brown colors with black patches	
10	5Y4/2	<p>brownish surface sediments grade into</p> <p>gray silty clay, homogeneous, black organic rich laminae all over the profile, worm tubes (polychaets) and dropstones down to core bottom</p>	
15			
20			
25		bioturbation down to core bottom, indicated by reddish, oxygenized colors	
30			
35			
EOC 29 cm			

GKG Description		Core Number	Gear: Box core		
			Length: 40 cm	Water depth: 260 m	
Lithology		Color Texture	Description, Remarks, etc.	Investigator	Date
				Nürnberg/Groth	Aug. 22, 92
Surface		10YR3/3	clayey silt, light brown colors with black patches sediment surface is highly disturbed and compressed since core overpenetrated, however, surface is not missing		
5		10YR3/3	clayey silt, light brown colors with black patches (manganese and iron oxides (7.5YR3/2))		
10		5Y3/2	sandy clayey silt light brownish oxidized layers intercalated at 4-5 cm, 5.5-7 cm, and 12-13 cm, uneven boundaries bioturbation down to core bottom, indicated by reddish, oxygenized colors, especially between 7-27 cm		
15					
20					
25					
30		5Y3/2	clayey silt black organic rich laminae are intercalated, worm tubes (polychaets) occur all over the sediment column		
35					
40					
EOC 40 cm					

GKG Description		Core Number	Gear: Box core		
			Length: 21 cm	Water depth: 145 m	
Lithology		Color Texture	Description, Remarks, etc.	Investigator	Date
				Nürnberg/Groth	Aug. 22, 92
Surface		2.5Y42 - 2.5Y4/3	sandy silt to silty sand, uneven surface, slightly disturbed by coring, small dropstones (-0.5 cm in diameter), ophiuroids (-5 cm in diameter), and hydrozoans common, worm tubes (polychaets)		
5		2.5Y42-4/3	sandy silt to silty sand		
10		10YR2/2	clayey sandy silt, very stiff, falls into small plates		
15		5Y3/1	sandy silt, homogeneous, sometimes spotty (10YR2/2)		
20					
EOC 21 cm					

BG Description		Core Number	Gear: van Veen grab
		230812 - DS 68-13	Length: ca. 15 cm
			Water depth: 275 m
		81°07.11 N 063°31.57 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator Date
		Nürnberg/Groth Aug. 23, 92	
Surface	10YR3/3	sandy silt, uneven surface, 1 shell fragment	
	10YR3/3	sandy silt,	
5	5Y3/2	silty clay to clayey silt, homogeneous, gray color	
10			
15			
EOC ca. 15 cm			

BG Description		Core Number	Gear: van Veen grab
		240811 - DS 68-15	Length: ca. 15 cm
			Water depth: 37 m
		80°20.57 N 060°19.94 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator Date
		Nürnberg/Groth Aug. 24, 92	
Surface	2.5Y3/3	silty sand, uneven surface, densely covered by pelecypod fragments, dropstones (-10 cm in diameter), and ophiuroids (-3 cm in diameter), rich in calcareous foraminifers and polychaets	
5	2.5Y3/3	silty sand, uneven surface, densely covered by pelecypod fragments, dropstones (-10 cm in diameter), and ophiuroids (-3 cm in diameter), rich in calcareous foraminifers and polychaets, dropstones all over sediment column	
10			
15			
EOC ca. 15 cm			

GKG Description		Core Number	Gear:	Box core
		260821 - DS 68-20	Length:	40 cm
			Water depth:	160 m
		80°43.90 N 058°52.90 E		
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
			Nürnberg/Groth	Aug. 28, 92
Surface	5Y3/2	clayey silty sand, uneven surface, few worm tubes (polychaets) sticking out of the sediment surface		
	5Y3/2	clayey silty sand, uneven surface, few worm tubes (polychaets)		
	5Y2.5/1	sandy silt, slightly darker than surface layer black organic rich laminae all over the sediment column, especially concentrated at 7-15 cm, 35-40 cm oxidized burrows with material from surface between 22-27 cm, 34-38 cm dropstone (4 cm in diameter) at 17-19 cm		
EOC 40 cm				

GKG Description		Core Number	Gear: Box core
		270811 - DS 68-23	Length: 32 cm
			Water depth: 214 m
			80°30.40 N 056°43.80 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 27, 92
Surface	5Y3/2	silty sand to sandy silt, uneven surface, slightly disturbed by coring, densely settled by polychaeta, rich in dropstones (< 0.5 cm in diameter)	
	5Y3/2	silty sand to sandy silt, densely settled by polychaeta, rich in dropstones (< 0.5 cm in diameter)	
5	5Y3/1	sandy silt, slightly darker than surface layer, oxidized light brownish patches and spots all over the sediment column due to bioturbation	
10			
15			
20			
25			
30			
EOC 32 cm			

BG Description		Core Number	Gear: van Veen grab
		270822 - DS 68-24	Length: ca. 15 cm
			Water depth: 31 m
			80°24.04 N 059°37.75 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 27, 92
Surface	5Y3/1	silty sand, rich in benthic life: large bryozoan colonies covering all surface, Mya truncata and Helioptera shells, worm tubes (polychaeta), barnacles	
		silty sand	
5	2.5Y3/2	silty sand, slightly darker than above	
10			
15			
EOC ca. 15 cm			

GKG Description		Core Number	Gear: Box core
		280811 - DS 68-25	Length: 1 cm
			Water depth: 49 m
			80°19.92 N 052°50.00 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 28, 92
Surface	5Y3/2	silty sand, uneven surface (glacier suspension), severely disturbed by coring, core overpenetrated and compressed, sediment is very soft, few oxidized worm tubes (polychaets)	
EOC 1 cm		5Y3/2 silty sand	

5

GKG Description		Core Number	Gear: Box core
		300811 - DS 68-31	Length: 31 cm
			Water depth: 165 m
			75°33.30 N 056°26.70 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 30, 92
Surface	5Y3/2	silty sand, uneven surface, dropstones (~1 cm in diameter) and worm tubes (polychaets) common, living bivalves in the upper 3 cm of sediment (Cardium sp.), ophiurideans (~3 cm in diameter) common, 1 snail house (Turitella ???)	
	5Y3/2	silty sand, see surface	
	5Y2.5/1	silty sandy clay, black organic rich laminae are intercalated, severely bioturbated	
	5Y2.5/1	sandy silty clay, few black laminae, more homogeneous than above	
EOC 31 cm			

GKG Description		Core Number	Gear:	Box core
		300821 - DS 68-32	Length:	28 cm
			Water depth:	120 m
			75°28.50 N 057°10.00 E	
Lithology	Color Texture	Description, Remarks, etc.	Investigator	Date
			Nürnberg/Groth	Aug. 30, 92
Surface	5Y4/1	clayey silt with minor sand portion, uneven surface, few dropstones and few worm tubes (polychaeta), only 1 bivalve fragment		
5	5Y4/1	clayey silt with minor sand portion, uneven surface, see surface, pelecypods in upper 3 cm		
10	5Y3/1	clayey silt with minor sand portion, uneven surface, black organic rich laminae and patches all over sediment column, surface material mixed down to core bottom due to bioturbation		
15				
20				
25				
30	ECC 28 cm			

GKG Description		Core Number	Gear: Box core
		300831 - DS 68-33	Length: 31 cm
			Water depth: 45 m
			75°21.50 N 057°35.80 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 30, 92
Surface	5Y4/1	silty clay, uneven surface, bivalve shells in the upper top centimeters, only small dropstones (<0.5 mm), very soft sediment	
5	5Y4/1	silty clay, black organic rich laminae and patches all over the sediment column, very soft sediment, bioturbation not evident, few dropstones and bivalve shells (glacier suspension)	
10	5Y3/1	at 15-17 cm dropstone	
15			
20			
25		at 25-27 cm dropstone	
30			
35	EOC 31 cm		
40		in sediment core taken by Tarasov, cyclic deposition of silty clay and black organic rich layers can be observed, layers become thinner the deeper in the sediment column they are hypothesis: annual variations in sedimentation (winter and summer deposits)	

BG Description		Core Number	Gear: van Veen grab
		310811 - DS 68-35	Length: ca. 15 cm
			Water depth: 120 m
			73°50.00 N 053°00.00 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Nürnberg/Groth
			Date
			Aug. 31, 92
Surface	5Y3/1	silty sand, densely packed with different kinds of dropstones (-10 cm in diameter), worm tubes (polychaeta), Helioptera, Cardium sp., Sipunculida	
5	5Y3/1	silty sand, densely packed with different kinds of dropstones (-10 cm in diameter), worm tubes (polychaeta), Helioptera, Cardium sp., Sipunculida	
10			
15			
EOC ca. 15 cm			

GKG Description		Core Number	Gear: Box core
		010911 - DS 68-39	Length: 9 cm
			Water depth: 85 m
			71°35.10 N 044°24.70 E
Lithology	Color Texture	Description, Remarks, etc.	Investigator
			Date
			Nürnberg/Groth
			Sept. 1, 92
Surface	2.5Y4/2	coarse sand, worm tubes (polychaets) sticking out of the sediment surface by 5 cm, bivalve shells (Clamys, Helioptera), barnacles, worms abundant, dropstones (-1 cm in diameter) abundant	
5	2.5Y4/2	coarse sand, worm tubes (polychaets), bivalve shells (Clamys, Helioptera), barnacles, worms abundant, dropstones (-1 cm in diameter) abundant	
		layer of bivalve fragments	
10	EOC 9 cm		